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Sustainable Energy in the G20

Prospects for a Global Energy Transition

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Summary

This IASS study considers the potential of the G20 to shape a global transition to sustainable energy, urgently needed in order to achieve the UN's climate and sustainability goals. The G20, a group of major emerging and industrialised economies, is a high-level political forum that brings together a heterogeneous set of members. The Group carries great weight in international energy governance, and accounts for 80 percent of the world's total primary energy consumption and 82 percent of global energy-related CO_2 emissions. Thus, decisions and actions of the G20 and its members have the capacity to significantly impact global energy systems.

The study analyses the energy sector developments of 14 G20 members (Argentina, Brazil, China, European Union, France, Germany, India, Indonesia, Japan, Russia, Saudi Arabia, South Africa, Turkey and the United States). Short case studies trace major trends and policy initiatives in the countries and identify both potential conflicts of interest and existing common ground within the G20. Each study offers an assessment of potential impulses originating from the respective case, and how these might help foster international cooperation for advancing a global energy transition.

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Abstracts

The G20 and its Role in Global Energy Governance

Sybille Roehrkasten and Kirsten Westphal

Global energy supply is still far from sustainable. There is no comprehensive approach in global energy governance to steer a global energy transition. The G20 comprises countries that are of utmost importance for global energy governance, and might therefore be well placed to coordinate action and to achieve greater coherence. The G20 has made initial steps to formulate an energy agenda and to commission other institutions. This is an appropriate approach, but more concrete steps need to follow in order to accelerate an energy transition. One step could be to promote “sub-clubs”.

Argentina: From an Energy Stalemate Towards Shale Gas Expansion and Creating a Renewables Market | Moïra Jimeno

After years of stalemate, attracting investment in the energy sector to mitigate electricity shortages and meet rising demand are top priorities for Argentina. To this end, the new government has established main goals of increasing shale gas production and fostering renewable energy deployment and development while drastically reducing energy subsidies. However, investments in renewables and unconventional gas are highly capital intensive and require long-term guarantees, while Argentina still lacks international financial trust. To recover financial trust, the current administration is seeking international agreements with the main financial institutions as well as the US and the EU.

Brazil: Long Tradition of Renewables-Based Energy Supply and Ethanol Diplomacy | Sybille Roehrkasten

The Brazilian energy sector has one of the highest renewables shares and remains one of the least carbon-intensive in the world. Electricity supply has long been based on hydropower. In recent years, significant gas, bioenergy and wind capacities have been added. Brazil has been a global pioneer in transforming the transport sector, replacing oil with sugarcane ethanol since the 1970s. Today, almost all new motor vehicles allow for any mixture of gasoline and ethanol. In its international energy policy, renewables – particularly bioenergy – play a key role. With the recent discoveries of deep-water oil reserves, Brazil furthermore aspires to become an international leader in the exploration of deep-water oil and gas.

China: Emerging Global Power in Clean Energy? | Rainer Quitzow

China's electricity supply is still strongly dependent on coal, but a strong domestic renewable energy industry is driving rapid deployment of wind and solar energy. Further progress will depend on the implementation of planned power sector reforms. In transport, the continued proliferation of automobiles is driving growth in CO_2 emissions. Investments in an electric vehicle industry may offer opportunities for decarbonisation in the long term. China's initiative to promote green finance during its G20 presidency is in line with its ambitions to promote overseas markets for its emerging clean energy industry.

The EU: In the Midst of Crisis – Downgraded Sustainable Energy Ambitions | Kirsten Westphal

The European Union (EU) is represented in the G20 by the Union as well as by the individual (EU-4) member states France, Germany, Italy and the United Kingdom. It could therefore play a role as an agenda-setter and multiplier in the G20 and beyond. However, internal consensus within the EU on the pace towards decarbonisation and an energy transition is eroding, and the EU is losing its frontrunner status and role as a 'best practice' reference for others. In particular, because of the multiple crises the EU faces, its ambitions in multilateral sustainable energy governance are stagnating.

France: Reducing Nuclear Dominance and Promoting a Low-Carbon Energy System | Carole Mathieu

With the adoption of its first Energy Transition Law in August 2015, France has scaled up its commitment to address global environmental issues. The transition process is intended to accelerate progress towards reducing greenhouse gas (GHG) emissions and energy use and increasing local renewable energy production. Meanwhile, France aims to reduce the nuclear share in its electricity generation, which is the highest in the world. Internationally, France pushes civil nuclear cooperation and initiatives to increase the share of renewable energy. As chair of the COP21, it has become an international pioneer in green finance.

Germany: Promoting an Energiewende Domestically and Globally | Sybille Roehrkasten and Karoline Steinbacher

The German Energiewende – literally translated as "energy turnaround" – is an outstanding example of a national effort to transform an energy system. Driven by public opposition to nuclear energy, and by efforts to combat climate change, the Energiewende builds on a massive expansion of renewable energy as well as improvements in energy efficiency. So far, efforts have focused on the electricity sector, while progress in the heating and transport sector has been very limited. In addition, Germany also has a long track record of promoting sustainable energy with its international energy policies.

India: Meeting Energy Needs for Development While Addressing Climate Change | Madhura Joshi and Radhika Khosla

India is undergoing structural urban and economic transitions and has set ambitious policy targets to meet its rising energy needs for development. Expanding coal and renewables are two important pillars of this undertaking and, since 2008, climate protection is of increasing concern. India's international engagements reflect these motivations of both energy security and climate change, where India is increasingly engaging in transfer of clean and efficient energy technologies to developing countries like itself.

Indonesia: A Long Way to Low-Carbon Development

Jens Marquardt

Indonesia is the biggest energy consumer in Southeast Asia and the world's leading coal exporter. Its primary energy mix is dominated by oil and traditional biomass. Almost a third of its population lacks access to modern energy services. In recent years, Indonesia has made promising steps towards a more sustainable energy supply. It has almost completely abolished fossil fuel subsidies and has announced ambitious energy efficiency and renewable energy targets, particularly for geothermal energy. It also aims to reduce greenhouse gas emissions, and engages in related international initiatives. However, policy implementation remains a challenge.

Japan: Dominated by Fukushima and Tackling Hard Problems in Decarbonisation | Llewelyn Hughes

Japan's energy policy remains dominated by the Fukushima nuclear disaster of 2011. While the government continues to be committed to nuclear power, its future is uncertain. Japanese greenhouse gas emissions have increased significantly as nuclear energy has been replaced by gas and coal. Ambitious policies in the transport sector promote battery electric and fuel cell vehicles. The introduction of feed-in tariffs favoured the build-up of non-residential solar photovoltaics. As part of its climate commitments, Japan aims to further expand the use of renewables, improve energy efficiency and restart nuclear energy.

Russia: A Gas Superpower Striving for Nuclear Expansion and Starting to Support Renewables | Alexander Gusev

Russia has the fourth highest electricity demand globally. In the mid- and long-term, fossil fuels (gas, oil and coal) and nuclear energy will remain the backbone of Russian domestic and international energy policies. Russia is spearheading international support for nuclear power. Recent governmental decisions clearly show growing support for renewables. Despite overall budget cuts, renewable energy has for the first time received direct financial support from the federal budget. While energy efficiency policies have experienced substantial setbacks in recent years, gasification of public transport could further contribute to decarbonisation

Saudi Arabia: Oil as a Burden in the Struggle for Energy Diversification | Sebastian Sons

Historically, Saudi Arabia's economic progress has relied heavily on high oil revenues. In times of low oil prices, its rentier state system suffers from decreased revenues, which are needed to sustain a generous welfare state and highly subsidised energy services for its growing population. To tackle this problem, the new Saudi leadership is now seeking energy diversification by investing in renewables and nuclear energy. However, it remains to be seen whether this reform agenda will be implemented, as traditional structural, political and societal obstacles remain. While Saudi Arabia has previously boycotted international climate agreements, it now supports the Paris Agreement.

South Africa: Carbon-Intensive Economy and a Regional Renewable Energy Frontrunner | Agathe Maupin

Due to its strong reliance on coal, South Africa is a middle-income country with very high per capita emissions. As host of the Conference of the Parties (COP) in 2011, the country has embarked on a significant change of trajectory for its energy sector. In its climate mitigation efforts, it has introduced renewable energy auctions and furthermore focuses on carbon capture and storage as well as energy efficiency. South Africa's regional activities concentrate on renewables, grid integration and energy access in Southern Africa.

Turkey: Great Potential, Missing Will | Jörn Richert

Turkey's energy policy focuses on the promotion of coal and nuclear power. Although sustainable energy legislation is in place and respective targets have been defined, implementation is lagging behind and sustainable energy takes a back seat in the country's political debate. Internationally, Turkey is concerned with regional (energy) geopolitics much more than with sustainability. In G20 negotiations on sustainable energy, Turkey might emerge as a laggard, particularly in matters related to the reduction of coal use.

The United States: Domestic Transitions and International Leadership Towards Low-Carbon Energy | Karoline Steinbacher

As the world's second largest energy consumer and emitter of greenhouse gases, one of its most important producers of oil and gas and home to the second largest capacity of renewable energy, the United States is a central actor in global energy governance. Energy policy in the United States has been characterised by an open approach with regard to the choice of energy sources and is aimed at reaching a target triangle comprising economic competitiveness and employment; energy security; and the development and deployment of low-carbon energy sources. This "all-of-the-above strategy" is reflected not only in domestic energy policy, where state initiatives also decisively shape the policy landscape for sustainable energy, but also in US international energy activities.

Members of the G20

1. Introduction and Main Insights from the Study

Sybille Roehrkasten,[1] Sonja Thielges[2] and Rainer Quitzow[3]

With the adoption of the Paris Climate Agreement and the Sustainable Development Goals (SDGs) in 2015, the international community has set itself very ambitious goals for shaping the future global energy system. Limiting global warming to well below two degrees Celsius will not be achievable without a fundamental transformation in how energy is produced and consumed. There is an urgent need to immediately curtail and then phase-out the global use of fossil fuels, which still account for more than 80 percent of the world's total primary energy demand (IEA, 2015). At the same time, the international community must ensure universal access to affordable, reliable, sustainable and modern energy by 2030 (SDG7). This remains a paramount challenge in a world where more than one billion people have no access to electricity and almost three billion rely on traditional biomass for cooking and heating (SE4All, 2016).

In the much-needed global transition to sustainable[4] energy, the G20, a group of major industrialised and emerging economies, plays an important role. It comprises major energy producers and consumers as well as key players in international institutions. The G20 countries account for 80 percent of the world's total primary energy consumption (G20, 2015) and 82 percent of global energy-related CO_2 emissions.[5] As a high-level political forum, the G20 can be a powerful agenda-setter and exert leadership in global energy governance. Moreover, the decisions and actions of G20 countries have the capacity to significantly impact global energy systems. The G20 energy agenda has evolved in recent years. The task of the German presidency in 2017 and of its successors is to seize the momentum of the Paris Agreement and the SDGs to foster G20 action towards a sustainable, decarbonised global energy system. This will be a challenging undertaking, as G20 members are highly heterogeneous, often with divergent interests in energy-related issues.

This IASS study analyses the G20's potential for advancing a global transition to sustainable energy. It comprises short studies on the energy trends and the domestic and international policy priorities of 13 G20 countries (Argentina, Brazil, China, France, Germany, India, Indonesia, Japan, Russia, Saudi Arabia, South Africa, Turkey and the United States) plus the EU.

The cases were selected to represent the heterogeneity of the G20: they include industrialised and emerging countries, renewable energy frontrunners and major fossil fuel producers, major donors to international energy cooperation and countries with prevailing energy poverty. The country studies help identify both potential conflicts of interest and existing common ground within the G20. Each offers an assessment of potential impulses originating from the respective country, which could provide major additional value for international cooperation towards a global energy transition.

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[4] We regard energy supply as sustainable if it complies with the SDGs and the Paris Agreement. The country chapters, however, show that there is no general agreement among the G20 countries about what sources constitute sustainable energy.

[5] Own calculation, based on the International Energy Statistics of the U.S. Energy Information Administration.

GUIDING QUESTIONS FOR THE COUNTRY STUDIES:

1) What energy transformations are under way in the G20 countries?

- What are the key overall trends and challenges in the countries' energy systems?
- What are the major trends with regard to renewable energy expansion and improvements in energy efficiency?
- What are key drivers and/or barriers to decarbonising the countries' energy sectors?

2) How are the G20 countries engaging in international energy cooperation and policies?

- What are the major overall priorities and strategies?
- How do the international activities contribute to decarbonising the global energy system?

3) What impulses from individual G20 countries might be relevant for a global transition towards sustainable energy?

All of the G20 members covered in this study remain highly dependent on fossil fuels. Final energy consumption in all members is strongly reliant on oil, particularly within the transport sector. Coal plays a major role in the electricity supply of countries like China, India, Indonesia, Germany, South Africa and the US. Gas is a key energy source in the final energy consumption of most of the countries, with shale gas being promoted in countries like Argentina and the US.[6] Countries such as Indonesia, Saudi Arabia and South Africa are important exporters of oil or coal. Moreover, fossil fuels play an important role in the international energy policies of most countries.

Despite their dependence on emission-intensive fossil fuels, all G20 members covered in this study have adopted the Paris Agreement. Even the petro-state Saudi Arabia no longer maintains its opposition to international climate protection efforts. Moreover, a growing number of countries now address climate protection in their international energy policies.

Renewable energies are on the rise in all G20 members assessed in this study. They all have renewable energy targets and policies in place and have experienced growth in renewable energy capacities over the last ten years, albeit from very different baselines (IRENA, 2016). In line with global trends, the expansion of renewables is concentrated in the electricity sector. In all countries except for Germany and Saudi Arabia, hydropower makes up the largest share of renewable power capacities.[7] However, non-hydro renewable electricity sources, in particular wind and solar energy, have rapidly increased their shares in a number of countries. Germany has the largest share of non-hydro renewable energy in its electricity mix, which accounts for more than 26 percent of power generation, while China has the largest total installed capacity at almost 200 GW (REN21, 2016). In Russia and Saudi Arabia, on the other hand, the use of non-hydro renewables remains embryonic. In Brazil, electricity supply has long been based on hydropower, and biofuels represent a significant share of the energy consumption in the transport sector. Brazil's longstanding support for ethanol as an alternative transport fuel has made it a world leader in this field.

[6] Own calculation, based on IEA country statistics for 2013.

[7] Own calculation, based on IEA country statistics for 2013.

The promotion of renewables is also a longstanding focus of international energy policies among front-runners such as Brazil and Germany. Corresponding to their domestic energy developments, Brazil is a major international proponent of biofuels, while Germany strongly supports the development of wind and solar energy. With the rise of renewables around the world, support for their development is also gaining importance among other countries, including France and the US.

It is important to note that the expansion of renewables implies a reduction of fossil fuels only in saturated energy markets with stable or even declining energy demand. However, the emerging economies among the G20 members are all confronted with strongly rising energy demand. Countries such as India and Indonesia face the additional challenge of suppressed energy demand, due to unstable supply, energy poverty and the widespread use of traditional biomass with significant negative impacts on human health and ecosystems. In these markets, not only renewables but also fossil fuels are on the rise. To assess whether these countries are gradually moving towards a more sustainable energy system, it is important to compare absolute growth in renewables and fossil fuels. In China, for instance, capacity additions in renewables have outpaced those in fossil and nuclear energy in recent years.

Most of the case study countries have vast potential for improving energy efficiency. While all countries have committed to improve energy efficiency within the G20, advances on the ground have been much more limited than those in the area of renewables. Here, the experience of the EU is symptomatic: though on track to meet its renewable energy targets, the EU is lagging behind on energy efficiency. Due to budgetary constraints, Russia has even downsized its energy efficiency efforts. Important progress has been made by China and India, in increasing energy efficiency within the industrial sector, albeit from a relatively low base. While China has mainly relied on top-down command-and-control measures, India's Perform Achieve and Trade scheme represents an innovative policy model based on tradeable energy efficiency certificates. Japan, a longstanding leader in energy efficiency, has legislation in place to enforce demand management, and relies on its Top Runner programme to encourage manufacturers to develop technologies with the best efficiency performance. The phase-out of fossil fuel subsidies, an important focus of G20 efforts, has also seen the first signs of progress in recent years. In an effort to reduce fiscal pressures, Indonesia utilised the window of opportunity afforded by low global oil prices to eliminate subsidies on gasoline and drastically reduce diesel subsidies. Saudi Arabia, under pressure to increase its revenues from oil exports, has introduced a carefully crafted reform of energy prices, which aims to increase prices mainly for large consumers.

Nuclear energy remains a dividing topic between the countries covered in this study. Historically, Germany has been strongly reliant on nuclear energy but is now phasing out its capacities by the year 2022. France – the country with the world's highest nuclear share in electricity generation – aims to reduce the nuclear share from 75 to 50 percent. In Japan, the Fukushima disaster of 2011 has weakened public support for nuclear energy. The majority of nuclear plants remain closed, due to more stringent safety regulations. Although the Japanese Government remains committed to nuclear energy, it has abandoned its previous plans to further increase nuclear power over the coming decades. Instead, it now aims to limit its share to 20–22 percent of electricity generation by 2030. Despite increasing public opposition to nuclear power in many countries, Argentina, China, Russia, Saudi Arabia, South Africa and Turkey are all aiming to expand their nuclear capacities. However, in the field of nuclear energy the mismatch between targets and actual implementation is particularly pronounced. Nuclear energy is furthermore an important pillar in the international energy policies of nuclear powers such as France and Russia.

While the expansion of renewable energies and improvements in energy efficiency are key pillars of a decarbonised global energy supply, the progress in most of the study countries is not driven primarily by concerns about climate change. In France and Germany, reducing the use of nuclear energy represents a central driver of renewable energy expansion. In Germany, this has been coupled with aspirations to gain a leadership position in an emerging renewable industry, a goal shared by countries such as China and the US. In a number of countries, promoting

renewables is a strategy for meeting rising energy demand while simultaneously diversifying the energy mix. In Argentina, for instance, investments in renewables are accompanied by support for an emerging shale gas industry. Resource availability and low costs have long been a central reason behind the utilisation of hydropower. Falling costs have also driven the development of solar and wind power. In Brazil, for instance, wind energy has outcompeted fossil-based generation in a number of its power auctions. Local environmental benefits – primarily air quality, but also water security – represent additional drivers in countries such as China and India.

To accelerate the promotion of sustainable energy, several barriers still need to be tackled. Overcoming path dependencies and vested interests in fossil and nuclear energy remains challenging in all countries. In Turkey, for instance, energy security concerns are driving increased investment in domestic coal resources. In the field of nuclear energy, geopolitical ambitions often trump the unresolved issues of nuclear safety and waste treatment. Infrastructure challenges hinder the expansion of renewables in several countries. Even in a frontrunner country like China, the grid operator has been slow to adopt the measures needed to effectively integrate wind and solar power into the electricity system. In the transport sector, progress has been even slower. Notably, Germany, an international frontrunner in renewable power generation, has taken a very reluctant stance towards increasing the fuel efficiency of German-made cars.

Concerted action by G20 countries can offer an important boost to building a sustainable, low-carbon energy system. First steps have already been taken since the launch of the G20's energy agenda in 2009. The G20 has established work streams on some of the most pressing issues for a transition to sustainable energy: renewable energy, energy efficiency, phasing-out of fossil fuel subsidies and access to energy. These are all central steps towards the implementation of the SDGs and the Paris Agreement. Yet, even in the dynamic field of renewable power generation, observed progress only represents a first step towards the establishment of a sustainable, low-carbon energy system. It is, therefore, essential that the G20 deepens its engagement in all the mentioned areas. Strengthening the links to global climate mitigation efforts and embedding sustainable energy into the G20's core track on finance and economic policy could provide additional impetus – not only for a strong G20 energy agenda under the German presidency in 2017, but also for subsequent presidencies in the years to come (see also Roehrkasten et al., 2016).[8]

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[8] The authors thank Sebastian Helgenberger, Carole Matthieu, Agathe Maupin, Ortwin Renn and Karoline Steinbacher for their helpful comments on this chapter.

2. The G20 and its Role in Global Energy Governance

Sybille Roehrkasten[1] and Kirsten Westphal[2]

Global energy supply is still far from sustainable. There is no comprehensive approach in global energy governance to steer a global energy transition. The G20 comprises countries that are of utmost importance for global energy governance, and might therefore be well placed to coordinate action and to achieve greater coherence. The G20 has made initial steps to formulate an energy agenda and to commission other institutions. This is an appropriate approach, but more concrete steps need to follow in order to accelerate an energy transition. One step could be to promote "sub-clubs".

Global energy supply is far from being sustainable[3]

Torn between the twin challenges of climate change and energy security, the world is facing energy dilemmas (Bradshaw, 2010). While the international community agreed to limit global warming to 2°C or even 1.5°C in the Paris Accord in 2015, it is still unclear how this goal will be achieved. Action in the energy sector will be key, as it accounts for two thirds of global greenhouse gas emissions. Global energy supply is still heavily dependent on conventional sources,[4] and thus heavily exposed to the associated environmental, economic and geopolitical risks. In 2014, conventional sources provided almost 90 percent of global final energy consumption.[5] Even within the electricity sector, where the expansion of renewables has been most advanced, non-renewable sources still accounted for more than three quarters of power generation in 2015. Final energy for heating and cooling was 92 percent conventional, while fossil fuels even accounted for 96 percent of global fuel for road transport in 2015 (REN21, 2016).

There is an urgent need to immediately curtail and then phase-out the global use of fossil fuels (primarily coal and oil, but also natural gas in the longer term) if the goal of limiting global warming is to be achieved (IEA, 2015a; IEA, 2014). The world faces the Herculean challenge of promoting the transition from the conventional to a sustainable energy system while at the same time guaranteeing the supply of fossil fuels for a transitional period without simply perpetuating existing production and consumption patterns (Westphal, 2012). A shift in investment towards sustainable energy sources is key in order to avoid lock-in effects (Baake, 2016). Under the current price regime of low energy prices and in an era of abundant energy sources, price signals to turn away from fossil fuels are too weak or simply lacking. Policy measures will thus be of central importance to decarbonise the global energy system.

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[4] Conventional energy sources comprise fossil energy (oil, gas and coal), nuclear energy and traditional biomass.

[5] The mix of global final energy consumption in 2014 was as follows: fossil fuels 78.3%, traditional biomass 8.9%, nuclear power 2.5%, modern renewables 10.3%.

Nuclear energy requires special attention because it is related to specific threats. The approach to decarbonise electricity production by nuclear power generation comes with widely understood safety risks and the unsolved problem of radioactive waste (Quitzow et al., 2016a). The geopolitical and security threats from proliferation are a tremendous challenge in a world of weak and failing states as well as transnational terrorism.

The ownership, access to and use of hydrocarbons has been a constant source of geopolitical tensions and conflict. Fossil fuels are unevenly distributed globally. Convincing those in control of fossil fuel resources to participate in a plan to phase out their means of wealth and abandon their mechanism of perceived leverage is a paramount challenge. Similarly, the shift away from fossil energy sources also entails a range of long-term economic risks, particularly those related to the risk of stranded assets or a devaluation of hydrocarbon deposits under a stricter climate regime.

Meanwhile, the success of a transition to a sustainable energy supply also requires attention to energy security. Energy security is generally defined as the availability of stable, secure and affordable energy at the time and place where it is needed. New forms of fluctuating energy sources require new technologies and institutional arrangements to guarantee electricity grid stability. Access to these modern technologies is becoming a key issue for social and economic welfare. In the developing world, many still lack access to modern forms of energy and are forced to rely on sources with negative health and environmental implications, while others lack access to any means of energy. An estimated 1.1 billion people (SE4All, 2016) worldwide – more people than living in the OECD world – lack access to electricity. In Sub-Saharan Africa, this is the case for two out of three people (see also Quitzow et al., 2016b). Worldwide, 2.9 billion people (SE4All, 2016) – almost 40 percent of the global population – rely on traditional biomass for cooking, which is responsible for indoor air pollution. The prevalence of traditional biomass, in addition to burning of oil and coal, has massive negative impacts on air quality and human health. Providing universal access to energy while maintaining progress toward climate goals poses tremendous challenges. Massive improvements around the world, in energy conservation, energy efficiency and renewable energies are urgently needed.

Global sustainable energy governance: weakly developed, but with significant recent advances

The challenges for global energy governance are paramount. Yet, for a long time, governments have been hesitant to engage in global cooperation on energy. This was primarily due to sovereignty concerns: energy policy is traditionally considered as a national task – and as a strategic good, crucial for the survival of a state and its political power in international relations (see, for example, Lesage et al., 2010). The United Nations – the primary forum for multilateral cooperation on a whole range of issues – has not been a strong actor with regard to energy policy. There is no intergovernmental energy organisation that covers the entire range of energy sources and is simultaneously open to universal membership. As an example, consider the most important international energy organisations: the International Energy Agency (IEA), the International Atomic Energy Agency (IAEA), the Organization of the Petrol Exporting Countries (OPEC) and the International Renewable Energy Agency (IRENA). Only IAEA and IRENA are open to all UN member states, while the IEA is the only international energy organisation that works on the whole range of energy sources. The latter is the major provider of data and analyses on global energy markets and policies. However, its membership structure, restricted to OECD countries, has come under increasing criticism as non-OECD countries such as China and India have become increasingly powerful players in energy markets.[6] Given that non-OECD countries already accounted for 60 percent of global energy demand in 2013 (expected to be 70 percent by 2040), the continued exclusion of non-OECD countries is increasingly detrimental to the IEA's credibility (IEA, 2015b). Therefore, an association process is currently under way with major non-OECD energy powers. These changes within the IEA are in response

[6] The IEA has also been repeatedly criticised for underestimating the potential of renewable energy. See for example Roehrkasten (2015) and Roehrkasten & Westphal (2013).

to a much larger transition: Decisions in emerging and developing countries will become the key drivers of developments in global energy markets.

However, in past years there have been significant advances in global governance in areas of sustainable energy (see also Roehrkasten, 2015). The official establishment of the IRENA in 2011 in particular is a major landmark. Its mere creation – and even more so its widespread membership with more than 145 member states – are remarkable considering the long history of failed attempts to address renewables in global fora prior to IRENA's creation (Roehrkasten & Westphal, 2013; Roehrkasten, 2015). In the same year as IRENA's official creation, the United Nations began to take an active stance on sustainable energy. The UN Secretary-General set up the Sustainable Energy For All (SE4All) initiative, which comprises three goals up to 2030: first, to double the share of renewables in global energy supply; second, to double the improvement rate for energy efficiency; and third, to ensure access to modern forms of energy for all. In September 2015, the UN General Assembly adopted Sustainable Development Goals (SDGs) that also include a goal on sustainable energy: to ensure, by 2030, access to affordable, reliable, sustainable and modern energy for all.[7] With the adoption of the SDGs, sustainable energy finally became an integral part of the UN sustainable development agenda. However, amid these advancements, energy efficiency is still underrepresented beyond the International Partnership for Energy Efficiency Cooperation (IPEEC), founded in 2009 by the Group of 8 (G8) and now comprising 16 members. Today, there is no lack of institutions in global energy governance, as many have been created since the 2000s. However, the governance structure remains highly fragmented: coordination and coherence are often missing.

G20: a steering committee for global sustainable energy governance?[8]

In theory, the G20 is well positioned to steer a global transition to sustainable energy. The G20 comprises major energy producers, consumers and key players in existing international institutions. Along with the G7 countries (Canada, France, Germany, Italy, Japan, the UK and US), the G20 includes the emerging powers Argentina, Australia, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, South Korea and Turkey as well as the European Union (EU).[9] Thus, the G20 unites a representative group of industrialised countries and new powers whose energy futures will shape energy developments both in their own right and via their outreach as global and regional powers. The G20 includes all permanent members of the UN Security Council, and major financiers of international organisations. Overall, G20 members accounted for 77 percent of the world's total final energy consumption in 2014 and 82 percent of energy-related CO_2 emissions in 2012.[10] Similarly, G20 countries host more than 80 percent of the world's installed renewable energy capacity, and the Report on G20 Deployment of Renewable Energy estimates that these countries hold most of the potential for renewables deployment from now until 2030 (G20, 2015). Last but not least, G20 members provided 90 percent of bilateral official development aid in the energy sector in 2014.[11]

[7] The targets of the energy SDG build on the SE4All goals. However, the target on renewable energy is less specific: it only foresees a significant increase of renewables, while the SE4All goal speaks about doubling the renewables share in global energy supply.

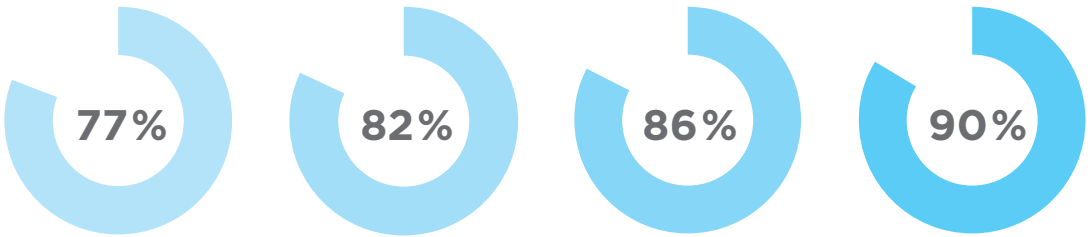
[8] This refers to van de Graaf & Westphal (2011).

[9] The selection of G20 countries beyond the G8 was based on their economic strength, geographic representation as well as further political considerations. It is important to note that the G20 is a self-appointed club and not an institution that has been legitimised by non-members.

[10] Own calculations based on IEA, 2016 (for total final energy consumption) and IEA, 2016 (for energy-related emissions).

[11] Own calculation based on OECD, 2016.

Figure 1: Weight of G20 members in the global energy system



a) Share of total final energy consumption 2014

b) Share of energy-related CO_2 emissions 2012

c) Share of installed renewable energy capacity 2015

d) Share of bilateral official development aid in the energy sector 2014

Sources:

a) IASS based on IEA Country Statistics

b) IASS based on U.S. Energy Information Administration

c) IASS based on IRENA Renewable Capacity Statistics 2016

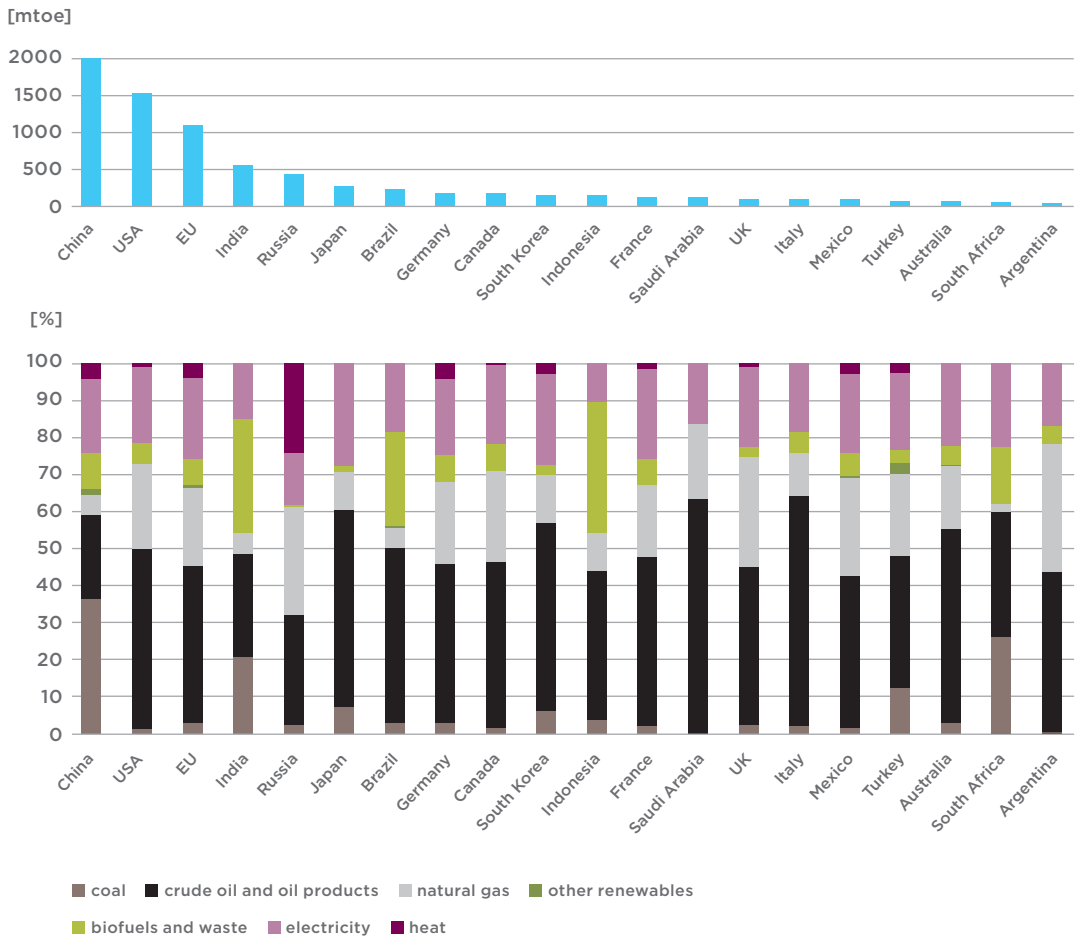
d) IASS based on OECD.Stat

Given their sheer weight in the global energy system, any move by the Group will make a difference to the global energy mix and GHG emissions. If the G20 members agree on joint action, this has important international signalling effects and considerable influence on international policymaking. This could make the G20 an ideal forum to steer an energy transition by complementing existing institutions and bringing greater coherence to the global energy architecture (Huang, 2009; Lesage et al., 2010). Exercising such a "soft steering" function will include deliberating and coordinating national policies, but also encouraging international cooperation (Van de Graaf & Westphal, 2011).

Initiated in 1999 to coordinate the prevention of financial crises, the G20 nowadays covers a very broad range of issues and can work beyond specific silos, easing issue-linkage in international policymaking. In addition to its finance track, which is still core to the G20 agenda and covers issues of international finance and economics, the G20 nowadays works on a wide range of issues in its "Sherpa track", such as sustainable development, energy, anti-corruption, climate change, employment and food security. The Group's members have key roles in other energy institutions such as the IEA and the IRENA, enabling the countries to channel dialogue and drive stringent, coherent action. Last but not least, the aligned platform for international business, B20, provides the G20 with the opportunity to straddle public–private sector lines. This is potentially a mechanism to be exploited by sequencing and channelling investments away from conventional fuels into sustainable energy technologies.

However, the G20 also consists of a very heterogeneous group of countries, such that finding common ground on energy matters is not an easy undertaking. The fact that the countries have very different positions and roles in the energy system is both a challenge and an opportunity. While China and the EU have by far the largest renewable energy capacities, installed capacities (particularly non-hydro renewables, which are often considered as 'new' renewables) in countries such as Saudi Arabia, Russia and Argentina remain very small. The G20 states represent a wide range of conduct in national energy policies and predominant structures in energy sectors. Whereas in some states the market is seen as the main coordination mechanism, others rely on state intervention and state-owned companies to secure their energy supplies. Moreover, many states still have regulated energy prices while in other countries prices have been liberalised.

Figure 2: Final energy consumption of G20 members 2014



a) Total final energy consumption

Source: IASS based on IEA Country Statistics

b) Energy balances

Source: IASS based on IEA Country Statistics

G20's evolving energy agenda

The G20 began to take action on energy matters under the US presidency in 2009, when G20 members declared their intention to phase out harmful and inefficient fossil fuel subsidies. Since then, the G20 has continued to exchange on and monitor the phasing-out of fossil fuel subsidies in cooperation with exiting energy institutions, including the IEA, OPEC and OECD. In addition, the World Bank published reports tracking fossil fuels subsidies. In 2013, the G20 endorsed a methodology for voluntary peer reviews. In 2016, China and the US became the first countries to release peer reviews on their fossil fuel subsidies.

The second area of 'early' energy cooperation within the G20 dealt with oil market functioning. It was complemented by a transparency initiative pushing the work of the Joint Organisations Data Initiative (JODI) to obtain better data on oil and gas markets as well as gaining more insights into price reporting agencies. Common concerns over oil price volatility, detrimental to both consumers and producers, were a driver of this process. Natural gas was a single issue, co-organised with the International Gas Union in 2015.

Since the Mexican Presidency in 2012, the G20 has addressed energy issues more comprehensively. An energy working group was established, which since the Russian presidency of 2013 functions under the title Energy Sustainability Working Group. The G20 Summit in Brisbane, Australia, in 2014, endorsed the G20 Principles on Energy Collaboration and expanded collaboration to energy efficiency, access to energy and renewable energy. The first G20 Energy Ministers Meeting took place under the Turkish presidency in 2015. In the area of energy efficiency, the G20 adopted a first Action Plan in 2014. Energy efficiency has been prominent in G20 action plans, as it represents a 'low-hanging fruit', i.e., an area in which the group's members can easily agree on expanding their activities. In 2016, the collaboration on energy efficiency was further expanded through the G20 Energy Efficiency Leading Program, which contains 11 key areas for collaboration, led by different countries. The G20 has mandated the International Partnership for Energy Efficiency Cooperation to organise the Group's work on energy efficiency. In 2015, under the Turkish presidency, the G20 endorsed an Energy Access Plan, focusing on Sub-Saharan Africa. Under the Chinese presidency in 2016, collaboration on energy access has been expanded to include the Asia-Pacific region. At the core of the G20 action on renewable energy is the toolkit of voluntary options that was developed by IRENA and adopted by the G20 in 2015. At the Energy Minister Meeting in Beijing 2016, the G20 furthermore emphasised the importance of the UN 2030 Agenda on Sustainable Development and the Paris Agreement for the G20 energy agenda.

Conclusions and outlook

The G20 unites a set of countries with very distinct and diverse policies and perspectives. Against this background, the group tends to focus on less controversial issues. Consequently, the G20 has only partly lived up to its potential as a steering committee. The initiative to phase out inefficient fossil fuel subsidies shows that countries prefer to pursue and commit to policies that are already under way. Nevertheless, exchange and deliberation on policy approaches has value per se, and should not be underestimated in its long-term impact. The G20 builds on the principle of voluntariness and on 'soft' modes of steering. It does not aim to establish legally binding declarations or strong commitments on goals, but rather focuses on agenda setting, coordination among G20 members, knowledge exchange and the involvement of international organisations. It provides an opportunity to meet on an equal footing and to create a dialogue on energy topics. This provides an important setting to exchange national views and standpoints. A major step forward seems to consist of mandating energy ministers to meet annually.

A promising approach, moreover, is that the G20 partners cooperate with other international institutions, including IEA and IRENA. This can help to develop these organisations' "Think-and-Do Tank" functions. It enhances, for example, the outreach and networking functions of the IEA. Assigning the institutions with tasks can also shape new paths towards sustainable energy and provide for greater continuity based on their function as multipliers for their respective members. The G20 can complement and add coherence to the global energy institutional landscape by entitling existing institutions to carry on its initiatives. If this is designed appropriately, with a clear long-term mandate, then such an approach can ensure continuity on the respective subject beyond individual agenda-setting by each revolving presidency.

An assessment of G20 and international energy governance initiatives must take into account the long lead times and timespans of the energy sector. In that respect, it is very early to judge the real impact of this deliberative and delegating process. Yet, concrete action to steer investments in the right direction is needed. The close links to the business community and the respective agencies must be exploited more efficiently for this purpose, in addition to leveraging "sub-clubs" of willing states.

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3. Argentina: From an Energy Stalemate Towards Shale Gas Expansion and Creating a Renewables Market

Moïra Jimeno[1]

After years of stalemate, attracting investment in the energy sector to mitigate electricity shortages and meet rising demand are top priorities for Argentina. To this end, the new government has established main goals of increasing shale gas production and fostering renewable energy deployment and development while drastically reducing energy subsidies. However, investments in renewables and unconventional gas are highly capital intensive and require long-term guarantees, while Argentina still lacks international financial trust. To recover financial trust, the current administration is seeking international agreements with the main financial institutions as well as the US and the EU.

General challenges for the energy sector in Argentina

High inflation and interest rates, scarce access to credit lines, a highly indebted public sector and lack of trust in the state have frustrated all kinds of initiatives to develop renewables, energy efficiency or shale gas. In addition, a powerful fossil fuels sector, shaped in the past and consolidated through a host of special advantages (e.g., non-targeted subsidies to maintain the electricity tariff households and industry), has contributed to low investment in renewables and energy efficiency. The electricity mix is strongly dominated by thermal plants (63.3% of total demand) fed mainly by natural gas (69%), oil (28%) and some coal (3%) (CAMMESA, 2016). National production of these fuels was insufficient to meet demand, so the government began importing fossil fuels in 2006. Despite the growth of imports, electricity shortages have worsened over the years, leading to frequent power outages. Increasing fossil fuel imports and state subsidies to maintain electricity and heating tariffs below market prices have financially squeezed the public sector. This has constrained innovation capacity within the energy system and had negative macroeconomic consequences. According to CADER (2015), in 2014 the state spent USD ten million on diesel fuel, liquid natural gas and fuel oil imports to generate electricity through thermal plants. In 2015, the share of renewable electricity generation, excluding hydropower, was 0.4 percent, which corresponded to an installed capacity of 201 MW, mostly in wind power and some photovoltaics (PV). Large-scale hydropower continues to be an important source of electricity (30.3%), but its share in the electricity mix has decreased since 2001 (CAMMESA, 2016) as there have been no new investments in the sector. Regarding primary energy supply, in 2012 fossil fuels contributed almost 88 percent (including 54% natural gas), while the contributions of hydro and nuclear power were about four percent and two percent, respectively. Biodiesel, bagasse, wood and bioethanol amounted to five percent (Jimeno, 2015).

[1] Project Manager, eclareon.

With a highly indebted public sector and the need to increase electricity supply, facilitating a return to international capital markets after a 15-year ban on capital market transactions and stimulating investments in power generation capacity were seen as urgent priorities when the Macri administration was elected in December 2015. To this end, the government implemented macroeconomic changes, such as reaching a financial agreement with international creditors, and implemented key energy sector reforms, including reducing energy subsidies and adopting cost-reflective tariffs. Immediately following the election, the new administration reduced subsidies in the electricity sector while retaining subsidies for the lowest-income households under the so-called social tariff. The increased tariffs provoked heated debate in the country; nevertheless, the government upheld the decision and announced that, in mid-2016, it would implement additional subsidy reductions for natural gas – the principal fuel for heating, electricity generation and transport. Subsequently, in June 2016, the Ministry of the Economy reduced subsidies for natural gas but had to limit tariff increases following resistance from the trade unions, certain governors and opposition political parties. Despite the introduction of these limits, residential users mounted a legal challenge to the increased gas tariffs in the household sector. The Supreme Court temporarily suspended, by unanimous decision, the increase in gas tariffs for residential users, though not for companies or corporations.

Main trends in shale gas and nuclear energy

The new administration upheld the state's support for shale gas and nuclear energy. The exploitation of the Vaca Muerta shale gas reservoir in Neuquén province constitutes one of the most significant initiatives to expand local generation capacity. For policymakers, the emerging shale industry has the potential to reverse the decline in Argentina's conventional gas production and meet its increasing energy demand, while potentially enabling the country to regain its position as a fossil fuel exporter. To achieve these goals, the former and current governments have implemented tax reductions and exemptions as well as higher prices for unconventional oil and gas produced domestically (Gonzalez & Martinez, 2016). Accomplishing these objectives still faces a number of challenges. Annual investment of about USD eight billion is required for drilling and well completion, along with financial security and a stable regulatory framework (World Oil, 2016).

In the case of nuclear energy, the National Commission for Nuclear Energy has signed an agreement with the German consortium TECNA-Siemens, to advance the construction of CAREM, a prototype small modular reactor designed in Argentina that was promoted by the former administration (Mining and Energy Ministry, 2016). The prototype might eventually be followed, in 2021, by a larger (100 MWe or 200 MWe) version, located in the northern Formosa province at the border with Paraguay. Although the proposal has not yet progressed beyond preliminary discussions, public protests have already taken place in Paraguay. The government has also confirmed the decision to extend the life of Embalse, a nuclear plant in operation since 1984.[2] Nuclear power accounted for 4.8 percent of electricity demand in 2015 (CAMMESA, 2016).

Renewable energy deployment

Argentina has enormous potential to develop renewable energy. There are several attractive sites, due to the low cost of land and very high solar irradiation and wind speed (CADER, 2015). The greatest potential for solar energy occurs in the northwest region and Cuyo, where solar irradiation is approximately 1.8–2.2 MW/h/m2 annually (Righini & Gallegos, 2011). Wind speed in the Patagonian region and in the central provinces averages 10 m/s with a capacity factor higher than 35 percent (Energías Sustentables, CREE). At the same time, electricity consumption has increased continuously since 2003 due to economic recovery and highly subsidised electricity tariffs (Haselip & Porter, 2010). The installed capacity would have to at least double by the year 2035 to

[2] Argentina owns three nuclear power plants, Atucha I, Atucha II, and Embalse. Atucha I is the oldest (operational since 1974), whereas Atucha II was commissioned in 2014.

meet predicted demand even with the implementation of energy efficiency policies (EEA 2030, 2015). Although energy needs and potential are very high, these difficult financial conditions and fossil fuel path dependencies have hindered investment in renewables and energy efficiency measures.

The new administration began to encourage the development of renewable energy, aiming to increase electricity generation capacity and open a new market that had previously been marginalised. On 31 March 2016, the government enacted Law 27191 establishing renewable energy goals for the coming years: Electricity consumers should meet eight percent of their demand through renewable energy, other than large hydropower, by the end of 2017, and 20 percent by 2025. Following this, the government issued a complete regulatory framework for renewable energy (the RenovAr Program), that sets the conditions and tax incentives for the calls for tenders and for FODER, the newly created renewables funding regime. Under RenovAr, tender rounds covering wind, solar PV, biomass, biogas and small-scale hydropower are foreseen. The first round tendered 1 000 MW of renewable energy, but the government received offers for 6 366 MW, mainly wind and PV. Offers will be allocated in November 2016. FODER constitutes a fund to guarantee the payment fulfilment and ensure compliance with the power purchase agreements signed between the winning projects and the national electricity market administrator (CAMMESA). The decision to implement FODER has been crucial to rebuilding investor confidence in the country's renewable energy policies and for increasing legal security, one of the main barriers to project development (German Solar Association & eclareon, 2015). The government has underwritten the fund by issuing treasury bills amounting to USD three billion in addition to USD five hundred million already issued by the World Bank for the same purpose (Decree 882/2016 & RenovAr Program Round 1, 2016). Another significant component of the new regulatory framework is that independent power producers are allowed to commercialise the renewable electricity directly with large consumers.

Parallel to RenovAr, the government launched the second phase of the Renewable Energy in the Rural Market Project, a call for tenders for about 6 500 off-grid systems to be installed in rural and isolated areas. The project has been running since 1999, aiming to support off-grid installations in areas without electricity access. It should be noted that five percent of the population does not have access to electricity, representing nearly two million people living in dispersed rural areas (German Solar Association & eclareon, 2015). About USD 58.2 million was invested in the first phase of the Renewable Energy in the Rural Market Project, with 70 percent from the World Bank and the Global Environmental Facility, and the rest from the national government, provincial funds and private investors (AHK, 2013). When the Renewable Energy in the Rural Market Project I was concluded in 2012, 27 422 households and more than two thousand schools were supplied through individual PV and wind systems as well as through mini grids. Additionally, it provided solar thermal energy systems to public service institutions (PERMER, Ministerio de Energía y Minería). The objectives of the second phase of the Renewable Energy in the Rural Market Project, issued in 2016, are not only to supply electricity to households and public service institutions but also to productive micro-enterprises (PERMER call for tender, 2016).

As of October 2016, the Deputy Chamber is debating a law to support self-consumption in the residential sector through distributed generation of renewables. It is considered highly likely that these distributed residential installations will initially be supported through a feed-in tariff, shifting in later years to a net metering mechanism (Villalonga, 2016).

A large project specifically within the solar sector is the Solar Cluster, located in Jujuy, a low-income northern province. The Solar Cluster was planned within the framework of the Plan Belgrano, a project to develop infrastructure linked to poverty mitigation in the northern areas. The plan expects to receive financial support from the World Bank Group, Inter-American Development Bank and Corporación Andina de Fomento (CAF: Development Bank of Latin America) (CADER, 2016).

Energy efficiency

As electricity tariffs have increased following subsidy reductions, the government has shown interest in

promoting energy efficiency. A few energy efficiency bills have been proposed and are currently under discussion. The Argentine Fund for Energy Efficiency (FAEE) is in place, with the purpose of providing credit lines to small- and medium-sized companies that present investment projects aimed at reducing their energy consumption.

International energy cooperation strategy (in preparation)

International cooperation strategies for the energy sector have still not been clearly defined by the new administration, as it has been in office for less than one year. The government has instead focused on the internal problems within the national electricity system. Nevertheless, it is possible to observe a departure from the approach of the previous administration. The government is seeking to re-establish the relationship with the United States and the European Union, confirmed by the first visits to Argentina by US and French presidents in almost two decades, and the visits by President Macri to the European Council, Germany and France (Télam, 2016a; La Nacion, 2016; The White House, 2016).

Since one of the country's main priorities is to attract national and foreign investment to expand electricity generation capacity, the international agenda has focused on establishing agreements with international financing institutions and multilateral banks. According to an expert on Argentinean energy policy, electricity supply shortages are not only an energy problem, but also a great difficulty for the sustainability of the entire economy, including both macro and microeconomics (Recalde, 2013 in Jimeno, 2015). This explains the efforts of the Macri administration to obtain financial support from the principal investment banks such as the World Bank Group, Inter-American Development Bank and the Development Bank of Latin America for the electricity and infrastructure sectors.

The World Bank plays a significant role in both the RenovAr and Renewable Energy in the Rural Market projects. Under RenovAr, a World Bank fund guarantees payment by the national electricity market administrator to renewable projects. Its role is also crucial for phase II of the Renewable Energy in the Rural Market Project (CADER, 2016). In October 2015, the World Bank agreed a loan to the Argentinean Government amounting to USD two hundred million to support the implementation of phase II through the Energy Ministry and the provinces (Loan Agreement, 2015).

Regarding climate change, the Macri administration declared its commitment to tackle climate change at COP21, as a first demonstration of the country's changing position. Following presentation of the Third Communication on Climate Change and the respective Intended Nationally Determined Contributions (INDCs) in October 2015, the Argentinian delegation at COP21 fell under the mandate of the outgoing Kirchner administration. Subsequently, the new government elected in December 2015 sent national deputy and former Green activist, Carlos Villalonga, to join the delegation and to announce Argentina's transition to become more closely aligned with the fight against climate change (Earth Journalism Network, 2015). This change in Argentina's position was confirmed by its ratification of the Paris Climate Change Agreement on 20 September 2016 (Télam, 2016b). Argentina is thereby committed to revise its intended nationally determined contributions (INDCs) and increase its ambition to reduce its greenhouse gas emissions. Revision of the INDCs should be completed before 2018 (Villalonga, 2016).

Additionally, following the visit of President Obama to Argentina at the beginning of 2016, the US and Argentina committed to cooperate on scaling-up renewables, including through US assistance on electricity market reform, system optimisation and integration of renewable energy within the power grid. The countries will carry out further work through the United States – Argentina Binational Energy Working Group and the State Department's Power Sector Program (The White House, 2016).

Argentina is a member of the International Renewable Energy Agency (IRENA), having signed the Statute on 26 January 2009. Argentina was among the first South American countries, together with Uruguay and Ecuador, to become a member of IRENA.

Since the second half of the 2000s, the country has been involved in international cooperation in the nuclear energy sector. In 2010, Argentina and Russia signed the first nuclear cooperation agreement on the

possibility of using Russian technology in the country, and in 2015 both governments signed a framework agreement to cooperate in constructing small-scale power plants, with Russian financing. In June 2012 the government signed a nuclear cooperation agreement with China, to conduct studies for a fourth nuclear power plant financed by China, and to transfer fuel fabrication and other technology. Subsequently, the Argentinean state-owned nuclear utility (NASA: Nucleoeléctrica Argentina SA) and the China National Nuclear Corporation intensified their cooperation, including operations and technology. In line with this agreement, the parties are also considering a joint strategic partnership to develop nuclear reactors in Latin America, under which Argentina would become a technology platform to supply Latin American countries with nuclear technology incorporating Chinese goods and services. In November 2015 NASA signed a commercial contract with the China National Nuclear Corporation to build Argentina's fourth nuclear plant, and an agreement for a further reactor. The projects are worth USD fifteen billion, and China will finance 85 percent of the costs. In June 2016 a further agreement was signed with the China National Energy Administration, confirming these arrangements and specifying early 2017 and 2019 for the construction (World Nuclear Association, 2016). In the nuclear field, the Macri administration is more focused on cooperation with China than on advancing the agreements with Russia.

With regard to fossil fuels, Argentina aims to regain its position as a fossil fuel exporter by developing its shale gas resources. For that purpose, in 2013, YDF, the state-owned oil and gas company, began to sign joint ventures with the large foreign oil companies Chevron, Petronas and Dow Chemicals. It is continuing to look for further partners on shale projects (Forest, 2015). According to IHS Markit and Platts (2016), there is still a concentration of several large operators in Vaca Muerta, whereas the country needs a large number of smaller and newer companies to expand its shale production and become a net exporter. Argentina has agreed with the US to promote safe and responsible development of unconventional gas and oil resources, including improving environmental outcomes, through the Unconventional Gas Technical Engagement Program and the United States – Argentina Binational Energy Working Group (The White House, 2016).

Best practices for a global transition towards sustainable energy?

So far, Argentina's energy policy may be an example of exactly what countries should not do in order to develop a sustainable and healthy energy system. Regarding the emerging policy development in renewables and energy efficiency as well as electricity tariff reform, it is too soon to observe best practices for other countries.

The lessons that can be learned from the Argentinean experience relate to rural electrification. In Argentina, a small fraction of the population still lacks access to electricity. In 1999 the Renewable Energy in the Rural Market Project started to address this problem in two provinces, being quite successful in the sense that it has been extended to several provinces and has lasted over time, now entering a second phase. This has been mainly due to the involvement of the private sector for the provision and maintenance of the electricity service, unlike in many other countries (CADER, 2016; GNESD, 2016). Furthermore, this model of competition has allowed the reduction of subsidies required for the electrification of rural communities (GNESD, 2016).

In addition, the Argentinean experience shows that the intervention of the national government in the electricity market creates an incentive for voters to make ever-increasing social demands, expecting low-priced and subsidised energy, and for the government to meet these demands. This political mechanism of reproduction may engender a path dependency in the electricity system, thereby becoming especially difficult for private actors to invest in new innovative sources such as renewable energy or energy efficiency (Jimeno, 2015).

Nevertheless, recent policy changes within the renewable sector, and the decision to reduce electricity subsidies, confirm that, even if the previous institutional setting of the electricity system constrained the development of renewable energy in the past, politics is not static. Although it is still not possible to confirm whether policy changes will be effectively introduced, it can be observed that the window of opportunity has already been opened and several conditions are in place to drive a path change in the electricity system.

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4. Brazil: Long Tradition of Renewables-Based Energy Supply and Ethanol Diplomacy

Sybille Roehrkasten[1]

The Brazilian energy sector has one of the highest renewables shares and remains one of the least carbon-intensive in the world. Electricity supply has long been based on hydropower. In recent years, significant gas, bioenergy and wind capacities have been added. Brazil has been a global pioneer in transforming the transport sector, replacing oil with sugarcane ethanol since the 1970s. Today, almost all new motor vehicles allow for any mixture of gasoline and ethanol. In its international energy policy, renewables – particularly bioenergy – play a key role. With the recent discoveries of deep-water oil reserves, Brazil furthermore aspires to become an international leader in the exploration of deep-water oil and gas.

Brazil is richly endowed with energy resources. It is the eighth-largest energy consumer in the world and the ninth-largest liquid fuel producer. Domestic oil and gas production increased significantly since 2006 when large reserves, primarily of oil but also of gas, were discovered in the deep pre-salt layers on the Brazilian shore. In 2014, Brazil produced 2.2 million barrels/day crude oil and 1.13 trillion cubic feet of natural gas (EIA, 2015).[2] Brazil is the second-largest biofuels producer after the US (REN21, 2016). Due to its vast hydric resources, hydropower has been the dominant electricity source in the country. Brazil has faced strongly increasing domestic energy demand. Primary energy demand doubled between 1990 and 2012 and is expected to increase by a further 80 percent by 2035 (IEA, 2013). The Brazilian population has almost universal access to electricity; however, five percent of the population relies on traditional biomass for cooking (REN21, 2016).

The ongoing economic recession, political crisis and corruption scandals also pose challenges to the Brazilian energy sector, as they hinder public and private investment. Since 2014, the Brazilian economy has been in recession. In 2016, President Dilma Rousseff was replaced following an impeachment process. The state-controlled oil company, Petrobras, has been at the heart of corruption scandals and is under investigation for bribery in Brazil and the US. It therefore has very limited access to international capital (EIA, 2015). Overall, government spending faces severe budgetary constraints.

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[2] Brazil has become a net exporter of crude oil but still remains a net importer of processed oil products. Gas production is for internal use only (IEA, 2016).

The Brazilian energy sector: high renewables-share and low carbon-intensity

Brazil has one of the highest global shares of renewables in its energy matrix, and its energy sector remains one of the least carbon-intensive in the world. In 2015, renewables accounted for 41.2 percent of the country's final energy supply (EPE, 2016). In its intended nationally determined contribution (INDC) to the Paris Agreement (Federative Republic of Brazil, 2015), the Brazilian Government underlines that the Brazilian renewables share is three times the world average and more than four times the OECD average, so that Brazil already qualifies as a low-carbon economy. The high renewables share is not only due to the dominance of hydropower in electricity generation but also due to the widespread use of bioenergy. Brazil has the highest global share of biofuels in road transport: ethanol admixtures varied from 47 to 90 percent between 2008 and 2014 (USDA Foreign Agricultural Service, 2014). In the electricity mix, renewables contributed 75.5 percent in 2015 (EPE, 2016). In the past, the energy sector has played a relatively small role in national greenhouse gas emissions, which have been dominated by land use change and the agricultural sector. With major improvements to slow deforestation over the last decade, Brazil's CO_2 emissions declined significantly from 2000 to 2010 (MSTI, 2016). In future, the energy sector is projected to become a more important source of emissions growth, as emissions from deforestation and land use change are projected to decrease further, whereas oil and gas consumption in Brazil are growing (IEA, 2013). Therefore, in the Brazilian case, the challenge is to maintain the low-carbon intensity of its energy sector rather than to decarbonise a highly polluting energy supply. In its INDC, Brazil commits to an economy-wide reduction of greenhouse gases of 43 percent by 2030, compared to 2005 levels. In the annex to the INDC, it specifies energy-related goals by 2030: 18 percent share of sustainable biofuels in the energy mix, 45 percent renewable energy share in the energy mix (with 28–33% for non-hydro renewables), 75 percent renewables share in the electricity mix (23% for non-hydro renewables) and 10 percent efficiency gains in the power sector. This implies that Brazil aims to maintain its high renewables shares by expanding the deployment of non-hydro renewables.

Hydropower remains the dominant electricity source in Brazil, albeit with declining shares. In 2015, hydropower accounted for 64 percent of electricity production (EPE, 2016), and Brazil had the second-largest hydropower generation after China (REN21, 2016). While hydropower generates electricity at a relatively low cost, the strong reliance on hydropower has increasingly become an energy security risk as Brazil has been hit by severe droughts. The worst impact was felt during the drought of 2001/2002, when the Brazilian Government had to impose a monthly ceiling for all residential, industrial and commercial consumers at 80 percent of their previous year's consumption (IEA, 2013). During the drought of 2015, the government also had to order rolling power cuts. In addition, it is increasingly difficult to exploit the country's remaining hydropower potential, which is concentrated in the Amazon region. New hydropower plants have to meet strong environmental standards; the building of large dams is subject to strong public resistance; and the Amazon region is far from the main demand centres, leading to high transmission and distribution losses[3]

To reduce its dependency on hydropower, Brazil has been striving to diversify its electricity supply, expanding both fossil energy and non-hydro renewables. In 2005, the government implemented a system of contract auctions to steer the evolution of the power mix. Since 2007, some of the auctions were only for new renewables (IRENA, 2015). The auctions led to a significant increase of thermal power generation, particularly gas. However, they also proved successful for building up bioenergy and wind capacities. Bioenergy capacities more than doubled, from 6.287 MW in 2006 to 13.422 MW in 2015, while wind capacity experienced an almost 40-fold increase, from 237 MW in 2006 to 8 715 MW in 2015. Progress on solar capacities has been more limited, reaching only 21 MW in 2015 (IRENA, 2016b).[4] The auctions led to an impressive price development for wind

[3] Despite these constraints, Brazil had the second-largest hydropower capacity additions in 2015 (REN21, 2016).

[4] Within South America as a whole, Brazil accounted for 87% of installed bioenergy and 79% of installed wind capacities in 2015, whereas installed solar capacity represented less than 2%.

energy, which is now the most cost-effective option for new grid-based power in Brazil (REN21, 2016). In 2015, natural gas provided 12.9 percent of electricity generation. As such, it was the second-largest electricity source after hydropower, followed by bioenergy[5] (8%), oil (4.8%), coal (4.5%), wind (3.5%), nuclear[6] (2.4%) and solar PV (0.01%) (EPE, 2016). In 2015, Brazil had the fourth-largest wind power capacity additions and biopower generation in the world (REN21, 2016).

Brazil has been a global pioneer in transforming the transport sector. As far back as 1975, Brazil introduced a comprehensive programme, called Proálcool, to replace oil with ethanol from sugarcane. A major aim of this programme was to reduce Brazilian dependency on oil imports after the 1973 oil price shock. In addition, it was seen as a suitable measure to support the Brazilian sugarcane industry. Proálcool introduced anhydrous ethanol for blending with gasoline and incentivised the production of cars that could run on pure ethanol. The country's broad coverage of filling stations providing pure ethanol is a legacy of that programme. With the market introduction of flex-fuel cars in 2003, the Brazilian ethanol market received an additional boost. Flex-fuel cars run with any mixture of gasoline and ethanol, and enable consumers to choose flexibly between pure ethanol and gasoline containing an obligatory ethanol blend of 27 percent. Today, 95 percent of all new motor vehicles in Brazil can run on any mix of petrol and ethanol (USDA Foreign Agricultural Service, 2014). However, ethanol has not competed on an equal basis with gasoline on the Brazilian market, as oil prices are government-controlled and kept artificially low in order to curtail inflation. Brazilian ethanol production hit a new record in 2015, of 28.2 billion litres. Since 2004, Brazil has also supported the deployment of biodiesel, and is currently the second-largest biodiesel producer after the US. However, at 4.1 billion litres annually (in 2015), Brazilian biodiesel production is significantly less than its ethanol production (REN21, 2016).

In 2015, Brazil achieved the third-largest increase in solar water heating capacity in the world, and the fifth-largest installed capacity. Since 2009, the Brazilian Government has incorporated solar water heating into all new dwellings constructed under the social housing programme. In addition, several cities have established mandates for solar water heating. For example, in Sao Paulo (Brazil's largest city, with at least 12 million inhabitants) 40 percent of water heating in new buildings must be provided by solar energy. Furthermore, sugarcane bagasse is used for industrial heating (REN21, 2016; IRENA, 2015).

The energy intensity of the Brazilian economy – a proxy for overall energy efficiency – is comparable to the OECD average and significantly lower than the average of other BRICS countries (Russia, India, China and South Africa). In 2011, it took 0.11 tonnes of oil equivalent (toe) to produce one thousand USD of gross domestic product in Brazil, compared to 0.12 toe OECD average, 0.19 toe worldwide average and 0.36 toe average among the remaining BRICS countries. This relatively low energy intensity is due to two main factors: in Brazil, very little energy is used for heating and cooling; and hydropower is a highly efficient form of power generation compared to fossil-based electricity, as it incurs no or very small conversion losses (IEA, 2013). Energy efficiency programmes have been in place for decades but have not resulted in major improvements. One of the most important instruments has been the Electricity Conservation Program, which has existed since 1985. It focuses on the labelling of most energy efficient equipment, energy savings in the housing sector and in public illumination, as well as awareness raising and training for energy savings in the public sector, industry and society.

[5] Bioelectricity primarily builds on the combustion of bagasse, a by-product of sugarcane processing.

[6] Brazil operates two nuclear power plants, which started operation in 1984 and 2000. A third plant has been under construction since 1984 (EIA, 2015).

Renewables as soft power and active ethanol diplomacy[7]

Renewables play a key role in Brazilian foreign energy policies. For more than a decade, Brazil has taken an active stance in international cooperation to expand the worldwide use of renewables. For the Brazilian Government, the high share of renewables in the Brazilian energy mix and its international pioneering in transforming the transport sector constitute two important sources of soft power in international relations. As such, renewables – especially ethanol – represent an area where the country can distinguish itself as a frontrunner. Following the pre-salt discoveries of large oil and gas reserves since 2006, the Government furthermore underlines its global leadership in the exploration and production of deepwater oil and gas. It aims to expand this leadership into research and development of these technologies and aspires to become a major oil exporter.

Brazil's international activities to promote renewables concentrate on biofuels, particularly ethanol. Biofuels were a top priority of Brazilian foreign policy from 2006 to 2010, when President Lula da Silva engaged in highly visible ethanol diplomacy. Since then, Brazilian ethanol diplomacy has lost momentum,[8] but continues despite its lower visibility. A major aim of the Government is to facilitate international biofuels trade and to promote biofuels production in developing countries. For the Brazilian Government, engaging in ethanol diplomacy not only provides the opportunity to increase the export strength of the Brazilian economy, but also to leverage its own influence in international policymaking.

South–South cooperation is one important pillar of Brazil's activities to promote biofuels. The Brazilian Government has financed and conducted biofuels viability studies in several African and Central American countries. In addition, it hasset up biofuel cooperation within multilateral South–South cooperation, such as the South American MERCOSUL and the IBSA (India–Brazil–South Africa) forum. Brazil has furthermore entered into bilateral cooperation with industrialised countries, particularly the EU and the US. Here, a major aim has been to open up markets for Brazilian ethanol exports. While cooperation with the EU has stalled due to European concerns on biofuels sustainability, cooperation with the US has proven very successful: Brazilian ethanol is nowadays recognised as an advanced biofuel on the US market, gaining a special market premium.

Brazil furthermore engages in multilateral forums to advance global use of biofuels. Since 2008, Brazil has co-chaired the Global Bioenergy Partnership (GBEP). GBEP was launched at the G8+5 Summit in 2005, and aims to facilitate high-level policy dialogue and international cooperation on biofuels. A major focus of GBEP is capacity building for bioenergy sustainability. At the International Organization for Standardization (ISO), Brazil engages in working groups to facilitate international biofuels trade. Brazil now plans to launch a new, international cooperation initiative on second-generation biofuels,[9] closely linked to the UNFCCC process. With this new initiative, Brazil wants to focus on quick actions that help countries around the world reduce emissions from their transport sectors. According to the Brazilian Ministry of Foreign Relations, second-generation biofuels allow for rapid scale-up (allowing for usage in current vehicle fleets) and can therefore reduce transport sector emissions even in the short and medium term.

Biofuels production has met fierce opposition in various parts of the world – particularly in Europe – whereas in Brazil, ethanol diplomacy builds on widespread political and public support. In Brazil, the country's international leadership on biofuels is a source of national pride. Next to its economic competitiveness, the strong emissions reduction potential of Brazilian sugarcane ethanol is repeatedly underlined – not only compared to oil, but also compared

[7] This section builds on Roehrkasten (2015); interviews with officials from the Brazilian Foreign Ministry in July/August 2016; and Itamaraty (2016).

[8] This was due to a variety of reasons. Internationally, the sustainability of biofuels was increasingly questioned, and domestically the scenario also changed: Lula da Silva had a stronger international presence and was a stronger supporter of biofuels than his successor Dilma Rousseff; and the Brazilian ethanol industry entered a phase of economic downturn and was less interested in opening up new markets.

[9] Second-generation biofuels are derived from cellulose and allow the use of residues.

to biofuels based on other sources, for example corn. Sustainability concerns that prevail in Europe – such as the clearing of rainforest and the 'food versus fuel' dilemma – are, from a Brazilian perspective, hardly relevant to Brazil's ethanol production. The soils of the Amazon rainforest are not suitable for growing sugar cane, which is mainly cultivated in south-eastern Brazil, far from the Amazon. The 'food or fuel' debate implies that the cultivation of biomass to produce biofuels drives out food producers and ultimately leads to hunger. In the case of Brazil, a country with vast swathes of fertile land, these assumptions are misplaced. The Brazilian Government suspects that, by making such sustainability demands, European countries simply aim to protect their own biofuel industries from cheaper and more climate-friendly competitors in Brazil. The Brazilian Foreign Ministry highlights that biofuels production can bring important socio-economic benefits to developing countries: it builds on technologies that poor countries can easily adopt; it is more job-intensive than any other energy source; and contributes to strengthening agricultural sectors. It argues that biofuels production in the developing world actually helps to tackle hunger. As it generates income in agricultural areas, it addresses one of the root causes of hunger: income poverty.

Brazil furthermore engages in international cooperation on hydropower, oil and gas as well as energy efficiency. Brazil's international engagement on hydropower focuses on regional cooperation and power market integration. In cooperation with its neighbouring countries, the Brazilian Government has supported the construction of hydropower plants close to the Brazilian border in order to import electricity. Furthermore, Brazil has bilateral dialogues with a number of countries on oil and gas, the most important being with the US, which focuses on shale gas technologies, and the UK, which emphasises technologies for deep water exploration. Moreover, it engages in bilateral cooperation on energy efficiency – primarily with the US and Germany, but also with China and the UK – to advance its domestic energy efficiency efforts.

Despite its active stance in international cooperation on renewables, Brazil is one of the few countries around the world – and next to Canada the only large country – that has refrained from membership of the International Renewable Energy Agency (IRENA). In the first years of IRENA's creation this was due to concerns by the Brazilian Government that IRENA would be too strongly influenced by industrialised countries like Germany, and that its work would favour renewable energy sources like wind and solar over other technologies such as bioenergy and hydropower. However, these concerns have abated in recent years. Nowadays, Brazil is not able to join IRENA due to budgetary constraints. Since the country is not able to pay the full fees of the international organisations of which it is already a member, it is not able to join further organisations.

Impulses coming from Brazil: (advanced) biofuels and renewable energy auctions

The Brazilian experiences in transforming its transport sector are of great value for a global energy transition. As outlined above, Brazil has vast experience with the production and technological development of biofuels, the adaptation of its fuelling infrastructure and vehicle fleet, as well as with the safeguarding of sustainability requirements. In international discussions on energy transitions, the transport sector has received very little attention and remains heavily dependent on fossil fuels. Several countries aim to increase e-mobility; however, this alone will not suffice to phase out the use of oil in global transport, as it will not be able to fuel aviation, shipping and heavy vehicles in the foreseeable future (IRENA, 2016a). Here, biofuels will have to play a key role.

Other countries could furthermore benefit from the Brazilian experience with renewable energy auctions. Brazil was one of the first countries in the world to implement such auctions and now has almost a decade of experience – both positive and negative. For the expansion of bioenergy and wind energy, Brazilian auctions proved to be quite successful, and also led to impressive price development for wind energy, which is now the most cost-effective option for new grid-based power in Brazil (REN21, 2016). However, there have also been several challenges: progress on solar energy has been rather limited; Brazil experienced difficulties in meeting its domestic content requirements; and project implementation has faced delays (IRENA, 2013; Bayer, 2016).

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5. China: Emerging Global Power in Clean Energy?

Rainer Quitzow[1]

China's electricity supply is still strongly dependent on coal, but a strong domestic renewable energy industry is driving rapid deployment of wind and solar energy. Further progress will depend on the implementation of planned power sector reforms. In transport, the continued proliferation of automobiles is driving growth in CO_2 emissions. Investments in an electric vehicle industry may offer opportunities for decarbonisation in the long term. China's initiative to promote green finance during its G20 presidency is in line with its ambitions to promote overseas markets for its emerging clean energy industry.

Whether the international community is able to live up to the ambitious climate targets agreed in Paris will to a significant degree be decided in China. For the past decade, China has been the largest global emitter of greenhouse gases and now accounts for approximately 30 percent of global emissions. This is twice the share of the US, the second-largest emitter. At the same time, China has become a central driver of global renewable energy development. In 2015, it accounted for approximately one third of global installed capacity in both wind energy and solar photovoltaics and more than one third of new investment in the renewable energy sector (see Figure 1). Similarly, China is an international frontrunner in electric vehicles, albeit based on an electricity mix that remains dominated by coal-based power generation.

Impressive growth of renewable energy versus continued reliance on coal

The development of China's wind and solar energy over the past decade has been impressive, growing from slightly more than 1 GW in 2005 to a total of 200 GW in 2015. In the field of solar water heating, China's 341 GW of installed capacity accounts for 71 percent of the global market. With a total of 296 GW of installed capacity, the largest share of China's renewable energy is generated by hydroelectric dams, representing almost 28 percent of global hydropower capacity (REN 21, 2006/2016). Since 2010, investments in renewable energy capacity have begun to outpace additions in fossil and nuclear energy and now represent approximately 60 percent of newly installed capacity (Mathews & Tan, 2015). In 2014, renewables, including hydropower, represented 23 percent of the country's electricity generation (IEA, 2015a) and approximately 11 percent of final energy (REN 21, 2016). Despite their strong growth, wind and solar power only account for less than three percent of total electricity generation (IEA, 2015b).

The remainder of China's electricity system remains dominated by coal. Coal-fired power generation represents three quarters of annual power generation and 80 percent of energy-related CO_2 emissions. To date, nuclear energy (2%) and natural gas (1.8%) only represent minor shares in China's electricity mix (IEA, 2015a,b).

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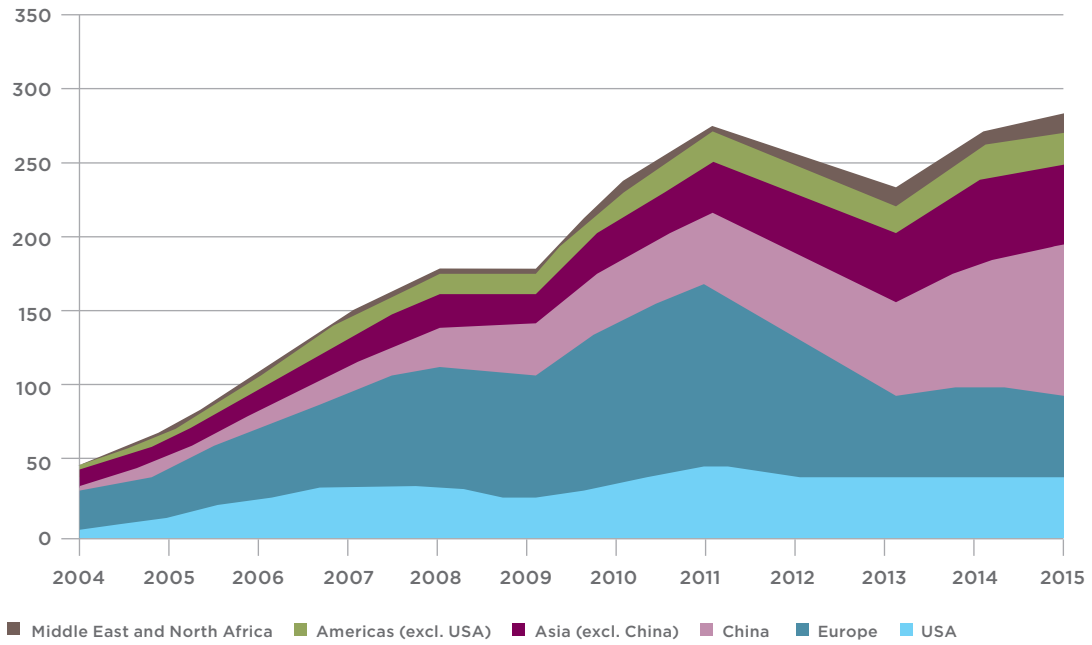
Figure 1: China takes over global leadership in renewable energy investment from Europe

[billion US Dollars]



Source: Author's graph based on FS-UNEP (2016)

Strong policy support for energy efficiency drives decrease in energy intensity

In the past decade, China has seen significant improvements in the energy intensity of its economy. Over the period 2004–2013, China increased its end-use energy productivity (gross domestic product/total final energy consumption) by 29 percent (IEA, 2015c). This is largely due to a strong policy framework aimed at boosting energy efficiency in industry, which accounted for almost half of final energy use in 2012 (IEA, 2014). The Ten Key Projects and Top 10 000 Enterprises programmes have introduced measures to boost energy efficiency in industrial processes and mandated the retirement of inefficient production facilities (NDRC, 2014). Total funds invested in energy efficiency under the 11th Five-Year Plan amounted to an estimated USD 120 billion (Qi, 2013).

Despite these efforts, China's energy consumption per unit of GDP remains significantly above the world and OECD averages.[2] This is partly related to heavy reliance on energy-intensive industries such as aluminium, steel and cement, where China accounts for 46 percent, 50 percent and 60 percent of global production, respectively. Similarly, the carbon intensity of China's economy remains significantly above world averages (Mathews & Tan, 2015).

Key targets and projected trends in China's energy mix

Key targets for the future development of China's energy sector have been set in the Energy Development Strategic Action Plan for the years 2014 to 2020. It foresees a share of 15 percent non-fossil energy (including nuclear and renewables) in the primary energy mix by 2020. To achieve this, a cumulative

[2] According to the World Bank's Development Indicators, energy intensity (expressed in MJ per unit of GDP, adjusted for purchasing power parity) was at eight in China in 2012, compared with OECD and global averages of five and six respectively.

installed renewable energy capacity of 650 GW and 58 GW of nuclear energy are planned. This is complemented by the commitment made in the joint US–China announcement on climate change to reach a share of 20 percent of non-fossil energy in primary energy consumption by 2030. These reductions in the share of fossil energy will accompany a continued increase in energy consumption, which the plan aims to constrain to 3.5 percent annually until 2020 (compared to an average of more than 5% over the past decade). This implies that total fossil energy consumption is expected to rise in the medium term (BP, 2016).

Simultaneously, China aims to limit the share of coal to less than 62 percent of primary energy demand by 2020. Even if the renewables targets are met, this implies a shift within the mix of fossil-based energy use, to increased shares of gas and oil. The share of natural gas in the energy mix has been targeted to double, from five percent in 2013 to 10 percent in 2020 (IEA, 2015d). The use of oil and related emissions is expected to increase significantly due to the projected quadrupling of car ownership by 2030. Energy-related emissions in the industrial sector, on the other hand, are expected to decline as a result of a structural shift away from heavy industry. Total CO_2 emissions are intended to peak no later than 2030.

Growing role of the transport and residential sectors

In 2012, China's transport sector still only accounted for 14 percent of total final energy consumption and six percent of CO_2 emissions, compared to global shares of 27 percent and 14 percent respectively (IEA, 2016b; IPCC, 2014). In the past decade, however, emissions have increased sharply, and, due to the rapid adoption of passenger vehicles, are expected to see further growth in the future. In 2010, China became the world's largest market for automobiles. Despite significant investments in public transport infrastructure, the market is expected to continue to grow at five percent annually in the coming years, with particularly strong growth in larger vehicles. These changes in purchasing behaviour may neutralise efficiency gains from the recent implementation of more stringent fuel economy standards. If accompanied by strong emission reductions in the power sector, the electrification of the transport sector may offer a pathway to decarbonisation in the long term. Strong policy support in this field, including subsidies of up to USD 10 000 for the purchase of electric cars, has recently made China the world's largest market for electric vehicles (IEA, 2016a).

In the residential sector, energy use grew by 35 percent over the period 2002 to 2012 (IEA, 2015c). In 2012, it accounted for 22 percent of total final energy consumption, thus equalling the global average (IEA, 2014/2016b). Floor space per capita is expected to increase by 40 percent by 2030, which implies continued growth in energy consumption for heating and cooling (Grubb et al., 2015).

Industrial ambitions drive the expansion of renewables and nuclear

With the joint US–China announcement on climate change ahead of COP21 in Paris and the recent ratification of the Paris Agreement, China has clearly signalled its ambition to act as a leader in the global fight against climate change. Concerns about urban air pollution and energy security act as additional motivations for the expansion of non-fossil energy. Arguably the most powerful driver, however, is China's industrial ambition in the sector.

To meet its renewable energy targets for 2020, solar power will have to more than double to 100 GW, while wind power is expected to grow by more than 50 GW to reach 200 GW total capacity. Underpinning these ambitious targets is a strong renewable energy industry, identified as a strategic emerging industry in China's 12th Five-Year Plan (2011–2015). The growth of its renewable energy industry has also spurred significant job creation in China. The renewable energy sector now provides 3.5 million jobs in the country, representing more than 40 percent of the global total. Building an internationally competitive renewables industry has been particularly successful in the solar PV sector, where Chinese suppliers of solar cells and modules have dominated production since approximately 2009. Chinese producers now account for approximately two thirds of total production and approximately three quarters of global exports. While China is also the largest global producer of wind turbines, its wind energy firms remain strongly dependent on sales in the domestic market (REN21, 2016; UNEP, 2014).

The continued expansion of nuclear power is also underpinned by industrial policy ambitions. Despite the more stringent safety requirements introduced after the nuclear disaster in Fukushima, installed capacity is projected to grow to more than 100 GW by 2030 (IEA, 2015d). Twenty nuclear reactors are currently under construction (The Economist, 2016). The resulting expertise in the design, construction and operation of nuclear reactors will support Chinese export ambitions in the sector.

Power sector reforms as critical precondition for continued renewable energy deployment

Although the shares of wind and solar energy in the Chinese electricity mix remain modest, the country is experiencing significant challenges with its efficient integration into the power system. This is reflected in the significant curtailment of renewable power, in particular wind energy. According to the Chinese Renewable Energy Industries Association, curtailment of wind power reached a record high of 15 percent in 2015. This has significant economic consequences for wind farm operators, who lost an estimated 18 billion yuan (USD 2.8 billion) as a result (Ying, 2016). Tackling these challenges of system integration will be critical to increasing the share of renewable energy in China's electricity mix going forward.

The causes of wind power curtailment are manifold. The mismatch between the location of China's major wind power capacities in the north and northwest, and major load centres along the coast represent a major challenge (IEA, 2015a). A further challenge relates to the fact that grid expansion frequently lags behind the installation of wind turbines (Luo et al., 2016). These technical challenges are further compounded by a variety of political and institutional barriers to increased renewables integration. Most importantly, grid companies still lack incentives to reduce curtailment as they do not participate in the related costs, and the existing pricing system does not incentivise flexibility among fossil-based generators.

In principle, a number of power sector reforms to tackle these issues were already introduced with the Program of Electricity System Reform announced by the State Council in 2002. However, the implementation of the reform package has not been enforced to date. Renewed reform efforts signal that important improvements can be expected in the near future. In March 2015, the policy document Deepening Reform of the Power Sector, also known as Document #9, was issued jointly by the State Council and the Central Committee of the Communist Party. This high-level policy document calls for "effective, market-based pricing for electricity" and states that power sector policy should, among other things, be guided by "energy savings, emissions reductions, and increased use of renewable and distributed generation" (Dupuy et al., 2015).

Tackling the political economy of coal

Despite important progress in promoting renewables, experts are concerned that economic interests at the local and provincial levels may continue to favour coal-based generation, a concern that extends beyond the management of power system integration. A report by Greenpeace, first published in 2015, has drawn attention to the fact that the current market environment in China has given rise to a so-called "coal power bubble" (Myllyvirta et al., 2016). The slowdown in economic growth, coupled with simultaneous structural shifts away from heavy industry, has led to a significant slowdown in the growth of coal consumption. Following a significant slowdown in 2012 and 2013, growth rates even turned negative in 2014 and 2015 (Yeo, 2016). Nevertheless, coal-fired capacity grew by 190 GW between 2011 and 2015. An additional surge in positive permitting decisions during the first half of 2015 is attributed to a transfer of additional decision-making power from the central to the provincial level.

The central government is now stepping in to slow the development of further capacity. In March 2016, Chinese media reported that the government had ordered a halt on construction of 250 new coal-fired power plants (Johnson, 2016). This complements previous measures to shut down smaller, less efficient plants and replace them with larger, higher-efficiency power plants. In Beijing and other major cities, concerns about air pollution have driven the replacement of coal-fired power plants with new gas-powered electricity generation.

Increased international engagement in the global energy sector

The priorities of China's energy transition targets go hand in hand with an evolving international energy policy agenda. The expansion of gas-fired power in the Chinese electricity mix, in particular, is heavily dependent on the ability to secure a reliable supply of natural gas resources. While previously the development of domestic shale gas resources seemed likely, the outlook is now significantly lower, due to a combination of local challenges and low global gas prices. Hence, China's efforts to diversify its supply of foreign natural gas are being pursued with renewed vigour. This includes the further development of liquefied natural gas (LNG) terminals as well as a number of pipeline projects, including the so-called Power of Siberia pipeline project and the Central Asia–China pipeline (Clemente, 2016). Concerns regarding security of supply have also spurred cooperation among ASEAN countries in moving forward the Trans-ASEAN Gas Pipeline project, aimed at integrating regional gas markets.

China's engagement in the international natural gas sector is in line with its efforts to increase its engagement in global energy markets. In the past, this has been primarily driven by a concern that Chinese energy security is heavily dependent on Western energy firms, and on the US military as the main guarantor of supply security in the Middle East. Among other things, this has given rise to engagements aimed at securing oil supplies from a number of African countries. With the rise of renewable energy, China has also developed significant economic interests in the continued growth of overseas markets for its renewable energy industry.

The global expansion of Chinese energy companies is being backed by China's growing financial power, which has further increased in the wake of the global financial crisis. According to Kong and Gallagher (2013), cumulative energy-related foreign direct investment for the period 2000 to 2015 was USD 258 billion, of which more than USD two hundred billion was invested after 2008. The vast majority of this is financed by China's so-called policy banks (i.e. Export and Import Bank of China and China Development Bank).

To date, more than 90 percent of Chinese foreign direct investment has flowed into the oil and gas sector and fossil-based power generation. However, this picture may be beginning to change. A review of Chinese overseas investments in the wind and solar energy sectors shows a sharp increase since 2007; Investments grew from under USD five billion to almost USD 32 billion in 2012 (Tan et al., 2013). In Africa, Chinese contractors, mainly state-owned enterprises, constructed approximately 30 percent of African capacity additions in the electricity sector, with a particular focus on hydropower (IEA, 2016c).

Financing of clean energy has also featured in a number of multilateral initiatives led by China. In the G20, China has spearheaded the working group on green finance, and the Shanghai-based New Development Bank recently announced its first loan package, totalling USD 811 million in renewable energy projects. The China-led Asian Infrastructure Investment Bank has the stated aim to be "lean, clean and green". Despite this commitment, observers have voiced concerns that energy-related financing in countries like Indonesia may ultimately support the country's planned additions in coal-based power generation (Nassiry & Nakhooda, 2016).

China's growth in nuclear power, coupled with its financial strength, is also likely to support an increasing role in the construction of nuclear reactors around the world. While the long-term goal is to export home-grown nuclear technologies, China is building on its expertise in the deployment of established foreign reactor designs to penetrate the market, primarily in emerging economies (Wübbeke & Ting, 2016). If realised, a joint venture with French EDF for the construction of the Hinkley Point C nuclear reactor in the UK would represent the first project in an OECD country.

Finally, China's increased engagement in global energy issues is accompanied by its progressive integration into the existing architecture of global energy governance as well as increased bilateral cooperation. Increased multi-lateral cooperation in energy is a declared goal of the 12th Five-Year Energy Sector Plan, and China is now a member or has established collaborative relationships with all major multi-lateral organisations in the energy sector. Among other

activities, China engages in institutionalised bilateral exchange with a focus on renewable energy and energy efficiency, with Germany, Denmark and the US (IEA, 2016d).

China as a partner for a global energy transition

The development of China's renewable energy industry since the turn of the century has strongly enhanced its commitment to the domestic deployment of renewable energy. As China increases its active involvement in global energy concerns, it will use its growing influence to promote renewable energy investments as a part of an ambitious industrial policy agenda. This can be an important driver for opening new markets for renewable energy in developing and emerging economies. Increased collaboration between China and traditional donor countries, on financing renewable energy infrastructure, can provide additional impetus for boosting renewable energies along with access to modern energy services. The related initiatives on green finance and energy access in Africa and the Asia-Pacific region within the G20 offer a suitable starting point for this. Additionally, such enhanced collaboration could help promote the decarbonisation of overseas investments by both OECD and emerging economies.

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6. The EU: In the Midst of Crisis – Downgraded Sustainable Energy Ambitions

Kirsten Westphal[1]

The European Union (EU) is represented in the G20 by the Union as well as by the individual (EU-4) member states France, Germany, Italy and the United Kingdom. It could therefore play a role as an agenda-setter and multiplier in the G20 and beyond. However, internal consensus within the EU on the pace towards decarbonisation and an energy transition is eroding, and the EU is losing its frontrunner status and role as a 'best practice' reference for others. In particular, because of the multiple crises the EU faces, its ambitions in multilateral sustainable energy governance are stagnating.

The EU's integrated energy and climate policy: losing momentum?

The 2015 Paris Agreement was commonly ratified in the EU and provides the reference point for formulating EU energy policies and defining the transition path toward a more sustainable energy system. The EU member states have not (yet) achieved internal consensus on commitment to an ambitious decarbonisation path for their energy system(s) in line with the Paris Agreement, nor a compulsory mechanism on how to share collective responsibility for achieving this goal. Certainly, from an international perspective, the EU is not an exception but rather the rule when compared to other countries. If this continues, the EU is likely to lose its role as an international frontrunner and exemplar of best practice.

Back in 2007, the EU embarked on a common and integrated energy and climate policy. This marked the beginning of a new era in EU energy policy. Since then, the EU's energy policy has been based on the strategic triangle of sustainability, competitiveness and energy security. In 2007, under the German Presidency of the EU Council, the then EU-27 agreed on ambitious climate targets to reduce emissions by 20 percent by 2020. The European Commission submitted An Energy Policy for Europe, which was the most substantial action programme in energy policy to date. The package is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020. Its targets include a 20 percent cut in greenhouse gas emissions from 1990 levels, 20 percent of energy to be produced from renewables and 20 percent improvement in energy efficiency compared to the projected use by 2020.

To achieve its climate goals, the EU emissions trading system (ETS) is the key tool for cutting greenhouse gas emissions. The ETS covers around 45 percent of the EU's greenhouse gas emissions from large-scale facilities in the energy, industrial and aviation sectors (COM, 2012). However, the price of certificates was previously too low to provide clear market signals, e.g., to shift away from coal; consequently, reform efforts are ongoing. For emissions not covered by the ETS, an Effort Sharing Decision of 2009 was translated into so-called annual emission allocations (in tonnes) that set binding national targets for emission reduction or limitation for 2020, expressed as per-

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centage changes from 2005 levels for each member state by year, from 2013 to 2020. The EU-4, UK (-16%), Germany, France (both -14%) and Italy (-13%) are among those member states that have taken on reduction obligations. Most Central and Eastern European member states are permitted to maintain (or even slightly increase) their present emission levels, compensated by other member states under a burden-sharing mechanism.

Under the Renewable Energy Directive, EU member states have also adopted binding national targets for increasing the share of renewables in their final energy consumption by 2020 (COM, 2016a). The targets vary, reflecting countries' different starting positions for renewable production, their economic situations and ability to further increase capacity. Different cooperation mechanisms would allow the EU as a whole to achieve its 20 percent target (doubling the 2010 share of 9.8%), and a 10 percent share of renewables in the transport sector. The Progress Report of 2016 highlights deficits on the path toward producing more energy from renewables. The EU is especially lagging behind in meeting the target for renewable fuels (or electric mobility) in the transport sector, which has only achieved a share of around six percent of biofuels (COM, 2015a). Nevertheless, most member states – and most likely the EU as a whole – are on track to meet the 20 percent target (COM, 2015a).

In the area of energy efficiency, binding targets were only set in the 2012 Energy Efficiency Directive, which stipulates that member states should formulate their own indicative National Energy Efficiency Action Plans. However, the Progress Report of 2015 states that, despite significant progress, the EU-28 as a whole falls short of achieving the 20 percent target (COM, 2015b). In October 2014, the EU-28 agreed the outline of a common strategy for energy and climate policy to 2030. The strategy contains qualified targets for climate mitigation, renewables and energy efficiency, and builds upon the 2020 targets. While on paper this raises the ambition for the EU as a whole, there remains broad scope for intergovernmental bargaining and compensatory mechanisms (Fischer, 2014). The targets for 2030 comprise a 40 percent cut in greenhouse gas emissions compared to 1990 levels, at least a 27 percent share of renewable energy consumption and at least 27 percent energy savings compared with the business-as-usual scenario (COM, 2016b). The 2030 framework for energy and climate builds on formula compromises with high level of ambiguity, providing the opportunity to change the goals through consensual intergovernmental decisions and "extensive financial transfers and exemptions for the blocking states." (Fischer, 2014: 3).

Important to note in the G20 context, there is no official deadline or pathway for phasing out fossil fuel subsidies, despite a number of EU policy declarations committed to ending this support by 2020. Moreover, the important tax directive in place stems from 2003 – i.e., from a different era of energy policy.

Shared competence and diverging energy mixes determine formula compromises

Energy policy is a shared competence in the EU. As a consequence of Art. 194 of the Treaty on the Functioning of the European Union (Lisbon Treaty), energy, and in particular supply security, became a field of shared competences. Furthermore, climate policy is part of environmental policy and, as such, an area of EU competence since the Treaty of Amsterdam. Moreover, e.g., fiscal policies and subsidies as part of national policies are subject to a number of departments (Directorates General) that are in competition over mandates and competences.

While member states retain their sovereign rights to determine their energy mix, coordinated action is needed to finalise a functioning and integrated internal market, to implement infrastructure projects of common interest (to interconnect energy networks) and to face security of supply challenges at the same time. Whereas differences in the final energy consumption are minor, the electricity mix displays significant differences.

Since the onset of the global financial crisis and the subsequent Eurozone crises, the discord over energy and climate goals has increased, creating stronger impediments to common EU policies and their implementation. Even among advocates for climate mitigation, discussions regarding the appropriate pathway became evident: whereas the UK focuses on ambitious decarbonisation policies, Germany focuses explicitly on energy efficiency and promotes the

expansion of renewables. France has embarked on an energy transition that aims to reduce electricity generation from nuclear power plants while expanding renewables. Considering the EU-28 as a whole, it is all the more clear that the member states are starting from very diverse energy patterns and with diverging levels of ambition. Moreover, social issues and energy costs are a major impediment to radical reforms. A major caveat will be the future of nuclear energy in France and the UK, and how the issue relates to decarbonisation.

The creation of an Energy Union was one of the 10 priorities of the Juncker Commission in 2015. The Energy Union, as proposed by the Commission, has five dimensions: energy security, a fully integrated internal market, decarbonisation, energy efficiency, and research and innovation. Whether, how and to what extent the dimensions will be substantiated remains to be seen. The issue of fossil fuel subsidies is likely to become a test case of communal will.

While the EU has been at the forefront of emission reduction efforts, the shaky internal consensus and decision-making procedures are impeding the EU-28 from moving forward with the Energy Union and a sustainable energy transition. A common functioning and integrated energy market, directed to achieving a sustainable energy transition, has been identified and perceived at several instances as a driver for deepening EU integration and as a model for growth. However, while the necessity of integration for achieving this goal is understood, the momentum is lost. At present, deepening cleavages in the EU-28 and growing fragmentation between the member states and their commitments to a sustainable energy transition are slowing implementation.

Energy policy priorities have been subject to change: While climate goals were at the top of the agenda in 2007, the 2008 financial crisis and the shale revolution have contributed to a shift in the EU's strategic priorities. Indeed, economic competitiveness has since become an equivalent priority. The Treaty of Lisbon emphasised the need for growth stemming from a sustainable economy and energy policies focused on sustainability, whereas for the new member states of Eastern Europe, energy security and growing independence from Russia are major drivers of national energy policies. In the aftermath of the Russian–Ukrainian gas crises in 2006 and 2009, energy, and in particular gas supply security, has had an overwhelming influence on EU policies. Most recently, the desire to diversify away from Russia was a major motivation behind the proposal of the Energy Union by then-Polish President Donald Tusk, in 2014.

All of this explains why, in 2016, there is growing fragmentation within the EU concerning the transformation toward a low-carbon energy system. The EU-4, as well as Sweden and Denmark, are moving forward with a transition, whereas the Central and Eastern European member states were substantially compensated and exempted from ambitious targets. The UK's 'Brexit' referendum of 2016, which signalled an intention to leave the EU, will most likely further slow the EU common approach toward an energy transition, as the UK has been an advocate for decarbonisation. The prospect of Brexit will fundamentally change the equation within the EU in this sensitive policy area that is characterised by deep-cutting cleavages healed by ambiguous formula compromises (Fischer & Geden, 2016).

The EU's presentation in international organisations is one of 'mixity' as a consequence of the legal provisions in the Lisbon Treaty. The "principle of conferral" is enshrined in Article 5(2) of the Lisbon Treaty and constitutes that the Union acts within "the limits of the competences conferred upon it by the Member States in the Treaties...". As a consequence, the EU's room of action is limited and constrained, as it lacks the explicit mandate. At the leaders' level, the EU is represented by both the President of the European Council and the President of the Commission, depending on the respective policy area, as well as by EU-4 representatives.

The EU's record on global sustainable energy governance

The EU has a patchy track record on energy and climate diplomacy. In recent years, the EU displayed an increasing preference for bilateral and regional energy governance structures focused on the European Neighbourhood Policy and Russia. A clear shift, away from multilaterally negotiated approaches such as the Energy Charter Treaty and toward regionally export-

ing EU rules, took place with the creation of the European Energy Community and its enlargement, as well as with the creation of the Union for the Mediterranean. The deterioration in the relationship with Russia following the annexation of Crimea and military destabilisation of Eastern Ukraine since 2014 is a major reason behind the shift of emphasis to the European Energy Community. The Energy Community builds upon exporting the energy *acquis communautaire* to the Western Balkans, Ukraine, Moldova and very soon Georgia as well. Such a strategy faces limitations, and the reform processes in Ukraine and Moldova are real test cases for this strategy. In summary, despite the fact that geopolitical crises and turmoil have moved closer to European borders, the internal crises concentrate and bind significant political and economic resources.

Rather than the EU as a whole, it has often been individual member states that have promoted decarbonisation and supported multilateral initiatives and architectures. With regard to global energy governance initiatives, the UK has been a promoter of consistent decarbonisation policies in many fora and arenas, also vis-à-vis developing countries. Germany has been the supporter for a renewable energy architecture with the creation of REN21 and IRENA. Germany also has a strong record within the G7 and G8, for promoting an integrated energy and climate agenda and for reaching out to the O5 emerging countries: China, India, South Africa, Brazil and Mexico.

In terms of climate diplomacy, the UNFCCC Summits in Copenhagen in 2009 and Paris in 2015 were major culmination points. When, in November 2009, the G20 agreed to phase out inefficient fossil fuel subsidies, this was also seen as a stepping stone to success of the climate summit in Copenhagen. However, the outcome of the 2009 Copenhagen summit disappointed the more ambitious EU member states. For the member states that blocked more ambitious targets, the lack of a clear international commitment served as an excuse not to move forward in the EU. For the COP21 in Paris in 2015, the EU submitted common intended (nationally) determined contributions. The EU-INDC was decided at the Council of the Environmental Ministers in autumn 2015. There was a strong desire by many member states and the French host to make the Paris Summit in 2015 a success. The EU was part of the High-Ambition Coalition.

The submitted INDC is highly ambiguous, as internally it offers much room for manoeuvre. On the one hand the EU-28 committed to the 2030 target of 40 percent reduction, while on the other hand, internally, there is broad scope for bargaining over the real effort-sharing among the EU-28/27 under the 'EU bubble' as agreed in the 2030 targets.

As outlined in the EU Climate Diplomacy Action Plan (2015) and in Climate Policy after COP21 (2016), the EU aims to push a global climate agenda by means of three strands. Strand one is to advocate climate change as a strategic priority in its external relations. Strand two supports the implementation of the Paris Agreement in the context of low emissions and climate resilient development. Strand three aims to increasingly address the nexus of climate, natural resources, prosperity, stability and migration. These strands should also be pursued in international fora such as the G20. Here, the challenge is that while the Commission indeed has strong competences in climate and environmental issues, the G20 does not offer a separate track on climate issues.

The conclusions of the Council of the EU on energy diplomacy, of 20 July 2015, emphasise the need to achieve common positions in multilateral institutions and frameworks in order to speak with one voice on major topics. The G7, G20, SE4ALL and IRENA are mentioned in that respect, yet the document is largely pragmatic and reflects low ambitions in the global arena.

The EU in the G20

The future of the EU-27 and UK will affect the sustainable energy transformation internally and externally in approaches to global governance. The EU is taking part in the G20 directly as a full member without having a fully-fledged mandate and the exclusive competence, and indirectly through the EU-4. The G20 Study group of Toronto gave the EU the lowest compliance rating in the energy field among all G20 members, whereas the EU-4 show the highest rate of implementing and meeting the commitments and wordings of the summits.[2] Here again, it is obvious that countries commit themselves to targets that match with national policies that are already underway.

Since the broadening of the scope of the G20 beyond financial issues in 2009, the only EU member state to preside the Group has been France in 2011. During the French Presidency, the major foci were the functioning and transparency of energy markets, improvement of the Joint Organisation Data Initiative, and price volatility. France also carried on the initiative to phase-out fossil fuels. This initiative is a case in point for the mixed performance of the EU in the G20. Germany is conducting a bilateral review in the G20 with Mexico. At present, the UK has even increased its fossil fuel subsidies. Most EU subsidies (60%) are directed to coal for social reasons. Moreover, the EU has or is in the process of approving funds for electricity and (liquefied) natural gas infrastructure. Yet, the IEA Investment Report of 2016 clearly shows that in 2015 the bulk of investment within the EU was for renewables.

For their part, the UK and France will be leading work-streams in key areas of the Energy Efficiency Leading Programme agreed at the G20 summit in China in 2016. Germany, which takes over the presidency after China, has a record of building new elements into the global renewable energy architecture. The least developed field in international energy governance is energy efficiency. What is at stake is to engage the G20 in committing itself to implementing action plans that are in line with the Paris Agreement.

Lessons from the EU

The EU is unique in the international system. Therefore, take-away lessons for either individual states or international organisations are limited. Internally, the EU example demonstrates that collective action toward a sustainable energy system is a challenging and complicated undertaking, due to different energy mixes and differing levels of economic prosperity. Yet, modernisation is at stake across the continent. It is easier to set long-term targets than to define concrete steps. As outlined above, there is growing political uncertainty about the pace towards decarbonisation and sustainability. The possibility of Brexit, weak economic performance in the southern EU, the migration crisis and the persistent reluctance among Eastern European member states to transform their energy systems all weaken the ambition to rapidly transform energy systems. The EU case illustrates that sustainability efforts need to be married with other national goals in order to become tangible priorities; and demonstrates the need for not just targets but tools of implementation and monitoring processes. Furthermore, the situation in the EU also underscores that cross-border energy cooperation will become increasingly crucial to the success of the global energy transition.

From an international perspective, of course, the EU took a leadership role with its ETS; even though the design was not always perfect, it continued debating and improving the regulatory regime and mechanisms. The encouragement and role of the EU in creating and supporting the High-Ambition Coalition also shows that EU climate diplomacy can go a long way in encouraging others, including members of the G20, to engage based on a common set of interests. The EU-4 and the EU are well positioned, as members of most of the other energy institutions, to carry on policy initiatives. Yet, the EU's impact on international sustainable energy governance will be limited. This imposes more responsibility on frontrunners among the EU member states.

[2] The compliance scores are measured by the G20 research group.

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7. France: Reducing Nuclear Dominance and Promoting a Low-Carbon Energy System

Carole Mathieu[1]

With the adoption of its first Energy Transition Law in August 2015, France has scaled up its commitment to address global environmental issues. The transition process is intended to accelerate progress towards reducing greenhouse gas (GHG) emissions and energy use and increasing local renewable energy production. Meanwhile, France aims to reduce the nuclear share in its electricity generation, which is the highest in the world. Internationally, France pushes civil nuclear cooperation and initiatives to increase the share of renewable energy. As chair of the COP21, it has become an international pioneer in green finance.

Improving resilience and sustainability of the French energy system

In terms of GHG emissions, France's starting point is more favourable than that of the majority of OECD countries, both in terms of emissions per capita and emission-intensity of GDP.[2] The average performance in the transport and heating sectors is largely offset by the very low emissions level in the electricity sector. Non-emitting sources represented 92.3 percent of overall electricity production in 2015,[3] with the contribution of nuclear energy being by far the largest (76.3%). France decided to make nuclear the backbone of the electricity system in 1974, at a time when geopolitical tensions were raising fears of frequent oil supply cuts and price shocks. Developing domestic nuclear capacity was also seen as an opportunity to acquire industrial know-how and create opportunities for technology exports. The quest for energy independence led to the rapid expansion of nuclear capacity. In two decades, it went from just two percent of annual electricity production to 75 percent, the highest rate in the world. Today, nuclear energy accounts for approximately 40 percent of France's total primary energy consumption.[4]

First steps in environmental regulation

While this unique predominance of nuclear is a strong asset in terms of climate policy, France has also been pursuing improvements in energy efficiency and renewable energy since the early 2000s. Feed-in tariffs were progressively introduced for wind, solar PV, biomass, geothermal energy, small-scale hydroelec-

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[2] Among OECD countries, France had the lowest CO_2 emissions per capita and the third-lowest emission-intensity of GDP in 2014 (EC JRC and PBL, 2015).

[3] French electricity production in 2015: nuclear (76.3%), hydroelectric (10.8%), natural gas (4%), wind (3.9%), coal (1.6%), solar (1.4%), bio-energies (1.4%) and oil (0.6%) (RTE, 2016).

[4] French primary energy consumption in 2015: oil (30%), natural gas (14%), coal (3%), primary electricity [nuclear, hydro, wind and PV] (45%), renewable thermal energy and energy recovered from waste (7%) (MEEM, 2016).

tricity and biogas. A law passed in 2005 strengthened the support mechanisms for renewables and also mandated an ambitious 80 percent reduction of GHG emissions by 2050 compared to 1990 levels. The following year, a scheme for energy savings certificates was established, requiring energy suppliers to offer tools and incentives focused on helping final customers save energy. Suppliers face non-compliance penalties if they fail to gather enough certificates, through the initiatives they launched or through the purchase of certificates from suppliers who exceeded their own CO_2 reduction targets.

In terms of actual improvements, France met its obligation under phase I of the Kyoto Protocol by achieving a 12 percent reduction in GHG emissions between 1990 and 2013 (MEEM, 2015b). It is now on track to meet its 2020 GHG targets derived from the EU Energy and Climate Package of 2008–2009.[5] The use of renewable energy has grown substantially but still accounted for only 14 percent of final energy consumption in 2014 (Ademe, 2016), while the objective for 2020 is no less than 23 percent. If France is to meet its EU obligation, achievements since 2005 will have to increase three-fold for renewable electricity and four-fold for renewable heat over the period 2014–2020 (OECD, 2016). In terms of energy efficiency, progress achieved since 2005 has been higher than expected for primary energy consumption but slightly lower than expected for final energy consumption.[6] Further action is required in the transport and residential sectors, which together account for more than 75 percent of France's final energy consumption (MEEM, 2015a).

2015: the new energy transition law

In the run-up to the 2012 presidential election, the Socialist Party (PS) and the Green Party (EE-LV) agreed on a list of measures to be introduced if the left-wing bloc clinched a majority. As expected, this pre-electoral agreement put a strong focus on speeding up the shift to a more efficient and renewable-based energy system. More controversial was the pledge to reduce the share of nuclear in electricity generation from 75 percent to 50 percent by 2025. This measure was put forward within the context of growing public concern about nuclear safety. The yearly national survey, conducted six months after the Fukushima nuclear disaster of March 2011, found that the share of French people judging nuclear safety risks as high grew from 48 percent (the year before) to 55 percent, the highest since the survey was launched in 1988 (IRSN, 2012). With this change in risk perception, the idea that France had become excessively dependent on nuclear started to gain traction. However, the 2025 reduction target for nuclear is not to be interpreted as the first step of a complete phase-out plan. The official strategy is to maintain nuclear as a central – but no longer predominant – source, while freeing-up more room for renewables.

Following François Hollande's election as President in May 2012, a national consultation on the energy transition was launched in November of the same year. Involving thousands of national and local stakeholders, the purpose of this consultation was to elaborate on the President's broad commitments. Its conclusions informed the preparation of the Energy Transition Law, which was finally adopted in July 2015. This law is the result of an extensive and unprecedented debate, and its 212 articles go well beyond the nuclear issue, covering eight major topics: targets for the future energy system, energy efficiency in the building sector, clean transportation, waste management and circular economy, renewable energies, nuclear safety, simplification of administrative procedures, and new means for citizens, companies, local and national authorities to take action. In addition to reducing the share of nuclear, the law sets out various ambitious targets, in line with and sometimes exceeding EU commitments. By 2030, GHG emissions will need to reduce by 40 percent compared to 1990 levels, and the share of renewables will need to increase to 32 percent of final energy consumption and 40 percent of electricity production. Finally, fossil fuel consumption will need to decrease by 30 percent compared to 2012 levels. Looking ahead to 2050, final energy consumption is set to reduce by 50 percent compared to 2012 levels.

[5] France is required to reduce emissions from sectors covered by the EU ETS by 21%, and to achieve a reduction of 23% from the other sectors.

[6] Primary energy consumption amounted to 257 Mtoe in 2015, while the objective for 2020 is 236.3 Mtoe. Final energy consumption amounted to 162 Mtoe in 2015, while the objective for 2020 is 131.4 Mtoe (MEEM, 2016).

One central idea is that preparing for the post-fossil-fuel era will benefit the French economy. In addition to an explicit reference to "green growth" in its full title, the law was published alongside governmental estimates showing that GDP would be boosted by 0.8 percent in 2020 and by 1.5 percent in 2030 thanks to the energy transition (MEEM, 2016). This economic stimulus would be highly welcome in a context where the unemployment rate has been above 10 percent since 2013. Undoubtedly, the potential creation of one hundred thousand jobs in the energy efficiency and renewable sectors has been a key argument in favour of ambitious targets (such as the retrofitting of five hundred thousand homes per year as of 2017) and the introduction or extension of fiscal incentives (such as the 30% tax credit on retrofitting works, zero interest eco-loans or the EUR ten thousand bonus for switching from old diesel cars to electric cars). In the same vein, the third public investment plan that is aimed at increasing the growth potential of the French economy will dedicate 60 percent of its credits – representing EUR six billion – to projects contributing to green growth. Its final approval is expected by the end of 2016.

Another salient feature of the French Energy Transition Law is the focus on empowerment. While energy policy has been highly centralised to date, there is now a clear willingness to achieve a more balanced distribution of power. In terms of governance, the state is expected to provide greater certainty to investors by presenting every five years a national low-carbon strategy (SNBC) and an energy programming scheme (PPE). As a second step, regional planning schemes (SRCAE) will detail the local implications. The role of local authorities in implementing the energy transition is also strengthened, particularly in relation to promoting energy efficiency measures. To encourage more bottom-up action, a call for local projects was launched in November 2015. So far, four hundred communities have been labelled "energy positive territories for green growth" and received financial help of EUR five hundred thousand to EUR two million to implement innovative projects in the fields of energy conservation, renewables, clean air, biodiversity, recycling and community engagement (MEEM, 2016). As for citizens themselves, they are given the means to take a more active role in the energy transition, such as through renewables self-consumption or crowdfunding for renewables projects.

Implementation challenges

Although there is broad agreement that the new targets are ambitious, many stakeholders and NGOs remain concerned that vested interests or a lack of political determination could undermine the implementation of the new law. To avoid speculation, the Energy Ministry accelerated the work on related ordinances and decrees. By July 2016, 85 percent of these texts had already been published. As for the first energy planning scheme (PPE), the main challenge is of course to provide clarity on how the nuclear share will be reduced by 2025. This will depend on consumption and export assumptions, the feasibility of fast-paced deployment of renewables and the decisions of the Nuclear Safety Authority (ASN) with regard to the operation of nuclear reactors beyond forty years.[7] In addition, many are still concerned that without sufficient time and flexibility, reducing the nuclear share would lead to unbearable revenue losses for the producer and a price spike for consumers. However, pursuing the newly agreed renewables targets without setting out a clear strategy for plant closures could also exacerbate the issue of overcapacity in electricity markets. The risk is even higher if France does reduce by half its final energy consumption by 2050, as required by the new law. At this stage, the draft roadmap (PPE) published in July 2016 foresees a 10–65 TWh decrease in nuclear production by 2023, which at best would lead to reducing the nuclear share to 65 percent, according to French environmental NGOs (e.g., Greenpeace France, 2016). Further clarity will be required for the operator, EDF, to adjust its nuclear fleet upgrade programme and prepare for the future. The two questions now are: whether a consensual plan can be agreed in the near future, and

[7] In 2015, the average operational lifespan of French nuclear reactors was 31 years. In 2025, only 30 GW of nuclear capacity (almost half the current capacity) will still be below the 40-year threshold.

whether it can withstand the next presidential election in May 2017.

COP21 presidency and the increased focus on international cooperation

France has strong experience in international energy cooperation, particularly in the sphere of civil nuclear power. In 2009, a new agency was created to assist foreign countries that are considering developing civil nuclear fleets. The objective is to promote non-proliferation, safety and security standards, but also to prepare the ground for potential intergovernmental agreements and industrial partnerships. In addition, France is actively involved in international research activities on the performance of nuclear reactors, for example through the construction of an experimental fusion power reactor (ITER) in southern France.

Since 2012, when France announced its candidacy to host COP21, the external dimension of the French energy and climate policy has been significantly bolstered. The French Government considered that it had to show the way: by improving its domestic record, France would gather sufficient political capital and be able to trigger global action. For example, France announced in September 2015 that it would no longer provide financial support for unabated coal-fired power plant projects overseas, to avoid carbon lock-in (Reuters France, 2015). In parallel, France pushed participants in the OECD arrangement on export credits to adopt similar restrictions on support for coal plants. These new OECD rules were finally published in November 2015 (OECD, 2015). Likewise, the Energy Transition Law echoes the global discussion on financial risks implied by climate change and introduces mandatory climate reporting for institutional investors. The latter are now required to make public the carbon footprint of their portfolio and to clarity the extent to which their assets contribute to the low-carbon transition. In line with this initiative, the French finance minister requested the Financial Stability Board to examine how climate change could impact the global financial system. Again, a concept that had been promoted by NGOs and scholars – here, carbon risk management – was first tested through domestic legislation, before French diplomatic efforts urged partner countries (here the G20) to take coordinated measures.

In addition to promoting reforms, France is providing direct support to facilitate access to energy and leverage global climate action. According to OECD statistics (OECD.Stat, 2016), France was the third-largest provider of energy-related ODA in 2014. In September 2015, President Hollande committed to increase the country's climate finance contribution from EUR three billion to EUR five billion a year by 2020. Convinced that "climate clubs" would help consolidate the Paris Agreement, France has also been a strong supporter of the various new initiatives launched ahead of COP21. To name only a few, France joined Mission Innovation and committed to double clean energy R&D funding by 2020. It is also co-chairing, with India, the International Solar Alliance aimed at accelerating the deployment of solar energy in countries with rich solar potential. Moreover, France is putting a strong focus on low-carbon development in African countries; EUR two billion are dedicated to the Africa Renewable Energy Initiative over 2016–2020. As COP president until November 2016, France is also preparing a report on how to foster access to clean energy in Africa. Its objective is to provide an assessment of the renewable potential in African countries and to propose measures to facilitate project financing.

Another central issue for France is the promotion of carbon pricing. The energy minister, whose portfolio includes international cooperation, is now co-chairing the Carbon Pricing Leadership Coalition, seeking to expand the use of carbon pricing by sharing information and know-how. Likewise, the French Government is in favour of strengthening existing schemes, particularly the EU Emissions Trading Scheme. France argues that investors need greater clarity on future carbon prices to take informed decisions, and therefore proposes a price corridor that would increase progressively along a predefined trajectory. Because this proposal is unlikely to get sufficient backing from the other EU member states, at least in the short term, France is considering a domestic carbon price floor or an additional tax on coal-fired power generation. Such measures – to be implemented by January 2017 – would complement the 2014 carbon tax by addressing fossil-fuel-related GHG emissions in non-ETS sectors. The next step for France will be to partner with other countries, to ensure that total

emissions are actually reduced and not simply transferred to countries/regions that lack robust carbon pricing schemes.

Turning France's energy transition challenges into valuable inputs for the G20

France's commitment to the energy transition has grown since the early 2000s and is now taken to a new level with the implementation of the Energy Transition Law. Nonetheless, the road ahead is still full of challenges – the first being adjustment of the power production mix. Should a clear and consensual strategy be defined in time, France would have the opportunity to establish a new model in which nuclear and renewables both play central roles and function as complementary sources. Managing nuclear output in order to respond to variations in demand has always been desirable, considering the size of the French fleet, and EDF has developed strong expertise in this area since the 1980s. The flexible operation of nuclear plants is now being enhanced to support the expansion of intermittent renewable sources, in addition to continued attention to demand-side response, development of storage solutions and use of cross-border power exchanges. On top of these operational challenges, expanding the share of low-marginal-cost renewables while investing for the upgrade and/or renewal of the nuclear fleet will only be possible if appropriate financial incentives are in place. Consequently, the success of the French diversification plan is also dependent on the reform of the European Union electricity market design. If such re-balancing of the French electricity mix is achieved without excessive costs and without greater reliance on fossil fuels, important lessons could be drawn for G20 members on how to reinforce synergies between nuclear and renewables.

Another area where the French experience could be valuable, from a G20 perspective, is green finance. As mentioned above, France is taking innovative steps to ensure that climate factors are integrated in financial decisions. In addition to information disclosure on climate-related risks, two certification standards for socially responsible investment were introduced in January 2016. The Energy and Ecological Transition for Climate label is granted specifically to investment funds financing the green economy, e.g., renewable energies, energy efficiency, electricity storage, smart grids, clean transport or forest management. Likewise, President Hollande announced in April 2016 that France would be the first country to issue green bonds, creating further dynamism in this incipient financial market. These early-stage solutions illustrate France's determination to speed up the reallocation of capital towards low-carbon solutions. By bringing forward these policies, the country can contribute to the global debate on how to *"make financial flows consistent with a pathway toward a low-emissions and climate resilient development"*, as required by Article 2 of the Paris Agreement.

Finally, the G20 could draw lessons from France's efforts to put citizens at the heart of the energy transition project. The country's starting point is a highly centralised system built around key industrial players and top-down energy mix choices. Promoting a more inclusive debate should be seen as another way to rebalance the French energy model and to improve its resilience. The new governance system that France is setting up relies on energy transition strategies being discussed at the national and local levels and then translated into consistent planning tools. Controversies and delays cannot be excluded, as experienced with the first energy roadmap (PPE). However, these discussions are crucial to avoid stranded high-carbon assets and to align regulatory, societal and technological innovations. If France ensures that these new planning tools cover all issues in depth and are sufficiently robust to resist changes in government, it may offer valuable conclusions for the G20 on how to carry out an orderly energy transition. Likewise, France is now keen to ensure broad participation in the energy transition project through creative approaches. For example, in May 2016 the Ministry for Energy launched its first 'hackathon' to create opportunities for collaboration between digital innovators, network operators and local governments, and to build software solutions around energy savings. Only time will tell whether these various initiatives bear fruit and whether the French Energy Transition can actually become more citizen-driven, but the intention is already worthy of attention by the G20.

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8. Germany: Promoting an Energiewende Domestically and Globally

Sybille Roehrkasten[1] and Karoline Steinbacher[2]

The German Energiewende – literally translated as "energy turnaround" – is an outstanding example of a national effort to transform an energy system. Driven by public opposition to nuclear energy, and by efforts to combat climate change, the Energiewende builds on a massive expansion of renewable energy as well as improvements in energy efficiency. So far, efforts have focused on the electricity sector, while progress in the heating and transport sector has been very limited. In addition, Germany also has a long track record of promoting sustainable energy with its international energy policies.

The Energiewende: A maturing energy transition

The Energiewende is a project to transform the German energy sector, driven by efforts to phase out nuclear energy and to protect the climate while safeguarding economic competitiveness and a secure energy supply. Chancellor Angela Merkel's decision to re-accelerate the phase-out of nuclear energy following the Fukushima nuclear accident in 2011 has brought the term "Energiewende" to the attention of an international audience. However, the Energiewende has a longer history. It is rooted in long-standing public opposition to nuclear energy in Germany, which was reinforced by the Chernobyl nuclear accident of 1986 and led to the vision of an energy system "without petroleum and uranium" (Krause et al., 1981) advocated by renewable energy pioneers. It was the government coalition of the Social Democrats and the Greens (1998–2002) which took the decision to enact policy with a view to fundamentally transform Germany's energy system. Due to renewed strong public opposition to nuclear energy after Fukushima, the phasing out of nuclear energy is now borne by a cross-party consensus (Roehrkasten & Westphal, 2012). Nuclear energy, which will be completely phased out by 2022, provided 30 percent of Germany's electricity supply at the beginning of the 2000s, but this share has already been halved amidst the growth of renewable energy sources (AGEB, 2016). The Energiewende is also taking place against the background of Germany's ambitious climate protection goals: greenhouse gas emissions shall be reduced by 40 percent by 2020 and by 80–90 percent by 2050, compared to 1990 levels (BMWi, 2012). As almost 85 percent of current greenhouse gas emissions derive from the energy sector (BMWi, 2015), this sector is the primary target of mitigation efforts in Germany. The Energiewende and its overarching goals are strongly backed by society. Public opinion polls consistently report approval ratings exceeding 90 percent (PwC, 2015; AEE, 2016). This overwhelming public support is also a result of strong citizen involvement in the energy transition, with pioneering activities of towns and villages since the 1990s and almost 50 percent of renewable energy capacity being owned by private citizens and farmers (AEE, 2014).

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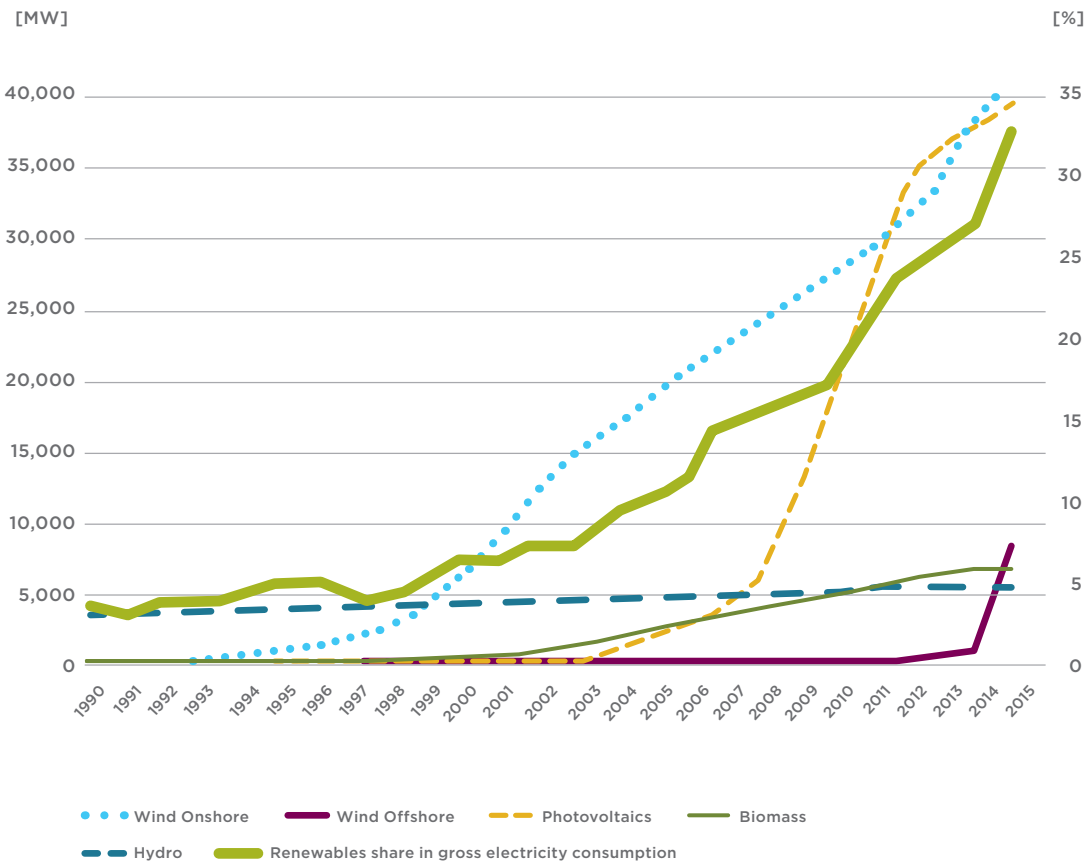
Renewables and energy efficiency as the two pillars of the Energiewende

The cornerstone and most visible success of the Energiewende so far is the expansion of renewables in the electricity sector. Electricity generation from renewable sources increased more than five-fold since 2000. With 195.9 billion KWh, renewables accounted for 32.6 percent of gross electricity consumption in 2015. The government has ambitious plans for future expansion: the share of renewables in the electricity mix is set to increase to at least 50 percent by 2030 and at least 80 percent by 2050. So far, the major renewable source for electricity generation has been wind energy (88 billion KWh, 14.7% of gross electricity consumption), followed by bioenergy (49.4 billion KWh, 8.3%) and solar PV (38.4 billion KWh, 6.4%) (BMWi, 2015; BMWi, 2016a). Although integrating the increasing share of energy that is derived from fluctuating generation sources inevitably requires adjustments to infrastructure and grid management, the supply quality of electricity in Germany has improved further over the years (BNetzA, 2015).

Figure 1: Installed renewable electricity capacity (in MW) and renewables share in gross electricity consumption (in %), Germany, 1990–2015



Source: Steinbacher (2016) based on BMWi 2016b.

A second pillar of the Energiewende is the reduction of primary energy consumption. Targets foresee a reduction of 20 percent by 2020 and 50 percent by 2050, compared to the levels in 2008. Here, the heating sector is the primary field of action: The target is to reduce the primary energy demand of buildings by 80 percent by 2020. Germany has managed to decouple economic growth and energy use, but the current mosaic of energy efficiency policies has also been judged too complex and generally insufficient to achieve the country's ambitious targets. The Monitoring Report of the German energy transition shows that greater efforts are required to get on track for achieving the energy efficiency goals (BMWi, 2015).

Reforming renewable energy policies

As renewables move from the periphery to becoming a pillar of electricity supply, the government is transforming its support mechanisms for renewables. Feed-in tariffs were adopted with the emblematic renewable energy act "EEG" (Erneuerbare-Energien-Gesetz) in 2000, on the basis of principles introduced with the 1990 Electricity Feed-in Law (Stromeinspeisungsgesetz, StrEG). These provided the basis for the exponential growth of renewable energies so far. Under these feed-in tariffs, producers of renewable electricity are guaranteed fixed, government-set levels of compensation for each kilowatt-hour of electricity produced over a period of 20 years, depending on the technology, size and site of their project. The EEG levy (i.e., the difference between the tariff and the market price) is paid by consumers. The EEG served as a policy model for governments around the world, and contributed significantly to global technological developments and associated cost digression of wind power and solar PV by advancing market creation (Quitzow et al., 2016).

In order to control the pace of renewable energy expansion and to enhance competition among renewable energy producers, several fundamental adjustments were made to the initial support framework for renewables. A 2012 reform to the EEG introduced compulsory direct marketing for larger plants; the subsequent 2014 reform, 'EEG 2.0', led to pilot auctions to determine the market premium for ground-mounted solar PV for the period 2015–2016. By 2017, auctions shall be used as a pricing mechanism for all forms of renewable energy. Another element of reform introduced in 2014 is a 'target corridor' for the increase in renewable energy capacity, diverging from the former approach of unlimited renewable energy expansion.

Coal phase-out and transforming the heating and transport sector as major challenges

A critical challenge for the electricity sector in the coming years will be the phase-out of coal-based electricity to meet the country's climate targets. Lignite and hard coal account for a persistently high share of final electricity consumption (44% in 2015, 273 billion KWh).[3] In 2016, Germany introduced new payment mechanisms for capacity reserves, consisting of standby coal-fired power plants. The UN climate change envoy strongly criticised this step as providing subsidies for the coal industry (Vaughan, 2016). The coal phase-out is highly controversial in Germany, as coal-producing regions of the country fear job losses and economic downturn. The government has not yet taken the necessary steps to approach this politically sensitive issue in a consistent manner.

Next to the coal phase-out, advancing an energy transition in the transport and heating sectors is urgently needed for effective climate protection. In 2015, renewables accounted for only 13.2 percent and 5.3 percent in the heating and transport sectors respectively. As a result, the renewables share of total final energy consumption remains relatively low, at 13.5 percent in 2015, which also means that 86.5 percent is still provided by conventional energy. While the government aims to increase the share of renewables to 60 percent by 2050, no explicit long-term targets for the transport and heating sectors are in place. Moreover, in the transport sector, Germany is very likely to miss its energy efficiency target. While this foresees a 10 percent reduction by 2020 (compared to 2005), final energy consumption in the transport sector actually increased by 1.7 percent to 2014 (BMWi, 2016a).

[3] Own calculation based on (BMWi, 2016c). The absolute amount of coal-fired electricity has not been reduced significantly since the 1990s. See BMWi 2016: Energiedaten: Gesamtausgabe (Stand Mai 2016).

International sustainable energy leadership

Germany's Energiewende has received much international attention: Germany is not only an early adopter of renewables that is now fundamentally transforming its electricity supply system; it is also a large, industrialised country that is globally renowned as a "green power" with a high level of technological expertise (Quitzow et al., 2016). From the beginning, ambitions to transform Germany's energy supply and international outreach have been deeply intertwined, and German decision-makers have repeatedly underlined the country's international sustainable energy leadership (Roehrkasten, 2015; Steinbacher, 2016; Steinbacher & Pahle, 2016).

Promoting renewable energies and energy efficiency is a key priority of Germany's international energy policy (BMWi, 2016d; Auswärtiges Amt, 2016; BMZ, 2016). In line with the goals of the German energy transition, the international activities of the German Government aim to reduce conventional energy use.[4] The aim is for renewables to gradually replace conventional energy sources or offer an alternative for future capacity additions, and for energy efficiency to curb overall energy demand. Similarly to the domestic case, Germany strongly links its international energy policies with climate protection. The agenda is less obvious with regard to the phase-out of nuclear power in other countries. Phasing out nuclear power is a cornerstone of the Energiewende at home, but the German Government has long been hesitant to explicitly address nuclear energy at the international level. Activities concentrate on rendering alternatives to nuclear energy – renewables and improved efficiency, which are more accessible, attractive and implementable rather than directly challenging the use of nuclear energy (Roehrkasten, 2015).

In line with the current focus of the domestic energy transition, the electricity sector also receives most attention in relation to Germany's international activities. An important aim of Germany's international activities is to strengthen institutions for renewables – nationally, regionally as well as internationally – and to help partner countries create favourable regulatory frameworks for renewable energy and energy efficiency as well as the necessary capacities to implement those frameworks. For a long time within the field of renewable energy promotion, much effort was given to promoting feed-in tariffs – the cornerstone of Germany's past promotion of renewables; today, policy advice in the sustainable energy field builds on a more extensive toolkit and a broader range of country experiences.

Germany has a strong track record of supporting sustainable energy in bilateral cooperation. During the 1970s, following the oil price shocks, the country already began supporting the deployment of non-exhaustible energy sources within the framework of its development cooperation. In 2014, Germany was the world's largest provider of official development assistance (ODA) in the energy sector (Roehrkasten et al., 2016 based on OECD data). German development cooperation supports sustainable energy in more than 50 countries, in 24 of which it is a focus area for cooperation (BMZ, 2014). Energy sector ODA has been expanded significantly with the acceleration of the Energiewende in Germany, seeing more than a tenfold increase since 2000, amounting to more than EUR two billion in 2013 (Steinbacher, 2016). As a commitment to the UN initiative, Sustainable Energy for All (SE4All), energy sector ODA is planned to increase further to EUR 3.6 billion annually by 2030 (BMZ, 2014). Next to renewable energy and energy efficiency, Germany's international development framework aims to expand global access to energy. A particular feature of Germany's development cooperation is the extensive presence abroad of the implementing agencies GIZ (in charge of technical cooperation) and KFW Development Bank (in charge of financial cooperation). The direct placement of GIZ staff in partner countries' institutions over extended periods of time ensures access to nodal points of energy policymaking in the countries. In addition to cooperation within the framework of international development, the German Government maintains bilateral energy partnerships with 12 countries that it considers strategically important.[5] These partnerships comprise regular high-level government consultations and serve as an umbrella for the various ongoing bilateral cooperation activities. While energy ODA is not directly linked to

[4] See also BMWi (2016e).

the export interests of German industry, the bilateral energy partnerships explicitly aim to improve the business environment for German companies in markets around the world (BMWi, 2016d).

In addition to its bilateral activities, Germany has established itself as a driving force for multilateral efforts to promote renewables (Roehrkasten, 2015). Germany's role as the initiator of the International Renewable Energy Agency (IRENA) in 2010 illustrates this ambition particularly well. Germany has strongly influenced the agency's institutional set-up and activities from the beginning. In addition, Germany is the founder and major financier of the multi-stakeholder network Renewable Energy Policy Network for the 21st Century (REN21). Moreover, Germany has used its past two G7/G8 presidencies to promote the decarbonisation of global energy supply. Both the Heiligendamm Declaration (2007) and the Elmau Declaration (2015) contain sections linking development of the global energy sector with climate protection.

In contrast to the foreign energy policies of many other countries, Germany's international Energiewende policy encompasses a broad variety of actors. The Ministry of Economic Affairs and Energy (BMWi) has overall competency for energy policy, both domestically and internationally. It is in charge of the bilateral energy partnerships, Germany's energy strategies vis-à-vis multilateral organisations and networks such as IRENA, REN21, G7 and G20, and initiatives to foster exports of German technologies for renewable energy and energy efficiency. However, the major funder of Germany's international activities to promote sustainable energy is the Ministry for Economic Cooperation and Development (BMZ), while the Ministry for the Environment (BMUB) is responsible for projects that are supported via international climate finance. The Federal Foreign Office (AA) deals with international communication of the Energiewende. Besides ministries, the implementing agencies GIZ and KfW, political foundations, NGOs, research institutes and business organisations are central to Germany's international activities to promote sustainable energy. The involvement of a range of different actors brings important advantages, as it facilitates comprehensive and multifaceted activities. Coordinating the activities of the different players is a major challenge. Nevertheless, due to the strong political consensus around the general direction of German energy policy, the various actors advance similar narratives (Steinbacher, 2016).

Relevant impulses for G20

Germany's domestic sustainable energy policies – the Energiewende – provide various lessons relevant to discussions in other G20 countries and beyond. In particular, broad societal and political consensus around the long-term goals of the Energiewende has created a favourable investment environment by providing stable framework conditions. While long-term goals of decarbonisation, nuclear phase-out and reduced energy consumption are no longer disputed, the particular design of steps toward an energy system transformation are issues for debate. Upcoming challenges such as coal phase-out will require long-term policy plans and roadmaps to ensure the country meets not only its renewable electricity goals but also its climate goals. In the power sector, Germany has acquired a wealth of knowledge regarding the deployment and integration of large proportions of fluctuating renewable energy, including decentralised systems, which can be shared with partner countries.

Knowledge sharing, institution building and capacity development are also at the core of Germany's international sustainable energy activities. The long-term secondment of advisors to the core energy policy institutions of partner countries has proven particularly valuable in this regard. Linking sustainable energy with topics of particular interest to developing and emerging countries, such as job creation and vocational training, is a promising avenue for further cooperation and an impulse that Germany's efforts may bring to the G20. In addition to bilateral cooperation, Germany has initiated or contributed to the creation of a range of multilateral sustainable energy fora. The importance of "coalitions of the willing" could be reflected in efforts within the G20.

[5] Currently, bilateral energy partnerships are signed with Algeria, Brazil, China, India, Mexico, Morocco, Nigeria, Norway, Russia, South Africa, Tunisia and Turkey.

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9. India: Meeting Energy Needs for Development While Addressing Climate Change

Madhura Joshi[1] and Radhika Khosla[2]

India is undergoing structural urban and economic transitions and has set ambitious policy targets to meet its rising energy needs for development. Expanding coal and renewables are two important pillars of this undertaking and, since 2008, climate protection is of increasing concern. India's international engagements reflect these motivations of both energy security and climate change, where India is increasingly engaging in transfer of clean and efficient energy technologies to developing countries like itself.

India's energy sector: an introduction

The provision of energy has long been a central tenet of India's development planning – and in the country's current socio-economic context, energy planning is even more urgent and complex. This is in large part because India is in the midst of at least three transitions with significant implications for its energy use. Firstly, the country's urban population is projected to almost double between 2014 and 2050, and a projected 83 million people will be added to the middle class by 2025 (UNDESA, 2014). Secondly, around 10 million people are expected to enter the job market annually in the next two decades (FICCI & EY, 2013). Thirdly, an unprecedented expansion is projected in infrastructure, with estimates that two thirds of the building stock in 2030 is yet to be built (Kumar et al., 2010). All these trends imply higher energy demand to enable development.

Planning for this energy future is a challenging undertaking. Despite India's high GDP growth rate of 7.4 percent in 2014–2015, significant inefficiencies and inequities persist within its energy ecosystem (MoF, 2016a). Approximately 30 percent of the population lacks access to electricity, and more than 70 percent still relies on traditional biomass for cooking (MHA, 2011). While India is the third largest consumer of energy globally, its per capita consumption is less than a third of the global average (IEA, 2015).

As Figure 1 illustrates, fossil fuels dominate India's electricity sector, with coal being the largest contributor in 2016 to the installed electric capacity of 305 GW. In terms of primary energy supply, coal and crude oil form the bulk at 51 percent and 37 percent respectively (TERI, 2015). However, these fossil fuels have constrained domestic availability, and imports now form a significant 40 percent of India's total primary energy requirements (MoSPI, 2016). High fossil dependence has also had adverse impacts on local environments, as marked by deteriorating air, water and land quality. Additionally, climate change compounds each of these pressures, since the energy sector accounts for approximately 77 percent of India's greenhouse gas emissions (MoEF, 2010).

Tackling energy concerns is thus at the heart of India's development and climate futures. The task is complex, given the energy sector's inter-relationships with

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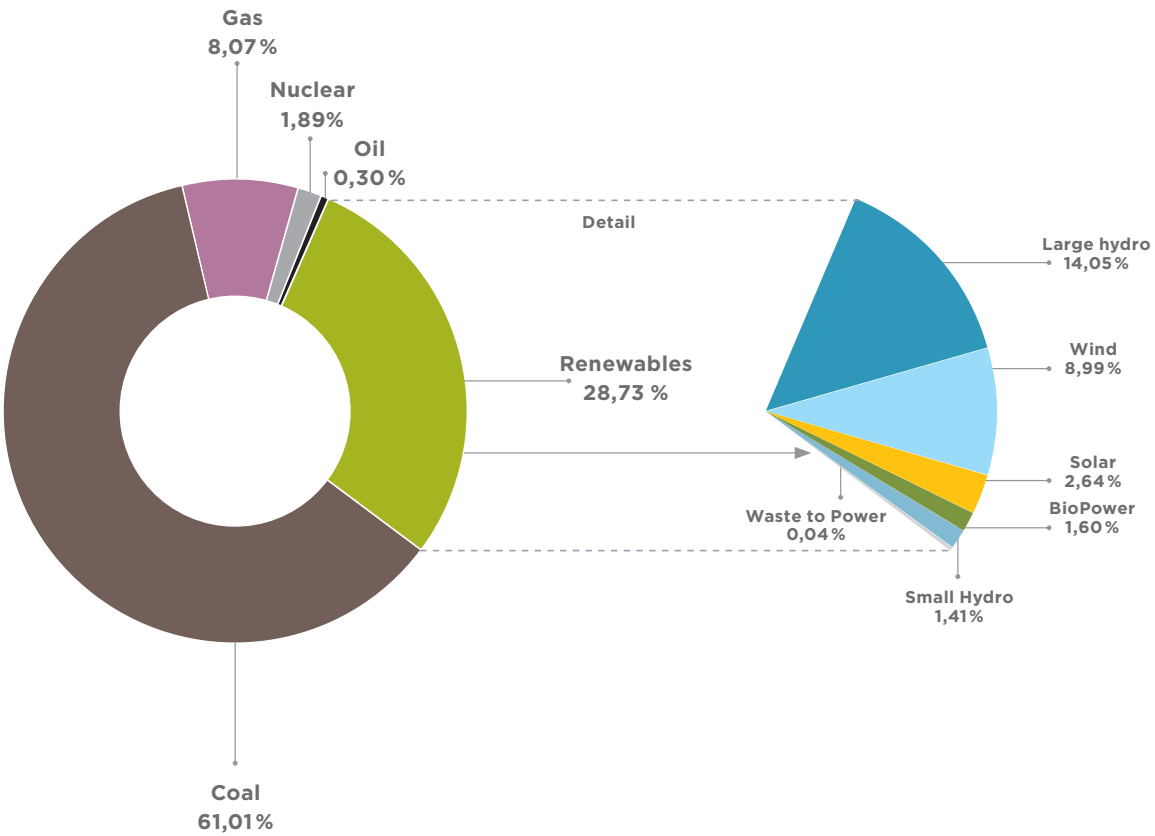
other socio-environmental aspects of the economy. Indian energy is increasingly grappling with objectives that are beyond those of pure energy growth, but rather include energy access, energy security and protection of the local and global environment. The road to a sustainable energy transition will hence depend on how well India negotiates these multiple – and at times competing – priorities.

Characteristics of an Indian energy transition

Any sustainability transition requires tackling the key issues that characterise India's energy sector: energy supply and security; access; energy demand; governance; and climate change.

Figure 1: Installed power capacity by fuel in India 2016

Source: Central Electricity Authority, 2016 and Ministry of Power and Ministry of New and Renewable Energy, 2016



Energy supply and security

Energy security was traditionally understood as the need to solve India's ubiquitous energy scarcity, aiming to reduce imports by increasing supplies across all sources – coal, oil, gas, nuclear, renewables, etc. This focus on the supply-side narrative continues, and is salient in current policies for coal and renewables. The government has a domestic coal production target of 1.5 billion tonnes by 2020 (aimed at reducing imports). For renewables, it plans to achieve 175 GW of installed capacity by 2022 (including 100 GW of solar), a five-fold increase in its ambitions since 2011. This target implies that, by 2030, India will add renewable capacity approaching the size of its current grid (Dubash & Khosla, 2015).

Both the coal and renewables targets are ambitious. The basis for promoting coal is often couched in its relative affordability, and most energy models predict a coal-dominant future for India. However, the coal requirement will vary under different scenarios, with projections ranging from 896 million tonnes to 1.22 billion tonnes by 2020 (Shegal & Tongia, 2016), up from the 910 million tonnes consumed in 2015–2016 (MoC, 2016). On renewables, India has dramatically increased its installed capacity to 44 GW, more than doubling capacity since 2011 (CEA 2016; 2015). In 2015, India ranked fifth globally in its annual investments in renewables, and fourth in total wind capacity (REN21, 2016). However, the actual requirements of coal and renewables to meet development needs will depend on resolving a variety of factors, including: socio-economic costs associated with coal; governance challenges in the electricity sector; climate and energy security considerations; the scale of future electricity demand; and the role of clean coal technologies.

Alongside the focus on coal and renewables, India has taken measures to rationalise fossil fuel subsidies in order to reduce fiscal burdens, supply leakages and distortions of demand. Petrol prices were deregulated in 2010, and diesel prices were incrementally raised in 2013. Coupled with rapidly declining crude oil prices, diesel was completely decontrolled in 2014.

Energy access

A second factor influencing India's energy transition is the provision of quality energy access. The government has targets for the electrification of all villages by 2018, and affordable power for all by 2019. Further, a variety of programmes aim to improve access and penetration of modern cooking energy through liquefied petroleum gas (LPG). In 2015, a national programme to rationalise and target LPG subsidies through unconditional cash transfers (*PAHAL*, Direct Benefits Transfer for LPG), resulted in 163.6 million registered households and a subsequent 24 percent reduction in subsidy-linked leakages (MoF, 2016b) – the largest global cash transfer scheme. More recent schemes continue the trend and provide LPG connections to women from poor households (*Pradhan Mantri Ujjwala Yojana*), whereas the 'Give it Up' campaign asks more affluent customers to give-up their subsidy.

While there has been some progress, challenges remain in providing reliable, affordable service to all. Issues surrounding the cost and penetration of LPG supply in remote areas, and possible re-transition of households to easily available biomass need to be resolved to bring about lasting, affordable transition. At the same time, gains in electricity access could help in 'leap-frogging' to electricity-based cooking in rural areas. Specifically, increased electricity access has led to falling consumption of subsidised kerosene, used for lighting. A new pricing policy, through small monthly increases, seeks to reform kerosene prices by April 2017. In addition, a national cash-transfer programme for kerosene aims to reduce illicit supply leakages and target subsidies, although this faces operational challenges. Financial literacy and access to reliable banking facilities will be key to the success of such cash-transfer programmes.

Energy demand

Understanding demand will help determine the nature of India's future energy requirement. Indian energy planning has a supply-side bias, but this approach has not been successful in solving the sector's continuing pathologies. Instead, a focus on understanding – and thereby changing – consumption patterns makes managing energy supply easier. Furthermore, emphasis on the demand side can help avoid locking-in unsustainable consumption patterns for the decades to come, since the bulk of infrastructure in cities, buildings, transportation, etc. is yet to be built.

Several measures to improve the efficiency of demand sectors are underway. For example, the Perform Achieve and Trade scheme, launched by the Bureau of Energy Efficiency in 2012, helps reduce specific energy consumption with an associated market-based mechanism in 11 energy-intensive industries. The first cycle of this scheme has been fairly effective, with a high compliance rate. The Bureau's star-labelling programme aims to phase out inefficient household appliances such as refrigerators, air conditioners, etc. Similarly, fuel efficiency norms for vehicles aim to leap-frog to EURO VI standards by 2020, from EURO III in most parts of the country and EURO IV in major cities. While conceptually promising, a more serious and strategic focus on demand-side planning, to include technological improvements and behavioural shifts, could feed into managing and reducing future energy requirements.

Governance

Three key issues animate Indian energy governance discussions. Firstly, the need for introducing regulators and strengthening their independence has been articulated across areas (such as coal, nuclear, oil and gas). Secondly, resolving the pricing regimes of different energy sources is necessary. For example, there are multiple prices for natural gas in India. Thirdly, there is a need to integrate energy demand and supply considerations within the planning system.

A robust governance structure with a successfully functioning electricity sector is crucial for an energy transition. However, India is plagued with a distressed distribution sector. Power distributing companies experience financial losses due to inefficiencies of generation and distribution, below-cost-recovery pricing and the increasing cost of supplying power (Pargal & Banerjee, 2014). Energy tariffs are intended to be set by electricity regulators, but are often influenced by political considerations. The regulated tariffs are partly cross-subsidised by high-paying sectors, and partly by subsidies from state governments, payment of which is often delayed. A scheme (Ujjwal DISCOM Assurance Yojana) to improve the financial health and performance of power distribution companies was launched in 2015, and is considered significant to the sector's future governance.

Climate change

Historically, climate change has not been central to Indian energy policy. However, since 2007, India has begun focusing on the climate implications of its developmental policies. The launch of the National Action Plan on Climate Change (2008) centred on the theme of "co-benefits", i.e., actions that address developmental concerns but also have climate benefits (PMCCC, 2008). Subsequent state climate action plans and state- and city-led initiatives to develop climate-resilient green growth strategies further provide an institutional platform for mainstreaming climate concerns in development planning. This link between energy, climate and development was made explicit by India's climate pledge ahead of the Paris Agreement in 2015.

Policies such as energy efficiency schemes, a clean energy cess (Box 1) and domestic targets such as 100 GW of solar will play an important role in fulfilling India's commitments to reducing emission intensity from 33–35 percent over 2005 levels, and to achieving 40 percent of non-fossil-fuel-based power capacity by 2030 (MoEF, 2015). While these developments have stemmed from the missions begun under India's Climate Plan, they are primarily driven by the development objectives of growth, security and sustainability.

India and international energy cooperation

India's international energy cooperation has centred on two related objectives: energy security, focusing on access and supply; and climate change (Dubash, 2011a). As a large energy consumer, India's energy diplomacy was historically driven by the need to ensure supply and access to resources. Climate change, while secondary, has now also become an important motivator (Dubash, 2011b; Michaelowa & Michaelowa, 2012). In addition, geopolitical concerns play an implicit role in energy cooperation. Overall, Indian bilateral, regional and multilateral efforts for energy cooperation have seen mixed results, with some efforts materialising faster than others.

BOX 1: POLICY INNOVATION FOR PROMOTING CLEAN ENERGY: CLEAN ENVIRONMENT CESS

The Clean Energy Cess on coal, lignite and peat produced in the country was launched in 2011, at a rate of INR 50 per million tonnes. The cess was progressively revised upwards to INR 100/tonne in 2014–2015 and to INR 400 in 2016–2017. While originally initiated to help reduce emissions and fund clean energy, the cess was renamed in 2016–2017 to a Clean Environment Cess, to broaden its scope. The revenue generated is used for the National Clean Energy Fund to finance clean energy projects and environmental conservation. The polluter pays principle of the cess is a step in the right direction, but two concerns arise: its impact on the coal and electricity sector (Chakravartty, 2015), and its use for activities outside the mandate of the fund (Bhaskar, 2015). Greater clarity and study are required on the scheme's goals for its more efficient use.

Bilateral efforts

Bilateral efforts have strengthened Indian ties with energy supplying nations – historically the gulf countries, with a later expansion to other countries and agendas. Initially, fuel supply agreements, and transnational pipelines, although with limited developments, were seen as a means of securing supply and strengthening political relations. In a more mercantilist approach, acquiring access to energy resources (coal, oil and gas, uranium, etc.) in other countries is still central to Indian policy (De Oliveria, 2008). For instance, supported by diplomatic efforts, Indian oil and gas companies have acquired resources in 24 countries (MoPNG, 2015).

Over time, India's bilateral dialogues have evolved beyond fuel supply. Clean fossil technologies, renewable energy and technology transfers are now key, with a view to increasing trade and investment and deepening cooperation. Successful examples include the Indo–German Energy Forum (2006) to promote energy security, energy efficiency and renewable energy. This resulted in the Climate and Renewable Alliance, a technology, innovation and finance partnership emphasising co-benefits for affordable renewable energy access and initiating trilateral assistance programmes. Its other recent notable outcome is support for the Green Energy Corridors to link solar and-wind sites with major demand centres (GIZ, 2015). Another example of bilateral success is the Indo–US partnership. Its recent feature, the Partnership to Advance Clean Energy (2009) has helped mobilise USD 2.4 billion to finance clean energy projects, and includes a focus on solar, off-grid technologies, biofuels, energy efficiency, smart grids, energy storage and cleaner fossil energy (USDoE, 2015). Overall, bilateral efforts that involve open exchanges and develop concrete measures to address key challenges and support policies on the ground have been successful.

Regional initiatives

Energy cooperation is a focus area in the charter of the South Asian Association for Regional Cooperation, to which India is a party. The narrative is based on enhancing energy cooperation within the region, especially energy trade, leveraging member countries' comparative advantages (e.g., hydro capacity in Bhutan; India's expertise in solar, wind, oil and gas). Joint emergency response mechanisms, such as strategic petroleum reserves, sharing of energy infrastructure for mutual development, and enhanced energy security have also been discussed. In 2014, the countries signed a framework agreement for cooperation to eventually enable a regional electricity grid.

India's regional efforts have also boosted other sub-regional initiatives, such as a multi-modal transport route between India, Bangladesh and Myanmar, and developments on a sub-regional electricity grid between Bangladesh, Bhutan, Nepal and India. While regional efforts have achieved limited material gains, primarily due to historical political mistrust between countries, they have nevertheless fostered an energy dialogue.

International engagement

India's international energy engagement has received a stimulus through its participation in several multilateral forums, including the G20, International Energy Agency (IEA) and International Renewable Energy Agency (IRENA). Within these fora and organisations, India influenced discussions in two issue areas: nuclear energy and technology transfer.

India's nuclear energy diplomacy, motivated by energy security and emissions reductions, was pursued in both bilateral and multilateral efforts (Grover, 2006). Specifically, the India–US Civil Nuclear Agreement of 2008 lifted the de facto embargo on nuclear power technology, and the uranium trade with India. Since then, India received clearance from the International Atomic Energy Agency for its civil nuclear plants and for importing uranium in the 2008 Nuclear Suppliers Group (to which India is campaigning for a permanent position). While the extent to which nuclear energy might play a role in the energy future remains to be seen (Joshi, 2015), geopolitically it remains an important factor.

India's stance on the need for technology transfers for developing countries has played an important international role. It informed the development of the Technology Mechanism in COP15, and subsequently the Technology Executive Committee and Climate Technology Centre and Network (UNFCCC, 2010). More recently, at COP21, India was instrumental in setting up the International Solar Alliance (ISA). Conceived as a coalition of solar-rich countries, the alliance aims to promote, disseminate and deploy solar energy, facilitating clean energy transitions for developing countries through technological and financial support. The alliance will supplement the efforts of existing multilateral bodies and be headquartered in India, with the UN as a strategic partner. Under the UN target of providing sustainable energy for all by 2030 and increasing the share of renewables, the alliance aims for a platform to enhance solar cooperation (ISA, 2015). In June 2016, the World Bank and the ISA signed an agreement that aims to mobilise USD one trillion in investment by 2030.

Lessons learned from India

Driven by the objectives of development, energy security and climate change, India has made initial progress towards a more sustainable energy future through ambitious cross-sectoral plans. Specifically, its policies on promoting energy efficiency in large industries, levies on coal, and expanded renewable energy capacity are noteworthy. These objectives are also reflected in its growing bilateral, regional and international energy engagement, which focuses on ensuring energy supply, fostering clean energy cooperation and on technology transfers. A useful lesson to emerge from India's transition is the importance of considering the linkages and synergies between development and climate planning and implementation – a concern that is relevant across developing countries. India's success in achieving a sustainable transition will ultimately rest on examining – and often untangling – the key characteristics of its domestic energy sector within the global context of progress toward low-carbon transitions.

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10. Indonesia: A Long Way to Low-Carbon Development

Jens Marquardt[1]

Indonesia is the biggest energy consumer in Southeast Asia and the world's leading coal exporter. Its primary energy mix is dominated by oil and traditional biomass. Almost a third of its population lacks access to modern energy services. In recent years, Indonesia has made promising steps towards a more sustainable energy supply. It has almost completely abolished fossil fuel subsidies and has announced ambitious energy efficiency and renewable energy targets, particularly for geothermal energy. It also aims to reduce greenhouse gas emissions, and engages in related international initiatives. However, policy implementation remains a challenge.

With more than 250 million inhabitants, Indonesia is the fourth most populous nation worldwide. Abundant natural resources and a huge domestic market make the world's largest archipelago a regional economic heavyweight. Accounting for 36 percent of total energy demand in the region, Indonesia is by far the largest energy consumer in Southeast Asia (IEA, 2013). Since 2012, Indonesia has also been the world's top coal exporter. Despite significant potentials for renewables, fossil fuels dominate Indonesia's energy system. The central government has formulated incentives for renewables, encouraged private sector investments and improved energy efficiency, but the country struggles to tap its tremendous renewable energy potential. Political barriers, the abundant availability of coal and substantial subsidies for fossil fuels have long hindered Indonesia's low-carbon development. However, recent developments such as the passage of a comprehensive geothermal law and substantial cuts in fossil fuel subsidies represent promising steps towards more sustainable energy supply.

Energy sector dominated by oil, traditional biomass and coal

Though severely hit by the Asian financial crisis at the end of the 20th century, Indonesia's economy has witnessed stable growth rates over the last 15 years. The country has become the world's tenth-largest economy in terms of purchasing power parity and national income. Gross national income per capita has increased from USD 560 in 2000 to USD 3 630 in 2014 (World Bank, 2016). In parallel, demand for energy has outgrown domestic production, and Indonesia has become a net importer of oil and natural gas. Total primary energy consumption more than doubled between 2004 and 2014 (IEA, 2016) with energy demand growing by more than 8 percent annually over the past five years. CO_2 emissions have almost doubled between 2000 and 2011. Although Indonesia's average per capita electricity consumption (814 kWh) is still relatively low, energy demand is expected to increase substantially over the next decades (IEA, 2016). The International Energy Agency (2013) estimates that the Indonesian economy will grow by an average of 4.9 percent annually until 2035. The population is expected to grow by 0.9 percent per annum, reaching 301.5 million in 2035.

Indonesia's energy mix is dominated by fossil-based energy sources. For total primary energy supply, crude oil and oil products account for 33 percent, followed by biofuels and waste (26%), mainly due to the use of traditional biomass. Coal and natural gas cover 16 percent each. Geothermal (8%) and hydro (0.6%) play a minor role (IEA, 2016). Due to Indonesia's

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development and industrialisation, energy demand is expected to grow by 2.5 percent annually, reaching 358 million tonnes of oil equivalent (Mtoe) in 2035, compared to 196 Mtoe in 2011 (IEA, 2013). For 2050, total primary energy supply is expected to reach 1 000 Mtoe. Over that period, the share of renewables in the primary energy mix is even predicted to decrease, due to higher overall demand, electrification programmes and decreasing consumption of traditional biomass. The use of traditional biomass and waste for energy is particularly prevalent in remote areas. In 2013, 39 percent of the population (98 million people) relied on firewood, charcoal and other forms of biomass (IEA, 2015). Biomass and waste account for nearly 18 percent of total primary energy consumption (IEA, 2015).

Being one of the world's leading producers of palm oil, Indonesia launched a biofuel development programme in 2006 to reduce the country's dependence on oil imports and support the domestic agricultural sector. For public and private transport, Indonesia aims to replace 30 percent of total diesel consumption with biodiesel by 2025, while bioethanol should reach at least 20 percent in 2025 (Wright & Rahmanulloh, 2016). Although growing domestic demand powers palm oil-derived biodiesel production, the government is well behind its targets. Biofuels accounted for less than 2.4 percent of total energy consumption within the transport sector in 2014 (IEA, 2016).

In 2013, on-grid electricity consumption was approximately 198 TWh. Coal (48% of installed electricity generation capacity) together with oil (12%) and natural gas (22%) cover the largest shares, leaving 18 percent of installed capacity to renewables, comprising hydro (11%), waste heat (5%) and geothermal (2%). For off-grid areas, diesel generators remain the dominant technology, despite the increasing number of widely distributed solar home systems that are mainly provided by the Indonesian Government and international donor agencies. Electricity demand is expected to almost triple between 2011 and 2035, at an average annual growth rate of 4.8 percent. Although the share of renewables in electricity generation is expected to increase slightly, coal-fired generation and natural gas will still dominate the future electricity mix. Whereas coal is expected to increase five-fold between 2011 and 2035, additional capacities from renewables will be much more moderate (IEA, 2013).

Despite Indonesia's rapidly growing energy demand, energy resources remain an important sector for export revenues. In 2012, 20 percent of all merchandise exports came from oil and gas, accounting for 24 percent of total state revenues (EIA, 2015). In 2015, Indonesia exported about 366 million tons of coal, leaving only 87 million tons for the domestic market (Indonesia Investments, 2016). Indonesia has coal reserves totalling approximately 32 billion tonnes, but economically retrievable resources (7.3–8.3 billion tonnes) could be depleted between 2033 and 2036 at current prices (Jensen, 2016). Indonesia also remains the region's largest oil producer, at 890 000 barrels of oil per day (IEA, 2013), but oil imports have already surpassed exports in the former OPEC member state. Indonesia is Southeast Asia's biggest natural gas supplier and exports roughly 45 percent of its production (IEA, 2013).

High fuel subsidies are a major political concern and hinder the development of alternative energy sources. Subsidies accounted for 7–25 percent of annual public expenditure between 2005 and 2013. In 2012 alone, Indonesia spent USD 36.2 billion in fuel subsidies (EIA, 2015), equivalent to around 4.1 percent of annual GDP. At the same time, less than one percent of GDP was invested in infrastructure (Benes et al., 2015). State-owned companies such as Perusahaan Listrik Negara (responsible for electricity generation, distribution and transmission) and Pertamina (in charge of oil and natural gas) control most energy infrastructure but struggle to improve or expand the system. Private sector activities are highly restricted in these state-controlled markets (EIA, 2015).

Reform of fossil fuel subsidies has been on the political agenda since the 1990s. A massive price increase due to subsidy cuts immediately after the Asian financial crisis in 1998 triggered widespread civil unrest that forced former President Haji Mohamed Suharto to step down. Another substantial reform in 2005 was backed by awareness raising campaigns, social spending in infrastructure and education as well as direct payments to the poor, which proved successful in preventing unrest. In 2014, Indonesian President Joko Widodo decided to almost completely abolish fuel subsidies. Since 2015, only minimal subsidies remain on diesel for public transport and underprivileged fishermen (Roberts, 2015). The drop in global oil

prices minimised the impact of the subsidy cut for consumers. Gasoline prices in January 2015 were even slightly lower than the subsidised price. While cutting fuel subsidies, President Widodo aims to foster investment in infrastructure, education and public health. This strategy has so far prevented public resistance. Additional social protection programmes underline the new government's political will to improve social services (Benes et al., 2015). Political leadership, together with a budgetary crisis and the lowest world oil prices since 2009, provided a window of opportunity for the Indonesian Government to remove gasoline subsidies without encountering significant protests. For 2016, energy subsidies are estimated to account for less than USD four billion in the state budget. However, subsidies for electricity and certain petroleum fuels remain in place (ADB, 2015).

Indonesia's energy situation is also shaped by the country's geographical fragmentation. Centres for demand and supply are unevenly distributed across the archipelago. The island of Java accounts for more than half of the country's population and more than 60 percent of national GDP (BPS Indonesia, 2014). Consequently, in terms of energy demand, Java and Bali consume more than 80 percent of the country's electricity. Whereas electricity access on both islands exceeds 80 percent, it is less than 60 percent in provinces like Kalimantan and Sulawesi, and less than 30–40 percent in areas like Nusa Tenggara and Papua (Beranda Inovasi, 2013). While in 2013, about forty-nine million Indonesians (19 percent) still lived without access to modern energy services, the central government seeks to provide modern electricity access to 99 percent of the population by 2020 (IEA, 2013).

Clean energy development: ambitious plans but lack of implementation

Despite Indonesia's abundant fossil-based resources, the government aims to diversify its energy portfolio and exploit new options for meeting growing energy demand and reducing dependency on diminishing oil, coal and natural gas reserves. According to Indonesia's National Energy Plan, "new and renewable energy sources" (which includes nuclear, hydrogen, coal bed methane, liquefied coal and gasified coal) should account for 23 percent of the country's energy mix by 2025. This would require these energy sources to grow more than eleven-fold, the use of gas to more than double and coal to more than triple by 2025 (IEA, 2015).

Indonesia has significant potential for hydropower (76 GW), solar (4.8 kWh/m²/day), biomass (33 GW), and wind (3–6 m/s), and the country holds 40 percent of the world's geothermal reserves (28 GW) (Tharakan, 2015). In addition, supportive policies for biomass and waste (feed-in tariff, 2014), solar (auction programme, 2013) and geothermal (geographically based tariff, 2014) recently came into effect. Indonesia has already established substantial geothermal capacities, particularly after the oil crises of the 1970s, but most potential remains untapped due to social and political constraints. The passage of the 2014 Geothermal Law indicates an important step forward. The law streamlines the formerly fragmented authority of government institutions, facilitates licensing procedures and declassifies geothermal as "mining activity", thereby allowing for development of geothermal projects in protected forest areas. The adoption of this law demonstrates that progress for renewables is possible even in a highly decentralised political system with various competing actors, multiple administrative levels and numerous potential veto players, such as the Ministry of Forestry (World Bank & ADB, 2015). In 2010, a Directorate General of New and Renewable Energy and Energy Conservation was established under the Ministry of Energy and Mineral Resources, to streamline clean energy activities. Government-run investment programmes and private initiatives also contribute to renewable energy deployment. For 2016, at least USD 1.37 billion of renewable energy investment is expected (Mahapatra, 2016).

Numerous donor-driven and government-led renewable energy projects have failed to provide sustainable energy access for Indonesian off-grid areas, but a few successful projects show that cooperation with local partners, private sector involvement, demand-driven solutions, appropriate technologies and awareness among local financing institutions are key to sustainable small-scale renewable energy projects. As an example, donor agencies and private companies have successfully installed more than eleven thousand biogas reactors in nine Indonesian provinces under the Biogas Rumah programme. Farmers were able to implement small-scale biodigesters for electricity, and to substitute kerosene with the help of crediting schemes provided by local banks. Local organisations

are also responsible for maintaining the systems. Implemented by the German donor agency GIZ, the Energising Development initiative is a good example for necessary capacity building. Being part of a global energy access partnership for numerous countries in Africa, Asia and Latin America, the Energising Development Indonesia project supports micro-hydropower and photovoltaic mini-grid installations that are community operated and administered. Rather than installing these systems, the initiative focuses on monitoring, troubleshooting and capacity building at different levels to improve ownership and establish systems that can be self-sustained without external support. Technical inspections, training for village management teams and a national hotline system are part of the service. As of 2016, Energising Development Indonesia has supported almost three hundred micro-hydropower and more than two hundred photovoltaic mini-grids under different government and non-government programmes.

Given the prospect of declining oil production in the near future, energy efficiency has also become an increasingly important strategic priority for Indonesia. The National Masterplan for Energy Conservation outlines the central government's aim to promote energy efficiency measures and reduce energy intensity by one percent per annum until 2025. The plan sets an energy conservation target of 15 percent for households and the commercial sector, 17 percent for industry and 20 percent for transportation, to be achieved by 2025 (DEN, 2016). Between 2010 and 2012, primary energy intensity has been reduced by five percent annually (IEA & World Bank, 2015).

Despite these ambitious targets for low-carbon development, a number of political and institutional factors have constrained progress. The country's highly decentralised political system, combined with limited local capacity, high levels of corruption and inter-ministerial tensions within the national government impede effective implementation of policies for promoting renewables (Ardiansyah, 2011). Local governments were given the right and responsibility to issue concessions and licenses for renewable energy, but they have very limited capacity for understanding the implications of various energy scenarios. Other obstacles are related to the perceived risks associated with renewable energy investments. Due to the comparatively high up-front costs and weak local capacity for operation and maintenance, financing institutions consider renewables to be high-risk investments. Consequently, loan interest rates are high. Furthermore, the permit process can be lengthy and unpredictable due to corruption or lack of technical expertise. Additional barriers include land availability issues resulting from potential conflicts with agriculture (especially for hydropower projects) or protected forests (particularly for geothermal sites), and a lack of reliable data on the availability of renewable resources for implementing feasible projects (Marquardt, 2014).

High ambitions at the international level

Providing affordable and reliable energy mainly through fossil fuels is a key priority of Indonesia's medium-term development plan. The country also encourages renewables and low-carbon development through international initiatives, but these efforts largely depend on international support and access to finance. Established with strong support from the International Energy Agency in 2016, the Bali Centre of Excellence for Clean Energy aims to attract international research collaboration for renewable energy and energy efficiency. International events such as the Bali Clean Energy Forum underline the government's commitment to maintain the topic high on the agenda. Indonesia is already a member of the International Renewable Energy Agency and joined the newly created Mission Innovation initiative during COP21 in Paris, to double investments in clean and sustainable energy. In 2015, Indonesia became one of the first associated members of the International Energy Agency. According to its Intended Nationally Determined Contribution, communicated to the United Nations Framework Convention on Climate Change, Indonesia seeks to reduce emissions by 41 percent below business-as-usual projections by 2030 with international support (Government of Indonesia, 2015). In other words, access to foreign assistance and investments is considered a precondition to achieve this target.

Bilateral energy partnerships such as the joint government-to-government cooperation between Indonesia and Denmark should foster knowledge exchange about renewable energy technologies and related policies and regulations (Danish Energy Agency, 2016). Indonesia also supports the ASEAN Plan of Action for Energy Cooperation. The plan aims to increase the

share of renewable energy to 23 percent by 2025 in the ASEAN energy mix, reduce energy intensity by 20 percent in 2020 based on 2005 levels, enhance awareness for renewables, foster research and development networks across the region and increase the commercial utilisation of biofuels (ASEAN Centre for Energy, 2015). Despite these broad visions and declared commitments, the Indonesian Government has yet to demonstrate how it intends to actually implement its ambitious plans.

Subnational authorities remain a critical barrier. However, Indonesia's decentralised political system also allows for local clean energy and climate activities: Jakarta is part of the C40 Cities Network steering committee; Cities such as Medan, Yogyakarta and Surabaya are members of Local Governments for Sustainability (ICLEI); Bogor and Balikpapan have become model cities under the international Urban Low Emissions Development Strategies programme due to energy efficiency principles and waste-to-energy projects.

Three promising lessons from Indonesia

Considering the dominance of fossil-based energy in Indonesia's energy mix, the country cannot be described as a frontrunner in terms of sustainable energy deployment and low-carbon development. Nonetheless, Indonesia provides some promising impulses for a global energy transition towards renewables. In particular, three lessons can be drawn: Firstly, having the largest geothermal potential in the world, Indonesia could become a global hub for geothermal energy development. Although regulatory obstacles previously prevented stronger exploitation over decades, the 2014 Geothermal Law provides a strong signal of the national government's political will and ability to act in favour of renewables despite a highly complex political system (World Bank & ADB, 2015). Secondly, the national Biogas Rumah programme and its support from various donor organisations has demonstrated that small-scale renewable energy projects for off-grid areas can be sustained successfully at the local level. Technologies adapted to farmers' needs, capacity building for local maintenance and appropriate financing schemes provided by local banks were critical factors for the successful dissemination of small-scale biodigesters. Rather than simply distributing the systems to selected households, the programme created ownership of the facilities and established a niche for local business models that can be sustained beyond the donors' intervention. Identifying these niches is critical for renewable energy projects in developing countries around the world. Finally, Indonesia managed to cut its fossil fuels subsidies despite increasing energy demand and a strong dependency on oil and gas. In 2014, the global oil price drop was instrumental in this step, as the government could remove subsidies without significant impacts on consumer prices. Investments can now be reallocated to energy infrastructure investments and social services, but it remains to be seen how effective and well accepted these reforms will be in the light of increasing fuel prices on the global oil market.

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11. Japan: Dominated by Fukushima and Tackling Hard Problems in Decarbonisation

Llewelyn Hughes[1]

Japan's energy policy remains dominated by the Fukushima nuclear disaster of 2011. While the government continues to be committed to nuclear power, its future is uncertain. Japanese greenhouse gas emissions have increased significantly as nuclear energy has been replaced by gas and coal. Ambitious policies in the transport sector promote battery electric and fuel cell vehicles. The introduction of feed-in tariffs favoured the build-up of non-residential solar photovoltaics. As part of its climate commitments, Japan aims to further expand the use of renewables, improve energy efficiency and restart nuclear energy.

The changing role of nuclear power in Japan's energy mix

Japan's energy policy remains dominated by the tsunami and nuclear disaster of 11 March 2011. The disaster had two effects that continue to reverberate through Japanese energy policy, including on sustainable energy.[2] Firstly, it reduced the share of nuclear power in the electricity system. Secondly, it led to changes in the decision-making process, which increased uncertainty concerning Japan's nuclear power planning and development.

The Japanese Government has long placed security of energy supplies at the centre of energy policy planning, informed by the country's lack of domestic fossil fuel resources. Prior to the 2011 disaster, increasing nuclear power was positioned by the government as the centrepiece of its plans to manage energy security and environmental risks. In 2010, for example, the government announced a target of achieving 70 percent self-sufficiency in energy by 2030. Central to this target – other than equity stakes in upstream oil and gas projects outside Japan's shores – was the extension of "zero-emission" power – defined as renewables and nuclear power – to 70 percent of the total power base by 2030. The plan outlined nine new nuclear units to begin operation by 2020, and a further 14 units by 2030, with plant efficiency also increased from 60 percent in 2008 to 85 percent by 2020 and 90 percent by 2030 (Government of Japan, 2010).

These goals have changed as a result of the disaster. The Japanese Government remains committed to nuclear power; however, the projected share of nuclear power in electricity generation has fallen, and almost all the country's 54 nuclear units remain shuttered five years after the disaster. In the supply–demand projection released in July 2015 that provides the basis for long-term Japanese energy planning, nuclear power is designated as 20–22 percent of total generated electricity by 2030 (Government of Japan, 2015).

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[2] I use the definition of "sustainable energy" adopted by Testar et al. (2005). That is, "A living harmony between the equitable availability of energy services to all people and the preservation of the earth for future generations." (Testar et al., 2005:xxi).

This reduced role for nuclear power is also reflected in the 2014 Basic Plan on Energy. The 2014 Plan notes that overall emissions from Japan increased by 83 million tons of CO_2 equivalent, even while emissions from outside the power sector fell by 29 million tons between 2010 and 2012. The difference, according to the 2014 Plan, was due to the rise in emissions from the power sector as thermal power replaced nuclear in the power mix. The report further notes that the "situation could raise doubt about the attitude of Japan, which has until now led the international fight against global warming." (Government of Japan, 2014: 11).

The government's position towards nuclear power is uncertain. On the one hand, in the 2014 Plan nuclear power was reconfirmed as an "important base-load power source", which caused public controversy, given increased safety concerns in the wake of the Fukushima nuclear disaster. On the other hand, the government recognised the weakened public support for nuclear power, stating that "nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation." Nuclear power is proposed to be gradually replaced by incremental increases in the use of natural gas and thermal coal, with the latter noted as being "re-evaluated as an important base-load power supply" (Government of Japan, 2014: 25).

Other energy policies remain in place or are receiving greater attention. Long-term energy planning, for example, predicts a 17 percent reduction in total energy demand resulting from energy efficiency measures (Government of Japan, 2015). This builds on the government's long-term emphasis on demand management, implemented through the Act on the Rational Use of Energy, and associated legislation. The centrepiece of Japan's energy efficiency strategy, in addition to tax incentives and subsidies, is the Top Runner programme, which incentivises manufacturers to improve standards to those of the most energy efficient product on the market. The programme is implemented across multiple sectors of the economy, and government data suggest it has been successful in improving energy efficiency using a name-and-shame enforcement mechanism.

Japan's next-generation vehicles strategy has also been retained and expanded since initially being announced in April 2010. Battery electric vehicles represented a new demand segment that could also make use of Japan's nuclear capacity during off-peak hours. Nevertheless, the decrease in nuclear capacity has not diminished the government's continued enthusiasm for promoting technologies that reduce the role of oil in the transport sector. The initial strategy aimed for 15–20 percent battery electric and 20–30 percent plug-in hybrid vehicles among new car sales by 2030. The new growth strategy passed by the Japanese cabinet in June 2014 sets a target of 50–70 percent of new vehicle sales to be from next-generation vehicles, such as battery electric and plug-in hybrids, by 2030. The government continues to support the roll-out of these vehicles by subsidising the development of next-generation vehicle-related charging infrastructure, although their efforts are complicated by the differing technological choices made by Japanese auto manufacturers, with some focusing on fuel cell technologies or battery electric vehicles, and others adopting a portfolio approach by investing in both.[3]

The nuclear disaster has thus had mixed effects on Japan's energy sustainability policies. On the one hand, it reduced the role of nuclear power in the electricity mix, which increased the use of fossil fuel – including thermal coal – in power generation. Japan's power utilities announced almost 12 000 MW of new thermal capacity between July 2011 and August 2016, with the majority natural gas. This has led to a marked increase in Japan's measured CO_2 emissions relative to the year prior to the disaster.

While the government remains focused on nuclear restarts, institutional changes and the rise of local politics represent continuing barriers to increasing the role of nuclear power. Indeed, a June 2016 report by Japan's influential Council of Business Executives *(Keizai Doyukai)* expressed doubt that the more modest goal for nuclear restarts can be met, because of

[3] The 2016 government budget includes, for example, a new budget item of 2.5 billion yen for subsidising charging infrastructure.

decreased social acceptance and the increased safety requirements put in place by the safety regulator (Japan Association of Corporate Executives, 2016).

Revising incentives for renewable energy

The second important issue facing the government is to reform incentives for the uptake of renewable energy. Japan introduced a feed-in tariff in 2012, targeting solar photovoltaics (PV), wind, geothermal, hydropower and biomass. Tariff rates for solar photovoltaics, both residential and non-residential (defined as equal to or greater than 10 kW), have been reviewed annually. Utility-scale solar PV rates, for example, fell from 40 yen/kWh in 2012 to 24 yen/kWh in 2016, reflecting rapid falls in system prices, while the rates for other systems have largely remained unchanged[4] Other types of renewable energy installations have lagged solar photovoltaics. Since the introduction of the feed-in tariff in 2012, non-residential solar photovoltaics have taken up 87.4 percent of installed capacity registered under the feed-in tariff, with residential solar making up 5.2 percent, biomass 3.4 percent and wind power 3 percent (Agency of National Resources and Energy, 2016).

The reasons for this imbalance in the effect of the incentive are various, including the lack of suitable locations for onshore wind in close proximity to the population centres of the Tokyo and Kansai regions, and the comparative lack of capacity in regional interconnects in Japan's regionalised high-voltage transmission lines.

An expert performance review of the feed-in tariff identified a number of other issues with the existing incentives. Firstly, the structure of the feed-in tariff gave an incentive for market participants to register projects even if they were far from the development phase. This meant there were a large number of projects that were yet to begin development even though they had been registered under the feed-in tariff (METI 2016a).

Secondly, the annual review of tariff rates created uncertainty for projects with long lead times, even though they remained unchanged for most power sources other than solar photovoltaics. The revision thus enables rates to be set on a multi-year basis, in order to reduce regulatory uncertainty. The government also intends to provide estimates of its projected prices on a fuel-basis for industrial customers.

Thirdly, capital and operating costs are high relative to other countries, with one estimate putting solar PV and wind power at USD 218/MWh and USD 155/MWh respectively, compared with USD 106/MWh and USD 80/MWh in Germany (Government of Japan, 2016a). Concern within the government regarding the household costs of the feed-in tariff led it to plan the implementation of capacity tenders for non-residential solar photovoltaics, following the German example. Given the concern with costs, and issues with the design of the feed-in-tariff system, the government is increasingly concentrating on reducing the potential costs for households of promoting renewable energy, while also seeking to meet the long-term goal of increasing renewable energy in the power mix to 22–24 percent by 2030. Revisions to the feed-in tariff incentives take effect from 1 April 2017 and are designed to resolve the issues outlined above.

Future choices concerning generation investment will be influenced by the effects of power market liberalisation on the investment choices of incumbent power utilities and new market entrants, in addition to revisions to the feed-in tariff incentives and the ongoing effect of the nuclear disaster. In general terms, there is some evidence that liberalised markets drive greater investment in natural gas, although this outcome is affected by the policy setting of government in addition to the economics of power plant development (Roques et al., 2008). In the case of Japan, the data show that utility companies are overwhelmingly investing in natural gas facilities. New market entrants, on the other hand, have invested in significant volumes of thermal coal.

Government efforts to introduce competition into the power and gas sectors predate the March 2011 disaster. Japan's power market has traditionally been dominated by regional power utilities, which were

[4] Exceptions are offshore wind, for which a new tariff was introduced from 2015 at 36 yen/kWh, and small-scale (2000 kW) biomass, which saw its tariff increase from 32 to 40 yen/kWh.

regulated monopolies within their service areas. Previous efforts at liberalising the power sector enabled competition in the industrial and commercial segments of the market, but led to few customers to change providers, and volumes in the wholesale power market remained low.

The government has now committed to a three-stage plan to liberalise the power market, with the first two stages already passed into law. In phase one, a system operator was established to oversee the management of power flows between the Balkanised service areas of the power utilities, and to enable the neutral treatment of new generation to the transmission grid. In fiscal year 2015 – the first full year of operation – the organisation received 2,300 requests for connection, 75 percent of which were from solar photovoltaic projects (Organization for Cross-regional Coordination of Transmission Operators, 2016). In the second phase, the power sector was opened to competition at the residential level, with competition beginning from 1 April 2016. In the third stage, slated for 2018–2020, utility companies will be required to separate the operation of transmission and distribution from generation and sales, with the goal of ensuring neutral operation of the transmission grid. The implications of these reforms for the final power mix will be determined by their effects on the investment choices of the incumbent utilities, the amount of competition introduced into the generation market and the effects for third-party access to the transmission grid.

Japan and international energy cooperation: between security and sustainability

Japan is a member or party to numerous international agencies and agreements related to energy cooperation, such as the International Energy Agency (IEA), the International Renewable Energy Agency, Asia-Pacific Economic Cooperation (APEC), the G20, the World Trade Organization and the United Nations Framework Convention on Climate Change (UNFCCC). The Japanese Government also supports private sector initiatives in standards and code-setting activities, through the International Organization for Standardization and other bodies.

The Japanese Government also plays a significant role in providing development assistance in the energy sector, particularly to the Asia-Pacific region. Between 2010 and 2014, Japan was the worldwide largest bilateral donor in the energy sector (own calculation, based on data from OECD.stat). Much of its energy-related development cooperation focuses on infrastructure development, with the largest share of assistance going to investments in electricity transmission and distribution, followed by hydropower, coal and gas-fired power generation. Energy diplomacy is also a core part of the Japanese Government's portfolio of activities in international cooperation, informed by its concerns about enhancing energy security. In addition to participating in IEA stockholding obligations, the government also developed a programme to provide international support for the fossil fuels exploration and production activities of Japanese companies, with the goal of diversifying their geographic supply and improving the competitiveness of Japanese resource companies.

In sustainability terms, the most important recent international commitment made by the Japanese Government is the Intended Nationally Determined Contribution (INDC) submitted in July 2015. While the ambition of Japan's INDC has been criticised, its credibility is relatively high, given that it was developed through a bottom-up process of coordination between the government and industry. The figures reached on an industry basis can thus be understood as consensus figures reached through negotiation between business and government. It sets a post-2020 target to reduce greenhouse gas emissions by 26 percent by 2030 relative to 2013, equivalent to a 25.4 percent reduction compared to 2005. In terms of energy, which makes up 90 percent of national greenhouse gas emissions, the INDC commits to a reduction of 25 percent relative to 2013 (24 percent reduction relative to 2005). The majority of these initiatives are domestic in nature, and focus on expanding the use of renewable energy, restarting nuclear power, and increasing the efficiency of thermal power generation (2030 emissions target of 73 million tons of CO_2 equivalent, compared to 104 million tons in 2005) and other measures.

Crucial areas identified by the government are to improve energy efficiency in the industrial sector (2030 emissions target of 401 million tons of CO_2 equivalent, compared to 457 million tons in 2005) and promoting energy saving in the residential sector (2030 emissions target of 122 million tons of CO_2

equivalent, compared to 180 million tons of CO_2 equivalent in 2005). These are ambitious targets, given Japan's low energy intensity. The government focuses on achieving them through incremental improvements across the industrial, commercial and residential sectors, through encouraging improvements in manufacturing processes, supply chain management and building construction. Japan's energy efficiency law is notable in that it has been revised numerous times as successive governments have sought to improve the incentives to industry, particularly to use energy more efficiently.

Japan's commitment made through the INDC does not focus on domestic measures alone. In addition to measures related to land use, land use change and forestry, the Japanese Government is promoting a Joint Crediting Mechanism (JCM) with the stated goal of reducing emissions globally on a least-cost basis through the implementation of projects outside Japan, while crediting marginal emissions reductions through these schemes to Japan. As of June 2016 Japan had signed bilateral agreements with 16 countries, with a large number of projects focused on energy infrastructure.[5] The JCM is not counted within the bottom-up calculation required to achieve the commitment under the INDC, but the Japanese Government does state that it will claim emissions credits from projects carried out under the JCM (Government of Japan, 2016b). It is able to do so under Article 6 of the Paris Agreement, which allows for international transfer mechanisms in order to enable countries to meet their INDC targets.

The lessons from Japan's transition towards sustainable energy?

The ongoing review process, which is a component of the Paris Agreement, offers an important opportunity for all countries to assess the performance of measures introduced to meet their commitments, as well as to disseminate information on which policies (ranging from market-based policies to command-and-control regulations) might be useful to other countries as they seek to develop their own sustainable energy strategies. An early and systematic cost–benefit analysis of Japanese sectoral measures as part of the UNFCCC process would be useful for identifying those measures that are most effective in terms of sustainability outcomes in the energy sector. Japan's Joint Crediting Mechanism has attracted some controversy. A review of the policy's effects on the sustainable energy policies adopted in partner countries would be useful for determining whether appropriate design can deal with measuring, reporting and verification issues; and the extent to which such measures function as complements to – or substitutes for – measures in the partner country; and on the ambitions of Japan's policy itself.

More importantly, Japan's commitment under its INDC also includes a large number of policy measures focused on shifting the supply of, and demand for, a range of different energy products and services, and here some measures could be relevant to global efforts to transition towards sustainable energy. Japan's commitments build on existing legislation implemented domestically, and negotiated with industry and other stakeholders. In the case of hydrofluorocarbon phase-outs, for example, the Fluorocarbon Emissions Reduction Act came into force on 1 April 2015 and includes a range of agreements on a sectoral basis designed to promote the introduction of low-Global Warming Potential gases.[6] It also forms the basis for subsidy schemes that support industry, as it makes investments in equipment in order to meet agreed-upon targets. In seeking to decarbonise the transport sector, the government is using a mix of subsidies for infrastructure investment, along with tax measures, to support the deployment of battery electric vehicles and fuel cell vehicles. Finally, Japan's efforts to promote energy efficiency build on incentives that appear to have successfully reduced energy intensity across a range of products in the economy.

[5] For a list of projects implemented under the JCM see http://gec.jp/jcm/projects/index.html.

[6] Global Warming Potential (GWP) measures the heat-trapping capacity of different atmospheric gases, normalised to carbon dioxide, which has a GWP of 1.

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12. Russia: A Gas Superpower Striving for Nuclear Expansion and Starting to Support Renewables

Alexander Gusev[1]

Russia has the fourth highest electricity demand globally. In the mid- and long-term, fossil fuels (gas, oil and coal) and nuclear energy will remain the backbone of Russian domestic and international energy policies. Russia is spearheading international support for nuclear power. Recent governmental decisions clearly show growing support for renewables. Despite overall budget cuts, renewable energy has for the first time received direct financial support from the federal budget. While energy efficiency policies have experienced substantial setbacks in recent years, gasification of public transport could further contribute to decarbonisation.

Increasing support for green energy with major reliance on fossil fuels

The Russian Federation remains one of the world's leading producers and exporters of fossil fuels. In 2015, it produced 12.4 percent of the world's oil, 16.1 percent of natural gas and 4.8 percent of coal (BP, 2016). It is also a key player in the nuclear sector in terms of uranium supply and enrichment services. The energy sector is of systemic relevance to the Russian economy, as export revenues are a major income source for the Russian budget. Despite the decrease in global oil prices, annual net profits of major Russian energy companies have continued to grow due to the combination of several factors such as low production costs, domestic currency devaluation and tax reforms. Moreover, oil production reached a record high in 2015 and continues to grow further. This is due to the so-called "tax manoeuvre", which implied a decrease in export duties for oil, therefore making exports more attractive for companies and stimulating them to maintain their production rates and export shares. In the gas sector, production volumes have declined, mostly due to decreasing domestic demand. Nevertheless, profits continued to grow, mainly due to currency devaluation, as oil and gas are traded in USD whereas Russia's investment programmes and budgets are calculated in rubles.

Russia has the fourth highest electricity consumption globally, after the US, China and India (IEA, 2015). Fossil fuels and nuclear energy still predominate in the electricity, heating and transport sectors. The break-down of electricity generation by source in 2015 shows that the largest share of electricity (65%) was produced by thermal power stations (Ministry for Energy, 2016a). Thermal power stations are mostly fuelled by gas in western and European parts of Russia and by coal in the Asian continental side. Electricity generation from nuclear energy has been growing steadily in recent years and accounted for 18 percent of total electricity generation in 2015. At the St. Petersburg Economic Forum in 2014, Vladimir Putin declared that Russia would increase the share of nuclear energy to at least 25 percent of total electricity generation. Electricity generation from renewable energy sources is mainly represented by hydroelectric power stations, which accounted for

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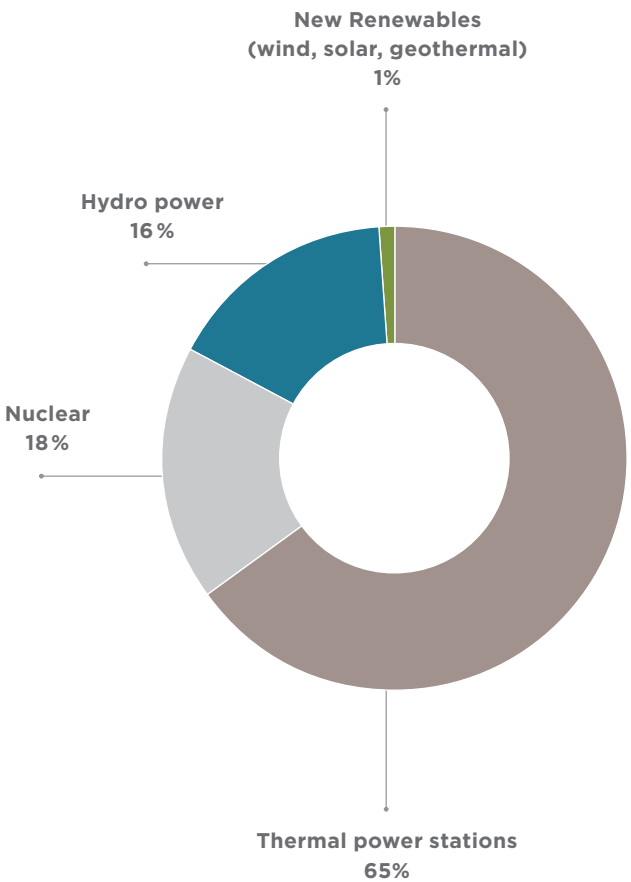
16 percent of electricity generation. Solar, wind, biomass and small-scale hydro power accounted for less than one percent of electricity generation. The government aims to increase the share of renewable energy, excluding large hydro power plants, to 2.5 percent by 2024. The key drivers are electrification of remote areas, and falling costs for green technologies versus increasing costs for the development of oil and gas greenfields. Furthermore, RusHydro, one of the key federal authorities dealing with renewable energy, actively engages in international cooperation on hydro power (Ministry for Energy, 2016a).

Therefore, electricity generation in Russia is characterised by steady growth of nuclear energy, stable position of thermal power stations and varying electricity production from hydro power stations, subject to seasonal fluctuations. In the mid-term, the electricity mix will not change substantially.

Figure 1: Electricity generation in Russia in 2015



Source: Federal Ministry for Energy, 2016

In the heating sector, heat-only boiler stations – working on gas, diesel or pellets – and central heating plants play the key role. The current situation in the heating sector is characterised by growing decentralisation. Since many large companies prefer to use their own independent sources such as boiler stations, the useful output of central heating stations has been steadily decreasing because of low levels of cogeneration. Thus, the share of central heating plants and heat-only boilers in heating production in 2014 accounted for 33 percent and 67 percent respectively (Ministry for Energy, 2016b).

Major trends with regard to renewable energy

The motivation behind renewable energy deployment is primarily economic: costs for new oil and gas fields are growing whereas costs for renewable technologies are decreasing. There is a growing perception that renewable energy does not compete with gas and oil but rather supplements them when used in remote areas. As a result, political elites are showing an increasing openness to promote wind and solar energy in Russia.

The first governmentally defined targets on the share of renewable energy in the national energy mix were specified in the Energy Strategy of Russia up to 2030, adopted in 2009. According to the national strategy, the share of renewables was expected to amount to 4.5 percent by 2020 (Ministry for Energy, 2009) or 8.1 GWt in absolute terms. This would require an annual increase of around 1.7 GWt between 2015 and 2020 (Semikashev, 2015). However, in April 2013 the target indicator was decreased to 2.5 percent or 5.8 GWt.

In May 2013 Governmental Decree No. 449, establishing several financial mechanisms to support deployment of renewables, was adopted, with initial tenders following in September. Among the key measures supporting renewables were capacity delivery agreements, which made renewable energy projects profitable and guaranteed paybacks on the wholesale market. The capacity delivery agreement was a unique approach: in most countries, renewables receive support for the volumes of electricity generated, whereas in Russia financial support was provided for capacities installed (the only specification being the minimum generation output). However, the law encompassed support only for solar, wind and small-scale geothermal projects, therefore excluding biogas (Gusev & Westphal, 2015). Furthermore, the legislation aimed to support electricity produced only for the wholesale market, thus excluding the deployment of renewables in remote areas, where large potential is concentrated. Finally, the installation of new capacities was subject to the provision of local content, which required any project to use a certain amount of equipment produced in Russia.

Despite initial success in developing support mechanisms, the first tender for renewable energy, organised in September 2013, revealed some problems and was only partly successful. Firstly, as a result of the local content provision, the bids received were mostly for solar, as Russia has only one largescale domestic producer of solar panels and almost no domestic production of wind equipment. Consequently, there were few bids for wind energy and none for geothermal. Secondly, the tender imposed tough guarantee requirements on project participants, who were mostly represented by small and medium enterprises (Boute, 2014).

In 2015 the government expanded its support for renewables, and two further steps were made. Firstly, renewable energy received support on the retail electricity market (previously limited to the wholesale market) including those in isolated and remote areas, where the use of renewable energy is more cost-effective than diesel generation. Secondly, deployment of renewables in isolated and remote areas was exempted from the requirement for local content provision. Finally, the decree provided support for all kinds of renewable energy, including biogas, biomass and landfill gas (Russian Federation, 2015). In 2016, despite the budget cuts in many other spheres, renewable energy received for the first time direct financial support from the federal budget (Dyatel, 2016). The government also extended the deadline for putting solar and wind stations into operation, from 2020 to 2024, and reduced the local content requirements for wind energy equipment due to the lack of domestic manufacturers (Fomicheva, 2016).

Therefore, despite evident progress in developing a legal basis for renewable energy in Russia, many problems still remain. Among them are the very limited

number of bids, and the delayed commissioning of planned capacities from 2020 to 2024. Finally, at present, the main electricity companies do not include renewable energy in their plans for capacity development. Nevertheless, an important message is that the government plans to further support renewable energy. All key Russian conferences organised by the Ministry for Energy, such as the Eastern Economic Forum and St. Petersburg International Economic Forum, include sessions on renewable energy.

Bumpy road for energy efficiency

Energy efficiency policies previously received considerable impetus under the presidency of Dmitry Medvedev, but have experienced substantial setbacks in recent years. Enactment of the Federal Law on Energy Efficiency in 2009 and the State Program on Energy Savings triggered the development of Russia's legislative framework on energy efficiency. This has greatly improved Russia's ranking among countries implementing energy efficiency measures recommended by the International Energy Agency. The State Program included 89 target indicators to be achieved across all sectors of the economy: buildings, industry, transport, lighting, appliances and equipment. Between 2008 and 2011, positive results were achieved in sectors such as state-funded organisations, lighting, appliances and equipment. Implemented measures led to reduced energy consumption in new and renovated buildings; the implementation of energy-efficient equipment; installation of metering devices; and mandatory labelling of buildings. In addition, a special programme on harmonisation and implementation of European technical standards in the construction sector is being implemented. However, the rush to adopt the new laws, combined with lack of monitoring, resulted in poorly drafted legislation that has required numerous amendments (Gusev, 2013).

In April 2014, a new state programme, "Energy Efficiency and Energy Development", abolished the previous programme and all of its established indicators. The new programme is less detailed and less specific in terms of objectives, tools and targets. Furthermore, federal funding of energy efficiency measures for the period 2015–2018 was reduced from USD one billion to almost zero (Shapovalov, 2014). This might be a reaction to the inefficient policy on energy savings over the previous four to five years, as well as the deteriorating economic situation that necessitated spending cuts. As a final step, the Department for Energy Efficiency and Energy Saving within the Russian Federal Ministry for Energy was recently dismissed in 2016 (Energosovet, 2016). Nevertheless, energy efficiency still remains on the political agenda and will get a second chance in the light of the Paris Agreement and CO_2 reduction measures. Thus, the government plans to restart energy efficiency policies in 2017 (Davydova, 2016b).

The potential for decarbonisation of the transport sector

The transport sector is the second largest emitter of CO_2 in Russia (UNFCCC, 2015a). The main factor driving efforts to reduce CO_2 emissions in the transport sector is the deterioration of urban air quality caused by the steady increase in vehicle numbers. Key policies on decarbonisation in this sector support gas and electric vehicles, and the use of Euro-5 standards for fuel and vehicles. A number of practical steps have been taken to expand the use of natural gas in the transport sector, since it has a smaller environmental impact than widely-used diesel. Therefore, in 2013–2015 the transport tax for gas vehicles was decreased, and regions received additional subsidies for shifting public transport to natural gas and constructing compressed natural gas stations. The government aims to increase the share of gas transport by 2020 to 50 percent in cities of more than one million inhabitants, and to 30 percent in cities with 300 000 inhabitants. Taking into account considerable governmental support, these goals are likely to be achieved.

Secondly, the important policy on decarbonisation of the transport sector is increasing support for electric vehicles. A recent report on electric vehicles worldwide, published by a leading Russian energy consultancy, clearly shows emerging political interest in this topic (Vygon & Belova, 2015). The first practical step to promote the adoption of electric vehicles was the elimination of import tax in 2014. This was followed by regulations (Decree No. 890) incentivising the installation of recharging points at fuel stations. Tesla Motors plans to open five supercharger stations in Moscow and Saint Petersburg by the end of 2016. Despite these measures, the number of electric vehi-

cles in Russia remains small: 647 light vehicles out of forty-eight million (Voronov, 2016). However, to boost the development of electric vehicles in Russia, the Government has drafted an ambitious strategy for the period to 2025. The programme enumerates a number of monetary and non-monetary incentives for the owners of electric vehicles, such as the use of bus-only traffic lanes, exemption from parking charges in cities and decreased highway tolls. Among practical steps is a pilot project on electrification of public transport, launched in Moscow in 2016.

Thus, decarbonisation of the transport sector in Russia is just beginning. Key challenges include the lack of specific target indicators on energy efficiency and energy saving, and the lack of detailed data on energy consumption and emissions by different transport modes.

Russian engagement in international energy cooperation

In the international arena, Russia actively engages, above all, in oil, gas and nuclear projects, followed by climate negotiations and the deployment of renewables.

Regarding oil and gas cooperation, Russian companies are involved in all sections of the added-value chain, from production and processing to distribution and storage. Cooperation includes European, Asian, Latin American and American companies. Current gas projects include the Nord Stream 2, Turkish Stream, Altai pipeline and LNG projects. Oil projects include expansion of refinery capacities in Europe, asset swaps with Asian companies and development of new fields abroad.

Russia is one of the leading supporters of nuclear energy. The main reasons are of an economic nature, as nuclear projects require large up-front investment and are accompanied by long-term ancillary services. Furthermore, the Russian Federation National Nuclear Corporation (ROSATOM) is diversifying its portfolio of services that use nuclear technologies in various sectors. Currently, Rosatom is involved in nuclear projects in 40 countries in Europe, Asia, Africa and the Middle East (Rosatom, 2016). Apart from construction of nuclear reactors and uranium enrichment, Rosatom develops medical and space nuclear technologies. A working group on nuclear energy was established within the framework of the EU–Russia energy dialogue. It addresses various aspects of nuclear energy deployment, but primarily safety requirements and the results of stress tests.

In April 2016, Russia among other countries signed the Paris Agreement. The Russian minister of natural resources and the environment emphasised that implementation of the Paris Agreement would give a positive impetus to modernisation of the economy. Indeed, climate policy in Russia started to develop primarily through its participation in international institutions to mitigate climate change, in particular – due to the adoption of international multilateral agreements – the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Russia submits annual national inventory reports to the UNFCCC, delineating its emissions situation.

Speaking at the 70th session of the UN General Assembly on September 28, 2015 (RT, 2015), Russian President Vladimir Putin paid special attention to the problem of global climate change, saying that Russia is planning to limit anthropogenic greenhouse gases to 70–75 percent of 1990 levels by the year 2030, thus making its Intended Nationally Determined Contribution (INDC) to slowing global climate change (UNFCCC, 2015b). The Russian INDC faced considerable criticism from foreign and Russian experts, as Russian greenhouse gas emissions in 2015 already amounted to only 71 percent of 1990 levels (Russian Federation, 2015), thereby actually leaving some space for growth in emissions, whereas any significant exceeding of this target appears unrealistic.

The Paris Agreement supplemented greenhouse gas emissions reporting and target-setting obligations by requirements for climate change adaptation policy. Although the National Adaptation Plan is underway, there is already a positive example of adaptation and mitigation policies at the regional level. In September 2015, Saint Petersburg presented its draft climate strategy to 2030 (Government of Saint Petersburg, 2015). Development of such a strategy is explained by statistically observed changes in Saint Petersburg's climate and negative impacts on the city's economy and public health.

To reduce CO_2 emissions, several key measures were identified, including: the establishment of a mandatory greenhouse gas monitoring system; assessment of reduction potential; the development of corresponding target indicators, and action plans by organisations and by sectors. Beyond that, the introduction of carbon pricing has been discussed. The issue of carbon tax has caused intense debate and revealed various opinions. Opponents argue that a carbon tax will burden the energy, metallurgic and cement industries, consequently reducing competitiveness. In turn, supporters underline that if carbon pricing is not established, then Russian export goods might become less competitive since they may be subject to additional environmental taxes in external markets (Davydova, 2016a).

Russia also cooperates in renewable energy development within the International Renewable Energy Agency (IRENA) and among the BRICS (Brazil, Russia, India, China and South Africa) countries. Russia became a member of IRENA in 2015, and joint projects currently involve a detailed analysis and Roadmap 2030 for renewable energy deployment in Russia. With the BRICS countries, Russia is chairing the group on green technologies and finance (Davydova, 2016c). Projects are funded through the New Development Bank, which financed the first projects in 2016. All the projects chosen were related to the development of renewable energy (Gurkov, 2016). Russia received USD one hundred million for small-scale hydro power plants in Karelia (RIA News, 2016). Apart from the cooperation with IRENA and BRICS, Russia actively engages in bilateral projects on the construction of new hydro power stations.

Impulses

Despite its dependence on fossil fuels, Russia shows some interesting developments in green technologies and decarbonisation. In terms of renewable energy, Russia actively supports cooperation on green technologies and green finance.

There is a growing understanding that renewable energy does not compete with gas and oil but rather supplements them in remote areas. As such, renewable energy projects in remote areas are often implemented by small and medium companies, and help to support local communities.

Russia engages more actively in international climate policy, and has a clear intention to establish a carbon market with mandatory monitoring of CO_2 emissions by sector and organisation. Along with the implementation of the Paris Agreement, energy efficiency policies will be restarted.

Finally, Russia is one of the foremost supporters and promoters of nuclear energy and new nuclear technologies in the context of low-carbon energy resources.

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13. Saudi Arabia: Oil as a Burden in the Struggle for Energy Diversification

Sebastian Sons[1]

Historically, Saudi Arabia's economic progress has relied heavily on high oil revenues. In times of low oil prices, its rentier state system suffers from decreased revenues, which are needed to sustain a generous welfare state and highly subsidised energy services for its growing population. To tackle this problem, the new Saudi leadership is now seeking energy diversification by investing in renewables and nuclear energy. However, it remains to be seen whether this reform agenda will be implemented, as traditional structural, political and societal obstacles remain. While Saudi Arabia has previously boycotted international climate agreements, it now supports the Paris Agreement.

Energy and economic transformations: In the clutches of oil

Saudi Arabia's energy mix is overwhelmingly dominated by its oil resources. With 16 percent of the world's proven oil reserves, the Kingdom is the world's largest energy exporter, valued at USD 285 billion in 2014 (OPEC, 2015). Oil production has increased from 6.4 million barrels per day (m b/d) to 10.2 m b/d between 1990 and 2016. Oil revenues still account for 90 percent of government fiscal revenues and around 85 percent of export revenues, while the oil sector comprises more than 40 percent of total GDP (SAMA, 2015). Oil revenues enabled the country's transformation from a tribal structure to a modern nation state and form the basis of the royal family's (the Al Saud) political legitimacy by financing a state-centred economic system . It provides free education, health care and job opportunities to the Saudi population, and has established an oil income-based system of subsidies for gas, water and electricity (al-Rasheed, 2002). Thus, Saudi Arabia can be characterised as the rentier state *par excellence* (Beblawi, 1987), in which the population is not allowed to participate in political affairs through elections, etc. and must demonstrate full loyalty and obedience towards the rulers in return for tax-free cradle-to-grave welfare distribution ("no representation without taxation") (Herb, 2005).

However, this system is on the brink of collapse today: It is estimated that Saudi Arabia's oil reserves will be depleted by 2030.[2] By providing generous benefits to almost all Saudis in the past, the state has created an entitlement mentality among its national population. Familiar with the Kingdom's long-standing social welfare system, the majority of the Saudi workforce continues to rely on the state as its caretaker and provider of energy and jobs, which are characterised by high salaries and short working hours. This so-called *mudir* (meaning boss or director in Arabic) mentality is one factor in the Saudi economy's inefficiency (Champion, 1999). In addition, the state bureaucracy is characterised by bloated patronage networks (Hertog, 2010). Furthermore, the population is growing by 2.2 percent per annum. By 2050, the present population of thirty million will have doubled. More than half of the population is younger than 25. The growing young Saudi workforce can no longer be absorbed within the public

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[2] Interviews in Riyadh and Jeddah in December 2014.

sector, and the state cannot provide unlimited social services to its population in the future. The private sector is still not attractive for Saudi job seekers, and is mostly dominated by foreign workers: 90 percent of the private workforce are non-Saudi nationals (Sons, 2014). As a result, Saudi youth unemployment (15–24 years) increased to 41 percent in 2013, and youth labour participation of Saudi nationals was just 14 percent in 2014 (McKinsey Global Institute, 2015).

Due to high population growth and high energy subsidies, both aggregate and per capita energy consumption have increased tremendously in recent decades. Per capita energy consumption is presently the highest globally and three times the global average. Since 2000, energy consumption has more than doubled, while electricity consumption has grown at an annual rate of 6–8 percent (Akhonbay, 2012). Almost one quarter of total oil production is consumed domestically, which is almost double the consumption in 2000 (Lahn & Stevens, 2011). In 2012, approximately 40 percent of energy was consumed by the transport sector (Akhonbay, 2012). In addition, almost all Saudi gas production is consumed by the domestic market (US Energy Information Administration, 2014). As part of the welfare system, the state has offered its population highly subsidised energy in the form of low petrol and gas prices in recent decades. Subsidies amounted to 9 percent of GDP both for the oil products (around USD 46 billion) and for the electricity sector (almost USD 15 billion) (Nachet & Aoun, 2015).

In the absence of reforms, continued population growth will lead to further increases in domestic energy consumption and rising expenditures to sustain the existing subsidy regime. At the same time, increasing domestic energy demand reduces the country's export capacities of oil and gas, thus further exacerbating the state's fiscal situation. It is predicted that Saudi Arabia may become a net energy importer in 2030 unless it initiates significant changes to present energy consumption patterns (Taher & al-Najjar, 2014). Since 2014, the low international oil price has further damaged the Saudi fiscal situation and is affecting the domestic socioeconomic situation. The International Monetary Fund (IMF) has projected continued fiscal deficits for the foreseeable future, amounting to 15 percent in 2015, which is expected to increase to 17.8 percent of GDP in 2016 (Jadwa, 2016). Consequently, Saudi Arabia's budget swung from a surplus of 6.5 percent of GDP in 2013 to a deficit of 2.3 percent in 2014 as proceeds from oil exports dropped (SAMA, 2015). Foreign exchange assets and saving dropped from USD 746 billion to USD 669 billion between mid-2014 and mid-2015 (Barakat, 2016).

Impulses and reform initiatives: Will the "Vision 2030" work?

Due to domestic socioeconomic obstacles based on high energy consumption and rising population in times of low oil prices, Saudi Arabia's leadership is aware of the dire need to diversify the Saudi energy mix. In this regard, ambitious reforms in the energy sector are planned. The diversification of the energy mix away from its current oil dependence is the main objective of the latest reform agenda, called "Vision 2030", which was announced in spring 2016 by the King's son, Deputy Crown Prince Muhammad bin Salman. As head of the newly established Council for Economy and Developmental Affairs, he is in charge of the reform agenda (Kéchichian, 2015). Muhammad bin Salman stated that Saudi Arabia plans to overcome its oil dependency "within 20 years" (Almashabi et al., 2016). Thus, USD 133 billion is required for energy infrastructure by 2023 in order to increase electricity production from 58 GW in 2013 to 120 GW in 2032 (Reuters, 2016). In addition, the following reforms are planned or under implementation:

Cut in subsidies

The Saudi Government decided at the beginning of 2016 to cut energy subsidies for the first time in modern Saudi history. Thus, the average crude oil price for domestic consumption has risen per barrel (Jadwa, 2016) and gasoline prices have been increased by 50–67 percent (Watts, 2016). It is estimated that the recent price reforms will enable the government to increase its domestic oil revenues by an additional USD 18 billion per year for the period (2016–2035) (Jadwa, 2016). However, subsidies have become integral parts of the welfare system, and it remains to be seen whether wide parts of the population will accept the negative impacts of these reductions in subsidies. In order to avoid such frustration and disillusionment, Muhammad bin Salman mentioned that subsidies should be cut for the wealthy

elites: "(...) We do not deserve subsidies (...). The people who deserve and need subsidies are those who are on average incomes and less" (Al-Arabiya, 2016).

Privatisation of Saudi Aramco

A 5 percent initial public offering of the national oil company Saudi Aramco is planned. This privatisation should generate new assets of around USD 250 billion, but it seems likely that only non-sensitive sectors of the business, such as non-oil production, will be included in the initial public offering. Nonetheless, this would open Saudi Aramco to public discussion, force it to provide more information about ongoing and planned strategies and projects and thus demonstrate greater transparency towards its investors and shareholders. This could have fundamental consequences for the Saudi energy system as a whole and could offer new opportunities for supporting alternative energy.

Personnel changes in energy administration

In May 2016, the long-serving oil minister Ali al-Naimi (in post since 1995) was replaced by Saudi Aramco CEO Khalid al-Falih, who is in charge of the newly created Ministry of Energy, Industry and Natural Resources. It remains to be seen whether the establishment of such a ministry will exert strong influence on the political system. However, it is apparent that the administration under King Salman seeks to create synergies between different parts of the decision-making process. This was also demonstrated by the merging of several economic committees into the Council for Economy and Developmental Affairs. This further serves to consolidate power within positions and institutions that are controlled either directly by King Salman and Crown Prince Muhammad (such as Muhammad bin Salman as head of the Council for Economy and Developmental Affairs) or by loyal technocrats (such as Khalid al-Falih).

Expansion of renewable energy

The expansion of renewable energy is also an important pillar of the new "Vision 2030" (Saudi Gazette, 2016): The potential for utilising renewables such as solar and wind in the Kingdom is tremendously high, with three hundred sun days per year, and long coastal and remote desert areas (King Abdulaziz Center for Atomic and Renewable Energy, 2010). Solar radiation potential is approximately fifty thousand GW per annum. Wind energy potential is also promising, with average wind speeds of 8–12 m/s (Rehman et al., 2012). The strategy document estimates investment of USD 109 billion in the renewable energy sector. The details of the investment strategy have not yet been fixed, but most of the projects should be implemented by public investors such as state agencies. It is planned to increase the share of renewable energy to 50 percent of installed capacities, which it is estimated would create one hundred and thirty-seven thousand new jobs by 2030. Vision 2030 mentions the installation of 9.6 GW of wind and solar energy (Saudi Gazette, 2016). In addition, it is planned to use renewables to run oil-intensive technologies such as water desalination.

However, these plans are nothing new: In 2010, the Saudi Government established the King Abdullah City for Atomic and Renewable Energy (KA-CARE) to increase new renewable and nuclear energy capacities, and the King Abdullah Petroleum Studies and Research Center (KAPSARC), which officially serves as an independent research centre for energy and environmental studies. However, the KA-CARE mission to install 54 GW of renewable energy by 2032 was postponed to 2040, approved projects have not been realised, and bid periods have passed without final decisions being made (Reuters, 2015). Furthermore, Saudi Aramco, the largest energy company in the world, and other players such as the Saudi Electricity Company (SEC) have also sought more control of the renewable energy sector.

This involvement has resulted in opaque hierarchies and delayed decision-making processes. It remains to be seen whether the establishment of the new Ministry of Energy, Industry and Natural Resources will solve these inter-institutional struggles. Lack of expertise in renewable energy technologies, and the mentality by which energy consumers rely on subsidised fossil resources rather than on unsubsidized alternative energy additionally limit the future prospects of renewable energy in the Kingdom. This is also due to the fact that there are no support mechanisms, such as feed-in tariffs, to stimulate investment. Political support remains limited due to the overwhelming dominance of the oil lobby; and adminis-

trative capacities and necessary engineering and managerial skills remain inadequate. Due to these barriers, solar and wind energy still account for less than one percent of the total energy mix.

Installing nuclear power

Nuclear energy also plays a significant role in the process of diversifying the Saudi energy mix. It is planned to expand nuclear energy capacity by building 16 nuclear plants by 2040 with a total power capacity of 17 GW. Nuclear energy is considered more prestigious than renewables, and Saudi nuclear power is perceived as counterbalancing Iranian nuclear ambitions (interviews in Riyadh, December 2014).

Strengthening energy efficiency

In recent years, Saudi Arabia has also intensified policy measures to foster energy efficiency in the construction, transportation and industrial sectors. In this regard, the National Energy Efficiency Programme (NEEP) and the Saudi Energy Efficiency Centre (SEEC) were founded in 2008 and 2010, respectively. The National Energy Efficiency Programme was initiated in cooperation with the UN Development Programme (UNDP) in order to enhance energy-efficient solutions and support research and development conducted by the King Abdulaziz City for Science and Technology (KACST). The programme is funded by USD 35.5 million provided by the Saudi Government. Key fields of activities are housing and buildings, consumer appliances, heavy industry, water and transport. It is planned to develop regulations, such as the Energy Conservation Law, and a national database on energy supply and demand; to implement capacity-building measures such as training courses for future experts in energy efficiency; and to start nationwide public awareness campaigns on energy consumption behaviour. Since the National Energy Efficiency Programme's launch in 2008, more than three hundred applicants have attended courses and workshops, a project management office was established and the energy efficiency standard for air-conditioners has been updated. On this basis, in 2014, the government banned air-conditioners that did not comply with the new specifications. Furthermore, energy efficiency labels for washing machines, refrigerators and freezers were implemented in 2015 (UNDP, 2011). The young Saudi population in particular has increased its awareness and sensitivity regarding energy efficiency. Therefore, future political initiatives might achieve better results than in the past. To date, energy efficiency has mostly been discussed within academic circles, and the trickle-down effect to broader spheres of society remained minimal. However, previously implemented regulations and the adoption of Vision 2030 are likely to improve awareness in the foreseeable future.

International energy policy: weakening global energy competitors and showing leadership and responsibility

Saudi Arabia plays a very important role as a global energy producer, and has maintained its position as the most influential member state of the Organization of the Petroleum Exporting Countries (OPEC) (Fattouh & Sen, 2015). This is evident during the period of low oil prices since 2014: While other OPEC members such as Venezuela, Nigeria and Iran sought to cut oil production in order to increase international prices, Saudi Arabia vetoed this decision for more than a year. Thus, daily crude oil production was maintained at a high level of approximately 10.2 m b/d in January 2016. Although shrinking oil revenues present the Saudi Government with formidable domestic challenges, Saudi Arabia nevertheless aimed to weaken its rivals on the global energy market – the United States, Iran and Russia – by driving down energy prices in order to maintain its market share (Sons, forthcoming). In this regard, the Saudi decision was driven by the calculation that the Kingdom was better able to withstand low oil prices than its rivals, due to its substantial foreign exchanges (Gause, 2015). However, this policy may change: For the first time since the significant drop in oil prices, Saudi Arabia agreed to cut oil production in September 2016 (Blas & Smith, 2016). Thus, OPEC's total daily oil production will be reduced from 33.23 m b/d to 32.5–33.0 m b/d. Saudi Arabia alone cut its production by four hundred thousand barrels/day at the end of 2016 (Said, 2016).

Furthermore, Saudi Arabia has worked on improving its international image as a responsible and reliable partner in multilateral climate policy initiatives. Therefore, the Saudi Government has extended its activities within the UNFCCC. Nevertheless, its

position on climate change is a double-edged sword: Due to its oil production, the Kingdom is a large contributor to CO_2 emissions through air conditioning, the use of cars with high fuel consumption and energy-intensive industries such as oil production. On the other hand, its arid and dry climate, air pollution and scarce water resources make Saudi Arabia highly vulnerable to the adverse effects of global warming and environmental pollution. By the year 2100, average temperature during the summer months is expected to rise to 60–70°C (Pal & Eltahir, 2016) from 45 C today. This may further increase energy consumption for air conditioning. In the past, Saudi Arabia boycotted international climate agreements and questioned the scientific evidence on the impacts of climate change (Windecker & Pfülb, 2016). However, the Saudi Government now shows greater political will to address climate challenges and seeks to present itself as a trustworthy partner in global climate and environment initiatives (Al-Naimi, 2012). Thus, in December 2015, the Kingdom submitted its first Intended Nationally Determined Contribution (INDC) to the UNFCCC at the COP21 climate conference in Paris, thereby contributing to the international community's climate protection strategy (UNFCCC, 2015). Saudi Arabia's leadership wants to implement its INDC between 2021 and 2030 in the following sectors: energy efficiency, renewable energies, carbon capture and utilisation/storage, utilisation of gas, and methane recovery and flare minimisation. However, no concrete details have yet been announced.

Lessons learned for the G20 process

At present, Saudi Arabia shows that even important oil exporters have begun to show greater political will to reshape their energy policies in order to promote domestic energy diversification and independence from fossil resources. In this regard, Saudi Arabia has also modified its stance towards international climate initiatives such as the UNFCCC. This may mean a significant step towards greater environmental responsibility, thereby offering new windows of opportunity for international cooperation. However, this strategic turn is also due to the socioeconomic challenges that the Kingdom faces: The low oil price has begun to impose severe pressure on the Saudi national budget. Declining oil incomes reduce the financial capacity to sustain the traditional rentier state. Thus, the Saudi leadership plans to implement fully-fledged energy reforms in order to reduce the state's oil dependency. However, it remains to be seen whether the ambitious reform agenda can be realised in the long run, as similar plans in the past have achieved only minimal outcomes. Although the new leadership is fully aware of the dire need to diversify the energy sector, other factors will also influence the future success of such reforms: Firstly, the government has to balance the socioeconomic consequences of cutting subsidies for Saudi nationals, in order to avoid social frustration and to change attitudes to sustainable energy consumption. Secondly, it remains to be seen whether King Salman and Deputy Crown Prince Muhammad have the will to persevere with these painful reforms, given the prevailing *mudir* mentality the strength of the oil lobby. Thirdly, most of the Saudi population perceive their own security as the biggest priority, and political reforms have lost relevance since the destabilising effects of the "Arab Spring" on the region since 2011. In this regard, most young Saudi nationals welcome Vision 2030 (Thompson, 2016). The trust of their people thus buys the royal leaders time to implement energy reforms and opens a window of opportunity to change not only the country's energy infrastructure but also the traditional social contract between the ruled and the rulers in general (Sons, forthcoming). Therefore, low global oil prices also offer an opportunity for the Kingdom to completely reshape its oil-dependent energy policy in favour of climate protection, renewable energy and energy efficiency.

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14. South Africa: Carbon-Intensive Economy and a Regional Renewable Energy Frontrunner

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Due to its strong reliance on coal, South Africa is a middle-income country with very high per capita emissions. As host of the Conference of the Parties (COP) in 2011, the country has embarked on a significant change of trajectory for its energy sector. In its climate mitigation efforts, it has introduced renewable energy auctions and furthermore focuses on carbon capture and storage as well as energy efficiency. South Africa's regional activities concentrate on renewables, grid integration and energy access in Southern Africa.

In international rankings of carbon dioxide emissions per capita, South Africa fluctuates between 10th and 15th position (Global Carbon Atlas, 2016). As most of South Africa's energy is currently derived from coal, this emerging middle-income country contributes increasingly to global emissions.

Nonetheless, South Africa is active in addressing climate change. In 2011, the country hosted the COP17 in Durban and embarked on a significant change of trajectory for its energy sector, notably by implementing a renewable energy programme. The South African Renewable Energy Independent Power Producer Procurement Programme (REI4P), which prioritises the inclusion of power derived from renewable energy sources, such as solar- and wind-powered stations, has gained traction among international energy stakeholders.

With a demonstrated interest in increasing the share of renewable energy to transform into a green economy, South Africa's priorities remain those of an emerging country. With about 15 percent of households lacking formal access to modern energy services (Statistics South Africa, 2016), it has to close the remaining gaps in electricity access among its population, while creating and transforming jobs in its energy sector and adjusting to industrial- and market-driven energy demands. In addition, the country experienced recurrent power cuts that were not only an inconvenience for the daily lives of South Africans but substantially limited the growth of the national economy. This has revealed that South Africa also needs to focus on better energy infrastructure maintenance, investment and planning. To this end, leveraging investment, with the help of international partners, is key to South Africa's ambitions. The South African Department of Energy has therefore made provisions to add new energy sources to the country's energy mix and attract foreign investment.

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Key challenges for transforming the South African energy sector

After decades of apartheid, with strong inequalities of access among South Africans, today South Africa faces the opening-up of its energy sector to liberalisation and to international players.

Overview of the South African energy policy situation

To date, mineral products and metals prevail as South Africa's largest export earners. Mining and quarrying activities also remain essential to South Africa's industrial development and dominate the country's energy landscape (OEC, 2016). As a result, the energy sector itself is the largest consumer of power and contributor to greenhouse gas emissions.

In a nutshell, most of South Africa's power generation derives from coal, with few gas turbines and small contributions from nuclear and hydro (including pumped storage plants). The country's primary energy mix is barely more diversified and is also heavily reliant on coal. However, since the end of apartheid, South Africa has strived to diversify its energy sources. After a White Paper on Energy Policy in 1998 (RSA, 1998) that aimed to increase energy access and infrastructure, the country released a White Paper on Renewable Energy in 2003 including ambitious targets to diversify the country's energy mix (RSA, 2003). A National Energy Act followed in 2008. Based on the work done by its National Planning Commission, South Africa also developed two baseline documents, the Integrated Resource Plan in 2010 and the National Development Plan in 2012. An Integrated Energy Plan was submitted for public consultation in 2013 and is still pending. Taken together, these documents set the scene for the country's sustainable development, with a cross-sectoral and integrated approach to resource management up to 2030.

With this recent policy framework, South Africa is paving the way to transform its carbon-intensive economy. However, restructuring state-owned energy institutions while finding a new balance in these institutions between the role of the state and those of a growing diversity of stakeholders (businesses, civil society groups) is not an overnight operation.

Re-structuring Eskom, South Africa's state-owned electricity enterprise

To understand South Africa's energy situation and recent key decisions, it is important to consider the role of the parastatal Eskom and this utility's slow and difficult transformation since the end of the apartheid era (Eskom, 2016).

Until recently, excess capacity, readily available cheap coal and the use of coal-fired power station technology enabled Eskom to achieve one of the lowest electricity costs in the world. During this time, Eskom was a monopolistic, state-owned enterprise with few regulatory processes. In 2002, Eskom was turned into a public company (RSA, 2001). However, the South African state has chosen to remain a majority stakeholder, and Eskom has maintained its monopoly in providing electricity to the country. Eskom's mandate includes growing national energy production capacity and increasing access to energy services for South Africans. The government claims that five million households have been connected since the end of apartheid. In 2007, the country ran out of additional capacity, partly due to a lack of investment and delays in constructing new energy infrastructures. Faced with woeful shortages in 2008, Eskom introduced infamous load-shedding practices – some of which continued until 2015 – to maintain and protect the national grid's integrity.

The 2008 energy crisis also triggered a change in energy price structure. Eskom was compelled to begin increasing power supply tariffs to support its investment in maintaining and expanding energy infrastructure. Today, South Africa ranks among the top twenty countries with the highest electricity delivered prices (Statista, 2016). In turn, this has significant socioeconomic impacts on the post-apartheid South African energy landscape, with energy services weighing heavily on the domestic budget.

South Africa also suffered from external factors, such as the international sanctions against Iran, a key provider of crude oil to the country. It is thus no surprise that the potential of other energy sources, such as shale gas and nuclear, has gained traction in the country after its 2008 experience of energy shortages. Following a cautious moratorium on the exploitation of shale gas in 2011, which was lifted a year later, the South African Government gazetted new regulations, and private companies such as Shell, Falcon and Bundu have recently received exploration licences. However, South Africa's supporting infrastructure (service industries and pipelines) remains insufficient to enable a similar success to the US shale gas revolution (RSA, 2012). There is also discussion on expanding South Africa's existing nuclear infrastructures.

Developing renewable energy to decarbonise South Africa

While shale gas exploration and new nuclear power plants are under debate in South Africa, the country has already embarked on harnessing its renewable energy potential. National renewable energy targets for 2030 have been set at 17.8 GW (with an interim goal of 7 GW by 2020), which would represent 21 percent of South Africa's future power capacity mix (RSA, 2010).

Developed in 2011 as an auctioning system, the REI4P programme has raised commissioned renewable energy capacity to 6 329 MW (see Figure 1), which is close to the DoE interim target of 7 GW by 2020; of this, 1 860 MW have begun commercial operation.

Table 1: Main results of the South African REI4P

RES technology		Window 1 2011–12	Window 2 2011–13	Window 3 2013–15	Window 3 (2nd phase) 2013–2015	Window 4 2014–2015	MW Total
Onshore wind		649	559	787	–	1363	3358
Solar	CSP	150	50	200	200	–	600
	PV	627	417	435	–	813	2292
Biomass		–	–	17	–	25	42
Landfill gas		–	–	18	–	–	18
Small hydro		–	14	–	–	5	19
Total (MW)		1 426	1 040	1457	200	2206	6329
Selected bidders		28	19	17	2	26	92

Source: DoE REI4P, http://www.ipprenewables.co.za

Further benefits of the REI4P mostly relate to job creation and significantly cheaper renewable energy prices. The South African Government has also reiterated its interest in technology transfer, as well as in the transformation of its energy market skills to match new energy technology development.

South Africa's energy policies have successfully scaled-up renewable energy and introduced independent power producers to the national bulk electricity market. Today, South Africa has the largest installed renewable energy capacities on the African continent (IRENA, 2016). However, Eskom has expressed several concerns about the Department of Energy's wish to pursue the REI4P beyond its initial target.

Beyond renewable energy: South Africa's additional actions

Using a peak, plateau and decline approach (from 2020 to 2030), South Africa's Intended Nationally Determined Contribution (INDC) has selected a specific set of priorities and short- to long-term actions. There is a strong focus on the energy sector, notably on clean energy and energy efficiency. Transport is also a key component, including the intent to increase public transportation.

According to the Department of Environmental Affairs the energy sector accounts for approximately 75 percent of national emissions (RSA, 2014). Besides the pursuit of the REI4P, developing carbon capture storage technologies and enhancing energy efficiency are key elements of the South African's INDC. This includes further actions to increase the use of energy-efficient lighting in buildings and streets, for example, and to favour energy-efficient appliances, notably for cooling and heating.

The transport sector accounts for 13 percent of the country's greenhouse gas emissions (RSA, 2014). As stated in South Africa's INDC, a modest investment in public transport infrastructure started at USD 0.5 billion in 2012 and is expected to increase at five percent annually. In addition, a green transport strategy is currently being developed. Some preliminary objectives include the conversion of 10 percent of the national fleet to electric and hybrid vehicles, and the use environmentally sustainable low-carbon fuels by 2022.[2]

In addition to these sector-based mitigation actions, there has been an on-going discussion in the country about the establishment of a carbon tax. The National Treasury has made several announcements toward its implementation, but progress has been delayed by the economic recession combined with firm opposition from business stakeholders, notably the mining and industrial sectors.

South Africa's aspiration to secure national energy supply while growing a green economy is sustained by undeniable advantages, such as a structured legislative energy framework, a favourable environment for investments and a growing renewable energy market. All these elements could also be beneficial to bolstering South Africa in its key position on the regional energy scene.

South Africa's leverage in energy cooperation: a regional focus

While South Africa is a key energy player in the region, its presence on the international energy scene remains limited. Securing national supply and developing the regional market have been prioritised so far. Eskom supplies 96 percent of electricity in South Africa, and is also the regional leader, with almost 80 percent of total regional supply and demand within the Southern African Development Community (SADC) (SADC, 2010). However, following Eskom's shortfalls during the 2008 crisis, several SADC member states have decided to work more closely on securing national energy supply, independently of South Africa and Eskom.

Are South Africa's energy priorities aligned with regional strategies?

In 2007, SADC energy ministers warned that the region would soon run out of surplus capacity if

[2] Personal discussion with representatives from the South African Department of Transport at the last consultation on climate change in South Africa, 28 July 2016.

planned projects were not commissioned and implemented on schedule (UN General Assembly, 2008). With a regional total installed power capacity of around 60 GW, the region has a regular operating power capacity of about 46 GW, of which renewable energy contributes approximately 23 percent. More than 75 percent of regional operating capacity comes from South Africa. More importantly, regional power generation is derived from coal, while hydro accounts for approximately 20 percent of the region's electricity. Except for South Africa, power generating capacity and electrification rates are extremely low among the SADC countries, which rely heavily on biomass. The quality of energy access is also highly differentiated at the national level (SADC, 2010).

Overall, the most striking regional challenges are, first, how unequally developed national energy networks are among SADC countries; second, a heavy regional reliance on coal; and third, the regional Member States' lack of investment in a regional framework to align their policies and initiatives. In response, a Southern African Power Pool was created in 1995 among the national power utilities operating in the region. This successfully managed the integration of the coal-based grid of its southern members and the hydro-based grid of its northern members via transmission facilities in Zambia and Zimbabwe.[3] Enforced regional market mechanisms within the power pool have also facilitated short-term electricity supply contracts between national power utilities. In turn, such contracts have enabled the operation of an interconnected regional power system, notably to deal with short-term imbalances experienced by national power utilities (Maupin, 2013). Simultaneously, the SADC has promulgated a regional energy protocol (SADC, 1996), along with other sector-specific strategies and plans. South Africa ratified this regional protocol; two years later, the first post-apartheid South African energy policy clearly mentioned the need for South Africa's energy policy to be compatible with the SADC regional energy protocol (RSA, 1998).

More recently, the SADC has also embarked on an ambitious regional Renewable Energy Strategy and Action Plan to gear the region towards the development of its untapped renewable energy, notably by developing off-grid solutions (SADC, 2010). Under SADC supervision, a regional Centre for Renewable Energy and Energy Efficiency (SACREEE) was recently opened in Namibia. It can be argued that in most SADC countries the use of renewable energy sources is not recent;[4] nevertheless, there is no doubt that these power sources are flourishing at present. In 2013, renewable energy represented 32 percent of the region's additional power capacity and 59 percent one year later (IRENA, 2015).

At present, South Africa is considering not only expanding renewable energy uses – notably their remarkable diversity of sources in the region and their implementation at various scales – but also a change in power generation and the energy mix model, which would include off-grid solutions and competitive energy trading. Specific divisions, regional legal instruments and sub-organisations have been implemented to manage energy issues regionally. In brief, power pooling and associated regional plans are becoming instrumental for South Africa in contributing to a regional electricity market including renewables on the one side, and on the other to increase the share of power derived from renewables. On this basis, regional responses now speak more adequately to meeting regional electricity needs.

South Africa's modest contribution to decarbonising the regional energy system

While South Africa and Eskom have been instrumental in the deployment of renewable energy nationally, this is less arguable across the region, where the SADC possesses the regional mandate to facilitate, and eventually achieve, the deployment of renewable energy regionally.

[3] A power pool is a mechanism for facilitating the exchange of energy between electricity generating companies. Five power pools currently exist across the African continent. The SAPP members include the national power utilities of Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe.

[4] Large-scale hydro schemes, such as the Kariba and the Cahora Bassa dams, have produced power for the northern part of the SADC region since the 1960s.

However, South Africa's renewable energy programme is an example of good practice for other SADC countries. In this regard, South Africa's actions in transforming its energy sector could provide an interesting model for other SADC countries. South Africa has successfully managed to balance national deployment of renewable energy – including at the small scale and with a diversity of sources – while retaining an interest in large-scale regional projects.

As a result, South Africa and Eskom have worked on the revival of the Grand Inga hydropower project. Since 2011, South Africa and the Democratic Republic of Congo have established a cooperative framework to develop the potential of the Inga site. Should the Inga 3 dam and associated power station reach completion, the two countries' national power utilities – Eskom and the Congolese SNEL – [5] would be the primary participants and beneficiaries after funding, construction and management of this hydropower project.

South Africa and the Democratic Republic of Congo have successfully paved the way to establish an energy-related cooperative framework. Nonetheless, significant behavioural shifts seem necessary to succeed in increasing energy access and availability for the two countries within the region. So far, the absence of a regional multilateral approach remains a concern. To this end, it is urgent to engage the Zambian and Zimbabwean authorities to initiate negotiations on transmission lines from the Congolese Inga hydro power plants to South Africa. This will also become a first step towards ensuring the building and rehabilitation of the regional network.

It remains to be seen whether South Africa plans to rely partly on regional electricity trades to balance its emissions. While the country holds an undeniable strategic position within the regional energy scene, most of this electricity is still derived from national resources, despite South Africa's commendable ambition to transform its energy system and promote regional integration.

Impulses coming from South Africa

Firstly, South Africa has developed relevant legislation that interlinks the overarching goal of sustainable development with the country's specific energy and climate change challenges. South Africa's strong framework of policies and strategies could provide inspiration for other countries in the region.

Secondly, South Africa has been cautious about exploring new energy sources and adopting recent water-intensive energy technologies such as shale gas and hydraulic fracturing. The ways in which South Africa has – and continues to – exercise caution, notably given its water constraints, could inspire countries facing similar challenges in transforming their water and energy sectors, if they are to emerge environmentally unscathed.

Thirdly, the REI4P illustrates South Africa's commitment to placing the country on a green economy pathway. Despite several pitfalls, such as the difficulties encountered in connecting newly operational power plants to the national grid through Eskom, the REI4P constitutes an interesting example of how middle-income emerging economies might balance economic growth and decarbonisation.

[5] The *Société Nationale d'Electricité* is the Congolese national power utility.

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15. Turkey: Great Potential, Missing Will

Jörn Richert[1]

Turkey's energy policy focuses on the promotion of coal and nuclear power. Although sustainable energy legislation is in place and respective targets have been defined, implementation is lagging behind and sustainable energy takes a back seat in the country's political debate. Internationally, Turkey is concerned with regional (energy) geopolitics much more than with sustainability. In G20 negotiations on sustainable energy, Turkey might emerge as a laggard, particularly in matters related to the reduction of coal use.

More demand, more coal, more nuclear

Turkey's primary energy demand was 125 Mtoe (million tons of oil equivalent) in 2015. This was mainly met by natural gas (35%), coal (28.5%) and oil (27%). Hydropower contributed seven percent and new renewables 2.5 percent to meeting demand (MFA, 2015). As the country's 2015 National Renewable Energy Action Plan (NREAP, 2015) shows, final gross energy consumption is approximately 49 Mtoe for heating and cooling, 21.5 Mtoe for electricity and 18.5 Mtoe for transportation. The major political focus is on the electricity sector. In 2015, electricity was generated mainly via natural gas (37.8%), coal (28.4%) and hydropower (25.8%), with minor contributions from wind (4.4%), geothermal energy (1.3%), biogas (0.6%) and oil products (1.6%) (MFA, 2015).

The two definitive trends in the Turkish energy system are its overall expansion, and its growing reliance on coal and, potentially, nuclear power. Since the early 2000s, Turkey's major challenge has been to keep up with growing demand. World Bank data show that the country's Gross Domestic Product (GDP) has grown by an average of 4.7 percent annually since the ruling Justice and Development Party (AKP) came to power in 2003. During the same period, overall energy use has increased by around 4.1 percent annually. By 2023, overall energy demand is expected to grow by almost three quarters, to 218 Mtoe (MFA, 2015).

Turkey's political targets are defined in the so-called 2023 vision (2023 being the hundredth anniversary of the Turkish Republic) that was revealed by President Erdoğan in 2011. The vision calls for making Turkey one of the world's ten largest economies by 2023. Its energy goals follow this expansive ambition. Mainly focusing on electricity, the vision calls for an increase of overall installed power generation capacity to 120 GW (from 64 GW in 2013) and for a significant expansion of transmission grid and power distribution capacity.

All types of resources are sought to contribute to capacity expansion. The second major trend is Turkey's focus on expanding nuclear and coal-fired power generation. The 2023 vision expects coal-fired capacity to rise from 15.9 to 30 GW, and the Energy Ministry's more recent Strategic Plan for the years 2015–2019 (MENR, 2015) calls for almost a doubling of coal-based electricity generation, from 32.9 billion kWh in 2013 to 60 billion kWh as early as 2019. Research suggests that these coal targets are likely to be overachieved, with more than 65 GW of new coal-fired generation capacity being announced or planned (Shearer et al., 2016).

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One major pro-coal argument is that the use of domestic coal reserves – mostly lignite rather than hard coal – would reduce Turkey's dependency on imported energy. Indeed, the Energy Ministry's Strategic Plan envisages the opening of several domestic coal fields. The government is furthermore preparing a law that would reintroduce exemptions form environmental regulations for coal-fired power plants after a similar initiative was previously rejected by the Constitutional Court. In a move to reduce "the negative effects of imports", Turkey also recently introduced an import tax of USD 15 per tonne on thermal coal used for power generation and originating from the US, Colombia, Russia and South Africa. This decision, in August 2016, came as a surprise to many coal traders and utilities (Platts, 2016). While it signals the prioritisation of domestic coal, it remains to be seen how it will fare in future.

Nuclear energy is the second major focus of Turkish energy policy: By 2023, two nuclear power plants are planned to be operational and a third plant is expected to be under construction. According to the Energy Ministry, the first of these plants in Akkuyu, located on the Eastern part of Turkey's Mediterranean coast, should be operational by 2019. A second plant at Sinop on the Black Sea coast should be under construction by then. Engineering surveys for the Akkuyu plant began in 2011. Construction was initiated in 2015, but halted in in November 2015 after the Turkish army downed a Russian fighter jet at the Turkish–Syrian border. However, Russia and Turkey have recently reconciled their relationship with a visit by Erdogan to Russia in August 2016; talks at the G20 meeting in Hangzhou, China; and a visit by President Putin to Istanbul in October 2016. The revitalisation and speeding up of energy projects – such as the Akkuyu nuclear plant and the so-called Turkish Stream gas pipeline – is at the centre of this reconciliation.

Sustainable energy: little progress despite great potential

By the end of 2015, Turkey saw installed capacity of approximately 26.2 GW hydro, 4.5 GW wind and only 250 MW of solar power (MENR, 2016). Hydropower is well established as a part of Turkish electricity generation. The development of so-called new renewable energy resources, however, has been slow in Turkey despite formidable potential and a well-developed legal framework (Baris & Kucukali, 2012).

Amongst European countries, Turkey ranks first for hydropower, wind and geothermal potential and second for solar power potential. In terms of legislation, a Renewable Energy Law was enacted in 2005 (No. 5346) that established a feed-in tariff and a purchase obligation for renewable energy production. In 2011, the law was amended (Law No. 6094) to increase feed-in tariffs, introduce a local content premium and to differentiate tariffs for individual renewable technologies. The Electricity Market Law of 2013 provided further support for renewables. The law raised the maximum capacity for facilities exempted from licensing from 0.5 MW to 1 MW and reduced licensing costs for other renewable facilities.

For the future, the 2023 vision holds that the share of renewable energy should increase to 30 percent of Turkey's electricity production. Priority is given to hydropower, the use of which is to be "maximised". The original 2023 vision furthermore envisaged installed capacity of 20 GW wind, 3 GW solar and 600 MW geothermal power by 2023. Regarding new renewables, more recent revisions to national targets suggest a shift of attention from wind to solar and, to a lesser extent, geothermal energy. The 2015 National Renewable Energy Action Plan pledges to increase solar and geothermal capacity to 5 GW and 1 GW respectively by 2023. Turkey's Intended Nationally Determined Contribution (INDC), submitted to the UNFCCC climate secretariat before the 2015 Paris climate conference, ultimately aspires to install 10 GW solar and 16 GW wind capacities by 2030. The solar target can be read as a continuation of existing plans. The wind power target, however, signals a clear and substantial reduction of ambition. Compared to the 2023 vision, it signals 4 GW less capacity within a period that is seven years longer. In terms of combined wind and solar capacity, the INDC suggests an increase of merely one additional GW capacity in the seven years between 2023 and 2030 compared to the updated vision 2023 targets presented in the National Renewable Energy Action Plan – a rather dim scenario for sustainable energy development.

Commentators highlight further road blocks to sustainable energy development. For one, they criticise the dominant role of hydropower. Hydropower

already contributes more than 25 percent of Turkey's electricity generation, and the 2023 targets hold that Turkey will exploit its full technically and economically feasible hydropower potential. While present capacity is approximately 26.2 GW, overall capacity is estimated to be 66 GW (Energy Charter Secretariat, 2014). This already high level of hydropower makes the 2023 renewable energy target of 30 percent look comparatively less ambitious. There has also been criticism of the side effects of hydro expansion: Projects can change river flows and negatively affect ecosystems. As the Ilısu Dam in Southeast Turkey demonstrates, land flooding can lead to the relocation of local populations and the loss of agricultural land and cultural sites.

Moreover, as an analysis by *Bloomberg New Energy Finance* (BNEF, 2014) observes, renewable energy targets are likely to be missed. Turkish policies are contributing to this anticipated failure. Investors and other critics highlight the comparatively low level and time span (10 years) of feed-in tariffs as well as substantial bureaucratic hurdles, particularly the rather complex, expensive and time-consuming licensing processes. Consequentially, large parts of the abovementioned solar power capacity of 250 MW result from so-called unlicensed (non-tender, small scale) projects. Conversely, the capacity of 600 MW that was offered in an initial tender in 2013 has remained largely unrealised. Energy Minister Albayrak recently announced a new tender for 1 GW capacity for the end of 2016. Given previous experiences, however, the success of this new tender remains uncertain.

Turkey's energy-saving potential has been estimated at more than USD 13 billion annually (Energy Charter Secretariat, 2014: 12). The country aims to reduce energy intensity by 20 percent by 2023 compared to 2011. Turkey enacted an Energy Efficiency Law (No. 5627) in 2007, followed by a Regulation on Increased Energy Efficiency in 2009, a Strategic Paper on energy efficiency in early 2012 and a subsequent Action Plan in 2014. In its Strategic Plan for 2015–2019, the Energy Ministry formulates several goals, such as reducing energy use for street lighting by 40 percent and that of Ministry buildings by 20 percent. It furthermore aims to increase public awareness and to curb the losses in electricity distribution from more than 15 percent to 10 percent.

Compared to renewable electricity governance, energy efficiency governance is still evolving. The Ministry thus also aspires to build further policy-making capacity and to further develop the regulatory framework for energy efficiency. Operational programmes include efficiency investment subsidies, voluntary agreements with industries, awareness-raising campaigns and support for small- and medium-sized companies through providing education and consulting. However, once more, there are doubts about whether Turkey will reach its 20 percent target. The country's National Renewable Energy Action Plan seems to imply that primary energy consumption might grow faster than GDP (cf. Figure 10, MENR, 2014). Furthermore, PwC's 2015 Low-Carbon Economy Index shows that Turkey actually performs worst among G20 countries in terms of the development of its carbon intensity – a measure partially related to energy efficiency. Turkey's economy's carbon intensity grew by 4.4 percent from 2013 to 2014 (PwC, 2015).

In terms of transportation, the National Renewable Energy Action Plan expects an increase of sectoral energy demand to 29.4 Mtoe in 2020 and 34.5 Mtoe in 2023. It calls for the use of renewable energy (electricity, hydrogen, renewable gas and biofuels) in transportation to increase (from less than one percent at present) to 10 percent by 2023. Existing policies, however, are limited in scope. They consist of biofuel content obligations (of 3%) and tax exemption for the added biofuel. There are no fuel economy standards in Turkey (Mock, 2016). Furthermore, while vehicle CO_2 labelling has existed since 2009, no CO_2 emissions standards have been implemented. Some indirect energy savings incentives are provided by a sales tax, and by an annual ownership tax that increase with larger engine displacement.

Fossil mindset, missing will, lacking investment attractiveness

Based on the above insights, it seems fair to say that decarbonisation of Turkey's energy sector is unrealistic in the short or medium term. The country's growing energy demand and its formidable renewable energy potential might – in theory – work as drivers for sustainable energy solutions. Nevertheless, at least three major barriers prevent the country from decarbonising.

The first of these is the country's policy focus on domestic coal, particularly on low-energy-content lignite (Stefanova & Popov, 2013): The financing of Turkey's coal plans has become one of the Turkish banking sector's priorities, and governmental financial support for coal substantially exceeds that for renewable technologies. As seen above, domestic low-energy lignite is furthermore supported by the new coal import tariff, plans to open coal fields and by the potential exemption of coal facilities from environmental regulations. If the Turkish Government should follow through on its projected coal expansion, this might increase energy sector carbon emissions by almost 150 percent by 2023 (Stefanova & Popov, 2013: 4).

A second significant barrier to decarbonisation is the lack of will among political elites to take sustainable energy policies seriously. This elite, including President Erdoğan, still seems to cherish the idea that expanding energy consumption is a sign of progress. Many officials like to point out that Turkey's energy demand growth is second only to China, implying that this is good news. The problem is replicated on the level of the bureaucracy. Here, the task to satisfy ever-growing energy demand has left energy planning in a rather reactive state of mind. Not only has planning often favoured established technologies, it has also tended to overlook the increasing competitiveness and potential value-added of renewable energy sources. For example, while IRENA reports onshore wind power generation costs of USD 0.09 or less per kWh, Turkey still pushes for building the Akkuyu nuclear plant that comes with a 15-year offtake agreement at a price of USD 0.1235 per kWh. The reactive approach has yet to give way to a policy approach built on solid, long-term planning and which is proactively embracing future chances and opportunities in the energy sector.

A third barrier is the sustainable energy sector's lack of attractiveness for investors. Fossil rhetoric and the absence of long-term planning increase policy risks and reduce investor attractiveness. The same is true for the regulative shortcomings highlighted above. This has led to a paradoxical situation: The attractiveness of renewable energy investment in Turkey is average at best, despite: Turkey's until recently booming economy; investor enthusiasm for Turkey's energy market; its large sustainable energy potential; and a global boom in renewable energy investment. In Ernst & Young's Renewable Energy Country Attractiveness Index, Turkey ranks 19th out of 40 states (EY, 2016). Furthermore, given Turkey's ongoing domestic political crisis, the situation might worsen. The unsuccessful coup attempt of July 2016 and the subsequent 'cleansing' of large parts of government by President Erdoğan's supporters might not only have negative effects on the country's capacity for effective governance; it is also likely to negatively affect the country's economic performance and raise doubts about Turkey's political stability. This would further hamper the willingness of (foreign) investors to commit to long-term sustainable energy projects.

Foreign policy focus on regional leadership and energy security

Turkey's energy foreign policy is based entirely on fossil sources, focusing on pipelines and energy security (Richert, 2015). The country is following an ambitious foreign policy agenda related to its 2023 vision, calling for making Turkey "one of the key players of global politics and a major actor for regional peace and stability" (AK Parti, 2016). The Turkish Foreign Ministry's energy policy thus focuses on Turkey's energy security, on reducing import dependency and the diversification of supply. Its second major ambition is to make Turkey an energy trade hub in the region. This implies a focus on expanding oil and gas pipeline infrastructure in the future. The Energy Ministry also defines two foreign policy goals in its Strategic Plan: first, to integrate Turkey into regional energy markets for electricity and gas; second, to make Turkey a powerful actor in the international arena. The latter is to be pursued in three ways: the acquisition of foreign coal, oil, gas and radioactive mineral fields; the expansion of staff in international organisations; and the opening of bilateral Representations of Energy and Natural Resources.[2]

[2] Priority is given to Representations in the United States, Russia, Azerbaijan, Iraq and France. These focus countries once again suggest the primacy of oil and gas (Russia, Azerbaijan, Iraq) and potentially nuclear power (United States and France) in Turkey's energy approach.

Sustainable energy is not part of foreign policy priorities. This is not surprising, given the domestic focus on further carbonisation. Turkey's 2015 G20 presidency featured the first ever G20 Energy Ministers' meeting, as agreed by G20 leaders at Brisbane the year before. Turkey chose to interpret the theme of "energy sustainability" in terms of energy access and investment rather than environmental sustainability and climate change. The Energy Minsters' meeting resulted in an Energy Access Action Plan. Also with regard to climate change, Turkey focused on issues of financing rather than reducing emissions. Analysis by the University of Toronto shows that Turkey subsequently failed to deliver on both of these pledges (G20 Research Group, 2016).

At the 2015 Paris climate summit, the targets presented by Turkey were weak: The country pledged to reduce greenhouse gas emissions by 21 percent (compared with a business-as-usual scenario) by 2030. Furthermore, the country's climate efforts have been evaluated as "inadequate" by the Climate Action Tracker (2016) and as "very poor" by the Germanwatch Climate Change Performance Index (2016). Its INDC furthermore emphasises Turkey's need to use its own resources. Given the abovementioned domestic situation, this would most certainly mean coal. Moreover, the contribution highlights special national circumstances and capabilities, mainly defined by the continuing growth of GDP and energy demand. Finally – and in gross contradiction of the global player and regional power rhetoric that Turkey tends to present in other contexts – the INDC stresses that Turkey experiences financial and technical constraints in fighting climate change, and that it would remain eligible for official development aid.

No impulses and the role of geopolitics

Turkey's current energy pathway is, by and large, rather contradictory to the overall agenda of decarbonising energy systems. Thus, given its domestic and international priorities, no positive impulses for a global transition towards sustainable energy are to be expected. Moreover, particularly in terms of reducing the use of coal, foot-dragging seems to be the most likely course of action.

It is furthermore important to note that Turkey tends to perceive energy negotiations in the context of – or as a proxy for – larger geopolitical constellations. This might have several implications: On the one hand, there might thus be some hope that Turkey remains neutral with regard to sustainable energy negotiations in the G20. The country's leader might be eager to avoid opening extra fronts of discontent internationally after heavy international criticism of the government's domestic political 'cleansings' that followed the failed coup attempt of July 2016, as well as the ever more apparent drift towards autocracy.

On the other hand, the connection of Turkey's position on energy to larger geopolitical constellations might also provoke a hardening of the Turkish position. Such hardening regarding sustainable energy issues might occur if it was seen as a way to foster Turkey's recent diplomatic rapprochement with Russia. Already, the Paris climate conference was perceived by President Erdoğan as an opportunity "to repair our relations with Russia", and the 2016 G20 meeting in Hangzhou served as an opportunity for the two parties to revitalise common fossil energy projects. The upcoming G20 events might be perceived in a similar light, making possible a Turkish–Russian energy coalition of the unwilling.

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16. The United States: Domestic Transitions and International Leadership Towards Low-Carbon Energy

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As the world's second largest energy consumer and emitter of greenhouse gases, one of its most important producers of oil and gas and home to the second largest capacity of renewable energy, the United States is a central actor in global energy governance. Energy policy in the United States has been characterised by an open approach with regard to the choice of energy sources and is aimed at reaching a target triangle comprising economic competitiveness and employment; energy security; and the development and deployment of low-carbon energy sources. This "all-of-the-above strategy" is reflected not only in domestic energy policy, where state initiatives also decisively shape the policy landscape for sustainable energy, but also in US international energy activities.

The United States energy mix: trends and status quo

The US energy mix is dominated by fossil sources and has been undergoing fundamental changes. For 2015, the US Energy Information Administration (EIA) reports that 29 percent of primary energy consumption came from natural gas, whose share is still on the rise given record domestic production, low gas prices and more stringent emission requirements (EIA, 2016a). Coal accounted for 16 percent of primary energy use, two percentage points less than a year before and the lowest share since 1982 (EIA, 2016a). The largest share of primary energy consumption was covered by petroleum (36%), whose utilisation was on the rise due to increased vehicle use linked to lower gasoline and diesel prices. Nuclear remained stable with a share of nine percent and hydroelectricity declined slightly because of low precipitation. In total, renewables accounted for 10 percent of primary energy consumption (of which 49% was biomass including biofuels, 25% hydroelectricity, 19% wind, 6% solar and 2% geothermal) (EIA, 2016b). With 39 percent, electric power generation is the largest energy consuming sector, followed by transport (28%), industry (22%) and commercial and domestic use (EIA, 2016a).

In the electricity sector, about two thirds of generation was based on fossil sources in 2015. Coal still accounted for about one third of electricity generation in the US, despite significant declines in production over recent years (Davis, 2016). Natural gas accounted for another third of electricity generation, while 20 percent came from nuclear, six percent from hydropower and seven percent from other renewables (of which 1.6% biomass, 0.4% geothermal, 0.6% solar and 4.7% wind) (EIA, 2016c). In a global context, in 2015, the US ranked second behind China for investment in renewable energy capacity, first for biodiesel and fuel ethanol production and was ranked second for wind and geothermal capacity additions (REN21, 2016). Overall, the US currently has the second largest installed capacity of renewable energy

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irrespective of whether hydro is included (REN21, 2016). The US ranks first globally for geothermal and biopower capacity, second for total wind and concentrated solar power (CSP) capacity and fourth for solar photovoltaics (PV) (REN21, 2016).

The US energy landscape has undergone significant changes in recent years, mainly related to the resurgence of domestic light tight oil and shale gas production (IEA, 2014). In 2015, the US came a close third in global oil production (OECD, 2016), but remained one of the world's biggest net importers of petroleum and the eighth most important importer of natural gas (OECD/IEA, 2015). Domestic oil production in the US has increased tremendously since the beginnings of the 2000s, rising by 30 percent between 2003 and 2013 (IEA, 2014). Starting in the middle of the 2000s, with improvements in hydraulic fracturing technology and the discovery of some of the world's largest gas fields, the US has become the world's largest producer of natural gas (OECD/IEA, 2015). Although the increase in shale gas and domestic oil production has slowed since mid-2014 amidst the global slump in the oil price, the overall trend of the US reducing net import dependency for natural gas is set to continue (EIA, 2016d). However, a decision taken by Congress in late 2015, to lift a 40-year-old restriction on crude oil exports, has not yet significantly affected net imports, given low global oil market prices (PennEnergy, 2016).

Another fundamental shift in the US energy landscape concerns coal. Domestic coal production was down about one third in the first half of 2016 compared to 2015, due to a combination of policy-driven (i.e., emission limits for power plants) and market-driven (abundant domestic gas) developments (Davis, 2016). Traditional coal-mining counties have seen challenges in structural adjustments and job losses, which have entered the national political debate on energy policy (Sussman, 2016). President-elect Trump has repeatedly promised to put coalminers back to work, including by repealing emission regulations enacted under the Obama administration – where possible, with immediate effect through executive orders.

Sustainable energy policy in the US: the federal level

The United States was an early leader in the development of renewable energy technologies. The first guaranteed tariffs for producers of electricity from renewable sources (an early version of so-called feed-in tariffs or FiT) was introduced through the Public Utility Regulatory Policies (PURPA) Act in 1978. In particular, the state of California's interpretation of the act led to a rapid increase in wind power capacity in the state, solar energy still being too expensive for rapid deployment at the time (Hirsh, 1999). While renewable energy efforts slowed noticeably over the course of the 1990s amidst decreasing natural gas prices and industry restructuring, policy innovation at the level of states – especially renewable portfolio standards and net metering schemes – led to a resurgence of sustainable energy leadership in the US from the late 1990s (Martinot et al., 2005).

Advancing US climate and sustainable energy policy has been a main objective of the Obama administration. This ambition is prominently reflected in President Obama's 2013 Climate Action Plan, which proposes, by 2020, to double solar and wind capacity and reduce emissions by 17 percent compared to 2005 levels (Executive Office of the President, 2013). The US Intended Nationally Determined Contribution (INDC) submitted ahead of the 2015 Paris climate talks increased this goal to 26–28 percent reduction compared to 2005 levels by 2025, with "best efforts" to reach 28 percent. Against the background of frequent tensions between the executive and the legislative branches of government, major energy and climate legislative proposals, such as the 2010 Waxman–Markey Bill on cap-and-trade, failed to be adopted. As a result, sustainable energy policy in the US today resembles a mosaic of local, state and federal initiatives, and the lack of cohesive overall strategies has been pointed out by the IEA (2014).

Fierce opposition to climate and sustainable energy initiatives in the US Congress during the Obama presidency led to increasing reliance on alternative regulatory instruments to reduce greenhouse gas emissions in the US (IEA, 2014; Leggett, 2015). A recent important example is the Clean Power Plan, presented in summer 2015, which is based on provisions from the 1970 Clean Air Act. The plan deter-

mines emission limits for gas- and coal-fired power plants and provides a range of alternatives to the states (e.g., introducing mass- or rate-based emissions limits, linking systems), which are responsible for implementing the Clean Power Plan through concrete policy action (DeBellis, 2015). An unprecedented verdict by the US Supreme Court on 9 February 2016, to stay the Clean Power Plan until a further decision is reached on the plan's substance, has halted its implementation over doubts regarding the Environmental Protection Agency's (EPA) mandate and interpretation of provisions from the Clean Air Act (Freeman, 2016). The prospects of the Clean Power Plan being implemented have, however, become highly unlikely under a Trump administration. Throughout his election campaign, Donald Trump made it clear that he would block the Clean Power Plan and drastically reduce EPA competencies. The appointment of Myron Ebell, a prominent climate sceptic, to lead the EPA transition team, is unambiguous evidence of the major reshaping of US environmental and climate policy to be expected in the coming years. Other policy instruments, in particular production tax credits and investment tax credits for solar and wind projects, which were prolonged in late 2015 by a Republican-led Congress, could nevertheless mitigate the lack of a federal framework for sustainable energy by encouraging investment in renewable energy sources (Linn et al., 2016).

At the federal level, sustainable energy policy under the Obama administration placed particular emphasis on innovation, research and development, particularly through the Department of Energy's Advanced Research Projects Agency-Energy. The agency's mission is to fund selected "high-potential, high-impact energy technologies that are too early for private-sector investment", an aim towards which it had invested USD 1.3 billion by early 2016. The prospects for the program are also unclear following the November 2016 election.

A heterogeneous energy policy landscape across states

Individual states have wide-ranging competencies in the definition of energy policies, including their own energy mix (Elliott, 2013). The degree of ambition, policy framework and actual increases in renewable energy capacity therefore vary widely between states. The importance of state-level initiatives in sustainable energy is set to increase dramatically, given president-elect Trump's pledge to repeal federal regulations in this field.

As of June 2016, 29 states as well as Washington D.C. and three US territories had renewable energy portfolio standards in place (DSIRE, 2016a). In 41 states, as well as in Washington D.C. and three territories, net metering schemes were implemented (DSIRE, 2016b). In addition to policy-driven deployment of renewables, in particular in states such as California, purely market-driven additions of renewable energy capacity prevail in some states including Texas. In 2016, the EIA expects 9.5 GW of new solar capacity to be added by electricity generating facilities across the US – almost three times as much as in 2015 – of which 3.9 GW are to be added in California alone, followed by North Carolina (1.1 GW) and Nevada (0.9) (EIA, 2016d). Most of the 8.1 GW of wind capacity to be added in 2016 will be located in a corridor ranging from North and South Dakota and Minnesota, to Texas and eastern New Mexico (EIA, 2016d). California is pursuing a 50 percent renewables goal by 2050 through its Renewables Portfolio Standard (RPS), has set a target of 1.5 million electric vehicles and has launched its first electricity storage mandate of 1 325 MW; in contrast, other states almost entirely lack policy frameworks for sustainable energy.

A recent report by the American Council for Energy Efficiency (ACEEE) ranks the US 8th in the world in terms of energy efficiency ambitions and achievements. Again, a look at the individual states provides a heterogeneous picture, with frontrunners including Massachusetts, California, Vermont and Oregon, and laggards comprising North and South Dakota, Wyoming and states in the South (ACEEE, 2016a). At the federal level, promoting energy efficiency is a cornerstone of the American Recovery and Reinvestment (ARRA) Act of 2009, which provided USD 17 billion for investments in energy efficiency, including for programmes at the state level (IEA, 2014). Policy measures at this level mainly concern standards for new buildings as well as vehicle fuel efficiency (IEA, 2014).

Although the policy landscape for renewable energy and efficiency is highly heterogeneous, similar lines of debate emerge across states. The growing share of

decentralised renewable energy installations such as solar rooftops is increasingly challenging the business models of traditional utilities, as are energy efficiency mandates such as Energy Efficiency Resource Standards (ACEEE, 2016b). In addition to challenges to incumbents' business models, growing shares of intermittent renewable energy capacity – both utility scale and residential – are creating new issues in terms of grid infrastructure, management and dispatch (IEA, 2014). One response has been to consider greater regional cooperation. Another area, identified by the Department of Energy's first Quadrennial Energy Review in 2015, is the modernisation of transmission and distribution grids across the country in order to make them ready for transformed needs (IEA, 2014; US Department of Energy, 2015).

US initiatives for international energy cooperation

President Obama's 2013 Climate Action Plan establishes the aim of "leading international efforts to combat global climate change and prepare for its impacts" as a central pillar of the administration's climate and sustainable energy strategy. International energy cooperation currently reflects the country's domestic "all-of-the-above" strategy by supporting all types of energy. Under a Trump administration, dramatic changes are also to be expected in this area, as Donald Trump has pledged to "cancel" US participation in the Paris Climate Agreement and revoke funding promises for international climate finance.

Two important US-led initiatives, the Major Economies Forum on Energy and Climate, and the Clean Energy Ministerial (CEM) were established in 2009. The Major Economies Forum, which includes 17 major emitters, has resulted in Technology Action Plans for different sectors accounting for 80 percent of global emissions, and has identified opportunities for collaboration among its member countries on these technologies. The CEM, which brings together governments from 23 countries and the European Commission, is organised around a series of initiatives (e.g., an Electric Vehicles Initiative or a Multilateral Solar and Wind Working Group) that governments may join, depending on their interest, to exchange experiences and further thinking.

In the framework of the G20, the United States pushed for a commitment at the Pittsburgh G20 summit in 2009 to "rationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption" (G20, 2009).

Multilateral energy partnerships driven by the United States include the US–Africa Clean Energy Finance Initiative (ACEF), the US–Asia Pacific Comprehensive Energy Partnership, the Clean Energy Finance Facility for the Caribbean and Central America (CEFF-CAA), and the US–Africa Clean Energy Development and Finance Center, which supports project development and implementation "while promoting US private sector participation" and contributes to implementing the goals of the Africa Clean Energy Finance Initiative (USTDA, 2014). US support for energy infrastructure also takes place in the framework of the Power Africa initiative carried out by the US Agency for International Development (USAID), with the goal of creating sixty million new electricity connections on the continent.

In addition to the mostly renewable-energy-focused initiatives mentioned above, the Unconventional Gas Technical Engagement Program, created as the Global Shale Gas Initiative in April 2010, provides policy support and resource assessments to partner countries. Countries including Botswana, Morocco, South Africa, who wish to "utilize their unconventional natural gas resources – shale gas, tight gas and coal bed methane" are supported in order to allow them to "identify and develop [resources] safely and economically" (US Department of State, 2010). The initiative's current level of activity is unclear, and the programme has faced criticism regarding potential pressure on partner countries to create enabling frameworks for shale gas development (Fang & Horn, 2016). In the field of nuclear energy, the US provides policy advice and training through its Nuclear Regulatory Commission and the Department of Energy, and entertains bilateral partnerships with more than 20 countries worldwide (Kerr et al., 2014). In the area of coal, the US is leading the so-called Carbon Sequestration Leadership Forum, which facilitates research activities and includes 24 member countries as well as the European Commission (CSLF, 2016).

One of the most recent international energy and climate initiatives launched by the US is Mission Innovation. Announced in the framework of COP21 in Paris in 2015, it led 20 countries to pledge a doubling of their governmental research and development spending on clean energy in the next five years. Linked to this is the Breakthrough Energy Coalition, a commitment by private sector investors to support action taken by Mission Innovation countries by providing patient capital for early-stage clean energy investments.

In addition to activities in multilateral fora, the US has also reinforced bilateral energy and climate cooperation during the Obama administration. Behind Germany, Japan and France, the US is the world's fourth largest bilateral donor in the energy sector and spent more than USD 350 million in this area in 2014 (own calculations, based on OECD Stats, 2016). Agreements were recently reached with major greenhouse gas emitters among emerging countries, including China, India, Brazil and Mexico. The most widely noted of these bilateral statement was announced in November 2014, between President Obama and President Xi Jinping of China. In the joint announcement, the US committed to reducing its carbon emissions by 26–28 percent below 2005 levels by 2025, and China pledged to undertake "to peak its carbon emissions by 2030 or earlier". Throughout his electoral campaign, president-elect Trump has questioned the reality of anthropogenic climate change, and recent appointments within his transition team also suggest a major redefinition of the US' role in international climate and sustainable energy efforts, as in foreign policy in general.

Impulses

Domestic leadership in sustainable energy has faced numerous challenges at the federal level in the US and is fundamentally under question from the incoming Trump presidency. Nevertheless, a multitude of cities and states have taken pioneering action in renewable energy and energy efficiency, creating laboratories for policy development and experimentation that can offer valuable lessons for other subnational entities and countries globally. The US "all of the above" approach to sustainable energy, which is reflected in its international outreach activities, means that dialogue can be established on a wide variety of energy issues with partner countries pursuing very different energy strategies themselves. Recent initiatives led by the US, such as Mission Innovation and the Breakthrough Energy Coalition, but also domestic experiences with R&D for sustainable energy, underline the strong role of private sector involvement in US sustainable energy efforts, which can potentially serve as an impulse for measures emanating from the G20 and are likely to continue regardless of the major changes to be expected in US environmental, energy and climate policy.

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