

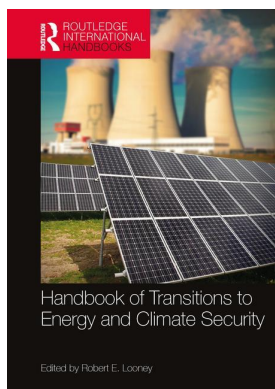
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Access details: *subscription number*

Publisher: *Routledge*

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: 5 Howick Place, London SW1P 1WG, UK



## **Handbook of Transitions to Energy and Climate Security**

Robert E. Looney

### **Introduction**

Publication details

<https://www.routledgehandbooks.com/doi/10.4324/9781315723617-1>

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**Published online on: 29 Nov 2016**

**How to cite :-** Robert E. Looney. 29 Nov 2016, *Introduction from:* Handbook of Transitions to Energy and Climate Security Routledge

Accessed on: 11 Dec 2023

<https://www.routledgehandbooks.com/doi/10.4324/9781315723617-1>

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# Introduction

*Robert E. Looney*

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## Overview

With increased concern over global warming, countries are finding energy security at affordable supplies is no longer simply a matter of diversifying energy sources and expanding use of the cheapest type of energy. Energy security and affordable energy now come with a cost – greenhouse gases that contribute to climate change. With environmental sustainability as an additional energy goal, countries are often faced with the hard choice of improved energy security coming at the expense of either increased energy costs, or reduced climate security.

Focusing on these energy choices the theoretical underpinning of the volume is the idea of an energy trilemma,<sup>1</sup> and the associated policy constraints facing countries as they attempt to achieve their main energy priorities. The trilemma implies that given a spectrum of different energy types, their associated costs, and their varying impact on climate security, countries will be forced to prioritize the goals of energy security, energy equity and climate security – high levels of all three will be very difficult to achieve at any one time. By opting for the top two, countries will likely find a deterioration in the third. For example, if clean, renewable energy costs more to generate than conventional power, improved energy security (more domestic sources of energy) and an improved environment (fewer greenhouse gas emissions) would result in higher energy costs

In terms of anticipating the likely success of global efforts at combatting global warming through voluntary cut-backs in greenhouse gasses, it's useful to know if there is a predictable pattern of energy goal tradeoffs. Specifically, are countries in certain energy settings more likely to prioritize the same two energy goals at the expense of the third?

One can easily think of different national settings/environments where the trilemma tradeoffs may be fairly similar. For example, the major energy exporters automatically have less difficulty achieving high levels of energy security and energy equity. Other countries with limited domestic fossil fuel supplies can easily improve their environmental sustainability, and with it improved energy security due to a reduction in energy imports.

While a number of country groupings are conceptually possible, four provide logical starting points. On this basis, countries examined in this volume were placed in one of four groups: (1) carbon producing countries, (2) carbon producing and consuming countries, (3) carbon

consuming countries. Several of the carbon consuming countries have shown a clear stated preference for the environment. Hence these were placed in a fourth group, the carbon reduction countries.

Energy priorities are also likely to be greatly affected by the global policy environment countries find themselves. The volume's first section identifies many of these elements and discusses their relevance in affecting national energy choices.

## Policy environment

A number of recent dramatic developments in energy markets and technologies are producing forces and consequences that are not yet completely understood. However, as Marcus King (Chapter 2) notes, some global trends are discernable and must be taken into account if countries are to design strategies to balance their preferred mix of energy security, climate security and economic competitiveness (energy availability). As he correctly points out, the development of clean energy technologies will be undertaken by many countries to maintain competitiveness while advancing the other primary goals of energy and climate security. Complicating the energy policy-making in most countries is the fact that rapid changes in clean energy technologies in such areas as nuclear energy, cleaner fuels and the possibility of geoengineering of climate will no doubt alter the impacts of trends currently underway. One thing is clear, however, countries successful in managing their energy trilemmas will be the ones able to rapidly adapt to this changing environment.

How well are most countries and international bodies prepared for the consequences of climate change? Francesco Femia and Caitlin Werrell see a large gap between the climate risks nations and peoples face, and the capacity and political will to respond to these risks. Given past failures they suggest the necessity of improving, augmenting, and possibly even creating new international, regional, national and sub-national structures for addressing climate change. But this is just a start. They feel serious responses will require that nations, and international institutions, place climate change at the top of the international security agenda, and find ways of collaborating on reducing those risks. This isn't wishful thinking. Their well-researched essay shows why an international climate and security imperative is both necessary, and achievable.

The energy trilemma is not a universal constant that will be with us for the indefinite future. As Peter Hartley shows, the trilemma is purely a transition phenomenon since reducing fossil fuel combustion should increase energy security while also reducing potentially harmful climate change. Although we have two policy goals, they should be treated as one, since one policy instrument can simultaneously further both goals. The trilemma problem arises in the transition because the costs of reducing CO<sub>2</sub> emissions are currently high, especially for developing countries. Eventually these costs, through research and development, will come down and at that time policies to force reduced fossil energy consumption would be unnecessary. He notes that in the transition policies aimed at encouraging basic research to lower the cost of new energy technologies, limiting the harmful consequences from climate change, or contending better with damaging weather events would yield far greater expected benefits for a comparable level of expected costs.

The costs of renewable energy will eventually come down, but not before a number of mistakes are made and money lost. While there are a number of good case studies to illustrate this point, one of the best involves a solar power project, the Desertec vision, in Northern Africa, Luigi Carafa and Gonzalo Escibano (Chapter 5) delve deeply into the factors that led to the failure of the project. They conclude that in the future the project's troubles will require a

rethinking of regional and industrial cooperation around a more inclusive narrative of sustainable energy development

Regional energy cooperation is increasingly seen as a means of achieving increased energy security, lower energy costs and a coordinated approach to achieving greater environmental sustainability. As one might imagine however, policy coordination across member countries with different energy needs, resource endowments, and priorities can be challenging. The two final essays in this section illustrate the difficulties and benefits of regional cooperative efforts.

In the first, focused on the EU, Benjamin Görlach, Matthias Duwe, and Nick Evans (Chapter 6) show there are a number of dynamics at work in EU climate and energy policy, which are not necessarily aligned. This has resulted in tension between unified EU targets on the one hand, and starkly different views of EU Member States about their future energy supply on the other hand.

In the second, Julia Nesheiwat (Chapter 7) ends the section on a more positive note. She sees regional coordination in energy systems not as a zero-sum game, but one that can benefit the national interest of all parties. Of course, there are always challenges and risks involved, but she shows that given the mutual problems of climate change and energy security, there is good reason for countries to cooperate. The integration of regional energy markets increases diversification of supply and delivery, cost-savings, and energy efficiency. Working together, countries can reduce climate change effects while promoting sustainable energy solutions and global energy security for the future.

With this background on energy trends, security concerns, climate developments, technological change and efforts at regional coordination the country case studies that follow show how many of these factors have played out in a broad spectrum of national settings. A number of interesting patterns emerge, leading to a set of predictions concerning where efforts at combatting climate change are likely to be the most concerted, and those where only limited progress can be expected.

## Country studies

The first group of countries (Table 1.1) consists of carbon producing countries. In these countries energy production easily outstrips domestic energy usage enabling significant amounts of energy to be exported to international markets. Each country has consistently scored low in energy sustainability, in part because their abundant energy has simply enabled improved energy security and to a lesser extent, energy affordability to progress easily. However, just because a country has abundant fossil fuel supplies, energy security, as in the case of Saudi Arabia, is not automatically assured if the country becomes overly dependent on fuel exports. In addition to Saudi Arabia, the countries in this section include three other oil exporters, Canada, Russia, and Mexico. South Africa is the lone coal producer.

James Russell (Chapter 8) correctly assumes that it is unrealistic to assume a truly effective global accord to limit carbon emissions will be possible without the agreement of Saudi Arabia (and its Gulf State neighbours). Unfortunately, to date there has been little enthusiasm in that part of the world for a concerted effort to limit greenhouse gas emissions. The Kingdom's energy priorities largely lie in providing the domestic population with low cost energy (energy equity in Table 1.1).

Professor Russell notes that while Saudi Arabia has done a good job in slowing down the world's progress towards a climate accord, the Kingdom will face increasing international pressure to do its part in limiting carbon emissions. In this sense, the Kingdom is fighting a losing battle over climate change and its transition towards a more environmentally sustainable

environment will be largely forced upon it, either indirectly through international condemnation, or directly through lower international oil prices as countries concerned over global warming transition to cleaner types of energy. Ultimately the shift away from oil internationally will force the Saudis to gradually diversify into more environmentally friendly forms of energy – solar and even nuclear. Professor Russell concludes that Saudi Arabia can survive for a time through oil revenues, but its days as a profligate welfare-spending state are slowly but surely coming to an end.

Canada and its oil stands are another country that has faced growing international pressure to cut back or even abandon production. Chris Bataille (Chapter 9) warns that, as in the case of Saudi Arabia, global climate security cannot be achieved solely by convincing fossil fuel exporting regions to stop producing. If pressure on one supplier is successful, as it seems to have been for the oil sands, there is a long list of potential suppliers waiting to take up the slack. Dr Bataille concludes that the best way to real climate security is to create real and perceived alternatives to fossil fuel consumption, and apply the necessary carrots (subsidies, development support) and sticks (technology performance regulations, carbon pricing) to encourage the great majority of firms and consumers to transition to low carbon options. As in the case of Saudi Arabia, this action will create a falling demand for oil, forcing Canada to limit oil sand development, and inducing the country to further develop green energies such as the country's hydro energy potential.

Russia is another country where energy security and affordability take precedence over environmental sustainability (Table 1.1). As Jack Sharples (Chapter 10) shows, the result has been little in the way of reduced greenhouse gas emissions. Unfortunately, the international community has, in contrast to Saudi Arabia and Canada, little leverage in inducing an energy path in Russia less associated with greenhouse gas emissions. Specifically, natural gas already provides the source fuel for half of Russia's electricity generation, with non-CO<sub>2</sub> emitting hydro and nuclear power providing a further third.

As Dr Sharples argues, the country's latent renewable potential will not be developed any time soon because at the present time it is simply not commercially profitable. In addition, shifting to renewables would require feed-in tariffs and electricity prices that are not politically and economically viable at present. In any case, with a low priority given to environmental sustainability together with abundant fossil fuel supplies an energy 'transition' in Russia is not expected in the medium-term future. The only significant development that may impact Russia's CO<sub>2</sub> emissions is the increasing use of nuclear power in place of coal for electricity generation.

Historically, Mexican energy policy has favoured energy security and equity to the detriment of energy sustainability. As a result, the country is the world's 10th largest emitter of greenhouse gas (GHG) emissions. However, Duncan Wood (Chapter 11) finds today that the country is assuming a leadership role in the international battle against climate change. He also finds that in recent years the Mexican government has initiated meaningful changes in national legislation aimed at reducing the country's GHG emissions. At the same time, the country has been successful in building a viable renewable energy industry.

Dr Wood feels the country's recent energy initiatives have defied those sceptics who argued that an oil producing state could not be taken seriously as a climate change leader. However, as he cautions, achieving the country's ambitious GHG reduction targets will require an enormous commitment of time, resources and political capital over a long period of time and across several administrations, a feat that has traditionally proved difficult in Mexico. Mexico's shift in energy priorities is too recent to have had a significant impact on the elements of the energy trilemma, but as Dr Wood notes, there is the hope that in the short term thanks to the modernization of the energy sector, in particular electricity generation results will soon be readily apparent.

The final country in the energy producer group is South Africa, a major coal producer. For years the country successfully implemented a ‘minerals–energy–complex’ development model, whereby cheap energy was able to give the country’s mines a competitive advantage. However, as Robert Looney observes (Chapter 12) in recent years this energy paradigm has come under increasing criticism as being no longer economically or environmentally sustainable. Part of the problem stems from years of underinvestment by the state power company, Eskom. By 2008, demand for electricity began to noticeably outstrip supply, but because new investment in generating capacity was not forthcoming for several years the country experienced sharply rising power tariffs and frequent periods of load-shedding, brownouts and even blackouts.

To alleviate the situation, the South African government finally made the pragmatic decision to turn to the private sector and its capacity to quickly deliver renewable energy to the nation’s grid. So far the experiment has been a huge success and the government is planning to gradually cut back coal usage, both on the grounds that this is the surest way in the near term to expand the country’s electricity generating capacity, but also as a way of protecting the country’s fragile environment from the effects of climate change.

Summing up this group of countries, one finds energy policies set to serve national interests and not necessarily taking into account global concerns over climate change. No doubt, when energy transitions come to Saudi Arabia, they will be largely induced by outside forces. Canada has active pro–environmental groups, so there is a much greater chance of a shift towards environmentally friendly energy sources. On the other hand, Russia seems immune to such pressures suggesting little hope for a significant reduction in greenhouse gas emissions over the foreseeable future. Finally, Mexico and South Africa represent cases where previously successful carbon based development strategies were becoming unsustainable, forcing a transition to a lower carbon energy mix. In Mexico’s case it was choking pollution and a bankrupt state oil company, while in South Africa’s case severe energy shortages, brought on by an under-funded, state electricity company, were an increasing strain on the economy.

Countries in the second group are both major carbon producing and consuming countries. This group has the highest level of energy security and relatively low energy equity scores (Table 1.1). On the other hand, it is more of a transition grouping with the UK and Brazil elevating a sustainable environment along with energy security above energy equity.

Traditionally, China has placed a high priority on energy security, and to a lesser extent to energy equity. The result has been an extremely low level of energy sustainability – an average ranking of 127 over the 2013–2015 period. As Xu Yi-chong observes (Chapter 13) however, China’s energy policies are rapidly changing with China expanding its low-carbon energy sources significantly since 2003. The government’s intent in this regard is to ensure adequate energy supplies while minimizing environmental and climate change threats. While the West’s perception of policy making in China is one of a monolithic, smoothly functioning bureaucracy capable of rapid transformation, the reality on the ground is very different.

In particular Dr Xu Yi-chong argues China’s energy transition will be difficult to implement because of: (a) fragmented government agencies competing for agendas, (b) the government lacking the capacity to adopt coherent and consistent policies and to implement them accordingly, and (c) slow creation of an operational legal and regulatory system. In addition, China’s leaders face the challenge of balancing long- and short-term development along with balancing the diverse interests of urban and rural population, coastal and interior regions, and the elite and the masses. Needless to say the story of China’s energy transition is far from over.

The United States energy picture is unique in a number of ways. As Robert Looney argues (Chapter 14) despite the fact that the US is the world’s second largest consumer of energy (after China), and also a major energy producer, the country has never formulated what might be

Table 1.1 Sample country characteristics

Country group	World energy council trilemma country rankings			WEC Evaluation			Trilemma priorities
	Energy security	Energy equity	Environmental sustainability	Security	Equity	Sustainability	
<i>Carbon producing</i>							
Saudi Arabia	54	8.7	123	B	A	D	equity, security
Canada	1	2	62.3	A	A	C	security, equity
Russia	6.3	47.3	103.7	A	B	D	security, equity
Mexico	32	50.3	76.3	B	B	C	security, equity
South Africa	38.3	83.3	129	B	C	D	security, equity
<i>Average</i>	<i>26</i>	<i>38</i>	<i>99</i>				<i>security, equity</i>
<i>Carbon producing and consuming</i>							
China	19.3	87.3	127.3	A	C	D	security, equity
US	7.7	1	88	A	A	C	equity, security
UK	8	20	19.3	A	B	A	security, sustain
Brazil	33	83.3	17.7	B	C	A	sustain, security
Indonesia	17	78.7	95	A	C	C	security, equity
Egypt	53.7	64.7	75	B	C	B	security, equity
<i>Average</i>	<i>23.1</i>	<i>55.8</i>	<i>70.4</i>				<i>security, equity</i>
<i>Carbon consuming</i>							
Japan	64.3	18.7	41	C	A	B	equity, sustain
Thailand	94.3	76	105	C	C	D	equity, security
Pakistan	61.7	104	90	B	D	C	security, sustain
India	68.3	106.3	122	B	D	D	security, equity
Jordan	114.7	61.3	103.7	D	B	C	equity, sustain
Turkey	66	77	72.7	C	C	C	security, sustain
<i>Average</i>	<i>78</i>	<i>74</i>	<i>89</i>				<i>equity, security</i>

Country group	World energy council trilemma country rankings			WEC Evaluation			Trilemma priorities
	Energy security	Energy equity	Environmental sustainability	Security	Equity	Sustainability	
<i>Carbon Reduction</i>							
France	42	9.7	10.7	B	A	A	equity, sustain
Denmark	3.7	43	10.7	A	B	A	security, sustain
Germany	27.7	33	33.7	B	B	B	security, equity
Italy	67.3	44	22.7	C	B	A	sustain, equity
Dominican Republic	114.7	93.7	55	D	C	B	sustain, equity
Costa Rica	57	70	2	B	B	A	sustain, security
Nicaragua	103.7	97.7	71	D	D	B	sustain, equity
<i>Average</i>	<i>59.5</i>	<i>55.8</i>	<i>29.4</i>				<i>sustain, equity</i>

Notes: Trilemma data from World Energy Council Trilemma Data Base. Values are the average country ranking for 2013, 2014 and 2015



considered a comprehensive energy policy. Other policy critics contend that the US actually has too many individually focused plans and programmes. These are more often than not limited in scope, with little consideration given to their impacts outside their intended beneficiaries. The result has been a morass of competing and conflicting outcomes.

Interestingly, despite the country's failure at energy planning and the penchant for selecting conflicting policies that often negate each other the country appears, thanks to a series of fortuitous developments, to be on a successful path of transition towards a sustainable increase in climate and energy security.

On the surface, the United Kingdom appears to have managed its energy transition extremely well through the adoption of a number of best practice policies. The transition began with the innovative Climate Change Act of 2008 which committed the country to legally binding, long-term carbon emissions reduction targets and a series of carbon budgets. However, as Caroline Kuzemko (Chapter 15) observes, a closer look suggests that below the surface, the country has not made sufficient progress in policy implementation to effect significant system change. Specifically, she finds the Act's climate targets may be unrealistic because they do not provide enough impetus and direction for political and market actors to respond with supportable innovations that can facilitate profound system change.

In sharp contrast to most emerging/developing countries, Brazil scores the highest on environmental sustainability (Table 1.1), with energy security coming in at a significantly higher ranking than energy equity. In looking at the country's energy sector Fabio Farinosi (Chapter 16) questions whether the country's successful energy transition and pattern of robust economic growth can continue without significant improvements in energy equity. In this regard he finds a number of obstacles will have to be overcome. In particular, he feels the country will have to find more ways of introducing competition into the country's energy sector. To date the Brazilian authorities have shown reluctance to fully opening the national market to international competition. The benefits of increased competition would bring down energy prices thus providing a stimulus to the economy. More importantly, increased economic growth and freer movement of international capital into the energy sector would enable it to better meet the needs of the country.

Economically, Indonesia is a dynamic country with a rapidly growing population. Historically the country has opted for energy security and energy equity at the expense of the environment. As Peter Maslanka notes (Chapter 17), because the country's energy is growing 7% per year, it is becoming increasingly difficult to achieve and ensure energy access for the population while providing adequate energy for the country's economic sectors. An energy transition is not taking place, nor will the country begin addressing climate security for the foreseeable future.

As is the case with Indonesia, policy makers in Egypt have given preference to energy security and affordability at the expense of energy sustainability. Still, as Robert Springborg shows (Chapter 18), while Egypt's per capita carbon dioxide emissions are well below the average of OECD countries, they are high by the standards of lower middle income countries and rising at one of the world's fastest rates, doubling between 1990 and 2010. Egypt's energy efficiency of production has not improved over the past two decades, making it one of the world's least energy efficient producers.

Professor Springborg sees little in the way of an Egyptian energy transition to a reduced carbon environment. Instead, the Sisi government's resolution of the energy trilemma has been along the lines of what might be expected from a country lacking democratic checks and balances. Specifically, there is no energy transition. Instead government has opted for an unsustainable growth model that ignores the environmental consequences of its efforts to accelerate economic growth and expand the country's energy supply.

The next country grouping includes a group of nations that have limited domestic sources of energy, and yet are large consumers of energy. Of the four country groupings this set of countries has by far the lowest level of energy security and energy equity (Table 1.1). These countries also have, next to the carbon producing countries, the lowest level of energy sustainability. There is quite a bit of variation across these countries, however, with Japan, Pakistan, Jordan and Turkey showing a preference for energy sustainability.

Japan has been a global leader in energy and climate reform for decades. As Julia Nesheiwat notes (Chapter 19), it is no accident that Japan hosted the Kyoto Protocol, which is currently the most significant framework for mitigating climate change. Dr Nesheiwat feels that by consistently leading efforts towards a greener globe, Japan had been established as an exemplary energy model for transformation, especially through its use of nuclear technology.

While many nuclear power stations will eventually come back on-line, following the disaster of March 2011 and the shutting down of the country's nuclear plants, the share of power generated from this source will be considerably less than that anticipated before 2011. As Dr Nesheiwat shows, although the nuclear accident represented a serious blow to the country's energy transition to a reduced carbon environment, the country has not been deterred from this goal. Currently, plans are for a significant expansion in renewable energy to gradually replace nuclear and coal sources of power generation.

As is the case with many emerging economies, Thailand, especially in the last several years, has emphasized energy security and energy affordability at the expense of energy sustainability and climate security. This has been particularly the case with the post 2014 military regime. However, as Adam Simpson and Mattijs Smits argue (Chapter 20) the country's democratic history has spawned a dynamic civil society with large groups of environmental activists pressing for a more sustainable environment. After examining several case studies, the authors feel that even under a military government there is a chance for these groups to be successful in their quest for cleaner energy production.

For years, Pakistan has been on the verge of a major energy crisis with demand for energy continually outrunning supply. In addition, the country is highly vulnerable to the effects of climate change. Unfortunately, as Michael Kugelman (Chapter 21) observes, in its efforts to ease its energy woes, the country risks worsening its climate vulnerability. While it might be reasonable to conclude a successful energy transition is out of the question Mr. Kugelman finds reason for optimism. First, the government is well aware of the situation and has taken encouraging steps to address the country's energy and climate problems. In addition, he finds with assistance from international donors, the country has a number of policy interventions that should help mitigate the current difficulties and even put the country on a sustainable path in the not too distant future.

Historically India has been primarily concerned with the country's energy security, with energy affordability or environmental sustainability receiving considerably less attention. Things are changing and as Lydia Powell (Chapter 22) observes, several somewhat parallel, but contradictory, transitions are underway. First there is the low carbon transition taking place through an increasing share of renewable energy in the country's energy mix. Second an energy access transition is attempting to provide growing amounts of affordable petroleum fuels and cheap electricity generated using coal.

Ms Powell's assessment suggests both transitions will likely remain incomplete. As she observes, ironically the continued co-existence of both high and low carbon growth and the co-existence of energy poverty and energy affluence offer yet another example that for everything that is true in India, the opposite is also true.

Over the years Jordan's precarious energy situation has led many observers to predict a major calamity for that country's economy. John Calabrese (Chapter 23) documents the government's

attempts to put the country on a more secure energy path. As he shows, the past decade has been marked by the unfurling of a comprehensive energy strategy and the enactment of legislation and policy reforms designed to facilitate its implementation. In addition, the government has launched a number of new energy projects. However, as an energy poor country in a violent, unstable part of the world, energy security needs have been so paramount that concerns of environmental sustainability, at least for the present, have not entered into the country's energy plans in any significant way.

In the last several years Turkey has given top priority to energy security. As in the case of Indonesia, Turkish energy demand is increasing due to rapid economic growth and population increase. It is expected that energy needs will increase by 80% by 2023. Mehmet Efe Biresse-lioglu (Chapter 24) notes that the overall Turkish energy dependency level is 74%, with much higher rates for oil and natural gas. As a result, the government has made increased energy security through diversification as its prime energy policy goal.

However, as in the case of India, Turkish energy policy has a fundamental contradiction. The country's diversification efforts have not only focused on suppliers, but also on resources. Hence, there are ambitious targets to decrease the share of natural gas in electricity generation. There are two main policy options for this decrease. The first is to increase the share of renewables and the second is to increase the share of coal in electricity generation. The intention is to implement these two policy options simultaneously. Professor Biresse-lioglu suggests there needs to be a balance between these resources in order to improve Turkey's position in terms of the energy trilemma. Specifically, he advocates these policy options need to be supported by the development of domestic resources, including nuclear energy.

The countries of the final group are also characterized as carbon consuming, but with the significant difference from the previous group in their determination to decarbonize. Each country<sup>2</sup> has placed a priority on sustainable energy, with Italy, Dominican Republic, Costa Rica and Nicaragua scoring the best on the energy sustainability dimension. As a result, this group of countries as a whole scores by far the highest of the four country groupings on the energy sustainability dimension.

France's energy transition began in the 1970s with massive investments in nuclear power. As John Duffield (Chapter 25) observes, nuclear power helped greatly to reduce both France's imports and consumption of fossil fuels, which in turn considerably lowered the country's CO<sub>2</sub> emissions. In addition, the substantial economies of scale made possible by such a large programme and a high degree of standardization meant that the cost of generating electricity from nuclear plants was kept relatively low in comparison with other fuels and other countries. However, these advantages did not come without a cost. Inexpensive nuclear power discouraged the development and introduction of new renewable sources of power. Similarly, an excess of generating capacity and the resulting low power rates discouraged efforts to improve energy efficiency. Currently with increasing concerns over nuclear safety and the escalating costs of new nuclear facilities, the continued dominance of nuclear power in France will be much less certain.

Professor Duffield concludes that France will eventually have to develop a new formula for managing the energy trilemma. The outlines of such a formula have been suggested by the energy law adopted in mid-2015. As in many other developed countries, greater emphasis will have to be placed on renewable sources of energy as well as advances in energy conservation and efficiency. This may result in higher energy costs, at least until technological developments result in lower generation and distribution costs.

Denmark has pioneered many of the new green technologies as part of the country's efforts at decarbonization. The country's new green industries have thrived enabling the country to

pursue improvements in energy security without raising the costs of energy to levels experienced in other Western European countries.

Despite past successes in the renewable area, Peter Karnøe and Jens Stissing Jensen (Chapter 26) see some dark clouds on the horizon. In essence the country's energy discussion has shifted from the technical to the political. Specifically, a new Danish right-wing minority government elected in June 2015 has introduced the notion of 'Green realism' in its climate policy. 'Green realism' is based upon the argument that given the significant gains already made by the country in reducing greenhouse gas emissions, the country can take a break from further progress in the area, especially given the material and economic consequences of integrating the increasing amount of wind power generated electricity in the electricity/energy system. What lies ahead for the country's energy transition? Given this surprising development, the authors develop a model capturing the country's political/economic dynamics to get a sense of the changes likely to occur over the next few years.

German energy policy is rather unique in that no one area stands out. Over the period from 2013–2015, Germany had nearly identical scores across the energy trilemma ranking an average 27.7 in energy security, 33 in energy equity and 33.7 in environmental sustainability (Table 1.1). This pattern has not occurred by chance, but as Andreas Kraemer (Chapter 27) shows is a consequence of the country's energy policies or *Energiewende*. As he notes, energy transitions are much cheaper and easier to traverse than is commonly believed. Kraemer argues the *Energiewende* provides valuable lessons for other parts of the world. That is energy transformations can produce short-term benefits that outweigh their costs. Furthermore, those costs are not higher than maintaining the old, non-sustainable energy system, and the costs are coming down as experience accumulates.

Italy is another country that ranks the highest on the sustainable energy dimension of the energy trilemma. Morena Skalamera and Fabio Farinosi (Chapter 28) argue that this pattern is likely to continue to transition toward an energy mix largely consisting of a combination of renewables and natural gas. Renewables have been influenced by the EU's 20–20–20 targets which Italy is not only expected to meet but highly exceed.<sup>3</sup>

Barring major and, for the moment, unexpected changes in attitudes to nuclear, the contributions of wind and solar to Italian power generation will continue growing. However, as they show there is considerable uncertainty over the pace and composition of the country's future energy mix. The country's depressed economic conditions stemming from the 2008–2009 international financial crisis and the ongoing eurozone crisis have greatly eroded the government's resolve to continue subsidizing these technologies as generously as they have in the recent past.

The final country chapter is actually a broad survey of the manner in which the countries of the Caribbean and Central America have dealt with their energy problems and the manner in which several of the larger countries, Dominican Republic and Haiti in the Caribbean and Costa Rica and Nicaragua in Central America, are transitioning to a more sustainable environment with improved energy security.

In his survey of the region Robert Looney (Chapter 29) notes the difficulty of making sweeping generalizations concerning energy transitions. Even in a regional setting where countries share a number of similarities such as small domestic markets with limited fossil energy reserves, a great variety of energy mixes are possible.

Still several patterns prevail. Progress or lack of moving toward a secure sustainable energy mix is largely related to government capacity, especially at the extremes as illustrated by Haiti with the least capacity and Costa Rica with the most. However, explaining progress in intermediate cases like Dominican Republic and Nicaragua requires additional insights. Are leftist

regimes more concerned with the environment and energy security? Is there a political economy effect where democracies tend to place more emphasis on energy affordability?

## Completing the picture

The country case studies suggest the four broad country groupings used to organize this volume provide an effective way of narrowing down the manner in which countries are likely to prioritize the elements in the energy trilemma. As a starting point these groupings show a gradual progression of increased concern over climate security as one progresses from carbon producers through carbon reduction countries (Table 1.1).

The first three columns represent each country's average score on each of the three main energy goals in the period 2013–2015. The second three columns represent the World Energy Council's assigned grade for the progress made in each area, while the final column identifies the two areas of priority (based on each country's rankings in the first three columns).

To see if it was possible to arrive at a clearer picture of countries likely to prioritize climate security, several other aspects were considered. For instance, do democracies predictably come to a different set of priorities than is usually the case with autocratic or authoritarian regimes? Do higher levels of per-capita income get translated into a greater effort at increasing climate security?

Rearranging our case countries into two groups, (a) those who prioritize energy sustainability either one or two in the energy trilemma and (b) those who place energy sustainability third (Table 1.2), it's clear that the average level of democracy is considerably higher (lower numbers represent a higher ranking) while per-capita incomes are a bit lower for those countries that prioritize energy sustainability. One cannot easily argue therefore that only the rich countries have the luxury of taking action to improve the environment.

The statistical analysis undertaken in Appendix A sheds additional light on the factors that might facilitate or accommodate increased emphasis on environmental sustainability. The empirical results suggest a key role for democracy in improved climate security efforts. Democracy enters in two ways: affecting the country's preference for giving climate security a priority over either energy security or energy affordability. Once a country has opted for climate security increased levels of democracy are associated with improved levels of climate security.

These countries are likely to comply with global conferences that set specific targets for carbon reduction. The costs of doing this might come at the expense of energy security, but in an era of cheap oil and abundant natural gas, energy security might not be a strong trilemma-type constraint. This would be particularly the case if increased climate security was accomplished through the development of increasingly lower cost domestic green energy sources.

For countries that have not made a commitment to climate security, obtaining promises from them to voluntarily reduce carbon emissions may not be particularly effective in meeting global carbon reduction targets. However, it has been suggested that many of these countries have not given climate security a high priority, not because they don't want to, but because they simply do not have the financial capability in deploying green technologies on a large scale. For these countries a new international financial institution similar to the World Bank, but charged with lending for climate related investments might be an effective means towards improved climate security.

Democracy may also play a subtle role in those countries not giving climate security a high priority. Many countries, the United States, Canada, and South Africa being a good example, have difficulty in coming to a consensus over energy policies at the national level, especially

Table 1.2 Country groupings on environmental sustainability

Country groupings	World Energy Council trilemma country rankings			Trilemma priorities	Democracy ranking	Per-capita income
	Energy security	Energy equity	Environmental sustainability			
<i>Group I</i>						
UK	8.0	20.0	19.3	security, sustain	16	38,118
Brazil	33.0	83.3	17.7	sustain, security	51	15,111
Japan	64.3	18.7	41.0	equity, sustain	23	34,635
Pakistan	61.7	104.0	90.0	security, sustain	112	4,590
Jordan	114.7	61.3	103.7	equity, sustain	120	11,496
Turkey	66.0	77.0	72.7	security, sustain	97	18,869
France	42.0	9.7	10.7	equity, sustain	27	37,214
Denmark	3.7	43.0	10.7	security, sustain	5	42,757
Italy	67.3	44.0	22.7	sustain, equity	21	33,039
Dominican Republic	114.7	93.7	55.0	sustain, equity	60	12,652
Costa Rica	57.3	69.7	2.0	sustain, security	23	14,232
Nicaragua	103.7	97.7	71.0	sustain, equity	95	4,692
<i>Average</i>	<i>61.4</i>	<i>60.2</i>	<i>43.0</i>	<i>sustain, equity</i>	<i>54.2</i>	<i>22,283.8</i>
<i>Group II</i>						
Saudi Arabia	54.0	8.7	123.0	equity, security	160	49,537
Canada	1.0	2.0	62.3	security, equity	7	42,778
Russia	6.3	47.3	103.7	security, equity	132	23,292
Mexico	32.0	50.3	76.3	security, equity	66	16,284
South Africa	38.3	83.3	129.0	security, equity	37	12,446
China	19.3	87.3	127.3	security, equity	136	12,599
US	7.7	1.0	88.0	equity, security	20	52,118
Indonesia	17.0	78.7	95.0	security, equity	49	10,033

Country groupings	World Energy Council trilemma country rankings			Trilemma priorities	Democracy ranking	Per-capita income
	Energy security	Energy equity	Environmental sustainability			
Egypt	53.7	64.7	75.0	security, equity	134	10,046
Thailand	94.3	76.0	105.0	equity, security	98	15,012
India	68.3	106.3	122.0	security, equity	35	5,439
Germany	27.7	33.0	33.7	security, equity	13	43,602
<i>Average</i>	<i>35.0</i>	<i>53.2</i>	<i>95.0</i>	<i>security, equity</i>	<i>73.9</i>	<i>24432.2</i>

Note: The values are for 2014 and are in purchasing power parity, constant 2011 international dollars.

those policies relating to the environment and where there is the perception that an improved environment comes at the expense of jobs or higher energy prices. On the other hand, local or state governments that have seen the consequences of climate change in their areas, or simply have a genuine concern about the environment are often able to make significant strides in carbon reduction. Hopefully these can serve as a grass-roots model for eventually forcing improved climate security at the national level.

In the more authoritarian or autocratic countries the chance these movements will have a discernable impact is likely to be less, although the Thailand case holds out some hope. These movements are not encouraged and in countries like Algeria often suppressed. Leaders in these countries are usually more concerned with energy security and lower energy prices deemed necessary to keep popular discontent from creating instability. It is these countries in which global accords to combat carbon will likely find the most resistance and underperformance in meeting reduced global greenhouse gas emissions.

## Notes

- 1 Cf. World Energy Council, Energy Trilemma Index for a complete description of the trilemma and estimates of its values for a variety of countries. [www.worldenergy.org/data/](http://www.worldenergy.org/data/).
- 2 In the German case, in 2015 energy equity and energy sustainability were ranked nearly identically after energy security (Table 1.1).
- 3 The 20–20–20 target is part of the EU's binding legislation to ensure the EU meets its climate and energy targets for the year 2020. The key targets in this package are: (a) 20% cut in greenhouse gas emissions from 1990 levels, (b) 20% of EU energy from renewables and (c) 20% improvement in energy efficiency.