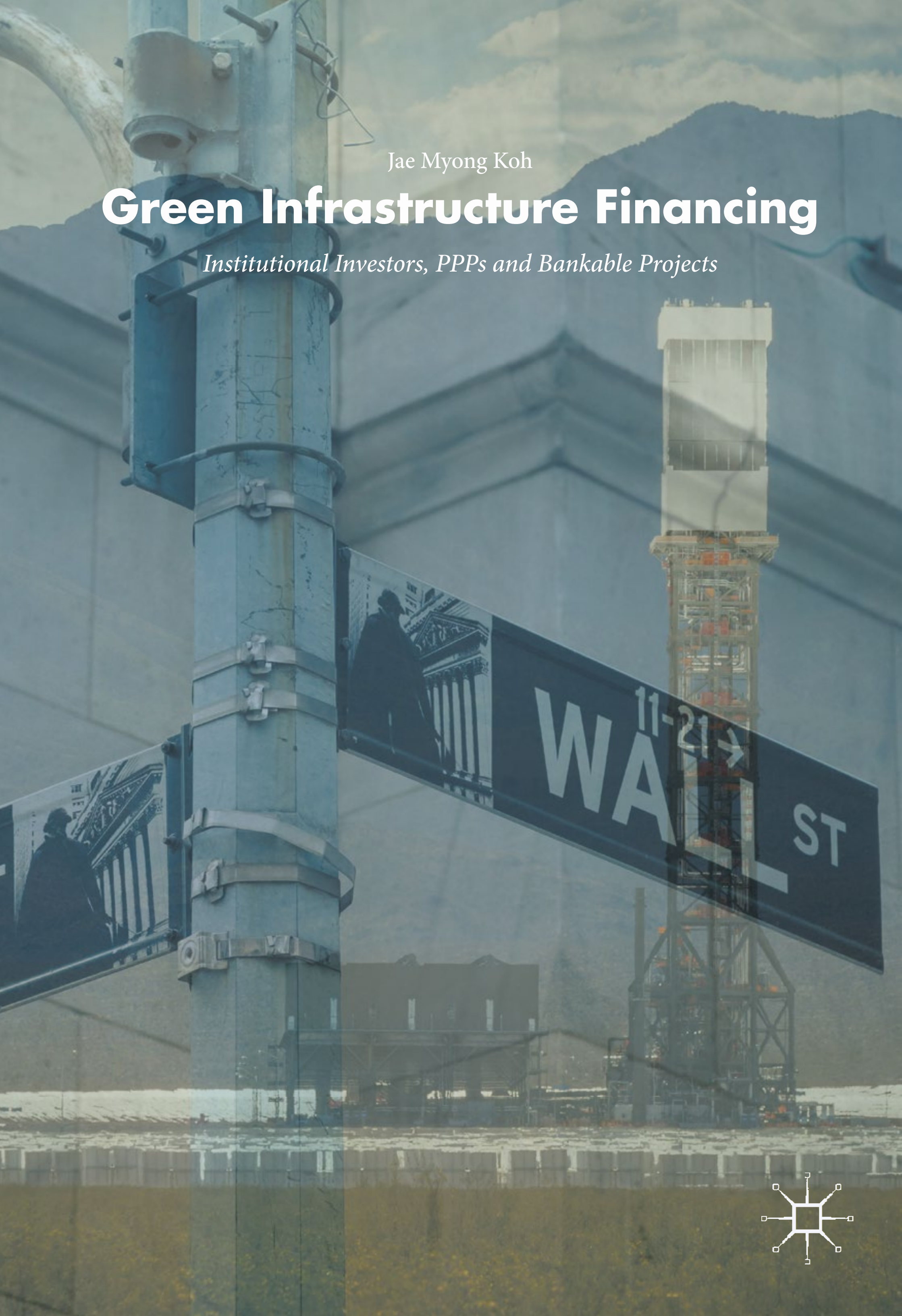
Jae Myong Koh

Green Infrastructure Financing

Institutional Investors, PPPs and Bankable Projects



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For my mother
Dominica Won Sim Ju (1944–)

Preface

Given that over 700 million people are still living in extreme poverty in our world, eradicating such global poverty is a priority issue that needs the urgent attention of our global community. One of most effective ways to eradicate global poverty is to make a country self-sufficient, even rich, by assisting economic development. At the same time, our global community cannot avoid another critical challenge that arises in the course of promoting economic development of countries. This challenge is the fight against climate change. If climate change is not addressed at the same time, it can seriously undermine the basis of economic development and exacerbate global poverty. Unfortunately, these parallel major global challenges—*global poverty* and *climate change*—do not give us the luxury of responding at our leisure; time is not on our side. Studies show that in about 20 years' time, the world is projected to cross an irreversible line in relation to climate change, if the current pace of greenhouse gas (GHG) emissions is not substantially reduced. Therefore, in order to keep the rise in global average temperature below 2 °C, the total amount of GHG emissions since 1870 needs to remain below 2900 $GtCO_2$ equivalent. Under ordinary circumstances, the earth is projected to pass the threshold of 2900 $GtCO_2$ equivalent in 2040. Surprisingly, even with new commitments of all countries under the Paris Agreement (2015) to reduce their national GHG emissions, the earth is estimated to pass the threshold only 8 months later than in the original timeline. Accordingly, the author proposes an innovative approach that is effective to achieve the necessary breakaway from the current inertia in the fight against global poverty and climate change. To be more specific, this book invites the attention of the global community to the potential of institutional investors who can make an enormous contribution to the fight against global poverty and climate change with their 'US$ 92 trillion in assets.' Harnessing the enormous power of the institutional investors, this book pursues win-win outcomes: profits for the investor and a parallel reduction in global poverty and climate change.

Importantly, this book is written to be accessible to the non-specialist with narratives on global challenges and countermeasures at a level that presupposes no specialized knowledge of the subjects. Rather, this book aims to promote a common understanding of general readers on the limits of the current global response to such challenges and an effective coping strategy. Common sense tells us that when efforts of ordinary individuals are consolidated into a force at the global level, strong momentum can be generated to rise to the global challenges. Empowering individuals with knowledge gives them tools for facing and overcoming these challenges. The author believes that changes to a paradigm in human history do not come overnight, but that such change comes gradually when many people share the sense of a direction and move together in that direction. If more people join in, the rate of change will increase.

Cairo, Egypt Jae Myong Koh

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Producing this book is a process of looking for truth standing on the shoulders of giants. Above all, I would like to extend my heartfelt gratitude to the late professor Choon-ho Park, former judge of the International Tribunal for the Law of the Sea, for his guidance since my undergraduate days. My special thanks go to Professor Joong-kyung Choi for leading me to the world of development cooperation and project financing. I would also like to extend my sincere gratitude to Professor Sung-hwan Kim for allowing me as his advisor to join the activities of the UN High-Level Panel on the Post-2015 Development Agenda for the period between 2012 and 2014. It was a pleasant eye-opening experience to learn about the insights and life philosophies of the panelists. Among them, the passionate voices of Professor Horst Köhler of Germany and Ms. Tawakkol Carmen of Yemen were sources of inspiration, stirring something deep within each of the participants at the conferences. I am also grateful to Dr. Ashraf Ghani of the Institute for State Effectiveness (ISE), for his insightful vision and advices on development issues. I also cannot forget the leadership and full support of Ambassador Enna Park in the development cooperation community.

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The views contained in this book are mine alone and are not intended to represent the perceptions of any institution or government with which I am associated. I am solely responsible for the outcome. The text seeks to represent the position as at February 1, 2017, although I have reflected changes of a more recent nature where possible.

Contents

List of Abbreviations

ABS	Asset-Backed Securities
ADB	Asian Development Bank
AfDB	African Development Bank
AFOLU	Agriculture, Forestry and Other Land Use
AIIB	Asian Infrastructure Investment Bank
ART	Articulation of Territorial Network
BCA	Border Carbon Adjustment
BRT	Bus Rapid Transit
BTA	Border Tax Adjustment
CCER	Chinese Certified Emission Reduction
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
DBFO	Design–Build–Finance–Operate
DBLOT	Design–Build–Lease–Operate–Transfer
DBOOT	Design–Build–Own–Operate–Transfer
EBRD	European Bank for Reconstruction and Development
ECOSOC	Economic and Social Council
EEA	European Economic Area
ERU	Emission Reduction Unit
ETF	Exchange-Traded Fund
ETS	Emission Trading Scheme
EUA	EU Allowance

FDI	Foreign Direct Investment
GATT	General Agreement on Tariffs and Trade
GCF	Green Climate Fund
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GNP	Gross National Product
GWP	Gross World Product
HLPF	High-Level Political Forum
IBRD	International Bank of Rehabilitation and Development
ICB	International Competitive Bidding
ICSID	International Centre for the Settlement of Investment Dispute
ICT	Internet and Communication Technology
IDA	International Development Agency
IDB	Inter-American Development Bank
IEA	International Energy Agency
IFC	International Finance Corporation
IMF	International Monetary Fund
INDC	Intended Nationally Determined Contributions
IPP	Independent Power Producer
JCM	Joint Crediting Mechanism
JFJCM	Japan Fund for the Joint Crediting Mechanism
JI	Joint Implementation
JVETS	Japanese Voluntary Emissions Trading Scheme
KAU	Korean Assigned Unit
KCU	Korean Credit Units
KDP	Kecamatan Development Program
LCOE	Levelized Cost of Electricity
LDC	Least Developed Countries
LRT	Light Rail Transit
MAC	Marginal Abatement Cost
MDB	Multilateral Development Bank
MIGA	Multilateral Investment Guarantee Agency
MNCs	Multinational Corporations
MRV	Measurement, Reporting and Verification
MSR	Market Stability Reserve
NPC	National People's Congress
ODA	Official Development Assistance

OTC	Over-The-Counter (OTC)
PCG	Partial Credit Guarantee
PPFs	Project Preparation Facilities
PPP	Public-Private Partnership
PRG	Partial Risk Guarantee
PRI	Partial Risk Insurance
RDBs	Regional Development Banks
REDD	Reducing Emissions from Deforestation and forest Degradation
RGGI	Regional Greenhouse Gas Initiative
SC	Supercritical
SDGs	Sustainable Development Goals
SEZs	Special Economic Zones
SPC	Special Purpose Company
TED	Turtle Excluder Devices
UN DESA	United Nations Department of Economic and Social Affairs
UNFCCC	United Nations Framework Convention on Climate Change
USC	Ultra-supercritical
US FHA	United States Federal Highway Administration
VAT	Value-Added Tax
VCS	Verified Carbon Standard
VCU	Voluntary Carbon Unit
WCI	Western Climate Initiative
WTO	World Trade Organization

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Part I

The Importance of Green Infrastructure

1

Seedlings of Change

In December 2012, the Jirau hydro power plant in Brazil was registered as a greenhouse gas-reduction project at the United Nations Climate Change Secretariat in Bonn, Germany and obtained a certified credit for the amount of reductions in greenhouse gas (GHG) emissions. The project aimed to build a hydro power plant with a capacity of 3750 MW at a cost of US$ 4.7 billion.[1] Through registration at the United Nations, the project can earn money by selling their certified reductions in GHG emissions. More precisely, the hydro power plant project is estimated to reduce GHG emissions by approximately 6 million metric tons per year compared to the level of GHG emissions from fossil fuel-burning power plants (CDM 2012c). Given that the technical lifetime of the hydro power plant is 30 years, the project could reduce about 180 million metric tons of GHG during its lifetime. Accordingly, if the price of GHG is US$ 10 per metric ton, the project could mobilize US$ 1.8 billion through the sale of certificates of GHG reduction.[2] If the price of GHG rises to US$ 20 in most of the developed world in the 2020s—as projected by the International Energy Agency—a project of such kind would garner US$ 3.6 billion in the 2020s.[3] If the price goes up to US$ 40 in the developed world in 2040, a project of this kind at that time could

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reap US$ 7.2 billion through the sale of the certificates of GHG reduction. Keeping in mind that this is a hypothetical scenario, the profits from the sales of the certificates for GHG reduction could be even greater than the entire project cost.

Similar potential for garnering profits from GHG reduction can also be identified in many other ‘green’ projects.

Solar Power

The Atacama photovoltaic power plant project in Chile was registered at the United Nations Climate Change Secretariat in December 2012 (CDM 2012d). The project aimed at building a photovoltaic power plant with a capacity of 250 MW at a cost of US$ 500 million. Given that the solar photovoltaic power project is projected to reduce 290,000 metric tons of GHG per year and its operational lifetime is 25 years, the project could reduce around 7.25 million metric tons of GHG during its lifetime. One sees that a project of this kind has the potential to reap sizable profits of somewhere between US$ 73 million and US$ 300 million on the premise that the price of GHG certificates falls somewhere between US$ 10 and US$ 40.

Wind Power

Inner Mongolia Bayannur Wulanyiligeng wind power plant in China was registered at the United Nations Climate Change Secretariat in August 2011 (CDM 2011b). The goal of this project was to build a wind power plant with a capacity of 300 MW at a cost of US$ 420 million.[4] Given that the wind power project is projected to reduce up to 900,000 metric tons of GHG per year and its operational lifetime is 25 years, the project could reduce 23 million metric tons of GHG during its lifetime. Similar to the solar project, this type of project has the potential to harvest a considerable profit of somewhere between US$ 225 million and US$ 900 million, likewise on the premise that the price of GHG certificates will fall somewhere between US$ 10 and US$ 40.

Geothermal Power

The Olkaria IV geothermal power plant in Kenya was registered at the United Nations Climate Change Secretariat in December 2012 (CDM 2012b). Here, the aim was to build a geothermal power plant with a capacity of 140 MW at a cost of US$ 520 million. Given that this geothermal power project is projected to reduce 651,000 metric tons of GHG per year and its operational lifetime is 25 years, the project could reduce 16.3 million metric tons of GHG during its lifetime. Accordingly, there is the potential to garner a remarkable profit of somewhere between US$ 163 million and US$ 651 million if the price of GHG certificates fall somewhere between US$ 10 and US$ 40.

Subway

The Metro Line 12 project in Mexico was registered at the United Nations Climate Change Secretariat in September 2012 (CDM 2012a). The objective was to build a 25 km-long subway system in Mexico City at a cost of US$ 1.97 billion.[5] Given that the project is estimated to reduce up to 137,000 metric tons of GHG per year and its operational lifetime is 30 years, the project could reduce up to 4.1 million metric tons of GHG during its lifetime. This project has the potential to garner a profit somewhere between US$ 41 million and US$ 164 million assuming that the price of GHG certificates falls somewhere between US$ 10 and US$ 40.

Rapid Transit System

The Bus Rapid Transit (BRT) Lines 1–5 EDOMEX project in Mexico was registered at the United Nations Climate Change Secretariat in May 2011 (CDM 2011a). The BRT Line 1–5 EDOMEX project aimed to establish a safe and rapid mass transit system by introducing bus-only lanes, rechargeable electronic cards for payment, real-time next bus information displays and centralized control systems. The BRT project is estimated to cost US$ 246 million.[6] Given that the project is estimated to reduce 146,000 metric tons of GHG per year and its operational lifetime is 30 years, the project could reduce 4.4 million metric tons of GHG during its lifetime. A substantial profit potential of somewhere between US$ 44 million and US$ 176 million could be projected based on the premise that the price of GHG certificates will fall somewhere between US$ 10 and US$ 40.

Non-green Projects

It is worthwhile to note that the potential of GHG as a new financing source is not limited to 'green' areas as mentioned above but can be further extended to 'non-green' areas like fossil fuel-burning power plants. Taking the example of a gas-fired power plant, Fujian Jinjiang LNG power plant project in China was registered at the United Nations Climate Change Secretariat in February 2009 (CDM 2009). The project goal was to build a natural gas-fired power plant with a capacity of 1516 MW at a cost of US$ 695 million.[7] Compared to GHG produced by 'cheaper' coal-fired power plants that are currently a more prevalent power source in China, GHG emissions produced by the 'expensive' natural gas-fired power plant project are estimated to drop by about 2.7 million metric tons per year. Given that the technical lifetime of the natural gas-fired power plant is 20 years, the project can reduce up to 55 million metric tons of GHG during its lifetime. Accordingly this project has the potential to reap a large profit somewhere between US$ 550 million and US$ 2.2 billion assuming that the price of GHG certificates will fall somewhere between US$ 10 and US$ 40.

Coal-fired power plants also play a role: Shanghai Waigaoqiao coal-fired power project was registered at the United Nations Climate Change Secretariat in December 2010 (CDM 2010). The project aimed to construct an ultra-supercritical (USC) coal-fired power plant with a capacity of 2000 MW at a cost of US$ 1.4 billion. The 'more efficient' USC coal-fired power plant project is projected to reduce GHG emissions by about 310,000 metric tons per year when its GHG emissions are compared with those of 'efficient' supercritical (SC) coal-fired power plants.[8] A supercritical coal-fired power plant operates at a higher temperature and pressure than a normal coal-fired power plant does, increasing efficiency and consuming less coal: reductions in coal consumption means a reduction in GHG emissions. Likewise, an ultra-supercritical coal-fired power plant operates at an even higher temperature and pressure than a supercritical coal-fired power plant does, making them even more efficient than supercritical power plants. Given that the technical lifetime of the ultra-supercritical coal-fired power plant is 20 years, the project can reduce up to 6.2 million metric tons of GHG during its lifetime. The profit potential of such project lies somewhere between US$ 62 million and US$ 248 million based on the assumption that the price of GHG certificates falls somewhere between US$ 10 and US$ 40. A summary of the cost of projects and their profit potential on GHG reductions can be seen in Table 1.1. The details on the calculation of reductions in GHG emissions for an individual project will be reviewed in Chap. 6.

Inevitably, such estimates as noted above are financial ones that do not take into account both political and technical issues as well as other real-life obstacles. For example, there is no consistent international roadmap for stabilizing GHG prices which have shown volatility since their inception. Moreover, the concrete future of United Nations' pilot mechanism that has certified many projects of GHG reduction remains uncertain. Nonetheless, it is clear from such United Nations' pilot projects that GHG can be converted into an economic commodity that can improve the financial situation of many projects. The 'seedlings of change' are apparent in these international attempts to address the challenges of cli-

Table 1.1 Project cost and profit potential in GHG reductions

Project	Investment cost (US$)	Potential of profits (US$)[a]	Percentage of profit (%)[b]
Jirau hydro power	4.7 billion	1.8 billion–3.6 billion	38–77
Atacama solar power	500 million	73 million–300 million	15–60
Inner Mongolia wind power	420 million	225 million–900 million	54–214
Olkaria geothermal power	520 million	163 million–651 million	31–125
Metro Line 12	1.97 billion	41 million–164 million	2.1–8.3
BRT Line 1–5 EDOMEX	246 million	44 million–176 million	18–72
Fujian LNG power	695 million	550 million–2.2 billion	79–317
Shanghai coal-fired power	1.4 billion	62 million–248 million	4.4–18

[a]Price range: US$ 10 per metric ton of GHG—US$ 40 per metric ton of GHG
[b]Percentage of profit against investment cost

mate change. At present, our mandate as global citizens is to help the seedlings grow into trees and forests. In other words, GHG reduction can yield profits that serve the common goods of humanity. The flourishing trees and forests would eventually provide us with the protection of cooling shade from the burning sun. Against this backdrop, Chap. 2 will examine the area which these profits are aimed to promote.

Notes

1. US$ 4.7 billion means US$ 4,700,000,000. Capital expenditure of the Jirau hydro power plant is estimated to be 9871 million BRL as of 26 December 2012. For further details, see Clean Development Mechanism-Executive Board (2012c, 2 and 42–44).
2. In 2014, the price of GHG in Europe was US$ 8 per metric tonne. It was US$ 9 per metric tonne in North America, US$ 66 per metric ton in Japan and US$ 107 per metric ton in Russia. See, International Energy Agency (2015a, 24).
3. International Energy Agency (2015b, 42). This is an assumed price under current policy scenarios of the EU, taking into account investment decisions, reflecting the expectation that some form of action is or will be taken to penalize GHG emission in the future. In the scenario of limiting the rise in the global average temperature to below 2°C above pre-industrial levels, the GHG price of the EU is expected to rise from US$ 22 in 2020, US$ 100 in 2030 to US$ 140 in 2040.
4. Clean Development Mechanism-Executive Board (2011b, 2 and 14). The foreign exchange rate at the date of the registration is applied in order to convert CNY to the US dollar.
5. Clean Development Mechanism-Executive Board (2012a, 27–28). The foreign exchange rate at the date of registration is applied in order to convert MXN to the US dollar.
6. The foreign exchange rate at the date of the registration is applied in order to convert MXN to the US dollar.
7. The foreign exchange rate at the date of the registration is applied in order to convert CNY to the US dollar.
8. The USC coal-fired power plant with the capacity of 2000 MW is estimated to produce 8.8 million metric tons of GHG per year, while SC coal-fired power plant with a similar capacity is estimated to produce 9.1 million metric tons of GHG per year.

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2

Green Infrastructure to Pursue Two Visions

One Arrow to Pierce Two Targets

Every country wants to be wealthy. The creation of wealth is an effective tool against poverty within the country itself (Kraay 2004).[1] In this regard, countries whose people live in poverty would naturally try to be wealthy. Currently, as many as 702 million people still live in extreme poverty (World Bank 2015). Further, the countries of today cannot avoid a global challenge of the twenty-first century when they run the race towards wealth: global climate change. To our dismay, scientists inform us that greenhouse gas (GHG) emissions keep increasing despite the global community's efforts to reduce them via initiatives such as the Kyoto Protocol, a UN initiative to reduce these GHGs. What concerns us primarily is that climate change poses a serious threat to the basis of economic development; say, by aggravating food shortage or causing political instability. Indeed, in the globalized and interconnected world, it can be said that a blind pursuit of economic growth regardless of environmental degradation poses a serious threat to the global community. With this point in mind, the author would like to pinpoint *green infrastructure* as a powerful arrow to pierce two targets: making a country

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wealthy and checking climate change. For this book, green infrastructure means GHG-reducing low-carbon infrastructure. Green infrastructure may include any infrastructure that reduces GHG such as renewable energy infrastructures, fossil fuel power plants with carbon capture and storage (CCS) facilities, and public transportation systems.

The First Vision: Making a Country Wealthy

Three Forces of Economic Development 'On the Supply Side'

In order for a country to make a profit which can lead to riches and wealth, the country needs to make products more cheaply and better than other countries do, and at the same time, the country should be able to sell them in diverse markets both domestically and overseas. The former step is related to the supply side, whereas the latter step is concerned with the demand side. In order to analyze the causes of the wealth of a nation on the supply side, one begins with the factors of production. In economics, the level of a nation's wealth is generally assessed based on the 'domestic production capacity,' usually in the form of Gross Domestic Product (GDP) per capita. To build such national production capacity, there are three factors of note: labor, capital and land. These are called the 'three factors of production' (O'Sullivan and Sheffrin 2003). Labor means workers; capital means any human-made resources that are used to create other goods or services like agricultural equipment, machinery or factory buildings; and land is all of the natural resources that are used to produce goods or services. Through the lens of the factors of production, three forces for building the wealth of a nation are noteworthy: Division of labor, mechanization, and technological progress.

Division of Labor

To begin with, it is the division of labor that is the most basic force in creating the wealth in society. The division of labor increases the efficiency of labor, which is a factor of production. Simply put, the core value of the division of labor is that 'one person can produce more.' In Plato's *Republic (360* BC), ancient people clearly understood the benefits of division of labor. Even Socrates knew that farmers should not specialize in making houses, clothing or shoes but that skilled men serve each other best by focusing on his own skill. Indeed, it is intuitively clear that the division of labor is a starting point in increasing the production capacity of a human society. Without the introduction of division of labor, humans would remain in a self-sufficient hunter-gatherer society.

The division of labor became increasingly highlighted with the advent of the Industrial Revolution in the late eighteenth century. While the division of labor in Plato's time was mostly made between broadly different sectors as illustrated above, the division of labor in the modern era focuses on works within the same sector. For example, in a manufacturing industry, a whole production process is divided into smaller tasks and each task is allocated to an individual worker. Hence, a rise in productivity is possible because a worker becomes more efficient in his or her task by focusing only on his or her task and repeating it numerously. Adam Smith, who laid the foundation of modern economic theory by publishing *An Inquiry into the Nature and Causes of the Wealth of Nations* in 1776, provided a famous case in this regard: a pin-maker alone could not make more than 20 pins a day because making a pin involves many works such as drawing out wire out of a furnace, straightening, cutting, pointing; grinding at the top, and making the head of a pin. Thus, 10 pin-makers who work separately could produce a total of at most 200 pins a day. However, if an owner of a small pin-making factory divides the whole production process into a couple of tasks and allocates them to his or her 10 workers, 10 workers in cooperation can produce more than 48,000 in a day. This example shows that the division of labor can increase productivity by 240 times, at least in pin production.

Added to his intuition of the division of labor, Adam Smith provided another powerful insight that the 'market size' is critical to promoting the division of labor. He took the example of a porter who cannot make a living in a remote and small village because the place is not large enough to ensure him constant demand for delivery. In his view, when the market is very small, there is hardly any incentive for a person to dedicate one's full time to a single employment. Against this backdrop, Adam Smith paid attention to an important role of *transportation infrastructure* in enlarging the size of market and thus, promoting the division of labor. He explained the significance of efficient transportation infrastructure by taking the example of trade between London and Edinburgh, which are 670 km away from each other. He indicated that maritime transportation enabled a factory in London to reach a distant market in Edinburgh at a much lower price as follows:

> As by means of water-carriage, a more extensive market is opened to every sort of industry than what land-carriage alone can afford it, so it is upon the sea-coast, and along the banks of navigable rivers, that industry of every kind naturally begins to subdivide and improve itself, and it is frequently not till a long time after that those improvements extend themselves to the inland parts of the country. A broad-wheeled wagon, attended by two men, and drawn by eight horses, in about six weeks' time, carries and brings back between London and Edinburgh near four tons weight of goods. In about the same time, a ship navigated by six or eight men, and sailing between the ports of London and Leith, frequently carries and brings back two hundreds of tons weight goods. Six or eight men therefore by the help of water-carriage, can carry and bring back, in the same time, the same quantity of goods between London and Edinburgh as fifty broad-wheeled wagons, attended by a hundred men, and drawn by four hundred horses. Upon two hundred tons of goods, therefore, carried by the cheapest land-carriage from London to Edinburgh, there must be charged the maintenance of a hundred men for three weeks, and both the maintenance and what is nearly equal to maintenance the wear and tear of four hundred horses, as well as fifty great wagons. Whereas, upon the same quantity of goods carried by water, there is to be charged only the maintenance of six or eight men, and the wear and tear of a ship of two hundred tons burthen, together with value of superior risk, or the difference of insurance between the land and water-carriage (Smith 2010).

Furthermore, the role of transportation infrastructure in enlarging the size of the available market is not limited to a domestic market. Efficient transportation infrastructure can allow producers to reach wider 'overseas markets.' Global competitiveness is connected to expansion into overseas markets: companies can increase their production capacity while lowering their production costs, which allows them to drive out smaller competitors from the market. Bigger companies with greater resources can also spend more on R&D, which can result in better products. Importantly, the impact of transportation infrastructure on the demand side has its indispensable counterpart on the supply side in our modern economy. Proliferation of factories and increasing urbanization require the smooth movement of workers to and from their workplace for optimizing the division of labor.

Mechanization

Another force of note is 'mechanization.' It enables human societies to make a quantum leap in productivity. Mechanization enhances the efficiency of capital, which is another factor of production. Replacing manual labor with machines in the production process is a revolutionary change on the supply side since machines can produce far more and much faster. For example, with a mechanization of the textile industry in Great Britain, the productivity of a single operator in cotton spinning increased a hundredfold in the space of a generation and a thousandfold in two generations during the seventeenth and eighteenth century (Ayres 1989). Hence, the core value of mechanization is that with the help of machinery, 'one person can produce much more.' Mechanization began to gain momentum in the eighteenth century with the introduction of the steam engine that obtained power to drive machinery from steam pressure from boiled water. While the steam engine considerably increased industrial productivity, the power it produced had physical limitations; unlike electric power, which could easily travel long distance with the help of electric wire, steam power could not travel long distances. Steam power could be transmitted from the steam engine to machinery only via shafts and belts. To make matters worse, big steam engines need a large stack of coal beside them as energy source. Therefore, the machinery was slow in operating speed, big in size and needed to be always installed near a large stack of coal (Devine 1983). Accordingly, engineers could not prioritize efficiency in designing the production line but always had to consolidate machinery around a power source, the large steam engine. In contrast, with electric motors machinery was much faster in speed, smaller in size and could be placed anywhere independent of power sources (Devine 1983). In particular, since power could be transferred to an electric motor with a wire that is flexible and easily extendable, there was no limitation in designing the production line. In short, machinery could be placed wherever engineers wanted. All this progress made substantial contributions to increasing productivity.

At this point, it is of note that with mechanization, the 'market size' becomes all the more important. Installing machinery in a factory requires a businessman to make a big initial investment for production, resulting in increase in the number of products. Under these circumstances, if a market is too small to consume all the goods produced, the investor cannot recover the original investment, resulting in financial distress. In a nutshell, since mechanization involves big investment and boosts productivity at the same time, it cannot be sustained without access to a wider market. Now, with the increase in the size of market, the cost of a product goes down due to the economies of scale. The economies of scale mean that the more you produce, the lower the production cost: a one-time fixed cost for building a mechanized factory can be divided by the number of products and is distributed to each product (O'Sullivan and Sheffrin 2003). For example, if the cost of building a mechanized factory is US$ 1000, and each product costs US$ 10 to make, manufacturing a product would cost US$ 1010 and manufacturing two products would cost a total of US$ 1020, or only US$ 510 each. Manufacturing five products will cost a total of US$ 1050 or just US$ 210 each. Accordingly, it is clear that with the increase in the number of products, the production cost goes down substantially. If a product is cheaper, it is more likely to be popular in the market. Consequently, if the production cost goes down, a factory can enjoy more profits.

Logically, by recognizing the importance of the size of market, it is also clear that transportation infrastructure for expansion of the domestic market as well as accessing the overseas markets is likewise indispensable to promoting mechanization. In particular, it is of note that in the twentieth century, the productivity of our society grew exponentially with the introduction of 'mass production', which combined the division of labor with mechanization. Indeed, mass production worked as a game changer in the industrialization process. The Ford Motor Company provides a good example: by introducing a conveyor belt powered by electricity into the assembly line, incomplete cars are delivered to workers on the conveyor belt, while workers stand at one position repeating same assigned tasks. Such continuous-process mass production raised productivity substantially (Beaudreau 1996). Consequently, the size of market became all the more important and so did transportation infrastructure in the era of mass production. The indispensable role of energy for sustaining mechanization in the modern economy is evident here: energy-intensive mass production systems inevitably require a stable *energy infrastructure*. Among various kinds of energy, electricity has been a critical input in the modern economy for operating electric motors as explained above. Electricity-based transportation such as electric cars and trains further highlight the significance of electricity in the modern world.

Technological Progress

Lastly, it is 'technological progress' that contributes enormously to a rise in productivity and the improvement of product quality. The empirical research of Robert Solow adds weight to this argument. Among the three factors of production as noted above, Robert Solow selected labor and capital for his study on the causes of economic growth. By examining the increase in Gross National Product (GNP) 'per worker' of the US economy from 1909 to 1949, Robert Solow found that the real GNP per worker increased by about 100 percent during the period, and that, surprisingly, capital accounted for only a 12.5 percent increase in output. Additionally, since his study analyzed the increase in GNP per capita, it did not measure the contribution of labor to the increase in GNP. Indeed, the residual increase of 87.5 percent in the real GNP per worker could not be accounted for. Robert Solow attributed the residual 87.5 percent increase to the outcome of technological progress (Solow 1957).[2] This research of Solow brought him a Nobel Prize in Economic Science in 1987.

Despite the usefulness of Solow's analysis in highlighting the importance of technological progress in economic growth, little attention was given to land, which is the third factor of production. In explaining the lack of attention to land in the Solow analysis, it should be considered that unlike the agricultural economy before the industrial revolution, the importance of land decreased in the manufacturing economy (Hansen and Prescott 2002). For example, the value of farmland in relation to GNP fell from 88 percent in 1870 to less than 5 percent in 1990 in the American economy. However, land is increasingly drawing attention with the emergence of the idea that the scarcity of land may function as a drag on economic growth. In order to understand this idea, it should be remembered that land as the third factor of production includes not only land in the literal sense but also natural resources on land surfaces as well as underground. Such an idea was first introduced in 1972 by a group of scholars in a book entitled *Limits to Growth*, which had been commissioned by the Club of Rome. The scholars argue that our planet has limits in the use of its resources and, therefore, there are limits to growth (Meadows et al. 2004). They warn that the modern economy is exhausting resources or emitting pollutants at an unsustainable rate, thus approaching collapse. Against such apocalyptic views, William D. Nordhaus adds land and natural resources as additional factors of production to the Solow analytic model, and shows that resource constraints are likely to be a relatively small drag on economic growth in advanced countries (Nordhaus 1992). He estimates that resource constraints are likely to undermine economic growth by about one-fifth from 1980 to 2050. Nonetheless, he predicts that such an obstacle will continue to be overcome by technological progress. Irrespective of the accuracy of Nordhaus's estimation, the value of his research is that it highlights the role of technological progress in enhancing and sustaining economic development.

Like other forces of economic development, the force of technological progress is also strongly affected by transportation and energy infrastructures. Since technological progress enhances both productivity and quality of products as well, it follows that technological progress requires a bigger size of market for consumption of the more numerous products generated. *Transportation infrastructure* then is an important element to sustain and foster technological progress. Interestingly, this technological progress is also mostly related to energy. While Robert Solow attributed the 87.5 percent increase in output from 1909 to 1949 to technological progress, he did not explain in which area such technological progress took place. Faced with such a 'black box' situation, Robert Ayres and Benjamin Warr analyzed technological progress and found that the unexplained 87.5 percent increase in production could be substantially explained by a rise in energy conversion efficiency.[3] Simply put, the substantial portion of technological progress reflects gains in energy conversion efficiency. The formula of economic growth from energy efficiency gains is as follows: a rise in energy conversion efficiency lowers production cost, which increases demand for products, thus eventually expanding production. Energy conversion efficiency is promoted in the process of producing two intermediate inputs: mechanical work and heat. Ayres and Warr's examples of energy conversion efficiency are illustrated in Table 2.1. With regard to a single conversion category, the energy conversion process takes place just once from fuel to mechanical work or heat. Representative examples are the steam engine for mechanical work and coal furnace for heat, respectively. In relation to a dual conversion category, energy conversion takes place twice: from fuel to electricity, and from electricity to mechanical work or heat. Representative examples here are the electric motor for mechanical work, and the electric arc furnace for heat.

It is evident that as fuel and electricity are important prerequisites for energy conversion powering technological progress, *energy infrastructure* becomes an essential condition in the framework of this progress. Reiner Kümmel supports the conclusion of Ayres and Warr. He proves that energy is cheap but a high productive power, while labor is expensive but a low productive power. Therefore, he argues, our economy is under mounting pressure to automate, replacing expensive labor with machinery

Table 2.1 Examples of energy conversion[a]

Category	First stage	Second stage	Third stage	Examples
Single conversion	Fuel	Mechanical work		Steam engine
		Heat		Coal furnace
Dual conversion	Fuel	Electricity	Mechanical work	Electric motor
			Heat	Electric arc furnace

[a]It should be noted that Ayres and Warr divided energy conversion into two categories

driven by cheap energy (Kümmel 2007). This means that as machinery plays an increasingly greater role in the modern economy, technological progress inevitably requires the energy infrastructure that drives such machinery.

Innovation as a Higher Concept to Embrace Three Forces of Economic Development

Given that the division of labor, mechanization, and technological progress are all separate concepts, measures to promote them have been separately analyzed thus far. However, if we could find a higher concept which can embrace the three distinct forces, we could also invent a powerful idea that could enhance the three forces with a common stroke, in addition to efforts to promote the three forces separately.

To this end, a higher concept of 'innovation' could be introduced in this chapter. Since the concept of innovation originally emerged as a theoretical framework to analyze the causes of long-term economic growth, it is natural that there is a common thread that underlies 'innovation' and the 'three forces for building the wealth of a nation.' In order to better understand the concept of innovation, a distinction needs to be made between invention and innovation. While invention is a creation of an idea for a new product or process, innovation is the first attempt to realize it in practice (Fagerberg 2006). Joseph Schumpeter categorized innovation into five types: new products, new methods of production, new sources of supply, new ways to organize business like M&A, and the exploitation of new markets. Among the five types, the first two are 'product innovation' and 'process innovation' respectively, which are important in establishing a framework to embrace the three distinct forces (Schmookler 1966). Based on the selection of the critical two types, innovation can be practically understood as a creative step that produces a new product, improves existing products, or improving production process.

Given such scope of innovation, the division of labor and mechanization can be put into the category of process innovation, while technological progress can be classified into both product innovation and process innovation. Accordingly, it can be said that innovation in a general sense embraces all three forces under its scope of activities.

Historically, innovation played a very powerful role in transforming the economic structures of countries. Accordingly, Nathan Rosenberg argues that innovation has been the single most important factor of long-term economic growth (Rosenberg 2004). There are many interesting stories of note, including the establishment of mechanized factory systems and the subsequent sophisticated division of labor, the rise of the steam engine and the invention of the telegraph, the proliferation of electric motors, the introduction of conveyor belts and mass production, and the wave of the Internet and Communication Technology (ICT) revolution (Freeman and Soete 1997).

Without a doubt, throughout history, innovations proved to be powerful game changers. Those who neglected the efforts at innovation were humiliated by those who actively promoted innovation. For instance, since the sixteenth century, countries in northwestern Europe made great efforts to raise the productivity of their agricultural and manufacturing industries (Wallerstein 2011). As a result, most of the innovations noted above were driven by countries like the Dutch Republic, England and France in their competition to dominate international markets.

At the beginning, the Dutch Republic made a head start in a race for innovation, thus establishing itself as a leader in textile manufacturing and shipbuilding in the sixteenth century. The technology of the textile industry in the Dutch Republic was so advanced at the time that undyed cloth from England was sent to the Dutch Republic for finishing (Wallerstein 2011). Surprisingly, it was calculated that 47 percent of the value of clothes produced in England came from the process of dyeing, which was done in the Dutch Republic (Wilson 1971). In addition to its prominence in the manufacturing industries, the Dutch Republic was also a leader in the shipbuilding industry at the time. The cost of ship construction in the Dutch Republic was 40–50 percent cheaper than in England (Wallerstein 2011).[4] The advantage of the Dutch Republic in the shipbuilding industry was possible because it introduced standardized and repetitive production methods on a large scale, including a sophisticated division of labor through dividing the shipbuilding process into several tasks and assigning them to different groups of workers as well as using labor-saving mechanized devices like wind-powered sawmill and a great crane to move heavy timbers (Wallerstein 2011). Furthermore, Dutch ships were constructed in such a way to require smaller crews, normally 18 instead of the 26–30 employed on ships of other countries (Wilson 1966). With the advantages in operating costs as well as production costs, the freight rate of the Dutch ships was far cheaper than their competitors. Consequently, Dutch shipping dominated the world carrying trade, growing tenfold from 1500 to 1700 (Wallerstein 2011). As of 1670, the tonnage under Dutch ownership was three times more than that of the English, and greater than the tonnage of England, France, Portugal, Spain, and the Germanies combined. Since the Dutch Republic was armed with low cost means of transportation as well as high quality products, it is no wonder that it grew into a rich and hegemonic power in the seventeenth century.

For Great Britain, it took about 200 years to overtake the Dutch Republic. The Industrial Revolution triggered in Great Britain consolidated its position in the world economy (Landes 1969). For example, during the Industrial Revolution, new machines were continuously invented and innovated, contributing greatly to the mechanization of key industries such as textiles or mining. Moreover, an energy revolution took place with the invention of the Newcomen steam engine and the subsequent innovations of James Watt's steam engine. Furthermore, the use of coal and steam engines as a new energy source triggered the development of factory systems that were a revolutionary process innovation at the time. As noted above, because of the physical limitations of steam power, big steam engines needed to be installed close to machines. Traditional small cottage industries could not accommodate large-scale centralized steam power systems and could not afford expensive machinery either. This factory system that combined machines and people unleashed not only the force of mechanization but also of that of the division of labor. Such innovative attempts shifted the center of technology from the Dutch Republic to Great Britain from the eighteenth century (Kindleberger 1996).

In contrast to the struggles for innovation in northwestern Europe, China, which had been the world's technological superpower for at least a millennium, dismantled its expensive ocean fleets in 1434, thus closing itself to international trade and access to advanced technology (Sachs

2005).[5] At the time, China thought that maintaining its ocean fleet was a heavy financial burden, and maritime trade would, as a source of income inequality, constitute a threat to political stability (Landes 1998). Accordingly, China continued to maintain a closed-door policy. It was well illustrated in a letter from Chinese Emperor Qianlong to the British King George III in 1792, which stated, "There was no need to import the manufactures of outside barbarians in exchange for our own produce" (Chang 2015). The consequence of this marked difference in national policy on innovation was the British gunboat diplomacy that forced the opening of China to international trade in 1842, following the Opium Wars between the two countries.

The Incorporation of Innovation into the Factors of Production

Indeed, given such importance of innovation in increasing production capacity as well as product quality, modern economics intended to include innovation in the factors of production. However, it should not be overlooked that factors of production need to be in a tangible form in order to be employed as 'inputs' in the production process. Hence, given that innovation is an abstract concept and therefore cannot be summoned as an input in the production process, an alternative approach is required. The entrepreneur serves as a clue to overcoming this barrier: an entrepreneur is a person who takes risks to develop ideas, combines factors of production, and creates new goods and services (O'Sullivan and Sheffrin 2003). In this context, Joseph Schumpeter labeled innovation as the activities of an entrepreneur (Schumpeter 1983). Thus, given the pivotal role of the entrepreneur in promoting innovation, an entrepreneur could be regarded as the fourth factor of production next to labor, capital and land.[6] In sum, it can be said that all three forces are considered to be outcomes of innovation in a wider sense, and that this innovation is 'personified' in the entrepreneur as the fourth factor of production in modern economics. On the supply side, the relations between the historical three forces and the factors of production can be illustrated in Fig. 2.1.

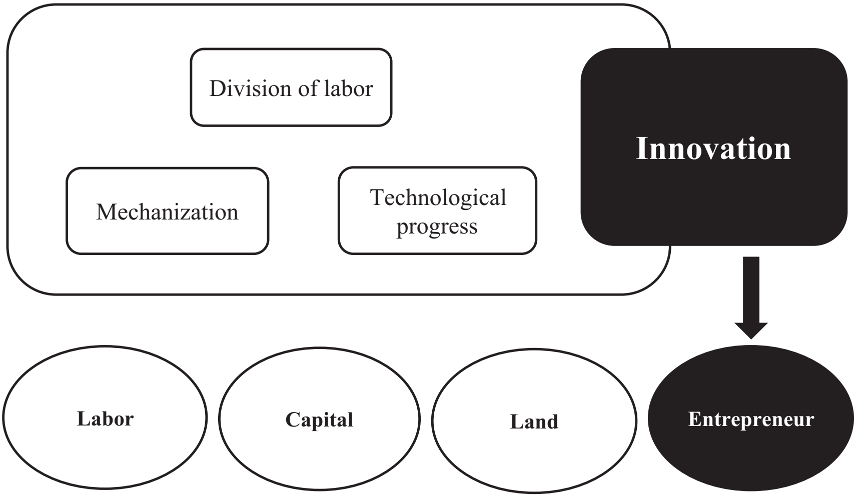

Fig. 2.1 Relations between historical forces and factors of production

How to Promote Innovation?

Against this backdrop, by identifying the systemic characteristics of innovation process and clarifying how innovation takes place, one finds common effective policies to promote the division of labor, mechanization and technological progress. From the definition of innovation, which means implementing a new idea into practice, one sees the first step is the learning of a new idea. Subsequently, learning by doing follows in the course of carrying out a new idea into practice. Accordingly, a key to promoting innovation is the 'learning process', which can be characterized as a collective, cumulative, and uncertain work (O'Sullivan 1998).

First, a 'collective' work since learning is not an isolated process, but one that requires interaction among different people with different capabilities (Lazonick 2006). Through such interaction, knowledge flows between economic entities and is transformed into innovation. The scope of participants of such interaction could be wide, including entities like firms (customers, suppliers and competitors), research organizations (universities and other private research institutes), and public agencies (ministries and technology transfer centers) (Gertler 2001). Tacit knowledge is increasingly recognized as the most important component of such interactions (Edquist 2006). Tacit knowledge is acquired through practice, becoming embedded in a specialist's or professional's skill set. Unique to tacit knowledge is that it cannot be articulated or codified into a written text and is, therefore, difficult to exchange over long distances. This makes it spatially sticky. Accordingly, in relation to innovation, spatial proximity matters. The need of social interaction for innovation and the growing importance of 'sticky' tacit knowledge as targets of such interaction make 'spatial proximity' a critical element to be considered in promoting innovation. In practice, the effect of spatial proximity in promoting innovation is well illustrated by the success of Silicon Valley in California, a cluster of academic institutions and business firms, where the Internet was invented. In terms of spatial proximity, urbanization is also an important concept to be taken into account, which will be revisited later in this chapter.

However, spatial proximity is not the only basis of effective interaction. Relational proximity can work as a complementary basis of effective interaction (Asheim and Gertler 2006). The logic is that tacit knowledge can also be exchanged through communities of practice. Communities of practice are defined as groups of people who share a concern or a passion for something that they do and learn how to do better as they interact regularly.[7] For example, if you are a member of an academic association for wind power technology, you can exchange your tacit knowledge online through emails with your friends living overseas. In such case, relational proximity can overcome long distance. The use of communities of practice, supported by ever cheaper and more powerful ICTs and air travel, can be an effective complementary basis of social interaction.

Indeed, in the course of promoting innovation, buzzing interaction at the local level is essential, while pipelines to global networks of excellence are another important source of innovative ideas (Bathelt et al. 2002). Such dynamics is succinctly captured by a metaphor, "local buzz and global pipelines."

Second, promoting innovation is 'cumulative' in that learning cannot be done all at once but that what is learned today lays the groundwork for what can be learned tomorrow (Lazonick 2006).[8] Such cumulative nature of innovation provides three points for in-depth thought. Firstly, knowing what ground has been covered is critical to innovation, making social interaction essential, as noted above. Consequently, policies that promote clusters or urbanization are important. Secondly, targeted innovation may not come immediately in the short-term, but require mid- or long-term efforts. Hence, innovation requires 'sustained and committed financing' with patience. Thirdly, such cumulative nature of innovation conflicts with the tendency of businesses that usually pursue short-term rather than long-term interests. In this sense, the role of governments to provide diverse incentives is critical to facilitating innovation, such as by directly launching public R&D initiatives or indirectly providing R&D subsidies to the private sector.

Third, promoting innovation is 'uncertain' work because we do not know the outcome until we finally come up with an innovative technology or harvest the profits from selling the innovation in the marketplace (Lazonick 1993). More precisely, despite its investment in search of innovative technology or products, a firm may fail to develop innovative processing technology or a targeted innovative product. This is called 'productive uncertainty,' and pertains to the internal operation of a firm. Development of a given innovative technology is no guarantee that the necessary resource supplies for employing this technology are available, nor that there is large enough market available. Even worse, the firm cannot exclude the possibility that its competitors may be more successful in pursuing alternative technologies or products. This is 'competitive uncertainty,' and is related to the company's external economic environment.

Given the three characteristics of innovation, it should be noted that government has acted in the private sector to both create incentives and support markets through procurement assurances for the private sector. During the Cold War, the American military sponsored numerous projects to develop high-speed calculators with a view to computing firing tables for artillery; these initiatives eventually led to the rapid development of computer technology in the USA (Flamm 1988). Another example is the support of the US government to IBM USA (Flamm 1988). As IBM was considering the possibility of developing a business computer, the projected sale of fifty computing machines to the federal government influenced IBM's decision to initiate the development of its first business computer.

Clearly, defense-related public R&D funding and government procurement exercised a pervasive influence in the development and diffusion of high-technology in the US economy, and ensured the lead of US firms in the global market (Bruland and Mowery 2006).[9] Such cases show the importance of active support of government in promoting innovation.

Last but not least, given that innovation is a higher concept that embraces the division of labor, mechanization and technological progress, the relations between innovation and infrastructure should be clarified. Because of the collective and cumulative nature of innovation, 'interaction' is pivotal to innovation's furtherance. Hence, a policy implication exists where *transportation infrastructure* both domestically and internationally is essential to promoting 'innovation in a general sense.'

In conclusion, the forces of economic development and innovation are critical to accumulating the wealth of nations. Where the forces are harnessed, a country can make many high-quality products at low cost. Needless to say, when the economy of a country performs like that, the country easily becomes wealthy, their products flying off the shelves. Against this backdrop, the need for energy and transportation infrastructure to ensure the successful operation of the forces should be highlighted. To summarize, the relations between the forces and their drivers are indicated in Table 2.2.

Table 2.2 Forces of economic development and their drivers

Types of force	Major drivers	Indispensable infrastructure
Division of labor (D)	• Size of market	• Transportation infrastructure
Mechanization (M)	• Size of market • Energy	• Transportation infrastructure, • Energy infrastructure
Technological progress (T)	• Size of market • Energy	• Transportation infrastructure, • Energy infrastructure
Innovation in general (I)	• Size of market • Interaction	• Transportation infrastructure

National Policies that Unleash the Forces of Economic Development

We have looked at the forces of economic development that increase the 'domestic production capacity' of a country, and now we turn to the 'national policies' that unleash these forces of economic development from the perspective of countries playing 'catch-up.' In order to facilitate understanding of readers, Table 2.3 sets out an overview of the relations between the national policies and forces. Of particular interest in this overview is that apart from outward FDI policy on the supply side, *all these national policies unleashed the forces of economic development*. Following are the details of national policies illustrated by some historical examples.

Industrial Policy

Overview

First of all, it is industrial policy that is of particular note in the historical race to be a rich country. By definition, industrial policy is 'government measures' aimed at improving the competitiveness and capabilities of domestic firms while promoting structural transformation (UNCTAD and UNIDO 2011). Industrial policy can be very attractive for catching-up countries when their products are low in quality and/or high in price, thus non-competitive with those of advanced countries on a level playing

Table 2.3 Effects of national policies on economic development

		Forces to be unleashed by national policy							
		On the supply side				On the demand side			
Nation policy		D	M	T	I	D	M	T	I
Industrial policy		√	√	√	√	√	√	√	√
FDI policy	Inward	√	√	√	√	√	√	√	√
	Outward	N/A	N/A	√	√	N/A	N/A	√	√
Urbanization policy		√	√	√	√	√	√	√	√

D stands for the division of labor; **M** for Mechanization; **T** for Technological progress; and, **I** for Innovation field. In this context, one of the industrial policies that catching-up countries may adopt is first to nurture their infant industries domestically, preventing the inflow of more advanced products from overseas. Then, when their infant industries mature and become internationally competitive, they let their industries compete in the wide global market. This is the basic storyline of a successful industry policy. Historically, nearly all successful catching-up countries adopted such polices. Industrial policy is important because *industrial policy unleashes the forces of division of labor, mechanization and technological progress; namely, the force of innovation in a broad sense*. Taking a closer look into the details of successful industrial policies, the vibrant operationalization of such forces of economic development is evident.

To begin with, on the supply side, industrial policy activates the three forces of division of labor, mechanization and technological progress by providing 'financial supports' to relevant economic actors and building energy infrastructure. Financial supports include financial loans with low interest rates, tax reductions and R&D subsidies.[10] Financial loans and tax reductions are helpful in establishing and operating large expensive factories that adopt the system of a division of labor and are equipped with expensive machinery. Energy infrastrucrture backs mechanization. R&D subsidies help companies make technological progress in new areas. Governments can also foster 'interaction' among economic actors, which facilitates the dynamic growth of innovation. Examples include governments helping to form industrial clusters or supporting people-to-people overseas exchanges.

However, industrial policy on the supply side alone cannot solve the problems that catching-up countries face. It needs help from industrial policy on the demand side.[11] The focus of industrial policy on the demand side is the enlargement of market size. As shown above in Table 2.1, market size is critical to setting free the forces of division of labor, mechanization, technological progress and the force of innovation in general. If there is little prospect of market share, companies would not devote their energy and resources to making good products at low cost. There would be no reason to build modern factories equipped with expensive machinery. In this context, small countries are more likely to suffer because their small markets cannot create economies of scale. As mentioned above, economies of scale arise when the fixed cost of expensive machinery or

R&D is spread out across individual units of output. The more units of output are sold, the smaller the portion of the fixed cost that each unit of output bears. As a result, with increase in sales of individual units, the production cost of an individual unit goes down. Such economies of scale can be enhanced if market continues to grow. In the age of mechanization and mass production, economies of scale appear to be increasingly important. Industrial policy on the demand side may include, for example, prohibiting the inflow of foreign products into domestic markets, guaranteeing public procurement of initial products, expanding domestic and overseas transportation infrastructure to enlarge the size of market or providing financial support for expansion into larger international markets. Importantly, encouraging domestic firms to export their products induces them to actively pursue innovation. In order to make inroads into the international market where only the fittest survive amidst fierce competition between outstanding firms, domestic firms must meet the higher demand by improving their products. Such interaction between domestic firms and overseas markets increases the will and capacity of domestic players to innovate. That is to say, motivating domestic firms to be export-oriented, for example, by providing export subsidies or favorable loans, drives them to improve their product quality and production efficiency.

In sum, a successful industrial policy is one that cultivates and channels the forces of the division of labor, mechanization and technological progress, namely the force of innovation in a broad sense. This also means that adequate transportation and energy infrastructures provide any necessary support promoting the forces as noted in Table 2.1.

Great Britain

Case studies can give perspective on the successful and real-life application of industrial policies. Importantly, history shows that almost all economically developed countries have adopted a certain form of industrial policy at some point, although such industrial policies do not always guarantee economic success (Chang 2003). In other words, industrial policy is not a sufficient condition for success but can be at least a necessary condition. For instance, Great Britain made very effective use of industrial policy in catching up with the Netherlands: before 1600, Great Britain was far behind the Dutch Republic in high-tech industries like textiles and shipbuilding (Kindleberger 1996). As illustrated above, England had to send its undyed cloth to the Dutch Republic for finishing, paying the Dutch up to 47 percent of the final value of the British textile product for the work. To overtake the Dutch Republic, English sovereigns adopted industrial policy on the supply side. For instance, they provided a form of R&D support to their nation by poaching skilled workers from the Dutch Republic, which unleashed the forces of technological progress (Defoe 1728).[12] They also rendered financial support for exporters by providing export subsidies; lowering import duties on raw materials used for manufacturing; increasing duty refunds on imported raw material for exported manufactures; and, strengthening quality control on export goods (Brisco 1907). All these financial supports were useful to establish and operate large expensive factories that adopted the system of a division of labor and were equipped with machinery. Furthermore, Great Britain built energy infrastrucrture to support mechanization. While steam engines increased coal production by enabling deeper mining, steam engines also increased demand for coal dramatically.[13] As a result, Great Britain expanded its inland canal systems with acts of Parliament to facilitate coal transport.[14] These inland canal systems could transport coals at a much lower cost than inland turnpike road systems. For example, in the eighteenth century, for the same cost as by land, coals could be carried twenty times as far by water (Szostak 1991). Accordingly, inland canal systems in the Great Britain grew exponentially from about 1400 miles in 1760 to 4100 miles in 1830.[15] During the period, coal transportation infrastructure was very important because it served as energy infrastructure for the British manufacturing industries.

While the English sovereigns were pursuing industrial policy on the supply side, they also pushed industrial policy on the demand side by enlarging the size of market. First, by relying on legal methods like rules and regulations, Great Britain sought to protect a minimum size market for its industries. For example, it prevented the inflow of advanced foreign products into its domestic market by raising import duties on foreign manufactured goods (Wilson 1971). Great Britain also ousted competitors from the domestic and overseas market, for example, by banning the export of raw wool that the Dutch needed; this checked the Dutch production capacity and ensured market share for British products (Defoe 1728). Second, utilizing transportation methods like roads, canals and ocean lanes, Great Britain spatially pushed for geographical expansion of its market. In relation to the domestic market, Great Britain consolidated isolated local markets into a single domestic market by linking major industrial centers with new turnpike roads and canals within two decades in the late eighteenth century (Landes 1969). Thus, raw materials and goods could be transported faster and at lower cost within the domestic market (Landes 1998). Interestingly, consolidating isolated local markets into a single market enhanced not only the division of labor in individual businesses but also the division of labor on a national scale. With access to a wider domestic market, each British industrial center could specialize in a certain product; for example, Birmingham's metal goods, Manchester's cottons and Cheshire's potteries (Landes 1998). Additionally, improvement of transportation infrastructure facilitated such division of labor between industrial cities. Such national division of labor between industrial centers increased the productivity of the specialized industry of each industrial city; industry specialization within the city itself, including labor supply and vocational training, raw material and intermediate goods supply, energy supply, machine maintenance service, sales and advertisement service, and tax and lawyer service resulted in substantial productivity gains. Furthermore, in order to get access to the overseas market, Great Britain established overseas transporation infrastructure by making massive investments towards building its naval supremacy, which enabled its products to break into vast foreign markets including new colonies (Defoe 1728). Through persistent naval warfare with rival countries resulting in successes like the victory over the 'Invincible' Spanish Armada in 1588 or the defeat of the combined fleets of Spain and France at Trafalgar in 1805, Great Britain gradually gained control of maritime trade and overseas markets. Kenneth Pomeranz contends that the countries of Northwestern Europe made the transition to innovation-based growth after the mid-eighteenth century mainly because, unlike China and Japan, they could acquire new colonies as large markets for manufacturing industries and sources of raw material (Pomeranz 2000).

Such all-out industrial policies both on the supply side and on the demand side paid off by activating the force of division of labor, mechanization and technological progress in the course of British economic development. Once Great Britain established itself as an industrial leader in the nineteenth century, it made efforts to restrain the transfer of its advanced technology to overseas competitors, alongside a policy shift towards free trade (Chang 2003).[16] As a result, Great Britain eventually emerged as a 'factory of the world,' producing more than half of the European steam energy, having half of the world's railroads, and controlling half of the world's industrial product market in the 1850s (Aldebert and Delouche 1997).

The United States

The United States of America took a path similar to Great Britain. As a colony of Great Britain, America was originally discouraged and banned from developing manufacturing industries until its independence in 1776 (Chang 2003). Great Britain did not want the USA to grow as a competitor, but instead wanted to keep the former colony as a supplier of raw materials and a captive market for its manufactured goods. Despite such obstacles, the USA pushed for industrialization by adopting its own industrial policy. On the supply side, the USA first adopted conventional measures such as R&D support and investment in public education (Chang 2003). Moreover, the USA implemented policies facilitating the inflow of advanced technology and skilled workers from Europe. It was an industrial policy to promote interaction with an advanced system. In this context, the US Government strengthened her ocean shipping infrastructure by providing shipping subsidies and enacting legislation to exclude foreign ships from the coastwise trade (Taylor 1951). Hence, the registered tonnage of USA's merchant shipping grew fourfold between 1815 and 1860, thus decreasing dramatically the shipping time and costs between the USA and the Europe. The development of such overseas transportation encouraged the inflow of numerous European migrants into the USA and infused European advanced technologies into the American continent, such as toolmaking and textile machinery. In 1790, the population of the USA was about 3.9 million, 75 percent of which was of already British ancestry (Tiersky and Tiersky 1990). Between 1836 and 1914, over 30 million Europeans migrated to the USA, bringing their expertise and knowledge with them (Evans 2001). Through such an exchange of people and goods, the more advanced European technology and machinery were imported to the USA and were freely copied (Taylor 2015). In addition, the expansion of inland railroad networks in the USA as it will be explained below, contributed greatly to promoting coal transport to industrial centers.[17] Given that coal was the main energy source of industries in the USA until the early twentieth century, expanding transport infrastructure was almost equal to building energy infrastructure. All in all, this can be understood as the American version of an industrial policy on the supply side, which, undoubtedly, unleashed the forces of division of labor, mechanization and technological progress; namely, the force of innovation in a broad sense.

On the demand side, for its infant industry, the USA enlarged and protected its domestic market from the invasion of overseas competitors (Taylor 2015). For example, the USA actively promoted government procurement policies in order to guarantee a minimum size market for its new industries like small-arms manufacturing. The tradition of using public procurement as a means of promoting its industries can still be found in defense-related procurement practices (Chang 2003). At the same time, the USA horizontally expanded its domestic market with the construction of a national transportation infrastructure such as railroads, canals and steamboats, mostly in the eastern coastal region in the first half of the nineteenth century (Taylor 2015). To this end, the US Government provided subsidies and public lands to facilitate the development of transportation infrastructure. Hence, by 1840, while the European continent had at most a total of 1818 miles of railroad, the USA had already installed about 3000 miles of railroad. Moreover, the USA kept enlarging its domestic market southward and westward, buying Louisiana from France in 1803, buying Florida from Spain in 1819, and taking Texas in 1845 and California in 1848 from Mexico by force. In fact, the vast territory of the USA took its current shape in the 1850s (Min 2006). By doing so, it can be said that the USA turned overseas markets nearby into a huge 'domestic' market. Consequently, with the creation of a single domestic market over a continental landmass and easier movement of goods and services, the force of the division of labor was seen to flex its muscles on a national scale (Fukuyama 2014). For example, New England and Middle Atlantic states were specialized in the manufacturing industries, whereas the western states were involved in processing the products of agriculture and forestry. As a result, between 1815 and 1860, the value of manufactured goods grew eightfold in the USA (Taylor 2015). Furthermore, the US government consistently maintained high tariff policies from 1820 to the end of the Second World War when her industrial supremacy finally went unchallenged (Chang 2003). Nonetheless, because of the vast size of its domestic markets, the USA did not need to rely heavily on overseas markets for consumption of its manufactured products. Given that the USA's exports accounted for only 12.6 percent of its Gross Domestic Product (GDP) in 2015, it can be said that the building of such a huge domestic market during the nineteenth century indeed laid the groundwork for the economic prosperity of the USA today (Chang 2015). Thus, while the value of American manufactured goods was lower than that of Great Britain's, France's, and Germany's in 1860, by 1894, the value of American manufactured goods not only exceeded that of each country but also almost equaled that of all three combined (Taylor 2015).[18] By combining industrial polices on the demand side and on the supply side, the USA opened a new era of Pax Americana, replacing the era of Pax Britannica.

Germany

The history of Germany provides a similar example. Following the Thirty Years' War from 1618 to 1648, the German-speaking region was physically devastated. To make matters worse, dozens of small German states were granted full sovereignty and independence, thus putting serious obstacles to efforts to develop as a modern and unified country (Min 2006). In fact, Germany consisted of 355 small states and 1476 autonomous knightships in 1790, which meant that there were more than 1800 customs barriers (Kindleberger 1996).[19] Inevitably, the movement of goods and people in this region was extremely slow and costly. For instance, in order to travel 260 km from Dresden to Magdeburg, merchants had to pass through 16 customs offices (Seidel 1971).

Under these dire circumstances, the unification of Germany by Prussia in 1871 changed the landscape. Prussia's power came from her active industrial policy that had been implemented since the eighteenth century. On the supply side, what was noteworthy was the direct involvement of the state in key industries such as metals, munitions and refining (Trebilcock 2013). Frederick the Great had state-run 'model factories' that disseminated new technologies to the private sector in the eighteenth century. Furthermore, the Prussian Government provided de facto 'R&D support' to the private sector by backing industrial espionage and poaching of skilled workers from overseas (Chang 2003). Moreover, Prussia established the famous 'Gewerbeinstitut,' a national craft institute, in 1820. The works of the institute were diverse, and included providing special training to skilled workers; subsidizing foreign trips to gather information on new technologies; collecting new machinery for copying; and providing support for business start-ups, especially in machinery, the steam engine and locomotive industries (Chang 2003).[20] In addition, the German region pushed for the expansion of their railroad networks during their industrialization period (Dunlavy 1994). Accordingly, given that coal was the main energy source until the late nineteenth century as explained above, the expansion of transport infrastructure had the effect of building new energy infrastructure in the region. Such support accelerated the division of labor, mechanization and technological progress; namely, the force of innovation in a broad sense in Germany.

Prussia also pursued conventional industrial polices on the demand side, such as tariff protection, export subsidies and monopoly grants (Trebilcock 2013). However, as explained above, the existence of numerous autonomous small German states placed serious obstacles to consolidating those scattered markets into a single domestic market. To overcome such obstacles, Prussia coordinated the establishment of Zollverein (customs union) throughout the German states in 1834 (Ploeckl 2010). Based on the initial economic integration, Prussia eventually unified the German region by force in 1871 under the clever guidance of Chancellor Bismarck. With already well-connected railroad networks throughout the German region, the unification policy of Prussia can be understood as an insightful industrial policy on the demand side, making a unified Germany subsequently emerge as a commercial hub in Europe (Aldebert and Delouche 2000). However, in relation to overseas markets, a unified Germany could not make much progress because overseas colonies were already occupied by early movers like Great Britain and France. Decidedly, tension arose between early movers and latecomers. Accordingly, it can be said that the struggles between early movers and latecomers for overseas colonial markets was one of major causes of the First World War (Gifford et al. 1967).

Newly Industrialized Countries

Then, what about the newly industrialized countries? For instance, South Korea is frequently cited as an interesting example that is worthy of analysis. However, the development path that South Korea took was not so different from the cases of previous catching-up countries such as Great Britain, the USA and Germany.[21] Following the Korean War from 1950 to 1953, South Korea was one of the most economically backward countries in the world. In 1961, South Korea's GDP per capita was only US$ 84, with the country relying on the US aid for 52 percent of its government budget (Park 1970).[22]

To jump start economic development, on the supply side, the government systematically implemented policies to build human resources (UNRISD 2012). To begin with, the Korean government selected several key industries to promote and highlighted skill requirements of the selected industries in its national economic development plans. In order to establish a direct link between education and technology development, the government regulated vocational training in schools and established quotas for students and faculty at universities in order to align graduates to labor demand in key industries. The government also established a number of national R&D institutions, including the Korea Institute of Science and Technology (KIST) in 1966 and Korea Advanced Institute of Science (KAIS) in 1971. Such measures contributed greatly to building the industrial labor pool and to developing technologies for key industries in steel, chemicals and electronics. Furthermore, as Korean firms lacked financial resources to build factories or import machinery, the government decided to guarantee overseas borrowing for the private sector in 1962 (Lim 2011). It was effective in facilitating the mechanization process of key industries. Moreover, the government invested very aggressively in building infrastructure in such areas as power, transport and water (Lim 2011). In order to provide an adequate and stable supply of electricity, South Korea increased its installed capacity from 367 MW in 1961 to 9835 MW in 1981. South Korea also made massive investments in expressways and ports to support its export-oriented industrialization. Exemplary of this effort was the iconic Gyeongbu expressway connecting Seoul and Busan and stretching 416 km, successfully completed in 1970 after two and half years of intensive work, despite the heavy criticism domestically and from abroad that it was economically infeasible (Choi 2013). After completion, it proved to be a backbone of Korean industrialization, greatly facilitating the exchange and interaction of people and goods between two key industrial centers located on opposite ends of South Korean territory.

On the demand side, the construction of the Gyeongbu expressway contributed to consolidating isolated local markets into a single domestic market. However, given the small size of its domestic market, South Korea decided to expand into overseas markets by adopting an export-oriented industrialization (EOI) policy from 1964, which was contrary to the import substitution industrialization (ISI) policy touted by international aid organizations and experts at the time (Choi 2013). The export-oriented industrialization policy was also needed in order to earn foreign currency (Rhee et al. 1984). Foreign currency was necessary to pay back the loans that private firms had borrowed from overseas to finance their investments under the guarantee of the Korean government, as mentioned above. To begin with, the South Korean government allocated export targets to individual firms. Then, President Park Chung-Hee engaged in face-to-face meetings with all stakeholders concerned with the export targets, personally chairing the monthly export promotion meetings and monitoring progress in reaching export targets. The monthly trade promotion meetings were gatherings of top economic bureaucrats and leading businessmen, as well as chief executives of export associations, research organizations and educational institutions. By airing problems among all parties concerned with export targets, the monthly meetings supported attempts at finding immediate solutions, making known 'on the spot' how firms and government agencies were performing (Rhee et al. 1984). As a result, many innovative measures were taken. Of note was the introduction of a readily scalable rewards mechanism based on intermediate performance rather than rewards contingent on the final accomplishment of pre-announced targets (Lim 2011). For instance, if an exporter obtained a letter of credit from a foreign buyer that guarantees the payment of 'planned' exports, the government allowed commercial banks to automatically approve loans to the exporter. The exporter could then get access to export financing without having to put up collateral. Such a mechanism had the effect of substantially simplifying the administrative process. Furthermore, South Korea took conventional measures to promote exports, like export subsidies, tariff reduction for intermediate goods to be used for making final export goods, and tax deductions for exporting firms. Moreover, the export-oriented policy brought significant benefits to Korean firms in terms of technological progress (Rhee et al. 1984). For example, foreign buyers and suppliers provided Korean technicians with access to information about what product styles were wanted and how to make these products. Under such circumstances, Korean firms themselves also made great efforts at innovation to meet the exacting demands of a competitive overseas market. As a result of such concerted efforts, South Korea has grown from an economic ruin to the world's 11th economy in less than two generations.[23]

Unsuccessful Cases

However, not all countries that adopted industrial policies were successful in catching up. After the Second World War, there were discussions in the international community on how newly independent countries should promote economic development. The first generation of such ideas was the industrial policy by the government with a focus on import substitution industrialization (ISI) that aimed to replace foreign imported goods with domestically produced goods (Van Lieshout et al. 2010). Most Latin American countries followed such idea until the late 1970s (Blouet and Blouet 2002). However, pursuing the ISI policy had a limitation in that it confined the size of market only to the domestic market, thus limiting the forces of the division of labor, mechanization and technological progress. Moreover, by cutting off interaction with overseas markets, competition and the motivations to make better and cheaper products were reduced, thus suppressing the force of innovation in general. Consequently, many Latin American economies suffered negative effects of ISI policy like the shortage of manufactured goods, higher consumer prices and low quality of products (Blouet and Blouet 2002).[24]

In response to the negative consequence of the ISI policy, a second generation of ideas prevailed from the 1980s, which was called the Washington Consensus (Van Lieshout et al. 2010). The core of this idea was trade liberalization and privatization of economic activities that was aimed at instilling the spirit of free trade and the elements of competition in the closed economies of catching-up countries. However, this idea was in conflict with traditional industrial policy premises, which argue that infant domestic firms would suffer in open competition if markets were opened too early to advanced, experienced foreign firms (Choi 2013). Accordingly, catching-up countries mainly in Africa and Latin America that followed the suggestions of the Washington Consensus experienced little or no economic growth, while countries like China, India, and Vietnam that followed their own course during the same period turned into growth paragons. The Washington Consensus that was originally shaped by the World Bank and the IMF appeared to be abandoned by the World Bank in 2007 with the publication of a report that recognized the essential role of the public sector for economic growth and the costs of liberalization (Van Lieshout et al. 2010).[25]

In conclusion, such historical cases show that successful industrial policy is one that effectively sets free the forces of the division of labor, mechanization and technological progress; namely, the force of innovation in a broad sense. Moreover, it should be re-emphasized that the successful unleashing of such forces is inextricably linked to adequate transportation and energy infrastructures.

Foreign Direct Investment (FDI)

A Need for an Alternative Approach

Learning from the past experiences of other countries, catching-up countries may consider introducing the successful models of industrial policy as confirmed in history. However, they are faced with a challenge to this end: while industrial policy needs 'smart top leadership' as a driver of implementation, not all catching-up countries have this advantage from the beginning (World Bank 1997).[26] Top leadership is composed of a good leader and a capable government (Ohno 2009). Given that catching-up countries are under various political and social constraints, smart top leadership is indeed important in setting priorities for national development projects, making coordination among diverse ministries, agencies and private sectors, and sustaining momentum. This leadership is especially pivotal in developing countries that do not have well-institutionalized systems for coordinating actions of diverse actors. Absent coordination, momentum for economic development is easily lost. In fact, a good leader is more important since under this leader other elements can be brought together where they do not exist. However, there is no guarantee that good leaders or capable governments would be available for catching-up countries whenever their roles are demanded by their people. Furthermore, the governments of most developing countries are weak in terms of their industrial policy management capabilities, mainly due to scarce public resources and poor governance.

History clearly testifies to the existence of smart top leadership in countries that successfully implemented industrial policy. Great Britain was fortunate to have a powerful and cohesive parliament as top leadership from the seventeenth century, which has contributed to making its government capable. After the British parliament created its own army and defeated the king in a civil war in 1649, it established its superiority over kings (Fukuyama 2014). The British parliament then contributed to eradicating public corruption by, for example, checking royal prerogative in excessive spending and the sale of public offices to incompetent candidates. At this point, it should be noted that the power to check the excessive spending of kings was very important because kings were generally tempted to sell public offices for the purpose of securing money for their ambitious projects, like launching a war or building luxurious palaces (Brewer 1989). However, the British parliament did not always object to grand national initiatives (Fukuyama 2014). With regard to taxation, the British parliament developed a principle of consent. Hence, British taxpayers were more willing to pay taxes in order to strengthen the national army with a view to outdoing neighboring countries in fierce competition for trade and colonies. Since the tax increase was a 'voluntary' action by the British people, Great Britain could collect more taxes than France, while experiencing less resistance. Great Britain collected as much as 30 percent of GDP in taxes in peak years during the eighteenth century, while France was never able to collect more than 12–15 percent during the seventeenth and eighteenth centuries. The increase in tax was also useful to increasing public borrowing because the sound British tax system guaranteed the payment of the government's debts (Adams 2001). Such adequate public revenue ensured the military superiority of the British army over that of neighboring countries (Fukuyama 2014). Consequently, military superiority was greatly useful in expanding the British overseas colonies and, importantly, its overseas markets. The USA was also fortunate to have a system to divide powers among the executive, legislative and judicial branches of the government, which was unique at the time. Such system of 'checks and balances' was incorporated into the US constitution in 1789, thus preventing any possible attempts by power elites to nullify such a system. As a result, the system ideally ensures not only the production of smart top political leaderships but also the maintenance of such leadership. Historically, the US political system has been effective not only in producing capable presidents but also in checking the extent of their power through the governmental division of powers. Germany was also fortunate to have Frederick William (r. 1713–1740) and Frederick the Great (r. 1740–1786) as top political leaders during the period of its rise in the eighteenth century. Likewise, South Korea was fortunate to have President Park Jung-hee (r. 1961–1979) as its top leader during the period of its rapid industrialization in the twentieth century.

Against such a backdrop, catching-up countries must make efforts to produce good leaders and to develop capable governments as well. However, as said above, there is no guarantee that good leaders would be available as they are needed by their country, and history shows that the development of a capable government takes a long time (Altenburg and Lütkenhorst 2015). For example, it took 1400 years for Europeans have a 'centralized government based on meritocracy' after they started to establish weak states (Micklethwait and Wooldridge 2014).[27] The rise of centralized governments in Europe was evident only in the late eighteenth century after the pattern of established weak states existing from the fifth century (Tilly 1990).[28] The introduction of meritocracy into their governments dated only from the nineteenth century, where capable bureaucrats began to be selected through civil service exams rather than primarily through nepotism and hereditary social status (Micklethwait and Wooldridge 2014).[29] Interestingly, there are some exceptional cases like China, Korea and Vietnam, which achieved the centralization of government alongside with meritocracy as early as the seventh century, eighth century and eleventh century respectively (Woodside 2001). However, in general, history shows us that achieving a capable government is a long process. Furthermore, even after such governmental reform is initiated, additional time is required for the new system to operate smoothly and become a 'new normal.'

Furthermore, it should be noted that catching-up countries in the twenty-first century face tougher competition than the catching-up countries of the past (Collier 2007). In a globalized world where the most efficient competitors can offer their products on a global scale and even reach out to very remote markets, competition becomes fiercer (Altenburg and Lütkenhorst 2015). It is evident that in a globalized world, the strong become far stronger, while the weak shrink further back. Accordingly, the economic productivity gap between leading countries and catching-up countries has become much wider in the post-cold war period (Chang 2003). For instance, in 1870, the ratio of the GDP per capita of rich Great Britain and poor Japan that was trying to catch up at the time was 4:1 (Maddison 1995). However, in 2015, the ratio of the GDP per capita of a developed country like the USA and middle-income countries was 12:1 (World Bank 2016). With low-income countries, the gap grows even bigger, up to 90:1 (World Bank 2016). Thus, it becomes more difficult for latecomers to join such global competition. Moreover, for some countries, the window of opportunity to catch up has become smaller than in the past because other catching-up countries have an early-movers' advantage. A case-in-point is Asia, which has been rapidly positioning itself as a competitive global center of manufacturing and for the service industry, making use of low wages and benefitting from economies of scale (Collier 2007). In short, catching-up countries may lack a strong driver to implement industrial policy; to make matters worse, there is tougher competition than in the past.

Advantages of FDI

In such a bogged-down situation, Foreign Direct Investment (FDI) policy could be complementary to industrial policy at the initial stage of economic development. With FDI, catching-up countries can promote economic development with external help. By definition, FDI means that a foreign firm invests in establishing new operations or acquiring tangible assets in one's country, with the gaining of 'control' of the operations or assets (Financial Times Lexicon 2016). FDI can be classified into two types (Hoffman 2013). The first type is 'greenfield investment' in which a foreign firm builds a new manufacturing factory. The second type is mergers and acquisitions (M&A), in which a foreign firm buys the ownership of an existing domestic firm. Like industrial policy, *FDI could unleash the forces of division of labor, mechanization and technological progress; namely, the force of innovation in general in a broad sense* (Milberg and Winkler 2013).[30] In order to understand such an unleashing mechanism, let us divide the direction of FDI two ways: inward and outward.

First, 'inward' FDI: from the perspective of catching-up countries, inward FDI is mainly greenfield investments done by advanced multinational corporations (MNCs) taking advantage of cheap labor, abundant raw material or the wide market of catching-up countries (Dunning and Lundan 1993). Examples include the General Motors factory producing engines and transmissions in Mexico, and the Apple factory manufacturing smartphones in China.

On the supply side, inward FDI unleashes the force of the division of labor because the production system of the modern economy fits well with inward FDI. By dividing the production process into smaller and simpler tasks, modern firms can use unskilled and low-paid workers with limited training (Rosenberg 1993). Such evolving division of labor provides foreign firms with a strong incentive to shift their production line to low-skilled catching-up countries, thus employing a large labor pool in catching-up countries. Furthermore, by bringing in foreign machinery to equip new factories, FDI can also contribute to unleashing the forces of mechanization, and gradually contribute to unleashing the forces of technological progress (Breschi et al. 2007). Advanced foreign firms can gradually produce well-trained employees, thus creating knowledge spillover to the economy of catching-up countries (Hoffman 2013). What's more, FDI enhances the force of innovation in broad terms by increasing interaction between domestic systems and advanced foreign systems in catching-up countries (Hoffman 2013). FDI could promote competition between domestic firms and advanced foreign investors' firms. Therefore, domestic firms would try to imitate and adopt the advanced technology and management systems of foreign firms. Furthermore, given that advanced foreign firms demand a better quality and standard of inputs from domestic intermediate suppliers, domestic firms would also benefit from the enhanced quality of inputs from intermediate suppliers.

On the demand side, FDI could enlarge the size of market by creating a new domestic market with better or cheaper products or by tapping overseas markets through an overseas network of foreign firms. For example, Peugeot's car manufacturing factory in Slovakia not only sells cars in the domestic market of Slovakia but also exports cars to the European market. Accordingly, such an enlarged market through the network of Peugeot unleashes the forces of division of labor and mechanization into the Slovakian economy. Furthermore, out of the need to break into the Slovakian market and the global market, Peugeot would try to incorporate state-of-the-art technology and better inputs into its products, thus unleashing the forces of technological progress and innovation into the Slovakian economy.

Second, let us look at the 'outward' FDI. Outward FDI is mostly M&A by a country's domestic firms for obtaining advanced foreign technology (Dunning and Lundan 1993). After succeeding in establishing an industrial base, catching-up countries often feel a need to make outward FDI to obtain advanced foreign technology. Acquisition of IBM's personal computer business by China's Lenovo and that of Land Rover by India's Tata Motors are good examples. However, given that the venues where investment is made are overseas, such outward FDI has some limitations in unleashing the force of economic development for catching-up countries. This means that the forces of the division of labor and mechanization are hard to realize. Instead, the forces of technological progress and innovation generally work more perceptibly through the 'interaction' of domestic systems with advanced foreign systems as indicated in Table 2.2. On the supply side, outward FDI enables the firms of catching-up countries to access advanced technologies and supporting systems of foreign countries (Dunning and Lundan 1993). For example, through M&A, the firms of catching-up countries may pool R&D activities together with foreign firms that they have acquired, thus facilitating bilateral knowledge transfer and reciprocal stimulation for new ideas. Moreover, those firms that make outward FDI may establish their research facilities in or near foreign research clusters both to monitor frontier technological developments and to benefit from other agglomeration advantages such as a pool of qualified personnel, specialized input suppliers, reliable infrastructure, and knowledge spillovers through labor turnover. On the demand side, it should also be pointed out that outward FDI has to serve competitive foreign markets. Accordingly, the firms of catching-up countries that acquire foreign firms need to try hard to keep the acquired foreign firm competitive in the overseas markets, which would definitely require the unleashing of the forces of technological progress and innovation.

However, it should also be understood that FDI policy is not a panacea for rapid industrialization and economic development. In order to successfully unleash the forces of economic development, it is important to note that FDI policy should adopt a targeted approach (Chang 2007). For example, entry of advanced MNCs into domestic markets may destroy existing domestic firms that could otherwise have grown up into successful operations absent premature exposure to competition, or it may pre-empt the emergence of domestic competitors. This means that FDI may boost the short-run production capacity of a national economy, as more productive foreign firms replace domestic firms, but it may lower the long-run national production capacity. Accordingly, FDI policy should be designed in such a way that does not kill off domestic producers but that promotes benefits like technology and managerial skill transfer to the maximum extent possible. For instance, China had success in developing its high-speed rail industry by wisely pursuing FDI policy.

From 2014, using its vast domestic market, China attracted advanced foreign firms such as Alstom of France, Siemens of Germany, Bombardier of Canada and Kawasaki of Japan into its domestic market. China awarded separate contracts to these firms on the condition that they should form a joint venture or partnership with local Chinese manufacturers, and transfer technology through joint local production (Lo 2014).[31] As a result, China built a local high-speed rail network of over 20,000 km in a decade, which is more than half of the entire network in the world. Furthermore, China has turned into an exporter in the global high-speed rail market, building a 533 km high-speed rail in Turkey in 2014 (Sweet 2014). In this sense, it can also be said that FDI could be a modified version of industrial policy in the twenty-first century when catching-up countries find it difficult to implement industrial policy in a 'traditional' manner. Indeed, this logic reminds us of the famous maxim of Chinese leader Deng Xiaoping: "It does not matter whether a cat is white or black, as long as it catches mice."[32] In 2014 alone, global FDI recorded a total of US$ 1.23 trillion, with inward FDI flows to developing countries reaching their highest level at US$ 681 billion (UNCTAD 2015). Among developing countries, China was the world's largest recipient recording US$ 129 billion. China is considered as having made wise use of FDI, for example by 'getting technology in return for market' in national strategic industries such as high-speed railway and cars. In this context, it is interesting to note that the USA was the largest recipient of FDI for the period of between the nineteenth century and the early twentieth century when it was the fastest growing economy in the world.

Given that what really matters for national prosperity is the country's ability to organize individuals into enterprises with high productivity (Chang 2010), FDI policy is an effective instrument, furthering synergistic policy goals in the twenty-first century.

Urbanization

Last but not least, catching-up countries need to consider adopting an active policy to promote 'urbanization' for economic development purposes. While catching-up countries cannot avoid urbanization in their journey of economic development, it is interesting to note that *urbanization can contribute greatly to unleashing the forces of division of labor, mechanization, technological progress; namely, the force of innovation in a broad sense*, if properly harnessed. It is a fact that no country has ever reached middle-income status without a significant population shift into cities (Annez and Buckley 2009). Originally, urbanization was often understood as a by-product of industrialization (Quigley 2009). In other words, as the Industrial Revolution in the late eighteenth century replaced small cottage industries with big factory systems, a large pool of workers in the labor force were required to live near factories in denser settlements. In such a process, urbanization was observed to generate negative side effects like the creation of slums, traffic congestion and pollution (Knox and McCarthy 2005). Reluctance is still found surrounding the issue of urbanization. According to a 2003 UN survey of the views of member governments on urbanization, the vast majority of these governments would like to shift populations back to rural areas and stop the tide of urbanization (Quigley 2009). Despite such negative attitudes, urbanization is an unstoppable global trend, which brings substantial economic benefits to developing countries if properly managed. For example, in the 1950s, two-thirds of the world's population lived in rural areas but two-thirds are expected to be urban dwellers by the 2050s (UN DESA 2014). Namely, since the developed world already records a high rate of urbanization, it is mainly the developing world that is expected to undergo urbanization. At present, the urbanization rates of North America and Europe have already reached 82 percent and 73 percent, whereas those of Africa and Asia still remain at 40 percent and 48 percent, respectively. Hence, 2.4 billion will be added to cities between 2014 and 2050, with 90 percent of the increase taking place in Africa and Asia. Furthermore, recent empirical evidence suggests that urbanization enhances productivity (Annez and Buckley 2009). It is shown that doubling city size increased productivity across industries in the USA by 3 to 8 percent (Rosenthal and Strange 2003). Hence, by a simple rule of thumb, moving from a city of 50,000 inhabitants to a city of 5 million inhabitants can increase productivity by more than 50 percent (Venables 2009). Moreover, urbanization contributes to checking global population growth since urban families do not need so many children as labor force, in contrast to families in agricultural societies (Randers 2012).

Let us take a look, then, into the operating mechanism of urbanization. On the supply side, urbanization contributes to unleashing the forces of economic development in three ways: matching, sharing and learning (Duranton 2009).

First, a city helps 'matching' between demand and supply in various situations, including between workers with particular skills and job vacancies with specific requirements; between intermediate goods and final goods; and between intermediate services and final producers (Quigley 2009). Hence, a city not only reduces search costs of demand and supply sides, but also raises the quality of matching by aiding both sides to make a better deal. Such an effect of facilitating matching contributes to boosting the force of division of labor.

Second, a city promotes the 'sharing' of high-quality intermediate goods and services that are produced by specialized providers, among different firms and across diverse sectors which otherwise would be improvised by an individual firm on its own if located in rural areas (Quigley 2009). Intermediate goods and services may range from 'capital-intensive' energy and transport infrastructures to operational services like repairing and advertising, and legal services regarding taxation and copyright. Access to infrastructure would be notably easier in cities than in small towns, since building expensive infrastructure can be justified only when it is built in an area that benefits a large population. Indeed, the sharing of high-quality intermediate goods and services in a city can enhance the opportunities of cost reduction in the economy, thus unleashing the forces of the division of labor and mechanization by sharing labor pool and economic infrastructure.

Third, cities accelerate the 'learning' of knowledge in industries of a kind or even across different industries (Quigley 2009). Namely, by placing workers with similar education and skills in dense areas, a city promotes knowledge spillover. These effects are called the 'economy of agglomeration' in technical terms. Without doubt, such benefits would increase interaction, unleashing the forces of technological progress, and in a broad sense, the force of innovation in general.

Furthermore, on the demand side, urbanization increases the size of market because urban dwellers are mostly wageworkers who can consume manufactured goods and services. Such an increase in the size of market would definitely provide motivation to expand national production capacity, enhancing the forces of economic development as seen throughout history. Following the Industrial Revolution, self-sufficient farmers in rural areas came to cities for jobs and became consumers of manufactured goods and services based on the salaries they received from their employers (Karatani 2014). Consequently, urbanization is increasingly viewed as a 'policy option' that should be actively promoted for economic development (Beall et al. 2010). These findings are important for catching-up countries all the more since they are now undergoing rapid urbanization while the developed world has already reached a high rate of urbanization (UN DESA 2014).

However, urbanization itself does not guarantee successful economic development (Beall et al. 2010). In some cases, urbanization can take place without economic development. Furthermore, as explained above, such historical logic of turning farmers into wageworkers to expand consumption and production might be criticized under the logic of 'planetary limits.' Nonetheless, given that urbanization is not a matter of choice but an inevitable trend, the question is not how to stop it but how to reap its benefits without paying too high a cost engendered by slums, traffic congestion or environmental degradation. It should be noted that neglecting cities can have only negative consequences such as the worsening of urban inefficiencies and 'overcrowded and poorer' rural areas (Duranton 2009). Overall, while trying to maximize the positive effects of urbanization, the concept of sustainability must be incorporated into the design of urbanization policy. One promising measure might be to promote low-carbon energy and transportation infrastructure in urban areas.

For such reasons, China, one of leading catching-up countries, has adopted a policy of promoting urbanization by establishing the National New-Type Urbanization Plan for the period of 2014–2020 (Xinhua 2014).[33] The national urbanization plan aims to raise the urbanization rate from 52.6 percent at the end of 2012 to 60 percent by 2020. One of the motivations for such aggressive urbanization policy is to utilize cities as a strong engine to sustain economic growth and to increase domestic demand by turning self-sufficient farmers into urban wageworkers. Furthermore, in 2015, the importance of managing urbanization was globally recognized with the inclusion of 'cities' as an independent goal within the 17 UN Sustainable Development Goals (SDGs) that will guide the world on how to promote social, economic and environmental development for the period 2015–2030.

In conclusion, as shown in the historical cases, urbanization policy is an effective instrument, furthering synergistic policy goals in the twenty-first century.

The Importance of Infrastructure for Economic Development

To summarize, we can conclude that economic development is promoted by aggressive *national policies* (industrial policy, FDI policy and urbanization policy); that such national policies can be effective because they can unleash the *forces of economic development* (the forces of the division of labor, mechanization, technological progress, namely, the force of innovation in broad sense); and, that the forces need *transport and energy infrastructures* in order for them to be unleashed. It was made clear from the cases of countries as illustrated above that all economically successful countries took a similar path in history; that is, the promotion of transport and energy infrastructures to support the implementation of such national polices. Hence, it can be said that economic development starts with the building of transportation and energy infrastructures. An empirical finding by the World Bank, that a 1 percent increase in the stock of infrastructure is associated with a 1 percent increase in Gross Domestic Product (GDP) across all countries, adds weight to such a conclusion (World Bank 1994). Moreover, given that such economic development is an effective means to reduce poverty (Collier 2007),[34] transportation and energy infrastructures should constitute a significant agenda not only for middle-income countries but also for low-income countries.

The Second Vision: Checking Climate Change

The Narrowing Window of Opportunity to Tackle Climate Change

Next, let us shift our attention to an environmental dimension: in our global community, climate change can be pinpointed as the biggest environmental challenge of our time, given the scale of its impacts and huge resources necessary to counter it. Accordingly, the global community adopted the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 as groundwork to combat climate change. In 2015, our global community declared its goal of limiting the rise in global temperature to well below 2 °C above pre-industrial levels with the adoption of another milestone document, called the 'Paris Agreement' (UNFCCC 2015).

However, in 2015, it was reported that global temperature already increased by 1 °C (Met Office 2016). Hence, the world is already halfway towards the threshold of 2 °C. In order to keep the rise in global average temperature below 2 °C, with greater than 66 percent probability, the total amount of GHG emissions since 1870 needs to remain below *2900 $GtCO_2$ equivalent* (IPCC 2014). However, 1900 $GtCO_2$ equivalent were already released into the air as of 2014 (IPCC 2014). Hence, the world has a space for additional 1000 $GtCO_2$ equivalent left. Given that annual GHG emissions are about 52.7 $GtCO_2$ equivalent in 2014, the world is likely to fill the space in 20 years unless urgent countermeasures are taken (UNEP 2015).[35] To make matters worse, despite a number of climate change mitigation policies, GHG emissions shows an increasing trend, growing by 1.0 $GtCO_2$ equivalent per year from 2000 to 2010, compared to 0.4 $GtCO_2$ equivalent per year from 1970 to 2000 (IPCC 2014). Namely, 39 $GtCO_2$ equivalent in 2000 to 49 $GtCO_2$ equivalent in 2010. Such increasing trend can be summarized in Table 2.4.

Since annual GHG emissions are not likely to be substantially reduced overnight, the threat of climate change indeed looms larger at the moment. In short, time is not on our side. For the reference of readers, GHG is mostly composed of CO_2, CH_4, and N_2O. One $GtCO_2$ equivalent means one gigaton tons or one billion tons of GHGs expressed in terms of CO_2 amount.

Table 2.4 Increasing trend of annual GHG emissions (IPCC 2014)

Year	2000	2010	2014
GHG emissions ($GtCO_2$ equivalent)	39	49	52.7

Negative Impacts of Climate Change

Then, why does climate change matter for all people on earth? Two major reasons can be presented: food security and sea level rise. First, Lester Brown warns that climate change is projected to pose a risk to food security in diverse aspects like the undermining of the fertilization process, water scarcity, or flooding. To begin with, the rise in temperature will be uneven (Brown 2012). It will be greater in the higher latitudes than in the equatorial regions, greater over land than over oceans, and greater in continental interiors than in coastal regions. Likewise, dry areas like mid-latitude and subtropical regions will be drier, while wet areas like the equatorial Pacific regions will be wetter (IPCC 2014). Under such circumstances, first of all, high temperature may thwart pollination by drying out pistils, the wet female reproductive part of plants, thus making it difficult for pollen to settle down in the pistils (Brown 2012). Furthermore, high temperature dehydrates plants. When a plant curls its leaves in order to reduce exposure to the sun, photosynthesis is reduced. Accordingly, it is found that pollination and photosynthesis of wheat, rice and corn fall from 100 percent at 34–35 °C to zero percent at 40 °C (Brown 2012). It is further found that a 1 °C rise in temperature above the norm during the growing season reduces wheat, rice and corn yields by 10 percent (Brown 2012).[36] Furthermore, since the glacier melt of the Himalayas and on the Tibetan Plateau provides water to the Indus, Ganges, Yellow and Yangtze Rivers during the dry season, the disappearing glaciers in the regions will reduce water flow into the river basins, thus seriously damaging irrigated agriculture and food security in the region (Brown 2012). Moreover, with high temperature, rising sea level will inundate low-lying major grain fields (Brown 2012). For example, if sea level should rise by about 1 m by the end of the twenty-first century, this would flood half the rice paddies of Bangladesh, a country of 152 million people. Such a sea level rise would also submerge a large part of the Mekong Delta, a region that produces half of Vietnam's rice, putting many countries that import rice from Vietnam in trouble. Details on a rise in sea level will be revisited below. To make matters worse, if climate change is combined with exponential population growth, food shortage may be further aggravated, since more population means 'more demand' for food. Between

1950 and 2015, the world population increased from 2.5 to 7.3 billion (UN 2002).[37] It just about trebled in just in 65 years. The world population is projected to reach 8.5 billion in 2030, and to increase further to 9.7 billion in 2050 and 11.2 billion by 2100 (UN DESA 2015). In relation to food shortage, it should be pointed out that more than half of the world population growth by 2050 is expected to occur in Africa (UN DESA 2015). In other words, an additional 2.4 billion people will be added to the world population between now and 2050, and among them, 1.3 billion will be added to Africa, followed by the addition of 0.9 billion to Asia. In this context, it is particularly worrisome that population growth is particularly high in a group of 48 countries designated by the UN as the least developed countries (LDC) with 27 of them in Africa.

Such food shortages can increase food prices sharply, as illustrated by the doubling of rice price during the food crisis of 2008. This follows from an inelastic demand for grains. Namely, when grain price rises, demand for grain does not decrease flexibly because people cannot do without food. Such a hike in food price poses a serious risk to the livelihood of low income-level people in the developing world. For example, an additional 112 million people in Asia could have escaped poverty annually if food prices had not increased in the late 2000s (ADB 2012). Similarly, 42 million people were pressed back into poverty as a result of increases in food and energy prices in the Asia-Pacific region in 2011 (UN ESCAP and KOICA 2012). At this point, it should be noted that global grain reserve stocks keep decreasing. Under such circumstances, one-time cropping failure in a region caused by an abnormal weather phenomenon might shake the entire global grain market and cause a sharp increase in food price. Against such a backdrop, Lester Brown warns us of potential shock in the global grain market, indicating that the annual world carryover stocks of grain declined from 107 days of consumption in the 1990s to only 74 days in the 2000s. Indeed, our world is now living from one year to the next without a safety cushion.

Second, climate change could trigger a substantial sea level rise. The Intergovernmental Panel on Climate Change (IPCC) estimates that between 1901 and 2010, the sea level rose by 19 cm. By 2100, IPCC projects a sea level rise of about 30 cm to 1 m from the 20-year mean of 1986–2006 as a baseline. To our surprise, it is virtually certain that once triggered, sea level will continue to rise for many centuries even if the global mean temperature is stabilized (Church et al. 2013). If the Greenland ice sheet undergoes a near-complete melt over a millennium or more, sea level is projected to rise by about 7 m (Church et al. 2013). With 7 m rise, port cities like London will be submerged and low-lying countries like Bangladesh and Maldives will disappear under water (National Geographic 2016).[38] Indeed, a rise in the sea level can create extremely serious situations, given that a quarter of the world's population lives on the coast or nearby, and that the majority of our megacities are situated in coastal areas (Pope Francis 2016). Since maritime trade has been one of major engines of economic growth throughout history and ports are major economic centers for many countries, such a sea level rise that inundates port cities would deal a serious blow to the global economy. The threshold that causes the near-complete loss of the Greenland ice sheet is projected to be somewhere between 2 °C and 4 °C rise above pre-industrial level (Church et al. 2013). Such a projection is based on historical evidence. This means that as the global mean annual temperature was 1 °C to 2 °C warmer than pre-industrial levels 130,000 ago, a sea level was higher than now by 7 m.

Causes of Climate Change

What are the major causes of climate change? According to the IPCC, 35 percent of GHG emissions were released by energy supply sector, 24 percent from agriculture, forestry and other land use (AFOLU), 21 percent by industry, 14 percent by transport, and 6.4 percent by the building sector in 2010 (IPCC 2014). To put it more precisely, the energy sector emits GHG through the energy supply activities, which comprise all energy extraction, electricity and heat production, and transmission processes that deliver final energy to the end-use sectors, which are industry, transport, and building (Bruckner et al. 2014). The AFOLU sector emits GHG mainly from deforestation, the raising of livestock, and the management of agricultural soil and nutrients (Smith et al. 2014). The industry sector emits GHG through on-site burning of fossil fuels for energy and from the manufacturing of products like steel, fertilizers and cement

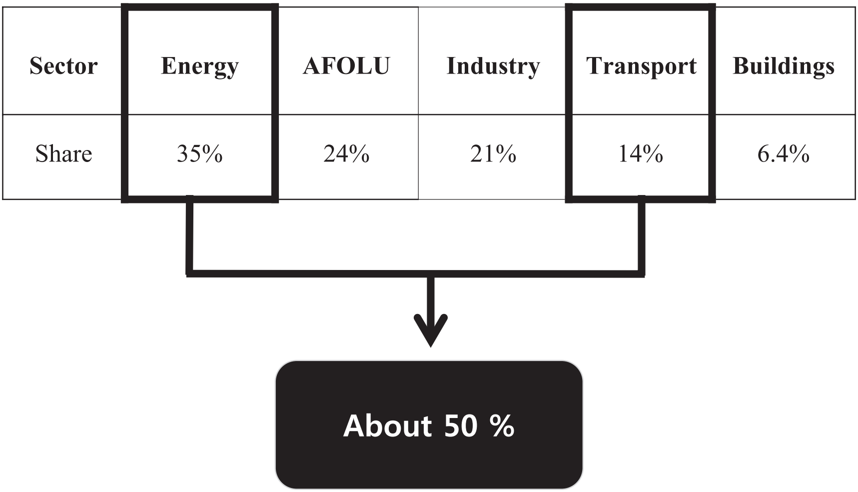

Fig. 2.2 Greenhouse gas emissions by sectors (2010). Source: The IPCC Synthesis Report 2014

(Fischedick et al. 2014). The transport sector emits GHG through the burning of fossil fuel for passenger and freight carrying activities (Sims et al. 2014). Buildings emit GHG through on-site energy generation and burning of fuels for heating or cooking, or through materials for cooling, refrigeration and insulation (Lucon et al. 2014). Against this backdrop, if the energy sector and transport sector are combined together, they account for about half of all GHG emissions. Thus, we can conclude that by *tackling the issue of energy and transport infrastructures*, the global community can *address almost half of all GHG emission sources* as shown in Fig. 2.2. Hypothetically, if renewable energy fully replaces fossil fuels, GHG emissions in the energy sector could be reduced dramatically since the world does not have to extract energy. Likewise, if public transportation fully replaces personal cars, GHG emissions in the transport sector could decrease substantially.

At this point it is important to note that tackling energy and transport infrastructures is expected to influence not only the GHG emissions of energy and transport sectors but also those of industry and buildings sectors because of the spillover effects of relevant technologies such as

Carbon Capture and Storage (CCS). Accordingly, in reality, more than half of all GHG emission sources can be placed under the influence of such an approach.

Conclusion: Green Infrastructure is a Common Denominator

Energy and transport infrastructures are a necessary condition for making a country wealthy, but energy and transport infrastructures are a major cause of GHG emissions at the same time. Consequently, if energy and transport infrastructures are built in a 'low-carbon' way, they can catch two birds, namely promoting economic development and checking climate change, at the same time. For example, if a railroad or bus-based public transportation infrastructure is built instead of a passenger car-based road, it can substantially reduce fuel consumption as well as GHG emissions per passenger, given that a small car emits twice as much GHG per passenger kilometer as an average bus, and four times as much as light rail (World Bank 2012). It should be noted that fewer GHG emissions mean less fuel consumption.

Out of such an urgent need to spread green infrastructure all over the world, Chap. 3 will explore a strategy that could accelerate the speed of spreading.

Notes

1. For further details, see Easterly (2002, 13–15), Bhagwati (2004, 53–54), and Collier (2007, 8–12).
2. For further details, see Rosenberg (1982, 24–25).
3. In order to explain the causes of economic growth, Ayres and Warr use the concept of 'exergy' that means a measure of potential work. While energy is always conserved, exergy can be used up. However, they explain that non-technical people use energy, a familiar term, in the sense of 'exergy.' Since this book is focused on the importance of energy infrastructure, the author does not go into the details of scientific difference between the two

concepts but use the familiar terminology of 'energy.' For the concept of exergy, see Ayres and Warr (2009, 78–79). For earlier insights on the role of energy, see, for example, Rosenberg (1982, 81–103).

4. For further details, see Parry (1967, 155–219).
5. For further details, see Fukuyama (2012, 316–317), Osterhammel and Petersson (2005, 38–39).
6. O'Sullivan and Sheffrin designated entrepreneurs as the fourth factor of production, and their view benefits greatly from the theoretical foundation laid by Schumpeter.
7. For a brief overview of the concept and its use, see Wenger-Trayner, Etienne and Beverly Wenger-Trayner. 'Communities of Practice: A brief Introduction,' 2015. http://wenger-trayner.com/wp-content/uploads/2015/04/07-Brief-introduction-to-communities-of-practice.pdf. Accessed 25 March 2016.
8. For further details, see also Pavitt (2002, 14).
9. For further details, see Malerba (2006, 393–394).
10. For the constraints on the supply side, see Altenburg and Lütkenhorst (2015, 72–73).
11. For the constraints on the demand side, see Altenburg and Lütkenhorst (2015, 72–73).
12. For further detailed discussion, see Chang (2003, 20).
13. It is worthy of note that the UK relied on coal mining even until mid-1950s. For the details on this history of energy in the UK, see Plante Energies, http://www.planete-energies.com/en/medias/saga-energies/history-energy-united-kingdom. Accessed 2 October 2017.
14. For details on the acts of the UK Parliament, see UK Parliament. 'Canals and Rivers,' http://www.parliament.uk/about/living-heritage/transformingsociety/transportcomms/canalsrivers/overview/canal-acts/. Accessed 2 May 2017.
15. For the details on the expansion of canal systems in the UK, see UK Parliament. 'Canals and Rivers,' http://www.parliament.uk/about/living-heritage/transformingsociety/transportcomms/canalsrivers/overview/canal-acts/. Accessed 2 May 2017.
16. For further details, see also Kindleberger (1996, 109–110).
17. Initially, the US relied on canal systems but it was railroads that accelerated its coal trade. See Economic History Association, https://eh.net/encyclopedia/the-us-coal-industry-in-the-nineteenth-century-2/. Accessed 5 May 2017.

18. See also Census Report (1902, iv).
19. For details on customs barrier, see Seidel (1971, 4).
20. For further details, see Kindleberger (1978, 192–194).
21. For an overview of Korean development experiences, see, for example, Kim (2011), Rhee et al. (1984), Choi (2013).
22. For detailed statistics, see Bank of Korea, http://ecos.bok.or.kr
23. In terms of GDP as of 2016.
24. For further details, see Baer (1972, 102–103), Bhagwati (2004, 61–62).
25. For the details on the position of the World Bank, see World Bank (2007, 39–42).
26. For further details, see Altenburg and Lütkenhorst (2015, 38–39 and 56–57).
27. For further details, see Tilly (1990, 51–70), Strayer (2005, 93–107).
28. For further details, see Strayer (2005, 93–107).
29. For further details, see Fukuyama (2014, 126–134).
30. For further details, see Stiglitz (2007, 188–189).
31. For further details, see Smartrailworld.com, 'China's high-speed rail hits the 20,000 km mark but financial issues persist,' 14 September 2016. http://www.smartrailworld.com/chinas-high-speed-rail-hits-the-20000-km-mark-but-financial-issues-persist. Accessed 24 September 2016.
32. Singapore also adopted a strategy to make use of FDI to jump-start its development. See Ghani (2008, 36–37).
33. For further details, see Knox and McCarthy (2005, 174–176), *The Wall Street Journal*, 'China Unveils Urbanization Plan,' 16 March 2014.
34. For further details, see Kraay (2004, 3), Easterly (2002, 13–15), Bhagwati (2004, 53–54).
35. In 2014, Out of such 52.7 $GtCO_2$ equivalent, the emissions of CO_2 from fossil fuel and industry were estimated at 35.5 $GtCO_2$. To limit the rise in global average temperature below 2° C, cumulative CO_2 emissions since 1870 should remain below 2900 $GtCO_2$, and 1900 $GtCO_2$ had already been emitted by 2011. For further details, see IPCC (2014, 10).
36. For further details, see International Rice Research Institute. 'Rice and Climate Change,' http://irri.org/news/hot-topics/rice-and-climate-change. Accessed 14 May 2016.
37. See also UN DESA (2015, 3).
38. For further details, see Weather Underground. 'Greenland,' https://www.wunderground.com/climate/greenland.asp. Accessed 21 May 2016.

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Part II

The Strategy to Spread Green Infrastructure Globally

3

A Game-Changing Strategy: A Business Approach for Environmental Issues

Introduction

In Chap. 2, we examined the critical area that the valuable profits generated from greenhouse gas (GHG) reductions are aimed to promote: green infrastructure. In this process, it was made clear that green infrastructure is an indispensable instrument for realizing two visions: 'making a country wealthy' and 'checking climate change.' It is indeed the one arrow for piercing two targets. To achieve the desirable goal of spreading green infrastructure worldwide in a short period of time, the significant barrier of *high cost* in comparison to conventional infrastructure must be overcome. Costs must be lowered to avoid losing potential customers, including central governments and local governments.

One of the major reasons for such high cost is the limited market size of green infrastructure. Currently, the market is not large enough to accelerate innovation, a necessary force for lowering cost and consequently increasing demand for green infrastructure plans. However, if governments leave market development to private companies, it is uncertain that the cost of green infrastructure will reduce with sufficient

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rapidity. Given these parameters, an effective strategy would be to *motivate the developed world to voluntarily provide green infrastructure to the developing world*. Motivation rather than obligation is key: such a strategy aims to enlarge the 'market size' of green infrastructure artificially, thus unleashing the forces of the division of labor, mechanization, technological progress, and innovation in general. Increase in production would lead to reduction in costs. With lowered costs, green infrastructure will rapidly spread worldwide. Keeping in mind that all these changes should be brought about 'voluntarily' by the developed world, we will explore background information on global infrastructure needs, and lay out a strategy for a rapid global spread of green infrastructure.

Global Infrastructure Needs

Bigger Demand from the Developing World

The developing world will be experiencing fast economic growth, substantial population growth and rapid urbanization in the coming decades, and the demand for infrastructure will grow accordingly. While the real gross domestic product (GDP) of Organization for Economic Co-operation and Development (OECD) countries is expected to grow by 1.9 percent per year from 2013 to 2040, that of non-OECD countries is projected to grow by 4.5 percent per year during the same period (IEA 2015a). Furthermore, world population is expected to increase from 7.3 billion in 2015 to 9.7 billion in 2050 (UN DESA 2015). Importantly, almost the entirety of world population growth is expected to occur in the developing world. This means that with a projected increase of 2.4 billion people between now and 2050, Africa will account for 1.3 billion and Asia will account for 0.9 billion (UN DESA 2015). Moreover, while the developed world already records a high rate of urbanization, the developing world is currently undergoing rapid urbanization. North America and Europe record 82 percent and 73 percent urbanization, respectively; however, Africa and Asia still remain at 40 percent and 48 percent urbanization, respectively (UN DESA 2014). Accordingly, the world's urban population is now close to 3.9 billion and is expected to reach 6.3 billion in 2050, with 90 percent of the increase taking place in

Africa and Asia (UN DESA 2014). Consequently, while two thirds of world population lived in rural areas in the 1950s, two thirds are expected to be urban dwellers in the 2050s (Van Lieshout et al. 2010). Given such urbanization trends in the developing world, special attention needs to be paid to applicable urban energy and transport infrastructures.

Against this backdrop, it should be noted that while the global infrastructure demand is projected to be about US$ 4 trillion per year up to 2030, developing countries are expected to account for the lion's share of the demand (WEF 2013). For instance, the electricity investment needs of non-OECD countries are expected to reach up to US$ 13 trillion between 2015 and 2040, which is twice as much as the needs of OECD countries that are estimated to be about US$ 7 trillion over the same period (IEA 2015a; WEF 2016). Likewise, with regard to transport infrastructure, the developing world faces greater challenges: globally, there are currently one billion cars on the road. Added to this, with absent alternative means of transportation, an additional two billion cars are projected to join the road by 2050, mostly in the developing world, as demand for car ownership increases dramatically at annual household incomes of US$ 6000–US$ 8000 (World Bank 2012). Such high demand for transportation requires massive investment in public transportation infrastructure. The choice in the developing world between personal individual transportation and public transportation will make an enormous difference in the campaign for sustainable development, as road transport already accounts for three-quarters of total transport CO_2 emissions (IEA 2015b; WEF 2014). The increase of cars will cause numerous negative side effects, like a rise in fossil fuel consumption and GHG emissions, traffic congestion and air pollution. Problems are both economic and environmental: a small car emits twice as much GHG per passenger kilometer as an average bus, and four times as much as light rail (World Bank 2012). More GHG emissions mean more fossil fuel consumption.

While there is a huge demand for infrastructure in developing countries, the governments have serious problems in carrying out infrastructure projects in the field due to limited public financial resources (Bhattacharya and Romani 2013). Whereas developing countries need an estimated US$ 2 trillion annually until 2020, less than US$ 1 trillion per year can be mobilized. Furthermore, given that the governments of developing countries already pay for 70 percent of infrastructure costs, there is little room for substantial expenditure increases. Moreover, as will be explained in Chap. 4 in further detail, the public revenue of developing countries is far less than that of developed countries in relative terms. For example, the average tax revenue of non-OECD countries is only 14.7 percent of GDP, while this revenue is about 35.6 percent of OECD countries (Heritage Foundation 2016).[1] Less tax revenue means less capacity to carry out infrastructure projects. What's more, many developing countries have already reached the limits of acquired debt. For instance, while the threshold on debt-to-GDP ratio for developing countries should not exceed 40 percent, about half of developing countries are close to or have already exceeded the 40 percent threshold as of 2015 (IMF 2013; IMF 2014). Given this, many governments of developing countries cannot rely on borrowing for the purpose of financing their infrastructure projects. Additionally, Official Development Assistance (ODA) from developed countries is not only unlikely to substantially increase in the near future, its volume is too small to be a reliable financial source to fill the financing gap of 'US$ 1 trillion' between demand and supply for infrastructure. Concretely, the ODA recorded US$ 143 billion in 2016 but only US$ 20.9 billion was spent on infrastructure projects (OECD 2017).[2]

The Dilemma of the Developing World

In addition to the dilemma of financing infrastructure projects, developing countries also must choose between 'less expensive' conventional infrastructure and 'more expensive' green infrastructure. In addition to infrastructure needs of US$ 2 trillion per year, upgrading conventional infrastructure to low-carbon green infrastructure would require an additional US$ 200 to 300 billion per year (Bhattacharya and Romani 2013). The scope of green infrastructure may include any low-carbon infrastructure that reduces GHG: renewable energy infrastructures, fossil fuel power plants with carbon capture and storage (CCS) facilities, and public transportation systems. As infrastructure itself is essentially costly, conventional infrastructure is less expensive than green infrastructure only in a relative sense. For developing nations to effectively build green infrastructure, they need to undertake two tasks: finding sources for general financing of infrastructure projects, and securing the financial support that can fill the gap in cost between conventional and green infrastructure. If developing countries succeed in finding general financing but fail to secure the financial support to fill the gap, they will choose conventional infrastructure. These challenges are best understood through reviewing data on the price of energy infrastructure using the concept of the levelized cost of electricity (LCOE) as a criterion of comparison. The LCOE is the net present value of the unit cost of electricity over the lifetime of a power plant (US EIA 2017). LCOE is calculated by dividing the total electricity output by the total cost of construction and operation during the operational lifetime of a power plant. The estimation of LCOE by power sources is illustrated in Table 3.1.

As shown in Table 3.1, 'green' power generation sources are generally more expensive than conventional sources; offshore wind power plants, solar PV plants and solar thermal power plants are all more expensive than conventional coal power and advanced combined cycle gas power, except for onshore wind power plants. A significant point in favor of green infrastructure is how it limits the increase in global temperature to 2 °C. As indicated in Table 3.2, six green technologies are indispensable to limiting the increase in global temperature to 2 °C.

Given that renewable energy has the potential of delivering 30 percent of the cumulative GHG emissions reductions required by 2050, it is important to lower the cost of renewables as rapidly as possible. Similarly, since CCS is the only technology to deliver substantial GHG reductions from the use of fossil fuel, namely, 13 percent of the cumulative GHG

Table 3.1 US LCOE for plants entering service in 2020 (US EIA 2015)

Plant type	LCOE (US$/MWh)
Conventional coal	95.1
Advanced coal with CCS	144.4
Advanced combined cycle gas	72.6
Advanced combined cycle gas with CCS	100.2
Wind (onshore)	73.6
Wind (offshore)	196.9
Solar photovoltaic (PV)	125.3
Solar thermal	239.7

Table 3.2 Potential contribution of green technology to GHG reductions (Elzinga 2015)

Green technology	Contribution to limiting temperature rise to 2 °C (%)
End-use fuel and electricity efficiency	38
Renewables	30
CCS	13
End-use fuel switching	10
Nuclear	8
Power generation efficiency & fuel switching	1
Total	100

Table 3.3 Construction costs of transportation infrastructure[a]

Type	Cost per mile (US$ million)
Road (urban, two-lane)	3–5
Light Rail Transit (surface)	86.0
Subway (underground)	585.0

[a]For the costs of subway and LRT, see Light Rail Now, https://lightrailnow.wordpress.com/2014/02/13/new-subway-metro-systems-cost-nearly-9-times-as-much-as-light-rail/. Accessed 13 February 2014; *Austin Rail Now*, 'Subway cost per mile nearly 9 times higher than for light rail, says study.' For the cost of road, Elswick, Frank, 'How much does it cost to build a mile of road?' http://blog.midwestind.com/cost-of-building-road/. Accessed 12 August 2017

emissions reductions, the lowering of CCS cost is also very pivotal (IEA 2015c). In particular, given that coal and gas account for 40.5 percent and 22.5 percent respectively of world electricity generation in 2012, the use of coal in power generation should fall to around one-third of current levels to achieve the goal of limiting the rise in global temperature to 2 °C, with 95 percent of coal-fired power plants and 40 percent of gas-fired power plants equipped with CCS by 2050 (Bhattacharya and Romani 2013). However, under the current price level of renewable power plants and fossil fuel burning power plants with CCS, developing countries are likely to opt for less expensive conventional energy infrastructure such as conventional coal power plants and advanced combined cycle gas power plants.

Likewise, transportation infrastructure creates a similar dilemma. Let us take the data of the USA for example. As shown in Table 3.3, building roads is the cheapest option for a government. If a government intends to build light rail transits or subways, these cost much more than roads. Accordingly, the government is faced with a dilemma in deciding between individual and public transportation infrastructure. In most cases, policymakers in the developing world are pressured to choose the cheap alternative.

However, unlike energy infrastructure, the implications of a policy choice in the transportation sector between conventional and green infrastructures are complicated by urbanization (World Bank 2012). In congested cities, public urban transport reduces congestion and air pollution, with large economic and health benefits. Furthermore, attention should also be paid to rapid urbanization trends in developing countries; since economic activities and systems organize themselves around infrastructure, the choice of infrastructure can exceed the physical lifetime of the infrastructure itself, permanently fixing the urban structures. If underground metro systems settle down first, factories, offices and shops develop along the metro lines. However, if road systems are fixed first, various economic activities would develop following road systems in which personal cars would be used. An initially less costly infrastructure choice like roadways will be an easier choice in the short term but will prove to be expensive in the longer term and—to make matters worse—sometimes irrevocable. In contrast, the more costly choice like the Light Rail Transit (LRT) or subway may be a difficult choice in the short term but will turn out to be a much wiser investment in the mid- or long-term. Hence, in the transportation sector, green infrastructure has more appealing points than in the energy sector.

Finally, attention should be paid not only to new infrastructure but also to existing infrastructure. Existing infrastructure between 2010 and 2060 is projected to emit 496 $GtCO_2$ equivalent, thus contributing to the increase in global temperature by 1.3° C (Davis et al. 2010). It should be noted that such 496 $GtCO_2$ equivalent are already 'committed' emissions. Given that the global climate change goal set by the UN is to limit the rise in global temperature to well below 2 °C, the committed 1.3 °C increase is a serious number that deserves attention. In considering the long-lived nature of energy and transportation infrastructure that can be expected to cause a substantial rise in global temperature over the next 50 years, widespread retro-fitting of existing infrastructure with green technologies such as CCS or early decommissioning of serviceable infrastructure should be prioritized (Davis et al. 2010). In this context, developing countries need priority attention as well. For example, let us review the case of China (Davis et al. 2010). Nearly one-quarter of the power plants commissioned worldwide since 2000 are coal power plants in China. Accordingly, the mean age of power plants in China is 12 years, while those of USA, Europe and Japan are 32 years, 27 years and 21 years, respectively. Consequently, as China's fossil-fuel burning power plants have a longer remaining lifetime than those of developed countries, China's proportion in global energy-related GHG emissions would gradually go up.

In sum, recognizing that the governments of developing countries have neither adequate financial resources to build conventional infrastructure nor financial support to upgrade their decisions from conventional infrastructure to more expensive green infrastructure, developing countries need to attract more financing from the private sector, primarily from developed countries.

A Strategy to Rapidly Spread Green Infrastructure

A Need to Overcome the Inertia

To achieve an outcome, an effective approach is to identify key actions that lead to the outcome (Cloud 2013). It is essential to measure the likelihood of success of these key actions. By regularly measuring the progress of these actions, ongoing momentum towards the outcome would be generated. Thus, a focus on the 'process' that leads to the outcome is a means to achieve the outcome itself. Simply put, the approach focuses on 'actions' that produce an outcome, not the outcome itself. Such an approach is particularly effective where accomplishing the outcome presents an overwhelming task. Where outcomes appear to present insurmountable difficulties, people are likely to feel powerless and to fall into a state of 'inertia.'

Accordingly, focusing on green infrastructure should also be understood in the context of such an approach. Spreading green infrastructure rapidly in the world is an 'action' leading to two outcomes: promoting economic development in developing countries, and limiting the increase in global temperature to 2 °C. Such a focused approach is all the more necessary where numerous issues in the international arena compete for time and resources. To achieve a breakthrough, international actors must consolidate their energy and attention on key actions to achieve a breakthrough and overcome the inertia prevalent in the campaign against global poverty and climate change. This is crucial as time is not on our side.

The Essence of the Strategy

How can we, then, promote green infrastructure worldwide? The essence of strategy is aligning business sector interests with those of the environmental sector 'in the same direction.' Commercial profit would motivate profit-seeking private sectors to see green infrastructure financially beneficial.[3] As an increase in production would lead to decrease in cost, this would accelerate the global spread of green infrastructure. Combining environmental and business goals is more likely to yield positive results; top-down regulation—obliging the business sector to build green infrastructure or reduce GHG emissions by force—is more likely to result in strong resistance and evasions within the business sector. Because time is not on our side in checking climate change, we need to consolidate the scattered energy of the global community into a unified breakthrough. We must avoid dissipation of energy through conflict.

Can the Strategy Really Work?

The key premise of such strategy is that an increase in production would lead to a decrease in cost. This premise is based on the basic theory of economics. As explained in Chap. 2, enlarging the size of market would unleash the forces of economic development such as the division of labor, mechanization, technological progress, and innovation in general. The result of such a process is the production of products at lower cost. Applied to green infrastructure, lower cost would increase demand for green infrastructure, thus creating a virtuous cycle between them. Such a virtuous cycle would continue until the price of green infrastructure becomes low enough to compete with conventional infrastructure. With regard to green energy infrastructure, grid parity—the point at which the electricity price of fossil fuel burning power plants and that of renewable power plants become equal—is a target. Swanson's law provides persuasive evidence supporting such a premise: according to Richard Swanson, the cost of solar PV panels decreases by 20 percent for each doubling of the cumulative production of solar PV panels (Swanson 2006). Swanson further clarifies that the main causes of such cost reduction are the expansion of factory production, new machinery, automation, new processing technologies, and the improvement of solar PV panel electricity generation efficiency. Swanson's law is effectively based on the operationalization of the forces of economic development. With the expansion of factory production, the division of labor becomes more sophisticated. With the introduction of new machinery and automation, the force of mechanization is enhanced. Moreover, with the improvement of processing technologies and electricity generation efficiency, the forces of technological progress are unleashed. The essence of such a strategy is to artificially enlarge the *size of market* for green infrastructure, and to concurrently pursue rapid cost reductions and innovation.

The Key Player of the Strategy

What business groups then can build green infrastructure in developing countries? Promising players include institutional investors such as pension funds, insurance companies and sovereign wealth funds. With enormous financial resources, institutional investors are increasingly highlighted as alternative players in infrastructure financing (OECD/World Bank 2015). In OECD countries alone, institutional investors held US$ 92.6 trillion in 2013. Moreover, their financial resources keep increasing at a rapid pace. For example, pension funds of OECD countries alone hold US$ 25 trillion in assets, and they collect about US$ 1 trillion in new contributions every year (Della Croce and Yermo 2013). Given this, such pension fund assets grew by 8.2 percent annually over 2009–2013 (Della Croce and Yermo 2013).[4] However, it should be noted that institutional investors are not only from developed countries, but also from developing countries (World Bank 2013). Collectively, developing countries' domestic savings stood at 34 percent of their GDP in 2010, up from 21 percent in 1970. Consequently, developing countries' share of global savings now stands at 49 percent; nearly double the level of the mid-1960s. With such huge savings, the agencies of developing countries are expected to increasingly constitute an important part of the institutional investors' group. Indeed, while the profits from GHG reductions may serve as seed money for green infrastructure projects, institutional investors represent a significant part of the main body for green infrastructure financing.

However, the evaluation of the role of institutional investors in the global economy is not always favorable (Chang et al. 2012). They have been criticized for creating speculative bubbles in various sectors of the global economy: this was apparent as massive global savings flooded IT markets in 1998, creating dot.com bubble that burst in early 2000. Likewise, global savings inundated real estate markets in 2001, creating a real estate bubble that burst in 2007. To make matters worse, whenever such bubbles burst they trigger financial crises.

Against such a backdrop, the late Meles Zenawi, then Prime Minister of Ethiopia, provided powerful insight at the Fifth Meeting of African Ministers of Finance in Ethiopia in 2012 by stating: 'The massive global saving that has now become part of the problem could become part of the solution if it were to be directed to investments in Africa.' Indeed, infrastructure should be a priority area attracting investments from such massive global savings (Köhler 2013). Through investment in infrastructure in developing countries, such massive global savings could indeed play a constructive role in the global economy; diverting just 0.15 percent of financial resources of institutional investors annually to infrastructure markets of developing countries would make US$ 138 billion per year available for green infrastructure financing. This volume is almost equal to an entire annual ODA volume—US$ 143 billion in 2016—and six times as much as the portion of ODA allocated to infrastructure in that year (OECD 2017).

Infrastructure investment is a commercially attractive option for institutional investors; although available data is limited, past records set positive signs. For example, in a survey of 100 European pension funds, the expected profits from investments in the asset class infrastructure over 10 years are 9.9 percent annually, while the yields of private equity, stocks and bonds are 11.3 percent, 9.0 percent and 5.1 percent, respectively (Inderst 2009). Furthermore, given the prolonged low-yield environment such as low interest rate and volatile stock markets of recent years, institutional investors are increasingly looking for new portfolios investment possibilities (Della Croce and Yermo 2013). Hence, the asset class infrastructure is increasingly appealing to institutional investors as a new candidate portfolio. Additionally, as infrastructure projects have long operational lifespans and correspondingly, require long periods to harvest profits, these projects would be a natural fit for institutional investors who prefer long-term, steady and inflation-linked income streams (Inderst 2009).

Despite such huge potential represented by institutional investors, investment in infrastructure markets by institutional investors is still very limited. Pension funds directly invested less than 1 percent of their assets in infrastructure, while insurance companies invested in infrastructure even far less than pension funds did (OECD 2011).[5] The cause for limited investment may be explained, above all, by the *diverse risks* in the infrastructure markets. This will be explored in Chap. 4. In particular, such risks are greater in developing countries than in developed countries. Furthermore, some regulations prevent institutional investors from investing in infrastructure markets of developing countries. Examples include the regulations that limit investment only to OECD member states, or that put a quantitative constraint on the amount of resources that can be allocated to infrastructure (Inderst 2009). However, as such regulations reflect reasonable concerns about various risks involving infrastructure investments, if a reliable mechanism could be established to protect the interests of institutional investors against the risks arising from developing countries' infrastructure markets, such prohibitive regulations could be loosened.

Thus, the key to attracting institutional investment into green infrastructure markets in developing countries is *ensuring the protection of their investments against inherent diverse risks*. Diverse risks represent the Gordian Knot in this sector: eliminate or reduce these risks, and the enormous potential of institutional investors can be optimized.

How Can We Involve the Key Player in Green Infrastructure Financing?

In order to protect institutional investors against diverse risks in developing countries, this book proposes three key devices for constituting a *protective mechanism*: profits from selling GHG reductions, protections by Multilateral Development Banks (MDBs) such as the World Bank and African Development Bank and the establishment of special economic zones (SEZs). First, profits from selling GHG reductions would be used to repay a portion of the 'originally invested money and its profits' to institutional investors. The governments of developed countries must play a critical role in ensuring the generation of adequate profits from selling GHG reductions. Namely, the governments need to provide a guarantee to buy such GHG reductions above a certain price level in order for project-implementing companies to generate adequate profits, which is the only way more expensive green infrastructure can compete with a less expensive conventional infrastructure on an equal footing. Second, with protection instruments such as guarantees and equity participation, MDBs would ensure the repayment of the rest of the originally invested money and its profits to institutional investors. Another crucial government role in this regard is that the governments of developed countries must financially support the protection work of MDBs with their MDB trust funds.[6] Third, by designating project areas as special economic zones (SEZs), developing countries would create an investor-friendly environment for institutional investors specifically in the targeted project areas where they would like to attract these institutional investors. Such SEZs could enjoy tax benefits, one-stop service regarding permits and licenses, protections against nationalization, or the freedom of transfer of profits. The details of the profits from GHG reductions and MDB protections will be addressed in Chapters. 6, 7 and 8.

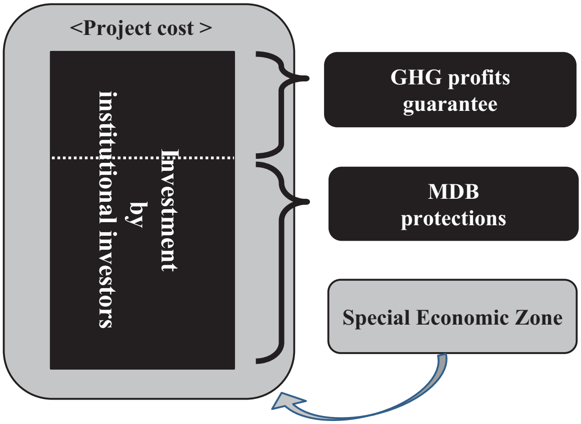

Fig. 3.1 Three devices of a protective mechanism

Overall, the protective mechanism based on the three devices would contribute to protecting the interests of institutional investors against diverse risks arising from developing countries' infrastructure markets as illustrated in Fig. 3.1, and thus contribute to promoting green infrastructure financing.

Conclusion: Changing the Direction of a Game

Given that GHG keeps increasing and time is not on our side, the global community urgently needs to overcome current inertia. One effective way to overcome such inertia is to focus on the actions leading to targeted outcomes. The course of action that this book proposes is aimed at a rapid global spread of green infrastructure. However, the global community faces a significant obstacle in taking such action: the high price of green infrastructure. To overcome such an obstacle, a wise strategy would be to align the interests of the business sector and the environmental sector. By creating investment incentives to the business sector, the strategy contemplated promotes broad business sector action in building green infrastructure in developing countries. Increases in production are assumed to lead to decreases in cost, which would accelerate the global spread of green infrastructure. Chapters 4 and 5 will analyze in greater depth the diverse risks of infrastructure markets in developing countries. Chapters 6 and 7 will show how GHG profits can be used as seed money for green infrastructure financing, and Chap. 8 will explain the details of MDB protections. Finally, Chaps. 9 and 10 will make a design proposal for a mechanism to protect the interests of institutional investors against the diverse risks prevalent in developing countries' green infrastructure markets, and suggest a roadmap to put the design proposal into practice.

Notes

1. For further details, see Savoy and Perkins (2014, 6).
2. For the details on the sectoral ODA data in 2016, see OECD, 'ODA by sector,' https://data.oecd.org/oda/oda-by-sector.htm. Accessed 7 January 2018.
3. For the need of subsidization of the deployment of green technology, see Altenburg and Lütkenhorst (2015, 32–33).
4. For further details, see OECD/World Bank (2015, 9).
5. For further details, see Kaminker et al. (2012, 16).
6. The details on the MDB protections will be addressed in Chap. 8.

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4

Diverse Risks of Developing Countries' Infrastructure Markets

Introduction

In order to attract institutional investors to support infrastructure markets in developing countries, two measures are essential. First, the diverse risks that they face must be made clear; second, they need adequate protections against those risks. Here in Chaps. 5 and 6, the groundwork for following chapters will be laid out providing both a clarification of the diverse risks of developing country infrastructure markets as well as a deeper analysis into the common root cause of these risks.

Two Project Models of Developing Countries

For the purpose of building green infrastructure in developing countries, there are basically two project models: a government budget-based model and a private investment-based model.

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Government Budget-Based Model

Under a government budget-based model, the government of a developing country finances a project through its public budget. The public budget is generally based on (1) tax revenue; (2) borrowings from outside the government; or (3) grants from developed countries. As background information, the grants are a type of Official Development Assistance (ODA). ODA is divided into three types: grants, soft loans or technical assistance. Developed countries normally provide ODA to developing countries to assist in development. Generally, given the shortage of tax revenue of developing countries, the recipient government tends to rely on borrowing or grants. With regard to borrowing, the government can borrow from its central bank, sell government bonds or seek foreign loans. Among these, seeking foreign loans is a frequently used option since the terms of borrowing are generally more favorable than other options; for example, interest rates would be lower than other options, and the repayment period would be longer as well. The process of seeking foreign export loans is as follows: if a developing country seeks a loan, it tries to get a foreign loan with the most possible favorable conditions, such as the lowest possible interest rate and the longest possible repayment period. In response, loan-providing countries try to make their loan proposals as attractive as possible. The loan-providing country usually makes its loan proposal contingent on the purchase of equipment and technology for the project strictly from its national companies. Accordingly, winning the project contract would increase the export of equipment and technology of the loan-providing country to the developing country. Such loans are of two kinds: soft loans (ODA) and export loans. A soft loan provided by a state-run bank of a loan-providing country has a much longer repayment period as well as a much lower interest rate than those of an export loan. Similarly, an export loan provided by a state-run bank of a loan-providing country has a lower interest rate than that of a commercial loan available on the international capital market. Given that developing countries are generally charged higher interest rates due to their low sovereign credit rating in the international capital market, such lower interest rates of proposed loans would appeal to developing countries. The term 'export loan' is used by loan-providing countries indicating that the loan supports the export of their equipment and technology to another country. In theory, a deal would be made where the interests of a loan-providing country and a developing country intersect. In reality, if the sovereign credit rating of a developing country is not seriously poor and a project is an attractive one such as those involving power plants and high-speed railways, the developing country may face several voluntary and favorable loan proposals from foreign countries. However, if the sovereign credit rating of a developing country is seriously poor or a project is an unpopular one like a road or simple construction work, the country may not be able to get a loan on favorable terms.

Private Investment-Based Model

In contrast, the private investment-based project model relies on the financial resources of the private sector. It has two sub-models: a public-private partnership (PPP) model and a privatization model. The two key differences between the two sub-models are 'ownership' and 'existence of service contract.' First, while ownership lies with a government in the PPP model, it belongs solely to the private sector in the privatization model (Weber and Alfen 2010). In relation to the ownership, there are several modalities in the PPP model, depending on the timing of the acquisition of ownership by a government. For example, under the Design–Build–Finance–Operate (DBFO) modality, ownership lies with a government from the beginning of the contract of a project (Weber and Alfen 2010). The DBFO modality allows a project-implementing company to design, build and operate facilities with its own financing for a duration of between 15 and 25 years. Toll roads are a case in point (US FHA 2007).

By contrast, under the Design–Build–Lease–Operate–Transfer (DBLOT) modality, ownership may be transferred to a government at the end of the term of a contract (Weber and Alfen 2010). DBLOT modality allows a project-implementing company to design and build a facility with its own financing, and then lease it to the government for a duration of between 20 and 30 years, providing the government with a purchase option of the facility at the end of the term of a contract as well. A good example is a public hospital (OECD 2014). Interestingly, there is also an in-between model. Under the Design–Build–Own–Operate–Transfer (DBOOT) modality, ownership is transferred to a government during the term of the contract of a project (Weber and Alfen 2010). The DBOOT modality enables a project-implementing company to design, build, own and operate facilities with its own financing for a duration of between 20 and 30 years, selling the facility to the government during the term of the contract. Examples are airports, sport facilities and waste management (Gatti 2013).

In addition to holding on to the ownership of projects, a government may be involved further in the PPP model by joining a project-implementing company. There are two means of achieving this: the first way is to be involved in a private partner-led company; the second is to be involved in a government-led company (Weber and Alfen 2010). As to the first, after a project-implementing company is established by the private partners, a government may participate in the project-implementing company as public partner. As to the second, once a project-implementing company is established by a government, private partners may join the project-implementing company as shareholders through the acquisition of its shares.

Ownership is transferred to the private sector in the privatization model. For instance, the Independent Power Producer (IPP) model is a case in point. An independent power producer owns the facilities of a project and sells electricity to public authorities or end users. In addition to their potential in large electricity markets, independent power producers show their usefulness in small electricity markets, contributing to rural electrification and increasing access to electricity in developing countries (Rugaba 2015; AfDB 2015).

Second, the PPP model can also be differentiated from the privatization model in that there is a service contract between a government and the private sector in the PPP model, whereas there is no service contract between a government and the private sector in the privatization model (Weber and Alfen 2010). While the private sector acts alone on the market in the privatization model, the PPP contract provides for concrete terms and conditions of service to be provided by the private sector to a government (Grimsey and Lewis 2004).

Importantly, the PPP contract provides for how payment is to be made to a project-implementing company. To illustrate, there are two methods in how a project-implementing company gets paid: budget-financed and user-financed (Weber and Alfen 2010). For the budget-financed method, a project-implementing company receives a monthly or annual fee from a government that covers investment costs, operating costs, any risk premiums or its profit. Under the user-financed style, a project-implementing company recovers its costs and profit by charging fees for the use of facilities like toll roads and sport facilities. However, under the user-financed style, if a project proves unprofitable due to insufficient demand, a government may subsidize the ongoing operation of the project. In this context, the PPP contract is important as a basis for cooperation between the government and the private sector for at least a couple of decades.

Regarding the private investment-based model, two points should be noted. Firstly, a project-implementing company should be established in accordance with the laws and regulations of the country where the project is launched, although the main investors of the project are likely to come from overseas. For the PPP model, such project-implementing company is called a 'Special Purpose Company' (SPC). Given the fixed duration of an infrastructure project, the mandate of the SPC is temporary in its nature. However, for the privatization model, there is no specific term for such project-implementing company. Simply, the private company that implements the project has only to be established in accordance with the legal system of the host country. It is because the project-implementing company needs to hold legal rights and obligations within a legal system of the host country for the purpose of making economic activities like production, transactions and sales in the host country. Secondly, the project-implementing company would usually rely on a project financing technique to mobilize financial resources for a project. The essence of project financing is that potential lenders base the credit assessment of a project on the projected 'cash flow' from the operation of a project, rather than on the physical assets of a project or the credit of sponsors of the project-implementing company (Hoffman 2008).[1] Hence, in a project-financing scheme, lenders cannot hedge their risks 100 percent but share some risks of the project. In other words, unlike mortgage loans that allow lenders to sell the secured property of a borrower in order to recover their loans in the event that the borrower fails to pay back the loans, lenders in a project-financing scheme cannot recover their loans safely if something should go wrong and the cash flow weakens. Therefore, it is natural that potential lenders of a project employing project-financing techniques would be far more cautious than potential lenders for a project with safe collateral. To summarize, once financial resources are mobilized and a project goes into full operation, the project-implementing company usually repays its debts gradually with profits from selling the infrastructure service to the government or the public over a long period. The following will show how these two project models can be implemented in the green infrastructure market of developing countries.

Diverse Risks in Developing Countries' Markets

The Emergence of a Private Investment-Based Model

Implementing green infrastructure projects involves diverse risks, with implementation in developing countries posing heavier risks. Generally, a government budget-based model faces more constraints in developing countries than in developed countries. While the government budget-based model relies on either tax or financial resources borrowed from outside the government, such public revenue of developing countries is far smaller than that of developed countries in relative terms. For example, the average tax revenue of non-OECD countries is only 14.7 percent of GDP, while it is about 35.6 percent with OECD countries (Heritage Foundation 2016).[2] With the shortage of tax revenue, it is natural that the capacity of developing countries to implement green infrastructure projects via the public budget is more limited than that of developed countries. Similarly, the borrowing capacity of developing countries is much weaker than that of developed countries. In order to borrow money from outside the government, the government must provide assurances or proof of ability to repay. One representative criterion in appraising such capacity is the 'debt to GDP ratio.' If the debt to GDP ratio is high, it means that the government has already incurred a large volume of debts. Hence, the government may not be able to manage the debts in a sustainable manner within its budget. In such a case, it would be difficult for the government to launch expensive green infrastructure projects through the public budget based on borrowed resources. Potential lenders would be hesitant to lend money to a government with such a large debt. Unfortunately, such a gloomy scenario is materializing in many developing countries. For instance, while the debt-to-GDP ratio is recommended not to exceed 40 percent for developing countries, around half of developing countries are close to or already exceed the 40 percent threshold as of 2015 (IMF 2013). Accordingly, many governments of developing countries cannot rely on a public budget based on either tax or external borrowing for the purpose of financing expensive green infrastructure projects.

Consequently, given such limited capacity of the government to carry out infrastructure projects, the private investment-based model is indeed a crucial alternative for developing countries. Furthermore, in addition to bringing in financial resources, the private investment-based model can also promote efficiency and cost optimization through the entire project life cycle by introducing competitive management skills and expertise from the private sector (Grimsey and Lewis 2004). However, despite its huge potential, there are numerous barriers that prevent the private sector from participating in the green infrastructure markets of developing countries. A key word that best describes the barriers to entering the green infrastructure markets of developing countries would be 'uncertainty.' The greater the uncertainty in a given project is, the less likely the private sector is to participate in green infrastructure projects. Such uncertainty may be caused by the diverse risks set out in Table 4.1. In the following, the risks of green infrastructure market will be explained 'in reverse order,' namely from implementation risks to preparation risks.

Table 4.1 Major risks of green infrastructure market in developing countries

Major risks		Details
Implementation risks	Political	• Permits and license • Output purchase (PPP model only) • Inconvertibility • Changes in laws • Nationalization • Political instability and succession
	Economic	• Inconvertibility • Currency devaluation • Inadequate revenue (privatization model only)
	Social	• Conflicts with local community
Preparation risks	Finance-related	• Finding financial sources to cover additional cost of a green infrastructure project • Finding financial sources to cover main cost of an infrastructure project
	Preparer-related	• Finding funding for project preparation • Securing a permit to implement a project

Implementation Risks

In relation to the implementation risks, green infrastructure projects are exposed to the same risks that conventional infrastructure projects have. Such risks can be broken down into three categories: political, economic and social.

Political Risk

Political risks are caused mainly when the government of a host country 'does not have a reliable legal system to protect investors.' In the absence of a reliable legal system to solve problems, investors have to seek political solutions through consultation with officials of the host country. Such a situation would maximize 'uncertainty' for private investors. Such political risks are mainly related to: permits and licenses, output purchase, inconvertibility, changes in laws, nationalization, political instability, or, political succession (Hoffman 2008).

Faced with such risks, the government of a host country may try to relieve potential investors of the concerns about such issues by incorporating its relevant commitments into the PPP contract or laws that regulate such issues. Nonetheless, problems may arise if the government breaches the contract or does not enforce relevant laws in a fair and transparent manner (Hoffman 2008). For example, regarding the issue of permits and licenses, these need to be issued in a timely manner to project-implementing companies so that the construction work of a project may be completed on schedule. However, large infrastructure projects generally require numerous permits and licenses from various central ministries or municipal authorities with regard to the ownership, construction, and operation of the projects. Under the circumstances, the refusal to issue or delay by relevant authorities on issuing necessary permits and licenses for unclear reasons would pose a substantial risk to a project-implementing company towards timely completion. Furthermore, if the government does not honor its output purchase agreement, this would pose a serious risk to a project-implementing company and its lenders. In other words, if the government does not buy the output of a project at a fixed price, or does not make up for the deficit in revenue caused by low demand as stipulated in the output purchase agreement, this would seriously threaten the stable revenue stream from the project. The output purchase agreement is pivotal to ensuring adequate revenue for private investors. The output purchase risk is connected with PPP models only. Privatization models are not protected as strongly as PPP models: despite potential risks, it is preferable to have an output purchase agreement rather than to have nothing to rely on. For the privatization model, a project-implementing company must persuade private customers to buy its product in order to generate profits. The risk of inconvertibility is also a serious obstacle: if the public authority restricts the conversion of profits into foreign currency, investors cannot send their profits overseas. Moreover, changes in the laws present significant risks, as well. If the government changes laws forming the legal basis for designing and implementing infrastructure projects, this would affect the ability of a project to service debt or make the project altogether unprofitable. Changes in laws may be linked with import and export restrictions, taxation including income tax and customs duties, and changes to environmental standards requiring additional financial investment. Even though a project-implementing company may incorporate protective provisions on legal changes in the PPP agreement or double-check with the government on the future stability of current laws before making a final decision to invest, there is still a risk that the government of the host country could later breach the contract or decide to change relevant laws out of policy considerations. In addition, the risk of nationalization must be noted; if the government of a host country nationalizes the facilities of a project without proper compensation, it would pose a financially fatal risk to the interest of lenders and sponsors of the project. Besides, political instability and succession are additional serious risks; political collapse and transfer of power through elections or violent overthrow may lead to a reversal of previous decisions on awarding PPP contracts or on the approval of permits to the current project-implementing company. The basis for the reversal can be, for example, a correction of perceived corruption or solicitation of 'contributions.'

Economic Risks

Economic risks are caused mostly when a host country 'does not have a solid economy' (Hoffman 2008). Noting the risk of inconvertibility once again is important, as it is a common and serious risk in developing countries. The risk arises because project revenues are generally denominated in local currency, while the financial resources of a project are often sourced from foreign lenders in foreign currencies (Delmon 2009). In the event, it may be difficult to change the revenues of a project into foreign currency if developing countries have a shortage of foreign currencies due to negative trade balance or heavy foreign debt. Similarly, the shortage of foreign currencies in a host country may lead to the drop in value of local currency against the foreign currency. In such a case, the devaluation of local currency would increase the cost of debt in local currency and decreases the return on investments that are originally sourced in foreign currency. Furthermore, the project may suffer from inadequate revenue; for example, due to the shortage of demand. From an analytical point of view, it should be noted that inadequate revenue is a political risk in the

PPP model while it is an economic risk in the privatization model. At the project preparation stage, such risk should be meticulously evaluated. If there is a risk of inadequate demand, such a project should not be adopted for implementation. However, if the implementation of such a project is essential for various reasons, it would be preferable for a project-implementing company to adopt the PPP model based on a government guarantee, rather than to retain the privatization model.

Social Risks

Social risks arise mostly when a host country does not 'have a reliable legal system to protect investors.' In fact, it is common that large infrastructure projects may face opposition or lawsuits from local communities for various reasons. Local occupants of the land earmarked for railroad construction may physically block the construction site, asking for additional compensation (Delmon 2009). Likewise, local environmental NGOs may object to a project for environmental reasons, occupying the project site illegally. In such a case, if there is no reliable legal system to settle the disputes in an efficient and fair manner, the dispute can be prolonged without any predictable timeline. Furthermore, the outcome of the dispute settlement process may be biased toward powerful local interest groups. Accordingly, in the absence of a reliable legal system to solve social problems, investors have to seek political solutions through consultation with officials or powerful groups of the host country. Such situations would indeed maximize uncertainty for private investors.

Project Preparation Risk

Importance of Project Preparation

Project preparation is extremely important given that the problem of the infrastructure market is not a lack of funding but the shortage of bankable projects (Leigland and Roberts 2007).[3] In other words, investors have money but they cannot find reliable projects to invest in. Such bankable projects are the outcome of project preparation. Hence, it can be said that the shortage of bankable projects can be solved if enough project preparation is done in advance.

Project Preparation Process

However, project preparation is extremely challenging. To best understand the nature of these challenges, it is important to view the procedures of project preparation (ICA 2006). Initially, a project preparer needs to form an enabling environment. This includes pushing for the introduction of legislation that allows PPP models like the Design–Build–Finance–Operate (DBFO) or Design–Build–Lease–Operate–Transfer (DBLOT). The project preparer may also have to seek institutional reforms in the host country in order to cure deficiencies in regulations, avoid overlaps in the authority of institutions, or sort out contradictions between relevant authorities.

Next, the project preparer needs to define a project, identifying the desired output and the characteristics of a project (ICA 2006). If there are several project options, a pre-feasibility study must be undertaken for cost estimates, assessment of economic viability and selection of the right project option (ICA 2006).[4] Subsequently, a feasibility study must be made. This involves checking whether the project is feasible in terms of technology, financing and environment, as well as other variables. A feasibility study produces a basic engineering design and several financing options (G20 Development Working Group 2014). Then, the project must be structured through selection of the right financing option, laying legal foundations, and refinement of the engineering design. Lastly, the project must be moved to the implementation stage at which financing is secured by concluding financial agreements with government or private investors, and goods and services like project management services are procured.

To make a long story short, project preparation can be simplified into two steps: 'designing' a project and subsequently 'securing' financial commitments to the project from investors. Importantly, the essence of project preparation is designing a project: if a project is designed well, the financial commitments of investors to the project follow automatically.

Three Challenges

There are three challenges that arise in the process of project preparation. The first challenge is that the solutions to all major implementation risks—hedging the risks—as indicated in Table 4.1 must be incorporated into the design of a project. However, it should be reminded that solutions are not always self-evident. For instance, a survey of private sector investors by the Infrastructure Consortium for Africa (ICA) noted that the most difficult work across the whole process of project preparation was establishing the enabling environment; such included identifying and eliminating legal, regulatory and institutional impediments (ICA 2012b).

The second challenge derives from two finance-related risks. To begin with, the finding of financing to cover the additional construction and operating costs of green infrastructure is a hurdle to overcome. As indicated in Chap. 3, green infrastructure is more expensive than analogous conventional infrastructure. Thus, launching green infrastructure requires substantial additional costs as compared to conventional infrastructure projects of a similar kind. For instance, solar power plants are more expensive than fossil fuel-burning power plants in terms of the levelized cost of electricity. Likewise, coal-fired power plants with a carbon capture and storage (CCS) facility are far more expensive than ordinary coal-fired power plants in terms of the levelized cost of electricity. With such additional cost, the profitability of a green infrastructure project would be lower than that of a conventional infrastructure project. Hence, a solution to increase the otherwise low profitability of green infrastructure should be included in the design of a project. Secondly, there is a risk of not being able to find financial resources to cover the main cost of an infrastructure project itself. The project preparer must secure the large volume of main financing from private investors; however, securing money in local financial markets in developing countries is difficult since their local financial markets are generally underdeveloped due to poor economic performances (Delmon 2009). To illustrate, the savings to GDP ratio over 2005–2010 in Africa was just 22 percent while it was 46 percent in East Asia (ICA 2014a). Money must come from overseas where domestic savings are insufficient, as is the case with Africa. Nonetheless, overseas investors are hesitant to invest in view of the high risks in the infrastructure markets of developing countries (Collier et al. 2014). Accordingly, as there is a substantial risk of not being able to find main financing to implement a project, it is necessary that solutions to hedge diverse risks be incorporated into the design of a project in order to attract overseas investors.

The third challenge comes from two risks that involve the project preparers themselves. To begin with, project preparers may not be able to secure adequate funding for project preparation. Project preparers are usually private companies that use either public or private funding. They generally prefer public funding because this shifts the risk of failure away from their own cost. However, public funding is often inadequate, while private funding is limited since private investors are reluctant to take on the immense risks related to project preparation such as those of failing to find solutions to all major implementation risks and the aforementioned two finance-related risks. Accordingly, there is a shortage of funding for project preparation (ICA 2012a). Against this backdrop, let us view the reality in more detail. Generally, project preparation costs about 5 percent of total project cost for green infrastructure (Ritchie and Usher 2011). Moreover, in Africa, project preparation cost for large projects can constitute between 10–12 percent of total project cost (UN ECA 2011).[5] Project preparation is also time-consuming: data from project preparation facilities (PPFs) indicates that it takes about 27 months per project (G20 Development Working Group 2014). In Africa, it can take up to 7–10 years for large infrastructure project preparation (Africa50 2016). Furthermore, statistics of skilled project preparation facilities show that a little less than two-thirds of projects moved to the implementation stage (G20 Development Working Group 2014). Given the combination of high cost, long time and a risk of failure, it is understandable why project preparers have difficulties in finding sponsors to provide funding for project preparation. In the case of Africa, PPFs that are mainly funded by the government of donor countries and development finance institutions have provided only US$ 80 million, while the required funding has amounted to US$ 500 million (Chaponda and Lishman 2013). Of course, PPFs are not the only source of funding, as there are other sources, like multilateral development banks, local governments and private sector institutions (ICA 2012a). However, the financial contribution to project preparation of other alternative sources is generally ‘incidental’ because their mandate is not focused on project preparation; by comparison, PPF is solely dedicated to project preparation (Chaponda and Lishman 2013). Hence, the shortage of PPF funding clearly leads to the general trends of shortage in project preparation funding at the global level. Namely, given the shortage of funding in the sources solely dedicated to project preparation, undedicated sources are unlikely to be large. Secondly, after devoting substantial money and time to preparing the project, a project preparer may not be able to secure rights to a project from the government of the host country (Hoffman 2008). Even if a project preparer almost completes its work including expensive feasibility studies and structuring of a project, the project preparer may lose its right to continue to develop the concerned project at the final moment, such as through the international competitive bidding process. Interestingly, what these two risks have in common is that after project preparers invest substantial time and money in preparing a project, their investment may not be properly rewarded (ICA 2012a). Hence, in order to encourage project preparers to work aggressively and produce as many bankable projects as possible, solutions to address such common problems must be explored.

Conclusion

To summarize, if all major implementation risks and the two finance-related risks are hedged, an investment-grade project results. Such a bankable project would indeed be attractive for investors in the market. Accordingly, project preparers need to incorporate risk-hedging schemes regarding the implementation risks and the two finance-related risks into the design of a project.

Notes

1. For further details, see Pretorius et al. (2008, 13–14).
2. For further details, see Savoy and Perkins (2014, 6).
3. For further details, see MDB Working Group on Infrastructure (2011, 3–4).
4. For further details, see G20 Development Working Group (2014, 4).
5. For further details, see ICA (2014b).

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5

A Root Cause of Diverse Risks and Root-Level Solutions

The Development Path of a State

In order to address the diverse risks of developing countries' infrastructure markets, a question arises: should we address such diverse risks one by one? Or, is there any common solution that applies to all such risks at the same time? Accordingly, if we can find *a root cause*, we can produce a solution that can address the common root-level cause of all problems. Needless to say, such a root-level solution can be much more powerful than superficial symptomatic therapy. How, then, can we find such common root cause? In the view of the author, the clue can be found in the development path of a state. It is because the level of such diverse risks is apparently 'higher' in developing countries than in developed countries (Fukuyama 2014). This clear fact implies that such a common root cause is somehow related to the development level of a state. Accordingly, in order to go deeper into the root of such diverse risks, the development path of a state may be divided into five phases: (1) an uncentralized situation, (2) A weak state that somehow manages to maintain security and public order, (3) a centralized state that is

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Table 5.1 Phases of the development of a state

Phase	State's development	Characteristics	Europe	China
1	Uncentralized situations	• Blood relations		
2	A weak state that somehow manages to maintain security and public order	• Impersonal administration	5th century	770 B.C.
3	A centralized state that is competent to maintain security and public order	• Direct rule	18th century	221 B.C.
4	A centralized state that is competent to enforce laws effectively and fairly	• Economic development	20th century	Ongoing
5	A decentralized state	• Stronger accountability mechanism • Detachment from the central system	20th century	

competent to maintain security and public order, (4) a centralized state that is competent to enforce laws effectively and fairly, and (5) a decentralized state as shown in Table 5.1.

To begin with the conclusion, the root cause of higher risks in developing countries is that they have not yet reached Phase 4. Only after a state reaches Phase 4 can any risks be hedged within the system of the state. At the far end of the spectrum, some fragile areas or states are stalled in Phase 1 or Phase 2. Hence, while explanations on Phase 1 or Phase 2 may appear to be obsolete, the reality is that some states, like Somalia and Yemen, remain in Phase 1 in the twenty-first century. Accordingly, attention needs to be paid to the characteristics of states in Phase 1 or Phase 2. Through understanding the characteristics of each phase, insights can be obtained leading to solutions addressing risks of infrastructure markets of those states.

Lastly, given that the modern developed world has its origin in Western Europe, a focus will be placed on the development of states in this region. Additionally, considering that the East provides interesting cases of a state formation, a comparative analysis will also be made by looking briefly into the history of China.

Phase 1

Now, let us look at Phase 1 of the 'uncentralized situation.' In this phase, human society is insecure since there is no centralized authority to maintain security and public order. The important characteristic of human societies in Phase 1 is that they are based on *blood relations* (Karatani 2014). Since such human societies are based on kinship, they generally reflect an egalitarian society (Fukuyama 2012). Such an egalitarian component is understandable, as relations between families within lineages would not function under coercion or exploitation. Generally, there are two societies belong to Phase 1: nomadic band societies and tribal societies (Fukuyama 2012). Humans began with nomadic band societies in which humans were hunter-gatherers who kept moving in search of wild plants and wild animals. Both hunting and gathering are done in a group, generally by a family or groups of families. Accordingly, such societies are based on blood relations. The transition from nomadic band societies to tribal societies is possible with the introduction of agriculture. Agriculture-based societies limit movement within the agricultural areas. With the increase in food supply from agriculture, population also increases. Hence, more humans come to settle down in one area. Fundamentally, such an increase in population in one area means the expansion of families of common descent. Thus, given that a tribe is formed by related families, tribal societies are also based on blood relations like nomadic band societies. Tribal societies are much more useful than band-level societies in defending life and property. Such tribal societies are far more powerful militarily than band-level societies in that they can mobilize hundreds or thousands of kinsmen at a moment's notice (Fukuyama 2012). Hence, tribal societies became predominant over the hunter-gatherers. However, in the absence of a centralized 'permanent' authority to maintain public order among different tribes, an individual tribe is constantly exposed to threats from other tribes (Karatani 2014). Faced with such threats, the temporary nature and loose organization of tribal armies reveals critical weaknesses as a military force since the tribal armies are mobilized only in times of crisis, and the heads of tribal armies cannot control their soldiers by absolute authority but instead have to rely on the voluntary obedience of their kinsmen (Fukuyama 2012).[1] These weaknesses stand in strong contrast with the characteristics of a regular army of a state. Understandably, it is logical that once certain tribes form a state with a regular army, other tribes must also quickly turn themselves into states to cope with threats from the more effectively equipped state (Karatani 2014).

Phase 2

Therefore, out of the need to better cope with external threats, humans proceed to Phase 2 of establishing 'a weak state that somehow manages to maintain security and public order.' Phase 2 is very important in an economic sense, since security and public order are a basis for all economic activities (Fukuyama 2014).[2] The logic is self-evident: in the absence of security and public order, the private property of individuals and tribes would be constantly exposed to the risk of being looted by intruders at any time. Under these circumstances, humans would not spend time and energy to make long-term investments and to increase private assets that can be plundered at any moment. The major characteristic of human societies in Phase 2 is that they are run by *impersonal administration*. Simply put, impersonal administration means running an organization without relying on blood relations. The initial focus of impersonal administration targeted mobilization of the civilian population to build an army and the raising of taxes to fund the army (Fukuyama 2014).[3] The story of the Rosetta Stone is illustrative in that it dates to around 200 BC, providing a clue to deciphering ancient Egyptian scripts. Interestingly, the inscriptions on the Rosetta Stone are about public decrees of the ancient Egyptian state on its taxation policy in three scripts: hieroglyphic, colloquial and Greek. From the Greek text, scholars can decode the other two scripts. Thus, the Rosetta Stone testifies to the existence of impersonal administration at the latest by 200 BC in ancient Egypt, showing that taxation policy was so important as to be cut in stone in ancient Egypt rather than being written on paper (Adams 2001). Importantly, from such impersonal administration, it can be concluded that human societies in Phase 2 are based on 'contracts' between a state and its people:

while a state protects its people with its army, its people must reciprocate the protection of their state by paying taxes. By comparison, in human societies in Phase 1, parents would not protect their children on the condition that their children must reciprocate with corresponding services. Indeed, such impersonal administration in Phase 2 stands in stark contrast with the operation of societies based on blood relations in Phase 1. With the introduction of impersonal administration, the armies of states in Phase 2 are believed to have undergone considerable changes. Unlike tribal armies, the generals of regular armies of states can control their soldiers by command based on strict military law, rather than expecting voluntary obedience based on blood relations. They can also decide on life or death for their soldiers in an impersonal manner. Overall, Phase 2 is characterized as impersonal administration with a contract between people and their state.

In history, human societies transitioned to Phase 2 during the period of 'extreme chaos.' Western Europe started to move to Phase 2 from the fifth century following the disintegration of the Roman Empire. After the Roman Empire collapsed, its territory fragmented into thousands of state-like entities like city-states, principalities, bishoprics and other authorities (Tilly 1990). In the absence of a centralized authority to provide security, individuals of fragmented political entities suffered a series of devastating external invasions by Vikings, Arabs and Hungarians, amongst others, unable to effectively defend themselves. Consequently, individuals voluntarily made contracts with other unrelated powerful individuals to seek protection and fiefdom in exchange for their services to the powerful individuals (Fukuyama 2014). In other words, under a feudal contract, a lord gives protection and a plot of land to his vassal on the condition that the vassal provides military service and financial support to the lord. The vassal can also create sub-fiefdoms out of his land and enter into feudal contracts with his own vassals. In a fiefdom or sub-fiefdom, vassals lend a plot of lands to peasants, collecting taxes and rents from them (History Learning Site 2016). This was the beginning of feudalism in Europe, in contrast to the Chinese blood relations-based feudalism under which a lord distributed lands to his kinsmen (Fukuyama 2014). Europe's feudalism that included elements of impersonal administration and contract can be understood as a type of state in Phase 2. By contrast, Chinese feudalism cannot be compared to a state in Phase 2 as its feudalism was based on blood relations.

Like Europe, China began to move to Phase 2 via fierce warfare during the Eastern Zhou Dynasty, which lasted from 770 BC to 221 BC, called the Spring and Autumn period and Warring States period (Fukuyama 2014). During this period, standing armies and impersonal administration to register populations and collect taxes arose. Unlike the orthodox approaches of the West and the East, an interesting variant can be found in history. It is a story of the Muslim world's transition from Phase 1 to Phase 2. The Muslim world in the medieval period pursued a unique way of eliminating blood-based administration by adopting a system of 'slave soldiers' from the mid-ninth century (Fukuyama 2014). The Ottoman Empire took healthy and smart boys as slaves from Central Asia and Europe, and trained them to be professional soldiers and high-ranking government officials. Despite their legal status as slaves of a sultan, such soldiers and high-ranking government officials enjoyed power and wealth. However, they were not allowed to marry. Even if they had children, they could not hand down their power and wealth to their children. In this way, the Muslim world maintained a strong army and a high quality of governance, while preventing the emergence of a political elite based on blood-relation groups that could threaten the status of a sultan.

To return to fragile states, such as Somalia or Yemen, that suffer civil wars, these have not yet reached Phase 2 in which security and public order are maintained. Indeed, reaching Phase 2 is very important to state development, as illustrated by the fact that no low-income country affected by conflicts has achieved even a single goal out of the eight development goals set by the United Nations in 2000 (World Bank 2011). At this point, it should be emphasized that Phase 2 means a weak state where a ruler cannot enforce direct rule all over his territory. Instead, the ruler must share the ruling power with other power groups such as aristocrats or local landlords. Generally, a ruler puts only a specific area under his direct rule delegating other power groups to rule the rest of the territory (Tilly 1990). Thus, Phase 2 is the era of indirect rule.

Phase 3

Accordingly, out of the need to make a strong state, kings proceed to Phase 3 of 'a centralized state that is competent to maintain security and public order.' Generally, when a state is just established out of tribal societies, a king would not have adequate armies or resources under his personal control to rule the entire territory. Thus, it would be inevitable for a king to share power with other power groups that have their own armies and resources (Fukuyama 2014). Such circumstances are beset by risks of disloyalty, dissimulation, corruption and rebellion (Tilly 1990). Therefore, a king must consolidate his power base, and reach Phase 3. The key characteristic of Phase 3 is *direct rule* by kings over their entire territory. In history, the opportunity for kings to strengthen power generally came from war (Tilly 1990). Out of a need to win wars, kings continued to increase taxes and strengthen armies; namely, a king gradually monopolized military powers and expanded supporting governmental structures, while incrementally taking power from other power groups.

In Western Europe, the pace to Phase 3 accelerated due to the French Revolution in the late eighteenth century (Tilly 1990). Kings had already began to make efforts to disarm nobles and landlords since the seventeenth century, making it criminal for most citizens to bear arms and outlawing private armies. In particular, Louis XIII, supported by Richelieu and Mazarin, rebuilt the armed force of the French state, demolished fortresses of nobles and reduced their rights to bear arms in the seventeenth century, thereby decreasing the odds of any serious future rebellion. Under such circumstances, the French Revolution forced the states in Western Europe to make a rapid transition from indirect rule to direct rule in order to survive in the wars, copying the French system. Centralized direct rule produced many benefits strengthening a king's army, including the ability to increase taxes, an increase in the number of conscripted soldiers and an increase in the volume of properties seized from nobles and the church. Indeed, the monopoly of military force led to the monopoly of taxation, creating a virtuous circle between them (Elias 1982).

On the other hand, the entirety of China reached Phase 3 as early as approximately 221 BC (Fukuyama 2014). Originally, the Zhou Dynasty rulers distributed 18 fiefdoms to unrelated power elites, and 53 fiefdoms to their kinsmen. Then, the Qin Dynasty established direct rule over the entire territory of China, unifying fragmented states in the region into a single state in 221 BC. After unifying the entirety of China, the first Qin emperor ruthlessly enforced direct rule. He divided the empire into 36 districts, and further divided them into prefectures, dispatching governors to the districts and prefectures for the purpose of displacing the power of local elites. Furthermore, he relocated 120,000 families of feudal nobility from the countryside to a district close to the capital, where they were kept under tight surveillance (Harrison 1972). He is also famous for burning classical books and burying alive 400 Confucian scholars who proposed to reestablish feudalism in China that would undermine his direct rule over China (Fukuyama 2014). Moreover, the first Qin emperor made an enormous contribution to establishing direct rule over China by standardizing the written Chinese language. Such a measure was originally intended to promote consistency in preparing government documents (Chang et al. 2005). However, it also led to an invaluable result of creating a uniform Chinese identity. Given that even now different dialects continue to be spoken all over China, China could not have maintained its unity throughout history in the absence of such a standardized written language (Fukuyama 2014). In addition to such active efforts by the Qin dynasty to strengthen its direct rule, it should also be pointed out that the Qin dynasty benefitted from the absence of aristocrat classes who might have checked the power of emperors (Fukuyama 2014). This meant that the numbers of Chinese aristocrats were almost depleted by incessant tribal warfare from 770 BC to 221 BC in which 23 political entities were reduced to 1.

Phase 4

At this point, it should be noted that the power of a state cannot grow without economic development. Hence, some states pushed for economic development, thus proceeding to Phase 4 of 'a centralized state that is competent to enforce laws effectively and fairly.' For the purpose of categorizing state development into five phases in this book, let us define the criterion of 'economic development' as 'being industrialized.' Through industrialization, an economy changes from one based on agriculture to one based on manufacturing industries, with individual manual labor being replaced by mechanized mass production, and craftsmen replaced by assembly lines (Investopedia 2016). Hence, industrialization unleashes the forces of division of labor, mechanization and technological progress, and motivates a state to break into larger markets to sell the increased number of products. Consequently, domestic production capacity of an economy increases, leading to the rise in per capita income.

In Phase 4, *economic development* generally enables 'effective' and 'fair' law enforcement. First, let us look into the relations between economic development and 'effective' law enforcement. It should be noted that effective law enforcement is available usually when a state is 'economically developed.' In the late eighteenth century, Adam Smith already took note of this point, saying that 'commerce and manufactures gradually introduced order and good governance (Smith 2010).' In some sense, it is self-evident that a state can enforce law effectively when public agencies are equipped with well-trained human resources and adequate budgets (Sachs 2005). Nevertheless, a counter-argument may also be possible that effective law enforcement enables a state to promote economic development. Instead of debating which came first, we look to empirical evidence, which clearly indicates that economic development is the precondition for effective law enforcement. The World Bank's Worldwide Governance Indicators (2011) shows that countries with effective rule of law are all economically developed countries. Therefore, the contrapositive of such finding would also be true. Namely, if a country is not economically developed, it cannot enforce law effectively. Given that catching-up countries face tougher competition nowadays than in the past, it would be challenging for developing countries to economically develop within a short time and consequently, introduce effective law enforcement.

Second, let us analyze the relations between economic development and 'fair' law enforcement. Economic development promotes the emergence of middle classes, which are likely to demand state accountability for its performance, contributing to the development of an accountability mechanism in a state. Simply put, accountability means 'limiting' the power of the ruling class (Fukuyama 2014). When a state has accountability mechanisms in place, fair law enforcement is usually available. Without adequate accountability mechanisms, ruling classes may be corrupt, putting their interests ahead of public interest (Collier 2007; Fukuyama 2004). Furthermore, since bureaucracy is a system focused narrowly on a specific job that must be done instead of necessarily delivering value to the public, there is no guarantee that bureaucrats would work towards the public interest instead of seeking their own interests (Ghani 2008). Given this, the mechanisms to provide checks and balances are critical to ensuring fair law enforcement. Representative accountability mechanisms that have developed throughout history include the rule of law, parliament, universal suffrage and IT technology (Fukuyama 2012).

From the point of view of foreign investors, a state in Phase 4 is very attractive since Phase 4 ensures an investor-friendly environment in which various risks can be *hedged within the system* of the host country. As Table 4.1 shows, while project preparers face project preparation risks such as finance-related and preparer-related risks, foreign investors face implementation risks like political, economic and social risks. Thus, foreign investors generally seek protection from such risks 'in the system' of the host country as their investments are placed in the territory of the host country. Under such circumstances, if the system of the host country is dysfunctional, foreign investors would face significant problems. Therefore, the reliability of the system of the host country is very important for giving assurances to private investors. In detail, foreign investors face political risks regarding permits and licenses, output purchase, changes in laws, nationalization, political succession and political violence. Foreign investors would accordingly seek solutions to hedge such political risk from investment contracts or from protective mechanisms stipulated in the laws of the host country. Hence, in order to secure solutions from diverse risks, the effective and fair functioning of the legal system of the host country is essential. Similarly, foreign investors would seek protection from social risk, such as conflict with local communities, through the legal system of the host country. Therefore, in order to secure protection in a reliable manner, effective and fair law enforcement is critical. Furthermore, economic risks like inconvertibility, currency devaluation and inadequate revenue can also be properly managed in Phase 4. Since states in Phase 4 are generally developed countries with a solid economy, their capacities to manage such economic risks are usually reflected by the high credit ratings of their sovereign bonds accorded by independent credit-rating agencies like Moody's Investors Service, Standard & Poor's and Fitch Ratings. Their reliability in managing the economy is also confirmed by the fact that developed countries are far less likely to seek IMF loans that are provided to countries in financial need. For example, among 42 countries that are financially supported by the IMF as of July 31, 2016, there are only two OECD member countries.[4] Thus, such reliable capacity would give assurances to foreign investors against economic risks.

In history, Western Europe proceeded to Phase 4 in the twentieth century. Regarding the first criterion of economic development, Western Europe accomplished this in the nineteenth century. Western Europe made an enormous leap in the mode of production by shifting from feudalism to capitalism from the sixteenth century onward (Tilly 1990). In this context, it is interesting to note that originally, 'capitalists' meant those who could pay the highest per capita tax rate in the Dutch provenance in sixteenth century (Tilly 1990). Thus, capitalists meant rich people who accumulated money and owned the expensive means of production, like factories. Importantly, capitalism produced not only wealthy capitalists but also middle-class wageworkers who could increasingly check the power of a king with their ability to pay taxes (Emma 2010). By the nineteenth century, Europe positioned itself as an industrialized region.

Next, regarding the second criterion of accountability mechanisms, Western Europe developed three major accountability mechanisms: parliament, universal suffrage, and the rule of law. Regarding parliament, the Western Europe introduced de facto parliamentary systems from the thirteenth century. For example, England laid the groundwork for its parliament with the signing of the Magna Carta in 1215, while France introduced the Estates General in the fourteenth century (Parliament Education Office 2016).[5] The Dutch established its States General in the fifteenth century (Koenigsberger 2007). The essence of a parliament system at the time was to protect the interest of two influential groups (aristocrats and capitalists) from the discretionary use of power like excessive taxation by kings (Fukuyama 2014). As explained above, the transition from feudalism to capitalism from the fifteenth century promoted not only economic development but also the rise of capitalists and middle classes as a result of such economic development. Moreover, Western Europe moved to direct rule only from the late eighteenth century on the occasion of the French Revolution. Until then, kings had to resort to indirect rule, sharing power with other influential groups that had their own armies and resources. Thus, such a long period of indirect rule during the medieval age provided a favorable environment in which parliaments emerged and strengthened their positions. Reflecting the interest of the two influential groups, some parliaments like that of England even established superiority over the authority of kings from the late seventeenth century.

Regarding universal suffrage, most countries in Western Europe introduced universal suffrage, which allowed ordinary men and women to vote as a way of expressing their opinions in a political process by the early twentieth century.[6] This was a result of the rise of the middle classes. While the parliamentary system until the nineteenth century enabled only influential groups like aristocrats and rich capitalists to check the power of the ruling classes, universal suffrage in the twentieth century enabled ordinary citizens to check the power of ruling classes. In this sense, it can be said that universal suffrage is one of the most innovative inventions of modern accountability mechanisms. At this point, attention should also be paid to the increasing role of IT technology in our modern age in making the voice of ordinary people heard in society. Indeed, with the combination of universal suffrage, IT technology provides important platforms for limiting the power of the ruling classes.

Regarding the rule of law, the Catholic Church established a strong tradition of rule of law in Western Europe as early as the twelfth century as part of the Catholic Church's effort to seek independence from the influence of kings who could depose popes at will (Fukuyama 2012). In the twelfth century, Pope Gregory VII wrested from kings the right of appointing and deposing bishops, and asserted his power over secular kings as illustrated by the episode at Canossa, Italy where the Holy Roman Emperor Henry IV waited barefoot in the snow for three days to seek forgiveness from Pope Gregory in 1077. In face of continuous conflicts with kings over rights and power, the Catholic Church selected the rule of law as its weapon to limit the power of secular kings. Through vast legal studies, the Catholic Church synthesized church law, the Roman law of the Justinian Code of the sixth century, and customary German law, into a single body of canon law in 1140, with a view to strengthening the universal jurisdiction of the church over a wide range of social issues like crime, family, property and contracts (Berman 1975). From this intensive work, two changes took place: (1) kings were not the sole source of the law but the church had legislative power as well to regulate the life of ordinary people, and (2) the newly proclaimed power of the pope to make new laws introduced the concept that law was subject to change in order to accommodate developments within society (Fukuyama 2012). As a result, a tradition that kings themselves are subject to the laws established by the Catholic Church came into being.

What, then, about the East? Within this paradigm, China has not yet reached Phase 4. Such a situation is quite surprising to historians, given that in history, China was always faster and more sophisticated than Europe in relation to state development. With regard to economic development, China began to flex its muscles from Deng Xiaoping's period by shifting to a market economy from a planned economy. Currently, China is in the midst of rapid economic development as illustrated by the fact that its GDP grew 9.7 percent annually between 1978 and 2015. China is now categorized by the World Bank as an upper middle-income economy, recording US$ 7820 in GNI per capita. Yet, with regard to accountability mechanisms, the unique history of China provides a totally different path compared with the West. In fact, the three European-style accountability mechanisms appear to be absent in China.

First, there was and is no parliament that limits the powers of a ruler in both ancient and modern China (Fukuyama 2014). Although there is currently the National People's Congress (NPC), it is different from the Western Europe-style parliament: the NPC is supposed to supervise both the executive branch and the judiciary branch, while remaining below the authority of the Chinese Communist Party (Fukuyama 2014). Against this backdrop, two reasons for the failure of a Western European-style parliamentary system to emerge in China can be suggested. The first reason is that the middle classes did not develop in ancient China. Unlike Western Europe, the failure of an independent commercial bourgeoisie to emerge before the establishment of a centralized state is also attributable to the Confucian culture which despised merchants as the lowest social class among four social classes: scholar, farmer, craftsman, and merchant (Levenson and Schurmann 1971). Moreover, Chinese bureaucracy had a strong regulatory grip on commercial activities (Maddison 2007). For instance, larger businesses were limited to state or publicly licensed monopolies, and international trade was severely restricted. Consequently, it was difficult for merchant classes to develop as an influential class in China, contrary to the situation in Western Europe. However, in modern China, given the fast development of its economy, the emergence of the middle classes is apparent. The second reason is that unlike Europe, direct rule was established too early on in China. Such early direct rule owes much to the fact that the Chinese aristocratic class was almost wiped out during the fierce tribal warfare period of the Eastern Zhou Dynasty from 770 BC to 221 BC. Hence, an influential group that could check the power of emperors had already disappeared at the time when the unified Qin state came into being. Furthermore, the centralization by the first emperor of the Qin Dynasty was so fast and so effective that the Qin state rapidly subdued the already weakened local hereditary aristocrats, thus giving them no chance to restore their powers.

Second, modern China has not yet introduced Western European-style universal suffrage into its political system. Thus, given that the ultimate authority of modern China lies with the Communist Party of China, one of the effective channels for the ordinary Chinese to have their voice heard in the political process is by seeking membership in the Communist Party of China.[7]

Third, Francis Fukuyama argues that the rule of law of Western European-style where a ruler should be subject to law was and is not available in either ancient or modern China. Historically, emperors in China enjoyed much stronger power than those in Western Europe, benefitting from the solid foundation built by the first emperor of the Qin Dynasty. Hence, while kings were subject to law in Western Europe, emperors used the law as their governing instrument in China. Such a different path is also due to the role of governing ideologies and the lack of external institutions (Fukuyama 2014). As to governing ideologies, legalism employed by the first emperor of the Qin Dynasty to unify China meant that law was mainly designed to implement the decisions of emperors; law was the codification of what emperors dictated (Loewe and Shaughnessy 1999). Similarly, Confucianism did not envisage any institutional checks on the power of emperors, but sought to produce a good ruler relying on education. Regarding external institutions, there was no institution in China that could play a role that the Catholic Church did in Western Europe in checking the power of emperors by developing its own laws. Furthermore, the Communist Party stands at the top of the state hierarchy and with the authority to write the Constitution of the People's Republic of China. In this context, it can be said that 'Western European-style' rule of law is barely present in modern China. Overall, absent Western European-style accountability mechanisms like parliaments, universal suffrage, and the rule of law, it remains to be seen how modern China will cope with such challenges of embracing the diverse interests of various groups into its system in a fair manner in the future. In sum, the transition from Phase 3 to Phase 4 needs economic development and subsequent chain reactions as illustrated in Fig. 5.1.

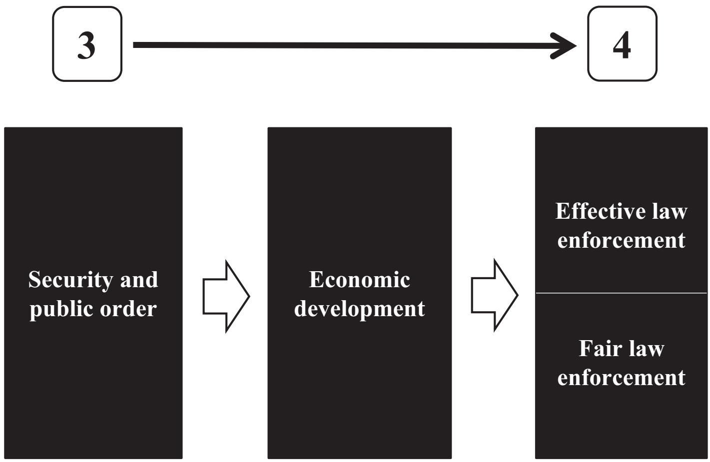

Fig. 5.1 Experiences of state development in Europe

Phase 5

Lastly, in response to the increasing demand of citizens for rights to participate directly in forming and implementing policies that affect their lives, some states moved further, to Phase 5 of 'a decentralized state.' Simply put, a decentralized state means allowing local communities more self-management (Dillinger and Fay 1999). Generally, a decentralized state transfers decision-making power and financial resources to municipal governments from a central government. At the same time, major officials of municipal governments and municipal parliaments are directly elected by local residents. Importantly, since the area to be administered is much smaller than the entire national territory, it is likely to be faster and easier to improve its system. In short, 'size matters.' In terms of social engineering, the advantage from the limited size of a targeted area should not be overlooked. In this sense, a decentralized state has two key characteristics: *stronger accountability mechanisms* and *detachment from the central system*.

First, a decentralized state is more accountable to its citizens (Dillinger and Fay 1999). This means that the decentralized state provides local citizens with more opportunities to participate directly in governance while being more responsive to the demands of local citizens. For example, if local citizens demand a reliable water supply in their residential areas, the municipal officials are more responsive to these demands than any central government's officials as their hold on power depends on being re-elected in the next round of elections. Such demands and vigilant monitoring by local citizens result in better direction of resources, improved delivery of service and promotion of transparency (Chirico 2014). Hence, as a result of more accountability, the decentralized area will have more effective and fairer law enforcement than a state in Phase 4. Thus, it is viewed as a policy option to mitigate the dysfunctions of a central government (Chirico 2014).

Second, a decentralized area can be detached from the central system of a country in two ways: general decentralization and specific decentralization. General decentralization means that municipal governments govern their responsible areas in their own way. Accordingly, under wise leadership, a decentralized area may quickly improve its system, insulated from the interference of an underdeveloped central system. For example, although Manila in the Philippines ranks 225th out of 277 cities in the world in terms of security, Davao, another city in the Philippines, ranks 41st.[8] Benefiting from its stable security condition, Davao topped in the Philippines with 9.4 percent economic growth rate, standing in stark contrast to the national average of 6.1 percent in 2014 (Philippines News Agency 2015). Another interesting story also confirms the potential of an approach focusing on a limited area insulated from a central system. As the city-state of Singapore became independent in 1965, the small state had no resources other than its strategic location and its nearly 2.7 million people (LePoer 1991). Interestingly, its independence was not voluntary but forced as Malaysia expelled Singapore despite its wanting to remain a part of Malaysia (LePoer 1991). However, under the wise leadership of Lee Kuan Yew, Singapore has grown into a hub of global commerce in just three decades (Ghani 2008). Specifically, between 1965 and 1995, the GDP per capita of Singapore grew 6 percent annually, jumping from 42nd place to 16th place globally (Baten 2016). If Singapore had been part of much bigger Malaysia during that period, such fast development would have been unlikely. Accordingly, these examples show the advantage of a limited area being insulated from a central system in making rapid transformation under competent leadership. In contrast, specific decentralization means only a specific sector is detached from the central system. A good example is the special economic zones (SEZs) in which special laws and administration systems are applicable, insulating them from the central system of the country. In such zones, tax rates can be lower than other regions of a country. Furthermore, investors can get permits and licenses via a one-stop service without bothering to visit many governmental agencies, as is often the case in the systems of developing countries. Moreover, the transfer of profits can be guaranteed to protect the interests of foreign investors. The host country can designate a substantial size of land as a SEZ or can designate simply the site of a single power plant as SEZ, as is the case with the 'Public or Private Free Zone' in Egypt. Overall, policy makers in developing countries can create a de facto totally different 'small economic country' within their territory by declaring a SEZ.

In history, many countries in Western Europe proceeded to Phase 5 from the mid-1980s (Chirico 2014). As a matter of fact, for Western Europe having already passed Phase 4, the transition to Phase 5 enabled their region to enjoy 'more' effective and 'fairer' law enforcement, through the benefit of direct interaction between municipal governments and citizens in a smaller realm. For developing countries that have not reached Phase 4, there is the potential to jump directly to Phase 5. However, such an approach must be pursued with careful planning since jumping to Phase 5 can present as many difficulties as advantages. Given that numerous developing countries began the experiment of decentralization in the mid-1980s, it remains to be seen whether these developing countries can rapidly achieve the two key characteristics of Phase 5; namely, stronger accountability and detachment from a centralized system. If successful, effective and fair law enforcement will result. In other words, in an optimal scenario, decentralization can catch, with one arrow, three birds: effective and fair law enforcement, and at the same time, economic development. Through direct interaction between a municipal government and its citizens, the specific decentralized areas can bring about effective and fair law enforcement, and, based on such improvements in governance, achieve economic development by, for example, attracting private and/or foreign investments. Thus, successful decentralization would have the effect of 'leapfrogging history,' jumping directly from Phase 1, 2, or 3 to Phase 5, bypassing Phase 4.[9] From such a scenario, we can draw an interesting analogy between a decentralized state and a mobile phone. In this scenario, the age of the landline telephone corresponds to a state in Phase 4, while the age of the mobile phone matches a state in Phase 5. Landline telephones require a labor-intensive installation of physical landline infrastructure to every house and every corner of a country to make communication possible. Thus, in developing countries, only the affluent class could afford to have landline telephones. However, with the introduction of the smart phone, developing countries did not have to enter the age of landline telephone, but jumped directly to the age of 'lineless' mobile phone. It enables even ordinary citizens of developing countries to enjoy easy and cheap communication services.

Against this backdrop, Phase 5 has the potential of enabling developing countries to expedite their state development without making a stopover at Phase 4. On the other hand, we cannot rule out the worst-case scenario that in the absence of economic development, promoting accountability too early and too strongly may lead, ironically, to corruption and inertia with little improvement in governance. Historically, states of Western Europe that reached Phase 4 underwent a process of economic development, and with the rise of middle classes, accountability mechanisms like parliament and universal suffrage developed subsequently, improving governance. In this regard, it is worthwhile to note the argument by Francis Fukuyama that sequencing matters enormously (Fukuyama 2014). He posited that those countries that achieved democracy ahead of modern state building have had much greater problems achieving high-quality governance than those that transited to modern states under an absolutist monarchy regime. For example, in the late nineteenth century, Greece introduced universal male suffrage half a century earlier than the UK, economically the most developed country at that time. However, looking at the Government Effectiveness of Worldwide Governance Indicators (2014) announced by the World Bank, Greece ranks 64th, while the UK ranks 15th in the world. Francis Fukuyama points out that what happened in Greece is that in the absence of economic development, the government became a major source of employment after introducing universal male suffrage in 1864. Accordingly, the Greek government in the nineteenth century filled the public sector with political supporters, fostering clientelism. Consequently, the number of its civil servants per capita was seven times bigger than that of the UK by the 1870s (Mouzelis 1980). Accordingly, it appears that simply introducing accountability earlier than other countries does not play a decisive role in producing better governance. Moreover, in the absence of economic development, it would also be difficult to control corruption in relation to elections (a representative accountability mechanism) themselves. The votes of people are likely to be easily manipulated by limited financial benefits (Mouzelis 1980). Additionally, if a state is not economically developed, the state would suffer from a lack of human and financial resources necessary for effective law enforcement. In conclusion, it is clear that caution is required in relation to the implementation of a decentralized approach.

A Root Cause and Two Policy Ideas

Against this backdrop, a root cause of diverse risks in the infrastructure markets of developing countries is that developing countries 'have not reached Phase 4.' This means that developing countries are stalled in Phase 1, Phase 2 or Phase 3. Importantly, it should be emphasized that reaching Phase 4 is a turning point in attracting foreign investors because various risks can be hedged 'within' the system of the host country. Thus, failure to reach Phase 4 means that risks *cannot be hedged within the system* of the host country. In some sense, such inability of the host country can be considered to be a situation under force majeure. In other words, a developing country is not in a position to protect the interests of foreign investors in a reliable manner because it does not have the resources and necessary mechanisms in place; providing reliable protection for foreign investors is thus beyond the system capacity of the host country. Accordingly, from this root cause, two policy ideas can be produced in relation to the designing of an infrastructure project in developing countries: (1) establishing external protection devices, and (2) adopting a decentralized approach.

First, a project preparer may incorporate *external protective devices* into the design of a project. It allows foreign investors to seek protections outside the system of developing countries. If risks cannot be hedged within the system of the host country, seeking protection outside the system can be a realistic alternative. Such external protection mechanisms can provide foreign investors with two advantages. One is that they can contribute to establishing system failure deterrents in the host country, and the other is that they can ensure the normal operation of a project and the protection of private investor interests even when the system of the host country does fail. The details of these two advantages will be revisited in Chaps. 6, 7 and 8.

Second, following the development path of a state directly, a project preparer may wait until the host country moves to Phase 4. However, as history shows, it may take an exceedingly long time to move to Phase 4. That is, proceeding to Phase 4 needs economic development at the level of developed countries along with strong accountability mechanisms. In particular, economic development through industrial policy, FDI policy or urbanization policy takes time even under the smart top leadership. Similarly, accountability systems like universal suffrage and the rule of law take time to take solid root in a society. Simply introducing universal voting rights in a mostly impoverished country does not create a reliable accountability system. Under these circumstances, developing countries can make a short cut by adopting *a decentralized approach*. More precisely, a host country may designate a small area to attract foreign investment, improving the system of the defined area with exceptional measures. The prevalent practices of establishing a 'special economic zone' (SEZ) would be a case in point. Such a special zone may enjoy tax benefits, one-stop service regarding permits and licenses, protections from nationalization or the freedom of transfer of profits. Developing countries can turn a substantial size of land into a SEZ or can make simply the site of a single factory a SEZ, as is the practices of Egypt. Once again, it should be emphasized that 'size matters' in relation to state building. Since the targeted area is limited, it is likely to be easier and faster to upgrade the underdeveloped system in the area, compared with the challenge of upgrading the entire system of the host country. Thus, by adopting a decentralized approach, developing countries may realize a 'perfect investor-friendly' environment only in such a targeted area where they would like to attract foreign investors. In this context, it is understandable that there arise many international initiatives to promote such decentralized approach. For example, United Nations Development Programme (UNDP) implements the Articulation of Territorial Network (ART) initiative that provides a multilateral platform in a local area to coordinate various local development initiatives, avoiding duplication and promoting synergy. Under the ART, participants in such multilateral platform would be diverse, including municipal governments, municipal parliaments, donor agencies, private firms, universities and NGOs. As of 2016, 17 ART initiatives are being implemented globally. Likewise, The World Bank partnered with the government of Indonesia to launch a decentralized community development program, called the Kecamatan Development Program (KDP). The program aimed not only at bringing benefits rapidly to the local population but also at giving them a voting right in a new relationship to the state (Ghani 2008). Under the KDP, the central government gives block grants to villages under the three conditions that each village would elect a council, hold a sufficiently participatory meeting, and publish its financial account in a public place. It is also worthy of note that former failed states like Afghanistan are actively seeking a decentralized approach. For instance, through its National Development Framework, the central government of Afghanistan provided block grants of between US$ 20,000 and US$ 60,000 to every village in the country on the three conditions that the village elect its leadership council by secret ballot, hold participatory meetings to design its own recovery plan, and post its financial accounts in a public place, as noted above (Ghani 2008). All in all, diverse experiments of a decentralized approach are ongoing at the national and global level, and we need more and bolder experiments to increase the probability of finding effective decentralized models.

Conclusion

In this chapter, the diverse risks in the infrastructure markets of developing countries were reviewed. For a deeper understanding of such risks, a root cause of such diverse risks was analyzed. Such analysis produced two ideas on how to attract private investors into green infrastructure markets of developing countries: incorporating external protective devices and adopting a decentralized approach. Based on this groundwork, Chaps. 6 and 7 will highlight an essential external protective device: profits from selling greenhouse gas (GHG) reductions. Chapter 8 will then focus on another external protective device: the guarantees and equity investments of multilateral development banks (MDBs). Finally, Chap. 9 will propose the sample designs that incorporate these essential protective devices into green infrastructure projects.

Notes

1. For the practices of American Indians, see Hoebel (1954, 132–133).
2. For further details, see Collier (2007, 27–34), Ghani (2008, 129–130), Kaplan (2008, 4–5 and 20–21).

3. For further details, see Tilly (1990, 19–20 and 26).
4. For the list of countries that received IMF loans, see IMF website, www.imf.org/external/np/fin/tad/extarr11.aspx?memberKey1=ZZZZ&date1Key2016-07-31. Accessed 31 August 2016.
5. For further details, see *Encyclopaedia Britannica*, s.v. 'Estates-General,' https://www.britannica.com/topic/Estates-General. Accessed 3 September 2016.
6. For example, UK (1928), France (1944) and Netherlands (1919).
7. In China, applicants have to undergo screening procedures to be a member of the Communist Party of China. For details, see Sullivan (2012, 183).
8. For the global ranking of cities in relation to security, see Numbeo website, www.numbeo.com/crime/rankings.jsp. Accessed 5 September 2016.
9. For the first use of the phrase of leapfrogging history, see Ghani (2008, 77).

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Part III

Components of Bankable Projects

6

Carbon Markets as Supporters of Green Infrastructure Projects

Introduction

In Chap. 5, with a view to the diverse risks of green infrastructure markets in developing countries, two policy ideas were proposed to involve private investors in green infrastructure financing: the incorporation of 'external protective devices' into the design of a project, and adoption of a 'decentralized approach.' This chapter proposes *the profits made with the sales of greenhouse gas (GHG) reduction credits* as supporters of green infrastructure projects. Without such financial incentives, it is difficult to promote green infrastructure, which is more expensive than conventional infrastructure. These profits are deemed to be an external protective device for institutional investors as they are provided from 'outside' the system of developing countries. In other words, since the owners of green infrastructure projects can garner profits through the sales of the GHG reduction credits in the carbon markets of 'developed countries,' profits are ensured outside the system of developing countries. To facilitate the understanding of how the GHG-related profits are generated, this chapter shows how to calculate GHG reductions and operating mechanisms of the global carbon market.

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How Can We Measure GHG Reductions?

As illustrated in Chap. 1, selling greenhouse gas (GHG) reductions from infrastructure projects could generate substantial economic profits. For instance, a project such as Brazil's Jirau hydro power plant has the potential to recover 38 percent to 77 percent of its investment cost by selling its GHG reductions. Table 1.1 in Chap. 1 sets out the financial details. Similarly, a project similar to Chile's Atacama photovoltaic power plant has the potential to finance 15 percent to 60 percent of its investment cost from its GHG reductions. Moreover, a project such as China's Inner Mongolia wind power plant has the potential to recover 54 percent to 214 percent of investment cost. In the best scenario of '214 percent,' the wind power plant might even be characterized as having been built absent any cost because the profit from selling GHG reductions of the project would exceed its original investment cost. Furthermore, even after deducting the original investment cost from the profit of 214 percent, there remains an additional profit of 114 percent. In such a case, from a businessman's point of view, selling GHG reductions may be positioned as a lucrative primary business instead of the building of a wind power plant. Likewise, a project such as Kenya's Olkaria IV geothermal power plant has the potential to recover between 31 percent and 125 percent of its original investment cost. The amount of profit from the geothermal power plant is as imposing as in the wind power plant scenario.

The list of promising projects does not end with renewable energy infrastructure. With regard to transport, a project such as Mexico's Bus Rapid Transit (BRT) Line 1–5 EDOMEX project may finance from 18 percent to 72 percent of its investment cost by selling profits related to GHG reductions. Also considering underground train systems, a project such as Mexico's Metro Line 12 can finance somewhere between 2.1 percent and 8.3 percent of its investment cost from the profits of GHG reduction sales. Such profits appear to be modest when compared with other kinds of infrastructure projects. Nonetheless, even a modest profit acquires meaning in designing the financial structure of an individual infrastructure project. For the BRT project, the profit of selling GHG reductions is substantial.

It is surprising to note that conventional fossil fuel burning power plants can also bring in profits from GHG reductions. For instance, a project such as China's Fujian Jinjiang LNG power plant has the potential to harvest dazzling profits somewhere between 79 percent and 317 percent. More surprisingly, coal-fired power plants, notorious for being a main culprit of GHG emissions, can harvest the profit from selling GHG reductions. A project such as China's Shangahi Waigaoqiano coal-fired power plant has the potential to finance somewhere between 4.4 percent and 18 percent of its original investment cost by selling its GHG reductions.

The following question naturally arises: how are such GHG reductions measured? It is indeed curious that a huge volume of GHG reductions can be achieved simply by building a fossil fuel burning LNG power plant or even a coal-fired power plant. To solve the mystery, we now turn to the formula for measuring reductions in GHG emissions from green infrastructure projects.

Two concepts are critical to measuring the size of GHG reductions: 'baseline' and 'additionality.' Since baseline and additionality are closely interconnected concepts, the following will address them together. Simply put, when a project preparer plans an infrastructure project, a baseline scenario is the 'expected' choice that the project preparer would make absent consideration for profits that a project may generate by reducing GHG.[1] The expected choice is the result of a reasonable analysis of all factors affecting the likelihood of a project. Such factors could be demand for infrastructure services, available financial resources, the level of profits or relevant policies and legislation—with the exception of the possibility of creating financial profits by selling GHG reductions (Lee 2005). For example, if a project preparer intends to build a power plant, it may consider several types such as coal-fired, gas-fired, or wind. In the event, if great emphasis is placed on investment cost, the reasonable choice would be the cheapest one, which is often the coal-fired power plant. This expected choice is called the baseline scenario of the project.

However, if financial support can be anticipated for greening the project, the 'unexpected' choice of a GHG-reducing project like a wind power plant might be the result. In such a case, the final choice by the project preparer allows the 'additional' GHG reduction from the global atmosphere, which would not be possible in a normal situation. Thus, if the project preparer goes for an unexpected choice rather than an expected choice, the project is considered to meet the criterion of 'additionality' (Lee 2005). In fact, proving the additionality of a project is one of the most difficult tests in registering a project at the United Nations as a GHG-reduction project. Bearing this in mind, if we measure the difference of GHG emissions between the expected choice and the unexpected choice, we can get the volume of GHG reduction for the project concerned. For instance, the difference of GHG emissions between a coal-fired power plant and a wind power plant is the volume of reduction by the wind power plant project. To summarize, the baseline scenario is the expected choice that a project preparer is likely to make absent consideration for profits by greening a project, and if the selected type is an unexpected choice, the additionality of the project is met.

In reality, baseline and additionality greatly affect a project's GHG reduction volume. This means that the higher the baseline emission of a baseline scenario is, the greater the GHG reduction of a project is achieved. This follows as the volume of GHG reduction is calculated by deducting the project emission from the baseline emission as is shown in Fig. 6.1.

In the event that the criterion of additionality is not met, a project is not approved as a GHG reducing project. In such a case, the GHG reduction of the project concerned is zero. Indeed, the two concepts are

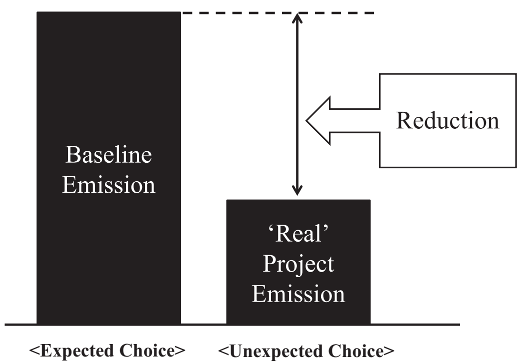

Fig. 6.1 Calculation of reduction in greenhouse gas emission

very powerful instruments for controlling the profitability of green infrastructure projects. However, applying the two concepts in a real-life situation is not a simple task since they have a very flexible and evolving nature; that is to say, these concepts are not absolute but ‘relative’ ones. Both concepts are strongly influenced by specific factors unique to the project concerned. The complicated considerations and calculations entailed can be illustrated through examples from Chap. 1.

Kenya’s Olkaria IV geothermal power plant was built with a planned capacity of 140 MW (CDM 2012c). This geothermal power plant project defined its ‘baseline scenario’ as the ‘existing power plants connected to the national grid with the addition of new grid-connected power plants.’[2] In other words, in the absence of financial support related to GHG reduction, the expected choice would be to make full use of existing power generation facilities, and to build new power plants if demand increases. In order to calculate the baseline emission of the baseline scenario, it must be noted that baseline emission and baseline scenario are different. For example, the Olkaria IV project has two sub-baseline scenarios: ‘existing power plants connected to the national grid’ and ‘potential added new grid-connected power plants.’ With regard to the first sub-baseline scenario of utilizing existing power plants, the project used the ‘average GHG emission per MWh’ of the existing plants to calculate the baseline emission: ‘total electricity’ generated by all existing plants was multiplied with the ‘average GHG emission per MWh’ of all the existing plants. The relative nature of this formula comes from the fact that the average GHG emission per MWh of existing power plants keeps ‘changing,’ depending upon the project location and the timing of the project implementation (Mutia 2012). In other words, since the average GHG emission per MWh considers all power plants connected to the grid, a grid system dominated by fossil fuel power plants has a higher average GHG emission per MWh than one dominated by renewable energy power plants (Nagara 2016). For instance, South Africa, where coal-fired power plants are the rule, the average GHG emission per MWh is set at ‘0.909 metric tons’ for the Red Cap Kouga Wind Farm (CDM 2012b), while in Kenya, with a more diverse power mix of hydro, fossil fuel and geothermal power, an average GHG emission per MWh is set at ‘0.629 metric tons’ for the Olkaria IV project (CDM 2012c).

The abundance of hydro and geothermal sources lowers the average GHG emission per MWh of the Kenya grid. Clearly, if a project preparer built a geothermal power plant in South Africa, the baseline emission would be much higher than that of a similar geothermal power plant in Kenya.

While the Olkaria IV project calculated 0.629 metric tons of average GHG emission per MWh for the first sub-baseline scenario, the project did not incorporate the second sub-baseline scenario—the addition of new grid-connected power—in calculating overall baseline emission (CDM 2012c). Namely, the project focused only on the first sub-scenario of making full use of existing power plants. However, given that fossil fuel-burning power plants were analyzed as a credible option in the event the project preparer intended to add new power plants to the Kenya national grid, the addition of GHG emissions for new fossil fuel power plants would definitely have raised the average GHG emission per MWh of the Kenya grid. This is apparent in the fossil fuel-burning power plants already established in Kenya by Independent Power Producers (IPP) like Tsavo Power and Iberafrica. More recently, another IPP, Rabai Power, commissioned a fossil fuel-burning power plant with a capacity of 90 MW. Plans are also underway by KenGen (the state-run power company of Kenya) to develop a coal-fired power plant with the capacity of 300 MW in Mombasa. Accordingly, if the second sub-baseline scenario had been added, the baseline emission of the Olkaria IV project would have risen further. In this sense, the baseline emission of the Olkaria IV project appears to be a conservative estimate.

Likewise, timing of project implementation matters. When there are no geothermal power plants in a given country, the first geothermal project would obtain a high level of baseline emission. Once many geothermal power plants have been built, the baseline emission level would likely be much lower because of the decrease in the average GHG emission per MWh of all existing power plants. To reiterate, the higher a baseline emission of a project is, the more the GHG reduction for this given project is. Thus, lowered baseline emissions serve as disincentives for project preparers launching similar geothermal projects where many geothermal power plants already exist. Nonetheless, instead of going for the expected choice of making full use of existing power plants and adding new fossil fuel-burning power plants, Kenya's Government made the unexpected choice of building a geothermal power plant based on anticipated financial revenues related to GHG reduction. In this case, the additionality for the Olkaria IV geothermal power plant project is met: additional global GHG reductions were achieved as a result of the financial support related to GHG reduction.[3]

For the scenario of the Olkaria IV project, once the baseline is defined and additionality is met, the next and final step is to measure the GHG reductions (CDM 2012c). This can be obtained by measuring the difference between the baseline emission (expected choice) and the project emission (unexpected choice). As indicated above, the baseline scenario made full use of existing grid-connected power plants or the addition of new power plants in the event increased demand could not be met by the existing ones. Hence, given that the Olkaria IV project is expected to provide 1,128,288 MWh of electricity per year to the national grid, it can be said that the 1,128,288 MWh per year would otherwise be provided by the existing grid-connected power plants absent the Olkaria IV project. Thus, the baseline emission (expected choice) is the volume of GHG emitted in the course of generating 1,128,288 MWh per year by the existing grid-connected power plants. If we multiply 1,128,288 MWh per year with the average GHG emission per MWh of the existing power plants, we can get the GHG reductions.[4] Taking the 0. 629 metric tons of GHG per MWh in Kenya, and then multiplying as follows: 1,128,288 MWh/year × 0.629 t/MWh = 709,693 t/year, the baseline emission is 709,693 metric tons of GHG per year. Since the actual emission of the Olkaria IV project is 58,344 t/year, the difference between the baseline emission and the project emission is 651,349 t/year, which is the volume of GHG reduction.

Interestingly, GHG-reducing fossil fuel-burning power projects adopt a more specific approach. The Shanghai Waigaoqiao ultra-supercritical coal-fired power project with a capacity of 2000 MW provides an illustrative example (CDM 2010). This Shanghai coal-fired power project defined its baseline scenario as a 'supercritical' coal-fired power plant with a capacity of 1200 MW. Generally, coal-fired power plants can be divided into three types: subcritical, supercritical (SC), and ultra-supercritical (USC). In the course of moving from 'subcritical' up to 'ultra-supercritical,' GHG emissions decreases since as the operating temperature and pressure of the coal-fired power plant increase, thermal efficiency increases and less coal per megawatt is consumed (IEA 2012). Reduction in coal consumption means GHG reduction. The thermal efficiency increases with the upgrading of technology: 38 percent (subcritical), 42 percent–43 percent (supercritical), and 45 percent (ultra-supercritical). Changing from subcritical to supercritical increases construction costs by 10–20 percent, and shifting from supercritical to ultra-supercritical increases construction costs by up to 10 percent (IEA 2012). Currently, three quarters of operating coal-fired power plants are of a subcritical type (IEA 2012). Given this, the Shanghai coal-fired power plant project defined its baseline scenario as a supercritical type of coal-fired power plant as the supercritical type proved to be the economically most attractive choice. Nonetheless, the project preparer went for an ultra-supercritical type, which is a more expensive choice. Accordingly, since the ultra-supercritical type is an unexpected choice that anticipates financial support related to GHG reduction, the criterion of additionality was met. Regarding the measurement of the GHG reduction, unlike the Olkaria IV project that broadly defined its baseline scenario as 'all kinds' of power plants connected to the grid that the project would serve, the Shanghai coal-fired power project pinpointed a 'specific type' of fossil fuel-burning power plant as a baseline scenario.[5] Consequently, the volume of GHG reduction is the difference between the baseline emission (a supercritical type) and the project emission (an ultra-supercritical type), which is estimated to be 310,000 metric tons of GHG per year.[6]

GHG reduction can also be made by changing the fuel type. For example, as regards China's Fujian Jinjiang LNG power generation project with a capacity of 1516 MW, its baseline scenario is defined as a subcritical coal-fired power plant (CDM 2009). Since this project can reduce GHG by 56 percent in comparison with the subcritical coal-fired power plant as indicated in the baseline scenario, it can make foreseeably substantial GHG reductions. Specifically, the project preparer can reduce about 2.7 million metric tons of GHG per year by shifting the fuel type from coal to natural gas.

Transport infrastructure can also make a substantial GHG reduction. As introduced in Chap. 1, the Bus Rapid Transit (BRT) Line 1–5 EDOMEX project of Mexico aimed to establish a safe and rapid mass transit system by introducing bus-only lanes, rechargeable electronic cards for payment, real-time next bus information displays and centralized control systems (CDM 2011). This project defined its baseline scenario as the continuation of the current public and individual transport systems including (future) investment in road-based infrastructure. For the municipal authorities of the project, such an option involved no large-scale public investment requiring additional subsidies and was the lowest risk of all options. Likewise, the Metro Line 12 project of Mexico that aimed to build a 25 km-long subway system had a baseline scenario similar to that of the BRT project (CDM 2012a). The Metro Line 12 project also defined its baseline scenario as the continuation of the current public transport systems. What is interesting to note is that the BRT project appears to be more cost-effective when compared with the Metro project. The BRT project with an investment cost of US$ 246 million is expected to reduce 4.4 million metric tons of GHG during its lifetime of 30 years (CDM 2011), while the Metro project with an investment cost of US$ 1.97 billion is expected to reduce 4.1 million metric tons of GHG (CDM 2012a). Accordingly, the BRT project has the potential of financing 18 percent to 72 percent of its investment cost with the profits related to GHG reduction, whereas the Metro project has the potential of financing 2.1 percent to 8.3 percent of its investment cost. The above reviews the current international practices of measuring GHG reductions from infrastructure projects developed by the United Nations, and from this, we can conclude that current international practices of measuring GHG reduction may be characterized as both flexible and evolving.

Making GHG an Economic Commodity

In order to use GHG as a new source of financing, prices must be set for these GHG. In economics, price is generally set by supply and demand. If demand is bigger than supply, price goes up; if demand is smaller than supply, price goes down. A price is set where demand equals supply. If demand is zero, there is no price for a commodity. The question here is how can the demand for GHG be created? A standard answer is by *obliging* countries to reduce their GHG emissions to a specific level (Brohé 2009).[7] Under current international practice, if countries or companies cannot reduce GHG to a targeted level, they must make up for the volume of GHG emitted above the targeted level, with reductions made by somebody else. In this context, two questions are critical to enabling GHG to be used as a new source of financing: (1) how to impose GHG reduction obligations on all countries at the international level, and (2) how each country can implement its obligation at the national level.

How Can the Global Community Impose an Obligation on Every Country?

In the global community, two approaches can be identified to achieve this end: the Kyoto mechanism and the Paris mechanism. While the Kyoto mechanism imposes 'more restrictive' obligations on a 'small group' of developed countries in a top-down way, the Paris mechanism places 'less restrictive' obligations on 'all' countries in a bottom-up way (Leal-Arcas 2011). Namely, the UN assigned restrictive GHG reduction targets to a small group of developed countries under the Kyoto mechanism, while in contrast, all countries have been encouraged to set the GHG reduction targets voluntarily and submit them to the UN under the Paris mechanism (Kopp 2011). Given the voluntary nature of target setting in the Paris mechanism, its GHG reduction targets are likely to be relatively less onerous than those of the Kyoto mechanism. Accordingly, it can be said that the Paris mechanism sacrifices strictness of obligations in order to involve all countries in the process. Currently, the Kyoto mechanism applies for the period of 2008 to 2020, while the Paris mechanism is supposed to replace it after 2020. However, the concrete contents of the Paris mechanism remain incomplete as yet, requiring a fleshing out of its structure over time.

To examine the Kyoto mechanism first, in 1992, the UN Conference on Environment and Development, also known as Rio Earth Summit, adopted the UN Framework Convention on Climate Change (UNFCCC).

The objective of the UNFCCC is to reduce GHG emissions and mitigate climate change. The UNFCCC has two annexes listing two groups of countries, respectively. Annex I countries are mostly developed countries including all EU member countries, Australia, Belarus, Canada, Ireland, Japan, Liechtenstein, Monaco, New Zealand, Norway, Russia, Switzerland, Turkey, Ukraine, and USA.[8] Annex II countries are a more limited group of developed countries that are supposed to provide financial assistance to the developing countries. Article 4 of UNFCCC imposes a 'superficial' obligation on the Annex I countries by stipulating that Annex I countries shall adopt national policies and take corresponding measures on the mitigation of climate change by limiting GHG emissions. In 1997, in order to advance the objective of the UNFCCC, the parties to the UNFCCC adopted a protocol to the UNFCCC in Kyoto, Japan—hence the Kyoto Protocol. In a legal sense, a protocol is a subsidiary document that supplements a main multilateral treaty. Importantly, the Kyoto Protocol imposes a 'concrete' binding obligation on the Annex I countries of the UNFCCC to commit the reduction of their GHG emission to a specific level. Specifically, Article 3 of the Kyoto Protocol stipulates that the Annex I countries shall reduce their overall GHG emission by at least 5 percent below 1990 levels in the first commitment period of 2008 to 2012. The specific reduction targets for all Annex I countries are indicated in Annex B of the Kyoto Protocol.[9] For example, Canada and Japan are given the reduction target of 6 percent below their base year levels, while most of the countries in Western Europe are given the target of 8 percent below base year levels. Basically, Annex I countries adopt 1990 as their base year, unless they notify the Conference of Parties to the UNFCCC as to different base years.[10] At Doha in 2012, an amendment to the Kyoto Protocol (the Doha Amendment) was adopted to extend the obligation period of the Annex I countries when the first commitment period was about to end.[11] This amendment launches the second commitment period from 2013 to 2020. Thus, the Kyoto Protocol divides the obligation period of Annex I countries into two parts, the first commitment period running from 2008 to 2012, and the second commitment period running from 2013 to 2020. However, contrary to initial expectations, the Kyoto Protocol did not enjoy strong support from the Annex I countries. The first country to break away was the USA:

although the USA initially signed the Kyoto Protocol and was listed in the Annex I countries, ultimately it did not join the Kyoto Protocol since its Congress refused to ratify it. A country generally binds itself to an international treaty through two steps: the administrative branch of government negotiates a treaty and signs it, and the legislative branch finally ratifies it. The following preamble of the Byrd-Hagel Resolution adopted by the US Senate against the Kyoto Protocol illustrates the concerns of the Annex I countries:

> Whereas GHG emissions of Developing country Parties are rapidly increasing and are expected to surpass emissions of the United Countries and other OECD countries as early as 2015;
>
> Whereas the Department of Country has declared that it is critical for the Parties to the Convention to include Developing country Parties in the next steps for global action and, therefore, has proposed that consideration of additional steps to include limitations on Developing country Parties' GHG emissions would not begin until after a protocol or other legal instrument is adopted in Kyoto, Japan in December 1997;
>
> Whereas the exemption for Developing country Parties is inconsistent with the need for global action on climate change and is environmentally flawed;
>
> Whereas the Senate strongly believes that the proposals under negotiation, because of the disparity of treatment between Annex I Parties and Developing countries and the level of required emission reductions, could result in serious harm to the United Countries economy, including significant job loss, trade disadvantages, increased energy and consumer costs, or any combination thereof (US Senate 1997).

In response to such criticism by the US Senate, the developing world has an argument that is not without logic. The developing world argues that the GHGs accumulated in the atmosphere are mainly the result of industrial activities by the developed world. Accordingly, the developed world should take the historical responsibility for emitting this huge volume of GHGs thus far. Such logic of the developing world was well incorporated into the text of the UNFCCC and the Kyoto Protocol, set out as the principle of 'common but different responsibility.' Indeed, while the developing world argued for assumption of historical responsibility of the developed world for climate change, there was a growing concern among the developed countries about the loss of their competitiveness through placing themselves under restrictive GHG reduction targets and thus burdening their economy. Nonetheless, as regards the first commitment period of the Kyoto Protocol (2008–2012), all Annex I countries joined the campaign to reduce GHGs, apart from the USA. Then, in 2012, at the end of the first commitment period, Canada withdrew from the Kyoto Protocol. Later, Japan, New Zealand and Russia announced that they would not set new targets nor put themselves under obligations for the second commitment period (2013–2020), although they would not withdraw from the Kyoto Protocol.[12] Given such controversy among the Annex I countries, it does not seem to be likely that the Doha Amendment (2012) to the Kyoto Protocol that aimed at launching the second commitment period (2013–2020) will enter into force in the near future.[13] Faced with the collapse of the coalition of developed countries to fight climate change, a new approach was urgently required. As a result, the Paris mechanism emerged as an alternative to the Kyoto mechanism.

The details on the Paris mechanism are as follows: in Copenhagen in 2009, the Conference of the Parties to the UNFCCC unsuccessfully attempted to forge a treaty among industrialized and industrializing countries (EIU 2015). However, the conference did produce three pivotal political outcomes (IEA 2015)[14]: agreements on the global objective of holding the increase in global temperature below 2 °C; the principle that both developed and developing countries will reduce GHG[15]; and the establishment of the Green Climate Fund. Two years later in Durban, South Africa, the Conference of Parties to the UNFCCC agreed to prepare a new agreement with legal force by 2015 so that the new agreement could be implemented from 2020 when the Kyoto Protocol commitment period (2008–2020) comes to an end (UNFCCC 2012a). Furthermore, in Warsaw, Poland, in 2012, the Conference of Parties to the UNFCCC invited all countries to submit their voluntary targets on GHG emission reduction, called 'intended nationally determined contributions (INDCs),' by 2015 (UNFCCC 2014a). Indeed, the decision to urge every country to prepare its INDC was a critical step forward towards building a 'universal and tangible' basis for the new 2015 agreement intended to replace the Kyoto Protocol (EIU 2015).

Against such a backdrop, in Paris in 2015, the Conference of Parties to the UNFCCC adopted the Paris Agreement. The Paris Agreement has five noteworthy points:

(1) it strengthens the global objective on limiting global temperature increases by aiming to limit them well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C;
(2) it sets a further objective that aims to reach a global peak of GHG emissions as soon as possible and to reach 'net zero' emissions in the second half of the century;
(3) it stipulates that each country shall submit its INDC every five years, and importantly, the successive INDC will be higher than the previous one;
(4) it leaves door open for the continued use of Kyoto-style implementation instruments that have been applied to reduce GHG emissions such as international GHG trading mechanisms, financial support mechanisms for developing countries through the implementation of GHG-reducing projects by developed countries in developing countries, and so on—the details on the use of Kyoto-style instruments will be explored below;
(5) it announces that the developed countries shall provide financial resources to assist developing countries in reducing GHG emissions and adapting to changes brought about by climate change (Cripps 2015). Accordingly, it can be said that the major global ideas discussed since 2009 are all consolidated into the Paris Agreement.

Nonetheless, the Paris mechanism requires significant work. First of all, the obligation under the Paris mechanism is soft; unlike the Kyoto mechanism, the Paris mechanism relies on the 'self-imposed' obligation by each country to meet its objective of holding the global temperature rises to well below 2 °C. In other words, while the Kyoto mechanism imposes a restrictive 'hard' obligation on a limited group of countries, the Paris mechanism places a self-imposed 'soft' obligation on all countries. The weakness of the Paris mechanism is that the self-imposed INDC target by each country is not high enough to meet the global objective of holding global temperature increases to well below 2 °C. For instance, in order to keep the rise in global average temperature below 2 °C with a probability of more than 66 percent, the total amount of GHG emissions since 1870 needs to remain below 2900 $GtCO_2$ equivalent (IPCC 2014). Given that 1900 $GtCO_2$ equivalent were already released into the air as at 2014, the world has a space for additional 1000 $GtCO_2$ equivalent left (IPCC 2014). Currently, the average annual GHG emission of the world is around 50 $GtCO_2$ equivalent. In the absence of INDCs, the world is projected to trespass the threshold of 2900 $GtCO_2$ equivalent in 2040 (IEA 2015). Surprisingly, with INDCs, the world is projected to trespass the threshold of 2900 $GtCO_2$ equivalent 'only eight months' later than the time line set in the absence of INDCs (IEA 2015). Furthermore, the analysis of the UNFCCC Secretariat on the self-imposed INDC targets also confirms that these would lead to limiting the forecast temperature rise to around 2.7 °C by 2100 (UNFCCC 2015). Nonetheless, it must be reminded that the Paris mechanism is a step forward in that it draws in more countries than the Kyoto mechanism, taking a 'bottom-up' approach based on voluntary participation of all countries (EIU 2015). Given that this greater participation is partly offset by the voluntary bottom-up approach, the Paris mechanism relies on the complementary mechanism that lets each country submit its INDC every five years on the condition that the successive INDC will be higher than the previous one. As of now, it remains to be seen how such an updating mechanism can effectively complement the weakness of the voluntary approach. Next, there may be a legal vacuum between 2013 and 2020 in addressing climate change at the international level as the Kyoto Protocol is currently not functioning optimally while the Paris Agreement will only replace the Kyoto Protocol as of 2020.

It should be pointed out that most INDC target declarations indicate reductions of a certain volume of their GHG emissions by a specific year without mentioning when they would start. For example, the EU and its Member Countries announced that they are committed to a target of at least 40 percent domestic GHG reductions by 2030 compared to 1990. The USA also declared that it intends to achieve an economy-wide target of reducing its GHG emissions by 26–28 percent below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28 percent.[16] Therefore, theoretically it can be said that all countries may start their efforts to reduce GHG emissions at any time. In this context, the Paris Agreement and the INDCs as part of a global campaign to reduce GHG emissions for the period of 2013 to 2020 is essential in order to fill the legal vacuum through engaging more countries as well, hopefully earlier rather than later.

How Can Each Country Implement Its GHG Reduction Obligation Domestically?

The implementation of an obligation by each country is divided into two steps: a government imposes an obligation to reduce GHG emissions on the private sector, and the private sector implements their obligations. It should be noted that the price of GHG is set at the second step.

The First Step

The first step should be addressed from the perspective of a government. Once a government sets its national GHG reduction target, the government needs to consider the question of how to impose obligations on individual companies and organizations. A government has two policy choices: 'direct' restriction and 'indirect' restriction. Direct restriction means a direct limitation on the total amount of GHG that a company can emit. A cap and trade system is one of representative methods of such a direct restriction policy. The cap-and-trade system is composed of two measures: capping and trading. The first measure is that a government puts a cap on the total amount of GHG that individual companies are allowed to emit; thus, the total amount of GHG is called 'allowances.' For example, if Company A and Company B are allowed to emit 10,000 metric tons of GHG respectively, they have 10,000 allowances respectively: a unit of allowance corresponds to a metric ton of GHG. There are many confusing names for calling a metric ton of GHG including CER, EUA, AAU, ERU; these various names of a metric ton of GHG will be explained later. The second measure is that the government encourages individual companies to trade their allowances in the marketplace. In the example of Company A with 10,000 allowances, if it actually emitted 12,000 metric tons of GHG, while Company B emitted only 8000 metric tons of GHG, Company A could buy the saved 2000 metric tons of allowances from Company B in order to stay below its cap. If Company

A did not buy that amount of allowances, it would alternatively pay a fine for exceeding its cap. Usually, the entire cap of a country is reduced over time so that total emissions of the country fall correspondingly (European Commission 2016).

The key strength of a cap-and-trade system comes from the fact that the system uses the force of the market, through which individuals seek their own private interest. Under the cap-and-trade system, the second measure releases the force of the market (Spash 2009). The cap-and-trade system is meant to minimize the cost to the private sector of achieving GHG reductions (Grubb et al. 2005). In economics, the market is supposed to maximize the efficiency of economic actors' activities. The key to maximizing such efficiency is motivating economic actors by choice, not compulsion. Contrasting the communist economy and the market economy provides a good example: in the former Soviet Union, the government owned everything while individuals did not have rights to own private property. Since individuals could not own factories nor the products that they produced in the factories, there was no economic motivation for individuals to make best efforts. Consequently, factory production cost was high and product quality was poor. Their productivity was low compared with that of a market economy.[17] In contrast, individuals can own factories in a market economy. Accordingly, there is strong economic motivation for individuals to try hard voluntarily. They avidly want to reduce production costs and promote product quality, with a view to maximizing their profits. The same logic is true of GHG reduction. After the first measure of capping, what the government is trying to do is to motivate individual companies to maximize their interest through the market. This means that the more allowances a company sells in the market, the higher profits the company can gain. Accordingly, individual companies would make voluntary efforts to reduce their GHG emissions as much as possible, thus securing sellable allowances to the greatest extent. On the other hand, a company that cannot avoid exceeding its cap would be able to buy extra allowances at a lower price through the market. As long as the price of a unit of allowance is lower than a fine for a unit that a company has to pay to its government, the company would choose to buy allowances rather than to pay a fine for its extra GHG emissions. In sum, it can be said that such market forces are expected to increase the efficiency of GHG reduction efforts for individual economic actors.

However, a critical weakness of the cap-and-trade system was found in the system within the EU regarding capping. Unlike trading, capping is not related to the force of the market (Spash 2009). As explained above, capping puts a ceiling on the maximum amount of GHG emissions that an individual company can emit. For the Phase I period (2005–2007) and the Phase II period (2008–2012) of the EU Emission Trading Scheme, a cap-and-trade system, such a ceiling was calculated based primarily on past emissions which were reported by individual companies: this approach is called 'grandfathering.'[18] To make matters worse, most allowances were allocated to companies cost-free. Accordingly, there was a tendency for individual companies to exaggerate their past emissions since the higher the cap of a company, the more allowances the company obtains at no cost (Grubb et al. 2005).[19] Such exaggeration was possible since a cap is a result of de facto negotiation between a government and the industry to which the company belongs (Grubb et al. 2005). Given that the industry has all real data and information for its past emissions, and the government is concerned that strict capping would undermine the international competitiveness of the industry, the negotiation between the government and the industry tends to be one-sided, allowing the industry a higher cap than necessary (Grubb et al. 2005). As a matter of fact, this weakness proved to be fatal to the cap-and-trade system, flooding the EU GHG market with a large volume of saved allowances. For example, in 2005, actual GHG emissions were around 80 million metric tons or 4 percent lower than the number of allowances distributed to individual companies (Skjærseth and Wettestad 2008). Consequently, the EU market experienced a collapse of GHG price to almost zero in December 2007 from €30 in May 2006 (Climate Wonk 2010). To correct such weaknesses, the EU is trying three corrective actions from Phase III (2013–2020). According to the *EU ETS Handbook*, first of all, the benchmarking approach will be used for the free allocation of allowances. In contrast to the grandfathering approach that allocates allowances based on the historical emission of each company, the benchmark approach is more objective and transparent, by setting benchmarks at the average emission level of the top 10 percent of each sector in terms of GHG efficiency. In this way, companies that are highly efficient should receive all or almost all of the allowances that they need to comply with EU ETS obligations, whereas inefficient firms needs to buy more allowances than before. Secondly, auctioning has been introduced in parallel with free allocation. In contrast to free allocation, auctioning creates public revenues and discourages companies from securing excessive allowances. In Phase III, about half of the available allowances will be distributed through auctioning. Thirdly, the Market Stability Reserve (MSR) will be operational from 2019. MSR will absorb the allowances where auctioning is postponed as well as unallocated allowances, thus reducing the current surplus of allowances in market and improving the system's resilience to major shocks.[20]

Looking at indirect restriction, this is intended to reduce GHG emissions indirectly by discouraging the use of GHG sources like fossil fuel, rather than directly restricting the total amount of GHG emissions. Taxation on the sources of pollution is a common policy of such indirect restriction. For example, carbon tax is levied on the carbon content of fuels; when fuel is burned, carbon is released from the burning process, constituting GHG (Hoeller and Wallin 1991). Accordingly, if the use of fuel decreases due to taxation on its carbon content, GHG emissions also go down. Similarly, energy tax is levied on the energy contents of fuels (IPCC 1996). By increasing energy prices, an energy tax can also suppress the use of fuels and their GHG emissions. Given that an energy tax is already prevalent in the world independent of the international campaign to fight climate change, the analysis herein addresses carbon tax focused on controlling GHG emissions.[21]

The strength of carbon tax is that unlike a cap-and-trade system, the implementing structure is 'simple.' Accordingly, the weakness of a cap and trade system becomes the strength of a carbon tax system. This can be understood that under the cap-and-trade system, GHG is a virtual commodity created by the paper decree of a government (Paterson and Stripple 2015). Thus, if a government declares that a company can emit 5000 metric tons of GHG, the company as of that moment has 5000 metric tons of GHG allowances that it can sell in the market. This virtual and complicated nature of a cap-and-trade system allows considerable room for manipulation by powerful vested interest groups; it is difficult to detect or monitor loopholes in the system (Spash 2009). By comparison, the structure of a carbon tax is simple. When fossil fuel is consumed by a factory or individual consumer, a carbon tax is automatically levied in proportion to the amount that fossil fuel is consumed; it is easy to measure the amount of fossil fuel consumed and by whom. Another advantage of carbon tax is that unlike a cap and trade system, it retains the polluter–pays–principle (Spash 2009). Under the cap-and-trade system, a company that is a polluter is given a certain amount of free allowances so that it can emit a certain amount of GHG free of charge. Accordingly, the company is free to pollute the atmosphere without any consequence or cost until the pollution reaches a certain cap level. The company has only to pay the amount that exceeds the company's cap. By contrast, a carbon tax makes a polluter pay for its GHG emissions from the beginning of its polluting activity and in proportion to its polluting activity. Lastly, carbon tax can raise government revenues, which can then be used to build low-carbon infrastructure or to help groups vulnerable to climate change (Spash 2009).

Notwithstanding such strengths of carbon tax, its weakness lies in the general truth that tax is generally unpopular (Brohé 2009). When the EU initially recommended a carbon tax as a policy method to address climate change, strong opposition from business groups and key member countries throughout 1990s led to the EU withdrawing the original proposal on carbon tax in 2001 (Jordan and Rayner 2010).[22] Similarly, the USA could not introduce a carbon tax due to the strong opposition of its Congress (Taylor 2015). Such hostility against the introduction of a tax related to climate change is well illustrated by the 'No Climate Tax Pledge' which the entire Republican leadership in the House of Representatives, a third of the members of the House of Representatives as a whole, and a quarter of US senators took in 2013 (Benen 2013). By taking the pledge, those politicians made commitments that they would oppose any legislation relating to climate change that includes a net increase in government revenue.

The Second Step

The second step needs to be taken by the private sector. It should be reiterated that the price of GHG is set at this second step. Two scenarios are possible: indirect restriction and direct restriction. The simpler scenario, indirect restriction, is as follows: once a government sets indirect restriction on the GHG emissions through carbon tax or energy tax, individual companies need only to pay the taxes. However, with regard to direct restriction on the GHG emissions, the issue is far more complicated: under direct restriction, like a cap-and-trade system, an individual company tries to stay below its cap through its own efforts such as via introducing energy-efficient technology into its production line or shifting to low-carbon fuels. If the company still cannot avoid exceeding its cap, it would try to buy the saved GHG allowances of other companies. At that moment, the act of buying saved GHG allowances from other companies creates the 'price' of GHG. The company would buy a GHG allowance from the moment when its cost to reduce a metric ton of GHG is higher than the price of a GHG allowance in market. Specifically, the company starts to buy a GHG allowance when its Marginal Abatement Cost (MAC) is greater than the price of an allowance. MAC means the cost of reducing an additional GHG unit in the company. Generally, as the company increases its reduction of GHG emissions, its MAC also increases as less costly ways of reduction inside the company are gradually exhausted. Exceptionally, under the Kyoto Protocol, such allowances can be bought 'internationally' between Annex I countries; this is possible because when the Kyoto Protocol assigned a national GHG reduction target to a given Annex I country, such a target served as an overall cap on the individual Annex I country. If the Annex I country emitted less than its cap, it could sell the saved national allowances, called Assigned Amount Unit (AAU), to another Annex I country (UNFCCC 2008a). However, under the Paris Agreement, AAU would no longer be produced. At the level of an individual company, notwithstanding its efforts to find inexpensive allowances in the domestic cap-and-trade system, what can the company do when it cannot find allowances at a reasonable price within the cap-and-trade system? Generally, the solution is to find allowances outside the domestic cap-and-trade system. The common solution for the company is to buy credits for GHG reduction made from 'tangible' projects in other countries. Such an act of buying outside the cap-and-trade system is called 'offsetting.' The price of GHG in a country is 'affected' by the act of buying the foreign credits for project-based GHG reductions. The supply of offsets lowers the GHG price in the domestic cap and trade system. Interestingly, unlike the allowances of the cap and trade system, which are created instantly by governmental decree, the production of credits for 'project-based' GHG reduction is the result of a slower, more elaborate procedure (Paterson and Stripple 2015). Illustratively, the procedure explained above regarding measurement of GHG reduction in the Jirau hydropower project or the Olkaria IV geothermal project is about the creation of such credits for project-based GHG reduction. Since these credits for project-based GHG reduction are expected to be the main channel of financial flows between the developed and developing worlds, its procedure was presented earlier in this chapter.

At this point, it should be noted that the credits for GHG reduction from projects must be 'certified' in a legitimate and transparent way before being sold to the company in need. If the credits for GHG reduction of a project are fraudulent, they cannot be used by the company in need for meeting obligations to reduce GHG. The certification modality can be divided into three categories: multilateral, bilateral and unilateral. Multilateral certification is strong in legitimacy and transparency, while it is weak in terms of speed and simplicity of certification procedure. Unilateral certification is strong in speed and simplicity of certification procedure, whereas it is weak in legitimacy and transparency. The strength and weakness of bilateral certification is in achieving a balance between multilateral and unilateral certification.

Currently, the UNFCCC Secretariat provides a representative multilateral certification service. Since the UN is a multilateral organization, the service provided is a multilateral certification. As way of background information, it should be noted that the Kyoto Protocol creates three mechanisms to reduce GHG: Clean Development Mechanism (CDM), Joint Implementation (JI), and international emission trading. Under CDM, a developed country implements a GHG reduction project in a developing country, and gets the GHG reduction credits from the project. The credit is called a 'Certified Emission Reduction (CER).' A CER is one metric ton of GHG reduced. All examples of GHG reduction projects introduced in Chap. 1 and this chapter are CDM projects that generate CERs. Under JI, a developed country implements a GHG reduction project in another developed country, and gets the credits from the project. The credit is called an 'Emission Reduction Unit (ERU).' Likewise, an ERU is one metric ton of GHG reduced. Lastly, international emission trading is allowed as an instrument to complement domestic GHG reduction efforts. As of now, the future of the multilateral certification modalities like CDM and JI is not clear yet, but it seems that the Paris Agreement intends to establish a Kyoto-style multilateral certification instrument, given that it provides for the establishment of a mechanism for use by Parties on a voluntary basis. Moreover, the Paris Agreement allows international emission trading to support the transfer of credits for GHG reductions from the projects. However, in the meantime, strong competitors of the multilateral certification modality have been developing outside the Kyoto Protocol, threatening its dominance in the international arena. In the following, the emergence and potential of both unilateral and bilateral certification will be addressed.

Unilateral certification may be made by private organizations or public authorities. One of the representative unilateral certification mechanisms is the Verified Carbon Standard (VCS), which was launched by business and environmental leaders in 2005, with its headquarters established in Washington D.C. in 2009 (VCS 2016).[23] Subsequently, groups of individual states in the USA have introduced cap-and-trade systems allowing companies under their jurisdictions to use the credits for GHG reduction certified by the VCS, called Voluntary Carbon Unit (VCU), to meet their GHG reduction targets. VCS closely follows CDM procedures (Kollmuss et al. 2008). VCS can certify GHG reduction projects in 'any country.' Thus, countries can use the VCS certification mechanism to create their own credits for their domestic use. The certification is done by auditors approved by the VCS. Indeed, while the member countries to the Kyoto Protocol use the Kyoto multilateral certification instruments such as CDM and JI, the USA, which is not a member to the Kyoto Protocol, has developed unilateral certification mechanisms outside the Kyoto Protocol. Importantly, unilateral certification can also be made by public authorities. For example, the Japanese government certifies the credit for GHG reduction from domestic projects, issuing the corresponding credits, called J-Credit.[24] The Chinese government also certifies GHG reduction projects through accredited agencies, issuing Chinese Certified

Emission Reduction (CCER).[25] The Paris Agreement does not express any specific position on such unilateral certification instruments.

The last category is bilateral certification, a hybrid between multilateral and unilateral certifications. The Joint Crediting Mechanism (JCM) is a unique case under this category as of 2016. Under JCM, Japan concludes a bilateral agreement with a partner country, organizing a joint committee between the two governments. The joint committee certifies credits for GHG reduction from projects in the partner country.[26] After bilateral certification, the two governments divide the certified credits and take their respective shares. As of February 2017, Japan concluded bilateral agreements with 17 countries.[27] Japan also sought cooperation with the Asian Development Bank (ADB) by establishing the Japan Fund for the Joint Crediting Mechanism (JFJCM) in 2014 within the ADB.[28] Through the JFJCM, ADB provides grants to the Japan–led JCM projects. The Paris Agreement leaves the door open for the JCM by stipulating that 'the use of internationally transferred mitigation outcomes to achieve nationally determined contributions under this Agreement shall be voluntary and authorized by participating Parties' (Koakutsu et al. 2016). In its Intended Nationally Determined Contribution (INDC), Japan intends to meet 5–10 percent of its national GHG reduction target with the credits from the JCM.[29]

Taking into account what is discussed above, some international practices on GHG reduction can be summarized as shown in Table 6.1

Table 6.1 International practices on GHG reduction

	Imposition of obligation by government			Implementation of obligation by private sector			
	Direct restriction		Indirect restriction	Indirect implementation methods			
	Cap-and-trade				Offsetting		
	Entire country	Part of country	Taxation	Allowances of cap-and-trade	Multi.	Bi.	Uni.
EU	√			√	√		
US		√		√			√
China		√		√			√
Japan		√	√	√	√	√	√
Korea	√			√			√

To begin with, the EU launched the EU Emission Trading Scheme (ETS) in 2005 that is an entire EU-wide cap-and-trade system; this was the first international emission trading system (Brohé et al. 2009). The allowances that are allocated to individual companies under EU ETS are called EU allowance (EUA). EU ETS allows only multilateral offsets from CDM and JI of the Kyoto Protocol. Importantly, experiencing the problems of over-allocation and the collapse of GHG price in Phase I (2005–2007) as explained above, EU limits free allocation to 43 percent of the total allowances to be distributed in Phase III (2013–2020). Since auctioning creates financial costs on the side of companies, it has the effect of suppressing a company's intention of applying for excessive allowances while contributing to increasing public revenue as well. Furthermore, responding to the volatility of GHG price, EU ETS will operationalize the Market Stability Reserve (MSR) from January 2019. EUAs whose release are postponed or are not allocated yet will be transferred to the MSR in order to control the oversupply of EUA in market.

In the USA, some individual states voluntarily grouped together to launch regional cap-and-trade systems as illustrated by the Regional Greenhouse Gas Initiative (RGGI), the Western Climate Initiative (WCI) and the Midwestern Greenhouse Gas Accord (Midwestern Accord). Moreover, the USA has private sector-led unilateral certification mechanisms like VCS.

China introduced a cap-and-trade system into part of her territory from 2013. China uses only credits from unilateral certification. However, given that China is the biggest producer of CDM credits, China uses CDM credits for its domestic cap-and-trade system after re-certifying them with her own unilateral mechanism (IETA 2003). The rebranded credits by the Chinese authority are CCER.

Japan introduced a mandatory cap-and-trade system in Tokyo in 2010, while its Ministry of Environment has been operating the Voluntary Emissions Trading Scheme (JVETS) since 2005 (Brohé et al. 2009). Under the JVETS, a company is given subsidies in exchange for commitment to a voluntary GHG reduction target. Japan also introduced carbon tax in 2014 (IETA 2015). With regard to offset, Japan approves all three kinds of multilateral, bilateral and unilateral certification mechanisms.

Table 6.2 Offset units of various origins

Implementation of obligation by private sector				
	Indirect implementation methods			
Direct implementation	Allowances of cap-and-trade	Offsetting		
		Multilateral	Bilateral	Unilateral
Firms reduce their GHG emission on their own	EUA AAU KAU	CER ERU	(JCM-related credits)	VCU J-Credit CCER KCU

The Republic of Korea introduced a nationwide cap-and-trade system in 2015 (MoE 2014). Under the nation-wide cap and trade system, a company is allocated the Korean Assigned Unit (KAU) under its cap. Auctioning will be gradually introduced from 2018 to allocate KAU to the private sector. If the company still needs more GHG reduction units, it can use Korean Credit Units (KCUs), which are project-based offsets certified by the Korean Government. For greater clarity, offsets of various origins classified in accordance with the structure presented in Table 6.1 can be illustrated in Table 6.2.

Remaining Issues on Carbon Markets

Lastly, there are some remaining issues in relation to imposing GHG reduction obligations on all countries. First, given that all countries undertake obligations to reduce GHG emissions under the Paris Agreement, attention should be paid to the need for 'standardization' in the criteria and procedures of measuring, reporting and verifying the implementation of their obligations. This is to say that the Measurement, Reporting and Verification (MRV) methodology on GHG reduction needs standardization across individual countries. Without standardization of MRV methodologies, the national implementation report of each country would be unreliable, with international trade of GHG reduction credits difficult. In this context, the standardization of 'existing' national MRV methodologies is urgently required. This concern seems to be well grounded, given that individual countries have already several options to certify their project-based GHG reductions, including multilateral certification like UN CDM, bilateral certification like Japan's JCM or unilateral certification like US VCS. Furthermore, the standardization of 'new' MRV methodologies of individual countries is also extremely important because each new methodology has the potential to unleash a new path for a different type of activity to reduce GHGs.[30]

Second, introducing 'sectoral approaches' in the global GHG reduction campaign may be considered. The sectoral approach means applying a standard MRV methodology to an entire industry or broad segment of an economy instead of a small project (Hart 2013). For example, in the power sector, it is feasible to design a sectoral approach that allows developing countries with high GHG emissions from electricity generation to earn GHG reduction credits if emissions in the entire power sector are below a specific emissions intensity target (Amatayakul et al. 2008).[31] Such an approach could be more effective than project-based approaches; less administrative efforts will be required for the same amount of GHG reduction by letting a whole sector adopt GHG-reduction practices or technology with 'a single touch' (UNEP 2009).

Furthermore, a sectoral approach could bring about structural changes in the sector (Amatayakul et al. 2008). With piecemeal GHG reduction projects, such structural changes on a broad scale would not be possible. Furthermore, sectoral approaches could be free from the criticisms that a project-based approach like the UN CDM suffers from: the UN CDM has faced skepticism for reasons that its MRV methodologies are subjective and, therefore, its GHG reductions are not necessarily real, as well as lacking additionality (Newell 2015).[32] By contrast, sectoral approaches could enjoy stronger credibility and environmental integrity mainly because the methodology to measure and verify GHG reductions is easier (as illustrated above) than project-based approaches like the UN CDM. However, depending upon the types of sector, caution is required in applying a sectoral approach. Some sectoral approaches may trigger controversy on green trade protectionism (Hart 2013). Such a scenario is possible when a sectoral approach in a trade-related sector aims to neutralize the difference in production costs across all countries by obliging all firms of the same sector in the world to adopt a common and expensive GHG-reduction technology. In such a case, some firms in developing countries that cannot afford such expensive technology may be prohibited from exporting their unqualified products to developed countries. In particular, energy-intensive industries like cement, steel or petrochemical industries could be affected by such a global sectoral approach.

Third, for the cap-and-trade system, massive GHG reduction credit-generating sectors could create an 'irony of the market place.' Namely, massive GHG reductions from a sector could lead to the collapse of the carbon market originally intended to foster GHG reduction to the greatest extent possible. Such irony takes place in the following way. To begin with, it should be noted that the objectives of the cap-and-trade system are to pursue efficient GHG reductions and to promote investment in low-carbon technologies (Hart 2013). Given this, the key to achieving such objectives is keeping the GHG price at a high enough level to ensure the private sector gains enough profits from selling the GHG reduction credits to make investment in low-carbon technologies. In this context, the low GHG price is not a blessing for consumers in the ordinary market sense but a disaster in the cap-and-trade market. In reality, tapping into new massive GHG reduction credit-generating sectors may cause the GHG price to plummet. Then, the low GHG price would cause a dysfunction of the carbon market by discouraging the private sector from making efforts to reduce GHG emissions. Namely, the low GHG price would decrease the profits from the sale of GHG reduction credits that the private sector needs in order to make investment in low-carbon technologies. Furthermore, tapping into new sectors by a given country may trigger a chain reaction in other countries. If the country exports its abundant cheap credits to other countries, the cheap credits may also destabilize the carbon markets of importing countries. In sum, the more GHG reductions a carbon market pursues by tapping massive GHG reduction credit-generating sectors, the less GHG reduction the carbon market may have in reality. As a matter of fact, it should be pointed out that the fundamental cause of such irony of the marketplace is the low demand for GHG reduction credits, which will be explained in further detail in Chap. 7.

Against this backdrop, it is understandable that the Marrakesh Accords issued restrictions on the use of GHG reduction credits from two sectors: nuclear energy and carbon sinks (forestry) (UNFCCC 2002). What the two areas have in common is that they can generate a huge volume of very cheap GHG reduction credits. However, at the moment, the pressure for expanding into such new areas is increasing from interest groups of countries. For example, regarding carbon sinks that absorb CO_2 from the atmosphere, the Marrakesh Accords allowed afforestation and reforestation to generate GHG reduction credits under the CDM, whereas it excluded 'avoiding deforestation' from the scope of activities that can generate GHG reduction credits (UNFCCC 2003). However, with regard to such allowed carbon sinks like afforestation and reforestation, the Marrakesh Accords placed limitations on the use of their credits in terms of time and quantity (Dessai and Schipper 2003). Namely, Annex I Parties could use the credits from afforestation and reforestation only for the period of between 2008 and 2012, up to a ceiling of 1 percent of the five-fold amount of a Party's 1990 emissions. This measure reflects the concerns about the flooding of cheap credits into the market. Nevertheless, Costa Rica and Papua New Guinea submitted the issue of 'avoiding deforestation in the developing countries' as a provisional agenda item to the annual meeting of the UNFCCC in Montreal, Canada in 2005 (O'Sullivan et al. 2012; UNFCCC 2005). Subsequently, in Bali, Indonesia, in 2007, the parties to the UNFCCC expanded the scope of discussion to cover five types of relevant activities including reduction of emissions from deforestation and forest degradation (REDD), conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries (UNFCCC 2008b). These five types of activities are now known as REDD+. Since three more types are added to the original two types (REDD) that Costa Rica and Papua New Guinea proposed, the symbol '+' was added.[33] Interestingly, in Durban in 2011, parties to the UNFCCC agreed to consider that appropriate market-based approaches could be developed (UNFCCC 2012b). However, in Warsaw in 2013, the parties to the UNCCC directed developing countries to take results-based actions and seek results-based payments from financing entities, including the Green Climate Fund (GCF), which is a new financing instrument of the UNFCCC (UNFCCC 2014b). Accordingly, it is yet uncertain as to how developing countries would obtain financial support for their activities of REDD+. In this context, developing countries would face three options: generating GHG reduction credits from REDD+ and selling them in the carbon market, seeking direct financial support from financing entities like GCF, and returning to the original business practices of cutting down trees and exporting timber to garner profits. Under the first option, the international community would face irony of marketplace. Given that deforestation and forest degradation account for around 20 percent of global GHG emission annually, which is more than that of the entire global transport sector, the potential volume of cheap credits from REDD+ would be huge (CIFOR 2009).[34] For example, given that the global GHG emission was 52.7 $GtCO_2$ equivalent in 2014 (UNEP 2015),[35] the forest sector is estimated to have the potential of generating GHG reduction credits up to 7.8 $GtCO_2$ equivalent annually (McKinsey and Company 2009).[36] Under the second option, this could provide a simple and effective option but a significant challenge is the question of what entity will provide adequate resources to financial entities like the GCF in order to support REDD+ activities for developing countries. For the third option, it would be the worst-case scenario for the global community, seriously undermining the momentum of the global campaign to check the progress of climate change.

In sum, it is necessary to standardize diverse existing and new national MRV methodologies in order to objectively assess the progress report of each country in relation to their national GHG reduction targets and to enable national GHG reduction credits to be traded internationally. However, given various conflicting interests, promoting such standardization is in no way a simple task. In particular, market mechanisms appear to be immature and lacking enough strength to deal with various challenges in the field. In this sense, the role of the UNFCCC Secretariat in developing rules and promoting standardization as a legitimate coordinator would be more critical than ever.

Notes

1. In the UN context, the baseline is the level of emissions of activities that are likely to occur in the absence of the proposed CDM (Clean Development Mechanism) activities. For further details, see Lee (2005, 8).

2. For details on the baseline methodology, see CDMb (n.d., 10).
3. When checking additionality, there is a step called a 'common practice test.' This test analyzes whether there are many existing projects similar to the proposed project in the same country, adopting similar technology and scale in the absence of financial support related to GHG reduction. If similar projects have been implemented widely in the same country, the project concerned cannot pass the common practice test and, therefore, cannot meet the criterion of additionality. However, the United Nations common practice test excludes from consideration 'any projects that were implemented with financial support related to GHG reduction,' which has been approved by the United Nations or 'any projects that were installed under a government scheme to promote similar projects,' benefits of which are not available to the proposed project. Thus, the common practice test appears to be leniently applied. The Olkaria IV project has also benefitted from this lenient application of the common practice test, because in Kenya, at the time of registration of the Olkaria IV project at the United Nations, 19.45 percent of electricity is already supplied by geothermal power plants. For details on the common practice test, see Lee (2005, 44–45). However, such lenient interpretation may be controversial, especially with coal-fired power plants, since it would lead to the result of fostering the expansion of coal-fired power plants with the financial resources related to GHG reduction. For criticisms, see for example, Lazarus and Chandler (2011, 6).
4. The average GHG emission per MWh is called 'Emission Factor (EF)' in professional terminology. The higher the EF, the greater the GHG emissions are.
5. For Olkaria IV project, see CDMa (n.d., 2).
6. For a baseline emission, two options were reviewed and the lower estimate was adopted conservatively. The first option was the average GHG emission per MWh of a supercritical power plant, which was 0.8827 metric tons of GHG per MWh. The second option was average greenhouse emission per MWh of the top 15 percent performing power plants of East China Power Grid (ECPG), which was 0.8792 metric tons of GHG per MWh.
7. For further details, see Aldy et al. (2001, 13–16).
8. For the most updated list, see UNFCCC. 'List of Annex I Parties to the Convention.'

9. In the Annex B of the Kyoto Protocol, the Annex I countries of the UNFCCC were listed again with the omission of Belarus and Turkey. Hence, the Annex I countries are also called as Annex B countries in some literature, thus creating confusion. However, it should be noted that the two groups of countries are basically same in nature.
10. For details on the base year of Annex I countries, see UNFCCC, 'Kyoto Protocol base year data.'
11. Article 3, paragraph 9, of the Kyoto Protocol stipulates that Annex I countries shall make another subsequent commitment to reduce their GHG emissions when the first commitment period (2008–2012) comes to an end.
12. For further details, see United Nations Treaty Collection. Depositary Notification (Reference: C.N.718.2012.TREATIES-XXVII.7.c).
13. To enter into force, the Amendment needs to be ratified by three-quarters (144 countries) of the parties (192 countries) but as of 30 June 2016, it has been ratified by only 65 countries.
14. As a matter of fact, due to the confrontations among countries, the 2009 Copenhagen Conference of Parties could not agree on final decisions and therefore, it released its decisions with a 'disclaimer' that it did not formally adopt the decisions but just 'took note of' them. Because of such procedural incompleteness, the decisions are called the 'Copenhagen Accord' instead of 'Copenhagen Agreement.' However, the three political outcomes of the Copenhagen Accord were formally adopted in the form of decisions by the Conference of Parties one year later in Cancun, Mexico. The Cancun document is called 'Cancun Agreements.' For Cancun Agreements, see UNFCCC (2011).
15. The mitigation actions by the developing countries are called 'Nationally Appropriate Mitigation Actions (NAMA).' The developing countries can voluntarily submit their NAMA plans to the Conference of Parties to the UNFCCC.
16. However, USA announced in June 2017 that it would withdraw from the Paris Agreement.
17. See, for example, Lerman et al. (2003).
18. The approach taken in Phase I of the EU ETS can be called the 'grandfathering/BAU' approach. Grandfathering is calculating a cap considering the past emissions. A business-as-usual (BAU) approach is calculating a cap taking into account the assumption that a company

would continue its emission trend in a normal economic situation. See Grubb et al. (2005, 134).

19. For further details, see also Grubb and Neuhoff (2006, 16–17).
20. For the details on the MSR, see European Commission. 'Market Stability Reserve,' https://ec.europa.eu/clima/policies/ets/reform_en. Accessed on 5 July 2016.
21. For the prevalence of energy tax, see for example, OECD (2015, 9–10).
22. For further details, see Christiansen and Wettestad (2003, 6).
23. Founding organizations of the VCS are the World Economic Forum, International Emissions Trading Associations, World Business Council on Sustainable Development and Climate Group.
24. For further details on J-Credit scheme, see J-Credit Scheme website, https://japancredit.go.jp/english/. Accessed on 8 July 2016.
25. For further details on CCER, see International Emissions Trading Association (2003).
26. For further details on JCM, see New Mechanisms Information Platform, http://www.mmechanisms.org/e/initiatives/. Accessed on 8 July 2016.
27. For the list of countries that concluded bilateral agreements with Japan, see JCM homepage, https://www.jcm.go.jp/. Accessed on 1 February 2017.
28. For further details on JFJCM, see ADB website, http://www.adb.org/sites/default/files/publication/177324/jfjcm-brochure.pdf. Accessed on 8 July 2016.
29. Japan's INDC toward post-2020 GHG emission reductions by 2030 is about 1 billion metric tons of GHG, and apart from contributions achieved through private-sector based projects, accumulated emission reductions or removals by FY 2030 through governmental JCM programs to be undertaken within the government's annual budget are estimated to be ranging from 50 to 100 million tons of GHG. UNFCCC. 'Submission of Japan's Intended Nationally Determined Contribution.'
30. For relevant discussions, see World Bank (n.d., 14).
31. For further details, see Baron et al. (2009, 12).
32. For further details on the criticisms on CDM, see Amatayakul et al. (2008, 2), World Bank (n.d., 16-17), Yan. 'WikiLeaks cable highlights high level CDM scam in India.'
33. For the details on REDD+, see Code REDD website, http://www.coderedd.org/about-redd/. Accessed on 15 September 2016.

34. For the urgent need of addressing deforestation and forest degradation, see Center for International Forestry Research (2009).
35. In 2014, out of such 52.7 $GtCO_2$ equivalent, the emissions of CO_2 from fossil fuel and industry were estimated at 35.5 $GtCO_2$. To limit the rise in global average temperature below 2 °C, cumulative CO_2 emissions since 1870 should remain below 2900 $GtCO_2$, and 1900 $GtCO_2$ had already been emitted by 2011. For further details, see IPCC (2014, 10).
36. Although McKinsey developed Version 2.1 curve in 2010 in order to reflect the impact of the global financial crisis on GHG abatement cost, the financial crisis is estimated to have little impact on the forest sector.

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7

How Can We Keep the GHG Price at a High Enough Level?

Introduction

As explained in Chap. 6, in order to use GHG as a new financial resource, it is necessary to transform the GHG into an economic commodity. To this end, it is important to assess the proper level of economic value that GHG needs in order to function as a new financial source. Regarding this question, the standard answer is to keep the GHG price at a level 'high enough' to motivate the private sector to pursue efficient GHG reductions, and to promote investment in low-carbon technologies. Such a high enough price is a relative concept, and does not mean a high price in an absolute sense that could damage the economy by increasing the cost of complying with GHG reduction obligations. Precisely speaking, the GHG price should be high enough to fill the gap between the cost of green infrastructure and the cost of conventional infrastructure as shown by 'double arrow A' in Fig. 7.1. This means that the profits from selling GHG reductions should cover the difference between the costs of the two projects. If the profits from selling

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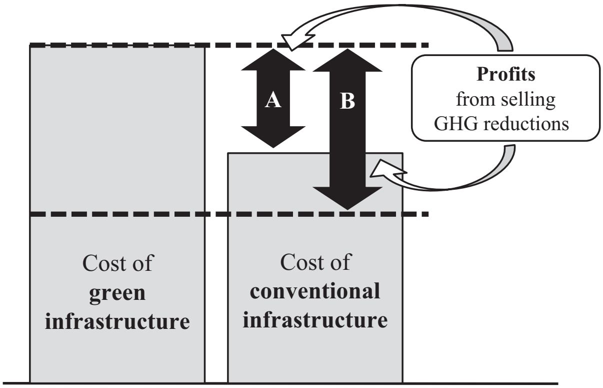

Fig. 7.1 The role of profits from selling GHG reductions

GHG reductions cannot fill the gap, the private sector would be unlikely to launch expensive green infrastructure projects instead of relatively cheap conventional infrastructure projects. In this context, GHG-related profits constitute a linchpin of green infrastructure projects. Moreover, if the profits from selling GHG reductions could be bigger than the gap between the costs of the two projects as shown by 'double arrow B' in Fig. 7.1, it would further enhance the financial viability of green infrastructure projects. Against this backdrop, some suggestions will be made to keep GHG price at a high enough level.

Three Conditions

Before proceeding to the main argument, it should be reiterated that the GHG price means the price of a GHG reduction unit or GHG reduction credit. To answer the question of how we can keep GHG price at a high enough level, three conditions are noteworthy: 'universality' of participants, 'strictness' of GHG target-setting, and 'strength' of enforcement. The three conditions aim at obliging individual countries to consistently reduce their GHG emissions, thus bringing about substantial GHG reductions at the global level. In order to keep GHG price at a high enough level through an ordinary market mechanism, all three conditions need to be met at the same time. By analogy, the pressure to support GHG price at a high enough level is like a pressure inside an air balloon. To maintain an adequate level of air pressure inside the balloon, the balloon must be intact, without a puncture; a single hole could vent out the pressure from the balloon. Similarly, absence of even just one condition could seriously undermine the possibility of making substantial GHG reductions at the global level. *If substantial GHG reductions are not made globally, GHG prices would remain low.* Such logic is based on the following mechanism. As illustrated in Fig. 7.2, a sample Marginal Abatement Cost (MAC) curve shows that the cost of GHG reduction is generally 'directly proportional' to the volume of GHG reduction.[1] Namely, with the increase in GHG reduction, the GHG reduction cost also increases.[2] Accordingly, the low GHG reduction price that reflects low GHG reduction cost is a strong signal that substantial GHG reductions have not been made at the global level.

For instance, with a view to reducing national GHG emissions, countries would begin with cheap methods like afforestation and energy-saving campaigns. After cheap methods are exhausted, countries would move to increasingly expensive ones, like the technology of carbon capture and storage (CCS). Accordingly, if substantial GHG reductions are not made globally, many cheap methods would be available globally, thus resulting in a low GHG price.

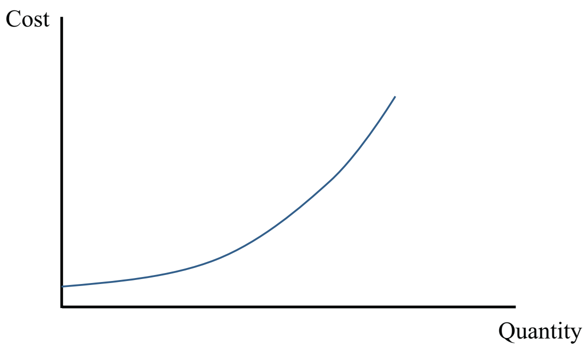

Fig. 7.2 A typical Marginal Abatement Cost (MAC) curve

Bearing such logic in mind, let us review the three conditions. First, participation should be 'universal.' If some countries participate in a GHG reduction campaign while others do not, substantial GHG reductions are not possible at a global level, thus keeping GHG price low. In more detail, given that GHG reduction efforts raise production costs in the private sector, companies of 'participating' countries would lose competitiveness against their rivals in 'non-participating' countries. Faced with such a scenario, most countries are unlikely to participate in GHG reduction obligations. Under such circumstances, the global volume of GHG reduction would still be small, and cheap methods of GHG reduction would be available across the world. In such a case, with weak demand and the expected large supply, the GHG price would remain low.

Second, GHG reduction targets should be set 'strictly.' If GHG reduction targets are restricted only for some countries, substantial GHG reductions would not be possible globally, thus keeping GHG price low. Namely, even if some countries set their GHG reduction targets strictly, it would be very difficult for them to maintain consistent efforts to meet their GHG reduction targets by setting harsh standards only on their own national companies; their companies would lose international competitiveness in the absence of parallel efforts by other companies. In such a case, the global community is still at the initial stage of the implementation of GHG reduction obligations, thus being able to use many cheap methods. Accordingly, despite efforts of some countries, the real volume of GHG reduction would still be modest globally with many cheap methods available. In such a case, under weak demand and the expected large supply, the GHG prices would remain low.

Third, enforcement must be 'strong.' Absent pressure of strong enforcement measures, substantial GHG reductions would not be possible globally, thus keeping GHG price low. In the absence of strong enforcement mechanisms, countries may not be serious about meeting their national GHG reduction target. Under such circumstances, they are not likely to exert strong pressure on their domestic companies to reduce GHG emissions. Consequently, domestic companies would not diligently seek GHG reduction. In such a case, cheap methods for GHG reduction would fail to be exhausted nationally as well as globally. Then, with weak demand and an expected large supply, the GHG price would remain low.

Two Enforcement Approaches

The Importance of the Third Condition: Enforcement

Against such a backdrop, the first two conditions—the universality of participants and strictness of GHG target-setting—are already fixed, while the third condition of 'enforcement' is waiting to be further developed. Specifically, the Kyoto mechanism fails to meet the first condition of universality of participants: those obliged to reduce GHG are limited to Annex I developed countries alone. However, the Kyoto mechanism appears to meet the second condition of strict target-setting in that it imposes 'binding' GHG reduction targets on Annex I countries in a top-down manner (Hare et al. 2010). All in all, the Kyoto mechanism could not support the global GHG price at a high enough level through an ordinary market mechanism because it clearly fails to meet the first condition.

With regard to the Paris mechanism, it meets the first condition of universality of participants in that all UN member countries are encouraged to submit their national GHG reduction targets to the UN. However, for the present, the Paris mechanism appears to fail to meet the second condition regarding strictness of target-setting, in that targets are self-imposed by individual countries. Such a concern is confirmed by the weak effect of such target-setting efforts on the reduction of GHG emissions at the global level. As noted, the first round of 'intended nationally determined contributions' (INDC) submission in the Paris mechanism is projected to delay the trespassing of the threshold of 2900 $GtCO_2$ equivalent 'by only eight months,' when compared with the scenario in the absence of the Paris mechanism (IEA 2015). Overall, the Paris mechanism cannot support the global GHG price at a sufficiently high level through an ordinary market mechanism because it currently fails to meet one condition; nonetheless, it should be reiterated that the global community remains engaged.

It is the third condition that has the potential to change the weak trends, depending on the approach. Namely, the third condition may overcome the constraint that one condition is not met in both mechanisms as shown in Table 7.1.

Table 7.1 Current status of three conditions to support GHG prices[a]

	Universality of participant	Strictness of GHG target	Strength of enforcement: Negative approach, Multi.	Strength of enforcement: Negative approach, Uni.	Strength of enforcement: Positive approach, Uni.
Kyoto	Weak	Strong	Weak	Weak	(?)
Paris	Strong	Weak	Weak	Weak	(?)

[a]The assessment of 'strong' and 'weak' is relatively made. The assessment of universality of participants and strictness of target-setting is based on the comparison between the Kyoto mechanism and the Paris mechanism. As to enforcement, it is based on comparison between international society and domestic society

The third condition of enforcement could be divided into two approaches: negative and positive. A negative approach is based on punitive measures, while a positive approach relies on incentive measures. In fact, the two approaches are not exclusive but can be mutually complementary, creating synergy between them in reducing GHG emissions at the global level. In the following, the details of the two approaches will be explained, followed by an overall assessment of their capacities to keep GHG price at a sufficiently high level.

Negative Enforcement Approach

To begin with, let us go to the 'negative enforcement' approach. The negative enforcement can be divided into two approaches: multilateral and unilateral. The negative multilateral approach uses a multilateral framework to meet its objective, whereas the negative unilateral approach is a unilateral measure by a country.

Negative Multilateral Enforcement

Starting with the negative multilateral enforcement approach, in the Kyoto mechanism, the negative multilateral enforcement is based on multilateral sanctions. The United Nations imposes an additional GHG reduction obligation on an Annex I country that fails to comply with its reduction target, and deprive the Annex I country of its right to sell Assigned Amount Units (AAUs) to other Annex I countries.[3] As the enforcement measure places an additional burden on a country, it is punitive in nature. However, there are no further enforcement measures to employ when the small group of countries fails to meet their obligation other than diplomatic humiliation for breaching international obligations. Thus, in the Kyoto mechanism, the negative multilateral enforcement approach is 'weak' in its power.

With respect to the Paris mechanism, the situation becomes worse because there is no concrete multilateral enforcement mechanism. Hence, it can be said that negative multilateral enforcement approach is also 'weak' in its power since there is no established enforcement mechanism yet under the Paris mechanism. In conclusion, the weak negative multilateral enforcement approaches of the Kyoto and Paris mechanisms appear to hardly contribute to keeping GHG price at a high enough level.

Negative Unilateral Enforcement

When compared with the negative multilateral enforcement approach, the negative unilateral enforcement approach could be a little more effective in keeping the GHG price at a high enough level. In both the Kyoto and Paris mechanisms, the negative unilateral enforcement is based on unilateral measures targeted at bilateral trade relations. In other words, countries take economic measures against countries that do not participate in GHG reduction obligations or do not implement them. Currently, the World Trade Organization (WTO) sets global rules to promote international trade and ensure fair competition for all 163 member countries. The core of such a negative unilateral enforcement approach is to ensure a 'level playing field' between international competitors. If Country A imposes GHG reduction obligations on its companies while Country B does not, the companies of Country A would be in a disadvantaged position. Their production cost would be higher than the companies of Country B. Accordingly, Country B can take countermeasures against Country A to create a level playing field between the companies of the two countries. Under the WTO regime, three major instruments are conceivable for negative unilateral enforcement approach: rules on border tax adjustment (BTA), rules on subsidies and rules on environment conservation (Kim 2011).

Let us start with the border tax adjustment, which is the most common instrument of negative unilateral approach. In order to apply border tax adjustments, there must be a difference in the level of a tax (or charge) on a similar product between two countries. The role of border tax adjustments is to equalize the difference in taxes (or charges) on similar products between two countries. Border tax adjustments adopt the destination principle: under this principle, when a product leaves its home country, it is relieved of all or some of the home taxes (or charges) (GATT 1970). After entering a foreign country, the product is taxed (or charged) in accordance with the tax (or charge) system of the foreign country. Hence, through border tax adjustment, countries can impose their domestic taxes (or charges) on imported goods (WTO 1997). In fact, border tax adjustments are very common in international trade practices.[4] Most imported goods undergo border tax adjustment when entering importing countries. For example, let us suppose that Country A imposes a 5 percent value-added tax (VAT) on cars that are sold in its territory, and Country B imposes 15 percent value-added tax on cars that are sold in its own territory. If a car made by Country A is exported to Country B, Country A does not impose VAT on this car but lets Country B impose 15 percent VAT on the car with a view to equalizing the VAT differences between the two countries. Likewise, in relation to international GHG reduction obligations, border tax adjustments, or a concept similar to border tax adjustments, may be introduced. Two simplified scenarios may be illustrated as follows. First, if an importing country adopts a carbon tax while an exporting country does not, the importing country could easily apply border tax adjustments to imported goods. Second, if an importing country adopts a heavy and restrictive cap-and-trade system while an exporting country implements a light and generous cap-and-trade system, there should be a difference in GHG reduction cost between two countries. Accordingly, some people argue that the concept of 'Border Carbon Adjustment (BCA)' should be introduced to equalize the difference in GHG reduction cost between two countries (Cosbey

2008).[5] Generally, given such apparent need of ensuring a level playing field among competitors, it is argued that such a challenge could be adequately addressed with a current border tax adjustment system under the WTO (Pauwelyn 2007). That is to say, the solution is to define the scope of a domestic tax (or charge) broadly so that the cost of GHG reduction mandated by a government may qualify as domestic tax (or charge). There are already some relevant cases reported. For instance, in 2012, all airlines using EU airports were brought into the EU Emission Trading Scheme (ETS) (Martina and Leung 2012). Given that all EU airliners had to pay for their GHG emissions, there arose a need to impose the same obligations on foreign airlines flying to and back from EU. Despite their initial objections, China and India having initially refused to impose GHG reduction obligations on their national airlines finally complied with the request of the EU in 2015, with their airlines surrendering their GHG allowances to the EU, but only for intra-European Economic Area (EEA) flights (Greenair 2015).

Next, applying the rules of subsidies could be another possible enforcement instrument. A subsidy needs two key elements: financial contribution by a government, and a benefit specific to companies or an industry. Under the WTO regime, subsidies are divided into three categories: prohibited, actionable and non-actionable.[6] Prohibited subsidies are the ones used to promote export of national goods or to encourage the use of domestic over imported goods. Actionable subsidies are the ones that result in adverse effects to the interest of another country. Except for the prohibited and actionable subsidies, the rest are non-actionable subsidies that include assistance for R&D, assistance to disadvantaged regions in the territory of a country, and assistance to promote adaptation of existing facilities to new environmental requirements. With regard to prohibited and actionable subsidies, countries can take countermeasures. In order to judge whether counter-measurable subsidies exist, three tests should be made: (1) whether an action meets the definition of a subsidy, (2) whether an action is related to export promotion (prohibited subsidies), and (3) whether an action results in adverse effect on another country (actionable subsidies). Although no case on GHG-related subsidies has been presented to the WTO dispute settlement procedure yet, some cases could be plausible in the future. For example, let us suppose that

Country A imposes a less restrictive GHG emissions cap on a specific steel company compared with other domestic industries. In such a case, the act of Country A may be equal to giving financial assistance to the specific company. The act would then constitute prohibited subsidies if it involves export promotion, or it would be actionable subsidies if it causes adverse effects on the steel industry of Country B. Consequently, Country B may take countermeasures.

Lastly, rules on environmental protection could provide another justification as well as instruments for unilateral enforcement. Article XX of the General Agreement on Tariffs and Trade (GATT) allows countries to take countermeasures for the purpose of protecting human, animal or plant life or health, or of conserving exhaustible natural resources (Pauwelyn 2007). As of now, no case related to GHG reduction obligations citing Article XX of GATT has been presented to the WTO dispute settlement procedure. However, some environmental cases leave the door open for future GHG-related cases. For example, in the Shrimp-Turtle case (1998), the USA imposed a ban on shrimp imported from India, Malaysia, Pakistan and Thailand for the reason that they did not use turtle excluder devices (TEDs) in their nets, thus catching endangered sea turtles during their shrimping operations.[7] Responding to this ban, the four countries brought a case against the USA before the WTO. After reviewing the case, the WTO dispute settlement panel ruled that WTO member countries have the right to take trade action to protect the environment (in particular, human, animal or plant life, and health) and to conserve endangered species and exhaustible resources, and further made clear that the WTO does not have to allow sovereign countries this right.

The respective strengths and weaknesses of these three instruments can be analyzed as they are shown in Table 7.2. For border tax adjustment,

Table 7.2 Three instruments for the negative unilateral enforcement approach[a]

	Ease of factual verification	Equalizing power
Border tax adjustment	Simple (nominal facts)	Small (for example, 10%)
Subsidies	Complicated (real facts)	Big (for example, 25%)
Environmental protection	Uncertain	Uncertain

[a]'Simple' and 'complicated' are relatively judged in comparison among the three instruments. Likewise 'small' and 'big' are relative concepts

the facts are easy enough to verify, but the equalizing power would be limited. For example, if Country A announces that it would reduce GHG emissions of all its steel companies by 20 percent through a cap-and-trade system, while Country B declares that it would reduce GHG emissions of all its steel companies by 30 percent likewise through a cap-and-trade system, Country B could impose a charge that corresponds to the cost of reducing GHG emissions by 10 percent more on steel products imported from Country A. In sum, since Country B has only to check the nominal facts that the GHG reduction target of Country A is 20 percent, verification of these facts is straightforward. Furthermore, its equalizing power is weak in that only the nominal difference (10% = 30% − 20%) needs to be addressed.

On the other hand, with regard to subsidies, verification is more complicated, but the equalizing power is potentially more significant. Before proceeding further, it should be reiterated that subsidies are a financial contribution by a government to a specific company or industry bringing about benefits to that specific company or industry. Making use of the hypothetical examples presented above, let us suppose that the real GHG reduction of a specific steel company of Country A is not 20 percent but 5 percent, and that the 20 percent figure reflects Country A government's condoning of the excessive past emissions of the steel company. Namely, the nominal 20 percent reduction would be made against the bloated past emissions reported by the company. Under such circumstances, if Country B could prove that Country A manipulated the figure, it could impose a charge corresponding to the cost of reducing GHG by 25 percent more on steel products imported from Country A. However, proving such manipulation would be difficult because Country B would need internal data and confidential information from both the steel company in question as well as from the government of Country A. Nonetheless, the equalizing power of subsidies is bigger than that of border tax adjustments in that the real difference (25% = 30% − 5%) could be addressed.

Lastly, as to the rule of environmental protection, it should be noted that the criteria for employing countermeasures in this category are not concretely set out in the text of the GATT, nor have cases of reference been developed through the WTO dispute settlement procedure.

Accordingly, it is difficult for policymakers to find the proper ways of employing countermeasures in the context of environmental protection. Hence, as of now, it appears that border tax adjustment or subsidies are more predictable enforcement instruments for a unilateral approach.

Against this backdrop, let us assess the capacity of the negative unilateral enforcement approach to keep the GHG price at a sufficiently enough level. In the Kyoto mechanism, China and the USA, the largest and the second largest GHG emitters respectively, did not participate in the GHG reduction obligations. Under the circumstances, even though a small number of countries employ unilateral enforcement instruments against goods imported from large economies like the USA and China, the volume of GHG reduction at the global level would be small. This follows as the small number of countries account for only a small portion of the global economy, and the countermeasures they could employ would only be against goods imported to their small economies. Small GHG reductions at the global level would lead to a low GHG price. Additionally, in the course of enforcement actions against the large economies, trade wars could ensue (Brohé et al. 2009). In sum, within the Kyoto mechanism, the negative unilateral enforcement approach is 'weak' in its power to keep the GHG price at a high enough level.

With regard to the Paris mechanism, since almost all countries participate in the GHG reduction obligations within the Paris mechanism, the justifications of countries for their countermeasures against non-complying countries are strong. However, the challenge is that GHG reduction targets are self-imposed. Accordingly, the level of strictness of GHG reduction targets varies across countries. For instance, 192 member countries set 192 different GHG reduction targets in different styles. China intends to reduce carbon dioxide emissions per 'unit of GDP' by 60–65 percent below 2005 levels (China 2015). The USA intends to achieve an economy-wide target of reducing its GHG emissions by 26–28 percent below its 2005 level in 2025.[8] The EU intends to make at least a 40 percent domestic reduction in GHG emissions by 2030 as compared to 1990 (EU 2015). Consequently, since there is no standardization on GHG reduction targets in the Paris mechanism, it would be very difficult to prove whether a level playing field exists among the different countries. Accordingly, in the Paris mechanism, negative unilateral enforcement approach is *weak* in power: it is difficult to trigger the enforcement mechanism due to the lack of information on the differences in the level of strictness of GHG reduction targets.

In conclusion, it is now apparent that the negative approach (both multilateral and unilateral) cannot provide 100 percent assurance that the GHG price can be kept at a high enough level. Given the circumstance that missing just one condition may seriously undermine the possibility of making a substantial GHG reduction at the global level, the negative enforcement approaches do not show any potential to overcome such a fundamental constraint. Without such assurance, project preparers would not venture into expensive green infrastructure financing. However, there remains another option. Let us turn to our last resort to support the GHG price at a sufficiently high level.

Positive Enforcement Approach

The Strength of the Positive Enforcement Approach

When compared with the negative approach as explained above, the 'positive' approach is significantly different in all aspects. The positive approach consists solely of unilateral measures. The core of the positive approach is that the government of a developed country provides a *guarantee* to buy GHG reduction credits at above a minimum price. If GHG price at the time of launching of green infrastructure projects is sufficiently high, the guarantee would be not be used by project-implementing companies. On the other hand, if the GHG price is low, the guarantee would be useful as an incentive. By providing a guarantee, the government of a developed country can provide relevant stakeholders with a 100 percent assurance that the GHG price would be kept at a high enough level at all times. In other words, even though all three conditions (universality of participants, strictness of GHG target-setting, and strength of enforcement) could not be met at the same time, the positive approach could support the GHG price at a sufficiently high level. The proposition that all three conditions should be met at the same time to support the GHG price at a sufficiently high level is based on the premise that they are applied to an ordinary, non-state-controlled market. In this context, it should be noted that the essence of the positive approach is that there is government intervention to cure market failure. The strength of positive approach is that its enforcement is simple and failure-proof. Once the government of a developed country decides to provide a guarantee to buy GHG reduction credits at above a minimum price, the result is immediately available. Furthermore, there is no need to monitor evasion, unlike the negative approach, which is based on punitive measures.

Making the Positive Enforcement Approach Compatible with International Law

The positive approach makes use of two infrastructure project models of developing countries that were explained in Chap. 4: the government budget-based model and the private investment-based model. At this point, it is very important to note that while a guarantee is given to the government of a developing country under the government budget-based model, a guarantee is given to the 'private company' of a developing country under the private investment-based model. Looking first at the details related to the government budget-based model, if the government of a developed country provides a guarantee to buy GHG reduction credits at above a minimum price to the government of a developing country, such action is likely to conflict with the rules regarding subsidies in the WTO regime. Under the model as noted above, the government of a developing country finances a project through its public budget that is based on either tax, or loans mostly from developed countries. If a developing country plans to seek loans, it would take either a soft loan or an export loan (see Chap. 4). At this point, it should be reiterated that ODA (Official Development Assistance) consists of grants, soft loans and technical assistance. If a foreign country makes a loan proposal and additionally offers a guarantee to buy the GHG reduction credits from the project at 'above' the market price, such an additional guarantee may constitute a subsidy under the WTO regime: the gap between guaranteed price and market price may be regarded as a 'financial contribution' by the foreign country to entice a developing country to select its loan proposal and buy the equipment and technology of its national companies. However, the risk of being defined as an illegal subsidy under the WTO regime diminishes if the loan-providing country observes the relevant rules of the ODA (Petsonk 1999). Accordingly, given that the *OECD Arrangement on Officially Supported Export Credits* provides for the rules to mix export loans and ODA with a view to fostering a level playing field between loan-providing countries, such ODA-related rules could allow the government budget-based model to remain legitimate under the WTO regime as shown in Table 7.3.[9] Precisely speaking, this rule applies only to a 'tied' ODA that is provided on the condition that a recipient country buys equipment and technology only from the ODA-providing countries.

To understand the logic, let us first review the typical formula of a mixed loan that consists of export loans and ODA. Generally, a mixed loan provides a developing country with better terms and conditions than a commercial loan does. For instance, the interest rate is lowered and the maturity is lengthened, when export loans are mixed with an ODA loan that has a lower interest rate and longer maturity. Thus, a loan-providing country is tempted to include more ODA in its mixed loan to entice a developing country to select the loan proposal and thus to buy the equipment and technology of the loan-provider's national companies. However, in an attempt to discourage such misuse of ODA for export-promotion purposes, the OECD Arrangement stipulates that if an export loan is mixed with ODA, it should be designed in such way that its concessionality level shall be at least 35 percent or higher.[10] As background information, the concessionality level means the *grant*

Table 7.3 A formula of mixed loans involving GHG-related profits

	Types of mixed loans	Concessionality level (granting portion) (%)
ODA context	Export loans + ODA	≥35
GHG context	Export loans + Payment for GHG (only when above the market GHG price)	≥35
	Export loans + ODA + payment for GHG (irrespective of market GHG price)	≥35

portion of the mixed loan compared to a commercial loan. Accordingly, if the concessionality level of a mixed loan is 35 percent, a loan-providing country recovers only 65 percent of the total value of the mixed loan from the loan-receiving country when the mixed loan matures. Namely, 35 percent is given free to the loan-receiving country. Hence, the OECD Arrangement basically intends to reduce the commercial profits made from the mixed loan by way of raising the grant portion of the mixed loan once a commercial loan is mixed with ODA. In essence, it can be said that the OECD Arrangement is basically aimed at preventing excessive competition among OECD member countries with regard to the promotion of their exports; the OECD Arrangement intends to prevent ODA from being misused as de facto export subsidies for the companies of ODA-providing countries.

In this setting, the rules of the OECD Arrangement in the GHG context have two scenarios. The first scenario is the combination of two elements: export loan and the payment for GHG reduction credits. This first scenario is possible only when the government of a developed country pays for GHG reduction credits of a project at above the market price, thus creating kinds of ODA effect. The gap between the guaranteed price and the market price could be regarded as grants. Then, for legitimacy under the OECD Arrangement and WTO regime, the mixed loan must be designed with a concessionality level at 35 percent or higher. However, it should be noted that if a private company from the developed country buys the GHG reduction credits from the concerned project, the concessionality test may not need to be applied to the mixed loan even if the buying price is a somewhat higher than the market price. So long as the private company is not a direct party to the loan contract, the concessionality test need not be applied.

The second scenario is a combination of three elements: export loan, ODA and the payment for GHG reduction credits. In such a case, the concessionality test should be made irrespective of whether or not the government of a developed country guarantees purchase of GHG reduction credits at above the market price since the determinative factor is the existence of ODA in the mixed loan package. In sum, so long as the government budget-based models observe the rules of the OECD Arrangement, potential risk of conflict with WTO rules is diminished.

At this juncture, it should be admitted that the use of a government budget-based project model is in fact 'limited' because the role of the public sector in infrastructure financing is increasingly diminishing. In contrast, the private sector has enormous potential to supply the much-needed financial resources for infrastructure projects (Della Croce and Yermo 2013). That is why the positive approach needs to put more emphasis on the private investment-based project model. However, private investors are unlikely to put their money into infrastructure projects unless they are protected from the diverse risks of such infrastructure projects. Under such circumstances, the guarantee by the government of a developed country to buy GHG reductions from the project concerned at above a minimum price could serve as an 'external protective device' for private investors. It can protect the interest of private investors even when the system of a developing country fails. For example, whether a developing country fails to honor an output purchase agreement under a PPP (public-private partnership) model, or whether the economy of a developing country fails to enable a project of a privatization model to generate the adequate revenue, private investors could secure stable profits by selling GHG reductions to the government of a developed country at a guaranteed price. Such an external protective device is indeed insulated from the malfunctioning system of the developing country. Hence, by boosting the financial credibility of a project, such a guarantee will send an attractive signal to potential investors.

In terms of the legality of the guarantee, the private investment-based project model does not violate the WTO rules on subsidies. This is primarily the case because such a guarantee given by the government of a developed country to a project-implementing company in the developing country constitutes a general exception approved under Article XX of the General Agreement on Tariffs and Trade (GATT). Article XX provides for general exceptions to discriminatory treatment in the international commerce as follows:

> Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, *nothing in this Agreement*

shall be construed to prevent the adoption or enforcement by any contracting party of measures:

(a) necessary to protect *public morals*;
(b) necessary to protect *human, animal or plant life or health*;
(c) relating to the *conservation of exhaustible natural resources* if such measures are made effective in conjunction with restrictions on domestic production or consumption. [Emphasis added]

To clarify, it can be said that the guarantee constitutes an act of supporting public morals in the global community. Namely, it should be noted that the final beneficiaries of such guarantees are 'developing countries.' The guarantee is necessary in the context of providing green infrastructure to developing countries that do not have adequate resources to build and operate green infrastructures for themselves. In particular, such a guarantee complements the role of the government of developing countries when developing countries are unable to honor output purchase agreements for lack of adequate government budgets or where their economies cannot ensure the adequate revenue for the investors of these infrastructure projects. Further to the argument of public morals, it should also be recalled that providing green infrastructure to the developing world is an international mandate under the Sustainable Development Goals (SDGs) set by the global community in the UN Assembly in 2015. Attempts to undermine the basis of a GHG profit guarantee without presenting an alternative means of providing green infrastructure to developing countries need to be viewed critically by our global community. Hence, given that the guarantee assists developing countries in obtaining infrastructure, it constitutes an act of promoting public morals within the global community. In a similar context, it can also be said that the guarantee constitutes an act of conserving exhaustible natural resources as well as protecting human, animal or plant life or health. It should be reiterated that if the profits from selling GHG reductions cannot fill the gap between the cost of conventional infrastructure projects and the cost of green infrastructure projects, the private sector is unlikely to launch 'expensive' green infrastructure projects instead of relatively 'cheap' conventional infrastructure projects. Without such guarantees to ensure adequate profits to the private sector to accommodate the gap in costs, our global community could not ensure the global spread of green infrastructure at the rate we need or expect. In short, attention must be paid to the nature of guarantees as *global public goods* for expanding the size of the market for green infrastructure and for promoting innovation of relevant technology.

In addition to these arguments for general exceptions, a procedural aspect should be noted. As emphasized above, a guarantee is provided to the company of a developing country by the government of a developed country, while the company implementing a project in a given developing country is usually formed under the laws of the same, although the main investors of the project are likely to come from a developed country. Given that the WTO Agreement on Subsidies and Countervailing Measures stipulates that a subsidy is a financial contribution specific to an enterprise or industry or group of enterprises or industries within the jurisdiction of the granting authority, such procedural consideration may also be taken into account in applying the WTO rules on subsidies.

Some Fundamental Reflections on Market Mechanisms

Last but not least, our global community needs to think about the effectiveness of market mechanisms in reducing GHG emissions. In order for the GHG market to function properly, the GHG price should be kept at a sufficiently high level as explained above. However, the GHG price could be kept at such a level only when the three conditions (universality of participants, strictness of GHG target-setting, and strength of enforcement) are simultaneously met. The three conditions help individual countries consistently reduce their GHG emissions, thus leading to substantial GHG reductions at the global level. If substantial GHG reductions are not made globally, the GHG price would remain low. Unfortunately, the Paris mechanism appears to fail to set strict GHG reduction targets. As explained above, the Paris mechanism is projected to make little contribution to global GHG reductions, given that it will delay the speed of global warming until 2040 'by only eight months.' Consequently, it can be said that the GHG price is not likely to be at a sufficiently high level until 2030. Such a gloomy scenario is already confirmed by the fact that the current average GHG price (US$ 7 per metric ton) is far away from the desired level of the GHG price to limit the rise in global temperature by 2 °C (US$ 80–US$ 120 per metric ton). Accordingly, given that the GHG price is not likely to be supported at a high enough level if it is left only to a market mechanism, the intervention by the governments of developed countries through the support of a minimum level of GHG price is indeed necessary. Precisely speaking, such an intervention by the governments of developed countries has the effects of curing market failure.

Now, it is understandable that there are sharp criticisms about the attempts to reduce GHG through market mechanisms (Pope Francis 2016). Critics argue that the strategy of buying and selling 'carbon credits' seems to provide a quick and easy solution under the guise of a certain commitment to the environment, but in no way does it allow for the radical change that our international society needs (Spash 2009). Under the current cap-and-trade systems, innovations in green infrastructure will not take place as fast as they are required. The risk is that these innovations may simply create the illusory appearance that significant action is being undertaken, thus diverting public attention from the urgency of the problem. Such diversion may delay actions urgently required in order to fight climate change. Importantly, this delay poses a real and present danger to the human race in the fight against climate change, since time is not on our side.

All in all, it should be admitted that our global community faces a collective action problem in responding to climate change. Under the current mechanisms in use to fight climate change, the GHG price is not likely to reach a high enough level. Accordingly, the central challenge that our international community faces now is how all countries can organize themselves to act in a mutually beneficial manner to obtain ongoing joint benefits despite temptations to free-ride, shirk responsibility, or otherwise act opportunistically. The challenges loom larger, given that new institutional arrangements like the Paris Agreement may not work because of the absence of strict requirements, the absence of empirical validity, and the uncertainty that the participants in a field setting may not apply the rules for successful outcomes (Ostrom 1990). To overcome such challenges, as Elinor Ostrom pointed out, it appears to be necessary for our global community to develop the institutions that enable individual countries to achieve productive outcomes despite ever-present temptations to free-ride and shirk responsibility. From this perspective, the negative enforcement approach that is based on punitive actions and which creates incentives for evasion is not a promising candidate. In contrast, the positive enforcement approach that is based on positive incentives and enhances voluntary participation is a strong candidate. Given that market mechanisms have already been adopted by many countries as a major tool to fight climate change, discarding these to look for a new 'weapon' would exhaust substantial time—a poor strategy given that time is not on our side. The alternative is a parallel approach: repairing the current tools and at the same time, trying new ones. In this context, the positive enforcement approach aims at repairing the dysfunctions of existing schemata. Given that the positive enforcement approach brings benefits for all stakeholders, there is no reason not to try it.

Conclusion

The profits of GHG reductions have the potential to be seed money for green infrastructure projects. Thus, the profits of GHG reductions could serve as a linchpin for the *more expensive* green infrastructure projects than the usual conventional infrastructure. It is not difficult to realize such potential because it could be done through unilateral action on the part of the governments of developed countries. Moreover, it does not require any complicated coordination to be effected. As a next step, we will move to another external protective device to be included in a mechanism to protect the interest of institutional investors from diverse risks.

Notes

1. For example, see Ellerman and Decaux (1998, 3).
2. The concept of the Marginal Abatement Cost (MAC) explains well such increasing tendency of GHG reduction cost. See, for example, Morris et al. (2008, 7), Mckinsey and Company (2009, 7).

3. A number of GHG equal to 1.3 times the amount of excess emissions is deducted from the country's assigned amount for the second commitment period (2013–2020). See Brohé et al. 78–79; UNFCCC, http://unfccc.int/kyoto_protocol/compliance/items/3024.php. Accessed 9 July 2016.
4. Article 1 of the WTO Agreement on Subsidies and Countervailing Measures stipulates that border tax adjustment shall not be regarded as a subsidy, in accordance with Article XVI of GATT 1994 and Note to Article XVI, and the provisions of Annex I through III of this Agreement. For Note to Article XVI of GATTT, see WTO Analytical Index, https://www.wto.org/english/res_e/booksp_e/analytic_index_e/gatt1994_06_e.htm. Accessed 16 July 2016.
5. For further details, see Persson (2010, 2).
6. See WTO Agreement on Subsidies and Countervailing, Measures.
7. For the details on the Shrimp-Turtle case, see WTO website, https://www.wto.org/english/tratop_e/envir_e/edis08_e.htm. Accessed 16 July 2016.
8. For the details on USA's commitment, see USA. 'USA INDC,' http://www4.unfccc.int/Submissions/INDC/Published%20Documents/United%20Countries%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf. Accessed 17 July 2016. However, with the announcement of President Trump in June 2017, the USA will withdraw from the Paris Agreement after November 2020.
9. For a background of the OECD guidelines on mixed loans, see Felonis (1984).
10. See OECD. 'Arrangement on Officially Supported Export Credit.' TAD/PG(0214)1, paragraph 38. If the beneficiary country is a Least Development Country (LDC), concessionality level shall be at least 50 percent or higher.

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8

Multilateral Development Banks as Overarching Protectors of Green Infrastructure Projects

Introduction

As found in Chap. 5, two policy ideas are critical to involving private investors in green infrastructure financing: the incorporation of 'external protective devices' into the design of a project, and adoption of a 'decentralized approach.' Against this backdrop, Chaps. 6 and 7 analyzed the potential of GHG-related profits to be used as an external protective device. In Chap. 8, we will continue our journey to explore another external protective device of green infrastructure projects. In this context, the *multilateral development banks (MDBs)* can be strong candidates for such an external protective device to protect private investors' interests from the diverse risks of green infrastructure markets in emerging and developing countries. Precisely speaking, MDBs' operating instruments such as guarantees and equity investments are considered to be an external protective device as they can provide protections for institutional investors 'outside' the system of developing countries based on MDBs' strong negotiation power vis-à-vis the governments of developing countries. The key strength of MDB involvements is that MDBs can attract much larger amounts of private

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investment relative to just the small amount of money to which they provide protection. Private investors have a tendency to trust projects in which MDBs are involved irrespective of the proportion of the MDB involvement. Such a tendency is understandable, because individual countries will not generally ignore the interests of MDBs that provide them with the financial resources under favorable conditions for various projects and exert a great influence in the international capital market (Delmon 2009). In this sense, MDBs can serve as an overarching protector of institutional investors in green infrastructure projects. The following will first provide an overview of MDBs. Then, the question of how to engage MDBs in green infrastructure financing will be examined. Lastly, some suggestions on scaling up MDB involvements in green infrastructure markets in developing countries will be made.

An Overview of MDBs

Mandate

MDBs were established after the Second World War in order to support postwar reconstruction. In the twenty-first century, MDBs have shifted the main focus of their operations to the promotion of global poverty reduction through an inclusive and sustainable globalization.[1] The history of MDBs began with the establishment of the World Bank in 1944. Afterwards, regional MDBs were established on each continent; namely, the Inter-American Development Bank (IDB) in 1959, the African Development Bank (AfDB) in 1964, the Asian Development Bank (ADB) in 1966, the European Bank for Reconstruction and Development (EBRD) in 1991, and the Asian Infrastructure Investment Bank (AIIB) in 2015.

Seed Capital Structure

The seed money of an MDB is mobilized through the selling of its shares at a specific price to each member country (Mistry 1995). Simply put, after the total volume of shares of an MDB is fixed, they are allocated to each member country in proportion to the relative weight of its national economy in the global economy. Such seed money is also called 'equity.' The details of seed money structure of an MDB are as follows: first, the total amount of seed money to be mobilized must be approved by the board of an MDB. Such initially planned seed money is called 'authorized capital.' When such total amount of initial seed money is fixed, the total number of shares to be issued is decided. Usually, the price of shares is calculated by dividing the total amount of the planned seed money by the total number of shares that are issued. For instance, if the initially planned seed money is US$ 100 billion, and the number of shares to be issued are 1 million, the price of shares are US$ 100,000 per share. It should be noted that not all shares that are approved by the board are allocated to member countries. That is to say, only the minimum number of shares that should be subscribed by a member country is fixed, while some of shares remain unallocated.[2] Thus, the minimum number of shares that should be bought by an individual member is called 'subscribed capital.' Such subscribed shares are further divided into two kinds: callable shares and paid-in shares. To clarify, even if shares are allocated to an individual member country, it does not make a lump-sum payment for those allocated shares in cash. Generally, the individual member country pays in cash only for a small portion of shares that are designated 'paid-in capital,' and postpones paying for the remaining shares, which are named 'callable shares'. The payment for such callable shares is generally made when the individual country receives a request by the MDB to pay for the rest of the shares. Such a situation occurs if the MDBs' resources are depleted. Seed capital structures of representative MDBs are indicated in Table 8.1.

Voting Power

Importantly, the voting power of each member country in an MDB is 'proportional' to the volume of shares that it owns (Mistry 1995). The relations between shares and voting powers of an MDB can be illustrated as in Table 8.2 (IBRD 2016b). For example, the USA has 16.53 percent

Table 8.1 Seed capital structures of MDBs (US$ mil. except for those of EBRD in € mil)[a]

	IBRD (June 2016)	IDB (December 2015)	ADB (December 2015)	AIIB (October 2016)	AfDB (December 2015)	EBRD (September 2016)
Authorized capital	278,400	170,900	147,547	100,000	66,975	30,000
Subscribed capital	263,329	156,864	147,052	89,128	65,482	29,700
Callable capital	247,524	151,240	139,678	80,000	60,598	23,500
Paid-in capital	15,805 (6%)[b]	5624 (3.6%)	7374 (5%)	20,000 (20%)	4884 (7.4%)	6200 (20.8%)

[a]IBRD (2016a), IDB (2016), ADB (2016), AIIB, "Purpose, Functions and Membership" (2016), AfDB, "Information Statement" (2016), EBRD, "Investment of Choice" (2016)

[b]A percentage of subscribed capital

Table 8.2 An example of relations between shares and voting powers of the IBRD

Country	Value of share (US$ mil.)	No. of voting powers	Percent of total voting power
USA	38,367	384,361	16.53
Japan	16,544	166,127	7.15
China	10,659	107,277	4.61
Germany	9657	97,257	4.18
France	9040	91,087	3.92

of voting power, while France has 3.92 percent of voting power. A country with a higher percentage of voting power could have greater influence in the decision-making process of the MDB; for instance, in relation to decisions to provide loans to other member countries.

Another interesting aspect of such voting power of MDBs is that it is linked to the voting power in other financial institutions (Mistry 1995). For instance, countries cannot become members of the World Bank unless they are already members of the International Monetary Fund (IMF). Therefore, it should be noted that the voting power of a country in the World Bank and that of the same country in the IMF are generally interlinked. As background information, while the World Bank provides mid-to long-term loans to developing countries in order to promote their poverty reduction, the IMF lends short-term loans in foreign currency to countries that suffer foreign currency shortages. Namely, the IMF serves as a crisis lender to help countries in making urgent international payments. Accordingly, given that the IMF can greatly influence the destiny of a country in crisis, the voting power that a country has in the World Bank is correspondingly very important in another sense.

Financial Sources

With a view to financing their operations, MDBs rely on four sources: seed capital, earnings from operations, sales of their own bonds, and participations in and sales of their portfolio (Mason and Asher 1973). First, seed capital is composed of callable capital and paid-in capital, as explained above. Second, earnings from operations consist of the commission charges for loans, the fees for guarantee, and the dividends from equity investments. Equity investments function to acquire part ownership of an asset; for example, through purchase of the shares of the asset. Simply put, equity is seed money and equity investment provides such seed money. Details on equity investment will be explained in Chap. 9. Third, the sales of the MDBs' bonds are a means to borrow money from investors in the capital market. Such sales fall into two classes: long-term bonds to private investors, and short-term bonds to government agencies such as central banks. Fourth, participations take place when an MDB loan is made and investors then contact the MDB to take part in a proportion of the loan, while the sales of portfolio are brought about when an MDB sells investors some part of the loans that it already provided.

Among the four sources, the chief source of financing for MDB operations is *borrowing*, namely, the sales of their own bonds (Mason and Asher 1973). In fact, the original architects of the World Bank intended to finance its operation with the borrowing of private resources from international capital markets rather than relying on the use of government-provided seed capital. This pragmatic goal has been realized through the practices of MDBs. Consequently, given their excellent credit ratings, MDBs can generally borrow money at a low interest rate with longer terms to maturity by selling their bonds in the international capital markets. With the borrowed money from the international capital markets, MDBs provide, in most cases, loans at a lower rate with longer terms to maturity than commercial financial institutions provide to the governments of developing countries. From the point of view of these governments, such borrowing with favorable conditions from MDBs gives them a big advantage since their relatively low credit rating would otherwise prevent them from obtaining such favorable conditions on the international capital markets. At this point, it should be noted that the interest rate of an MDB loan is set above the borrowing interest rates of an MDB itself in the international capital market but below the interest rate that a developing country would pay in the international capital market.

Regarding the other sources, looking first at seed capital, the architects of MDBs aimed to support MDBs' borrowing power with the government guarantees from all member countries; any MDB debts to creditors would be paid from the members' seed capital (callable capital and paid-in capital) (Mason and Asher 1973). However, if an MDB has to call up its seed capital in order to pay its debts, this could send a negative signal that the MDB is in financial trouble, namely that the MDB is exhausting its seed capital itself. Such a situation would seriously undermine the MDB's credit in the capital markets. Accordingly, this would be the worst scenario for the MDB. Given that seed capital is the financing source of last resort, MDBs cannot use their seed capital for ordinary operations (Mason and Asher 1973).

Second, there are earnings from operations. Given that MDBs are not commercial profit-seeking institutions, their earnings are not big enough to play a substantial role in the MDBs' operations. For instance, while the gross disbursement of the IBRD in the fiscal year 2016 was US$ 22.5 billion, its net income was only US$ 0.49 billion (IBRD 2016a).

Lastly, there are the participations in and sales of MDBs' portfolios (Mason and Asher 1973). In the past, such participations in and sales of MDBs' portfolios constituted a considerable portion of MDBs' financing sources. For instance, while total loans of the World Bank amounted to US$ 16.1 billion in the fiscal year 1971, outside participation in these loans totaled US$ 2.4 billion. However, such partnerships with private financial institutions declined after 1961–1962 for various reasons. Initially, there was a rise in the international interest rate; given that the interest rates of MDB loans were generally lower than commercial interest rates, the gap between profits from the interest payments of MDB loans and profits from the interest payments of commercial loans expanded. Consequently, private financers found it increasingly difficult to tolerate lower profits from loan participation provided by MDBs to member countries. Furthermore, the quality of loans held by MDBs deteriorated as the MDBs shifted their lending operations from war-torn, but rapidly recovering, developed countries to developing countries.

Operating Mechanisms

Four Instruments

MDBs generally have four operating instruments: loans, grants, guarantees, and equity investments.[3] Loans in this context are soft loans that have lower interest rates and longer terms to maturity. Grants are financial aids that do not require repayment. Guarantees function to assume the responsibility of guarantors in the event of guarantor default on their obligations. Details on guarantees will be explained later on. Equity investments are, as explained above, for acquiring part ownership of an asset; for example, by buying shares in the asset.

Loans vs. Guarantees

Originally, the World Bank, the first MDB, was primarily designed to use guarantees instead of loans (Humphrey and Prizzon 2014). The intention of the World Bank's designers is well illustrated by Article 1 of its founding agreement:

> The purposes of the Bank are:
>
> (i) To assist in the reconstruction and development of territories of members by facilitating the investment of capital for productive purposes, including the restoration of economies destroyed or disrupted by war, the reconversion of productive facilities to peacetime needs and the encouragement of the development of productive facilities and resources in less developed countries.
> (ii) To promote *private foreign investment* by means of *guarantees* or participations in loans and other investments made by private investors; and when *private capital* is not available on reasonable terms, to supplement private investment by providing, on suitable conditions, finance for productive purposes out of its own capital, funds raised by it and its other resources. [Emphasis added]

From this founding document, it is clear that the World Bank intended to facilitate private capital flows through the use of guarantees, supplemented with direct loans only when necessary. However, this original intention was discarded immediately after the establishment of the World Bank as a result of two problems (Humphrey and Prizzon 2014). Firstly, there were concerns that providing guarantees for the bonds issued by member countries would 'damage the borrowing power' of the World

Bank by undermining its credit. As we know, a bond is a debt instrument through which an investor lends money to an issuing entity in the form of purchasing the bond. At the end of the terms to their maturity, bonds must be re-purchased together with interest payments by the issuing entity. Generally, bonds issued by a poor country have a higher possibility of becoming worthless papers if the issuing country goes bankrupt. Consequently, bonds issued by a poor country need to be promoted with the assurance of higher interest payments in order to be sold in the capital market, while bonds issued by a rich country can be sold even with lower interest payments. In effect, given that the World Bank intended to finance its operation with private resources mobilized from international capital markets rather than relying on the use of its government-provided seed capital, undermining its credit could be considered a 'suicidal' act, with the logic deemed as follows, in the words of Crena de Iongh: 'It would not be a very good thing for the Bank's credit if a bond of some small country with the guarantee of the Bank would be quoted in the market at a lower rate than bonds of a big country also guaranteed by the Bank. This would cast some shadow on the solvency of the Bank' (Mason and Asher 1973). In other words, since the World Bank did not have enough financial capacity to repay guaranteed debts at the initial stage of its establishment, there were concerns that a guarantee provided to the big volume of bonds of a 'big country' would increase the probability of bankruptcy of the World Bank more than a guarantee provided to the small volume of bonds of a 'small country.' Hence, there were concerns that the bonds of the big country would reflect such a risk in its price, and consequently reflect a lower price than that of the bonds of the small country that placed a lesser financial burden on the World Bank. From this reasoning, it is apparent that had the World Bank been involved in guarantee operations at the initial stage of its establishment, its credit rating would have been exposed to constant testing by the market and would have undergone constant 'fluctuations.' Instead, the World Bank moved directly into lending operations when it opened its doors in 1946 (Humphrey and Prizzon 2014). Since the World Bank was not involved in guarantee operations, its credit rating did not undergo the risk of frequent testing nor was it subjected to fluctuations in the capital markets. Instead, the World Bank began with a seemingly 'stable and high' credit rating at the initial stage of its establishment (Mason and Asher 1973). Such a stable and high credit rating helped the new financial institution strengthen its borrowing power and its new position as a 'bank' in the capital market.

Secondly, when a borrower intended to receive the same amount of money, guarantees cost 'more' in comparison with other instruments, reflecting the higher transaction costs generated by guarantees (Humphrey and Prizzon 2014). In other words, while loans involve only two parties (a borrower and the World Bank), guarantees involve three parties (a borrower, a lender, and the World Bank). As a result, since guarantees involve more than one party (a lender), the procedures of a guarantee are more complicated than those of loans, costing more time and more money. Consequently, from the point of view of the borrower, loans are a natural choice. At this point, it should be reiterated that the MDBs' main customers have been the governments of member countries because the MDBs' main operations are related to infrastructure projects that generally belong to the realm of governments.[4] In sum, MDBs were originally designed to help the public sector with private resources, while currently MDBs are helping the public sector with the MDBs' own resources as illustrated in Table 8.3. This is primarily due to the disadvantages of guarantees, as noted above.

Today, given the huge infrastructure needs of developing countries, MDBs need to play more active roles in accelerating financial flows into these developing countries. Nonetheless, so long as the governments of these developing countries are the MDBs' main customers, the MDBs cannot accelerate such financial flows given that the respective governments are constrained in their borrowing capacity (see Chap. 3). Moreover, the scale of many infrastructure projects is beyond the ability of MDBs to finance directly through the MDBs' own resources (Humphrey and Prizzon 2014). Consequently, the current business model, in which MDBs help the public sector with the MDBs' own

Table 8.3 Main customers and financial sources of MDBs

	Original intention	Current practice	Future recommendation
Main customer	Public sector	Public sector	Private sector
Financial source	Private resources	MDBs' resources	Private resources

resources, is approaching its limit in addressing the huge infrastructure needs of developing countries. In this context, new business models are necessary for both the countries in question and the MDBs. A possible solution could be to transfer more weight to an innovative model in which MDBs help the 'private sector' with 'private resources,' in addition to helping the public sector with the MDBs' own resources. Effectively, this is a shift from a public budget-based model to a *private investment-based model*.

To illustrate, let us suppose that private project-implementing companies in developing countries intend to finance their infrastructure projects with the *payment* that the governments of these developing countries make for project infrastructure services. Of course, private investors lending their money to the project-implementing companies want protection from the diverse risks of infrastructure markets in developing countries. At this juncture, the intervention of MDBs could be very useful through guarantees providing that the MDBs would cover payments for infrastructure service to the companies in the event of default by the governments of developing countries. Such a private investment-based model has the potential to facilitate the flow of huge resources from institutional investors into green infrastructure markets in developing countries.

However, before examining how MDBs could promote the private investment-based model, it is important to ascertain whether the original two problems that forced MDBs to prefer loans to guarantees could affect the private investment-based model. As noted above, those two problems of guarantees are the undermining of the MDBs' credit rating, and their higher transaction costs. To begin with, the credit rating problem could re-emerge under the public-private partnership (PPP) model in the form of a difference in the prices of bonds of a small project and a big project. With the provision of guarantees to bonds of individual projects, the bonds of a small project guaranteed by an MDB could sell at a higher price than the bonds of a big project also guaranteed by the same MDB. The difference in prices could arise, reflecting the risk that the big volume of bonds of a big project could increase the probability of bankruptcy of the MDB more than the small volume of bonds of a small project in the event of failure of the concerned project to create revenues necessary for repurchasing its bonds at their committed price along with interest payments to investors. Such a situation could cast a shadow on the solvency of the MDB. Hence, if such a difference materializes in reality, it could imply financial weakness on the part of the MDB, thus undermining its credit rating and borrowing power. However, MDBs could avoid such vulnerable situations by adjusting the scope of coverage of their guarantees; namely, if the scope of the coverage by the guarantee could be differentiated for the same project, it is natural that there would be differences in the prices of bonds of individual projects guaranteed by the MDB. So long as an MDB does not provide 100 percent coverage of risks for all projects, the price in the different project bonds guaranteed by the same MDB would not matter. With regard to the higher transaction cost problem, it should be noted that the scale of many infrastructure projects is beyond the ability of MDBs to finance directly with the MDBs' own resources. Thus, although loans have lower transaction costs than guarantees, they would usually be excluded from the choice of instruments under the private investment-based model.

The Use of MDB Guarantees

Types of Guarantees

A guarantee involves three parties: a guarantee is a commitment by a 'guarantor' to assume the responsibility for the implementation of an obligation of 'another entity' to a 'beneficiary,' and to compensate the beneficiary in the event of non-implementation of this obligation (Independent Evaluation Group 2009). For example, a guarantor pays a creditor the money lent on behalf of a debtor. There are essentially two categories of guarantees: risk guarantees and credit guarantees (Humphrey and Prizzon 2014). A 'risk guarantee' is triggered only if the risks specified by the guarantee contract take place. Such specified risks are nationalization, dishonoring of output purchase agreement, inconvertibility, and changes in laws. A 'credit guarantee' may be called regardless of causes. Given that the World Bank Group is the biggest MDB in the world, it serves to illustrate the types of its guarantees. In detail, the World Bank Group consists of the International Bank of Rehabilitation and

Development (IBRD), International Development Agency (IDA), the International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA) and the International Centre for the Settlement of Investment Disputes (ICSID) (World Bank 2016). The IBRD lends to governments of middle-income and creditworthy low-income countries or provides guarantees in relation to them. The IDA provides interest-free loans and grants to governments of the poorest countries or provides guarantees in connection with them. The IFC usually provides loans, equity, guarantees and advisory services to stimulate the private sector in developing countries. The MIGA provides political risk insurance to private investors to enhance their direct investment in developing countries. The ICSID provides services for conciliation and arbitration of investment disputes. While the IBRD, IFC and MIGA generally finance their operations from their own equity or from money borrowed in the capital market at a very low interest rate utilizing their high credit ratings, the IDA mobilizes its resources mainly from contributions from member countries (World Bank 2016).[5]

Three types of MDB guarantees are illustrated in Table 8.4 (Independent Evaluation Group 2009). To begin with, Type A is an MDB guarantee that could generally be given to private investors of developed countries exposed to risks from the unfavorable acts of the government of a developing country, for example nationalization, defaulting on an output purchase agreement, inconvertibility, and changes in laws. To cover such risks, the MDB could provide a guarantee to compensate the private investors on behalf of the government of a developing country in the event of its unfavorable acts. This Type A is applicable to the PPP model for green infrastructure financing introduced in this book. Examples are the Partial Risk Guarantee (PRG) of the IBRD, the Partial Risk Guarantee (PRG) of the IDA and the Partial Risk Insurance (PRI) of the MIGA (Independent Evaluation Group 2009).[6]

Type B is an MDB guarantee that is given to a lender for the benefit of the government of a developing country that intends to borrow money (Independent Evaluation Group 2009). Generally, given its low sovereign credit rating, the government of a developing country faces unfavorable situations in the international capital market, such as difficulty in borrowing, higher interest rates and shorter terms to maturity. Hence, to

Table 8.4 Exemplary types of an MDB guarantee

	Category	Main beneficiary	Need for guarantee	Example
A	Risk guarantee	Private investors of developed countries	Risks of unfavorable acts by the governments of developing countries	IBRD (PRG) IDA (PRG) MIGA (PRI)
B	Credit guarantee	Governments of developing countries	Low sovereign credit ratings	IBRD (PCG)
C	Credit guarantee	Local banks or companies of developing countries	Low bank or company credit ratings	IFC (PCG)

complement the developing country's low credit rating, the MDB could guarantee that it will pay the lender the lent money in the event of non-payment by the developing country. Consequently, the developing country government could borrow money under better financial terms including lower interest rates and longer terms to maturity. An example is a partial credit guarantee (PCG) by the IBRD. Interestingly, given that the IDA aims to assist the poorest countries that are considered non-creditworthy in the debt markets, the IDA does not provide a PCG (Delmon 2009).

Type C is an MDB guarantee that is generally provided to creditors for the benefit of a local company in a developing country (Independent Evaluation Group 2009). Given that local companies in developing countries may not have sufficiently high credit ratings to borrow money from local or international capital markets, an MDB guarantee could boost the local companies' credit ratings, enabling them to get loans with lower interest rates and longer terms to maturity from these capital markets; the partial credit guarantee (PCG) provided by the IFC is a good example.[7]

Multiplying Effects

From the MDBs' point of view, the key strength of guarantees in comparison with other instruments such as loans and grants, is that guarantees can mobilize the greatest financial resources through their *multiplying effects* where the amount of seed money is the same. Because of the huge infrastructure needs of developing countries and the shortage of their public resources, such an advantage makes guarantees a strong candidate instrument for alleviating the shortage of financial resources in green infrastructure markets in developing countries. Such a multiplying effect of MDB guarantees takes place based on the MDBs' special relations with their member countries, in essence 'outside' the MDBs. This is possible because an MDB has very strong deterrence power to prevent its member countries from defaulting on their obligations to private investors (Delmon 2009).[8] Accordingly, MDBs provide guarantees only to the extent necessary to mobilize the private financing for a project (World Bank 2012a). Namely, by guaranteeing only a small portion in a project, an MDB can send a positive signal to other private investors that the project concerned is safe from the risks of default by the developing country government's obligations. That is why the MDBs generally provide partial guarantees as implemented by the Partial Risk Guarantee (PRG) or Partial Credit Guarantee (PCG) of the World Bank.

Deterrence Power

Looking into the deterrence mechanism in more detail, the basis of such strong deterrence power is the *creditor-debtor relations* created by the 'counter-sovereign guarantee' that an MDB generally requests from the government of a developing country when the MDB provides a guarantee to any beneficiaries (Independent Evaluation Group 2009).[9] By way of illustration, if one supposes that a project-implementing company of a developing country makes a PPP contract with the government of that developing country, an MDB could provide a guarantee to the company that the MDB would pay on behalf of the government. In the event, the MDB could demand that the government repay the money to itself. At this point, the relations of creditor and debtor are created between the MDB and the individual country through the counter-sovereign guarantee. If the individual country does not repay the money to the MDB, the individual country could face serious consequences: given that MDBs provide financial support to many projects in developing countries with favorable conditions, dishonoring contracts with the MDBs may prevent the individual country from further borrowing from the MDBs. Moreover, given that the major shareholders of MDBs are also members of the Paris Club (the international public creditors' group) and MDBs also attend the Paris Club, this could be shared with the Paris Club that meets monthly; in such a case, major international lenders are unlikely to lend money to the country in the future. Thus, it would become very difficult for the country to borrow money from MDBs and the international capital market. At this point, it should be reiterated that developing countries are usually faced with constraints in public budgets, seeking overseas financing to implement essential infrastructure projects. Generally, if MDBs are involved in a project by providing a guarantee, such a guarantee is likely to be called into action infrequently (Humphrey and Prizzon 2014).

As already noted, given these strong deterrence effects, an MDB's guarantee does not have to cover the full amount of money concerned, but generally covers only a portion of the amount of money concerned (Delmon 2009). Such strong deterrence power and the strong multiplying effect are well illustrated by the evidence that each dollar of guarantee catalyzed US$ 6 of private finance over the past decade under the Partial Risk Guarantee Program (PRG) of the IDA (World Bank 2013a). It can be said that partial guarantees of the IDA help the private sector of developing countries to mobilize 'six times' as much as the guaranteed money.

Such partial guarantees are also useful to prevent the occurrence of moral hazards (Humphrey and Prizzon 2014). If borrowers receive 100 percent coverage, they are unlikely to have a strong incentive to monitor the performance of projects (Mody and Patro 1996). In this sense, partial guarantees maintain a proper level of incentive for borrowers to undertake their own due diligence on the projects. In practice, such a partial guarantee considers not only the portion of the money covered but also timing of coverage. For instance, the IBRD and IFC cover payments in the latter stages of project life, somewhere between years 10 and 15 in the event of a debt service default of a project whose life is 15 years (Independent Evaluation Group 2009). Any default before that time would be the lender's risk.

Such partial guarantees are particularly useful in nurturing domestic capital markets in developing countries where the strength of the MDBs' credit ratings can have a greater impact, with the investors finding the resulting product more attractive (Humphrey and Prizzon 2014). It should be reiterated that project-implementing companies of developing countries are amongst the beneficiaries of such partial guarantees in their status as companies formed under the domestic laws of these countries. Guarantees help those companies to mobilize financial resources in international capital markets as well as in domestic capital markets in developing countries, which tend to be populated by extremely conservative investors and are usually inaccessible to most companies except the local blue chips that already have excellent credit ratings with no need for further rating improvement.

At this point, some clarification is necessary in relation to the possible multiplying effect 'within' MDBs themselves. Such a multiplying effect within MDBs could take place if MDBs finance their guarantee operations with 'their own resources.' This follows because a guarantee typically requires no immediate payment (WEF 2015). Namely, while loans and grants immediately decrease the financial reserves of providers, guarantees do not immediately reduce their financial reserves unless a negative event occurs in the short term. Since guarantees use up less MDB resources than loans, more resources could be put to use elsewhere. Consequently, this sporadic nature of a guarantee enables even small amounts of financial resources to be spread across multiple projects (Humphrey and Prizzon 2014). However, since the private investment-based model does not use MDBs' own resources but facilitates direct financial flows between private investors and project-implementing companies, the possibility of putting the unused MDB's own resources elsewhere does not apply. Hence, a multiplying effect does not take place within the MDB under the private investment-based model.

Last but not least, it is important that the inclusion of an MDB's guarantee in the design of a bankable project should not be interpreted as applying pressure on developing countries. On the contrary, it should be noted that such inclusion fundamentally aims to assist developing countries in gaining trust from foreign investors. It should be remembered that the key role of an MDB's guarantee is to enhance the credit of the projects that urgently need foreign investments. Thus, involvement of an MDB in green infrastructure financing would send a clear signal to foreign investors that their interests would be protected in a reliable manner from diverse risks.

The Use of Equity and Debt Investments

Equity

As will be explained in Chap. 9, an equity investment means the act of buying part ownership of a company, usually in the form of buying its shares. Becoming an owner of a company presents a 'high risk and high return' since the owner is fully responsible for the outcome of management (Delmon 2009). Once investors become an owner of that company, this means that they are in the same boat, sharing a common fate with the company. In this context, it should be noted that equity investors are given the lowest priority in terms of rights to get a company's revenue or assets. Accordingly, after lenders obtain any fixed revenues or any portion of assets, equity investors are the last ones to have the rights to any remaining revenues or assets.

Interestingly, equity investments by MDBs can also bring about *multiplying effects*, inducing a greater volume of private financial flows into public-private partnership (PPP) projects. A representative example is the IFC of the World Bank Group. Generally, an infrastructure project receives equity investments amounting to between 10 to 30 percent of the total investment (Weber and Alfen 2010). Given that a government is obligated to purchase service from a project-implementing company through an output purchase agreement under PPP models, an MDB's participation in the company as equity investor creates *de facto creditor–debtor relations* between the government and the MDB.

If an MDB joins a project-implementing company of a PPP infrastructure project as an equity investor, the MDB has the right to revenues or assets of the project only after lenders obtain any fixed revenues or any portion of assets. Under this circumstance, as the MDB is the last one to recover its invested money from the infrastructure project, creditors can recover their lent money from the project ahead of the MDB. This means that they are automatically protected under the MDB's deterrence

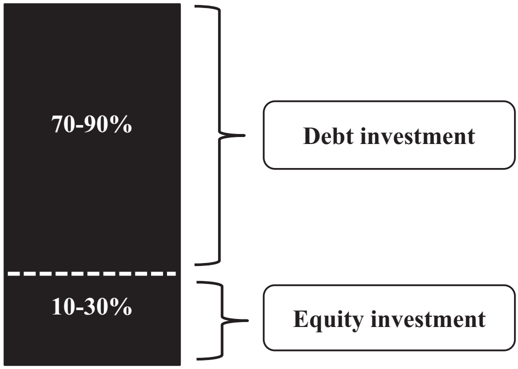


Fig. 8.1 An example of financing sources for an infra project

powers against the diverse risks in the developing country. Consequently, with the small amount of equity investments, MDBs can mobilize a large amount of financial resources from private investors. For example, with an equity participation of only 10 to 30 percent of a project, MDBs can attract 70–90 percent of financial resources from private investors as illustrated in Fig. 8.1.

For MDBs, an equity investment is much simpler than a guarantee because it does not require a counter-sovereign guarantee from the government of a developing country, while it also brings about powerful multiplying effects. A disadvantage of equity investments in comparison with guarantees is that equity investments require MDBs to make 'immediate payment' to the project, whereas a guarantee does not exhaust MDB resources until it is called.

Loans

In an effort to accelerate private financial flows into infrastructure markets of emerging and developing countries, MDBs can also use loans—a typical debt instrument—in an innovative way.[10] In this context, some pilot initiatives find ways of attracting institutional investors into emerging and developing countries. A good example is the Managed Co-lending Portfolio Program (MCPP) launched by the IFC with Allianz in October

2016 (IFC 2016). MCPP allows institutional investors the opportunity to passively participate in the IFC's loan portfolio. Specifically, institutional investors can join the MCPP fund that is managed by the IFC, and then this MCPP fund provides loans to borrowers in emerging and developing countries. The IFC enhances the credit of loans by providing a first loss protection in the event of default. Thus, if any loss occurs, the IFC suffers first. Consequently, institutional investors can rely on the IFC's deterrence powers as well as expertise in managing infrastructure loans. On the donor side, the Swedish International Development Cooperation Agency (SIDA) shares such risks through a guarantee that covers the first loss of the IFC on a portion of the loan portfolio. As a result, the IFC and SIDA partnership is expected to enable each US$ 1 invested to mobilize an additional US$ 8–10 from a third party. In the words of IFC CEO Philippe Le Houérou, 'Yet a huge investment gap exists in this sector—totaling trillions of dollars a year in emerging markets alone. MCPP Infrastructure marks a breakthrough in the search for large-scale financing solutions to the challenges of development. It is a key building block in the global effort to move from billions to trillions in development finance' (Allianz 2016).

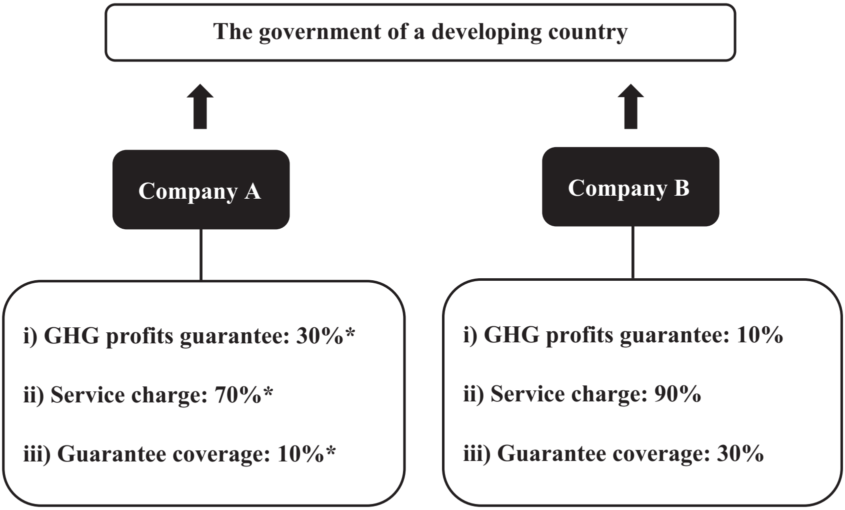
Applying International Competitive Bidding Procedure

A Principle

In the light of above, MDBs appear to be powerful players in the quest to help developing countries mobilize financial resources for green infrastructure projects. However, in order for MDBs to be involved in a specific project, they must go through a mandatory *international competitive bidding (ICB)* procedure. When MDBs provide financial resources to their customers, they must ensure that their customers can select an optimal service provider who provides the best value for money through open competitive bidding. Accordingly, in relation to the MDBs' involvement in the PPP model, the ICB procedure can be applied to two stages: the selection of an infrastructure service provider (also referred to as 'upstream' procurement), and the selection of input providers who will deliver goods and make construction works for the infrastructure service provider (also referred to as 'downstream' procurement) (World Bank 2010a). It should be noted that the service provider means a 'project-implementing company' in the context of this book.

Given this, a problem may arise when an MDB supports a PPP project that is located in a developing country and is connected with a 'specific developed country' through its GHG profit guarantee. For this to happen, an ICB procedure needs to be pursued in accordance with the rules and regulations of the MDBs. Generally, MDBs hold such an international competitive bidding process in relation to a project that the MDBs support with their funding, irrespective of whether the project is a government budget-based model or a private investment-based model (ADB 2015). Thus, this ICB procedure may conflict with a scenario in which a project-implementing company procures equipment and technology from the companies of a specific developed country that provides a guarantee to buy GHG reductions from the concerned project at above a minimum price.

In relation to the selection of an infrastructure service provider, one of the solutions to resolve such a conflict is, firstly, to introduce the ICB procedure in relation to the awarding of a right to implement a project, and then to provide an MDB's guarantee (or make an equity investment) for the successful winner (World Bank 1998). To this end, the government of a developing country and the MDB need to engage in prior consultation on the provision of guarantees (or equity investments) before starting the ICB procedure. They must decide whether an MDB's guarantee (or equity investment) is necessary to boost the financial viability of a project for the purpose of attracting private investment to a project. If they decide that an MDB's guarantee (or equity investment) is required, the government of a developing country may request bidders to indicate how much guarantee or equity investment they need in order to make a project viable. Let us take a hypothetical example as illustrated in Fig. 8.2. The government of a developing country may ask bidders to include three criteria of evaluation in their bidding documents: (1) the amount of GHG profits to be guaranteed; (2) the amount of service charge to be made by the winner; and, (3) the scope of necessary coverage



* Denominator is an entire project cost

Fig. 8.2 An example of international competitive bidding

of the MDB's guarantee. Company A of a developed country may propose that it will provide a guarantee to buy GHG reductions at a high enough price to generate profits to finance 30 percent of a project cost; that it will finance 70 percent of a project cost with service charges made to the government; and that it will request coverage of 10 percent out of the 70 percent of the project cost with an MDB's guarantee. If we interpret the proposal of Company A, given that the combination of GHG profit guarantee and service charge should make 100 percent, Company A intends to cover 30 percent of the project cost with the support of its home country through a GHG profit guarantee. Since a GHG profit guarantee already covers 30 percent of a project cost, Company A reduces substantially the volume of the project cost to be covered by an MDB's guarantee, thus alleviating the financial burden on the government of a developing country caused by its counter-sovereign guarantee responsibility. Overall, Company A intends to cover 40 percent of the project cost with two kinds of guarantees.

In the second scenario, analyzing the proposal of Company B, this company intends to cover only 10 percent of a project cost with a GHG profit guarantee from its home country. 90 percent of the project cost is to be covered by the service charge. In order to protect its investment, Company B intends to cover 30 out of the 90 percent of the project cost with an MDB's guarantee. Hence, the scope of the guarantees' coverage is 40 percent, which is the same percentage as the case of Company A. However, Company B imposes a heavier financial burden on the developing country's government.

Through an ICB procedure, the government of a developing country can select an infrastructure service provider with the most favorable conditions for the developing country. At this point, it should be noted that the three criteria of evaluation given here are merely exemplary and can be reformulated depending on the creativity of policymakers and MDB staff. For instance, a fixed level of an MDB's guarantee could be announced to bidders in advance by the government of a developing country; bidding documents of individual bidders would then be evaluated against the remaining two criteria.

In relation to the selection of input providers who will provide goods and make construction works for the infrastructure service provider, the infrastructure provider may select its input provider using its own procurement procedure. For example, the World Bank exempts the infrastructure service provider from the obligation to use ICB procedure to select its input providers so long as the infrastructure provider is chosen through the ICB procedure (World Bank 2010b). Accordingly, limited competitive bidding may be held only among the national companies of the specific developed country that provides GHG profit guarantee for the project concerned.

Lastly, attention should be paid to the risks of project preparers who work for the institutional investors of developed countries, as explained in Chap. 4. Such project preparers may not be able to secure rights to projects from the governments of the host countries in the ICB process, despite having devoted substantial money and time to project preparation including expensive feasibility studies and the structuring of the project (Hoffman 2008). Accordingly, given that project preparers play a key role in producing bankable projects, the development of proper reward paradigms for them is all the more essential in implementing the strategy for rapid promotion of green infrastructure financing. Given such importance of project preparation work, this issue will be revisited in more detail in Chap. 9.

Exceptions

Although the ICB is an important principle in the MDB operations, the PPP model is not always compatible with the ICB principle in practice due to two considerations: the need for innovative ideas, and the need for private financing. Unfortunately, given the complex and evolving nature of the PPP model in practice, MDBs have not found a solution, for example by standardized guidance, on the question of how to make their ICB principle compatible with the PPP model. Under the current MDB system, attempts to address such incompatibility can be examined as follows.

Firstly, with regard to the need for new ideas, governments can benefit from direct proposals from private investors—unsolicited proposals—as a source of innovation. In the event, if the government implements these project ideas through ICB procedures, this can discourage private investors from making such unsolicited but innovative bids in the future. In order to pre-empt such problems, MDBs may agree that the government will award a bonus score to the original proponent of a project concept in the ICB process—a bonus system as adopted by Chile and South Korea (World Bank 2003). Alternatively, MDBs may provide approval for the government to invite third parties to make better offers for a project during a designated period, allowing the original proponent of a project concept to counter-match any superior offers—the Swiss challenge system as adopted by the Philippines (World Bank 2003). Where neither of these two approaches is taken, the government may purchase the intellective property right for a project concept from the proponent and then award the project through the ICB procedure in which no bidder has a predefined advantage (World Bank 2003).

Secondly, with regard to the need for private financing, MDBs can encourage contributions by private investors to project financing by way of allowing a private investor—a service provider—to select its input provider who will provide the goods, construction works, and services required for the project using its own procedures so long as the service provider is selected through the ICB procedure, as is the case with the World Bank (World Bank 2010b). However, the ICB procedure still needs to be applied to the selection of input providers—downstream procurement—if the service provider is not selected through the ICB procedure and if goods, construction works, or services to be delivered by the input provider are to be financed by the World Bank (World Bank 2010b).

Lastly, a question may arise, 'Can both service and input providers be selected without the ICB procedure?' Such an exception to the ICB principle is possible so long as such procurements assure economy, efficiency, transparency and consistency (World Bank 2010a). However, such an exception to the ICB procedure must comply with applicable MDB integrity and anti-corruption requirements: such an exception needs to demonstrate sufficient fairness, transparency, and competition; further, the resulting contract award must be reasonable in terms of price, quality, and risk allocation (World Bank 2012b). For the selection of input providers by a service provider who does not go through the ICB procedure—depending on the 'added value' of such a proposed PPP project within the relevant MDB's strategic and operational framework—MDBs may endorse the selection of input providers by the service provider if such practices follow competitive bidding procedures acceptable to the MDB or private sector commercial procurement practices. Among common practices to get approved exceptions to the ICB principle is that a construction company—basically an input provider—joins the service provider as an equity investor, or provides loans to the service provider. For a reference for future MDB guidance on procurement under the PPP model, the World Bank guidance on 'direct contracting' may be worthy of note, which allows direct contracting under the following conditions (World Bank 2010b):

> 3.6 Direct contracting is contracting without competition (single source) and may be appropriate method under the following circumstances:
>
> (a) An existing contract for goods or works, awarded in accordance with procedures acceptable to the Bank, may be extended for additional

goods or works of a similar nature. The Bank shall be satisfied in such cases that no advantage could be obtained by further competition and that the prices on the extended contract are reasonable. Provisions for such an extension, if considered likely in advance, shall be included in the original contract.

(b) Standardization of equipment or spare parts, to be compatible with existing equipment, may justify additional purchases from the original Supplier. For such purchases to be justified, the original equipment shall be suitable, the number of new items shall generally be less than the existing number, the price shall be reasonable, and the advantages of another make or source of equipment shall have been considered and rejected on grounds acceptable to the Bank.

(c) The required equipment is proprietary and obtainable only from one source.

(d) The Contractor responsible for a process design requires the purchase of critical items from a particular Supplier as a condition of a performance guarantee.

(e) In exceptional cases, such as in response to natural disasters.

Some Food for Thought to Scale-Up Protective Operations

Despite such great potential of MDBs' guarantees and equity investments in rapidly spreading green infrastructure all over the world, their usage still remains very limited (Humphrey and Prizzon 2014). For example, MDBs approved US$ 37 billion in guarantees between 2001 and 2013, which constitutes only 4.5 percent of the total loans approved by the same MDBs over that period. For equity investments in PPP projects, the number is more negligible. For example, in 2016, equity investments that IFC, the private sector-oriented wing of the World Bank Group, has committed amounts to only US$ 2.6 billion (IFC 2017). In view of this, there are some possibilities for scaling-up the guarantee operations and equity investments of MDBs: the use of trust funds to increase the resources of guarantees, and the use of staff incentives.

The Use of Trust Funds to Increase the Resources of Guarantees and Equity Investments

Resources for guarantees and equity investments must be increased to scale-up operations. A possible solution could be to allow a member country to increase its financial support to an MDB *after* its company wins a PPP contract supported by the MDB's guarantee or equity investment. Since the winner of a contract is supposed to be selected through an international competitive bidding (ICB) procedure, getting financial support from a country whose company has won a contract does not conflict with the untied aid policy of MDBs. As a matter of fact, MDBs adopt the policy of untied aid because tied aid raises the cost of procurement by 15–30 percent (OECD 2001). However, since the recipient country could select the winner that proposed the most favorable price and conditions through the ICB, getting financial support from a country whose company has won the contract does not conflict with the MDB policy of untied aid. Subsequent to the ICB procedure, an MDB can contact a member country whose company has won a contract supported by the MDB's guarantee or equity investment, and request the member country provide financial resources for a guarantee of the contract concerned. The requested member country in question would then have the motivation to provide financial support to the project since its national company would already have won the contract.

How, then, could such a member country, whose company won the contract, provide financial resources for a contract guarantee or equity investment? To this end, the member countries have two possible options: an increase of seed capital, or an increase in the single donor trust fund. Looking first at the option of increasing seed capital, MDBs generally have difficulties in increasing seed capital especially for guarantee operations because such an irregular increase in a specific member country's share of seed capital would change the MDBs' voting power structures. In fact, changing the voting powers of member countries is a complicated process that requires multilateral negotiations among MDB member countries with consideration of diverse factors, such as economic relations and political situations. Such a change would be like opening a 'Pandora's box.' Were voting powers to change whenever guarantees were provided, it could destabilize governance of the MDBs. Hence, providing resources to seed capital is an unrealistic option.

As to second option, increasing the volume of single donor trust funds in MDBs can be analyzed. A single donor trust fund is a fund in an MDB installed by a member country, while a multi-donor trust fund is a fund in an MDB installed by several member countries. Generally, such single donor trust funds are categorized as 'multi-bi' aid—essentially bilateral aid in nature but delivered through a multilateral agency (World Bank 2013b). Such multi-bi funds are used to support projects on which both an MDB and the donor country agree. Simply put, the single donor country could have a say in deciding which project its trust fund will support. If a project-implementing company wins a PPP contract in a developing country through an ICB procedure, a developed country that is connected with the company through a guarantee to buy GHG reductions at above a minimum price could provide resources for the guarantee of the project out of its trust fund in an MDB. Given that such a single donor trust fund is not included in the calculation of seed capital of MDBs, increasing the single donor trust fund would not affect the voting powers of member countries in the least. In this context, single-donor trust funds could be strong candidates to fill the shortage of resources in scaling-up guarantee operations of MDBs. Yet, to date, the weight of single donor trust funds in MDBs' capital structures is not so substantial. For example, only US$ 4.4 billion was held in single donor trust funds of IBRD and IDA as of 2013 (World Bank 2013c), while the seed money (subscribed capital) of IBRD was US$ 223 billion in the same year (World Bank 2013d and IBRD 2013). Namely, the single donor trust fund is only 1.9 percent of the seed capital of the IBRD. Thus, given that single trust funds occupy only a small portion of MDB resources, they have the potential to grow further within MDBs in the context of supporting guarantee operations and equity investments.

However, this second option would be subject to the critique that single donor trust funds undermine aid-effectiveness of MDB work by making their operations 'out of focus,' meaning that each member country would be likely to use its trust fund based on its own priorities, thus failing to align with the priorities of the MDBs (Independent Evaluation Group 2011). In other words, since every member country seeks its own priorities, MDBs would be less likely to achieve focused targets as the MDBs would have to address multiple priorities of individual member countries in their operations. In response to such criticisms, MDBs have been encouraging donor countries to close down single donor trust funds (OECD 2015). However, under the private investment-based model in which MDBs help the 'private sector' mainly with 'private resources,' the use of single donor trust funds could be revisited for the purpose of promoting the *public good* of the global community. Namely, a new mandate could be given to single donor trust funds as a facilitator of financial flows between institutional investors and the project-implementing companies of the green infrastructure markets in developing countries.

The Training and Incentives for Staff of MDB Secretariats

Another point is that the training and incentives of the MDBs' staff are necessary to scale-up guarantee operations and equity investments (Humphrey and Prizzon 2014). Since a guarantee or equity investment involves three parties while a loan involves two parties, preparations for the approval of a guarantee of the MDB board are far more complicated than preparations for the approval of a loan. For instance, MDB staff need to contact not only 'private investors' in relation to the conditions of a guarantee or equity investment but also the 'government of developing countries' to secure the counter-sovereign guarantees from the government or to discuss an output purchase agreement. From the point of view of the MDBs' staff, dealing with two parties instead of one party costs additional time and money, while the fees of a guarantee or equity investment would be generally the same as that of a loan. Furthermore, the MDBs' staff are not familiar with guarantee operations and equity investments because they have been, thus far, seldom used by MDBs. In short, given that MDBs' staff face heavier workloads and are not familiar with guarantee operations and equity investments, providing in-depth training on them along with strong incentives, such as bonus or career advancement, are pivotal in scaling up the use of the two instruments within MDBs.

Conclusion

With the emergence of the private investment-based model in which MDBs help the private sector mainly with private resources, in addition to the old business model in which they help the public sector with the MDB's own resources, it should be noted that MDBs have great potential to facilitate such private financial flows into the private sector of the developing countries. Based on this preliminary work, the final work of designing a bankable project will be examined in Chap. 9.

Notes

1. See, for example, World Bank. 'History.'
2. See, for example, Article 2, Section 3 of Articles of Agreement of the IBRD.
3. See, for example, ADB (2015, 6).
4. See, for example, ADB (2015, 6).
5. See also Article 5 of the Convention establishing the Multilateral Investment Guarantee Agency; Humphrey and Prizzon (2014, 14–16).
6. Generally, it should be noted that guarantees and insurances are interchangeable in a broad term.
7. For the details on the IFC practices, see IFC. 'Structured and Securitized Products.'
8. For relevant discussions, see also Humphrey and Prizzon (2014, 22).
9. However, there are some exceptions with MIGA, IFC and IDB instruments that do not require a counter-sovereign guarantee in relation to PRGs. See Humphrey and Prizzon (2014, 17–18).
10. I am grateful to Mr. Richard Manning for the idea and examples on MDBs' use of loans to mobilize financial resources from institutional investors.

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Part IV

Assembling Components of Bankable Projects

9

Producing Bankable Projects

Cutting the Gordian Knot

In the previous chapters, green infrastructure was presented as effective in achieving two desirable goals: making a country wealthy and checking climate change. To ensure the fast global spread of green infrastructure, a strategy was present to lower the overall cost of green infrastructure. That is to say, with the strategy, the market size of green infrastrucrture is enlarged, which leads to increase in production. This will contribute to decreasing production cost. Decrease in production cost will then increase demand further. As lowered cost increases the demand for green infrastructure, a virtuous circle between cost and demand is created. Such a virtuous circle would bring many global benefits, both to the developing world and the developed world. The key to implementing this strategy is to attract the huge resources of institutional investors into the green infrastructure markets of developing countries. However, institutional investors are hesitant to invest due to the *diverse risks* in these markets (see Chap. 4). Indeed, such diverse risks represent the 'Gordian Knot' in this sector. Correspondingly, eliminating or reducing these risks could be compared to the event of 'Cutting the Gordian Knot' in the green infrastructure markets of developing countries. In this context, Chap. 9 will

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propose the sample designs of a bankable project that provides powerful solutions towards hedging the diverse risks of green infrastructure markets in developing countries.

Investment Instruments of Institutional Investors

An Overview of Private Investment-Based Models

Before proceeding to the main analysis of investment instruments of institutional investors, it is worthwhile to review the private investment-based project models: the Public-Private Partnership (PPP) model and the privatization model. Two key differences between the models are 'ownership' and 'existence of service contract.' While ownership lies with the government in the PPP model, it lies solely with the private sector in the privatization model (Weber and Alfen 2010). Furthermore, in the PPP model, there is a service contract between the government and the private sector, whereas in the privatization model, there is no such service contract between the government and the private sector (Grimsey and Lewis 2004).

With a view to attracting investment from institutional investors, two points are of note. The first is that a project-implementing company should be established in accordance with the laws and regulations of the host country where the project is launched, although main investors of the project are likely to come from overseas. For the PPP model, such a project-implementing company is called a special purpose company (SPC). For the privatization model, there is no specific term for such a project-implementing company. The second point is that the project-implementing company usually relies on a project financing technique to mobilize financial resources for a project: use of projected 'cash flows' from the operation of a project for paying dividends or repaying debts to institutional investors. Namely, once financial resources are mobilized and a project goes into full operation, the project-implementing company gradually distributes dividends to investors or repays its debts to lenders with profits made from selling the infrastructure service to the government or the public over a long-term period.

The question for green infrastructure projects is, which model is preferable? To begin with, in terms of risk reduction, it is better to involve the governments of developing countries, although such governments in Phases 1, 2 or 3 may not be able to fully protect the interests of private investors since infrastructure investment requires long-term periods for recovery of the originally invested money and profits. Governments are generally more reliable customers in the long term than private customers. Accordingly, PPP models are usually preferred for infrastructure service suppliers.

However, if it is difficult to involve the governments of developing countries in green infrastructure projects, the privatization model is an alternative option. Since GHG profit guarantees involve the governments of developed countries, projects financing the *large* portion of project costs from profits of GHG reductions may be more suitable for the privatization model with the GHG profit guarantee as the main protective device. As explained in Chap. 1, projects such as wind power, geothermal power, and hydropower have the potential to finance the larger portion of the project costs with profits from GHG reductions, compared with subway projects and coal-fired power plant projects.

Investment Instruments of Institutional Investors

Types of Investment Instruments for Infrastructure Projects

What the PPP models and the privatization models have in common for green infrastructure projects is that a 'project-implementing company' is the main actor in the project. Such project-implementing companies that are located in developing countries are the final recipients of investment from institutional investors.

When institutional investors intend to invest in the project-implementing companies, they have two instruments: *equity* and *debt*. The difference between equity and debt is whether the 'ownership' of a project is transferred to investors or not (OECD 2015). Obtaining ownership presents an investment profile of 'high risk and high return' to institutional investors. Looking first at equity instruments such as stocks, institutional investors can obtain a certain portion of ownership of a project through buying equity. For instance, if a project-implementing company sells 30 percent of the stocks of a project to an institutional investor, the investor has 30 percent ownership of the project. With equity participation, investors become the owners of infrastructure projects but they are not given collateral for their investments (OECD 2015); instead, investors share a common fate with the project-implementing company. Also, equity investors are given the lowest priority in terms of rights to access project revenues or assets (Delmon 2009). In other words, in terms of priority, other types of investors obtain any fixed revenues or any portion of assets before the equity investors, who are the last ones to have rights to any remaining revenues or assets. Consequently, equity investors bear the highest risks and, therefore, potentially receive the highest returns. Generally, equity investment amounts to between 10 and 30 percent of the total financing volume of an infrastructure project (Weber and Alfen 2010).

Second, looking at debt instruments, debt is divided into two types: loan and bond. Providing loans to project-implementing companies or buying bonds issued by the project-implementing companies does not enable institutional investors to acquire any portion of the ownership of a project. Debt investors are given a higher priority than equity investors in terms of rights to project revenues or assets. Hence, debt investors bear lower risks and therefore, potentially receive lower returns. Precisely speaking, debt investors get a 'fixed income' from interest payments from such debt instruments (OECD 2015). Generally, debt investments amount to between 70 to 90 percent of the total financing volume of an infrastructure project. If we look into debt instruments in more detail, two differences can be made between loans and bonds in terms of duration and liquidity. The first difference is that while the average term of traditional project finance loans is 7–12 years, the term of bonds is much longer, sometimes extending as long as 50 years (Weber and Alfen 2010). Given that the operational lifetime of most infrastructure projects is from 20 to 30 years, bonds are a better candidate instrument for infrastructure financing regarding the time frame. The second difference is that bonds enjoy stronger liquidity since bonds can be divided into smaller units and put on sale in public markets, as will be explained below.

Markets for Trading Investment Instruments

With regard to venues where investment instruments are traded, investment instruments can be divided into two types: *listed* and *unlisted*. While listed investment instruments are traded on a public exchange (public market), unlisted investment instruments are traded privately (private market). Investment instruments must be registered for trading on the public exchange. Hence, registered equity or debt is called 'listed' equity or debt (OECD 2015).[1] By contrast, since investment instruments that are traded privately are not registered on a public exchange, they are called 'unlisted' instruments. Trading in a private market is also called an over-the-counter (OTC) deal.

Looking first at trading on a public exchange, for registration purposes, asset information on investment instruments needs to be announced, and the requirements set by the regulatory bodies of the public markets must be met (Weber and Alfen 2010). Hence, trading on a public exchange brings transparency to the whole process. Furthermore, since every party is exposed to offers by every other party in a public market, it is easier to find buyers and sellers; thus, liquidity is higher with public trading (Investopedia 2016b). Simply put, it is easier to convert investment instruments into cash in a public market. Moreover, trading in a public market creates a market price for an investment instrument through the interaction of demand and supply in the marketplace (Weber and Alfen 2010). Thus, public trading can maximize the power of price in adjusting supply and demand, thus enhancing the efficiency of an economy.

Trading in a private market involves a bilateral exchange in a non-public setting; for example, private trading taking place via a dealer's network (Investopedia 2016b). Given that investment instruments are not registered to the public market, private trading is not transparent. Furthermore, since investment instruments are not offered to the public at large, it may not be easy to find buyers and sellers. Accordingly, liquidity is then limited. Moreover, as prices are not necessarily published for the public, and do not often reflect the real demand and supply of market, this undermines the role of price in promoting efficiency within an economy (McCrank 2014). Nonetheless, there are some advantages in relation to private trading. To begin with, trading privately can bypass the time-consuming registration process necessary in a public market, thus mobilizing financial resources more quickly (Weber and Alfen 2010). It can also reduce the cost of trading since there are no trading fees such as those payable to the operator of a public market (McCrank 2014). Furthermore, making extraordinary deal is possible without creating large impacts in the market in terms of quantity and price ((McCrank 2014). For instance, if an investor orders a huge volume of stocks in a public market, the owners of those stocks would ascertain the size of the entire demand, and, with the prediction of an increase in price due to the upward pressure from this (explosive) demand, would set a higher price. Such a situation would easily force investors to pay more than expected. However, if investors contact several owners of the stocks bilaterally in a private mode, the owners may not be aware of the size of the entire demand for the stocks, and are less likely to inflate the asking price.

Current Trading Practices for Investment Instruments in Infrastructure Markets

First, equity instruments can be traded both in a public market as a listed equity or in a private market as an unlisted equity. With the liberalization movement of the 1980s and subsequent privatization of infrastructure assets, investment practices of infrastructure markets have developed through the 'unlisted equity' (OECD 2014). From 1980 to 2005, spending by OECD countries (mainly on infrastructure) fell from 4 percent of GDP to 3 percent. The private sector filled the gap created by this drop in governmental spending in infrastructure, mostly in the form of public-private partnership (PPP) models. Precisely speaking, under such PPP models, the private sector participates in infrastructure projects in the role of both equity investor as well as debt investor. All in all, while unlisted equity has been the common instrument for investment in infrastructure so far, risk-averse institutional investors have traditionally preferred listed equity and debt instruments (Della Croce and Yermo 2013). Thus, the involvement of institutional investors in infrastructure financing has been quite low thus far (see Chap. 3).

Second, debt instruments can also be traded either in a public market or in a private market (Weber and Alfen 2010). To begin with, loans are traded only in private markets. There are two kinds of loans: traditional bank loans and syndicated loans. Traditional bank loans are provided by one bank to a project-implementing company. On the other hand, syndicated loans are offered by a group of banks to a project-implementing company. If a large loan is required for an infrastructure project, a loan can be divided by a lead bank into several small tranches and placed in syndicated loan markets to attract other banks to buy the small tranches and join in the overall loan as a member. In fact, such syndicated loans are traded in the OTC markets (OECD 2015). In the event there is large demand for such syndicated loans in the future, these syndicated loans could be traded in a public market subject to supervision by a public authority. In such a case, listed loans (see Fig. 9.1, instrument 9) might be available as products for sale in a public market. Regarding bonds, these can be traded both in public markets and privately (OECD 2015).

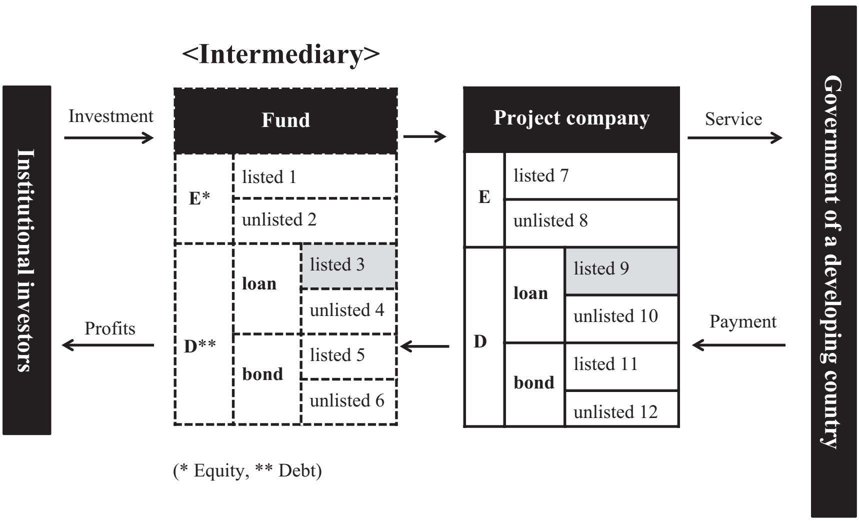

Fig. 9.1 Investment instruments of institutional investors

If project-implementing companies opt for private trading, they usually offer bonds directly to big institutional investors such as pension funds and insurance companies (Weber and Alfen 2010). Of note, although loans are generally not traded in public markets, they can be traded in public markets in the form of bonds (OECD 2015). Namely, a bank (or a lender) bundles several infrastructure loans together, and transfers them to a newly established special purpose company (SPC). In return, the SPC gives the bank the bonds that are issued based on the bundled loans and their expected interest. Such bonds are called Asset-Backed Securities (ABS). ABS boosts the liquidity of loans since loans could be traded in a public market in the form of bonds. Namely, through the securitization process, banks can transform long-term infrastructure loans into cash. Through ABS, loans can change their status from unlisted loan (instrument 10) to listed bond (instrument 11).

Investment Instruments Selection Criteria

Naturally, there arises the question of which instruments institutional investors should choose. In this context, with a view to assisting institutional investors in making a choice, there are three possible criteria: *expertise in infrastructure investment*, *expectation of returns on investment*, and *duration*.

Firstly, if institutional investors have expertise in infrastructure investment, they can make direct investment by directly contacting project-implementing companies. However, given the complicated nature and inadequate data of infrastructure investments, as well as the diverse risks of infrastructure markets of developing countries, deep expertise is required to assess such risks and return on investment; in fact, many years and dedicated resources are required to build up such expertise (Della Croce and Gatti 2014).[2] Consequently, since only the largest investors have the capacity to invest directly in infrastructure projects, institutional investors may seek *indirect investment* via intermediaries, such as funds that are specialized in infrastructure investment (OECD 2015). Instruments 1 through 6 fall into such a category of indirect investment as shown in Fig. 9.1. As a matter of fact, such intermediaries can offer similar portfolios to institutional investors as those that project-implementing companies might offer to them. At this point, it should be noted that the types of instruments through which the intermediaries receive investment do not—in theory—influence the intermediaries' choice of instruments when investing in project-implementing companies (OECD 2015).

Let us first analyze the listed infrastructure funds (instruments 1 and 5) that mobilize financial resources through a public market and which may freely invest in instruments 7–12 (OECD 2014). A good example is an exchange-traded fund (ETF), one of most popular indirect investment instruments for more than two decades (OECD 2015). According to *Investopedia*, in order to establish an ETF, the manager of an ETF must first obtain any suitable instruments among instruments 7–12 that are put on sale by the project-implementing company—mainly through big brokers—in return issuing ETF stocks to the big brokers. The big brokers will then sell the ETF stocks on the public market. If these ETF instruments generate any profits in the form of dividends or interest payments, such profits will be consolidated into dividends and be distributed to the ETF stockholders. Under current practice, most ETFs are operated in an index-fund style. The index represents the value of a specific sector of investment markets such as stock, bond and commodity markets, or the overall value of entire markets (Investopedia 2016a). Namely, if an index fund targets a specific industrial sector of a stock market, it comprehensively collects the stocks of a group of companies in the targeted sector (Ferri 2002). Thus, an index fund can reduce the risk caused by a single company in the targeted sector; for example, a solar power index fund collects the stocks of major solar power companies in a stock market; in the event, if the stock prices of solar power companies go up, the index of the solar power sector follows suit. In reality, the profits of an index fund are decided by the stocks that it owns, not by the movement of the index in a literal sense that represents the overall value of the solar power sector. Nonetheless, given the 'seeming' link between the index of a specific sector of the stock market and the profits of a fund, such a fund is called an index fund. Adopting this technique, ETFs invest in a group of companies in a targeted sector, thus distributing risks to multiple companies in a targeted sector. However, the designing of an ETF in relation to a given index is not limited to that of a specific sector in the stock market of a country but can be extended to the global level. For instance, it is possible to design a connection between the fund and the index of the entire stock market of a targeted country, as is the case with a Vietnam stock market index fund or an India stock market index fund (Investopedia 2015). In this case, the ETFs are not related to a specific sector of the stock market concerned but to all sectors of the stock market. To establish such ETFs, the ETFs must acquire as their portfolios the stocks of companies that have primary influence on the stock market of the targeted country.

Next, let us examine unlisted infrastructure funds (instruments 2, 4 and 6) that mobilize financial resources through a private market and which may invest in various investment instruments (7–12). Aravis Energy I managed by Aravis and Japan Solar Fund managed by Equis Funds Group are good examples. However, this indirect investment entails certain problems such as high fees and the short life span of intermediary funds (OECD 2015). In particular, given the mismatch between the short service period of typical infrastructure funds (10 years) and the longer operational lifetime of infrastructure projects (30–50 years), institutional investors may dislike the idea of either selling assets purchased for long-term income or having to make efforts to set up successor funds (Inderst 2009). Indeed, given such long-term liabilities to sustain their customers, institutional investors prefer long-term instruments that produce stable long-term incomes. Hence, large institutional investors are increasingly opting for direct investment, building in-house expertise on infrastructure investment (OECD 2014). In order to visualize the scenario in which institutional investors make a direct investment, readers have only to delete intermediaries (the big dotted rectangle) from the investment flow in Fig. 9.1; the types of direct investment are instruments 7–12 in Fig. 9.1.

Secondly, it is about the expectation of *returns* on investment. While equity presents investment profiles of 'high-risk and high-return' to institutional investors, debt ensures a fixed income for institutional investors. Furthermore, it should be remembered that direct investment can avoid the high fees that intermediaries may charge. Hence, if an investment instrument should combine the elements of direct investment and equity investment, such an instrument could show attractive profitability. Listed equity (instrument 7) and unlisted equity (instrument 8) fit into such type. An example of instrument 7 is the yieldco model. A yieldco is a subsidiary company to which a parent energy company transfers the ownership of power projects (Team 2014). The yieldco is listed on the public market and sells its stocks directly to private investors. Yieldcos provide stable and attractive returns to investors through long-term output purchase contracts with the public sector as well as through a financial structure that creates tax benefits (OECD 2015). Unlisted equity (instrument 8) is, as explained above, the common instrument that has developed the investment practices of infrastructure markets since the 1980s. With the increased use of the PPP model, instrument 8 is expected to increasingly play a more active role in attracting institutional investors who have built in-house expertise on infrastructure investment.

Thirdly, institutional investors need to think about the *duration* of instruments since institutional investors, for example pension funds and insurance companies, have long-term liabilities (OECD 2015). Institutional investors have long-term obligations to provide financial support to their customers, so given such long-term liabilities, institutional investors prefer long-term instruments that produce long-term incomes in a stable way. Fortunately, this preference for long-term investment by institutional investors matches well with infrastructure investments that have long operational lifetimes (30–50 years). In this context, it can be said that institutional investors may not prefer instruments that have a short life span such as loans with a typical life span of 7–12 years or intermediary funds with a typical life span of 10 years (Inderst 2009). Logically, indirect investments (instruments 1 and 2) that rely on intermediary funds with a short life span, may not be good candidates. Given that equity allows the institutional investors to have ownership, institutional investors can enjoy investment benefits until the life span of an infrastructure project comes to an end. In this sense, equity (instruments 7 and 8) can be an attractive option. Furthermore, given that bonds generally have longer terms than loans, bonds (instruments 11 and 12) could be alternative options. Moreover, since liquidity may not be an important factor to affect the decision of institutional investors, unlisted instruments (instruments 8 and 12) could also be good options, because unlisted instruments are not traded in a public market, and the frequency of their trading is low. Hence, unlisted instruments are typically 'buy and hold' asset classes that suits the preference of long-term investors (Della Croce and Gatti 2014). The criteria and results of selection of instruments are summarized in Table 9.1. All in all, the instruments meeting the three criteria at the same time are listed equity (instrument 7) and unlisted equity (instrument 8).

Producing Bankable Projects

The Need for a Protective Mechanism

As explained in Chap. 4, there are diverse risks in the green infrastructure markets of developing countries. These risks are classified into two categories: project preparation risks and project implementation risks. Interestingly, through historical analysis, it is apparent that such risks have a root cause. Understanding such a root cause is important because then we could produce a fundamental solution to more effectively address such risks. To this end, the development process of a state is divided into five phases:

(1) Uncentralized situations,
(2) A weak state that somehow manages to maintain security and public order,
(3) A centralized state that is competent to maintain security and public order,
(4) A centralized state that is competent to enforce laws effectively and fairly, and
(5) A decentralized state.

Table 9.1 Criteria of selection of investment instruments

Criteria	Candidate instrument
Having expertise	**7**, **8**, 10, 11, 12
High returns	**7**, **8**
Long duration	**7**, **8**, 11, 12

Note: Instruments 7 and 8 meet the three criteria in relation to the selection of investment instruments

Historical analysis points to the root cause of diverse risks of the infrastructure market of developing countries as structural: developing countries have *not reached Phase 4 of a centralized state that is competent to enforce laws effectively and fairly*. This means that developing countries are stuck in Phase 1, Phase 2 or Phase 3. Reaching Phase 4 is important because it is a turning point in attracting foreign investors; at Phase 4, diverse risks can be hedged *within* the system of the host country. Otherwise, if a host country is not in Phase 4, it is not in a position to protect the interests of foreign investors in a reliable manner because it lacks adequate resources and mechanisms in place. Strictly speaking, providing reliable protection for foreign investors is beyond the capacity of the system of the host country. Accordingly, from this root cause, two policy implications can be drawn in relation to the designing of green infrastructure projects in developing countries. First, a project preparer should incorporate *external protective devices* into the design of a project so that foreign investors can seek protections outside the system of developing countries. If risks cannot be hedged within the system of the host country, seeking protection outside the system could be a realistic alternative. Such external protective devices can both contribute to deterring the system of a host country from failing to protect the interests of investors, and also ensure the normal operation of a project and the protection of interests of private investors even when the system of the host country fails. Second, a project preparer may request that the host country rapidly improve its system in a targeted area up to the level of Phase 4 by adopting *a decentralized approach*. Namely, a host country may designate a small area as 'special economic zone' (SEZ) to attract foreign investment and to improve the system of the small area with exceptional measures. This SEZ can be designated in such a flexible way that covers either a wide area or just a single factory site, as is the case with 'public or private free zones' in Egypt. In so doing, developing countries may create an investor-friendly environment within the targeted area in a short period of time, insulated from the central system.

In this context, in Chaps. 6–8, three key devices were proposed for inclusion in the designs of green infrastructure projects. The first key device is GHG profit guarantees: the government of a developed country agrees to buy GHG reduction units at above a minimum price with a view to ensuring project-implementing companies a minimum level of profits to fill the gap in the cost between expensive green infrastructure and relatively cheap conventional infrastructure. The second is MDBs' protections: an

MDB agrees to protect the revenues of project-implementing companies against diverse risks of developing countries. The third is the establishment of SEZs. In designing a project, GHG profit guarantees and MDBs' protections could be regarded as the 'external protective devices.' The establishment of SEZs could be understood as a 'decentralized approach.'

Sample Designs of a Bankable Project

Sample Designs

Finally, we have arrived at the point of designing a bankable project. Such a bankable project can be presented from three perspectives: the locus of support, the beneficiary of support, and the timing of support.

In terms of the *locus* of support, support could be provided at three loci as shown in Figs. 9.2 and 9.3. First, a GHG profit guarantee (external protective devices) could be given to a project-implementing company to ensure it the minimum profits for launching an expensive green infrastructure project. Namely, it is a guarantee by the government of a developed country that it will buy the GHG reductions generated from the concerned project at above a minimum price. Second, MDBs' protections (external protective devices) could be provided either through guarantees or equity investments to a project-implementing company in order to ensure the company adequate revenue in the event of a failure of a developing country's government to honor a PPP contract with the company. Looking first at guarantees, an MDB can provide its own guarantee to a project-implementing company against the potential default of government coverage of the PPP contract, while the MDB seeks a counter-sovereign guarantee from a developing country's government. In so doing, the MDB creates creditor–debtor relations between a developing country's government and itself; the MDB would then effectively be seeking repayment from the government for the MDB's having stepped in to cover the default (see Fig. 9.2). Third, the project area could be designated as an SEZ, thus guaranteeing special benefits and privileges for the project-implementing company and institutional investors.

Alternatively, an MDB can make equity investments in a project-implementing company creating de facto creditor–debtor relations

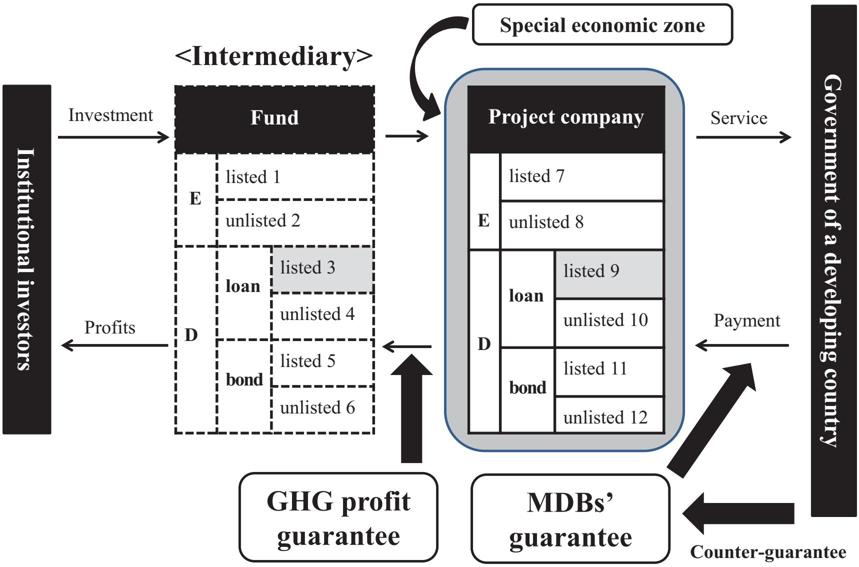

Fig. 9.2 A design of a bankable project (MDB guarantee model)

between a developing country's government and itself; the MDB would effectively be charging a developing country's government for its service in accordance with an output purchase agreement between the developing country government and itself (see Fig. 9.3).

In terms of *beneficiary* of support, two groups would be eligible. First, GHG profit guarantees can be given to protect the profits of 'overseas' institutional investors whose home country provides such GHG profit guarantees. Second, MDB protections can be used in order to protect the profits of both 'overseas' institutional investors and 'local' institutional investors. Added to the apparent need of overseas institutional investors for new investment opportunities, abundant liquidity in many developing countries also drives local institutional investors to look for new investment instruments (Independent Evaluation Group 2009). In this context, MDB protections can provide assurances to both overseas and local institutional investors.

Regarding the details of MDBs' guarantees, three points are of note. The first is that MDB guarantees might not fully cover the profits of both groups of investors, yet partially cover the profits of both groups.

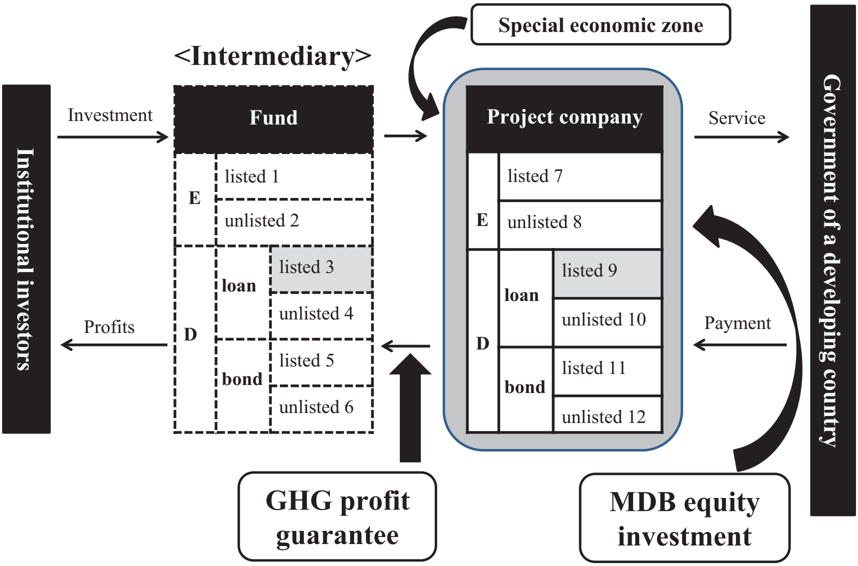

Fig. 9.3 A design of a bankable project (MDB equity investment model)

As illustrated in Chap. 8, the Partial Risk Guarantee Program (PRG) of the IDA catalyzed US$ 6 of private finance with each dollar of guarantee over the past decade (World Bank Group 2013). As noted, partial guarantees of the IDA enabled the private sector to mobilize six times as much as the guaranteed money. Accordingly, a similar logic could be applied to the design of a bankable project. The second point is that the financial resources for such MDB guarantees could be supported by single donor trust funds of developed countries in the MDBs after their national companies win contracts. The support by single donor trust funds is optional. The third point is that the recovery of such financial resources provided by single donor trust funds could be further guaranteed by a developing country's government through an MDB counter-sovereign guarantee mechanism. In sum, the beneficiaries of MDB guarantee instruments could be illustrated in Figs. 9.4 and 9.5.

Regarding MDB equity investments, the three points as noted in relation to MDB guarantees are similarly applicable. Firstly, MDB equity participation can de facto fully cover the profits of both groups of investors

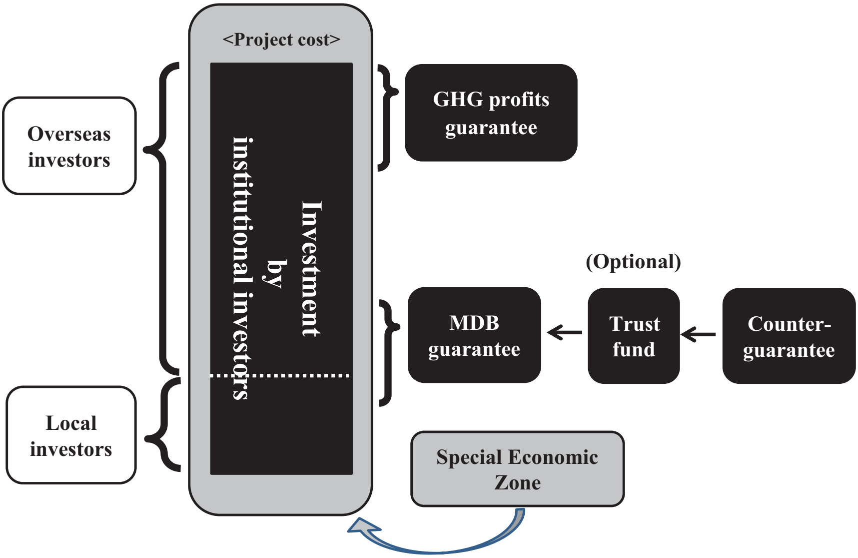

Fig. 9.4 The beneficiaries of protective devices (MDB guarantee model)

since the MDB recovers its invested money from the infrastructure project only after both overseas and local creditors recover their lent money from the invested project. Namely, creditors are automatically protected under the MDB's deterrence powers against the diverse risks in the developing country. Secondly, the financial resources for such MDB equity investments could be supported by single donor trust funds of developed countries in the MDBs after their national companies win contracts. This support by the single donor trust fund is optional. Thirdly, the single donor trust funds within the MDB can provide financial support to the MDB equity investments (see Fig. 9.5).

In terms of *timing* of support, GHG profit guarantees could be given several times during the operational lifetime of a green infrastructure project. For example, if the operational period of an infrastructure project is 30 years, the GHG profit guarantee could be given every seven years because GHG reduction units are generated approximately every seven years, according to current international practices. Thus, the developed countries' governments would buy such GHG reduction units at above a minimum price every seven years in accordance with

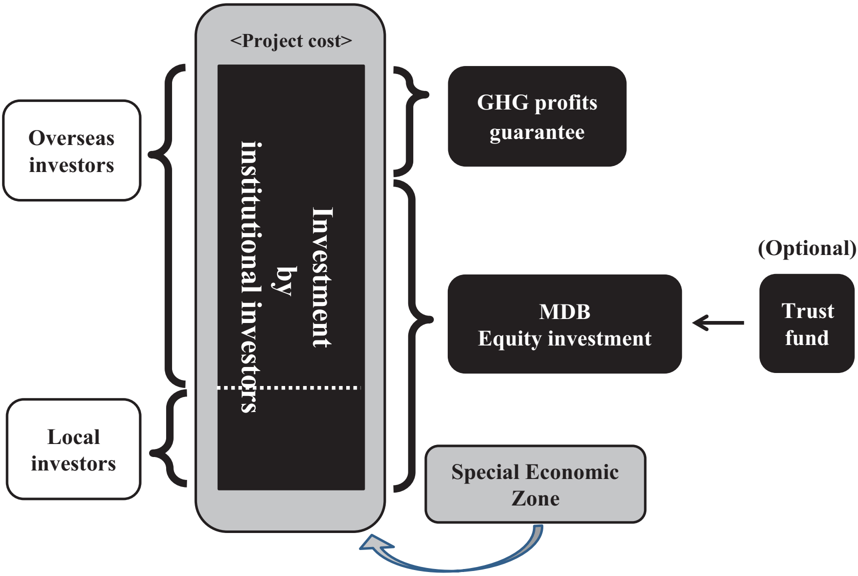

Fig. 9.5 The beneficiaries of protective devices (MDB equity model)

their guarantees to the project-implementing company. The first set of GHG reduction units would be generated for the period of the initial seven years, followed by another set of GHG reductions for the next seven years. Accordingly, given that the operational lifetime of an infrastructure project is generally 30 years, four sets of GHG reduction units could be generated during the lifetime of an infrastructure project. Whenever a set of GHG reduction units is generated, the set would be covered by the GHG profit guarantees by the government of a developed country. Such a practice is necessary because GHG reduction units could be generated only when the concerned green infrastructure project is 'in operation.' If the green infrastructure project in question stops operating several years after its launching, the project could no longer produce GHG reduction units. Consequently, in order to prevent the moral hazard that the project in question stops operation after it sells all its GHG reduction units that correspond to its entire operational lifetime, the practice of dividing the production of GHG reduction units into several stages appear to be both logical and pragmatic.

With regard to an MDB guarantee, even if it covered only some portion of the operational lifetime of the project, it could prevent moral hazard impacts on the project-implementing company. With a reference to the partial guarantee of the IDA, as mentioned above, MDB guarantees need only be given to cover the revenues during one sixth of the period necessary for the institutional investors to recover their originally invested money; for example, from Year 11 to Year 14. In this context, it is important that guarantees help institutional investors pass the threshold at which the recovery of the original invested money with minimum interest payments from the institutional investors is completed. The revenues of the project after that threshold are the net profits of institutional investors. Therefore, it is the design that enables institutional investors to recover at least their originally invested money even in the worst scenario. In sum, timing of guarantees could be illustrated as in Fig. 9.6.

Regarding an MDB equity investment in a project, it should be made from the beginning of project preparation, serving as a platform to attract private investment. This participation of an MDB in the capacity of an

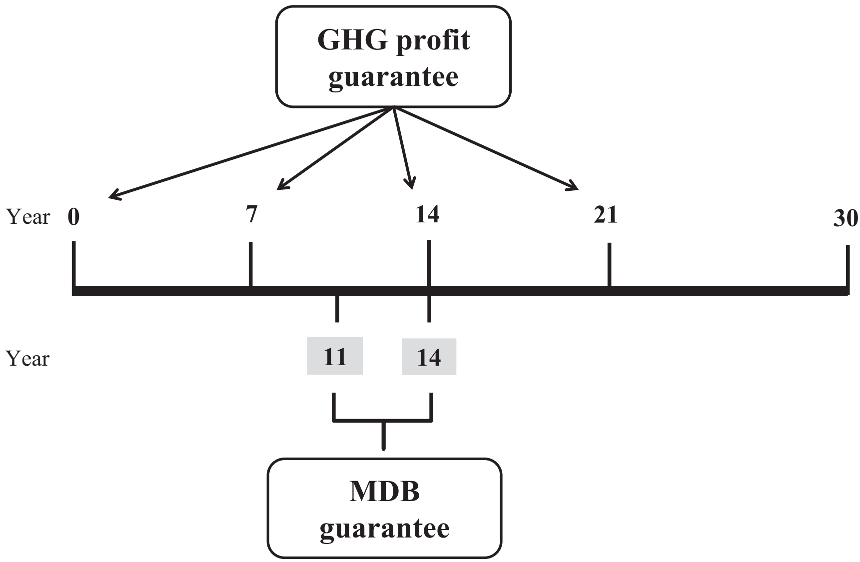

Fig. 9.6 The timing of support (MDB guarantee model)

owner will provide full assurances to potential debt investors in relation to the concerned project, as the participation creates the de facto creditor–debtor relations between the MDB and the developing country's government. That is to say, the equity-participating MDB is supposed to recover any remaining revenues or assets from the project concerned only after other debt investors do. This means that the creditor–debtor relations do not end until all debt investors recover their invested money and profits, and subsequently, until the MDB recovers its own invested money and profits from the project as well. In this context, the scope of protections that MDB equity investments provide is wider than MDB guarantees (see Fig. 9.7).

As a result of such designs, a *bankable project* could be produced. Such bankable projects will play a role of an aqueduct through which the enormous financial assets of institutional investors can flow into the developing world. Logically, if bankable projects are available in large numbers in the green infrastructure markets of developing countries, institutional investors could invest more assets in the markets. It would be the point at

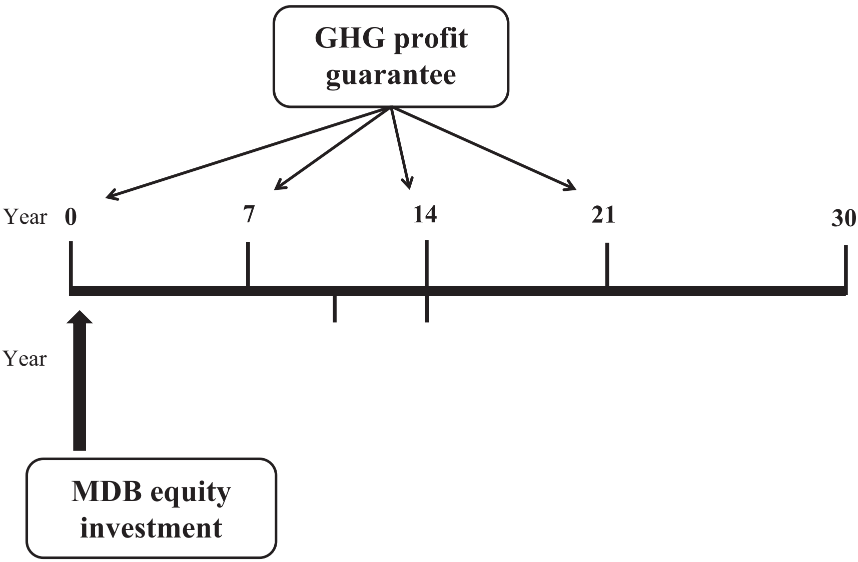

Fig. 9.7 The timing of support (MDB equity investment model)

which the Gordian Knot is cut, thus clearing the bottleneck in the financial flow from developing countries to developed countries.

Win-Win Results

With the strategy to motivate the developed world to provide green infrastructure to the developing world, both sides will benefit greatly in terms of *business interest*. Above all, the developed world would see three immediate benefits (increase in export, supporting the profits of institutional investors, and securing the supply of GHG reduction credits) and three mid- to long-term benefits (enhancing economic resilience, less exposure to external shock and increase in global aggregate demand). At the same time, the developing world would also see three immediate benefits (available unforeseen infrastructure, enhancing economic resilience and supporting the profits of their institutional investors), and three mid- to long-term benefits (less exposure to external shock, economic development and checks to population growth).

Benefits to Developed Countries

First, the export of green infrastructure products to developing countries will increase. Actors implementing green infrastructure projects in developing countries are likely to be private companies because of the constraint on public resources in developing countries. At the same time, private companies are expected to attract financial resources from institutional investors, mostly from the developed world as those from developed countries currently dominate the investment markets. Given these two points, it is inevitable that such private companies will work with the governments of developed countries, with such governments playing a decisive role in ensuring GHG profits and MDB protections for private companies. Hence, the private company is highly likely to buy infrastructure products from the national companies of the developed country. Absent this quid pro quo, governments of developed countries are less likely to provide financial support with their taxpayers' money for private companies operating abroad. Were the private company to be a local subsidiary company of a private investment entity in the developed country, this would naturally strengthen connections with the government of the developed country.

Second, institutional investors could secure a stable source of profits protected by the governments of their home countries and MDBs. Namely, institutional investors have only to choose a private company implementing green infrastructure projects in developing countries with support from the investors' home country government and MDBs. Through support from the home government and MDBs, institutional investors would be ensured of stable income flows via green infrastructure projects in developing countries. Given that institutional investors are increasingly looking for new portfolios, the emergence of a reliable, new overseas asset class, protected by their national governments and MDBs would be an investment incentive.

Third, developed countries could secure an adequate supply of GHG reduction credits at a reasonable price. Thus, they could keep their financial burden down in meeting future national GHG reduction targets. As all countries are encouraged to submit their national GHG reduction targets to the United Nations, a country may either reduce GHG emissions domestically or buy the GHG reductions made by other countries, which are sold in the form of GHG reduction credit or GHG reduction unit. Logically, if the cost to reduce GHG emissions domestically is too high, countries will meet national GHG reduction targets by buying cheap overseas GHG reductions sold by other countries. In 2014, the average GHG price at the global level was around US$ 7 per metric ton (IEA 2015). However, with the tightening of global GHG regulatory regimes in coming decades, the price may go higher than now. For example, in order to limit the increase in global temperature to 2 °C, most scenarios analyses indicate that the GHG price should be between US$ 80 per metric ton and US$ 120 per metric ton (World Bank and Ecofys 2015). Therefore, if the global community is really serious about limiting the increase in global temperature to 2 °C, the GHG price must go up considerably. In this context, securing an adequate supply of GHG reduction credits at a reasonable price can serve as an insurance measure for possible increases in future prices. Moreover, if developed countries have an extra reserve of GHG reduction credits, these may be sold to other countries, thus creating government revenue.

Next to look at three mid-to long-term benefits of developed countries: first, developed economies could be more resilient against volatility in fossil fuel prices. With decreases in the cost of green technology, developed countries can enhance their economic resilience by retrofitting the existing conventional infrastructures with green technology, or retiring them early and building green infrastructures in their place at a lower cost. By introducing green infrastructure earlier than expected, the economy of developed countries can escape from the influence of fossil fuel. In this regard, attention should be paid to the rising trend of oil prices as global demand for oil is growing and leading to sourcing from less accessible deep offshore or deep underground oil once the most easily available ground oil is exhausted (Randers 2012). This restricted accessibility leads to a rise in production costs. Although the current low oil prices give global markets a brief respite in contrast to continuous alertness vis-à-vis 'peak oil' since the 1970s, the current low prices are unlikely to last long as global demand is expected to exceed global supply in the near future (IEA 2016). Under such circumstances, if coal power plants are retrofitted with carbon capture and storage (CCS), businessmen can use cheap and abundant coal without being constrained by GHG reduction regulations. Oil demand would accordingly go down. Likewise, if wind power plants are built, businesses would reduce their reliance on oil for power generation. In such cases, the economy of a country would be less influenced by fluctuations in oil prices. In this regard, as Ayres and Warr argue, dramatically transforming economic structures into low-carbon ones is, in fact, the only option that enables developed countries to sustain economic development in the long term (Ayres and Warr 2009).

Second, developed countries would be less frequently exposed to external shocks caused by the shortage of resources. To begin with, the fast global spread of green infrastructure can dampen global demand for fossil fuel. Given close links between fossil fuel and certain related commodities, dampening global demand for fossil fuel would stabilize not only the price of fossil fuel but also the prices of these commodities. For example, food and oil prices are closely linked because oil is used as fuel for farming and food processing machinery as well as transportation, and as raw material for agricultural inputs such as pesticides and fertilizers (Turner 2014).

High oil prices also induce a massive diversion of grain to biofuel production (Roni et al. 2011). Such diversion could have an extremely negative impact on food security: the grain required to fill a 113-liter fuel tank of a sport utility vehicle with ethanol merely one time would feed one person for a whole year (Brown 2012). The grain turned into ethanol in the USA in 2011 could have fed approximately 400 million people. Hence, dampening global demand for oil by spreading green infrastructure would also contribute to keeping food prices stable. Furthermore, the fast spread of green infrastructure would have a positive impact on agricultural productivity by mitigating climate change.

Third, the economic development of developing countries supported by the expansion of green infrastructure could increase aggregate demand at the global level, thus increasing the general export of developed countries to the developing countries (Okonjo-Iweala 2011).[3] Thus, building economic infrastructures in developing countries would assist their economic development. With a rise in income level, the demand for overseas goods from the middle class in dynamic emerging economies would correspondingly increase. In this context, the G20 Summit (2010) declared that in order for the world to enjoy continuing levels of prosperity, it must find new drivers of aggregate demand and more enduring sources of global growth, with a view to enhancing the role of developing countries and low income countries (LICs).

In conclusion, such strategy provides developed countries with many economic benefits, while contributing to improving the environment. Hence, there is no defensible reason for developed countries not to carry out such a strategy. Any hesitation on the side of the developed countries might be attributable to the level of intervention of their government, as this entails public expenditure. However, given the overall benefits of the strategy, governments of developed countries need to bear the risks in order to create a virtuous circle between environmental protection and sustainable economic development.

Benefits to Developing Countries

For developing countries, there are three immediate benefits (having green infrastructure, enhancing economic resilience and supporting the profits of their institutional investors) and three mid-to long-term benefits (less exposure to external shock, economic development and checks to population growth).

First, regarding immediate benefits, such a strategy could provide developing countries with infrastructure and, what's more, with the more expensive green infrastructure. The alternative might be no infrastructure altogether given the constraints on public resources in developing countries. Despite the enormous potential of infrastructure markets of developing countries, diverse market risks are a disincentive for private investors. Accordingly, an effective strategy can overcome a seemingly insurmountable obstacle by clearing away any mistrust that keeps private investors on the sidelines. Indeed, with such a strategy, developing countries could both 'build more' and 'build right,' overcoming their financial dilemmas. Secondly, developing countries could enhance their economic resilience: by introducing green infrastructure, the economies of developed countries could be less influenced by the availability and price vagaries of fossil fuel. In particular, as developing countries are more vulnerable to the price volatility of fuel and raw materials, it is essential for developing countries to make their infrastructure as resource-efficient as possible. Recent examples underscore the vulnerability of the developing world: 42 million people were pressed back into poverty due to increases in food and energy prices in the Asia-Pacific region in 2011 (UN ESCAP and KOICA 2012). Similarly, 112 million people in Asia could have overcome poverty annually if food prices had not increased in the late 2000s (ADB 2012). Given the expected upward trend in the cost of resources, having 'resource-efficient' green infrastructure would function as an important insurance policy for the developing world against possible future shock caused by such price volatility. Thirdly, institutional investors of developing countries could also secure a stable source of profits protected by the MDBs as well as the governments of developed countries. Since adequate liquidity in emerging markets requires less external funding than production of investment-grade projects, this strategy could serve the needs of institutional investors of developing countries (Independent Evaluation Group 2009). Institutional investors of developing countries may invest in green infrastructure projects in their home country, along with the institutional investors of developed countries that takes an initiative in launching the project concerned. This assumes that the governments of developed countries take the initiative in launching more expensive green infrastructure projects by providing the seed money. Developed country governments need to make commitments to buying GHG reductions from those projects above a certain price level, thus ensuring adequate profits to fill the cost gap between 'more expensive' green infrastructure projects and 'less expensive' conventional infrastructure projects.

Now, let us review the three mid-to long-term benefits. First, with the fast spread of green infrastructure all over the world, developing countries would be less frequently exposed to external shocks caused by resource shortages; the aggressive building of green infrastructure all over the world would dampen global demand for fossil fuel. Consequently, with stable prices for fossil fuel, the prices of other related commodities could be stabilized as well. Secondly, with green economic infrastructure in place, developing countries could develop economically at a faster rate. Given that economic infrastructure is a necessary condition for economic development, installation of green infrastructure in developing countries would lay the groundwork for mid- to long-term economic development. Thirdly, such economic development could check population growth, relieving the burden on developing countries to sustain a rapidly growing population. Sound economic growth is not only a solution to harness the advantage of population growth, but also a recipe to limit further population growth (Meadows et al. 2004). Namely, absent sufficient educational or economic opportunities, women often choose to have more children as a way of investing in the future. Similarly, Professor Hans Rosling indicates that reductions in the child mortality rate were mirrored by a corresponding reduction in birth rate per woman all over the world. Rosling thus concludes that only by raising the living standards of the poorest and, subsequently, lowering the child mortality rate, can global population growth be checked. This underscores the importance of creating a virtuous circle between economic growth and limits on population growth. If global population growth could be slowed down, this could lead to reduced demand for resources, thus alleviating resource constraint. With the global spread of green infrastructure, such a virtuous circle could be created. The alternative is a vicious circle in which poor economic performance lowers the living standards and accelerates population growth, thus increasing demands for resources.

Table 9.2 Win-win benefits of the strategy for the developed and the developing world

Time	The developed world	The developing world
Immediate benefits	Increase in export of infrastructure	Availability of unforeseen infrastructure
	Supporting institutional investors	*Enhancing economic resilience*
	Securing GHG reduction credits	*Supporting institutional investors*
Mid-to long-term benefits	*Enhancing economic resilience*	*Less exposure to external shock*
	Less exposure to external shock	Economic development
	Increase in global aggregate demand	Checking population growth

In sum, such a strategy provides developing countries with many economic benefits, while contributing to a better environment. Benefits and incentives for developing countries outweigh any reasons not to implement such a strategy. As an overview, the win-win benefits of the strategy are summarized in Table 9.2.

The Importance of Project Preparation

Project preparation is, as explained in Chap. 4, extremely important work, given that the problem of the infrastructure market is not a lack of funding but the shortage of bankable projects (Leigland and Roberts 2007).[4] Namely, investors have money but they cannot find reliable projects to invest in. Such bankable projects are the outcome of this *project preparation*. Hence, it should be noted that *the shortage of bankable projects could be solved if enough project preparation was carried out*.

However, project preparation is an extremely challenging work because of two kinds of risks (see Chap. 4): implementation risks (political, economic and social), and project preparation risks (finance-related, and project preparer-related). With the design of a bankable project as indicated above, project preparers can find the solutions to implementation risks based on external protective devices. Furthermore, such design includes solutions to the two finance-related risks of project preparation: the risk of not being able to fund the 'additional' cost of expensive green infrastructure projects, and the risk of not being able to fund the 'main' cost of expensive green infrastructure project. Namely, the first risk related to the additional cost is hedged by the GHG profit guarantee. The second risk related to the main cost is also hedged because the design of a bankable project can attract institutional investors into green infrastructure projects by protecting their interests from both the implementation risks and the risk related to the additional costs of developing countries' green infrastructure markets. If the design of a project is good, the financial commitment of investors to a project follows automatically. With the design of a bankable project, all risks are hedged except for the project preparer-related risks; given that an absence of project preparation means non-production of bankable projects, it is very important to find solutions to the project preparer-related risks.

As explained in Chap. 4, the project preparer-related risks fall into two kinds: difficulty in finding funding for project preparation, and difficulty in securing a permit to implement a project. First, a project preparer may not be able to find funding for project preparation. This is due to absence of adequate public or private funding for project preparations (ICA 2012). Since the public sector is short of financial resources, while private investors are reluctant to take on the immense risks related to project preparation, such as the risks of failing to find solutions to all major implementation risks (political, economic and social) and two finance-related risks (the risk of not being able to fund the *additional cost* of expensive green infrastructure projects, and the risk of not being able to fund the *main cost* of such projects). Accordingly, there is a shortage of funding for project preparation. Second, the project preparer can, after investing substantial time and money into preparation, lose the right to undertake the project, either because the government simply does not grant this right, or the preparer loses in an international competitive bidding (ICB).

Hence, in order to encourage project preparers to work aggressively and produce as many bankable projects as possible, proper incentive methods need to be explored. Such methods could fall to two categories: the increase in public funding to project preparers, and the establishment of a mechanism to allow project preparation cost recovery. First, the governments of developed countries need to increase public funding (grants, loans or equity) to project preparers (ICA 2014).[5] Given the burden of project preparation such as high cost, long time commitment and a risk of failure, it is necessary for the governments of developed countries to actively share in the risks of project preparation work. In relation to grants, with a view to preventing the early depletion of public financial resources, the governments of developed countries might require project preparers to reimburse the public financial resources once they succeed in moving the project to the implementation stage. To this end, before starting project preparation, the project preparers need to agree with a developing country's government on the government's policy that the successful winner of the PPP contract in the ICB will reimburse the cost of project preparation to the project preparer. Furthermore, in order to prevent moral hazard on the part of project preparers, the governments may limit the eligibility to apply for public funding if applicants have a record of failure. Second, the government of a developed country may adopt an incentive policy for private funding-based project preparation. The developed country's government could ensure that project preparers could recover their cost of project preparation from the same government if the preparers succeeded in preparing a bankable project for a project-implementing company supported by this developed country through the GHG profit guarantee.

Presenting Bankable Projects to Institutional Investors

Certifying a Project as 'Bankable'

The design of a bankable project involves and affects diverse stakeholders such as project-implementing companies, institutional investors, the governments of developing countries, the governments of developed countries, MDBs, the public of developing countries, and the public of developed countries. Accordingly, once the design of a project is produced, it needs to be objectively *certified* as a bankable project that is deemed 'fair' to every stakeholder by an authoritative third party. The certification of bankability is critical to attract the institutional investors. The certification of fairness is essential to avoid any possible criticism from various stakeholders such as the taxpayers of developing countries that are supposed to pay for infrastructure service and the taxpayers of developed countries that are supposed to provide financial support to green infrastructure projects in the form of GHG profit guarantees and MDB protections. By doing so, the bankable project acquires the trust from relevant stakeholders, which is critical to the success of green infrastructure projects that have a long operational lifetime.

In this context, it is very important to decide who will certify bankable projects. To this end, two criteria could be proposed: legitimacy and specialty. First, 'legitimacy' is fundamental because the certification work is to review whether or not different interests of diverse stakeholders are in harmony. In order to play the role of referee, the certifying organization needs to be recognized as legitimate by all stakeholders. Thus, given the international nature of bankable projects, international organizations would be suitable referees. In terms of legitimacy, UN organizations appear to be more suitable than multilateral development banks (MDBs). Second, 'specialty' is pivotal because the certifying work needs deep expertise in very specialized areas such as greenhouse gas (GHG) reductions and project financing. UN organizations that have expertise in climate change issues as well as financing work seem to be strong candidates.

Accordingly, one such strong candidate for such certification work is the Green Climate Fund (GCF), which is the financing wing of the UN Framework Convention for Climate Change. First, UN GCF has perceived legitimacy as the 24 members of its board members are composed of an equal number of members from developing and developed countries. Thus, democratic decision-making is guaranteed, unlike that of MDBs whose voting powers are proportional to the size of a national economy of a member country in the global economy. Second, GCF specializes in climate change as shown by its stated objective that 'the purpose of the Fund is to make a significant and ambitious contribution to the global efforts towards attaining the goals set by the international community to combat climate change' (UNFCCC 2012). Since the GCF has flexibility in its financing model as illustrated by its governing principle that 'the Fund will provide financing in the form of grants and concessional lending, and through other modalities, instruments or facilities as may be approved by the Board,' the possibility of including the certification of bankable projects as its new portfolio is feasible (UNFCCC 2012).

Putting Bankable Projects in the Show Window

Following the certification by an objective third party, it is necessary to advertise the bankable projects to institutional investors. In this sense, it would be extremely helpful if such bankable projects could be displayed in reliable show windows that could attract the attention of institutional investors, making it easier for institutional investors to get access to the bankable projects. Given that the bankable projects need to be certified by an objective third party, it would be simple if such a certifying body could put such certified bankable projects in its register and connect any investors who are interested in the bankable projects with project-implementing companies for the bankable projects concerned.

Conclusion

Through the long journey of this book, the sample designs of bankable projects are presented. These designs can provide powerful solutions towards hedging the diverse risks of the developing world's green infrastructure markets. It is important to note that such designs for bankable projects can produce win-win results for both developing and developed countries. With the designs and certification modality of bankable projects outlined, the next step is to produce as many projects as possible within a short period of time. To this end, let us address how to promote the 'mass production' of bankable projects as a 'global agenda' in the next chapter.

Notes

1. For further details, see Weber and Alfen (2010, 206).
2. For further details, see Della Croce (2012, 13), OECD (2015, 8).

3. For relevant discussions, see also Kharas (2011, 165).
4. For relevant discussions, see also MDB Working Group on Infrastructure (2011, 3–4).
5. For relevant discussions, see also Hoffman (2008, 37).

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10

Global Problems and Global Countermeasures

Global Problems

This book is about two global problems: global poverty and climate change. These two problems tend to reinforce each other. An illustrative example of how climate change aggravates global poverty and escalates tensions within and between nations internationally is the political chain reaction triggered by climate change leading to 'Brexit' in 2016 that doomed the dream of a united Europe (Sternberg 2013). During a once-in-a century winter drought in China in November 2010, fears of potential wheat crop failure and the specter of historical famine led the Chinese government to purchase wheat from the international market as a preventive measure. Given that only 6–18 percent of annual global wheat production is traded across borders, any decrease in the world supply contributes to a sharp rise in wheat price. Consequently, global wheat prices doubled from US$ 157/metric ton in June 2010 to US$ 326/metric ton in February 2011. Against this backdrop, it should be noted that the top nine importers of the world's major wheat-importing countries per capita are all in the Middle East, of which seven had political protests in

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2011. The nine importers are UAE, Libya, Israel, Jordan, Algeria, Tunisia, Yemen, Egypt and Iraq. Thus, the effects of climate change on food prices exacerbated the underlying tension that led to the civil unrest in the Middle East, called the Arab Spring, in 2011. Unfortunately, some countries in the Middle East and Mediterranean are still suffering the impact of the civil unrest of the Arab Spring, with their refugees flooding the EU. Hence, arguably, this refugee crisis substantially influenced the psychology of the British people, thus leading them to vote for Brexit, namely, withdrawal from the EU (Cohen 2016).[1] Although research and literature on the linkage between climate change and social instability is still emerging, with more evidence needing to be gathered, more attention needs to be paid to this linkage in order to develop proper countermeasures in a timely manner, given the expected rise in frequency and strength of climate change-related social unrest.

To summarize, climate change would undermine the global food security, which negatively affects developing countries more than developed countries (Hessel 2012). With climate change, dry areas would be drier, while wet areas would be wetter; thus, developing countries in the arid region would suffer increasingly severe drought (IPCC 2014). In such a case, the vulnerable political system of many developing countries could be negatively affected, even leading to the collapse of political systems themselves. Furthermore, the problems of developing countries aggravated by climate change could easily escalate into a problem at a global level as illustrated by Brexit.

To emphasize the urgency of circumstances as highlighted by the facts set out in Chap. 6, it should be noted that in order to keep the rise in global average temperature below 2 °C, the total amount of GHG emissions since 1870 needs to remain below 2900 $GtCO_2$ equivalent (IPCC 2014). Under ordinary circumstances, the earth is projected to pass the threshold of 2900 $GtCO_2$ equivalent in 2040. To reiterate, even with new commitments from all countries under the Paris Agreement (2015) to reduce their national GHG emissions, the earth is estimated to pass the threshold merely eight months later on from the original timeline (IEA 2015). Once the threshold is surpassed, climate change is likely to trigger irrevocable chain reactions, thus aggravating global poverty and other interconnected problems (Carbon Brief 2014).

How shall the global community address such global problems? Given the 'global' nature of the problems, it is clear is that a 'global' response to solve the problems is needed. To design the global response, a global perspective is necessary as a theoretical basis for such a design. To this end, this chapter first reviews some social contract theories used to analyze the 'structural' problems of society at a national level, with solutions to the problems. Then, the chapter extends such theories to the international level where 'structural' problems parallel those of society at a national level. The results of this theoretical analysis confirm that the strategy of rapidly spreading green infrastructure throughout the world is an effective solution that follows the direction prescribed by social theories on human society. Based on this finding, this chapter makes a proposal on the roadmap to implement the strategy.

Theories on Society at a National Level

Humans form societies to promote 'personal interests.' In order to sustain personal interests without moral degradation and structural instability, humans need to transform *societies* into *communities* by alleviating the disparities between the large part of society and its marginalized groups.

A Society

A society—more precisely, a civil society—can be defined as a 'space' in which individuals can freely pursue their personal interests through interaction with each other (Hardimon 1994). Such a society is based on the modern market economy (Hardimon 1994). The market economy is generally believed to promote economic efficiency and innovation through competition among individuals. The strength of markets is in motivating individuals to produce more products at a lower cost to maximize their profits. On the other hand, as defined in *Merriam-Webster*, a community can be defined as a group of people in which its members 'share a common interest.' A community can be created by circumstances, when individuals cannot help but share something in common. However, a community could also be created voluntarily if individuals join the community of their own free will and share the same thing willingly based on the definition above. The concept of a shared common interest is very flexible; for example, the members of a political party might share the same political objective, rising and falling together. Similarly, the employees of a private firm might share an economic interest, earning and losing together. Likewise, the natives of an indigenous language community would share a common language, using the language and adapting (losing) the language together. The citizens of a city might share the same air, breathing together whenever the air is clean or dirty. There is something 'cohesive' within a community, when compared with a society that is individualistic in nature.

How, then, can a society be transformed into a community? In understanding such a transformation process, three philosophers are of note: Thomas Hobbes and John Locke laid the groundwork for the formation of a society, and G.W.F. Hegel found a clue to transforming a society into a community at the state level. First, Hobbes argued that the essential function of a society is to ensure the safety of its members (Hobbes 1968). Since economic development could not be made without public order and security, Hobbes's argument is indeed common sense. Second, Locke clarified that the essential function of a society is to enable its members to freely seek their own private interest (Ehrenberg 1999). Locke's argument supports the emergence of the free market economy. Third, Hegel found a 'structural problem' characteristic of societies, and presented a clue to a solution (Hardimon 1994). Namely, Hegel found that marginalized groups inevitably emerge from the competitive system of a society based on the market economy. If some groups lead, other classes are inevitably left behind. Consequently, the marginalized groups suffer poverty and inequality, thus becoming indignant and raising internal tensions between different groups within a society. Upon such a finding, Hegel regarded poverty as evil—because it alienates poor individuals from society—and argued that the state needs to intervene in order to cure such alienation to promote social reconciliation. The historical setting out of which Hegel spoke provided support for his ideas: the welfare state that appeared in Prussia in the nineteenth century was just such an intervention. Prussia introduced accident insurance for the first time anywhere in the world in 1871, followed by health insurance in 1883, and pension and disability insurance in 1889 (Van Lieshout et al. 2010). Consequently, Prussia served as a welfare state model for all of Western Europe in subsequent decades.

Transformation

Hegel's theory was a breakthrough for the transformation of a society into a community. A community is defined as a group of people that share a common interest; based on this definition, the transformation of a society into a community can take place when two things happen simultaneously: *realization* and *intervention*. Realization takes place when a group of people understand that they share a common interest. Intervention happens when the group takes action to protect that shared interest. What Hegel contributed is to justify the intervention by arguing that governments should intervene to help marginalized groups in a given society. However, it is also important to understand the motives of intervention because the motives are interconnected with realization. The underlying motives for such intervention can be explained from two perspectives: moral assignment and self-interest.

As to the first perspective, one of the major arguments that trigger a sense of moral assignment in the minds of individuals is based on human rights (Van Lieshout et al. 2010). If an individual 'realizes' that all individuals in a society share the same identity as 'human,' there is the obligation to support other humans in enjoying their basic 'human' rights. Namely, a sense of obligation serves as motive of intervention. In this context, the Universal Declaration of Human Rights that recognizes the inherent dignity and the equal and inalienable rights of all members of the human family is a cornerstone for this trend of thought (UN 1948). Another argument indicates a natural tendency that lies in human nature to feel sympathy for others in need. Such sympathy is de facto the voice of human conscience. All in all, it should be regarded as the moral assignment of humans to help other humans in need. Accordingly, individuals in a society would support their government's intervention to help marginalized groups with their taxes. In short, with the realization that all individuals share the same human identity, and the subsequent intervention by a state to help them, a society is transformed into a community. Similarly, on the side of the marginalized group, the marginalized groups develop a sense of solidarity with other humans after receiving help from them. With such realization and acquisition of benefits from intervention, a society would be transformed into a community in the minds of the members of the marginalized groups as well.

Second, there is a perspective of self-interest (Van Lieshout et al. 2010). In a peaceful situation, individuals take it for granted that they can freely pursue their private interests and accumulate wealth. What is not openly acknowledged or even recognized is that all such activities are possible because their society is essentially functioning as a 'platform' on which these activities take place. Accordingly, if individuals find that the normal operation of their society is threatened due to internal tension, they would 'realize' that they share the 'same platform' with other individuals on which everybody could pursue their personal interests (Hardimon 1994). This means that self-interest serves as a motive of intervention. In fact, such a threat to society from an internal tension was already recognized from the late nineteenth century. For example, given that marginalized groups inevitably emerged in a competition system of the market economy, some radical theorists such as Karl Marx even argued that the marginalized wageworker groups should overthrow the unequal society via revolution; this theory was put into practice as seen in the Communist Revolution in Russia that erupted in 1917. Accordingly, at the moment of realization that the stability of their society could be threatened by marginalized groups, individuals in a society would understand a need for their government's intervention to help the marginalized groups with their taxes (Hardimon 1994). In short, such realization and subsequent intervention would transform a society into a community. Similarly, on the side of the marginalized groups, they might naturally realize that they share with other individuals the same platform after they get help based thereon. Hence, they would also find a reason to maintain such a platform because help would not be forthcoming without it. In such a process, the marginalized groups would develop a sense of belonging to society and have a vested interest in the destiny of that society. With such realization and acquisition of benefits from intervention, a society would be transformed into a community in the minds of the members of the marginalized groups as well.

If we look closer at the history of welfare state policy in nineteenth century Prussia, this perspective is vividly revealed. The conservative Otto von Bismarck, the first Chancellor of Germany, never formally consulted with workers' organizations as he introduced the social safety net as mentioned above for those workers (Van Lieshout et al. 2010). His main objective was to destroy the growing social democratic movement of the workers; clearly, the welfare system at the time was largely based on the fears by the middle class and the elite of chaos, rebellion, crime, and poverty-related sickness and infectious diseases (Flora and Heidenheimer 1984).[2]

To summarize, the transformation of a society into a community is necessary to sustain the prosperity of a human society without moral degradation and structural instability. The transformation is possible through the realization of individuals and the intervention of a state to cure the structural problems. Such realization can be made not only from a moral perspective but also from a selfish perspective. Once realization and intervention take place at the same time, a society is transformed into a community. As a result, the community becomes far more 'cohesive' than a society.

The Extension of Theories to an International Level

As individuals form a society to promote their personal interests, countries also interact at an international level to form a society. In order to sustain the particular interests of all countries without moral degradation and structural instability, countries need to transform *society* at an international level into *a community* by helping countries in need. Currently, faced with global problems, the society at an international level is already being transformed into a community.

A Society at an International Level

In order to understand the need for a society at an international level, the theories of Hobbes, Locke and Hegel that were applied to a society within a state can also be similarly applied to the society at an international level.

First, in relation to the safety of the members of a society, Hobbes's theory is also applicable to the society at an international level. Namely, the function of the society at an international level should be, above all, to ensure the safety of all states. In this context, the establishment of the United Nations in 1945 following the Second World War was a critical event laying the groundwork for building a society at an international level. Although the United Nations is not a centralized world government, it has played a substantial role in maintaining peace and security in the international society through the operation of its Security Council. It was formed exactly 150 years after Immanuel Kant proposed establishing a federation of nations in his essay 'Perpetual Peace: A Philosophical Sketch' in 1795 to this end (Karatani 2014).

Second, in relation to the freedom of society's members to seek their particular interests, Locke's theory can also be applied to the society at an international level; the function of the society should be to enable its member countries to freely seek their particular interest at an international level based on a global market economy. In this context, the establishments of the World Trade Organization (WTO) in 1995 and the International Monetary Fund (IMF) in 1944 were the result of insightful decisions of visionary leaders to make the functioning of the society at an international level a reality. To provide historical context, the General Agreement on Tariffs and Trade (GATT) was adopted in 1947 in order to promote international trade by way of reducing tariffs and other trade barriers among countries. Afterwards, GATT was replaced by the WTO, a formal organization to facilitate international trade. At the same time, given that a country could have troubles in making international payments in the event of a shortage of foreign currency, the IMF was established to promote free trade by way of providing short-term foreign currency loans to countries having difficulties in making such international payments. Overall, the main role of the two organizations is the promotion of free trade, and eventually strengthening of the global market economy.

Third, Hegel's finding on the structural problems of a society based on a market economy is also applicable to the society at an international level. Namely, it is inevitable that marginalized countries emerge in a competition system of the global market economy, and that these marginalized countries suffer poverty and inequality. Based on Hegel's view, it can be said that the existence of such poverty in the international society is morally evil because it alienates individual countries from the international society and, therefore, a certain form of intervention is necessary to reduce the poverty of countries in need. Such intervention is to cure the alienation of countries in need and to promote the reconciliation within the society at an international level. In this context, the establishment of the International Bank for Reconstruction and Development (IBRD) in 1944 was a critical step forward towards curing such structural problems of the society at an international level. The mandate of the IBRD is to assist developing countries in fighting poverty. Added to this, developed countries are also bilaterally providing aid to countries in need.

Transformation

Like a country-level society, it should be noted that the transformation of the international society into a community takes place when two things happen simultaneously: *realization* and *intervention* as mentioned above. This transformation can be analyzed using the same paradigm of the two perspectives of moral assignment and self-interest.

Applying the perspective of moral assignment, if individuals of a country 'realize' that the individuals of other countries share the same identity as 'human,' there arises a duty of owed mutual support toward individuals of other countries in need so that they might enjoy their human rights as well. There is also what might be deemed the 'voice of conscience' to help individuals of other countries in need. Hence, a sense of moral assignment serves as a motive of intervention. Accordingly, individuals of developed countries would support their governments' interventions to help developing countries. Similarly, the individuals of a country in need would develop a sense of solidarity with individuals of other countries after receiving help from them. To summarize, with the realization that all peoples of all countries share the same human identity, and the subsequent intervention by international organizations such as IBRD or developed countries to help them, the society at an international level is then transformed into a community.

Second, let us see the perspective of self-interest. As noted above in the explanation of transformation, during times of peace, individuals often pursue private interests and accumulation of wealth without regard for their own interdependencies within an international context. Where international tensions arise caused by the 'marginalized countries,' this allows for a realization that the society at an international level functions a common basis—the platform—upon which all countries can pursue private interests, but not at the cost of disregarding the interdependencies. For example, such marginalized and fragile countries may fall into a civil war, eventually leading to refugee crises and the collapse of trade networks at the regional or global level. Accordingly, at the moment of realization that the stability of the international society could be threatened by marginalized groups, citizens of all countries in the international society would support their governments' interventions to help the marginalized countries with their taxes. In short, such realization and subsequent intervention would transform the international society into a community. Similarly, on the side of individuals of marginalized countries, they would also naturally realize that they share with individuals of other countries the same 'platform' after they receive assistance based upon it. The platform as a source of support would give them reasons to sustain it, since without the platform, they would be isolated. Such a process of assistance given and received allows the individuals of marginalized countries to develop a sense of belonging to the society at an international level, with a vested interest in the destiny of that society. With such realization and acquisition of benefits from intervention, the society at an international level would be transformed into a community in the minds of individuals of the marginalized countries as well.

The Emergence of the Global Community

Last but not least, we need to think about shifting from the 'international' paradigm to the 'global' paradigm. Although the word international implies affairs between 'national states' or, in other words, between ethnic states, with the rapid development of transportation and communication, particularly since the late twentieth century, other entities such as multinational corporations (MNCs) and individuals are also emerging as important actors on the world stage. Accordingly, it is necessary to find other terminology that reflects the current development in a balanced manner.

In this sense, the term 'global' is a practical option to describe the change in the society at an international level. The term 'global' could de-emphasize the nation states' dominance on the world stage, while enabling the embracing of diverse actors such as MNCs and individuals. Furthermore, since 'global' means the affairs in relation to the 'globe,' it could also accommodate aspects of an environmental dimension such as the planet itself, animals and plants, in addition to elements of human society.

At this point, it should also be remembered that the game-changing strategy to rapidly spread green infrastructure throughout the world requires the participation and support of diverse actors like institutional investors, ordinary businessmen who prepare projects, taxpayers of developing and developed countries, and international organizations. In this regard, the term 'global' would also be suitable in the context of a campaign for green infrastructure. Overall, for the purpose of addressing the structural problems of the society at an international level, it would not be enough to transform a society at an international level into a community. We need to go further to the point of transforming this 'society' at an international level into *a global community*, with a view to unifying the energy of all possible actors towards a single goal.

A Road Map

Next Missions

The results of the theoretical analysis made above underscores that the strategy to rapidly spread green infrastructure all over the world as proposed in Chap. 3 is the correct solution that follows the direction logically set out by the social theories on human society. The strategy requires developed countries to carry out intervention with a view to providing green infrastructure to developing countries. From this point on, a concrete roadmap to implement the strategy will be set out.

Based on the theoretical work above, it can be said that 'realization' must precede 'intervention.' Specifically, individuals of all countries must realize that the platform on which they pursue their particular interests could be destabilized by global poverty and climate change. Such realization follows by highlighting the aggravating impact of global poverty and climate change on the stability of the global community. At present, if ordinary people are presented with the argument that climate change and Brexit are related as illustrated above in this chapter, such a conclusion may be dismissed offhand. In the fact of weak common understanding of global problems and inadequate analytical hard evidence, global citizens would lack the ability to generate momentum for solving such global problems. Hence, such *highlighting* of the relationship between global poverty, climate change, and global stability is essential work. Following this realization, global citizens must then engage in intervention to cure these global problems. Such intervention is possible only by *designing* a global solution and subsequently *implementing* the global solution. In this book, the author has proposed a strategy that could constitute a skeleton of the *design* of a global solution. Thus, as a next step, we need to consider how to flesh out the skeleton of the design, and accomplish the two tasks of highlighting and implementing. To this end, we need a road map.

Production of Recommendations by Opinion Leaders

First of all, 'recommendation papers' on how to highlight, design and implement should be officially produced by international opinion leaders; for example an intergovernmental body. Given that highlighting, designing and implementing involves diverse actors including the governments and international organizations, a division of labor among the actors is necessary. To enforce this division of labor, an intergovernmental body would be an appropriate entity since such a body is suitable for generating the necessary political momentum to enforce the division of labor for producing such recommendation papers. In this context, G20 could be an attractive candidate; G20 was established in 1999 and has been making strategic recommendations regarding global issues of significance (Ramachandran 2015). The G20 economies account for around 85 percent of the gross world product (GWP), 80 percent of world trade, and two-thirds of the world population. The G20 heads of government or heads of state have been meeting annually since their initial meeting in 2008.

Fortunately, the coordinating style of G20 fits into the work of 'highlighting,' 'designing' and 'implementing.' For example, as G20 prepared a paper called 'Mobilizing climate finance' in 2011, G20 finance ministers requested international organizations to prepare the paper with the allocation of tasks to individual organizations. Hence, the World Bank Group coordinated the work on the paper, in close partnership with the IMF, the OECD and the Regional Development Banks (RDBs) such as AfDB, ADB, EBRD, EIB and IDB (G-20 2011). The IMF led the work stream on sources of public finance. The OECD contributed the analysis of fossil fuel support, monitoring and tracking of climate finance and other inputs. The IFC and EBRD led the work stream on private leverage, while the World Bank led those on leveraging multilateral flows and carbon offset markets, with inputs from other RDBs. As a result, a paper was produced that could serve as reference material for more official discussions at a global level, such as those at the conferences of the United Nations, with a possibility of evolving into global guidance in the numerous areas.

In this light, G20 can push for the division of labor among international organizations for the production of recommendation papers on highlighting, designing and implementing work by assigning the divided work to individual international organizations by virtue of its political influence. In particular, given that G20 countries occupies the majority of the board members of such organizations, the voice of G20 could be effective in letting international organizations adopt their internal rules and procedures necessary to highlight the aggravated global problems and to implement the strategy of spreading green infrastructure throughout the world. In this context, recommendation papers on *five separate issues* are essential.

The first issue is on how to highlight the effect of global poverty and climate change on the stability of the global community. Namely, concrete scenarios must be developed as a warning for the global community against the threat of such aggravated problems. Awareness of such concrete scenarios will provide motivation for individuals to take action. Furthermore, if in-depth papers on highlighting the benefits of the strategy for both developing and developed countries, as explained in Chap. 9, would be available, this would further contribute to motivating individuals of all countries. To this end, G20 could assign tasks to the OECD, relevant UN organizations, and MDBs for preparation of in-depth papers on the effects of global poverty and climate change on the stability of the global community, and the short- to long-term benefits of the strategy to spread green infrastructure in terms of both developing and developed countries.

The second issue is on how to promote the practices of GHG profit guarantees at a global level. As explained in Chap. 7, given that GHG prices are not likely to be supported at a sufficiently high level if they are left solely to market mechanisms, the intervention of the governments of developed countries via supporting the minimum level of a GHG price is absolutely necessary in the context of curing market failure. Thus, G20 could assign tasks to the OECD, relevant UN organizations, and MDBs to prepare in-depth papers on the logic of supporting the intervention of the government from a legal perspective; for example, in relation to WTO regulations on subsidies. Furthermore, G20 could assign tasks to such international organizations to prepare concrete guidelines on the intervention of individual governments of developed countries, for example, in relation to the use of overseas GHG reduction units in domestic carbon markets.

The third issue is on how to reform MDBs' internal rules and incentives on guarantees and equity investments. As explained in Chap. 8, given the shortage of MDBs' resources to support guarantee and equity operations, there is a need to increase the resources of guarantees and equity investments to scale up their operations. Furthermore, given that MDBs' staff face heavier workloads and are not familiar with guarantees and equity investments, providing in-depth training on guarantees and strong incentives are pivotal to scaling up guarantee and equity operations within the MDBs. Thus, G20 could assign tasks to the OECD, relevant UN organizations, and MDBs to prepare in-depth papers on the question of how to increase resources for guarantee operations and equity investments including the use of single donor trust funds in MDBs, and on the training and incentives for staff of MDB secretariats.

The fourth issue is on how to designate an organization for the certification of bankable projects. As explained in Chap. 9, once the design of a project is produced, it needs to be objectively certified by an authoritative third party as a bankable project that is fair to every stakeholder. By so doing, the bankable project could win the trust from relevant stakeholders who are critical to the success of green infrastructure projects that have a long operational lifetime. To this end, G20 could assign tasks to the OECD, relevant UN organizations, and MDBs to prepare in-depth papers on the designation of a certifying organization and the basic guidelines on such certification work.

The fifth issue is on how to reform the regulations on institutional investors. As explained in Chap. 3, some 'regulations' under which institutional investors are placed prevent them from investing in the infrastructure markets of 'developing countries.' For instance, some internal regulations of institutional investors limit the investment of their assets to OECD member states alone, or put a quantitative constraint on the amount of resources that can be allocated to infrastructure (Inderst 2009). Thus, with the designing of the strategy to spread green infrastructure throughout the world, institutional investors need to review their internal regulations. Hence, G20 could assign tasks to the OECD, relevant UN organizations, and MDBs to prepare in-depth papers on such reforms of the regulations of institutional investors in this new context.

Approval of the UN

Next, the recommendations of the papers should be fed as reference material into the discussions of the United Nations, and be *approved by the UN for universal implementation*. Namely, despite the strategic role to be played by the G20, the Achilles' hill of the G20 is the legitimacy in the eyes of non-G20 countries. In this sense, it is necessary that such concrete recommendations in the papers prepared by G20 should be legitimized by the universal body in order to gain support from all countries. To achieve this, the High-Level Political Forum (HLPF) that is the central body for reviewing the implementation of Sustainable Development

Goals (SDGs) could be used as a universal body for approving the findings and recommendations of papers produced by G20 countries.

As background information, originally, the United Nations adopted the Millennium Development Goals (MDGs) for the period between 2001 and 2015 as guidance for international development. Following the end of the mandate of the MDGs, SDGs were adopted in 2015 for the period of between 2015 and 2030. Then, in order to provide political leadership, guidance and recommendations for implementing the SDGs, the HLPF was established as a coordinating body (UN 2015). Under the auspices of the General Assembly of the United Nations, the HLPF will meet every four years to provide high-level political guidance on the implementation of the SDGs. Furthermore, under the auspices of the Economic and Social Council (ECOSOC) of the United Nations, the HLPF will also carry out an annual review of the implementation of the SDGs.

While the Security Council of the United Nations contributes to maintaining the peace and security in political terms, the global community needs a new global governance to deal with ever more-complicated economic and environmental affairs (Hessel 2012). In this sense, given that SDGs are related to sustainable development in political, economic, social and environmental aspects, and that HLPF is supposed to coordinate the implementation of the SDGs, HLPF could be compared to another 'Security Council' in the economic and environmental areas. Hence, it appears that such potential of the HLPF also fits into a supporting role within the strategy to spread green infrastructure throughout the world. At this point, it should be noted that among the 17 SDGs, four goals are directly related to green infrastructure as follows:

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix.
7.3 By 2030, double the global rate of improvement in energy efficiency.

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.
9.a Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States.

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable
11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

Goal 13: Take urgent actions to combat climate change and its impact.

Accordingly, it can be said that HLPF has the mandate as well as great political potential to support the operating mechanism of the game-changing strategy to spread green infrastructure throughout the world. The HLPF could, accordingly, be used to *approve* the strategy to rapidly spread green infrastructure throughout the world as well as the recommendations to be made by the G20 for implementation of the strategy.

Implementation

Lastly, various stakeholders such as individuals, companies, and governments should actively seek their 'business interests' in the context of implementation of the strategy of spreading green infrastructure worldwide, making full use of new institutions and protective mechanisms made available.

The Last Point: To Be Generous or to Be Strict?

In order to cope with aggravated global problems, we need to transform a society at an international level into the global community. Such transformation is possible only when we realize that all people are impacted by the aggravated problems and, at the same time, that joint action is necessary to cure such aggravated problems. The essence of such intervention is being generous both in our thoughts and actions. At this point, it should be noted that *generosity* is not merely an act arising out of moral obligation, but one of enlightened self-interest. Accordingly, by promoting a mentality of generosity, our global community could escape its current inertia in the fight against the aggravated problems composed of global poverty and climate change. It would be a small but practical step forward in our journey for sustainable development of our global community.

Notes

1. For relevant discussions, see also Hamed, 'Refugee crisis "decisive" for Brexit will break EU apart–Austrian FM,' 2016.
2. For relevant discussions, see De Swaan (1988, 125–138), and Van Lieshout et al. (2010, 33–34).

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Epilogue: How Does an Idea Become a Truth?

Arthur Schopenhauer (1788–1860), a German Philosopher, said that every truth goes through three stages before it is accepted by society. First, beginning as an unconfirmed idea, it is ridiculed. Second, it is fiercely criticized. Third, it is taken for granted.

This book proposes an idea that the developed world should help the developing world acquire green infrastructure for win-win results. Given that time is not on our side in the fight against global poverty and climate change, it is essential that we take *bold* action promoting global partnership, as gurus of the UN High-level Panel on the Post-2015 Development Agenda have urged.

At the stage of concept building, such an idea may be ridiculed in view of uncertainties about technological breakthroughs and economic viability. At the stage of implementation, it may be criticized due to financial burdens on the governments and the taxpayers of the developed world. Nonetheless, this idea must proceed to the third stage; namely, being taken for granted as verifiable *truth*. Proceeding to this third stage is not a matter of choice between equivalent outcomes but what must be done in order to promote sustainable development of our *interconnected* world. To this end, our concerted and consistent efforts are required more than ever.

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[1]Note: Page numbers followed by 'n' refer to notes.

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