Chapter 1
Introduction

Renewable energy has emerged as a primary tool in the global strategic race towards a low-carbon economy. Countries that are successful in this race will gain economic strength, while making a contribution to climate policy that may raise their international political standing and reduce their dependency on imported energy. The ability to forge fruitful partnerships across borders will be a decisive factor. In this book, we examine whether and in what ways Russia might be suitable for such partnership. We seek to provide an overview of the Russian renewable energy landscape that may:

- help foreign governments and research funds to formulate policies to promote international cooperation with Russia on renewable energy,
- help international researchers to identify which Russian research institutions, sectors and locations may be worth targeting for collaborative ventures,
- provide students, researchers and practitioners with insights into the situation in Russia in the field of renewable energy as well as its future potential,
- hold up a mirror, making an outside view available to Russian researchers and thereby help them develop their own renewable energy sector,
- shed light on Russia's strengths in renewable energy, as well as the obstacles to renewable energy research and investment in the country.

The book highlights the vast potential that Russia has in renewable energy, as well as obstacles to renewable energy research and investment in the country. Relatively little information is available on Russia and renewable energy, so this volume should be of interest to readers generally involved in global renewable energy issues, as well as those more specifically interested in Russian politics and economics, or in the Eurasian energy balance.

In addition to providing a detailed picture of the actors and framework conditions in Russia's renewable energy sector, we examine cooperation between the European Union (EU) and the Russian Federation, and use the cooperation between the Nordic countries and Russia as an informative case study. The EU is Russia's largest trade partner, and within the EU the Nordic countries have spearheaded relations with Russia. There is much to learn from the experience of the Nordic countries, with their proximity to Russia, the intensity of their broader economic cooperation with Russia and their advanced technologies for renewable energy.

While considerable academic work has been done on Russia's petroleum sector, renewable energy in Russia has remained less studied. Nonetheless renewable

energy in Russia is a timely topic, as we explain in the following section. In the final part of this introductory chapter we go on to outline the topics covered in this book and its structure.

Why renewable energy in Russia?

Why pay attention to renewable energy in Russia – a country so richly endowed with fossil fuels? After all, it holds the world's largest reserves of natural gas, the second largest coal reserves, eighth largest oil reserves, and is the world's largest exporter of natural gas, the second largest oil exporter, one of the main nuclear powers and the world's largest energy exporter.[1] Russia's position as an energy superpower is based on its natural abundance of fossil and nuclear fuels – not 'wishy-washy' renewable energy.

In fact, renewable energy is highly relevant for Russia, for several reasons. First of all, Russia can benefit economically from giving greater priority to renewable energy sources, since this will improve its opportunities for energy exports by decreasing the domestic use of fossil fuels. Secondly, Russia can make the transition to renewable energy usage more cost-efficient and cheaper by using mechanisms in the global climate regime that promote increased production of renewable energy. Thirdly, whereas fossil fuels are exhaustible, finite resources, renewable energy sources are not. This means that developing renewable energy sources will be necessary sooner or later. Being proactive in this development will undoubtedly be an advantage. Fourthly, Russia's vast size means that renewable energy solutions are the most economically viable option in certain isolated areas such as the Northwest. And finally, Russia enjoys several competitive advantages linked to its natural resource base and its strong tradition of research in the natural and technological sciences.

As Russia's position as an emerging energy superpower is based primarily on its natural abundance of fossil and nuclear fuels, one might imagine that the country's increasing international leverage is exclusively related to its conventional energy sources, and has little to do with the 'softer' renewable energy forms. As we shall see below, however, the two are intertwined.

Russia and the international climate regime

The Kyoto Protocol under the International Framework Convention on Climate Change, aimed at reducing the greenhouse gases that contribute to climate change,

1 Energy Information Administration. 'Russia Energy Profile', May 2008. http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=RS [accessed 9 June 2008].

entered into force in 2005. In 2008 the global emissions trade system became effective. The first period of the Protocol runs until 2012, and the second period is currently under negotiation. Russia ratified the Kyoto Protocol in 2003. Since it accounted for 16.4 per cent of 1990 carbon emissions, and since Annex B parties accounting for together 55 per cent of 1990 carbon emissions had to ratify, in order for the Kyoto Protocol to enter into force, Russia's ratification tipped the scales and triggered activation of the Protocol. Paradoxically enough – given the low priority of climate issues on the Russian policy agenda, and the scepticism of Russian scientists to the linkage between greenhouse gas emissions and climate change – it was Russia's ratification that brought the Kyoto Protocol into force.[2] The Russian debate on climate politics has emphasized the potential for wealth redistribution that lies in the Kyoto mechanisms (for example, through technology transfers), and the Russian negotiators in the ratification process stressed side-benefits like potential WTO accession.[3]

So far, Russia has not had any problems in achieving its Kyoto target level. The target level of greenhouse gas emissions set for Russia in the first period of the Kyoto Protocol (2008–2012) is the equivalent of its 1990 emissions. Greenhouse gas emissions were at the highest level in Soviet history in 1990, which made this year a logical choice as Russia's target level.[4] By 1995, emission levels of greenhouse gases had fallen by approximately 40 per cent.[5] However, this reduction was not a result of structural changes or technological improvements in the industry that led to actual reduction in emissions from ongoing production: it was more the result of factories being shut down due to the collapse of the Soviet economy in 1991.

The difference between a country's business-as-usual emissions and its official emissions ceiling is referred to as 'hot air'. Under the emissions trade system, this can be sold as a right to emit equal amounts of greenhouse gases elsewhere. The possibility of profiting from the sale of 'hot air' emission quotas without having to reduce emissions further appears to be an important reason why the Russian government chose to ratify the Kyoto Protocol in October 2004 – only six months after then-President Vladimir Putin's ultra-liberalist economic adviser

2 Moe, Arild. 'The Kyoto Mechanisms and Russian Climate Politics'. Presentation at the conference *Renewable Energy in Russia: How Can Nordic and Russian Actors Work Together?*, Oslo, Norway, 8 May 2008.

3 Moe 2008.

4 1990 is the base year for most countries in the Kyoto Protocol. Being an economy in transition, under Article 3.5 of the Protocol, Russia could however have selected a different base year, either 1990 or any earlier year. See Golub, Alexander and Elena Strukova. 'Russia and the GHG Market'. *Climatic Change*, no. 63 (2004): 223–43, p. 225.

5 Oldfield, Jonathan D. *Russian Nature: Exploring the Environmental Consequences of Societal Change.* Aldershot: Ashgate, 2005, p. 56.

Andrey Illarionov had denounced the work of the UN International Climate Panel as following a totalitarian ideology, and had claimed that the link between climate change and carbon emissions was not scientifically proven.[6] There were also hopes on the Russian side that the EU countries would support Russian WTO membership in return for ratification of the Protocol.[7]

For the first five-year period of the Kyoto Protocol, relying on the 'hot air' quotas will probably be enough for Russia to achieve its Kyoto target level.[8] Despite its seeming unwillingness to accept the global climate change paradigm, and depending on how the market for emissions trading develops, the Russian leadership might actually find itself benefiting economically from implementing the climate regime, due to the 'hot air' quotas. However, post-*perestroika* Russia is not a country where environmental issues enjoy priority; moreover, being highly dependent on oil and gas revenues, it is likely to consider the effect of the availability of 'hot air' on oil and gas prices. If 'hot air' emission permits were to become less readily available, that would force greater reductions of energy consumption in other countries, which in turn could cause a reduction in the international value of fossil fuels. That would mean a loss of Russian export revenues from oil and gas exports. There is likely to be a trade-off between the revenues from permits sales, and revenues from oil and gas. The outcome will depend on petroleum prices, and price developments in the emissions trade market.

The decline in Russia's greenhouse gas emissions in the early 1990s was steep, but not as steep as the decline in its GDP. That meant that the Russian economy became more carbon-intensive, among other things because the natural resource sector contracted less rapidly than other sectors of the economy.[9] The Russian economy is highly energy-intensive, and the country's energy needs are met primarily by fossil fuels. In 2005, natural gas accounted for 54 per cent of primary energy consumption in Russia, while oil and coal accounted for 19 per cent and 16 per cent respectively. Altogether 89 per cent of the country's energy consumption is met by sources that cause greenhouse gas emissions. The remainder is accounted for by nuclear energy (5 per cent) and hydropower (6 per cent – this estimate includes big hydro).[10] Nevertheless, since the 1998 crash and devaluation of the rouble, Russia has experienced a rapid economic recovery, and in 2007 GDP reached the 1990 level (in absolute terms) – although its greenhouse gas emissions did not.

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6 *Russian Courier*. 'Putin's Aid: Kyoto Protocol is Totalitarian', 19 May 2004. http://www.gateway2russia.com/st/art_236288.php [accessed 5 May 2008].

7 Oldfield 2005, p. 137.

8 Golub and Strukova 2004.

9 Golub and Strukova 2004, p. 224.

10 BP statistics quoted in *Russian Analytical Digest*. 'Russia's Energy Policy', no. 18 (3 April 2007): 1–17.

Emission target levels are currently being negotiated for the second period of the Kyoto Protocol, due to start in 2012. It seems likely that the increasing acuteness of the climate issue will make it necessary for all signatories to take on tougher commitments, which in turn will necessitate structural changes in energy systems. Russia, which obviously had an easy target in the first Kyoto period, and which has now recovered from the economic collapse of 1998, should be prepared to meet demands to accept heavier commitments at this crossroads. The main source of greenhouse gas emissions in Russia is the energy sector. Developing renewable energy sources and energy efficiency measures could therefore contribute greatly to the structural changes needed for the country to assume tougher commitments without slowing its economic growth.

However, Russia seems unwilling to give environmental issues priority over economic development – a stance that is in no way unique and was mirrored for example in the US position under the George W. Bush administration, and the former Australian position under Prime Minister John Howard.

Increased export opportunities

If the climate regime is not top priority for Russian decision-makers, economic development certainly is. The possibilities offered by renewable energy and energy efficiency in terms of increasing energy exports should therefore catch their interest. The importance of efficient and reliable electricity services for economic development within the country is also clear. Russia is pursuing a strategy of high economic growth, aiming to double its GDP in ten years. Efficient and reliable electricity markets will be critical to the success of this policy.[11]

By increasing its production of renewable energy and realizing its vast potential in energy efficiency, Russia could make a significant contribution towards improving the Eurasian gas balance, and ultimately strengthen its own importance as an energy provider for European gas markets.[12] Currently, there is increasing concern in the EU about declining production in the Nadym Pur Taz area of northwestern Siberia, underinvestment in the Russian gas sector and the slow development of new fields.[13] There is also the risk that mutual insecurities

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11 IEA. *Russian Electricity Reform: Emerging Challenges and Opportunities.* Paris: IEA, 2005. http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1473 [accessed 29 February 2008].

12 The RussCasp research project run by FNI, NUPI and ECON is exploring this issue by conducting research on energy efficiency as a possible key to the Eurasian gas balance towards 2020.

13 Perović, Jeronim. 'Russia's Energy Policy: Should Europe Worry?'. *Russian Analytical Digest*, no. 18 (3 April 2007): 2–7.

between the EU and Russia could contribute to a race to diversify purchases and sales away from each other, even though existing mutual dependencies make this outcome undesirable to both sides.[14] By decreasing its domestic gas consumption, to which the introduction of renewables and greater energy efficiency could contribute, Russia could increase its energy exports.

Russia is one of the world's least efficient countries in terms of the amount of energy it uses. According to the Energy Strategy announced by the Russian Ministry of Energy in 2003, Russia expends 3.1 times the amount of energy that the EU uses to produce one unit of GDP.[15] In the Energy Strategy, the Ministry indicates that Russia could save half of the energy it currently uses. Economizing energy on this scale would allow more gas to be sold abroad, in turn contributing to Russia's economic growth as well as its importance for Europe. According to the Russian Energy Strategy towards 2020, the export of energy resources can grow by 45 to 64 per cent by 2020, which would strengthen the country's economic position and geopolitical influence, while taking into account the interests of the next generation of Russians.[16] This not only shows that decision-makers are aware of the potential energy efficiency gains, it also brings out the link between the country's economic potential and the expected gains in geopolitical leverage.

Adjusting to future energy systems

Russia has the advantage of vast geographic size and variation in climate and terrain, giving it the potential to develop virtually any kind of renewable energy.[17] This comparative advantage in renewables, along with the extreme inefficiency in current energy use, provides Russia with considerable potential for contributing to greener energy use on a global scale.

Russia's Federal Law on Energy Saving defines renewable energy sources as 'solar energy, wind, earth thermo energy, natural hydro movement and nature heat production' – thereby excluding traditional large-scale hydroelectricity.[18] Estimates of the potential of renewable energy can be variously calculated. For example, estimates of available resources can tell us the energetic equivalent of

14 Perović 2007.

15 Ministry of Energy of the Russian Federation. *Summary of the Energy Strategy of Russia for the Period of up to 2020*. Moscow: Ministry of Energy of the Russian Federation, 2003.

16 Ministry of Energy of the Russian Federation 2003.

17 IEA. *Renewables in Russia: From Opportunity to Reality.* Paris: IEA, 2003. http://www.iea.org/textbase/nppdf/free/2000/renewrus_2003.pdf [accessed 29 February 2008].

18 Brown, Anna. 'Russian Renewable Energy Market: Design and Implementation of National Policy'. *Russian/CIS Energy and Mining Law Journal*, vol. 3, no. 6 (2005): 33–9.

Table 1.1 Russia's renewable energy resources, PEEREA estimates, Mtoe/year[19]

Resource	Technical potential	Economic potential
Small hydro	88	49
Geothermal	–	80
Wind energy	1400	8
Biomass energy	37	5
Solar energy	1610	2
Low-grade heat	136	37
TOTAL	3271	181

the total amount of renewable energy available for extraction. Taking into account the technological limitations as well as the social and ecological factors yields what is referred to as the 'technical potential'. What is really decisive – the *economic* potential – is that part of the technical potential which is economically justified when one takes into account the costs of fossil fuels, heat and electricity, equipment, materials, transportation and wages.[20] This means that the economic potential of renewable energy sources will increase with the rise in fossil fuel prices.[21]

Russia, as the biggest country in the world, has natural preconditions that grant it a competitive advantage in the development of renewable energy. With its vast and varied territory, the country has so many different types of nature that there are few energy sources that do not exist there. However, it is difficult to ascertain the exact potential of the various resources, and estimates diverge. The Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA) from 2007 provides one set of estimates, as shown in Table 1.1.

Pavel Bezrukikh, Deputy Director of the Russian State Institute of Energy Strategy, has made another widely quoted estimate of the renewable energy potential in Russia, which is presented in Table 1.2. He found that the economic potential for development of renewable energy sources in Russia could cover 35 per cent of the country's total primary energy supply (TPES). When we compare this with today's situation, where renewable energy sources account for less than 1 per cent of Russia's energy, two points stand out: renewable energy sources

19 Source of data used to compile table: EC. *The Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects: Regular review of Energy Efficiency Policies.* Brussels: EC, 2007a.

20 IEA 2003.

21 This is highly relevant for Russia, which has heavily subsidized natural gas for domestic consumption.

Table 1.2 Russia's estimated renewable energy potential[22]

	Potential (Mtoe)	
Energy source	**Technical**	**Economic**
Wind	1551.2	7.7
Small hydro	88.2	49
Solar	6786.5	2.1
Biomass	90.3	48.3
Geothermal	8308.3	79.8
Low-potential heat	135.8	37.1
Total	16981	228

are underdeveloped; and renewable energy sources can contribute tremendously to the energy balance, export potential, emissions trade potential and economic development of the Russian Federation.

The International Energy Agency survey from 2003 found that wind energy can be exploited in many parts of Russia – including Arkhangelsk, Astrakhan, Volgograd, Kaliningrad, Magadan, Novosibirsk, Perm, Rostov, the Tyumen regions, Krasnodar, Khabarovsk, maritime territories, Dagestan, Kalmykia and Karelia. According to the same source, the country's solar energy potential is greatest and can be exploited in the southwest (the North Caucasus, the Black Sea and Caspian Sea regions) as well as in Southern Siberia and the Far East. The IEA survey found geothermal resources viable for production in several places, notably on the Kamchatka Peninsula and Kuril Islands, but also in the North Caucasus as well as certain locations in Central Russia, Western Siberia, Lake Baikal, Krasnoyarsk Krai, Chukotka and Sakhalin.[23] In addition, Russia is the world's largest producer of biomass, which means that it also has a tremendous potential for bioenergy.[24]

Contrasting Russia's potential for renewable energy with its installed capacity reveals considerable scope for expansion. (See Table 1.3.)

22 Source of data used to compile table: Pavel Bezrukikh, quoted in Merle-Béral, Elena. 'The Wider Perspective: Russia's Energy Scene'. Presentation at the conference *Renewable Energy in Russia: How Can Nordic and Russian Actors Work Together?*, Oslo, Norway, 8 May 2008.

23 Merle-Béral, Elena. 'Russia Renewable Energy Markets and Policies: Key Trends'. Presentation at *Global Best Practice in Renewable Energy Policy Making*, expert meeting, Paris, France, 29 June 2007. http://www.iea.org/Textbase/work/2007/ bestpractice/Merle_ Beral.pdf [accessed 23 July 2008].

24 Brown 2005, p. 35.

Table 1.3 Installed renewable energy capacity[25]

Type	Installed capacity, MW
Geothermal energy	73
Small hydro	1,000
Large hydro	46,000
Biomass	1,270
Wind	14
Tidal	0.4 (not currently operative)

In addition there are hydro-projects planned (capacity: 5GW by 2010), as well as wind projects in Kalmykia (23 MW), Kaliningrad (50 MW) and Primorsk (30 MW). Two tidal projects are planned, one at Mezenskaya (19 GW) and another at Tugurskaya (9MW).[26] There may also be other projects in the pipeline, but the lack of comprehensive data makes it difficult to present a complete overview.

Energy efficiency

Russia's industrial sector is highly energy-intensive. It is, however, not only in industry that energy use is inefficient. It is estimated that 30 to 40 per cent of all Russian energy is lost in production, transport, transmission or inefficient consumption.[27] This is why Russia is sometimes referred to as 'the Saudi Arabia of energy efficiency'.[28] The energy currently being wasted could in fact become the country's largest energy source. Industry and residential costumers alike are wasteful in dealing with energy. An important reason for this is how energy has been priced. Prices have not reflected production costs: ever since the Soviet period, access to inexpensive energy has been granted to industry and private consumers alike. In a market economy, this is not sustainable, and energy prices are set to increase.

A case study from Kirovsk and Apatity illustrates the potential for saving energy at all levels, for both industrial and residential energy consumption, throughout Russia.[29] The mining industry in these two cities has an energy consumption four

25 Source of data used to compile table: IEA 2003.

26 IEA 2003.

27 Aron, Leon. 'Privatizing Russia's Electricity', *Russian Expert Review*, no. 4 (2003): 9–17, p. 11.

28 Merle-Béral 2008.

29 Keikkala, Gudrun, Andrey Kask, Jan Dahl, Vladimir Malyshev and Viktor Kotomkin. 'Estimation of the Potential for Reduced Greenhouse Gas Emission in North-East *[sic]* Russia: A Comparison of Energy Use in Mining, Mineral Processing and Residential Heating in Kiruna and Kirovsk-Apatity'. *Energy Policy*, vol. 35, no. 3 (2007): 1452–63.

times higher per tonne of raw ore and six to seven times higher per ton of product, compared to a comparable mining company in Kiruna in Sweden. With regard to residential consumers, the same case study indicates an energy efficiency potential of 30 to 35 per cent, and in distribution in the district heating system losses can be reduced by 30 per cent. Despite its consistent references to the Kola Peninsula as being in the 'Northeast' of Russia (!), that case study convincingly shows how great the energy-saving potential is at all levels of the Russian energy system. Most fixed infrastructure in the system was built up during the Soviet period, and the structural flaws as well as the inadequacies in maintenance are similar throughout the nation. This means that the potential for energy saving can be assumed to be equally great in other parts of Russia.

Research tradition

Finally, Russia has a clear advantage with regard to the development of renewable energy due to its long traditions of high-quality scientific research. Ever since the Soviet period, there has been a heavy emphasis on education and training within the natural sciences. The country also has a strong track record of scientific research specifically on renewable energy technologies. In the early 1930s, the USSR constructed the first utility-scale wind turbines in the world. The first Russian atlas of wind energy resources was published in 1935. Over 7000 small-scale hydropower stations were built in the late 1940s. Research on photovoltaic cells was advanced due to the space programme, and the first solar-powered satellite, Sputnik 3, went into orbit in 1958. The 5 MW Pauzhetskaya geothermal power station was completed in 1967, and a 450 kW tide power station was built in 1968.[30] Unfortunately, this tradition suffered in the late 1960s and 1970s, when Soviet central planners came to favour nuclear energy and fossil fuels. Further details of Russia's scientific and educational system are presented in Chapter 3.

As an example of how Russia's strong scientific tradition could contribute to developing renewable energy, it is tempting to note the case of Google. The world's leading online search engine was founded by the American Larry Page and Russian-born Sergei Brin. The latter is the son of a mathematician and an economist from the Soviet Union, and his background is very much rooted in Russia's strong academic traditions. Brin contributed some of the key innovations to Google's search technology. Google earned 16.5 billion USD in 2007, a 56 per cent increase from 2006, and is currently valued at 137.8 billion USD.[31]

30 IEA 2003.

31 Hagen, Guro Aardal. 'Neppe et must for Google'. *Dagens IT* (2 June 2008), http://www.dagensit.no/finans/article1415158.ece?jgo=c1_re_left_6&WT.svl=article_title [accessed 6 June 2008].

Russian renewables: A future object of investment?

We have listed three reasons why Russia should improve its efforts in energy efficiency and development of renewable energy sources. Admittedly, the reasons relating to environmental concerns are not at the forefront of Russia's current priorities. However, the possibility of increasing the country's energy export potential and its economic growth should attract the attention of Russian decision-makers, so the sector may well expand in the near future.

In the hunt for new markets and new competitive advantages, some of the largest companies in the world have moved into the Russian market over the past decade or so, as exemplified by the investments of major Nordic companies like IKEA, Telenor, Carlsberg and Fortum. In spite of a range of severe problems including the manipulation of the legal system as a bargaining tool in business negotiations, several of these Nordic majors have made some of their biggest profits in Russia. Might not renewable energy prove to be a suitable future object of investment and cooperation with Russia?

Conditions for renewable energy in Russia

As pointed out above, with its geographical size and great variation in climate and terrain, Russia has the potential to develop virtually any kind of renewable energy. There are nevertheless difficulties in ascertaining the exact potential of the various resources, and estimates diverge. Contrasting Russia's potential for renewable energy with installed capacity, one can see that there is considerable scope for expansion. The country's size, and the consequent proximity of the various parts of the Russian Federation to Western Europe, China and Japan, may also be an advantage in terms of global market reach.

We have also noted how Russia is among the world's least efficient countries in its energy consumption, with some 45 per cent of its primary energy consumption wasted due to energy inefficiency.[32] Both industrial and residential customers have been spendthrift in their energy use, largely due to underpricing by state-controlled utilities. This is an unsustainable legacy from the Soviet period, and energy prices are now set to increase. Russia's comparative advantage in renewables, along with the extreme inefficiency in current energy use, indicates considerable potential for contributing to greener energy use. In contrast to the Russian leadership's vacillation between lip service and indifference to renewable energy, improving energy efficiency has now been recognized as important in the country's official energy strategy.

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32 World Bank in Russia. *Energy Efficiency in Russia: Untapped Reserves*. Moscow: World Bank, 2008.

Exploring the conditions for the development of renewable energy sources in Russia, this book features an analysis of the ongoing reform of the country's electricity sector. The reform redefines the rules of the game, liberalizes the sector through the introduction of competition in some segments and also involves privatization of the state-owned monopoly RAO UES. The reform isolates one part of the electricity sector (transmission lines: both high-voltage and low-voltage), to be kept as a natural monopoly, while competition is introduced in generation and retail. The government will continue to regulate prices.

Much is likely to depend on not just the design of the reform, but its implementation. Examples from countries that have had a more developed market economy, a better regulatory framework and more transparent business environments than Russia have clearly shown the pitfalls in this area. Russia might end up repeating some significant errors. The likelihood that the reform will create substantial levels of market power and even monopoly power under peak-load conditions in certain regions is a serious threat to the development of renewable energy, as it will create considerable barriers to market entry. This calls for establishing truly independent regulatory mechanisms, and highlights the necessity of creating incentives and building the right institutions to enable Russia to realize its potential in energy efficiency and renewable energy.

The major impediment to the development of renewable energy in Russia is, however, the continued existence of subsidies for domestic gas consumption. These subsidies remain a major issue in the negotiations for Russian WTO membership, as prices are not expected to reach the European market level before 2014/15, given current trends. This market distortion is an impediment to the profitability of other energy sources, justifying the charge that the Russian market is not open to fair competition between non-renewable and renewable energy sources today.

Markets for renewable energy in Russia

Research on renewable energy in Russia has tended to deal mainly with the natural resource base for renewable energy, or with technologies for specific forms of renewable energy. By contrast, this book focuses on a topic that has received much less attention: the market potential for renewable energy.

Several factors that make Russia a potentially strong market for renewable energy: the steady growth of the economy and of the purchasing power of the population since 1998; the large numbers of summer cottages or *dachas* (an estimated 22 million); and an estimated five million farms and ten million people that are not connected to the central grids. One should, however, also bear in mind the limitations on the emergence of markets for renewable energy in Russia. We have mentioned the subsidies for natural gas and electricity. Additionally, gathering

reliable statistical data can be difficult in Russia, and this lack of data can be an obstacle to the development of renewable energy markets, as it forces investors and innovators to operate in uncharted territory.

Here we should note that there is one niche where renewable energy might be able to gain considerable ground, without having to compete with subsidized natural gas and nuclear power: the remote settlements in the northern parts of the country without access to central electricity and gas grids. Northern areas with harsh climatic conditions make up around 60 per cent of Russia's territory. Yet, with less than one person per km^2, it is prohibitively expensive to connect most of these areas to the central grids. Additionally, transporting coal, gas and other energy commodities is extremely costly. These settlements could emerge as one of the first realistic market niches for the profitable implementation of renewable energy in Russia, pending the growth of better framework conditions in the rest of the country. As such, they could function as a testing ground for renewable energy, preparing the country and local as well as foreign actors for future expansion in this sector.

International projects in this niche market can count as joint implementation (JI) projects under the Kyoto Protocol. This means they can benefit the climate accounts of foreign partner countries as well as reducing overall emissions.

The Russian scientific-educational system

The book contains an introduction to the Russian scientific-educational system in order to help actors interested in scientific and education collaboration with Russia to understand the country's long history of research and vast landscape of scientific and educational institutions. We also present an overview of organizations that fund research in Russia, which may be of use to international research funding organizations wishing to make joint calls with Russian funding institutions.

The economic chaos of the 1990s had severe consequences, and there has been a double brain-drain from Russian science: from research to other sectors of the Russian economy, and from Russia to other countries. The decline in funding and the lack of opportunities for young scientists are interrelated and equally negative developments. Recently the outlook has improved slightly, thanks to greater governmental focus on science and some of Russia's largest companies maturing, with prospects for heightened interest and investment in research. The research and development share of Russian GDP has increased, and the disbursement of state funding is now more timely and predictable than during the difficult 1990s.

The book contains a table listing some central Russian research funding institutions that could be relevant for international actors interested in co-financing renewable energy projects. We have also prepared a ranking of the leading Russian

research and education institutions in renewable energy, to serve as a guide for those searching for Russian partners for EU or other international projects. The ranking offers insight into what may be the top institutions when it comes to renewable energy in Russia. All the institutions ranked are presented in a table with web addresses.

Innovation

The economic growth currently experienced by Russia is heavily dependent on high commodity prices. Focusing on research and innovation would help to foster new industries, increase productivity and diversify the economy. Russian innovation indicators remain disappointing, although the potential remains great, due to a firm science base and an educational system strong on science and technology.

Russian research and development is still primarily financed by the state. Innovation has remained low in the private sector, which has focused on imitation rather than research-based innovation. Poor communication between the public and private sectors has also affected the levels of commercialization. With most research and innovation being state-funded, researchers in the public sphere have generally little incentive to concern themselves with the commercial applications of their work. A second major constraint on commercialization is Russia's weak intellectual property rights framework. Educational backgrounds can also have an effect on commercialization, insofar as many educational programmes still do not fully prepare students for market-oriented work. International actors aiming to carry out commercialization in cooperation with Russian partners must therefore explicitly highlight both the benefits to be achieved from commercialization and the opportunities available.

Kyoto mechanisms

Due to its position as one of the most energy-intensive economies in the world, as well as one of the most inefficient and wasteful, Russia offers a prime opportunity for Joint Implementation (JI) projects under the Kyoto Protocol. This can enable EU countries to fulfil their commitments to reducing emissions under the Kyoto Protocol, while at the same time establishing a presence in the Russian renewable energy sector. Of the 163 JI projects currently underway in the world, 109 are located in Russia, the majority of them initiated by actors in the EU countries.

Learning from the Nordic experience

A survey of cooperation between the Nordic countries and Russia on renewable energy is included as a case study in this book. Cooperation between the Nordic

countries and Russia is relevant to a broader audience, for several reasons: the Nordic countries are world leaders in renewable energy technology; the Nordic region, unlike the USA, Japan or most EU countries, shares a long land border with Russia; and Nordic companies have invested heavily in the Russian economy, more so on average than the companies of other OECD countries. For all these reasons, the richest experience of renewable-energy cooperation with Russia is to be found in the Nordic countries, and can offer important lessons for other actors.

A large number of pan-Nordic and pan-Baltic institutions have been created to foster regional collaboration involving Russia. However it appears that there is significant overlap between the goals and aims of the various multilateral organizations. They form a complex interwoven web, sharing focus areas and often working on and financing the same projects. The nature of this web and the shared priorities make it difficult to identify which actors have the best expertise in specific areas. A weakness of some Nordic funding is that it has been spread too thinly and between too many actors to serve as the main financing for serious research projects. This is especially the case when dealing with Russian actors, who will rarely be familiar with the Nordic institutions in the first place. This experience may be of particular relevance for EU organizations, which also often comprise multifarious institutional webs.

Nordic actors seeking cooperation with Russians on renewable energy have tended to focus on setting up generation capacity for renewable energy for the Russian electricity market. In fact, a more appropriate angle might be to search for high-level competence in areas of basic science that are central to the development of renewable energy technologies. Any manufacturing needed could take place in Russia or elsewhere, and the most realistic markets at present are outside Russia. Solar power and hydrogen technologies are two areas where Russian science has traditionally been strong and where researchers and companies could contribute significantly to international projects.

The Nordic experience highlights a range of challenges that actors wishing to collaborate with Russian scientists will need to grapple with. There is a significant degree of bureaucracy, and finding the right researchers can be difficult. Disagreements between foreign and Russian scientists about the anthropogenic causes of climate change may be a problem as well. More general communication and cultural differences also pose challenges.

Collaboration with the Nordic countries has also been limited due to a lack of co-financing from the Russian state. One reason could be the combined Nordic-centric and aid-oriented character of many of these projects, giving the Russian side little incentive to contribute. However, this also reflects a lack of interest in renewable energy on the part of Russia's federal government. Here it should also be noted that the Russian government is more than willing to allow Nordic

actors to continue to undertake energy efficiency projects, as long as most of the funding keeps coming from the Nordic side. At the same time there is considerable potential for private partnerships and working with NGOs in Russia.

In addition to the general overview of European and Nordic cooperation with Russian actors on renewable energy, we have conducted a study of the subjective experiences of ten Nordic actors who have been involved in collaboration with Russian counterparts on renewable energy projects. We find that perceived opportunities are mostly related to Russia's natural resources, mainly hydro, wind and bioenergy. The challenges relating especially to cultural differences, corruption and bureaucracy are described at length, based on the experiences of ten Nordic actors with experience from renewable energy collaboration in Russia.

Russia's comparative advantages and disadvantages

Again utilizing the case study of the Nordic countries, the book maps some of the areas within renewable energy where Russia has particular strengths or weaknesses. In Russia, commercial, sociological and political approaches to renewable energy have enjoyed very low priority – and that has an important implication for international cooperation with Russia. The complementarities are evident: strong Russian basic research in the natural sciences complements the often strong skills of foreign actors in social science, commercialization and marketing. In the mapping of Nordic–Russian complementarities, hydrogen and solar power – both of which are high-tech fields where it is an advantage to draw on strong basic science – emerge as the best match of Russian and Nordic strengths in renewable energy. This may be the case for many other countries as well.

While acknowledging the potential of Russia's natural resource base and large population, foreign actors should be aware of the current obstacles to producing and selling renewable energy in Russia. At present it may make more sense to engage in projects oriented towards the export of materials, equipment and/or energy *from* Russia, than the production of renewable energy for the Russian market. On the other hand, although establishing renewable energy production in Russia may not yet be profitable in the short term, it could be worthwhile for actors wanting to position themselves for the future. In the long term, Russia could prove an exciting market for renewable energy.

As to cooperation of a more aid-oriented nature, the most productive areas are those related to changing policy in order to facilitate growth in the use of renewable energy. One important thing foreign actors could do is influence Russian climate policy. Transferring international technology for windmills, small hydro and the like makes little sense as long as the regulative framework and attitudes are not in place for implementing such technology.

Our understanding of 'cooperation'

Cooperation can take many forms and have different objectives – among them, aid, economic self-interest, environmentalism or joint scientific benefit. In this book we touch on activities that have a variety of objectives, but ultimately our interest is in cooperation with Russia that can generate mutual benefits in science and innovation through complementarities. This can be either through the joint development of scientific knowledge, or through invoking complementarities between scientific knowledge, natural resources, capital, management skills and/or markets. Mutual benefit is also emphasized in the EU's approach to cooperation with industrialized and emerging economies.[33] Collaboration on renewable energy can also have other consequences:

- Scientific cooperation in an area such as renewable energy is also a form of relatively uncomplicated 'low politics'. When other issues cloud relations with Russia, continued collaboration in an area like renewable energy can be a good way to maintain at least a minimum of relations. That is not a primary focus of this book, but stands as a possible benefit of the cooperation discussed here.
- Collaborating with Russia on renewable energy will also in many instances make a contribution to the global effort against climate change and help to slow the depletion of hydrocarbons.

We see these possible side-effects of cooperation on renewable energy as positive and significant, but subsidiary to the main objective of complementary mutual benefit in science and innovation. In many cases, the collaboration may have several different consequences at the same time. For instance, strengthening Russian climate policy will obviously benefit the global effort against climate change, but it will also strengthen renewable energy in Russia, which in turn will ease cooperation with Russia on renewable energy.

Empirical basis

This book is based on a broad range of data. Seven fieldwork trips have been carried out: five to Russia, and one each to Copenhagen and Stockholm to cover the Nordic case from the authors' base in Oslo.

Over 100 interviews have been carried out for this study. With some individuals we have had little more than a fleeting, informal conversation; others were subjected to fully structured interviews, while yet others were interviewed

33 EC. *The European Research Area: New Perspectives*, Green Paper. Brussels: ECf, 2007b, p. 21.

by telephone. Ten of the interviews were carried out as part of a sub-component of the project exploring the experiences of Nordic actors with personal experience of cooperation with Russia on renewable energy. In these ten interviews we used an interview guide, which can be found in the appendices. From the five fieldwork trips to Russia we have amassed a large collection of written material on renewable energy. Assuming that most of our readers do not read Russian, we have not emphasized these sources in the book. We have cited some of them, but used others more indirectly for our own orientation.

The book has been reviewed by three prominent external peer reviewers, and significant feedback has also been provided by the organization Nordic Energy Research. In addition, various parts of the book have been presented in six presentations at four different international conferences. For further details about the interviews, peer review and conferences, see the appendices.

Overview of contents

The next two chapters provide an overview of the conditions for renewable energy development in Russia. Chapter 2 examines Russia's power sector, first looking at the reform of the Russian electricity monopoly RAO UES, and then moving on to examine the market potential for renewable energy in Russia. The reform of RAO UES, completed on 1 July 2008, is the most important event in the development of the Russian power sector during the past 15 years, and is therefore essential to an understanding of the Russian energy sector. It has resulted in the break-up of the former RAO UES conglomerate and the formation of a series of smaller companies, RusGidro being the one that focuses on renewable energy. At the end of Chapter 2 we examine some potential niche markets for renewable energy in Russia, and find that remote northern settlements could be an important niche.

Chapter 3 gives an overview of Russia's educational, scientific and innovation systems. These are important in highlighting the foundations and background of renewable energy research and development in Russia. Here we present a ranking list of the top educational-scientific institutions on renewable energy in Russia, which should help non-Russian actors in their search for partners. A section on Russian research funding organizations is also included.

Chapter 4 maps Russia's solar power sector. Russia excels in both solar power and hydrogen technologies, both of which are of potential global importance. The solar power sector was selected for detailed study because it is the most scientifically and industrially mature of the two. We found that the Russian solar power cluster is spread across several locations in the country and includes many commercially successful companies. Some of these, such as Nitol, are large and poised for international expansion.

The next three chapters map some of the existing international cooperation with Russia. Chapter 5 focuses on EU–Russian cooperation and provides a short overview of international projects. Chapter 6 provides a similar overview of Nordic–Russian cooperation. We use the case of Nordic–Russian cooperation to highlight the complementarities that can be utilized and taken into consideration when developing collaboration with Russian actors. Our mapping of complementarities between the Nordic countries and Russia is intended to serve as a model for other countries seeking to identify meaningful collaborative ventures with Russian partners, as well as for Russian actors who are looking for foreign partners.

Chapter 7 offers a qualitative description of the experiences of ten Nordic individuals with personal experience of working on renewable energy in Russia. This chapter is intended to help international actors wishing to engage in Russia's renewables sector to see what cooperation already exists, and what experiences the pioneering Nordic actors have had. This information can be useful in trying to fill in the gaps, avoid overlaps and find a place for new actors.

In the concluding chapter, we summarize our findings and put forward a set of policy recommendations for policy-makers, researchers and research funding agencies seeking to develop renewable energy partnership with Russia. The book ends by drawing up three scenario sketches for the development of the Russian renewable sector, aimed at helping both Russian and international actors to see the possible trajectories for Russia's renewable energy sector and position themselves in relation to these trajectories.