CHAPTER 1

Framing the Renewable Energy Context for Asia

Nandakumar Janardhanan and Vaibhav Chaturvedi

1.1 Introduction

Renewable energy (RE) deployment has been making significant strides across the world in the past few decades. Perceptibly, global energy markets have started shifting towards different forms of renewable energy. This movement is driven to a great extent by concerns surrounding energy security and climate change. The securitisation of petroleum energy sector, the demand for diversification away from the conventional fossil fuel sources as a way for reducing the dependency on the geopolitically vulnerable petroleum producing region, and concerns related to mitigating climate change have contributed remarkably to the development of renewable energy sources. Early adoption of renewable energy technologies, mainly solar and wind, was propelled by the European countries, particularly

N. Janardhanan (✉)
Institute for Global Environmental Strategies (IGES), Hayama, Japan
e-mail: janardhanan@iges.or.jp

V. Chaturvedi
Council on Energy, Environment and Water (CEEW), New Delhi, India
e-mail: vaibhav.chaturvedi@ceew.in

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Germany and Denmark, which paved the way for continued investment and achievement of economies of scale in the production of solar panels and wind turbines. The rapid decline in costs ultimately changed the direction of global energy markets. The question now is not 'if RE will come in a big way or not', it is 'what will be the pace of this expansion', and will it be fast enough for the world to achieve the ambitious deep decarbonisation targets adopted under the Paris Agreement. The Asian region will play an important part in this transition as the countries in the region are expected to contribute to a significant share of the future energy demand. Even on the supply side, Asia, particularly China, has captured a large share of the international supply of renewable energy technologies. Other countries have tried to increase their market share of the renewable energy technology supply. Currently one can witness that though the countries in Asia have very different political, economic, and social circumstances, renewable energy technologies have been increasing, and are expected to increase significantly in the long-term future irrespective of the contrasting contexts, and alter their footprint in Asia's energy scenarios with a higher share of renewable.

Challenges, however, remain for the pace at which renewable energy is going to be deployed. The biggest potential renewable energy resources, be it solar, wind, or tidal energy, are variable and uncertain. Technical challenges for integrating these sources in the grid are being faced and solutions are emerging. Technical challenges are arguably easier to solve. What is probably more difficult is changing the way economic rents in the energy sector are distributed. Business models that are emerging are challenging the status quo and altering the game. The issue of how to manage losers during the transition process is already throwing challenges. The discovery of unconventional fossil resources, especially shale gas, is only adding to the uncertainty. The geopolitics of the transition could also impede it. Asia has some of the largest oil producers in the world, who will need to implement and manage drastic changes to their economy to align with a renewable driven Asia.

This chapter presents a framing outline for the renewable energy transition in Asia. It first presents and discusses a framework for RE in Asia, its different elements, and then provides an overview of the key discussions that are the focus of this book.

1.2 Key Elements of the Framework

Several factors impact the future of RE in Asia. The first key element of the framework, that differentiates most countries in Asia from those in North America or Europe, is the policy priority increasingly being given to energy access. Access is not just about supplying energy, it is about supplying energy at an affordable cost to the poorer segments of the society. As grid extension is expensive, many developing countries are experimenting with off-grid solutions, which give a fillip to renewable energies like solar or biomass which are more amenable for off-grid and mini-grid solutions (Fig. 1.1).

Another fillip to RE comes from the interaction of energy security and climate change. Many Asian economies import fossil fuels to meet their energy requirements. At the same time, they also have significant domestic reserves of fossil fuels, e.g. coal for China and India. Addressing the challenge of climate change requires a serious move away from fossil fuels. While this is expected to enhance the energy security of many Asian nations that

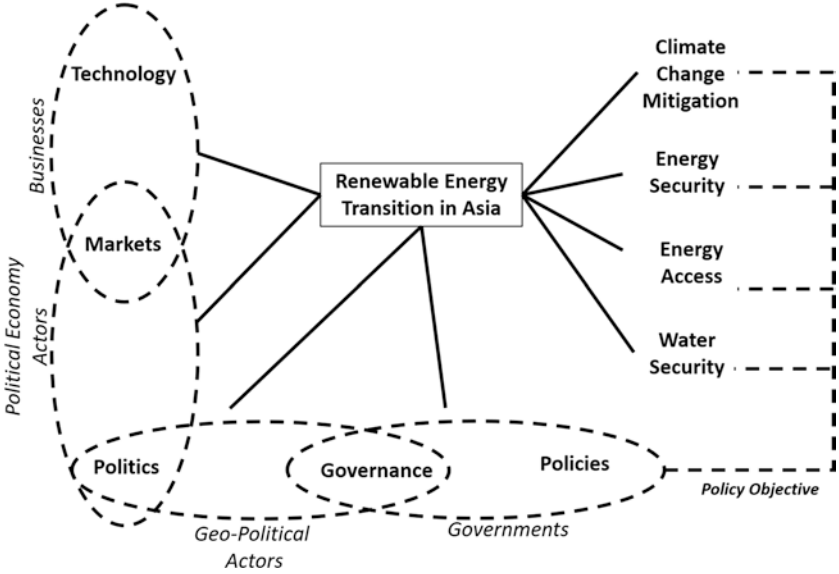

Fig. 1.1 A framework for renewable energy in Asia. (Source: Authors' analysis)

are oil importers, it also implies that they will not be able to use their domestic fossil resources, like coal in China and oil in the Middle East. Solar, wind, hydro, and biomass are resources that are available across all geographies and can be harnessed within countries for enhancing their energy security. Hence, the interplay of climate change and energy security implies a positive outlook for RE in Asia. This, however, is complicated by politics.

Another relevant debate is about the geopolitics in RE sector. As traditional energy producers and their revenue models get disrupted, their incentive is to impede the transition towards a low-carbon society, while traditional energy importers' incentive is to start gaining market access and power over the new supply chains that are being created for renewable energy. This can be best illustrated by the critical minerals required for solar panels. As more and more countries use solar panels, manufacturing of panels is emerging as a big business opportunity. However, some critical minerals are required for this process which are not available everywhere, or the process of mining these has a significant cost to the local economy in terms of local environmental pollution. Countries are already competing to gain control of global companies that have control over critical mineral mines. The emerging geopolitics will have its own winners and losers, and will shape pathways for energy markets, renewable technologies, and policies for pushing these.

The larger forces of policy objectives, geopolitics, and market dynamics determine the fate of technologies. Access to technology and energy sources is heavily influenced by politics and geopolitics, which introduce an element of competition between different countries and various market players. In contrast, there are also opportunities for technology cooperation that could be harnessed, ensuring a win-win for all. In the technology debate, a significant role is essayed by innovation, and research and development (R&D). R&D has been critical in the development of technologies like solar photovoltaic that are spearheading the revolution towards a green energy system. This book discusses technology collaboration among countries and introduces the concept of co-innovation, which is a collaboration and iterative approach to jointly innovating, manufacturing and scaling up technologies.

Markets are fundamental to any transition. The incentives provided by markets to actors on both the demand and supply side of any commodity make it possible for the commodity to move up the supply chain. Unless markets move decisively in the favour of RE, it would be impossible for the world to move away from fossil fuels. A key element in markets is prices of competitive goods that ultimately determines which commodity

would dominate. Prices are shaped by many factors. The primary ones being R&D and economies of scale. Once R&D is successful in creating a scalable technology, the economies of scale have to play an important part in price reduction of that technology. Government policies play an instrumental role to drive up economies of scale.

Policies, in the context of RE, are measures introduced by governments to support uptake of RE. These ultimately either incentivise RE or disincentivise fossil fuels. In the beginning phases of the RE revolution, policies were critical in increasing its penetration. The German policy of incentivising roof top solar is much regarded as instrumental in driving solar panel prices down rapidly due to significant uptake of solar energy in its domestic market. Similarly, the Clean Development Mechanism (CDM), a market mechanism under the umbrella of Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC), is known to be instrumental in rapid penetration of wind energy in China and India. These policies changed the direction of energy markets by providing initial support to RE, driving up their demand, and leading to significant decline in costs with economies of scale in production. Once the market becomes competitive, the need for policy support declines and is not required beyond a stage. If this stage is achieved, policies have been considered as successful in achieving their objectives.

Energy policies, however, also have to be mindful of the impact on other sectors, and interaction with other sectoral policies. Energy policies favouring fossil fuels have also resulted in significant air-pollution, both domestic and ambient, as well as water stress in many parts of Asia. Water policies have an unavoidable nexus with energy policies. Traditionally, these resources have been managed in their own silos due to the very different nature of these resources. But it is evident now that choices for RE could impact water security negatively, which is another important objective of policy makers.

The overarching framework, within which policies are and would be devised, markets would be shaped, RE technologies would be ramped up, geopolitics would be managed, and policy objectives would be achieved, is the framework of governance. There could be different models of governance, that countries in Asia choose and have chosen in the past. This would be another critical element that would shape the future of RE in Asia. The book also presents the discussion on internal geopolitics. In the chapter on political risk assessment, the author discusses the interplay of external and internal geopolitics and highlights the finer nuances of the political economy of centre-state engagement in the Indian context.

Ultimately, it is the actors that play different roles across multiple elements of the framework that we have presented. These actors are governments, business, and actors in the political-economic and geopolitical arena who make choices to achieve their respective objectives. Businesses deal with technologies and markets, governments deal with politics and policies, actors in the political economy of any transition influence political and market choices, and similarly actors in the geopolitical arena influence politics and governance. Understanding the incentives of all the actors related to each element of the framework is going to be critical to understand and influence the future of RE in Asia.

1.3 Energy, Geopolitics and Transition

The unequal geographic distribution of hydrocarbon sources in the world has always been one of the major reasons for geopolitical tensions between countries. The decision of British Royal Navy to shift from coal to oil as fuel to propel the British Military Ships (Yergin 2011) has been often noted as one of the most critical policy decisions that have made way to bringing petroleum resources to the forefront of global energy geopolitics. Subsequently, the surging use of petroleum fuels during World War II has further magnified the role of oil as a strategic commodity that has an undeniable role in the global security domain. It is noted that in international politics energy has been one of the major elements that often brings countries together to corporate and at times to the battlefront.

While the conventional energy sector has been at the epicentre of the global energy geopolitics for long, in the recent years the development of alternative energy sources, the trade associated with the equipment export and import of same and the search of dominance in the global renewable energy market also have been shaping the global geopolitical landscape into a new paradigm. Several points are critical as energy transition emerges as priority in today's world. These include the conflicts between conventional and non-conventional energy sector and the changing debates of geopolitics of energy and of the energy markets.

Dominant energy sources and the industries behind it have always received enormous support from the end-users. As a result, the conventional fossil fuel industry has emerged as a strong player influencing government policy and public perception. The fossil fuel industry has often influenced and shaped bilateral relations between producing and consuming countries. It is also noted that the conventional energy sector has

played a critical role in limiting the entry of renewable or alternative energy sources into the mainstream. This is especially important in the case of countries which have been heavily dependent on fossil fuel revenues. Today, some of the major petroleum producers in the world are located in the Persian Gulf region and the non-conventional energy sector is yet to make any significant growth in these countries. For example, the renewable energy sector within the Gulf Cooperation Council (GCC) countries is considered to be at an early stage, through the plans and aspirations are being gradually shaped. (Mas'ud et al. 2018). There are inherent challenges faced by the alternative or renewable energy sector in the GCC countries. First of all, the leading petroleum producers lobby traditionally did not support of the development of alternative energy sector fearing a potential challenge to its own existence. Secondly, there have been huge subsidies given to the conventional sector. These subsidies give conventional power a significant unnatural advantage over RE and limit the private investment in the sector, making RE compete with energy sources that are already cheap and widely available (Ferroukhi et al. 2013).

The global climate mitigation debate and the concerns surrounding conventional energy sector have given way for development of renewable and alternative energy sources in a remarkable way. Even in academic research and policy studies, a significant change has been evident. Though the energy debates have been dominated by conventional energy sector, the perception that interruption of petroleum supplies presents an existential threat to economies has largely changed as countries began to invest heavily in the non-conventional energy. Transitioning to cleaner energy sources has already been a part and parcel of every country's energy policy. Technology cooperation between countries has been an important element in the global energy and climate discourse and has been argued as critical for the transition towards the 'well below 2 Degrees' world (Ghosh 2019). The growing policy attention gained by the alternative energy sector was an outcome of three factors. 'First, the global efforts to reduce energy-related emission led fossil fuel dependent countries to promote energy transition domestically. Second, the over reliance on conventional fossil fuels also posed various economic challenges to fossil fuel importing countries. Energy diversification emerged as significant policy tool to enhance the alternative energy sources and minimize the energy bill incurred to importing countries. Third and the most important factor that shaped energy policy in favour of alternative energy sources has been the security concerns associated with the external supplies of fossil fuels' (Janardhanan 2017).

As alternative energy sector has been growing over the past several years, the equipment and service industry associated with the same has also been developing. Countries that have been investing heavily in the development have made remarkable progress developing efficient technology and equipment necessary for the implementation. Today China is the largest renewable energy producer and major exporter of equipment for the alternative energy production. As the energy equipment export has been increasing, Chinese companies seek to enter into various new markets and in some cases make investment in long term energy renewable energy projects. The $400 million investment in the Cauchari solar power station in Argentina's Puna Jujeña plateau, a super-efficient electrical substation in Kenya's volcano-strewn Rift Valley to funnel clean power from the nearby Olkaria Geothermal Plant, the upcoming, world's largest offshore wind farm in Moray East in Scotland are some of the recent examples of Chinese investment in overseas region (Campbell 2019). China is also selling equipment to several small and big renewable energy developing countries. Though this has undeniably led to the development of the domestic renewable energy in the host country, many have been raising concern that the cheap equipment from China is challenging the domestic industry's survival. While Chinese industry points out that there is no strategy to challenge the local industry in host country, the government report from the US points there has been a deliberate strategy of competition. 'China has achieved a leading position in many traditional manufacturing industries using preferential loans and below-market utility rates as well as lax and weakly enforced environmental and health and safety standards' (White House 2018). The chapters in this book elucidate the geopolitical and policy aspects of alternative energy sector and energy transition.

1.4 Energy Transition: Policies and Markets

Markets and supporting policies play a critical role in achieving any policy objective. Unless markets move decisively in the favour of any resource, that resource will not be able to penetrate significantly. This has been true for the renewable energy pathway as well. Historically, the cost of RE has been much higher than fossil fuels. Global and Asian energy systems, consequently, have been dominated by fossils. This, however, started changing in the last decade with renewable energy witnessing a much higher growth trajectory.

A large part of growth in RE came on the back of development in electricity generation technologies. Wind energy started growing in early 2000s in Asia, mainly due to support from Clean Development Mechanism (CDM), one of the market mechanisms under Kyoto Protocol. Essentially, CDM meant financial support to low-carbon technologies which otherwise were financially unviable. The cost of solar energy was very high during this period, while wind energy was much cheaper. A large part of CDM money went to support wind energy, especially in China and India. This financial support through global policy intervention was critical for developing Asian countries in the initial period of wind energy deployment.

From early 2010s, however, markets decisively shifted in favour of solar energy, mainly photovoltaic (PV) technology. Costs of PV technology has fallen significantly in the past decade, driven by cheaper materials, as well as cheaper production process due to economies of scale. Global markets have been increasingly dominated by cheaper solar panels from China which has made it possible for many Asian countries to increase the share of solar in their electricity generation portfolios.

Even though costs of solar and wind have declined continuously, the importance of domestic policies in pushing these RE technologies cannot be over emphasised. All the Asian countries have been pursuing domestic policies in one form or the other to push renewable energy. Feed in Tariffs have been used to incentivise solar and wind electricity generation. Biofuel mandates have been put in place. Countries have favoured transparent processes like auctioning to get the lowest bids. Must run status has been provided to solar and wind power plants. Dedicated infrastructure has been built to evacuate variable renewable electricity. Legal and contractual frameworks have been strengthened. Co-benefits has been an important theme assisting the penetration of RE. Particularly in China and in India, air-pollution and energy security have been important drivers of RE. Generally speaking, Asian countries have followed by and large a similar template in terms of domestic policies for pushing renewable energy. The only difference has been in terms of the fuel that has gained the most. For example, for most countries in Asia, solar power has a huge potential as compared to wind. Consequently, most of the policies in these countries have been focused on promoting solar energy, though wind energy has also got a lot of policy support. As against this, many countries in the EU region have abundant wind potential, and less of solar potential. The policies in these countries seek to maximise the penetration of wind energy.

Research and innovation have always been a critical pillar for the commercial development of any technology, same has been the case with renewable energy. However, one country that has been much more structured in terms of its approach for research and innovation has been South Korea. It had a dedicated programme, called the New and Renewable Energy Research, Development and Demonstration Programme. Within this, there were and are programs related to basic technology development, technology commercialisation, and knowledge capability and infrastructures. This is detailed in the chapter focusing on the historical evaluation of Korea's policy on renewable energy. These programs were supported by R&D implementation plan and promotion strategy focused on green technology. Funding was allocated to R & D for four strategic technologies- integrated gasification combined cycle (IGCC), wind power, solar PV, and fuel cell. Korea has always been a leader in R & D, and this has been a result of dedicated policies for promoting R&D.

Countries have also attempted following export led strategies. This is most clear for China, and increasingly being attempted by India, as discussed in the chapter on green industrialisation. China has been increasingly dominating global exports because of its labour cost advantage, administrative efficiencies, subsidies to industrial sector, as well as exchange rate management. It has extended this to the renewable energy sector as well, where it has become the biggest exporter for solar panels. India has off late been trying to emulate the same without success, because of multiple economic and administrative regions. The Chap. 5 argues that export led green industrialisation makes it easier to shift to renewable energy domestically. Many countries do envisage having some domestic manufacturing capacity for supporting domestic jobs and value addition.

The transition would be very interesting in the Gulf Cooperation Council (GCC) countries, as described in Chap. 8. These countries, traditionally, have cooperated to create a monopoly in the global oil market, hence the need of a cooperation council. In the wake of the impending transition towards renewable energy, these countries are trying to adjust their electricity markets, which in general are public monopolies with an almost 100% reliance on fossil fuels given their domestic reserves of oil. Though there is a significant potential for harnessing solar energy, these countries might need to import solar panels, or import the minerals required to manufacture panels. While the cooperation is always a source of strength, how the current cooperation framework based on oil resources

evolves when (and if) oil exports reduce significantly due to climate change concerns, will be interesting to watch.

Though countries have been doing a lot in terms of domestic policies, low-cost finance has been an impediment in most developing countries of Asia. High cost of finance implies a higher perception of underlying risks related to RE projects. Risks are shaped by strong legal framework and contract enforcement process, as well as critical infrastructure like availability of land, transmission infrastructure, etc. In developed economies like Japan, Korea, or high-income countries of the middle east, as well as China which have a strong credibility to implement plans, cost of finance for RE projects is not much of an issue. However, in the developing countries of Asia, cost of finance could be the single largest component. De-risking projects in the new sectors like solar energy is critical for the pace of growth. The role of strong legal frameworks and platforms like the International Solar Alliance (ISA) becomes critical.

Legal frameworks are critical for the success of any new and upcoming sector, like RE. The RE debate, as it stands now, is largely a debate related to the electricity generation sector, though many countries also have policies related to liquid biofuels for use in other sectors. Arguably, the single most important instrument for ensuring strong legal architecture is that of Power Purchase Agreement (PPA). PPAs are long-term contracts that define the terms of engagement between the seller (RE electricity generators) and the buyer (distribution company). There are different kinds of risks that a RE generator faces- off taker risk, technology risk, infrastructure risk, demand risk, political/regulatory risk, and currency risk, as explained in Chap. 9 on power purchase agreements for risk evaluation. The PPA has to ensure that these risks are identified, priced, and allocated in the most rationale way that is conducive for the sector. As countries move from an incentive support policy (e.g. Feed in Tariff) regime to a competitive auction-based regime, the role of long-term purchase agreements becomes even more important. Ultimately, it is crucial to have a balanced understanding of risks in the markets for supporting RE in Asia.

Along with legal frameworks for addressing risk concern of investors, another crucial development is the creation of International Solar Alliance (ISA). ISA is the newest multilateral organisation, with an aim to help increase the penetration of solar energy by bringing solar rich nations together and offer a larger market, facilitating deployment of existing solar technology, reducing prices further, and promoting collaborative solar R&D and capacity building. ISA has the potential to play a decisive role in

enhancing the share of solar energy in Asia through market interventions. One such instrument that is being discussed at the ISA platform is the Common Risk Mitigation Measure (CRMM) that seeks to address three categories of risks (off-taker, currency and political) through a single facility. Through appropriately reallocating risks in developing Asia, and lowering the cost of finance, ISA can ensure significant benefit for the cause of climate change mitigation. There could be many interventions related to solar mini-grids, solar roof-top, etc. that could be facilitative by ISA, as explained in Chap. 4.

1.5 Emerging Issues Shaping Renewable Energy Transition in Asia

Traditionally, policy and markets have been the most critical for the pace of uptake of a technology. Supportive and aggressive policies have managed to rapidly scale up technologies, while ill-conceived policies have distorted markets while failing to achieve policy objectives. Along with policies that focused on the core themes of supporting grid connective large investments in renewable energy, there are some emerging issues that have the potential to shape the debate in a significant way. Water-energy nexus has been at the forefront of such issues and has been in mainstream conversations since almost a decade now. Framed broadly under the food-energy-water-climate nexus, the issue seeks to highlight the critical trade-offs between water and energy, across many levels on which they interact. Literature on this issue has been growing exponentially in the last few years. Many Asian countries are water scarce, and water could become a constraint on processes related to energy production, transformation, and distribution. Similarly, energy availability and prices could impact water treatment and provision for different needs.

Some of the emerging critical nexus narratives, as highlighted in Chap. 12 are related to (i) renewable energy integration, (ii) carbon capture and storage for negative emissions, and (iii) solar pumps for irrigation. The first two narratives are critical for a low-carbon world, while the third is critical for food security and livelihoods for the farmers, along with impacting the emissions debate. The first narrative on RE integration highlights the trade-off related to the concentrated solar power (CSP) technology. This solar technology has been highlighted as an important technology, better than photovoltaic (PV) in terms of integration of

variable renewable energy in the electricity grid. However, the best resource for CSP is in desert and arid regions like the middle East where water is a big constraint. The water footprint of this technology is much higher than that of PV. The second narrative highlights the significant water requirement for bioenergy crops, as well as CCS technology for power generation. The water required while growing biomass could become a constraint for many economies, which might need to import biomass from water abundant areas. CCS also requires a higher amount of water during the power generation process. Water constraint on bioenergy-CCS could impede the world's progress towards the 'well below 2 degrees' goal as enshrined in the Paris Agreement. Finally, the third nexus narrative is related to solar pumps, which are growing at a fast pace in south Asian countries that have significant area under agriculture. Solar pumps, though capital intensive, take away any incentive to conserve water as there is no marginal price of water. Unless solar pumps use is coupled with innovative arrangements and business models to incentivise water conservation, their scale-up could be detrimental to the groundwater situation of already water stressed Asian countries.

The nexus element is also an emerging challenge to central Asian countries, that are increasingly facing water related trans-boundary conflicts. The trans-boundary water resource was managed within one framework when these countries were with the Soviet Union. With the collapse of the union, conflicts have started emerging. Chapter 13 presents a unique nexus perspective for central Asian economies with a focus on hydropower and the synergistic impact of this resource on the macroeconomy as well as cooperation between these countries. The central Asian region has traditionally had a history of cooperation. Water resources are concentrated mainly in two countries in this region, Kyrgyzstan and Tajikistan, which can be used to provide low carbon power to other countries in the region through a cooperative cross-border electricity trading framework. This chapter highlights the positive benefits for the macroeconomy as well as energy-water linkages in Central Asian countries through a general equilibrium analysis. Investments in forward and backward linkages of hydropower would have significant implications for trade, investment and GDP of the region as well as impact energy related emissions of central Asian countries.

Another emerging issue has been that of solar-based mini-grids. Energy access has been a high-priority issue for economically poor countries of Asia. Energy access is one of the most important development concerns of

the world. As investments in central grid expansion could be significant, many Asian countries are exploring setting up solar-based mini-grids to provide access to underserved communities. The experience has been largely positive. The critical question, as explored in Chap.11, is what happens to a mini-grid when a community or village gets connected to the central grid. A case-study-based analysis presented in the book argues that solar mini grids could complement the central grids during peak hours, and predictable grid expansion plans are important to maximise the gains from mini-grids.

1.6 Conclusion

Asian countries are at different stages of energy transition. Japan has been a major consumer of imported fossil fuel for several decades and countries like China have emerged as major energy consumers in the recent decades. On the other hand, many of smaller economies in the South and Southeast Asian region have comparatively higher share of non-fossil fuels in their energy mix. Hence, it may be difficult to draw a common pattern and the catalysts behind the pace of energy transition in Asia. However, as described earlier in this chapter, one can notice several major elements that shape the energy transition though there is no uniformity in the magnitude of influence of each factors across the region.

The framework proposed in this chapter looks at the interplay of the key elements such as governments, geopolitical factors, political economy and business, and the role played by these elements in influencing the energy transition through policies, governance, politics, market, and technology. Undeniably the governance structure and the policy apparatus in Asian countries have been influenced by various global and regional factors. Policies of governments based on their respective national circumstances, domestic, environmental trends etc. have made remarkable steps towards the development of renewable energy sector. On the other hand, the geopolitical considerations have been two folded. The need for diversification of energy supply away from politically volatile producing regions, and the potential instances of clash of energy search by Asian countries within and outside the region have given impetus to energy transition debates.

Though Asian countries were relatively late entrants in the global renewable, the pace of development of alternative energy industry in China and India, and the increasing demand for cleaner energy sources in

other developing economies mainstreamed energy transition debate in the region. Another significant factor that shaped energy transition in Asia has been the growth of domestic energy industry, especially in China, and the availability of technologies and cost-competitive equipment supply from China. As private sector investments and government funds as well as financial incentives for developing renewable energy began pouring in, China's trade of renewable energy equipment and technology to other developing economies in the region gained remarkably. While many countries have often raised concerns about the cost-effective Chinese equipment and technology hampering their respective domestic energy industry, this has undeniably given impetus to energy transition in the region.

Being at the epicentre of global consumption of commercially traded primary energy sources, the Asian region will continue to play a determinant role guiding the world energy sector in the years to come. This will be not only in the case of fossil fuel consumption but also in terms of greater investment in the alternative energy sector, technology and innovation, transborder trade of electricity, and cooperation among the countries in the region.

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