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Renewable Energy Law: An Introduction

I. Introducing Renewable Energy Law

Humans have always met energy needs from renewable sources. Biomass, wind, water and solar radiation have been harnessed by civilisations to produce energy for millennia.[1] Biomass remains a principal energy source for many people in the developing world to this day.[2] Consumption of energy from renewable sources was largely displaced in states that underwent industrialisation during the eighteenth, nineteenth and twentieth centuries by energy from fossilised sources such as petroleum, coal and natural gas. The rapid global expansion of economies, populations, and urbanisation in the 8 decades following the end of the Second World War has seen further massive growth in fossil fuel consumption. As a result, fossil fuels are the dominant energy source in the world today, amounting to 81 per cent of production and consumption in 2019.[3] However, interest in renewables as a means of meeting energy demand has returned in recent decades. The best-known reason for this is the major contribution that the extraction of fossil fuels and production of energy from them are making to climate change by releasing carbon dioxide, methane, and other less prevalent but more potent greenhouse gases into the atmosphere.

The revival is at a small scale at present. Around 13 per cent of global energy production and 16 per cent of energy consumption were from renewable sources in 2018.[4] Over half of that production and consumption derives from long-established renewable sources of traditional biomass and hydropower with more recently introduced renewables technologies including for wind and solar energy and biofuels making up the

[1] Vaclav Smil, *Energy Transitions: History, Requirements, Prospects* (Praeger 2010) 26.

[2] United Nations, *Leveraging Energy Action for Advancing the Sustainable Development Goals* (SDG 7 Policy Brief 2021) 2021-POLICY BRIEFS.pdf (sdgs.un.org) (accessed 1 October 2022), 20–1 and 84.

[3] European Commission, *EU Energy in Figures: Statistical Pocketbook 2021* (Publications Office of the European Union, 2021) 11 and 15–17.

[4] ibid.

balance.[5] However, renewables became a leading destination for energy sector investment during the 2010s with investment in new electricity production capacity from modern renewables now consistently exceeding investment in new fossil fuel capacity.[6] Renewable electricity accounted for 75 per cent of global power sector investment in 2019 compared to 21.2 per cent in fossil fuel electricity.[7] Renewable energy use is very likely to grow significantly during the next three decades and beyond if the world's states are serious about achieving agreed goals of international climate action to which the great majority of them have committed by ratifying the Paris Climate Change Agreement including that greenhouse gas emissions should be reduced to a 'net zero' level during the second half of the twenty-first century and that the increase in global average temperature since pre-industrial times should be kept to well below 2˚C and below 1.5˚C if possible.[8]

Some of the growth in renewable energy to date will have been due solely to the uptake of relevant technologies by energy producers and of their output by consumers because of the attractive attributes which energy from renewable sources tends to possess. However, much of it will have happened because of legal interventions made to promote the growth in availability and use of energy derived from renewable sources and of the technologies needed for its production, transmission and consumption. Law has a major part to play in the revival of renewable energy. Laws are needed at all levels, international, regional, national and sub-national, to implement pro-renewables policies. Law can be used to encourage renewable energy production and consumption, for example by creating rights to financial support. It can also be used to lessen and remove the many barriers that would otherwise constrain its growth, for example by addressing causes of public opposition to renewable energy development. The great majority of the world's states have already introduced laws which seek to promote the renewable energy revival including by removing barriers.[9]

The appeal of renewable energy without legal intervention is only likely to increase as the cost of energy production from relevant technologies and of the technologies themselves decline through experience with their use, related efficiency gains, economies of scale in production both of energy and technologies, and the modification of energy systems and their institutions so that the positive features of renewables can be better enjoyed. However, legal intervention is likely to remain necessary in many respects during the decades ahead for reasons including:

- the continuing dominance of fossil fuel energy sources;
- related needs for very significant growth of renewable energy and for urgency in securing this growth if greenhouse gas emitting fuels are to be displaced at a rate

[5] REN21, *Renewables 2020 Global Status Report* (REN 21 Secretariat, 2020) 32.
[6] ibid, 165–73.
[7] ibid, 173.
[8] Paris Agreement (adopted 12 December 2015, entered into force 4 November 2016) 3156 UNTS, arts 2(1)(a) and 4(1); International Renewable Energy Agency (IRENA), *Global Energy Transformation: A Roadmap to 2050* (IRENA, 2019) 10–14.
[9] See the IEA/IRENA Renewables Policies Database at www.iea.org/policies/about (accessed 1 October 2022). See also Penelope Crossley, *Renewable Energy Law: An International Assessment* (Cambridge University Press 2019).

commensurate with the seriousness of threats posed by climate change for human well-being;

- particular needs for intervention in energy for heating and transport in which the proportion of supplies from low carbon energy remains very low;
- socio-economic lock-in to ways of living predicated on the ready availability during several decades of cheap high-density energy from fossil fuel sources; and
- inadequacies of existing systemic arrangements and laws for accommodating renewable energy.

A. The Book's Purpose

The book's purpose is to inform and educate readers about the growing bodies of laws which are being adopted to promote renewable energy's growth, to overcome constraints on this and to address problems which renewable energy's expansion creates. The book has three main aims. Its first is to aid readers' understanding of reasons why legal interventions are often needed to enable the growth of renewable energy. Its second is to advance readers' knowledge and understanding of ways in which law is being or could be used to promote renewable energy including by overcoming barriers to its use and addressing consequences of the sector's expansion. Its third is to assist readers with developing capacities to look critically at laws adopted to address commonly occurring problems encountered by the renewable energy sector as it expands. Understanding problems that relevant laws are intended to address creates a learning context in which the likely efficacy of legal responses for achieving intended aims can be assessed.

In addition, the book aims to support teaching on renewable energy law and research in this field by contributing to its development as a legal sub-discipline. The author was motivated to write a book that advances these aims by her 10 years of experience with developing and teaching courses on renewable energy law and as a researcher in the field. Law concerning renewable energy is quickly growing in importance in view of well-recognised urgent needs for replacing fossil fuel energy with renewable alternatives. Knowledge and understanding of how law can be used to enable expansion of the renewables sector are therefore of increasing value for students, policymakers and practitioners alike. However, this is not a straightforward topic for educators to develop courses on and teach or for recipients of teaching to benefit from for the following reasons. First, renewable energy law is not an established field of legal scholarship with well-defined parameters and rules for determining what lies within and without its ambit. It was therefore necessary for the author when first developing renewable energy law teaching to decide upon the scope of this emerging sub-field, and to identify its contents.

The temptation when developing a renewable energy course may be to concentrate on examining well-established legal areas such as trade law, competition law and environmental law in which issues have arisen concerning renewables. Whilst the appeal of this approach is understandable, courses which take these topics as their principal focuses may prove poor for cultivating knowledge and understanding of why law has

a role in promoting renewables, of what that role is, and of how the likely contribution of laws to expanding renewable energy production and consumption can be discerned and evaluated. Instead, the author chose to concentrate on laws that drive growth of the renewables sector and that seek to enable this by overcoming the many factors constraining growth in the use of energy from renewable sources when deciding on what should fall under the sub-discipline's purview. The purpose of this exercise was not to lay exclusive claim to laws as belonging to the sub discipline. Many of the laws that it covers and which this book examines fall primarily under other fields such as climate law and environmental law. Rather, renewable energy law as a field of legal scholarship and education is concerned with determining law's role in enabling the growth of the renewables sector, and with developing bases for: identifying laws whose purpose is to promote the renewable sector's growth; analysing whether they are well designed for realising this objective; and exploring how limitations identified in current laws for promoting renewables could be remedied.

Second, acquiring command of this subject matter is a labour intensive and lengthy process. It is only through extensive reading that the author has been able to gain sufficient understanding of the contexts in which laws relating to renewables are deployed to recognise whether or not reading materials are suitable for supporting teaching and research on renewable energy law. Relevant reading materials for introducing readers not only to law used in connection with renewable energy but also the needs and challenges for integrating renewables that those laws are designed to address are spread across several legal sub-disciplines and also across several non-legal disciplines. Legal sub-disciplines in which relevant literature is found include energy law, environmental law, climate law, public international law, the law of the sea, and trade law amongst others. Non-legal disciplines in which important papers for understanding the contexts in which renewable energy development are published include economics, politics, sociology, engineering, and natural sciences including terrestrial and marine ecology. Literature in these legal sub-disciplines and non-legal disciplines must first be read and understood by the course designer to enable informed appraisal of whether or not secondary sources are likely to be useful for educational purposes.

Third, understanding of the contexts in which the rollout of renewables takes place (eg, the investment environment, the functioning of energy systems, considerations informing public responses to energy developments) is needed to teach renewable energy law in a way which enables students to think critically about its likely efficacy for supporting the rollout of renewables. Literature which examines these contexts typically derives from research in disciplines other than law and will usually, if it is presenting research results, not be aimed at supporting education for those without a background in the discipline concerned. It may therefore be too challenging for students to attain full understanding of subject matter examined in course seminars without significant support. The author has been able to acquire understanding of these contexts through broad interdisciplinary research and uses this in the book to provide foundational explanations of renewable energy law's role in different settings so that others can benefit from it when teaching, studying, and researching in the field.

To summarise, the book has been developed to address the three challenges outlined above with a view to making renewable energy law more easily accessible as a topic for course developers, students, and legal researchers alike. It defines a coherent body of

legal topics linked by their relevance for enabling the growth of renewables despite the several major challenges that confront this sector's expansion. In doing so, it fills a gap in legal literature by providing what, to the author's knowledge, is the first book publication intended to perform a textbook role in support of new course development and delivery on renewable energy law. The author hopes that this product of her teaching experience will help with democratising renewable energy law as a component of legal education. The book also adds to legal scholarship in two ways. It proffers a basis for determining the parameters of renewable energy law and identifies core contents of the field. It also proposes methods in relation to each of the topics which the book examines for recognising laws that contribute to renewable energy's growth and for assessing their likely value for securing this outcome. Methods are developed by reference to the roles of renewable energy law in different contexts. For example, the purpose of laws examined in Chapter 4 is to strengthen confidence amongst investors and other actors in policy commitments made by governments to meet renewable energy targets by providing them with legal backing. The chapter identifies features that laws which provide strong support for targets in this way should possess and suggests a basis for assessing the strengths and weaknesses of relevant laws by reference to their presence or absence. The purpose of laws examined in Chapter 6 is to address challenges retarding the integration of renewable electricity into electricity networks (network access challenges). The chapter's initial review of network access challenges and of the types of intervention needed to address them aids the following explorations of how law can assist with meeting the challenges and of whether laws employed in practice to modify network operation and development are capable of doing so.

B. The Book's Approach

The book does not offer comprehensive descriptions of or proposals for laws relating to renewable energy in different jurisdictions. Books based on focused studies of challenges with introducing renewable energy in specific states and administrations and of legal responses to them are required to service these needs. Instead, it employs an approach to examining renewable energy laws which the author has developed during a decade of designing and teaching courses on this topic. The courses were taken by cohorts of students from multiple different developed and developing world jurisdictions. The author's own background is in UK and EU law, but courses that are limited to accounts of the law in these jurisdictions and of their legal peculiarities would be of limited value for such diverse groups. In view of this, the author's approach in teaching, also used in this book, is to start by identifying and exploring types of problems which efforts to introduce renewable energy tend to encounter or create wherever they are made. Commonly occurring problems are due to intrinsic characteristics of energy from renewable sources and of relevant technologies including the intermittency of energy from wind and solar sources, the fact that sources are often remote from existing networks, and the costs of renewable energy and of related technologies because of their newness. They are also due to intrinsic characteristics of fossil fuel energies and therefore of the energy systems, institutions, societies, and economies which are still dominated by them. The common nature of these problems creates much scope for

those wishing to learn about how law can be used to address them to draw from experiences in jurisdictions other than their own, whilst being alert to perennial difficulties with transplanting experience from one legal culture and its socio-economic context to others.

The author employs examples from the UK and EU in examining how law can assist with addressing challenges for introducing renewable energy. Experience in these jurisdictions is useful for learning about renewable energy law as both have been proactive in promoting energy production and consumption from renewable sources. As leading proponents of renewable energy, they have also been ahead of other jurisdictions in encountering problems that pro-renewables policies can meet or create and in developing legal responses to them. The author also draws on experience from other jurisdictions with introducing renewable energy to illustrate challenges which arise and ways in which law can be used to address them. The examples used show that the type of legal responses developed in the UK and EU are not unique to them but are being employed elsewhere. As noted above, similarities in response reflect the common nature of problems raised by efforts to promote renewable energy and its integration into energy systems that were designed around qualitatively different fossil fuel energy sources.

C. Chapter Contents

The following sections introduce readers to renewable energy law by setting out essential background information for studying this topic. Section II defines renewable energy. Section III examines the main drivers for the adoption of pro-renewables policies and laws for implementing them. Section IV identifies and explains the nature of common barriers facing the growth of a new renewables sector. Knowledge and understanding of barriers are particularly important from a legal perspective as much of the law examined in this book has been introduced wholly or in part to overcome them. Section V further defines the parameters of renewable energy law as it is understood for the purposes of this book. Section VI concludes the chapter by setting out foundational legal information for following chapters on the different administrative levels at which renewable energy law is adopted.

II. What is Renewable Energy?

“可再生”一詞用於描述來自來源的能量，這些來源以與使用相同的速度補充。

The term ‘renewable’ is used to describe energy derived from sources that are replenished at the same rate as they are used. This is in contrast to fossil fuels, the consumption of which reduces the stocks available for future generations The principal sources of renewable energy are the sun, the wind, waves, tides, tidal currents, geothermal energy and organic matter (biomass). The majority of these sources are the product, either directly or indirectly, of energy from the sun. The exceptions to this are tidal and geothermal energy which are derived respectively from the gravitational

effect of the moon and from the heat of the Earth's interior. Most of these sources are fully renewable, but biomass and geothermal energy are only renewable to the extent that consumption does not exceed the capacity of the Earth and its interior to replace them. Technologies have been developed to produce energy from all these sources. Some of the technologies are well-established and widely used for commercial energy production (eg, wind and solar energy) whilst others are at an earlier stage of development (eg, wave and tidal current energy).[10]

Renewable sources can be used to meet demands for energy for electricity production, heating and transportation. Electricity can be generated from solar energy (including through photovoltaic (PV) units), through the release of water stored behind dams (hydropower and tidal barriers), through turbines driven by wind, wave and tidal currents and by the burning of biomass. In addition to meeting current demand for services such as lighting, renewable electricity is expected to have a growing role in providing energy for heating and transportation if fossil fuels consumed for these purposes are to be replaced by lower carbon alternatives. Energy for heating can be attained directly from the sun, including through its heating of the air and water, from the burning of biomass and gases derived from them in boilers, from the capture of heat produced as a by-product of electricity generated from renewable sources in combined heat and power units, and through tapping into geothermal energy. Fuels derived from a wide variety of biomass feedstocks and from organic waste can be used to power road, marine and air transportation.

A common characteristic of most renewable sources is that carbon dioxide is not emitted during the production of energy from them. The exception to this is biomass which is often described as a 'carbon neutral' energy source because carbon dioxide that organic matter absorbs during its growth is released into the atmosphere when it is burnt. 'Carbon neutral' is a controversial term with many arguing that its use conceals a complex reality with biomass burning sometimes adding to atmospheric greenhouse gas levels over the near-term timeframes in which rapid decarbonization is required because of the time taken to replace lost biomass, particularly old-growth wood, with biomass possessing an equivalent capacity for carbon storage.[11] Critics of the term also reference greenhouse gas emissions from conversion of the source material into usable energy products and from its transportation to consumers. Awareness is shown of this complexity in laws which seek to distinguish 'sustainable' bioenergy sources from sources labelled as being 'unsustainable' for reasons including their carbon footprint.[12]

Hydrogen does not occur naturally and is not a renewable fuel itself. However, it can be used as a carrier for renewable energy.[13] For example, electricity from renewables

[10] For a fuller explanation of renewable energy sources see Stephen Peake and Bob Everett, 'Introducing Renewable Energy' in Stephen Peake (ed) *Renewable Energy: Power for a Sustainable Future* 4th edn (Oxford University Press, 2017).

[11] Mihnea Catuti, Milan Elkerbout, Christian Egenhofer and Monica Alessi, *Biomass and Climate Neutrality* (CEPS Policy Insights, No. 2020/19, August 2020) www.ceps.eu/ceps-publications/biomass-and-climate-neutrality/ (accessed 1 October 2022).

[12] See Chapter 9, Section III.

[13] Crossley (n 9) 53–4.

which exceeds demand at the time of generation can be used to power electrolysis of water to separate hydrogen from oxygen. Stored hydrogen can then be burnt to produce electricity when renewable sources are not sufficient to meet demand. It can also be used directly as a fuel in vehicles fitted with hydrogen fuel cells. Hydrogen has sometimes been included in legal definitions of renewable energy because of its close association with renewable power generation.[14]

It has been argued that nuclear energy should also be viewed as a renewable energy source.[15] The argument is based on revived interest in nuclear power because of its low carbon credentials, and on the substantial remaining reserves of resources required for the manufacture of nuclear fuels (primarily uranium). The argument has found little success.[16] Feedstocks for nuclear fuels, although substantial, are exhaustible. There is also much reluctance to support nuclear energy in the same way as renewable energy sources because of the potentially very significant negative effects of the former in the event of radioactive releases, still-unresolved questions about how to deal with nuclear waste and the manifest security concerns that certain states and actors may gain access to nuclear materials and technologies. Nuclear power is not included within renewable energy as defined in this book.

III. Drivers for Renewable Energy Development

The ready availability of reliable affordable energy supplies is essential for maintaining peoples' security and for the operation of economic and social systems which enhance their wellbeing. The content of energy supplies is therefore (or should be) a matter of interest for all governments. This remains the case even in national energy systems which have been deregulated in order to pass control from the state to markets. Governments use energy policies and laws to prefer certain energy sources over others where use of the preferred sources contributes to overarching policy objectives. Recent decades have seen many of the world's states adopt policies and laws in favour of increasing energy production and consumption from renewable sources. They have done this because compelling reasons demand that the content of energy supplies must be altered to address a raft of threats to the secure functioning of progressive societies including change in the Earth's atmospheric composition, accelerating worldwide environmental deterioration, localised environmental threats to public health, geopolitical turmoil and economic shocks. Renewable energy's expansion is also seen as a means of creating security and improved living conditions in states whose populations are prone to insecurity and poverty. The following paragraphs explore these reasons which are driving the widespread adoption of policies and laws in favour of renewable energy sources.

[14] ibid.
[15] ibid, 56–60.
[16] ibid.

A. Climate Change

The great majority of the world's states have entered into legally binding treaties under international law in which they commit to tackle climate change, describing it as a 'common concern of humankind'. The most recent of these treaties, the Paris Climate Change Treaty agreed in December 2015, had been ratified by 193 of the 197 states in the world by the end of 2021.[17] Climate change is occurring because human activities have led to change in the gaseous composition of the Earth's atmosphere and therefore of its climate system due to the release of large volumes of gases which are referred to collectively using the adjective 'greenhouse'. Greenhouse gas growth alters the Earth's climate by increasing the level of solar radiation that is trapped rather than escaping back into space. Consequences include growth in the global average temperature, alteration in historic patterns of rainfall, extreme weather events and worsening ecosystem degradation for reasons including extinction and relocation of species which are unable to cope with changed conditions. Carbon dioxide accounts for around three-quarters of current greenhouse gas emissions with the remaining quarter being made up of methane (16%), nitrous oxide (6%) and fluorinated gases (2%).[18]

The combustion of fuel to produce energy is responsible for around three-quarters of greenhouse gas emissions overall and for an even higher proportion of carbon dioxide emissions.[19] Fuel combustion as a category includes energy production by power and heating sectors, for transportation, for industrial processes, for agricultural processes, and for residential use. Greenhouse gas releases from fuel combustion are largely due to gases emitted by burning petroleum, oil and natural gas. The power and heat production sectors make the largest contribution to greenhouse gas growth (34% worldwide in 2019, 32.5% in the EU in 2019).[20] Transport's contribution is not far behind and growing, being responsible for 15 per cent of greenhouse gas emissions globally in 2019 and 30.2 per cent of emissions in the EU in 2019.[21] Manufacturing, industry and construction are together the second major contributor worldwide and the third major contributor in the EU (24% worldwide in 2019, 15.7% of emissions in the EU in 2019).[22] In addition to fuel combustion, methane is released by coal mining and by oil and gas operations.

In view of these stark statistics, decarbonisation of the energy sector provides the main focus for efforts at all levels to combat climate change with attention turning to renewable energy because either no or, in the case of carbon neutral biomass, no additional greenhouse gases are released into the atmosphere at the point of energy

[17] United Nations Framework Convention on Climate Change, 'Paris Agreement – Status of Ratification', https://unfccc.int/process/the-paris-agreement/status-of-ratification (accessed 1 October 2022).

[18] United States Environment Protection Agency, 'Global Greenhouse Gas Emissions Data', www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data (accessed 1 October 2022).

[19] ibid.

[20] IPCC, 'Summary for Policymakers' in Priyadarshi Shukla and others (eds) *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, 2022), 12; European Commission (n 3) 163.

[21] ibid.

[22] ibid.

production. Renewable sources are not the only options available for emission-free energy production. Nuclear power production has seen a revival in national policy support largely because it offers a means of producing large volumes of carbon free electricity at stable and predictable levels. Carbon capture and storage technologies offer the potential to exploit fossil fuels without greenhouse gas growth by capturing emissions at the point of production and piping them for storage underground including in depleted oil and gas fields. However, the latter is a still developing technology and both are perceived to be high-cost options for energy production whose use creates risks of significant negative impacts on human well-being. In addition, all means of producing greenhouse gas free energy will be needed in the future if gas-emitting fossil fuel production is to be eradicated.

The relationship between legal agreements made by states on combating climate change and the worldwide diffusion of renewable energy technologies is examined in detail in Chapter 2. Regional and national policies on combating climate change are also major drivers for the adoption of the renewable energy targets and laws considered in Chapter 4 and of the laws required to support renewable energy's growth examined in Chapters 5 to 9.

B. Harm to Environments and Human Health

Climate change is not the only cause of environmental concern associated with fossil fuel energy. Other problematic impacts can occur at all stages of production and consumption for different fossil fuel types. Effects include deliberate destruction of environments to access coal in strip and opencast mining, pollution of aquatic environments and drinking water due to acid runoff from mining, fracking for shale gas, leaks of crude oil from rigs and pipelines and spills from oil tankers. Air pollution from noxious gases, heavy metals and microscopic particles released from burning fossil fuels for electricity, heating and transportation is a serious enough threat to human health and environmental functioning on its own to justify their replacement with less polluting energy sources.[23] Levels of air pollution exceeding safe levels for human health are endemic in many of the world's cities.[24] IRENA projects that tackling air pollution by moving to cleaner energy sources would lead to strong human welfare gains worldwide.[25] Some of these polluting releases contribute to global warming (carbon dioxide, ozone, nitrous oxide, black carbon) whilst releases of sulphur dioxide from coal burning for electricity production lead to the acidification of rain and serious impacts from this such as forest decline and loss.

This catalogue of environmental consequences spurs calls for replacing fossil fuels with energy from renewable sources. Positive steps to tackle these problems, including

[23] IRENA, *Global Renewables Outlook: Energy Transformation 2050* (IRENA, 2020) 58; Frederica Perera, 'Pollution from Fossil Fuel Combustion is the Leading Environmental Threat to Global Pediatric Health and Equity: Solutions Exist' (2018) 15 *International Journal of Environmental Research and Public Health* 1.
[24] ibid.
[25] IRENA (n 23) 52.

by moving to cleaner fuels, are also required by legal duties of states and of subnational authorities at several legal levels. States party to the UNECE Convention on Long-Range Transboundary Air Pollution and its several protocols and Member States of the European Union have obligations to keep certain pollutants below specified levels and to take action when they are exceeded.[26] National and subnational laws set limits for levels of pollutants in the atmosphere, in terrestrial and marine waters, and in drinking water. Conventions ratified by many of the world's states such as the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea alongside many species-specific instruments place duties on states to address sources of harm for biodiversity at large and for particular species and their habitats.

The environmental consequences of fossil fuels create interest in technologies that reduce or avoid these effects. Renewable energy technologies are often far preferable from this perspective.[27] Gases are not released directly by electricity production from renewable sources apart from biomass burning. Electric vehicles do not emit the gases or particulate matter which are major contributors to urban air pollution. Using off-grid renewable electricity production to replace reliance on diesel generators and biomass burning assists with alleviating air pollution, particularly in peoples' homes, that impacts negatively on the lives of many without access to secure centralised electricity supplies. It is unsurprising therefore that states are turning to renewable technologies in national energy and transportation policies and laws. Crossley finds that nearly half of the 113 national renewable energy laws examined in her research had addressing environmental problems as an objective including air pollution, unsustainable water use, water pollution, thermal pollution, waste and biodiversity loss.[28] We should keep in mind however the adage that 'there is no such thing as a free lunch' with energy use. Renewable energy production and consumption can also have negative environmental effects. As already mentioned, biomass burning can contribute significantly to air pollution, particularly in homes. Producing feedstock for bioenergy can lead to worse environmental effects than it avoids if this is not done sustainably.[29] Damming rivers and tidal waters to produce electricity has substantial and typically damaging impacts on river and marine ecosystems which are altered for this purpose. Care is needed with siting other means of electricity production to avoid locations where they would cause harm (eg, siting a wind farm next to a coastal breeding place for seabirds). Laws that can be used or are specifically designed to address these environmental consequences are an important part of renewable energy law as we will see in Chapters 8 and 9.

C. Energy Security

Fossil fuel resources are not evenly shared amongst states. Some such as Russia, Saudi Arabia and Venezuela have plentiful reserves whilst others must import oil and gas

[26] Philippe Sands and Jacqueline Peel with Adriana Fabra and Ruth Mackenzie, *Principles of International Environmental Law* 4th edn (Cambridge University Press, 2018) 259–77.

[27] IRENA (n 23) 58; Perera (n 23).

[28] Crossley (n 9) 139.

[29] See the discussion of biomass and carbon neutrality in Section II of this chapter and at Section III of Chapter 9.

from them to meet demand for these energy sources. For example, many European states and the European Union overall depend heavily on oil and gas supplies from Russia and from Central Asian states. The EU imported 96.8 per cent of its oil and petroleum products supplies and 89.7 per cent of natural gas supplies in 2019.[30] South-East Asia balances supply and demand as a region, but other Asian regions are net importers of fossil fuels.[31] Uneven distribution of fossil fuels confers geopolitical power and economic advantage on states possessing fossil fuel resources whilst leaving others economically and socially vulnerable to their actions and to disturbances in fossil fuel exporting areas. Disputes between Russia and the Ukraine through which gas pipelines pass gave European importers of gas cause for concern that supplies may be disrupted in the first decade of the twenty-first century, whilst instability in the Middle East and related risks of supply disruption are a constant source of anxiety for states which rely on oil and gas imports from the region.[32] Russia's invasion of Ukraine in 2022 led to the rapid doubling of already high oil and gas prices in the EU, and related calls for accelerated investment in green energy.[33] Means of reducing reliance on energy imports are unsurprisingly attractive to affected states. States which have fossil fuel surpluses may also choose to shore up domestic energy security by increasing non-fossil fuel energy resources domestically so that they are able to export more of their output.

Being energy secure means more than that people have the possibility of accessing energy supplies. They should also be affordable. Fluctuation in oil and gas prices can also threaten energy security, even for states with reserves of these commodities, when this leads to high prices. Means of reducing exposure to fossil fuel price volatility and related risks of harm to peoples' standards of living and national economies will appeal to many states, and not just those with net dependencies on imports.[34] Conversely, a projected long period of low prices with little prospect of volatility leading to much higher prices could depress investment in non-fossil fuel alternatives.

Renewable energy resources are also not distributed evenly. Some states possess much greater potential for commercially viable renewable energy exploitation than others. However, the renewable resource is distributed more widely than exploitable fossil fuels with every state possessing some potential for producing energy from ubiquitous sources such as solar radiation and wind. Its exploitation is also positively encouraged by global climate action as a means both of decarbonizing existing supplies and advancing adaptation by enabling the transition of socio-economic systems to a post-carbon future. In this regard, questions arise over whether it is appropriate to view energy resources whose use heightens risks of harmful climate change as secure. Energy security is therefore a major driver for renewable energy exploitation and one which operates independently from as well as alongside reducing greenhouse

[30] European Commission (n 3) 75 and 77.
[31] IRENA (n 23) 122.
[32] Crossley (n 9) 113–15; Matt Bonass, 'Why Renewable Energy' in Matt Bonass and Michael Rudd (eds) *Renewables: A Practical Handbook* (Globe Law and Business, 2010) 9, 11–12.
[33] OECD, *OECD Economic Outlook, Interim Report March 2022: Economic and Social Impacts and Policy Implications of the War in the Ukraine* (OECD Publishing, 2022).
[34] Crossley (n 9) 116–17; Bonass (n 32) 11–12.

gas emissions. Crossley identifies bolstering energy security in the face of diminishing national capacity to meet demand, particularly through fossil fuels, as a common reason given by states for adopting national renewable energy legislation.[35] REN 21's global status report on renewables for 2019 identifies improving energy security fears due to supplier hostility as a major reason for the adoption of pro-renewables legislation by the Ukraine and of a 100 per cent renewable electricity target for 2050 adopted by the Ukrainian city of Zhytomyr.[36] The United Arab Emirates furnishes an example of an oil-rich state which has also been proactive in exploiting renewable resources including by hosting the International Renewable Energy Agency.[37] Diversifying within renewable energy supplies can also enhance security by reducing risks from dependence on one type of renewable resource, particularly solar and wind, which derive from intermittent conditions or on particular technologies and by enabling experience to be gained with newer technologies through which learning-related reductions in costs of producing energy can be realised.[38]

D. Economic Benefits

Global transition to a low carbon economy is seen not only as an essential response to climate change, but as a driver of economic growth and creator of new jobs during the first half of the twenty-first century. Expansion of the renewables sector is expected to be a major component of this growth by creating economic demand for and employment in technology manufacturing industries and installation, operation and maintenance services. IRENA projects that losses in economic contributions and jobs due to the decline of fossil fuel industries will be outweighed by energy transition economic drivers leading to substantial net positive growth in the global economy and employment in the energy sector.[39] Economic and job opportunities through low carbon energy growth were also widely advocated for as a means of recovering from the global financial crisis in the 2010s with $190 billion support for renewable energy being made available globally under fiscal stimulus packages.[40] A similar response to economic disruption caused by COVID-19 is likely. Statements by IRENA, the IEA and the Council of the European Union on the pandemic argue for the low carbon energy transition as a spearhead of the economic response.[41]

Developing specialisations in the renewables sector has been viewed since interest in relevant technologies began to grow as a contributor to job and wealth creation.

[35] Crossley (n 9) 112–18.
[36] REN 21 (n 5) 182.
[37] See numerous references to renewable energy investment in the UAE in REN 21 (n 5).
[38] Crossley (n 9) 115–16.
[39] IRENA (n 23) 142–46.
[40] Crossley (n 9) 122.
[41] Council of the European Union, 'Conclusions on the response to the COVID-19 pandemic in the EU energy sector – road to recovery' (Ref 9133/20 25 June 2020); IRENA, *The Post-COVID Recovery: An Agenda for Resilience, Development and Equality* (IRENA, June 2020); International Energy Agency, *Sustainable Recovery: World Energy Outlook Special Report* (IEA, June 2020), www.iea.org/reports/sustainable-recovery (accessed 1 October 2022).

For example, the European Commission advised in 2012 that strong renewables growth to 2030 could generate over 3 million jobs, and emphasised the value for the EU's global competitiveness of maintaining its leadership in renewable technologies 'as 'clean tech' industries become increasingly important around the world'.[42] IRENA's employment report for 2019 advises that jobs in renewable energy were continuing to grow during 2018 with 11 million persons employed in the sector worldwide by the end of 2018.[43] Its modelling for the low carbon energy transition to 2050 projects fourfold growth in renewables employment to 42 million.[44] It is important to note that much of this growth is already concentrated in certain states and regions and that this concentration is likely to persist: 60 per cent of renewable energy jobs were in Asia in 2018 with 39 per cent in China alone.[45] Job concentrations are found in China, Brazil, the US, India, and the EU whilst other states and regions lag behind. However, opportunities for growth which others may take advantage of will continue to arise as the renewables sector diversifies geographically and technologically, with many technologies that will be needed for a full decarbonisation of economies still being in pre- and early commercial stages of development.

Finally, the rapidly declining costs of producing energy using well-established technologies drives increasing interest in exploiting renewable sources such as wind and solar because they are often lower-cost options for energy production than fossil fuels. See Section 1 of Chapter 5 for discussion of how renewable energy costs from better established technologies have fallen dramatically during the last decade.

E. Sustainable Development

Sustainable development has been a high-profile theme in international dialogue on tackling global problems since the 1980s.[46] It was proposed as a goal that would enable compromise between advocates of limiting economic growth and living standards due to related environmental problems that were becoming apparent in the 1970s and of economic growth and social improvements to reduce deep disparities in wealth and in qualities of life between inhabitants of developed and of developing states. Sustainable development as conceptualised by interstate agreement at Johannesburg in 2001 involves progress which advances the three pillars of the concept, economic, social and environmental, together.[47] Renewable energy's vital contribution to tackling climate change and other environmental and public health crises such as air pollution are considered above. Renewable technologies also have a central role to play in enabling future economic growth whilst respecting limits to the Earth's environmental capacity

[42] European Commission, 'Renewable Energy: A Major Player in the European Energy Market' COM (2012) 271 final, 2.
[43] IRENA, *Renewable Energy and Jobs: Annual Review 2019* (IRENA, June 2019).
[44] IRENA (n 23) 145.
[45] IRENA (n 43) 24–25.
[46] Sands (n 26) 217–21.
[47] United Nations, *Plan of Implementation of the World Summit on Sustainable Development* (Johannesburg, 2001) WSSD_PlanImpl.doc (un.org) (accessed 1 October 2022), para 2.

to support human exploitation. With regard to the social pillar, renewable electricity generation technologies are key to raising standards of life in developing world countries, particularly in sub-Saharan Africa. Over half of the population of sub-Saharan Africa did not have access to electricity in 2020.[48] Nearly 3 billion people were without access to clean cooking solutions, often relying instead on polluting fuel and stove combinations.[49] Off-grid electricity produced primarily from solar and wind energy provided 60 per cent of new electricity access in the 2010s.[50] That contribution is only likely to grow under the influence of the United Nations Sustainable Development Goal 7 which seeks 'to ensure access to affordable reliable sustainable and modern energy for all' by 2030.[51] The relationship between sustainable development policies and law in driving renewable energy development is examined further in Chapter 3.

IV. Obstacles to Renewable Energy Development

Renewable energy production and consumption is made possible by choices of several types of actors. Energy producers decide to invest in producing energy from renewable sources. Energy suppliers decide to purchase renewable energy from producers for provision to customers. Consumers may make a positive choice to buy energy from renewable sources, to buy an electric vehicle or to install a biomass boiler. Manufacturers decide to invest in facilities for producing technologies required for producing and consuming renewable energy and to expand them as demand for their products grows. Infrastructure owners and operators make investment decisions to adapt electricity and pipeline networks or to introduce new energy distribution facilities to anticipate or stimulate demand for a shift to renewables in energy supplies. All these changes may happen, to some extent, in the normal course of market operation without intervention being required from governments by adopting pro-renewables policies and laws. However, market operations alone will not bring about change in energy supplies from fossil fuels to low carbon energy sources including renewables at the scale and rate required by the drivers examined in Section III. IRENA advises in its 2050 roadmap that this will involve 'much stronger public sector interventions and global collaborative efforts'.[52] The main reason for this is that the growth of the renewables sector, notwithstanding its clear appeal from climate, environmental, security and economic perspectives, faces many barriers. Legal interventions in favour of renewable energy are required precisely because of the obstacles and constraints which confront efforts to implement policies that promote renewable energy directly or which drive recourse

[48] United Nations Economic and Social Council, 'Progress Towards the Sustainable Development Goals: Report of the Secretary-General' (Ref. E/2020/57, 28 April 2020), paras 67–72.
[49] ibid.
[50] IRENA, *10 Years: Progress to Action* (IRENA, January 2020) 14–15.
[51] United Nations, 'SDG7: Affordable and Clean Energy' (Sustainable Development Goals, Internet Site), www.un.org/sustainabledevelopment/energy/ (accessed 1 October 2022).
[52] IRENA (n 23) 55.

to it indirectly by requiring that drivers examined in Section III such as greenhouse gas growth should be tackled over a short timescale. Knowledge and understanding of the barriers are therefore essential both for understanding why renewable energy law is required and for well-founded critical analysis of the effectiveness of relevant laws for advancing renewable energy goals. The following sections outline the core challenges for expanding availability and use of renewable energy.

A. Financial Barriers

Renewable energy generating plant became the most attractive option for investment in the electricity sector during the last decade, consistently attracting more than half of the monies invested globally in electricity production from 2015 onwards – 69 per cent of global investment in power production ($283.3B) went to renewable energy developments in 2018.[53] This is partly due to financial support by states, but is increasingly the result of rapidly decreasing costs of producing electricity from renewable sources, particularly onshore wind and solar energy, with projects using these technologies being cost competitive with all forms of fossil fuel generation in 2019.[54] However, investment in generation from coal and gas still continues due to ongoing state support and to disparities within regions and even within states in the cost competitiveness of energy sources. The appeal of renewable energy is also dampened by two respects in which it compares unfavourably with coal and gas power plants. The first is that it can be difficult to integrate distributed renewable electricity into networks developed for centralised generation because systems were designed only to convey electricity directly from centralised power plants to consumers and the best renewable resources are often in remote areas far distant from grids serving communities.[55] The expense of connecting generating plant to networks can add substantially to a project's cost profile, particularly if developers are expected to bear 'deep' connection charges covering the cost of associated network modifications.[56] Secondly, initial development costs for renewable energy projects are largely fixed and incurred at the outset.[57] A high degree of confidence that revenues will be sufficient to repay monies borrowed is therefore required at the outset of projects to secure the funds needed to pursue them at affordable interest rates.

In addition, it is important to remember that renewable energy is a heterogeneous category made up of multiple technologies for extracting energy from different sources, and of different technologies for each source (eg, the constant drive to develop new turbines capable of extracting more power from the wind than current models). Only the better-established technologies have become consistently cost competitive with

[53] REN 21 (n 5) 154.
[54] IRENA, *Renewable Power Generation Costs in 2019* (IRENA, June 2020) 12.
[55] Marcelino Madrigal and Steven Stoft, *Transmission Expansion for Renewable Energy Scale-Up: Emerging Lessons and Recommendations* (World Bank Group Publications 2012) 3–13.
[56] ibid.
[57] Intergovernmental Panel on Climate Change, *Renewable Energy Sources and Climate Change Mitigation* (Cambridge University Press, 2012) 194.

fossil fuels. Costs for producing electricity from newer technologies such as offshore wind and concentrated solar power increasingly fall within the fossil fuel cost range, but still tend to exceed the costs of electricity from cheaper fossil fuel options as well as those of better established renewables.[58] All such technologies are likely to be needed to replace the four-fifths share of global energy consumption for fossil fuels, to prevent a future return to high carbon energy under the duress of growing energy demands from an increasing global population and to enable an increase in electricity supplies from their current level in connection with decarbonising transport, industry and heating. The failure of some supported technologies is a preferable risk to that of runaway climate change which every unit of additional fossil fuel consumption heightens.

Electricity is the low-hanging fruit of decarbonising energy supplies. Reducing emissions from transport, industry and heating is more challenging due to there being fewer and less well-established low-carbon alternatives, and limited progress has been made with moving away from high carbon energy in these sectors.[59] For road transport, responsible for over two-thirds of greenhouse gas emissions from transport,[60] this is due to a combination of: the much lower price of fuels that have benefitted from 100+ years of experience with their production and distribution compared to newer alternatives such as advanced biofuels that are still being readied for commercial application or that have not yet achieved economies of scale in production; the lower price of vehicles consuming petrol and diesel than those using alternatives, again due to the long experience with their use and resulting learning efficiencies and economies of scale; the lack of infrastructure for refuelling alternative fuel vehicles; and, for all of these reasons, the lack of popular demand for alternatives that would be required to prompt change in manufacturing sectors.[61] The much lower cost and easy availability of fossil fuels and related technologies are also the key obstacles to decarbonising marine and air transport.[62] The lack of progress with decarbonising heating and industry is partly due to cost, but also to a lack of awareness of the alternative options.[63] The weakness of state support for these sectors compared to the strength of backing for renewable electricity contributes to their slow rate of decarbonisation.[64]

B. Carbon Lock-in

In addition to factors retarding investment in renewable energy, its diffusion is hampered by the entrenchment of fossil fuels. Their 80 per cent share in global energy consumption reflects enormous sunk investment in infrastructure for energy generation, in

[58] IRENA (n 54) 10–17.
[59] REN 21 (n 5), 37–40.
[60] International Energy Agency, 'Transport' (Tracking Report, September 2022), Transport – Analysis – IEA (accessed 1 October 2022).
[61] IRENA, *Renewable Energy Policies in a Time of Transition* (IRENA, 2018) 13 and 38–55.
[62] ibid.
[63] ibid at 13 and 24–37.
[64] ibid at 13 and 24–55.

the extraction, refining and distribution of resources, in the design and manufacture of vehicles consuming fossil fuels, in building stock designed for fossil fuel heating, and in general into the more than a century's worth of learning and knowledge and skills acquisition that has fed into creating and maintaining the fossil fuel economy. Businesses, their shareholders and governments have corresponding vested interests in the continued utilisation of fossil fuel assets and related revenue streams and tax receipts. Economies that have become dependent on the availability of easily distributable, dense and inexpensive energy baulk at the thought of disruption to its supply. Societal practices such as commuting are based on the easy availability and affordability of fossil fuels and of vehicles that consume them whilst attitudes derived from accustomisation to the receipt of remotely produced energy without knowledge of its origins informs hostility toward renewable energy development in areas that have only been recipients of energy produced elsewhere in recent decades.

All these factors contribute to the lock-in of socio-economic systems to fossil fuel energy that must be undone to create space for renewable energy development.[65] Combinations of measures are therefore required that weaken the hold of fossil fuels alongside promoting alternative energy sources. The most immediate means available to states of destabilising the high carbon energy sector would be to follow through on commitments already made to withdraw fossil fuel subsidies whose value far exceeds that of support for renewable energy.[66] Measures for integrating the environmental costs of greenhouse gas emissions into energy prices would also assist with dispelling the perception of renewable energy as an expensive alternative and with persuading manufacturers to invest in low carbon alternatives.[67] Much broader policy and legal intervention is also required at all levels of government to enable economic and social transition and adaptation to a post-fossil fuel era.

C. Characteristics of Renewable Energy Sources

Networks of cables and pipelines transport electricity and gas to consumers. Rights to access and use them affordably are therefore essential for participation by energy producers in the markets through which electricity and gas are sold to suppliers and directly to large consumers. Integrating renewable electricity and gas into these networks and energy markets can be problematic. A reason for this is that some of the main renewable energy sources including wind and solar differ qualitatively from the fossil fuels and nuclear energy sources for which networks and arrangements developed for governing their development, maintenance and operation were designed. The main differences include:

- *Intermittency*: Fossil and nuclear energy production is controllable and predictable. Renewable electricity produced from sources such as wind and solar which depend on weather conditions are less controllable and hard to predict with accuracy.

[65] Gregory Unruh, 'Understanding Carbon Lock-in' (2000) 28 *Energy Policy* 817.
[66] IRENA (n 23) 62–63.
[67] REN 21 (n 5) 63–64.

- *Location*: Humans decide on the situation of nuclear and fossil fuel power and gas production units and can transport resources for producing energy to them. Sources for renewable electricity other than biomass and its derivatives are not transportable. Locations at which renewable electricity sources are found may either not be located near to a network or to one that was designed to do more than distribute energy produced elsewhere to consumers. The latter problem also arises with gas networks.
- *Scale*: Electricity and gas networks and markets in the pre-renewables era were typically connected to and used by a limited number of corporate or publicly-owned power and gas producers possessing the financial capacity to invest in and obtain funds for large capacity power and natural gas production plants. The increasing affordability of renewable power and gas technology (eg, solar panels on roofs, anaerobic digestors) makes it possible for multiple individuals, communities and small commercial operations to produce energy and sell it commercially as long as they are able to access and use networks and markets.

The qualitative differences obstruct the integration of renewables into energy systems and their markets. It will not be possible for renewable energy developers who plan to do more than meet their own energy needs to obtain funds for relevant development if they are unable to reach consumers through marketplaces and networks. Lock-in can make it difficult to address problems related to renewable energy sources' characteristics for reasons including the need to maintain security in networks which were physically developed to carry and remain dominated by energy from fossil fuels (eg, gas quality standards, voltage standards) and reluctance to alter governance arrangements that are not suited to accommodating qualitatively different energy sources.

D. Public Acceptance

Some members of the public will welcome the switch from fossil fuels to renewable energy and be willing to accept associated changes and costs including:

- The production of renewable electricity and gas in remote and rural places which are not used to producing energy locally or to development on an industrial scale.
- The inclusion of charges relating to renewable electricity and gas in prices to cover subsidies and network adaptation costs, potentially leading to higher prices for electricity and gas than would otherwise be the case.
- Higher prices for fossil fuel use due to the inclusion of charges and taxes related to carbon emissions in costs passed on to consumers.

Others may be less willing or able to accept these charges and changes even if they are supportive of the switch from fossil fuels to renewable energy and to related development in principle. Concern over changes can lead to public opposition which can lead, in turn, to the withdrawal of pro-renewables policies by governments and to the rejection of renewable energy development and of essential infrastructure for its transmission by their representatives. Public opposition has impacted significantly on

renewable energy development and has led to the curtailment of renewable energy policies in many jurisdictions.[68] Laws have already been developed to address the causes of opposition and will need to increase in sophistication and reach as changes required by a low-carbon energy transition become more pronounced.

E. Developing World Challenges

The avoidance of dangerous anthropogenic interference with the climate will involve more than action by developed states to decarbonise. It also requires developing countries that are growing economically and the least developed countries that are yet to undergo significant economic growth to follow a different developmental pathway based on non-carbon-emitting and carbon neutral energy sources. The need for developing countries to embark on a low carbon energy transition or simply to avoid a fossil fuel-based stage in their development has grown during the last three decades because of carbon-intensive growth in some developing states since the early 1990s. A range of challenges need to be overcome to enable or persuade those countries classed as developing to follow a different route to that taken by developed countries during the nineteenth and twentieth centuries. The more economically advanced developing states may have acquired the ability to develop and deploy renewable energy technologies themselves but may be unwilling to do so because it would hand competitive advantage to those states who have developed on the back of cheaper and well-established fossil fuel technologies. They may also regard making commitments to replace fossil fuels with renewables as being incompatible with the fairness argument that the states primarily responsible for causing the climate crisis in the first place should take responsibility for addressing it by cutting their emissions to the extent necessary to allow others to have the same opportunities for economic and social development.[69] For those countries, the provision of financial and technological support by developed state parties as compensation (although developed states would not agree to such a description) for their consumption of much of the safe climate space may be viewed as a precondition to taking on obligations to mitigate climate change.[70]

Whilst certain developing countries may have some choice over how development is conducted, the reality for many of them, particularly the least developed countries, is that they do not have the capacity to initiate low carbon energy development. States may lack any of the factors required to exploit renewable resources including access to relevant technologies, knowledge of how they operate and are maintained, awareness of the resources available to them, a capacity to conduct or support research

[68] IRENA (n 61) 21 and 88; Ana Maria Gonzalez and others, 'On the Acceptance and Sustainability of Renewable Energy Projects – A Systems Thinking Perspective' (2016) 8 *Sustainability* 1171; doi:10.3390/su8111171.

[69] Philippe Cullet, 'Common but Differentiated Responsibilities' in Malgosia Fitzmaurice, David Ong, and Panos Merkouris (eds), *Research Handbook on International Environmental Law* (Edward Elgar, 2010) 161, 169–70.

[70] ibid. Sanford Gaines, 'International Law and Institutions for Climate Change' in Joshua Sarnoff (ed), *Research Handbook on Intellectual Property and Climate Change* (Edward Elgar 2016) 33, 38–39.

on development, the infrastructure required for enabling access to energy for their peoples, or the institutions needed to support the growth of a renewables sector including appropriate policy and legal frameworks.[71] States lacking a supportive policy and legal environment for renewable energy development will also struggle to attract investment even where funding is available.

V. Defining Renewable Energy Law

The drivers considered in Section III of this chapter incentivise governments to adopt policies which promote the production and consumption of energy from renewable energy sources. Giving effect to pro-renewable energy policies often requires the adoption of laws which create new rules and rights or which reform existing rules and rights for reasons including overcoming barriers discussed in Section IV of this chapter. Relevant laws collectively make up the category of renewable energy law which this book examines. The wide range of challenges and barriers confronting its growth necessitates legal action in several different areas to enable growth of the renewables sector. This book focuses on the areas in which legal intervention is most needed to effect pro-renewables policies at all levels of policy and law-making. They are covered in its chapters as follows:

- Laws adopted to pursue agreed goals of the world's states which drive renewable energy developments including those for mitigating and adapting to climate change and for making development sustainable. International treaties such as the Paris Climate Change Agreement and non-binding initiatives such as the UN's Sustainable Development Goals for 2030 create a framework within which renewable energy development takes place, and whose effectiveness for supporting renewable energy development is a key focus for renewable energy law. Relevant laws are examined in Chapters 2 and 3.
- Laws such as the European Union's Renewable Energy Directive 2018 which were adopted to create frameworks within which pro-renewables policies are given effect at regional and national levels. Their key roles include establishing and legally entrenching renewable energy targets as well as mechanisms for securing compliance with them. Relevant laws are examined in Chapter 4.
- Laws adopted to overcome barriers to renewable energy development including by weakening lock-in to fossil fuel energy. The types of barrier and legal responses to them which the book examines are: those which make it difficult to access investment in renewable energy (Chapter 5); those which make it difficult to integrate renewables into networks for transmitting energy (Chapter 6); unnecessarily

[71] Intergovernmental Panel on Climate Change (n 57) 195; David Ockwell and Alexandra Mallett, 'Introduction: Low-Carbon Technology Transfer – From Rhetoric to Reality' in David Ockwell and Alexandra Mallett (eds) *Low-Carbon Technology Transfer – From Rhetoric to Reality* (Routledge 2012) 3, 3–18.

complex administrative procedures (Chapter 7); and public disquiet over renewable energy development (Chapter 7).

- Laws which establish legal frameworks enabling the exploitation of renewable energy resources which are found offshore such as wind, wave, and tidal energy (Chapter 8).
- Laws adopted or used to enable renewable energy development by mitigating the negative environmental effects which exploitation of some renewable energy sources can give rise to and by avoiding and managing conflict with legal protections for the environment. Chapter 8 examines laws adopted to regulate the environmental effects of marine renewable energy. Chapter 9 examines laws adopted to regulate the environmental effects of energy production for transport from biomass.
- Law's role in enabling renewable energy growth in the road transport sector which remains heavily dependent on fossil fuel energy. The sector is examined in Chapter 9.

These areas of legal action do not cover the full extent of renewable energy law as a legal category, but acquaintance with them will provide readers with wide-ranging knowledge of law's role in supporting the growth of energy production and consumption from renewable sources.

VI. Levels of Law

Readers will encounter four levels of law in this book. First, international law governs relationships between states. It is made through two main routes. Treaties negotiated by representatives of states confer rights and place duties on states which ratify them. Rules of customary international law are legally binding on all states or sometimes on all states falling into a category (eg, enclosed sea coastal states) unless they have consistently opposed its application to them. They are not negotiated by states but come into existence when two elements are present. First, evidence is available that the substantial majority of states have adopted a common position. Second, they have done so because they consider the position to be binding on them under international law. Provisions of treaties may become rules of customary international law due to extensive support through ratification and endorsement by non-ratifying states, and therefore become binding on non-parties. For example, the entitlement for coastal states to establish exclusive economic zones in which they have certain exclusive rights under the United Nations Convention on the Law of the Sea has become recognised as a right for all states under customary international law due to widespread endorsement. It therefore governs relations between all states regardless of whether they are party to UNCLOS.

Chapter 2 concentrates on treaties of relevance to renewable energy with a particular focus on treaties concerning states' response to climate change. Chapter 3 concentrates on statements on making development sustainable which, although they have been negotiated and endorsed by most of the world's states, are not legally binding on them. They are referred to as soft law instruments to distinguish them from legally binding

treaties. This does not mean that provisions of soft law instruments are legally irrelevant. They may signpost progress towards a rule of customary international law's emergence by recording interstate consensus on desirable practices such as the eradication of greenhouse gas emitting energy consumption. As discussed in Chapter 3, careful analysis of their structure and wording is also necessary. Provisions in soft law instruments may have characteristics placing them toward the harder end of the soft law/hard law spectrum whilst those in hard law instruments may be softer in character depending on the strength of commitment and the precision of the language used.[72]

Second, European Union law as a category includes treaties ratified by the Member States of the European Union which lay down its executive and legislative powers and laws adopted in exercise of those powers. They affect directly only the European Union's 27 Member States, but other European states may be required to observe or apply them to defined extents by virtue of their ratification of the Energy Community Treaty and the European Economic Area Agreement. Switzerland also applies aspects of EU energy law in line with bilateral agreements with the EU. Other regional treaty-based organisations exist such as the Association of Southeast Asian Nations (ASEAN) and the Caribbean Community (Caricom), but they do not possess independent law-making powers to the same extent as the EU.

Third and fourth, frequent references are made to national laws adopted by the law-making institutions of individual states and to laws governing areas at sub-national levels such as those adopted by the legislatures of states operating with a degree of independence from the sovereign states which they comprise (eg, the legislatures of the 50 states of the US) and by authorities with law-making powers delegated by the central government of their states (eg, the Scottish parliament).

Classroom Questions

1. What is renewable energy? Identify and describe commonly occurring characteristics of energy sources described as being 'renewable'.
2. What are the different sources of renewable energy?
3. How can renewable energy be used to meet demands for energy for the production of electricity, transport and heating?
4. Why should we exploit renewable energy when fossil fuels are still available?
5. What are the main barriers for the growth of renewable energy production? Think of some examples.
6. How can states use policy and law to overcome the barriers you identify in your answer to Question 5 with a view to promoting renewable production and consumption? Think of some examples.

Scenario

Arcadia is a small state with a varied geography. It has sunlit flatlands including desert areas that often reach high temperatures due to solar radiation in Arcadia's summer, mountainous areas with high wind speeds, a major river flowing down from

[72] See Section IV of Chapter 3 for further discussion of the soft law/hard law spectrum.

its mountains to its coastline, hot springs indicating subterranean volcanic activity and a coastline from which relatively shallow but frequently wild and windy coastal waters with a significant tidal range stretch out towards its maritime boundaries with its nearest neighbour, Ruritania. Arcadia's energy system is largely reliant on fossil fuels for the production of electricity and for heating and transport. Electricity and gas are transported from centralised production sites around the state through long-established grid and pipeline networks. Arcadia does not have indigenous fossil fuels and imports most of its energy supplies from Ruritania, a state with which it has not always had good relations. It's capital city, Murkyville, has an unfortunate reputation for atmospheric pollution due to its traffic-clogged streets.

Fossil fuels have served Arcadia well enough in the past, but the state's government is now looking at possibilities for replacing the fossil fuel energy mix with alternative supplies. One reason for this is that it has committed to reduce greenhouse gas emissions rapidly from the 2030s onwards in its recently submitted nationally determined contribution to global climate efforts under the Paris Climate Change Agreement. It wishes to explore possibilities for exploiting indigenous renewable energy supplies as an alternative to fossil fuels. It lacks expertise on renewables and has been reluctant to explore this route in the past due to a lack of national expertise in using renewable technologies for energy production. Its reluctance also stems from concerns over the reliability and affordability of renewables for Arcadia's peoples, some of whom live in poverty. The government's energy minister seeks guidance from the renewable engineering/legal consultancy for which you work on the following matters:

- What types of renewable resource is Arcadia likely to possess?
- How could these resources be employed to meet Arcadia's energy needs?
- Why should Arcadia consider exploiting its renewables resources when its neighbour, Ruritania, has ample supplies of oil, gas and coal?
- What barriers might Arcadia encounter in exploiting its renewable energy resources?
- Could law have a role to play in overcoming whatever challenges Arcadia may meet in switching to renewable energy?

Suggested Reading

Books

Penelope Crossley, *Renewable Energy Law: An International Assessment* (Cambridge University Press, 2019), Chapters 2, 3 and 4.

Nick Jelley, *Renewable Energy: A Very Short Introduction* (Oxford University Press, 2020), Chapters 1 and 2.

Articles and chapters

Harald Kohl and Wolfhart Dürrschmidt, 'Renewable Energy Sources – a Survey' in Roland Wengenmayr and Thomas Bührke, *Renewable Energy: Sustainable Concepts for the Energy Change* (Wiley, 2013), 4–13.

Simone Negro, Floortje Alkemade, and Marko Hekkert, 'Why Does Renewable Energy Diffuse So Slowly? A Review of Innovation System Problems' (2012) 16 *Renewable and Sustainable Energy Reviews* 3836–46.

Richard Ottinger, Lily Matthews and Nadia Czachor, 'Renewable Energy in National Legislation: Challenges and Opportunities' in Donald Zillmann and others (eds) *Beyond the Carbon Economy: Energy Law in Transition* (Oxford: Oxford University Press, 2008), 183–206.

Policy Documents

The website of the International Renewable Energy Agency (IRENA) is an excellent source of information and guidance on renewable energy development. The many useful reports for those seeking information about the renewables sector produced by IRENA include *Global Renewables Outlook: Energy Transformation 2050* (2020 Edition) and *Renewable Energy Policies in a Time of Transition* (April 2018). See: www.irena.org/.

REN 21, a body which describes itself as 'the only global renewable energy community of actors from science, governments, NGOs and industry', produces a comprehensive annual statement on the worldwide spread of renewable energy entitled *Renewables Global Status Report*. For example, see the 2021 report at: Renewables Global Status Report – REN21.