Chapter 1

Trends in global renewable energy markets and national policies[1]

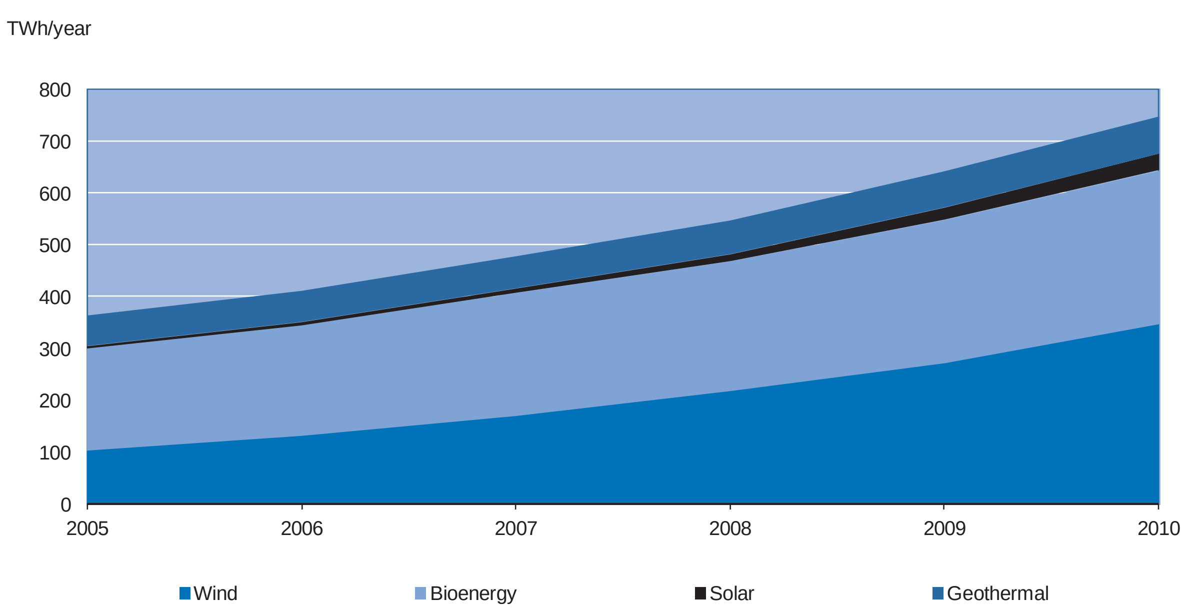
This chapter provides background information for the overall report. It assesses the trends of installed capacity, taking into account electricity, heating and cooling. It compares the cost of producing renewable energy to that of conventional fuels and discusses the current trends. The chapter presents an outlook on renewable energy deployment, based on IEA projections. Finally, it presents the drivers underpinning renewable energy across the globe.

The boom in global renewable energy

The renewable electricity sector is booming: it grew by 26% between 2005 and 2010. Today it provides about 20% of the world's power. Hydro-electric power generates 84% of the world's renewable electricity, while the other newer renewable electricity technologies have also grown rapidly, doubling their production between 2000 and 2010 (Figure 1.1). Wind has grown most rapidly in absolute terms. Solar photovoltaic has grown at a rate of 50%, and installed capacity reached about 70 GW globally by the end of 2011. Renewable energy (RE) for heating, cooling and transport fuels is also steadily growing. The production of heat from renewable sources grew by 6% between 2005 and 2009, with the use of biomass (e.g. wood) still the dominant technology, accounting for around 10% of global primary energy supply if one includes the use of "traditional" biomass, with low efficiency, for heating and cooking in developing and emerging economies. However more "modern" heating technologies – particularly solar, but also geothermal – have seen an overall growth rate of nearly 12% between 2005 and 2009. This growth was driven in large part by rapid increases in solar heating in China. The production and use of biofuels for transport have also been growing rapidly, providing 3% of road transport fuels globally (2% of all transport fuels) in 2009. Ethanol production and consumption are mainly concentrated in the United States and Brazil, while Europe principally produces and consumes biodiesel.

Progress in RE electricity penetration was initially concentrated in OECD countries, but the emphasis has shifted in recent years to the developing economies – particularly to China, India and Brazil – in response to their rapidly growing appetite for electricity.

Figure 1.1. **Global trends in renewable power generation except hydro-electric, 2000-2010**



Source: IEA (2011), *Deploying Renewables 2011: Best and Future Policy Practice*, OECD Publishing, Paris, *10.1787/9789264124912-en.*

These positive trends are linked to policy interventions that have tried to capitalise on the potential of RE to deliver on different key policy goals such as climate change mitigation, energy security and economic development. National and supra-national authorities have put in place a range of subsidies, grants and regulations to support RE deployment and experimentation, which have helped reduce the cost of RE. However, RE deployment still faces structural challenges that need to be tackled. These include their competitiveness with conventional source of energy in terms of price and reliability, avoid to become dependent on public support; providing investors with a stable policy environment; the highly complex policy environment; and public acceptability (discussed in Chapter 2).

Can renewable energy compete with conventional energy?

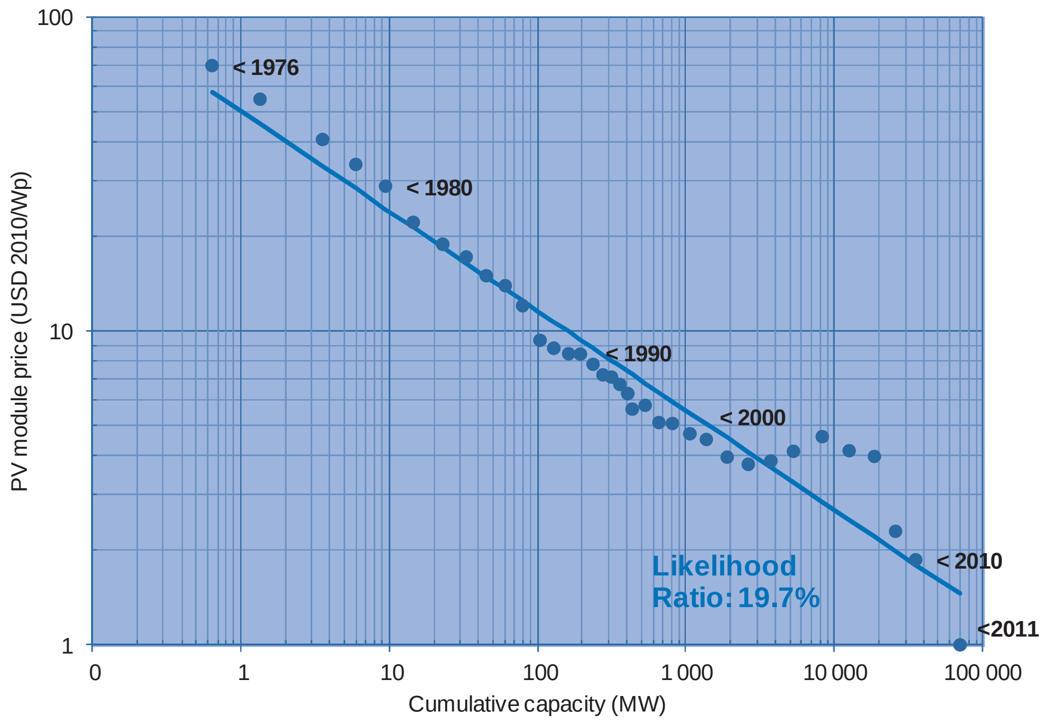
The costs of producing energy from renewable sources depend very much on location and the resources involved. In favourable circumstances (large solar irradiance, or good wind resources, for instance), renewable energy from hydro, wind and geothermal electricity can be cost-competitive with energy from fossil fuels, as can heat from biomass, geothermal and solar energy. As deployment levels rise, the costs of less mature renewable sources – such as wind and solar photovoltaic – are falling as experience and cumulative capacity grows. The capital cost of on-shore wind turbines has been halved over the last 30 years, while efficiency and reliability have increased. Wind energy is cost-competitive in an increasing number of cases. For example, wind projects in New Zealand (where mean annual wind speeds can be above 10 metres per second) are being developed in the absence of any government support. The cost of solar PV has also been falling very quickly over the last few years as demand has risen sharply, with costs declining by 19% with each doubling of global capacity (Figure 1.2). Electricity from PV is expected to be competitive with retail electricity prices in some regions within the next few years, especially where both solar radiation levels and the cost of generation from fossil sources are substantially higher – for example, in remote off-grid locations at low latitudes.

Nevertheless, RE production costs are generally still higher than for conventional energy systems. This gap is buffered by various forms of public financial support in most OECD countries. Support is provided to make investment in the technologies profitable. This is necessary within current pricing structures, which often fail to reflect the externalities associated with the environmental impacts of fossil fuels, for example, or where fossil fuel use is subsidised. Much will depend on what happens to fossil fuel prices.

The outlook for renewable energy

The share of renewables in the energy sector is bound to grow considerably. In Europe, this growth will largely be driven by policies adopted at supra-national level, especially the European Union's renewable energy sources directive, which requires each EU country to give renewable energy sources (RES) a 20% share in final consumption by 2020 (Box 1.1). This translates into a share of renewables in the power sector of 35% – a strong increase on current penetration levels. In the United States, by contrast, the impetus is coming largely from the state level: there is no federal target. State targets vary widely:

Figure 1.2. **The sharp fall in the cost of solar PV modules, 1976-2011**



Source: IEA (2011), *Deploying Renewables 2011: Best and Future Policy Practice*, OECD Publishing, Paris, *10.1787/9789264124912-en*.

- 29 states (and the District of Columbia) have mandatory Renewable Portfolio Standards (RPS);
- 8 states have renewable energy goals; and
- 18 states offer performance-based financial incentives, including feed-in tariffs (FITs) or tradable renewable energy credits (RECs) schemes.

Despite this very different policy framework, RE (including large hydro) accounted for about 10% of total power generation in the US in 2010, which is similar to the EU level. RPS targets should add about 4-6 GW of power every year from renewable energy between 2011 and 2020, independent of the federal incentive picture (see US case studies in Part II). However, if economic recovery proves difficult, deployment may fall below these levels.

Box 1.1. **The European Union's renewable energy targets**

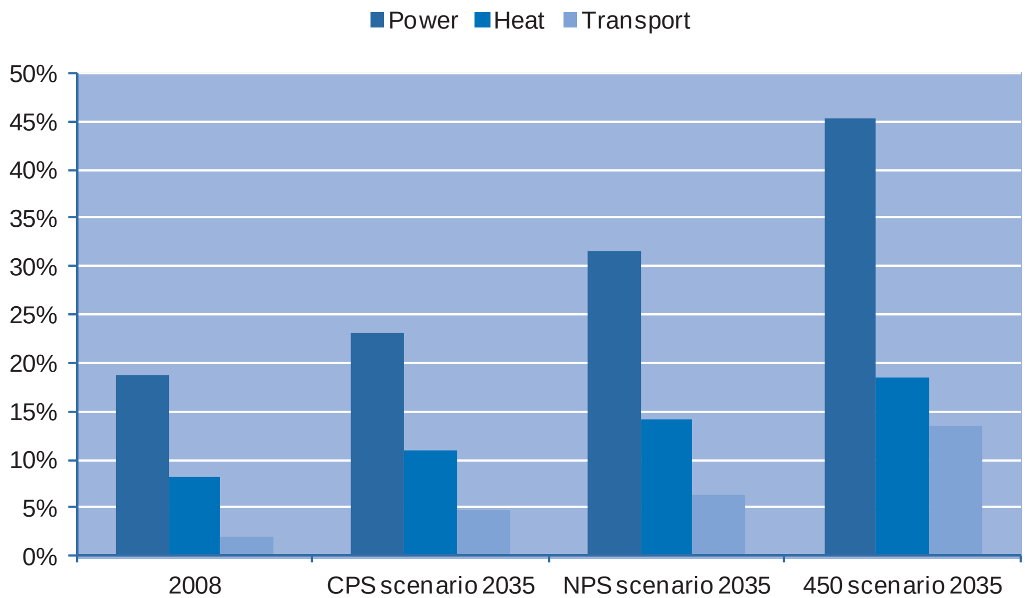
The EU's directive on the use of energy from renewable sources requires EU member states to reach an overall RE target of 20% of gross final energy consumption by 2020, with a sub-target of 10% for renewables in transport (EU, 2009). The share today is 8.5%. The overall target is divided among member states, so some states can have higher or lower shares. The directive requires member states to submit National Renewable Energy Action Plans (NREAPs) to the European Commission. These provide a detailed description of policy measures adopted by the member states to achieve their renewable targets in electricity, heating and cooling and transport by 2020.

According to the NREAPs, a total of 1.211 terawatt-hours (TWh) of electricity from renewables will be generated by 2020, of which 1.160 TWh will come from OECD-EU countries. In terms of installed capacity in the 27 countries of the European Union, the plans foresee a total installed capacity of 491 GW (of which 469 GW would come from OECD-EU countries). In OECD-EU countries, wind energy is expected to dominate the expansion in RE generation, and is likely to supply 478 TWh, while solar is expected to provide PV 82 TWh in 2020.

Source: EU (2009), "Directive 2009/28/EC of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC", *Official Journal of the European Union*, 23 April.

RE plays an increasingly important role in projections for future global energy provision, particularly in scenarios which include measures to reduce carbon emissions from energy production. For example the IEA has modelled three such scenarios to 2035 (IEA, 2010). The first scenario, the Current Policies Scenario (CPS) assumes that only existing policies are in place. The second scenario, the New Policy Scenario (NPS) models the impact of promised but as yet unimplemented actions to fulfil countries' various pledges and other commitments to combat climate change.[2] The third scenario, the 450 Scenario, outlines an energy pathway that would limit the concentration of greenhouse gases in the atmosphere to 450 parts per million (ppm) of CO_2, which would be required for constraining further global warming. RE technologies feature in each scenario, but it is striking that the growth of the RE share under the CPS scenario is relatively modest, a fact which highlights the continued importance of climate-change policies in driving the growth of renewables (Figure 1.3). The more ambitious the effort to limit climate change, the greater the shift towards RE is likely to be.

Figure 1.3. **IEA projections for share of renewable energy in power, heat and transport by 2035**



Note: CPS = Current Policy Scenario; NPS = New Policies Scenario.

Source: Derived from IEA (2010), *Energy Technology Perspectives 2010: Scenarios and Strategies to 2050*, OECD Publishing, Paris, *10.1787/energy_tech-2010-en*.

The policy drivers of renewable energy

The growth in the deployment of RE has to a very great extent been policy-driven. Governments acting to encourage the deployment of RE technologies have typically cited three interlinked reasons:

- to improve energy security;
- to protect the climate and the wider environment from impacts of fossil fuels use; and
- to encourage economic development, particularly associated with land-based and marine industries (agriculture, forestry, etc.), or with manufacturing (Müller, Brown and Ölz, 2011).

In the sections which follow we consider the extent to which this is the case.

Energy security

Increasing the share of RE in a country or region's energy mix can improve energy security by providing greater diversity of supply, and, in many contexts, providing a less centralised and more modular supply that may be less prone to disruption. However, renewable sources have some associated security issues of their own. These include supply fluctuations due to diurnal and seasonal variations in wind and sunshine, or changes in hydro generation when precipitation levels are lower than expected. Such factors should also be considered in any energy security appraisal, particularly when renewable sources provide a significant proportion of supply in any energy sector. In essence, RE sources can add to system security only when they are dispatchable and controllable, and any assessment of their impact on energy security in a given context must take account of the full range of technologies engaged and the ways in which they can interact.

Reducing greenhouse gas emissions and environmental impacts

Current global patterns of energy production and consumption are unsustainable. Continuing with business as usual will lead to unacceptable increases in global average temperature levels, with potentially catastrophic consequences.

RE technologies can play a key role in combating climate change. Studies indicate that RE technologies have life-cycle CO_2 emissions that are significantly lower than fossil-based technologies and comparable to those of nuclear generation (e.g. Cherubini *et al.*, 2009; NEEDS, 2009; POST, 2006). The life-cycle balance is also an important consideration for the other sectors, such as heat and transport.

IEA has assessed the contribution of RE technologies to reducing greenhouse gas emissions in the power sector (IEA, 2011a). They did so by comparing CO_2 savings from RE with a hypothetical situation in which no RE technologies (including hydro) are present in the power generation mix. To define a country's baseline, its renewable electricity share was replaced by the country's average non-renewable power-generating technology mix. Each conventional technology contributed to the replacement according to its share in the 2008 generation mix. The analysis was performed for 56 countries.[3] The results show that, for 2008 alone, RE technologies in the focus countries avoided the emission of 1.7 gigatonnes (Gt) of CO_2. This total is more than the aggregate power sector-related CO_2 emissions of the OECD Europe region in the same year (1.4 Gt CO_2). While these results in part reflect the exclusion of large hydro, which accounts for a very large share of power generation in many places (98% in Norway, for example), they underscore the role of conventional power generation in the emission of greenhouse gases. Most countries will find it extremely difficult, if not impossible, to achieve their climate change objectives without addressing emissions from the power sector.

Economic development

The deployment of RE technologies is frequently given high priority within a comprehensive strategy for more sustainable economic growth, sometimes summarised by the term "green growth" (OECD, 2011). RE technologies featured prominently in a number of countries' economic recovery packages in 2008/09, such as the United States. RE technologies provide new sources of natural capital, by allowing locations with good solar or wind resources, for example, to exploit these "new" assets to support their own energy needs. RE technologies may also allow countries to exploit RE resources with long-term export potential, by producing biofuels sustainably or by using high levels of solar radiation to generate exportable electricity via concentrating solar power (Brown *et al.*, 2011).

Job creation is another policy objective cited by governments as a reason for promoting RE. In its 2008 *Green Jobs* report, the United Nations Environment Programme (UNEP) concludes that "Compared to fossil-fuel power plants, renewable energy generates more jobs per unit of installed capacity, per unit of power generated and per dollar invested" (UNEP *et al*., 2008).[4] Such claims are particularly appealing to policy makers facing high and persistent unemployment. They should not, however, be taken at face value. Firstly, many of the jobs in RE sectors depend on a high and stable level of public subsidies to RE supply chains. Secondly, at an aggregate level, the critical question concerns not the creation of "green jobs" in specific sectors, but the aggregate employment impact of de-carbonising the economy: over the very long run, this impact should be zero, but in the short-to-medium term it will involve a good deal of both job destruction and job creation, and it may turn out to be negative in many places. For host communities, however, the more relevant concern is often the potential employment impact locally. In rural communities, even small-scale job creation can make a difference, and it is this prospect that has prompted many rural communities to embrace RE projects. RE has been particularly attractive to rural communities hit hard by rising fossil fuel prices and/or the decline of traditional sectors.

Potentially, at least, RE projects can offer rural host communities a range of economic benefits, including new investment, increased tax revenues and new jobs. They may stimulate the creation of new firms in the area and, in some cases, they may foster the emergence of new sectors that occupy niches in larger national or international supply chains. Where projects involve a significant degree of community ownership, local communities may directly capture a share of the resource and policy rents. In some circumstances, RE projects may also reduce the cost of heat or power, with concomitant benefits for local competitiveness. However, none of these benefits is a necessary or inevitable consequence of RE deployment. As will be seen later in this report, the benefits to rural host communities depend to a great extent on the way in which projects are designed and deployed. Issues like community ownership, appropriate design of public support instruments and the engagement of local stakeholders all loom large in the analysis that follows.

Notes

1. This chapter is largely based on information and data provided by the International Energy Agency (IEA, 2011a). The IEA is an autonomous body established in November 1974 within the framework of the OECD to implement an international energy programme. It carries out a comprehensive programme of energy co-operation among 26 of the OECD's 30 member countries. The basic aims of the IEA are: *i*) to maintain and improve systems for coping with oil supply disruptions; *ii*) to promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations; *iii*) to operate a permanent information system on the international oil market; *iv*) to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use; *v*) to assist in the integration of environmental and energy policies. IEA member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA.

2. *E.g.*, the pledges made at the Conference of Parties of the UN Framework Convention on Climate Change in Copenhagen (2010) and Cancun (2011).

3. A detailed methodology is presented in IEA (2011c).

4. It should be noted that energy is a capital-intensive sector with a very low use of labour and that the energy sector generally represents a very small share of employment at the national level.

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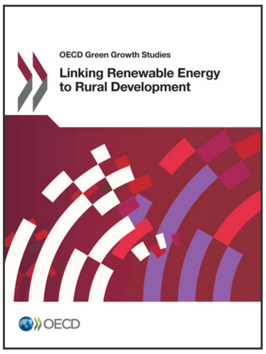

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