Research Paper

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Paris Mismatches

The Impact of the COP21 Climate Change Negotiations on the Oil and Gas Industries

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Executive Summary

This paper analyses the impact of international climate action agreed at the COP21 meeting held in Paris in December 2015 on the oil and gas sector. It includes summaries of the relevant aspects of the individual Intended Nationally Determined Contributions (INDCs) of China, the EU, India, Japan, Saudi Arabia (with some comments on Iran) and the United States. These countries represent not only the largest contributors to greenhouse gas (GHG) emissions, but a mix of developed, developing, and oil and gas exporting countries. This paper highlights the different approaches these governments propose, compared with previous policies, the impacts on the oil and gas sector, and the challenges for managements and investors within the sector.

- There is a mismatch between the stated objective of the Paris Agreement to limit global average temperature increase to well below 2°C and the contributions to climate change mitigation put forward by the parties to the agreement in their INDCs. The likely outcome of the first round of INDCs, for 2020–30, is estimated to be a temperature rise of 2.7°C, in a range of 2.2°C–3.4°C,[1] by the end of the century, compared with 3.7°C under 'business as usual'.

- This means that additional, and more stringent, measures are likely in the future. The Paris Agreement provides for this to happen through a five-year review cycle in which parties will submit progressively more ambitious contributions. As a result, the impact on the oil and gas sector will intensify.

- The INDCs only apply to the period 2020 to 2030. This paper emphasizes the importance of establishing credibility by fulfilling current commitments in the period before the first review (2020), so that more ambitious targets can be considered.

- Credible policies are also needed to send a strong signal to those who consume and produce carbon-based fuels so that their investment plans can be amended to reflect the shape of a lower carbon economy.

- Without credible policies, investment in consumption and production of fossil fuels will continue and oil and gas companies will make risky investments to meet unsustainable demand.

Within each INDC, the policies that impact most directly on oil demand are those concerning the transport sector. These are widespread throughout the INDCs and include increasing efficiency standards for vehicles as well as commitments to develop alternatives for new cities (e.g. mass transit systems). Subsidies for oil are being reduced or eliminated in many countries, which is likely to lead to lower oil demand.

[1] Climate Action Tracker, *Climate pledges will bring 2.7°C of warming, potential for more action*, Climateactiontracker.org/news/253/ (accessed 10 Dec. 2015).

- For oil, these trends are not new: demand has fallen in most developed countries, while rising in many developing countries. The policies within the INDCs will exacerbate the decline in demand in developed countries, while reducing the growth of oil demand in developing countries.

- Between 2020 and 2030 total global demand for oil may peak and begin to decline. Impact over and above this depends on the emergence of disruptive technologies, such as batteries for electric vehicles. These in turn depend not only on technical innovation but also on the availability of relatively cheap electricity (generated by low-carbon fuel sources).

- The impact of the INDCs on oil demand will be negative, but relatively predictable, at least until batteries become economically available at scale.

The policies emerging from the Paris Agreement are much more unsettling and unpredictable for natural gas.

- The main use of gas is in the electricity sector and many countries (and indeed gas-producing companies) envisage a greater use of natural gas in power generation, replacing coal.

- The markets available for new gas supplies are the uncertain residual of aggressive policies to use renewables (e.g. wind and solar), governments' policies on nuclear and their attitude to legacy coal generation.

- Each country needs investment in infrastructure, and market and pricing systems to cope with intermittent and decentralized supply.

There is a distinction between developed markets and developing (and growing) markets for gas.

- There are developed countries where electricity demand is not growing and within which the promotion of renewables, without a managed exit for coal, neither creates room for gas nor the profitability that power companies need to make the necessary investments (in smart grids, for example).

- In developing countries, where access to power is important and demand is growing, it is for the gas producers to persuade governments that gas has a place (particularly where imported coal is very cheap) and achieve volumes sufficient to fund infrastructure investment.

- Overall there is greater uncertainty about the size and profitability of markets for new gas supplies than for oil, particularly those requiring infrastructure investments for exporting from gas-rich to gas-poor countries.

Company managements will adopt different strategies in response to these policies.

- In the oil sector, a realistic assessment of demand growth is crucial. Managements should not overinvest in potentially unnecessary projects. The corollary of this may be spending, through consolidation or diversification in renewables or decapitalization, through dividends and share buybacks, allowing the market to reallocate capital.

- In the gas sector, the challenge is twofold: to try and negotiate a space for gas in the generation systems of developed countries – where it would be a substitute for existing assets (largely coal); and to gain a share of generation growth in developing markets (perhaps driven by pressure for improved air quality, and/or diversity of supply) sufficient to justify the infrastructure investments that gas needs.

- Managements of companies producing both oil and gas will have to decide how to allocate resources between the two, given the different risk profiles.

Some investors may be precluded from investing in oil and gas companies by their investment mandates, and some may decide not to do so for ethical reasons. Those that continue to invest will be keen to see capital deployed appropriately and will pressure managements to be realistic about viable investments over the next decades. This may lead companies to move away from projects that leave them exposed for long periods, in order to be able to react to future climate change-related measures. Companies and shares can do well even in a low or ex-growth sector (e.g. tobacco) given the right management strategy: investors will reward different strategies as appropriate.

- A fundamental transformation will need to take place in all economies in order to reduce energy demand and the use of oil, gas and other fossil fuels. The vast majority of the cost of this transformation will be met by the private sector. Investments, outside the oil and gas industries, will be needed to improve the efficiency of consumption – automobiles, industry, heating; every business will be changed to some extent.

- There is a risk that assets committed to high-carbon intensity consumption will be stranded (as is now happening to coal-fired power stations). The seriousness with which market participants in all sectors adjust their investments to enable this transformation depends on the credibility of current policies and belief in the future tightening of policies.

Although the diverse nature of the INDC structure enabled a very broad buy-in at Paris, that very diverse nature makes them challenging to monitor and review. It is vital that this is done well.

- The INDCs of the developed economies are largely an agglomeration of existing policies (extensions at best), those of the developing economies are very general (i.e. economic growth with less carbon intensity).

- In order for the Paris Agreement to be truly effective the INDCs must be the start of a dynamic process in which new technology, better regulation, experience, process re-engineering and the sharing of best practice are all fed into tightening regulations and higher requirements throughout economies in a way that harnesses the innovation and flexibility of the private sector, rather than restricting progress.

The process is already attenuated, if the attitude of most participants is 'how little can we get away with?' before the 2020 review rather than 'how much more can we do?' then our chances of limiting climate change to 2°C, let alone 1.5°C are small indeed.

1. Introduction

This paper examines the 2015 Paris Agreement as it pertains to the oil and gas sector. The countries' INDCs vary greatly in levels of detail and number of specific measures contained within them. In general, the INDCs divide into three groups:

1. Those of the developed countries that generally choose a baseline date for GHG emissions (a different date from country to country) and make a commitment to reduce those emissions by a specified percentage by a future date (again not necessarily the same date). They outline policies by which this is to be achieved, with varying degrees of detail.

2. Those of developing countries, which take the form of commitments to reduce the carbon intensity of their future economic development compared to the present (some give a target for the change in carbon intensity). The level of detail varies, from specific policies (such as those on renewables in the power sector or efficiency standards for vehicles) to the very general (intentions to transform the economy).

3. Those countries deserving special consideration because of their economic dependence on fossil-fuel exports. Saudi Arabia cites its status as one of the countries whose economies are highly dependent on income generated from the production and consumption of fossil fuels and associated energy-intensive products.[2] By implication its contribution cannot therefore be measured in the same terms as those of economies not dependent on fossil fuel exports. The INDCs of Iran and UAE similarly flag their case for special consideration.

This paper is specifically for stakeholders of the oil and gas industries: consumers, producers, policy-makers, investors, regulators and advocacy groups. It focuses on the direct impacts on the oil and gas industry of the INDCs – to which major emitting countries pledged to adhere as part of the December 2015 Paris negotiations – compared with preceding policies. Many of the procedural complexities are not covered in this paper, and the most appropriate numbers from various studies are used without detailed reconciliation. There is uncertainty about the numbers used in climate policies and about the willingness and ability of some governments to carry out their promises. A broader assessment of the Paris outcomes is available in a Chatham House Briefing: *Post-Paris: Taking Forward the Global Climate Change Deal*.[3]

This paper highlights the core of the Paris Agreement, compares the INDCs of five major countries, and the EU, with their pre-Paris policies, and suggests the major challenges for policy-makers, oil and gas companies, and investors in oil and gas production and consumption.

[2] The country qualifies for consideration of special needs under article 4, 8(h) of the UN Framework Convention on Climate Change (UNFCCC) if it is called upon to make 'disproportionate contributions' (Article 3, para. 2).
[3] Bailey, R. and Tomlinson, S. (2016), *Post-Paris: Taking Forward the Global Climate Change Deal*, Briefing, Royal Institute of International Affairs, https://www.chathamhouse.org/publication/post-paris-taking-forward-global-climate-change-deal (accessed 6 May 2016).

2. The Paris Agreement and its Challenges

The Paris Agreement covers a wide range of policies and processes intended to hold the global average temperature increase to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change. The agreement will take effect after ratification by 55 countries accounting for 55 per cent of GHG emissions.

The key elements of the Paris Agreement are:

- A 'bottom-up' process: the declaration by each country of an INDC – this becomes a Nationally Determined Contribution (NDC) once ratified – by which individual countries submits its intentions for action between 2020–30,[4] to mitigate global emissions and prepare to adapt to global warming. In addition, the countries agreed to a five-year cycle of review and new targets thereafter.

- There will be further rounds of monitoring, review and further pledges, beginning in 2018, to take stock of collective efforts, with a view to a further round of contributions to be pledged in 2020 for the period of 2030–40,[5] informed by a new round of scientific assessments by the Intergovernmental Panel on Climate Change (IPCC).

- Differentiation between the contributions of developed countries, based on reducing emissions from a baseline, and from developing countries, based on reducing the energy intensity of their economies as they develop, or achieving reductions below projected emissions.

Policy will become more aggressive

Policy-makers, preparing for the next round of reviews and pledges in 2018–20, will consider a forthcoming IPCC report on the impacts of global warming of 1.5°C above pre-industrial levels and related GHG emission pathways. They will need to balance priorities between early reductions of emissions using current technologies and systems, and the possibility of waiting for improved options later (with a greater risk of exceeding the temperature target). Better integration between environmental and energy policies will be important.

At the same time, companies and investors in oil will need to adjust to the worsening of existing negative demand trends in the short to medium term. In the medium to long term, there are potentially much more disruptive scenarios driven by advances in technology (e.g. batteries) and increasingly stringent policies for the transport sector. Although the potential for these developments will become clearer, the speed of their uptake will be difficult to predict and, if the normal S curve growth path is followed, could be significant.

[4] 2025 for the United States.
[5] With the United States pressed to extend its target date to 2030.

In the gas sector, companies need to understand that the expected golden age of gas as the cleaner, transitional fuel may not materialize as hoped. Structural changes to the power sector are increasing uncertainties for long-term investment, especially in the infrastructure for gas trade.

Climate change mitigation policies that favour renewables limit the expansion of gas markets on a country-by-country basis, and are not necessarily balanced by a managed exit from coal (existing assets and cheap coal are very competitive).

Companies with both oil and gas operations need to balance the relatively clear medium-term future for oil with the uncertainties of expanding the market for gas with investment in international gas transportation infrastructure. Meanwhile investors need to challenge company managements about capital allocation and, where appropriate, demand that capital should be returned (via dividends and share buybacks), to be reallocated to other sectors.

Advocacy groups face the challenge of maintaining the credibility of the Paris policies by pressing for stronger implementation of INDC policies in key sectors and countries; keeping pressure on all participants to continue tightening policy; ensuring that the monitoring and review process is active and honest; and reconciling climate change mitigation with poverty reduction and economic growth objectives.

The mechanics of the Paris Agreement

For the first time in more than 20 years of negotiation, 195 countries – parties to the UN Framework Convention on Climate Change (UNFCCC) – have agreed (subject to ratification) that each will make a contribution to mitigate and adapt to climate change. For most, it is no longer a question, as it was when the UNFCCC was agreed in Rio in 1992, whether global warming and the threat of climate change deserve an international response.

There were, from the beginning, difficulties in reconciling the wishes of many developed countries to halt and reverse the growth of GHG emissions and the absolute reluctance of many developing countries to subject themselves to limits on their economic growth. These issues were still apparent during the negotiation of the Kyoto Protocol in 1997, which did not include quantified commitments from developing countries. Since the Copenhagen meeting of 2009, the commitment of China to an international agreement has changed the balance.

There is an unavoidable mismatch between the collective responsibility for the unfettered past emissions of relatively rich countries and future emissions of emerging economies and countries, where energy consumption has been held back by a lack of access. This has been a toxic subject in the wider arena of politics than just climate change. However, it was resolved, at least conceptually, at the 1992 UNFCCC by the idea of 'common but differentiated responsibilities'.[6] Building on this idea, the Paris Agreement allows each country to differentiate itself by nominating its own actions against the threat of climate change. As a result, reductions in the carbon intensity of economic growth (CO_2 emissions per unit of GDP) in emerging economies became more acceptable politically,

[6] Article 3, UNFCCC, 1992 FCCC/INFORMAL/84 GE.05-62220 (E) 200705, https://unfccc.int/resource/docs/convkp/conveng.pdf (accessed 5 May 2016).

alongside absolute reductions from a baseline of emissions in developed economies. It is a fragile political balance, and the credibility of the agreement would suffer if the balance of countries' different contributions were seen to be unfair.

Numbers and uncertainties

The contribution of 'anthropogenic' emissions, those caused by human activity, to global warming is discussed at length in the 2015 IPCC reports. While the modelling of climate and energy systems has improved, there remains major uncertainty about how future levels of global warming will affect the climate, and of how temperatures may rise due to future GHG concentrations. The MIT Energy and Climate Outlook 2015[7] predicts (with a 5–95 per cent range of probabilities) a 3.1–5.2°C increase in the global average temperature based on policies announced by major emitting countries in August 2015. The UN Environment Programme estimates that with full implementation of conditional INDCs there would be a greater than 66 per cent chance of limiting the global average temperature increase to 3–3.5°C by 2100.[8] Carbon Action Tracker estimates a median warming of 2.7°C in the range 2.2–3.4°C; these estimates have various qualifications, and some are conditional on broadly parallel actions by other countries. This sensitivity at the heart of the projections from climate-economic models means that the outcomes of policy will be uncertain, even if the policy effects are well measured and the economic forecasts generating them are correct. In the longer term, these uncertainties suggest that if 2°C is the threshold at which serious damage to the environment occurs, then it would be prudent to aim for a tougher target and increase the probability of avoiding 2°C.

In terms of strategy and action, similar uncertainty applies. There is a mismatch between medium-term and possible long-term technologies. In the medium term, to 2030, the uncertainty of climate sensitivity has slightly less influence on temperature, and confidence in the economic and technological parameters is higher than it is for the long-term. Disruptive technologies are likely to impact the longer term, but it is unclear when and by how much.

Financial mismatches

The language of both the Copenhagen and Paris agreements commits developed countries to mobilize $100 billion a year by 2020 to help mitigation of and adaptation to climate change in developing countries. Some developing countries make receipt of this money a condition of their climate change contributions.

In the EU, and possibly some other countries that use the sale of permits to regulate industrial emissions, there will be flows of money from the auctioning of emission allowances. EU legislation requires that at least half of these auction revenues, and all revenues from auctioning allowances for

[7] Reilly, John et al. (2015), *Energy and Climate Outlook 2015*, MIT Joint Program on the Science and Policy of Global Change, Boston://globalchange.mit.edu/research/publications/other/special/2015Outlook (accessed 6 May 2016).
[8] Estimates are compared by Climate Action Tracker (2015), 'What do the CAT, UNFCCC Synthesis Report and the UNEP 2015 Emissions Gap report say about the prospects of limiting warming to below 2°C and 1.5°C from INDC levels for 2025 and 2030?', http://climateactiontracker.org/global/235/What-do-the-CAT-UNFCCC-Synthesis-Report-and-the-UNEP-2015-Emissions-Gap-report-say-about-the-prospects-of-limiting-warming-to-below-2C-and-1.5C-from-INDC-levels-for-2025-and-2030.html (accessed 6 May 2016).

aviation, should be used for climate change mitigation and adaptation policies either domestically or internationally.

The bulk of the finance for transforming economies – the economies of consuming countries that are major emitters of GHGs – will be provided by the private sector. New mechanisms and financial arrangements may be necessary or this may be dependent on the effectiveness of existing market mechanisms. It is for policy-makers to make more rather than less possible, but it is by no means a simple task. There are many categories of lenders and investors with many different time horizons, risk tolerances and return requirements. Traditionally, high levels of uncertainty and political risk make attracting investment more difficult and expensive, thus, the more policy clarity and stability (more so even than levels of subsidy) that governments can provide, the more likely it will be that funds can be raised. A combination of well-designed regulations/incentives and enlightened self-interest on the part of the private sector can produce more innovation and progress than heavy-handed policy alone.

The scope of this paper is specifically the impact on the oil and gas industries. Clearly coal, as the most carbon-heavy fuel, will bear the brunt of climate mitigation policies and the role of coal will be challenged by regulation or taxation. In countries where policies are lax, the low cost of coal will maintain a share of power generation and cause the market share of renewables and gas to suffer. Some investors have restricted lending for new coal-powered generation, and this may be extended.

Just as the responsibility for emitting GHGs is shared with consuming companies and individuals, so will the responsibility of transforming economies be borne by all participants. It is clear in the scenario outlined by the International Energy Agency (IEA) of 450 parts per million (ppm) of CO_2 in the atmosphere (consistent with a 2°C stabilization pathway) that the majority of carbon savings come from efficiency and productivity, rather than from the growth of renewables alone. Efficiency savings will be shared amongst companies and individuals, throughout economies, and will be driven by a mixture of legal/regulatory requirements, technical progress and enlightened self-interest. Costs to the emitters of GHGs will be market opportunities for the providers of low or zero-carbon technologies. This places a responsibility on investors and advocacy groups to monitor and challenge developments on the demand side as well as for carbon-based fuel producing companies.

For the oil industry, there is a mismatch between the oil demand growth trajectory – driven by growth in GDP, population and the middle class – which has informed companies' investment plans in the past, and the medium- to long-term impact of climate change measures that will combine to reduce or reverse growth in demand per capita, and per unit of GDP. Hence, the oil intensity of future economic growth will fall.

Accepting this lower demand future should lead oil and gas company managements to be more cautious in their investments and to focus more on low-cost projects. This presents a problem for private sector oil and gas companies that are generally excluded from the lower cost opportunities open to state companies in, for example, the Middle East. In the longer term, there is also the risk of significant disruptive technological change (e.g. when batteries will be available at such scale and cost, combined with cheap electricity, to enable real mass electrification of road transport). It will be difficult for company managements to prepare for the uncertain timeframe and likelihood of disruptive change given the long life and high-cost investment of their projects. Managements may

move towards shorter time at risk projects, and fewer very large scale, colossal total cost projects to reduce this risk (success in US shale may become crucial, given its much shorter term nature).

Ultimately, private-sector industry will need to grow more slowly and thus invest less, and may well consolidate. This would generate excess capital that can be returned to investors (via dividends, share buy-backs) for the market to reallocate (rather than embark on a round of ill-advised, value-destroying diversifications). There is a parallel challenge for state-owned companies in oil-dependent economies. Saudi Arabia's 'Vision 2030'[9] and National Transformation Plan address precisely the issue of diversifying the economy away from dependence on oil revenues.

For the gas industry, the mismatch is between the much-vaunted golden era of gas as a cleaner transitional fuel and the likely future, limited by the complexity and political nature of the restructuring of the power sector. The great expense and long-time at risk of investments to move gas long distances (whether via pipelines or as LNG) is also less appealing to investors at a time of such change and uncertainty. In response, companies may put more emphasis on developing gas regionally. In developing countries, where access to power is limited, the power system can be expanded, creating space for gas generation (as opposed to developed countries where substitution of existing assets is the only area of growth). This may be on a smaller scale than current very large projects. In developing countries there should be room for local development of new gas markets where there are local gas resources but limited economic opportunities for export. Where the power market is saturated and there is abundant low-cost gas there is also long-term scope for gas to penetrate the transport market, either as a direct fuel or through a dedicated electricity system.

Although the power sector does not strictly fall within the scope of this paper, the importance to gas demand of restructuring being done rationally or not cannot be over-estimated. It is also worth noting that investors are already alienated by policy uncertainty, hence the very few new gas power stations built in Europe in recent years. Many power companies, particularly in Germany are already under considerable financial stress (cut dividends, dreadful share price performance) and with the business model effectively broken, it is this area that is most likely to find attracting investment difficult despite the need for a new structure.

Investment in renewables is also dependent on policy clarity and stability (more than on a specific level of subsidy) but investments tend to be smaller scale, shorter time at risk. There is a large section of the investment community that has a particular mandate to invest in socially responsible and/or 'green' companies as well as interest from conventional investment managers. This should be a sector able to attract funding for economically viable projects.

Supplementary issues

There are many influences on global warming that need to be addressed by new policies, even in countries where the science is understood. Examples are emissions of methane and various industrial gases, and the emission or absorption of GHGs from changes in land use. Monitoring and

[9] *Saudi Gazette* (2016), 'Full Text of Saudi Arabia's Vision 2030', 26 April 2016, http://saudigazette.com.sa/saudi-arabia/full-text-saudi-arabias-vision-2030/ (accessed 6 May 2016).

regulating these is technically and administratively challenging. These difficulties are being addressed in the follow-up work to Paris.

Emissions from international bunkers at sea or in the air are another problem because they are covered by separate international agreements: the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO). Negotiations are in train on both fronts involving the industries concerned.

Earlier, in 1997, the Kyoto Protocol set up Joint Implementation (JI) and the Clean Development Mechanism (CDM), which were designed to enable developed countries to restrict emissions growth by investing in ways to reduce emissions in developing countries. Both JI and CDM have proved complicated and difficult and do not feature in most of the Paris INDCs (though they have not been rejected).

3. The INDCs

This section reviews the Intended Nationally Determined Contribution (INDC) of the EU and five major countries: China, India, Japan, Saudi Arabia and the United States, as presented at the Paris Conference. These accounted for 59 per cent and 47 per cent of global consumption of oil and gas, respectively, in 2014 (in line with present policies, the IEA projected slightly lower shares for oil 2030 in its World Energy Outlook 2015).

Comparisons

There are three key considerations when making comparisons of INDCs:

- It is difficult to compare the INDC of one country with that of another due to the lack of correlating detail.
- More importantly, the INDCs reflect economic structures and trends that are very different.
- Where existing policies are somewhat confused, or the INDC is very minimal in scope and detail, the analysis is correspondingly short.

In line with this paper's objectives the most effective comparison to be made is between each country's Paris INDC and those of its pre-Paris policies that impact the oil and gas industries. Neither one is driven by least cost pathways such as those produced by the IPCC. These have a place in the debate about the future trends of commitment under the agreement but it is difficult to use them to focus on short-term and medium-term implications for oil and gas.

Of the countries analysed in this study, the United States, EU and Japan are developed countries that had or have previous commitments under the UNFCCC to which they were parties, based on the principle of reducing their GHG emissions below a historic deadline – generally 1990. For each of these countries the INDC represents incremental changes from recently adopted climate policies and continuation of existing methods of implementation: the emissions trading system in Europe, regulation in the United States, and a mix (not yet fully determined) of government intervention in Japan.

In China and India, the context is different. The climate policy objectives are expressed as target reductions in the energy and carbon intensity of the economy. No policies are envisaged that might limit economic growth. However, both countries have recently committed to fundamental transformation of their economic structure: in the case of China the change comes in the form of a 'new normal' in which GDP growth is slower and the focus shifts towards consumption and service industries rather than the energy-intensive and high-polluting heavy industries. In the case of India, the government of Prime Minister Modi is also committed to accelerating growth through market-based reforms, and to shifting the balance of the economy towards the services and manufacturing sectors and away from agriculture. Both countries based their INDCs on the assumption that these changes will take place. In China, detailed energy and climate policies were

included in the country's 13th five-year plan. In contrast, India has yet to produce a detailed plan, and a desire to preserve state industries in the oil, gas and coal-producing sector continues to influence its policies, while it endeavours to improve efficiency and reduce emissions. The Indian INDC, unlike that of the Chinese, also places great emphasis on the need for external finance to support the changes required.

Saudi Arabia is different again. It is included in this study because it is a significant emitter of GHGs. Furthermore, like Iran and some of the other fossil-fuel-exporting countries, claims to qualify for special consideration in terms of the obligations it accepts and the compensation it expects from developed countries. Saudi Arabia is also in the first stages of an economic transformation intended to liberalize the economy, and shift away from its dependence on oil. It thus combines discontinuities in both its own economic structure and its relationship with global climate solutions.

Common features

The INDCs reviewed in this paper have certain common features.

- All policies affecting oil and gas operate through reducing expected demand (there are no policies expressly restricting supply).
- For oil, the INDC reinforces existing trends: lower demand, lower prices and a shift in consumption from developed to developing countries.
- For gas, the effects of Paris are more uncertain: climate mitigation policies mix with reform of the power sector. Gas demand will be largely residual after policies for renewables, coal, nuclear, competition and the organization of the sector, all of which are national political decisions.
- The investment needed to bring about mitigation will depend mainly on the private sector, which will be influenced by the credibility of mitigation policies, the certainty of the science that underlies them and on policy stability sufficient to underpin investment horizons.

The INDCs of other countries vary widely. A summary of some key agreement-related points in the INDCs of other countries is in a table of submitted INDCs indices as of 21 December 2015 by the Center for Climate and Energy Solutions (formerly the Pew Center).[10] That table does not compare the INDCs with pre-Paris policies.

[10] Center for Climate and Energy Solutions (2015), Comparison Table of Submitted INDCs (as of December 21, 2015), http://www.c2es.org/indc-comparison (accessed 6 May 2016).

INDC of China

Summary

If the policies outlined in the INDC are effective, China will meet its Paris contribution obligations (CO_2 emissions are to peak around 2030) with room to spare, as it did its Copenhagen pledge. The Chinese contribution is critical to the global outcome, both because of its scale and the far-reaching nature of its pledges. It will be a challenge to develop appropriate incentives for investment – much of it by state-owned enterprises – and the degree of flexibility to take account of the different environmental and resource endowments of the provinces of China. The main factors are:

- A change to a 'new normal' economic structure with a greater proportion of growth coming from consumption and services, which are less energy intensive than export-led heavy industry; and
- A reduction in the carbon-intensity of its energy sector, mainly by halving the share of coal in power generation by 2040.
- Oil and gas demand will not peak in the projections to 2040 and 2050. The gas share of energy demand will increase while the oil share will remain constant.

Although China's INDC and policies is clear, there are big uncertainties as to how successful the country will be:

- Evolution of the 'new normal' economic structure;
- Social resistance to the reduction of coal production but also resistance to continued burning of coal in or near polluted cities;
- Disruptive technologies for transport;
- The structure of the power market; and
- Tensions between central and local governments about implementation and priorities.

Background

Like other INDCs, the Chinese INDC reflects its pre-Paris set of policies, based on the Copenhagen pledges, the US-China Joint Presidential Statement on Climate Change (25 September 2015), the National Plan on Climate Change 2014–20, and other policy statements.[11]

Consistent with the Chinese and other developing countries' policies throughout the UNFCCC history, the Chinese INDC cannot be interpreted as accepting any restraints on China's economic

[11] Listed in the Chinese INDC.

growth: their targets are not reductions from a past baseline quantities of emissions (like developed countries), but reductions in the energy and carbon intensity of GDP.

For China the programme of decarbonization fits with the transformation of the Chinese GDP growth model to a 'new normal'.[12] Rapid industrial growth, with an emphasis on heavy industry, is reaching limits in regards to environmental pollution, lower productivity, and financial and foreign exchange imbalances. Industry accounts for about 50 per cent of China's final energy consumption – twice the OECD average – and that share is expected to fall. Chinese GDP per person (adjusted for purchasing power parity) has reached a level that in many other economies has signalled a shift towards transport, services and residential space. Consumer-oriented products and services sectors tend to be less energy and carbon intensive than industry.[13] Given this shift, the energy intensity of the economy will fall as promised in the INDC. The high and increasing level of urbanization in China means that less-energy-intensive mobility solutions are required; new cities may be better able to achieve this than those in the OECD with well-established legacy infrastructure. Chinese climate policy also aims to reduce the carbon content of the energy system, and to reduce the environmental and health impact caused by dependence on burning coal.

The peaking and eventual reduction of GHG emissions beyond 2030 is feasible through a combination of economic growth, which will be both lower than in the past and structurally different, and a reduction in CO_2 intensity by using more zero or low-carbon energy products.

A study by China's National Center for Climate Change Strategy and International Cooperation (NCSC) highlights the phenomenon that – because China will move to a low-carbon economy earlier in its development than the US or Europe, and with more coherence between industrial, energy and environmental strategies – the cumulative carbon footprint per capita is likely to be permanently lower in China.[14]

The Chinese contribution

In the case of China, the INDC commitments largely embody policies announced in 2014–15, and were expected to form part of the 13th five-year plan (2016–20).

The main points are:

- To achieve peak CO_2 emissions around 2030; with best efforts to peak earlier;
- To lower CO_2 emissions per unit of GDP by 60–65 per cent from 2005's levels, by a combination of reducing the energy intensity of the economy, and the share of high-carbon fuels in the energy supply;

[12] Outlined by President Xi Jinping at the APEC CEO summit in November 2014, Xinhua (2014), 'Xi's "new normal" theory', 9 November 2014, http://news.xinhuanet.com/english/china/2014-11/09/c_133776839.htm (accessed 5 May 2016) and on other occasions.
[13] Green, F. and Stern, N. (2016), *China's changing economy: implications for its carbon dioxide emissions*, Climate Policy, DOI: 10.1080/14693062.2016.1156515 (accessed 5 May 2016).
[14] Fu, S., Zou, J. and Liu, L. (2015), NCSC, 'An analysis of China's INDC', http://www.ncsc.org.cn/article/yxcg/ir/201507/20150700001490.shtml (accessed 6 May 2016).

- To increase the share of non-fossil fuels in primary energy consumption to around 20 per cent; and
- To increase the forest stock (thereby increasing carbon sequestration) by around 4.5 billion m^3 compared with 2005.

Various supplementary measures, such as the introduction of emissions trading on an experimental basis, are listed but not detailed in the INDC. These include the Action Plan on Prevention and Control of Air Pollution (2013), which aims to reduce the share of coal used in the primary energy portfolio to below 65 per cent by 2017 by using a combination of taxes and caps.

The reduction in carbon intensity reflects a critical macroeconomic shift that began in 2012–13 and was emphasized by a series of policy announcements promoting the transition to a new economic growth model. The mismatch between past and 'new normal' economic structures may be so great that modelling based on the past is essentially obsolete. A survey of 12 major models and 89 scenarios suggests most models currently used to project Chinese energy demand do not reflect the shape of the 'new normal' future economic structure of China and its effect on imports.[15]

A further mismatch exists between the INDC targets, which appear to provide for higher emissions to persist than the sum of the individual subordinate targets.[16] If the latter prevail, China might achieve its 2020 Copenhagen pledge and 2030 INDC commitment earlier than expected. This raises the question about whether the INDC target is misleadingly too soft, or whether the other targets will be relaxed to minimize the cost and disruption of the transition to the new economic model[17] for example, by reducing energy-intensive industries and the coal-mining sector.[18]

Some projections and their stories

The following is based on (a) the calculations of the Primary Energy Consumption modelled by the NCSC[19] analysed in (b) Green and Stern 'new normal'.[20]

The 'new normal' energy and carbon intensities of GDP show greater reduction than the more conventional NCSC model. The NCSC model, following the INDC, extends to 2050. This shows a slower change in energy intensity (as the new normal becomes normal) and an increasing importance in reductions in carbon intensity in the later period of the timeframe.

[15] Grubb, M., et al. (2015), *A Review of Chinese CO_2 emission projections to 2030: the role of economic structure and policy,* UCL Institute of Sustainable Resources, http://climatestrategies.org/wp-content/uploads/2015/10/15-12-Paris-CP-China-Special-Issue-launch.pdf (6 May 2016).
[16] Climate Action Tracker, *Assessment: China* 2015 http://climateactiontracker.org/countries/china.html (accessed 6 May 2016).
[17] West, J. (2016) 'Good news: China's greenhouse emissions might already have peaked', climatedesk.org, 7 March 2016, http://climatedesk.org/2016/03/good-news-chinas-greenhouse-emissions-might-already-have-peaked/ (accessed 6 May 2016).
[18] Climate Action Tracker: *Tracking INDCs*: *Assessment of contributions on the way to Paris* 'Xunateactintracker.org (accessed 20 Mar. 2016).
[19] Fu, S. et al., (2015), NCSC, 'An analysis of China's INDC'.
[20] Green, F. and Stern, N. (2016), *China's changing economy: implications for its carbon dioxide emissions'.*

Table 1: INDC scenarios: change compared to 2005

	2015	2020	2030	2040	2050
Energy intensity of GDP					
(a) NCSC model	-32%	-41%	-57%	-71%	-82%
(b) Green and Stern		-45%	-63%		
Carbon intensity of energy					
(a) NCSC model	-6%	-11%	-20%	-37%	-61%
(b) Green and Stern		-10%	-17%		
Carbon intensity of GDP					
(a) NCSC model	-36%	-47.5%	-66%	-82%	-93%
(b) Green and Stern		-51%	-72%		
Copenhagen pledge		**-40–45%**			
Paris target			**-60–65%**		
Annual reduction in carbon intensity of GDP from previous decade					
(a) NCSC model			4.4%	6.3%	9.2%
(b) Green and Stern			5.4%		

Source: (a) Fu Sha, Zou Ji, Liu Linwei (2015), 'An Analysis of China's INDC', NCSC translated by China Carbon Forum, http://www.chinacarbon.info/wp-content/uploads/2015/07/Comments-on-Chinas-INDC.pdf (accessed 5 May 2016); Aspen Institute (undated) (b) Green, F. and Stern, N. (2016), 'China's changing economy: implications for its carbon dioxide emissions', Climate Policy.

Beyond 2030, the reduction in carbon intensity per unit of GDP accelerates because of changes on the supply side. This is mainly due to the growth of non-fossil energy sources, particularly wind and solar. A critical issue is how far these reduce coal burning in the power generation sector. In the IEA accelerated effort scenario coal's share of generating capacity in China falls to 42 per cent by 2040 and its share of electricity generated falls from 75 per cent to 49 per cent.

Table 2: Renewables in power

Wind and solar as % of *new* non-fossil power station capacity	**2005–20**	**2020–30**	**2030–40**	**2040–50**
	50%	76%	80%	84%

Source: Fu Sha, Zou Ji, Liu Linwei (2015), 'An Analysis of China's INDC', NCSC translated by China Carbon Forum, http://www.chinacarbon.info/wp-content/uploads/2015/07/Comments-on-Chinas-INDC.pdf (accessed 5 May 2016).

Implications for oil and gas

Most published model results do not show the underlying shares of different fuels used in power generation. However, the IEA's World Energy Outlook 2015 (WEO 2015) New Policies scenario to 2040 and the MIT/Tsinghua 2015 scenario to 2050[21] do give a breakdown of primary energy

[21] Zhang, X., et al. (2014), *Carbon emissions in China: How far can new efforts bend the curve?,* Tsinghua- MIT China Energy & Climate Project Report 267, http://globalchange.mit.edu/CECP/publications/latest/2849 (accessed 6 May 2016).

sources. Both are supposed to reflect the INDC in addition to existing policies. Emissions peak around 2030 in both scenarios but neither oil nor gas demand peaks in the scenario period and the gas share of primary energy rises by 4–8 per cent.

Oil

In the MIT/Tsinghua projection for 2050 (which incorporates policies announced up to mid-August 2015), Chinese oil demand could be almost double the 2015 level, but there are many risks and such projections are subject to great uncertainties. For example, the current policies for city planning aim to make greater use of public transport, pre-empting the growth of private car ownership. The development of low-cost, high capacity batteries could support greater use of electric vehicles and LPG could be used in trucks and urban transport. All of these could have more impact than is factored into these projections.

Natural gas

As in the case for oil, the two projections do not show a peaking in Chinese demand for natural gas during the projection period. Chinese policy (not specified in the INDC) is to double the natural gas share of primary energy (from 5 per cent to 10–11 per cent, relatively low compared to industrialized countries) with unconventional domestic supplies and additional imports from Russia and Central Asia. The MIT/Tsinghua model promotes the idea that post-2030 changes in emissions will come more from fuel switching than from further large changes in energy intensity.

In a scenario in which the CO_2 price increases from $9 in 2014 to $29 per ton by 2030 and rises further to between $77–$115 per ton by 2050:

- Gas consumption will increase almost seven-fold from 2015 to 2030, and by a further 50 per cent by 2050; and
- Wind and solar consumption would double to 2030 and increase by a further 90 per cent by 2050.

Projections for natural gas consumption in China are precarious. Growth in the industrial sector depends on the development of the cap-and-trade system, now being trialled. Growth in the power sector depends on settling a large number of complex issues, including how prices are set and whether renewables are a priority in the merit order for dispatch. The structure of the industry, which is mainly regional, may also evolve.

Challenges

For Chinese policy-makers

- The main challenges for Chinese policy in executing its INDC concern the structural shift in the economy from a focus on infrastructure and manufacturing to domestic consumption. This will be extremely difficult given that it requires rapid and wide-ranging changes in industrial structure, business practices and consumer behaviour.
- It must be done while managing internal migration and high levels of employment for the new workers entering the labour market each year.

- Measures must be taken to enforce energy efficiency throughout all sectors of the economy: industrial, commercial and residential. There will be challenges in regulatory design, pricing and implementation.
- Additional incentives are needed to diversify the fuel mix (including pipelines and LNG for increased imports of gas). There has been a clear commitment to promoting renewables, particularly solar energy. China is now the largest generator of solar power in the world.
- The country will need to take a diplomatic approach when handling discrete regions of the country that received different renewable endowments; the tension between central and regional power and policy is often underestimated.
- The state will need to manage the scaling down of coal mining and coal-fired power stations, while balancing local pressure to preserve coal mining from dependent regions.
- Government planners will promote long-term innovation in transport demand and supply. In new cities there is an opportunity to establish mass transit systems or requirements for electric cars (in the future), the challenge will be to decide which systems to invest in, given the risk of their becoming obsolete.
- China is committing large resources to battery research, which, if successful, will be crucial in terms of storing renewable energy.

For the Chinese oil and gas industry

- The main challenge is to keep pace with all these developments and to adapt to a more decentralized and competitive structure for the power sector.

For foreign investors

- The challenge is to move with, and acclimatise to, the changes in the energy sector.
- Oil exporters may continue to invest in Chinese downstream sectors and possibly accept bilateral deals with Chinese investment upstream or in infrastructure.
- Gas producers and gas companies may similarly need to choose between bilateral and global market relationships, trading security of contract for security of supply.

INDC of the EU

Summary

The EU INDC embodies policies adopted in 2014 that are now becoming legislation. The targets are more aggressive than those declared at Copenhagen, and there is a legacy target (80 per cent reduction below 1990 levels) from the European Council in 2009, extending to 2050. There is further promotion of renewables (but biofuels are restrained from competing with food). The main instrument to do this is the emissions trading system (ETS), which has been reformed to control surpluses of allowances. The INDC does not specify particular commitments on energy conservation and there will be no new international credits. The main challenges arise in the power sector. Many aspects of environmental and energy policy remain the prerogatives of individual member states. As a result, local interests, such as those in the German or Polish coal industries, weaken the collective effort.

Background

EU total GHG emissions peaked in 2007.[22] In 2020, with current policies, EU emissions are estimated to reach 24 per cent below the Kyoto-defined base year of 1990, a decrease in excess of those outlined in the EU '20-20-20' policy. The EU is on track to meet its Kyoto obligations (a GHG emission reduction of 20 per cent), but not its Copenhagen pledge (of 30 per cent), which was conditional on comparable efforts by other countries. The INDC policies are to be applied within the context of reform of the electricity market and increasing security of gas supply.

Targets[23]

The EU INDC, effective in 2020, reflects the decisions of the European Council in December 2014 due to become legislation in 2016. They include:

- A binding EU target of 40 per cent less GHG emissions by 2030 (compared with 1990), the previous goal had been a reduction of 20 per cent by 2020;
- An EU aggregate binding target of at least 27 per cent renewable energy consumption by 2030 (previously 20 per cent by 2020) with a 10 per cent share in transport (subject to constraints on biofuels competing with food sources) and 45 per cent by 2030 of electricity generation; and
- A 27 per cent non-binding energy efficiency increase by 2030 (was 20 per cent by 2020).

There is a legacy target from the European Council meeting held on 29 October 2009, before the Copenhagen conference, of a long-term commitment to a 50 per cent global-GHG emission reduction by 2050 with developed countries agreeing to reductions of 80–90 per cent from the

[22] European Commission Brussels, 18.11.2015 Com (2015) 576 'Final Report From The Commission To The European Parliament And The Council', http://ec.europa.eu/clima/policies/strategies/progress/docs/com_2015_576_en.pdf (accessed 8 May 2016).
[23] Unless otherwise stated, figures refer to GHG emissions excluding international aviation and net CO_2 capture from changes in land use and forestry (LULUCF).

1990 level. This 80 per cent target, although often cited, is not in the INDC for the EU, which applies to 2020–30.

The Council is also committed, outside the INDC, to completing the restructuring of the internal EU energy market including an electricity interconnection target of 10 per cent of installed capacity by 2020, with an aim to increase this to 15 per cent by 2030.

In February 2016, the Commission published a set of proposals for gas security that include the development of a regional approach to backups and interconnections, and a vetting procedure for new long-term gas contracts that should be submitted to the commission before finalization.[24]

Implementation

For the EU, four instruments will drive progress towards its GHG targets:[25]

The EU Emissions Trading System (ETS)

The ETS covered half of the EU's 2014 emissions, including power generation and energy-intensive industrial plants. The ETS does not apply to small emitters such as vehicles, homes and small businesses. Internal aviation is dealt with by a separate scheme; application of the ETS to international flights (outside the EU) is suspended pending an ICAO initiative to develop a global market-based system (see below).

The ETS was reformed after the Copenhagen summit in 2009 to provide EU-wide auctions of emission allowances, with countries having the right to keep the revenue raised, and to grant some exemptions, according to a share of the EU cap agreed with the Commission (see ETS box below). The INDC embodies further changes agreed by the European Council in 2014 to cure the mismatch that had developed between allowance supply and demand and the resulting low price of allowances:

- The cap in emissions will be lowered annually by a fixed amount (2.2 per cent of 2010 emissions, approximately 48 million units[26]), to achieve a reduction of 43 per cent by 2030 compared with 2005's emissions from the ETS sector;
- Use of the market stability reserve will be used to absorb past surplus allowances and release or absorb future allowances in circulation if the number exceeds 833 million units, or falls below 400 million units: this is intended to reduce price volatility;
- There will be no new international credits; and
- Allocation of emissions and use of revenues will be reformed (see Box 1) not least to take account of the UK's leaving the EU. (On 30 June 2016, the UK government announced its fifth carbon

[24] European Commission (2016), Energy Union: Commission Presents Energy Security Package, 16 February 2016, http://europa.eu/rapid/press-release_AGENDA-16-272_en.htm (accessed 6 May 2016).
[25] Unless otherwise stated, targets and emissions exclude land-use related emissions and sinks (LULUCF).
[26] A unit equals one tonne of CO_2 equivalent.

budget, aiming to cut CO_2 emissions by 57 per cent by 2032). Additional incentives are needed to bring out market-based GHG restraint promised by the ICAO.

Box 1: The European Emissions Trading System (ETS)

- Under phases three (2013–20) and four (2021–2030) of the ETS, each member state auctions a share (agreed with the Commission) of the EU cap set by the Council in 2014.
- 5 per cent of allowances are reserved (free) for new entrants, some can be allocated to fund energy infrastructure, and to modernization of energy systems in some countries (mainly eastern Europe).
- 300 million units are allocated to a new energy fund and 10 per cent are redistributed to the poorest EU members.
- Existing allowances to emitters are recognized and CDM and JI projects continued, with closer monitoring; about 300 CDM projects continue but closely monitored.
- Allowances may be issued to industries recognized by the Commission (by a list) as being at risk of carbon leakage – i.e. removal of their business to countries where emission costs are lower.
- Allowances and their derivatives are now regulated as financial instruments.
- Proposals will be developed for treatment of land-use changes.

In 2013, public electricity generation and heat production accounted for 26 per cent of EU GHG emissions.[27] The ETS system applies to the power sector. However, there are fundamental mismatches between the market-based ETS system and policies adopted by the EU itself and member governments[28] to compel the use of renewables. The EU target of renewables making up 27.5 per cent of the energy portfolio by 2030 applies in aggregate and individual minimum targets are agreed for each country. Tax incentives for initial investment are no longer the norm. There are diverse subsidies on renewables supply, covering about 12.5 per cent of EU electricity supply with an average rate of €13.68 per megawatt hour (MWh) (but ranging from €2 in Croatia to €32 per MWh in Italy). The cost to EU governments or consumers in 2012 was about €45.6 billion.[29] Most subsidies take the form of 'feed-in tariffs' (FiT) or derivatives of them. These subsidize production and are paid by consumers – another piece of extra-budgetary cash allocated by governments.

There are mismatches between intervention, which gives renewables priority in the daily and hourly markets, and the Commission's efforts to achieve a market-based structure based on the theory of price competition through open access infrastructure. In most European countries, the pricing system does not reward investments to bridge the gap between intermittent supplies and capacity to react to them.

There are mismatches between the levels of support for renewables in different countries. Though some markets are coupled, there is insufficient coupling and interconnection to cause prices to converge or relate to a European or regional base point (as they do in gas). In 2015, the Commission proposed some guidelines to reduce national differences.

[27] European Environment Agency (2015), 'Annual European Union greenhouse gas inventory 1990–2013 and inventory report 2015', http://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2015 (accessed 6 May 2016).
[28] Each country retains authority over its energy mix under article 194 of the Lisbon Treaty (in force since 2009).
[29] Buchan, D. and Keay, M. (2015), *Europe's Long Energy Journey Towards an Energy Union*, Oxford, Oxford University Press for the Oxford Institute of Energy Studies, p. 49.

The result is a distortion of investment decisions and of the choice of fuel for operation by the generators. Subsidies have also enabled renewables investors to expand capacity to 24 per cent of the EU's total generating capacity in 2013, in the face of an electricity market that has essentially plateaued since 2005. The 2030 target of 27.5 per cent share for renewables may be unsustainable unless demand for electricity remains flat. One can see a continued mismatch between demand trends and investment in power generation until some overall balance is established between supply capacity and demand.[30] This has significance for the gas industry; the gas market will be the residual of the demand for power station fuel after absorbing subsidized renewable expansion and in some cases policy towards nuclear and coal.

Effort sharing

The EU's INDC target is to reduce aggregate non-ETS emissions by 30 per cent between 2005 and 2030, mainly by new or tougher regulations on vehicle emissions.

Under 'effort sharing', (a specific term used by the EU) under which the Commission agrees national emission caps for each country, reflecting its economic development. Richer countries receive the biggest cuts, the poorest get breathing space. In 2013, four countries exceeded their cap (Luxemburg, Ireland, Belgium and Austria), all mainly due to the higher intensity of transport in their economies.

Transport

The main mismatch between targets and policy is in the transport sector (14 per cent of EU GHG emissions come from road transport, and another 6 per cent from other forms of transport). Emissions from transport peaked in 2007 (estimated from actual fuel consumption). The main policy instrument is the regulation of fuel efficiency and emissions from vehicles. The 2020 emissions targets for new cars and vans were already achieved in 2013[31] but, at that time, still stood at 19 per cent above the 1990 reference level – while the aggregate of other sectors was 26 per cent below that level.

The EU has softened its policy for transport biofuels: though the overall target for 10 per cent of transport fuels is to be biofuels, which, to avoid competing with food production, are capped at 7 per cent until 2020.[32] To improve efficiency, further work is necessary on sustainability of biofuels production and competition with food crops.

The EU target for emissions from transport for 2030 is to limit the increase from 1990 levels to 9 per cent. In the longer term, the object is to reduce transport GHG emissions in 2050 to half the 1990 level (the INDC does not specify this target).[33] It is not clear whether this is feasible.[34] A

[30] European Commission Directorate-General for Economic and Financial Affairs (2015), 'Energy Economic Developments – Investment perspectives in electricity markets', European Commission, http://ec.europa.eu/economy_finance/publications/eeip/ip003_en.htm (accessed 6 May 2016).
[31] 2021: 95gCO_2/km for cars, ≈ 65 gasoline mpUSg: 75 diesel mpUSg. For vans, 147 g/k ≈ 42 mpUSg diesel; extrapolates to 60 g/km for cars, 95 g/km vans in 2030 (Ricardo 'Central Ambition' case (accessed 6 May 2016).
[32] Lane, J. (2016), 'EU reshapes its biofuels policy', Biofuels Digest, 16 April 2016, http://www.biofuelsdigest.com/bdigest/2015/04/16/eu-reshapes-its-biofuels-policy/ (accessed 6 May 2016).
[33] European Environment Agency (2015), *Greenhouse Gas Emissions From Transport Indicator Assessment*, http://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases (accessed 6 May 2016).
[34] Delcampe, D., European Environment Agency: GHG Emissions of Transport, http://www.eutransportghg2050.eu/cms/assets/Session-1-Transport-GHG-emissions-trends-David-Delcampe-EEA.pdf (accessed 6 May 2016).

modelling exercise by the consultancy Ricardo[35] shows that recent policies (as of 2015) would reduce transport sector emissions by 16 per cent compared with 2005 – still short of the 30 per cent target. However, a combination of options – including carbon and security taxes, an increase to 9 per cent of the share of biofuels and low-carbon liquids by 2030[36] and technical developments – could yield a 40 per cent reduction. Policies to close the gap with the target could reduce transport fuel demand by about 16 per cent versus the 2013 level by 2030.

Money

Of the current EU budget, 20 per cent is climate-related (expected to rise to 35 per cent by 2030). The auctioning of ETS allowances generates unbudgeted cash for member states (€3.6bn in 2013, of which 87 per cent was designated for climate and energy). The EU requires that at least 50 per cent of auction revenue must be spent on energy and climate. National governments can also grant ETS exemptions (see box earlier), which have monetary value.

Next steps

In 2016, the Commission will propose new legislation for heavy-duty vehicles emissions. More action is needed at both the EU and national level to achieve the target.

Furthermore, in 2016, the Commission is 'road-mapped' to:

- Revise the Renewable Energy Directive and Fuel Quality and Biodiesel Sustainability Policy;[37]
- Establish national minimum targets for renewable energy;
- Revise heating, cooling and labelling strategies (for appliances and buildings);
- Incorporate land-use-related emissions into targets, policies and reporting;
- Respond to the ICAO proposals for global aviation emission trading; and
- Develop a legal framework for carbon capture and storage (CCS) projects.

Summary of EU policies under its INDC

- The EU has set aggressive targets, and reformed the ETS, which it sees as the main vehicle for implementation.
- ETS auctions will provide governments with substantial cash flows outside budgets. These may be used at the discretion of individual governments to hypothecate revenue for favoured climate related projects

[35] European Climate Foundation (2016), *SULTAN modelling to explore the wider potential impacts of transport GHG reduction policies in 2030*, https://europeanclimate.org/launch-of-new-report-on-potential-impacts-of-transport-ghg-reduction-policies-in-2030/ (accessed 6 May 2016).
[36] Current EU policy caps primary biofuels at 7 per cent of transport fuel.
[37] 2015 decision limits to 7 per cent share of food crops in 10 per cent renewable energy target for 2020.

- The INDC has credible targets: a 40 per cent reduction of GHGs, below the level of 1990, by 2030 is not inconsistent with the 20 per cent reduction expected by 2020. As such, the more ambitious target can be seriously considered.
- The UK has more ambitious targets and its withdrawal from the EU will require some recalibration of the numbers for the remaining countries.
- Targets for renewable energy and biofuels are supported by a variety of measures in different member countries with potential conflicts in terms of their effect on competition and levelling of the playing field for electricity prices.
- The aggressive target for renewables outside the power sector has to be reconciled with commercial realities.

Challenges

For EU policy-makers

- Policy-makers of the EU and its member states will need to follow up the Paris Agreement by making the ETS work effectively to produce a sensible carbon price. This would support the growth of renewables and gas at the expense of coal.
- They will need to progress European electricity market reform especially with regard to interconnection and competition rules. The challenge is to balance the growth of renewables with some mechanism that generates funding for infrastructure investment (e.g. smart grids).
- There will be other incremental challenges: to improve the implementation of vehicle emission regulations especially regarding diesel; to consolidate relations with gas suppliers, particularly Russia (Gazprom access to European pipelines remains an unresolved issue); and to clarify longer term intentions for stronger, long-term mitigation policies. Some post-Paris rhetoric seems to lack commitment for early further progress.

For the oil industry

- The drive for efficiency will reduce the general demand trajectory for oil. The ICAO proposals for international aviation, due in 2016, are likely to have similar effect.
- The proposed GHG limits on transport fuels are likely to be more severe after the 2018–20 review, as they currently do not match the overall emission reduction targets.
- The threat to oil demand from biofuels in the EU is relatively low (10 per cent target penetration, further limited by the restriction on biofuels competing with food production).
- Technologies in the vehicle industry – batteries, electric vehicles and automated driving – are the more disruptive threat to the transport fuel markets, though probably after 2030.
- Overcapacity in refining remains and worsens as demand decreases. Refineries are hard to shut down and switching to growth (e.g. Asian) markets is limited by the dominance of national oil companies there.

For the gas industry

- For the ETS sectors, emission allowances will shrink every year from 2021; surplus allowances will be reserved for potential future use rather than being left on the market or cancelled.
- There is a mismatch between the ETS System and the policies in most countries that impose a minimum percentage of renewable sources used in the electricity sector.
- Renewables will be supported by extra-budgetary subsidies (paid mostly by consumers) and by the obligation on generators to buy their production regardless of price, before buying any other fuel.
- There is a mismatch between the structure and pricing systems in electricity markets and the necessity to incentivize investment in capacity for intraday, day ahead and long-term generation. Change is inevitable.
- Evidence of the havoc that mismatches in power policy can wreak can be seen in Germany where subsidies to renewables have created a surplus of electricity. This readily available electricity has caused the price to plummet, while, at the same time, the contradictory policies of early closure of nuclear plants (with the attendant costs and legal battles to allocate those costs) and continued subsidies of coal have all combined to put the business models of German power companies under extreme strain.
- In Europe, in particular the long-vaunted golden age of gas as the cleaner, transition fuel is unlikely to be realized, unless there is a managed exit from coal power generation (politically difficult but could be driven by concerns about air pollution).
- Investment is needed in infrastructure to integrate renewable supplies into grids as well as to implement the diversification required to meet security of supply objectives; with power companies financially weakened and investors concerned by poorly designed policies, it may prove difficult to fund such investment.
- How governments allocate the money raised from auctioning ETS allowances, dispensing exemptions, and imposing costs on electricity will affect both oil and gas industries.

INDC of India

Indian GHG emissions matter to the world. They were about 8 per cent of global emissions in 2013 and this figure will rise to 11 per cent by 2030, according to the IEA's WEO 2015.[38] This continued rise, regardless of the decrease in energy intensity and increase in renewables is outlined in the Indian INDC. Unlike China, India foresees an increase of 5 per cent in the share of fossil fuels in its primary energy supply: 4 percentage points of this is coal and 1 percentage point is gas. Simultaneously, the share of bioenergy is due to fall (this includes rural use of solid biomass for cooking). From 2013 to 2030, coal consumption in India will increase more than the net increase of global coal consumption – 350 million tons of oil equivalent (mtoe) compared to 290 mtoe.

Background

> Clarity of vision for the energy sector is difficult to achieve in India, not least because of the country's federal system and complex institutional arrangements.
>
> WEO 2015: Energy in India Today[39]

The energy sector in India is overseen by a combination of five fuel specific ministries (they now have a common minister), and by the governments of the 32 states and territories in the Indian Federation. Energy and climate are within the mandate of the National Institute for Transforming India (NITI Aayog), which is chaired by the prime minister. It was formed by the new government and replaces the planning commission, but it does not have executive authority. The Indian Environment Action Policy of 2006, Indian National Action Plan on Climate Change 2006 and related state action plans have been superseded by the wider economic reforms of the Modi government, elected in 2014.

Modi's plans for energy are part of a national effort to reform the economy, including major structural changes. GDP per capita will increase because of the shift from agriculture to the services and manufacturing sectors. The switch to manufacturing will increase energy intensity, but the increases will be offset by measures to promote energy efficiency by means of standards and regulations on buildings, lighting, planning for public transport, and labelling.

The INDC target of reducing the energy intensity of GDP by 33–35 per cent, between 2005 and 2030, is predicated on the success of the change in structure of the economy.

Subsidies

The INDC does not refer to subsidies except in very general terms. India, as a G20 member, had pledged in 2006 to reduce subsidies, but no timetable or accountability mechanism exists to achieve those pledges.

[38] IEA *World Energy Outlook 2015. Paris 2015.*
[39] Ibid, p. 448.

The government removed gasoline subsidies in 2010, and aligned diesel prices with international prices (though they are still controlled). Instead of subsidies, taxes have been imposed, which are estimated to be the equivalent to $60 per tonne of CO_2 for petrol and $42 per tonne of CO_2 for diesel, resulting in a reduction in emissions of 11 million tonnes of CO_2.

The Indian government increased the coal 'cess' (tax on coal production) in 2016 from Rs 200 to Rs 400 ($6) per tonne, providing an implicit tax of approximately $6 per tonne of CO_2 on domestic and imported coal.[40] Subsidies are still available for natural gas used to produce fertilizers, such as urea, and LPG for households, though these are being replaced by direct payments to the poorest households.

Consumption taxes that do not relate to CO_2 are not normally regarded as carbon taxes, since they serve other purposes. Some studies count the excess of the consumption tax over normal VAT as an environmental tax (or, if the tax is lower than VAT, as a subsidy), although it is also argued that this excess goes to pave the way for public investment in infrastructure. However, the point is that the switch from subsidies to taxes will have an effect on the demand for oil and gas.

Transport

The INDC mentions fuel efficiency standards (based on EU standards), which will take effect from April 2016. India will impose Bharat 6 (based on EU Euro 6 standards, and covering pollutants including GHGs for new vehicles supplied in 2020). This is estimated to reduce annual CO_2 emissions by 50 million tonnes.

There is an aspirational target for 20 per cent of transport fuels to contain biofuels, beginning with 5 per cent within diesel.

There are a variety of minor initiatives for reducing emissions from transport by investment in new public transport systems and using solar power on transport facilities to reduce waste in cities, starting with 100 'smart cities'.

A recently convened government panel is investigating whether India could switch the whole transportation system to electric vehicles by 2030. While this seems extremely unlikely, the fact that it could even be considered highlights the mismatch between external expectations that India is the next great growth driver of oil demand and the pressures from climate change-inspired policies in India.

Industrial emissions

The INDC covers the Perform, Achieve and Trade (PAT) system. The scheme encompasses 478 enterprises in eight sectors and mandates a decrease in specific energy consumption. The government plans to extend PAT to energy producers and the transport system so that it will cover

[40] Government of India, *Economic Survey 2014–15*, Chapter 9*: From Carbon Subsidy to Carbon Tax: India's Green Actions*, http://indiabudget.nic.in/es2014-15/echapvol1-09.pdf (accessed 6 May 2016).

about half the commercial energy in India. Enterprises that beat their energy-saving target will receive energy-saving certificates that can be sold to those which fall short.

The power sector

The only clear INDC objective for the power sector is to achieve 40 per cent cumulative installed capacity from non-fossil fuel sources by 2030, with the help of transfer of technology, low-cost international finance and investment by foreign companies in Indian enterprises.[41]

Changes are already underway that should improve the efficiency of India's extremely complex power industry. These include the introduction of an independent power producer regulator, the unbundling of infrastructure, corporatization of state enterprises (which dominate oil, gas and coal production, power generation and the national grid) and open access to certain aspects of infrastructure and distribution networks.

However, scope for improving total efficiency in power generation through building new plants to replace old ones is limited because of recent rapid growth; two-thirds of India's thermal power capacity and half its nuclear capacity is less than 20 years old.

More generally, the expansion of electricity use is restricted by inefficiency, poor performance and underinvestment in the distribution system. The weakness and inefficiency of electricity generation and distribution from the central grid favours decentralized generation. Back-up for intermittent renewable supply is often quicker and more cheaply supplied using local diesel than energy from the grid. Battery technology, when it is developed, could allow a disaggregated system to address access in rural areas, but its timing is unclear.

Addressing these obstacles must play a critical role in extending power supplies to the whole population by 2040, which is the government's intention. The future gas pricing system, and the role of gas in the economy is still clouded by uncertainty of policy, which the INDC does not resolve.

Gas for power

India accounts for less than 10 per cent of the expected growth in global consumption of gas to 2040.

The main immediate obstacles to the expansion of gas in India are price and supply. Both issues are exaggerated by uncertainty of the government policy. Recently built gas-fired generating plants have been idle in the face of inadequate wholesale electricity prices (though special prices have been introduced for gas plants used for peak supply).

[41] Buckley, T. (2014), *India's Electricity-Sector Transformation,* Institute for Energy Economics and Financial Analysis, Cleveland Ohio, http://ieefa.org/wp-content/uploads/2015/08/IEEFA-Indian-Electricity-Sector-Transformation-August-2015.pdf (accessed 6 May 2016).

Pricing of fuels for power

One aspect of reform that impinges on the power sector is the country's pricing system. Currently, complicated government controls[42] restrict domestic prices for gas and coal, keeping them low. This in turn tends to depress the development of domestic production. Because not enough domestically produced fuel is available this perversely increases the demand for higher priced imports.[43] However, even following the recent fall in international LNG prices, which is linked to the drop in oil prices, internationally traded coal is still competitively priced. This limits the scope for reducing GHG emissions by expanding the use of gas in the Indian electricity sector (though there may be some niche markets that can bear the higher cost of imported LNG).

The IEA estimates[44] that the coal share of generating capacity will fall by 15 per cent, to 44 per cent (from 2013–30). The 18 per cent rise in renewable capacity is not matched by a corresponding increase in renewable use, which is inevitably intermittent. The IEA estimate involves a slight increase in oil consumption used in power (about 3 million tons) and about a 30-mtoe increase in gas. It may be that objections to rising urban pollution may require a further shift away from coal for power generation and domestic use. The huge expansion of power generation to meet the access to electricity objective may be disrupted due to shortages of water in many areas.

The IEA has offered its own vision: four chapters of the WEO 2015 are devoted to India, and include a 'vision for India' that attempts to suggest efficient solutions for reductions in energy intensity. This vision involves manufacturing holding a larger share of the economy, with the higher energy use met by a higher input of renewables to electricity. CO_2 emissions are not shown in the report of this 'vision'.

Land use

The INDC, using the Green India Mission, plan to increase forest cover by planting long-deforested land to increase total forest cover to 35 per cent from 21 per cent on the total land area. This would fix about 2.5–3 billion tonnes of CO_2 and reduce annual GHG emissions by 100 million tonnes of CO_2 by 2030. The programme will be funded by $6.2 billion from funds accumulated by deforestation permits and fees, according to a bill awaiting Senate approval.

Finance

The INDC suggests, though not explicitly, that the whole programme is in effect conditional on financing from largely outside India. Although national funds will be created such as the National Clean Environment Fund, worth about $2.7 billion, financed by the coal cess (tax).

This opens up the question of whether finance is to be sought from private investors, international financial institutions or funds that are supposed to be created by the Paris Agreement. The (various) estimates in the INDC range from $834bn (in 2011 prices) per year, or $2.5 trillion in the period to

[42] For a detailed analysis see Sen, A. (2015), *Gas Pricing Reform in India: Implications for the Indian gas landscape,* The Oxford Institute for Energy Studies, https://www.oxfordenergy.org/wpcms/wp-content/uploads/2015/04/NG-96.pdf (accessed 8 May 2016).
[43] The 'circular problem' described by Sen, A.
[44] IEA (2015) *World Energy Outlook 2015*.

2030 (in 2014–15 prices). The IEA estimates $100bn per year (2014 prices), including an adaptation element of about 10 per cent (of the $100bn). In addition to the measures stipulated in India's INDC, there are some measures being taken to reduce the impediments to foreign investment, for example in coal mining and in the gas and electricity distributors, but there is still a great deal to do.

The INDC contains aspirational language about the objectives of improving the quality of life in India, and references to a variety of policy and executive measures needed to enhance the capacity of the institutions and areas affected to adopt and make effective the main objectives, and to keep pace with technology.

Challenges

For policy-makers

- The main challenge is to make a successful transition away from agriculture into a higher-value, less-energy-intensive economy.
- The risk is that huge changes are required in many institutions and practices to improve the efficiency of the economy. The list of changes is long, many seem aspirational, and implementation needs to be done credibly.
- Overcoming the challenge of reorganizing the power sector, more investment and efficient management of the project to increase access to electricity for the whole population will be particularly difficult.

For the oil and gas industries

- Reform of the pricing structures will bring producer prices more in line with those of international markets.
- It will be a challenge to find a gas pricing system where prices are low enough to develop new markets and an increase share of the power market, but high enough to support the expansion of domestic production and imports.
- Improving the productivity of the state gas and oil companies, Gas Authority of India Ltd. (GAIL) and Oil and Natural Gas Corporation (ONGC), is a major (and long-standing) government objective. The industry and government need to resolve the question of whether this is best done by privatization, splitting up the companies, or increasing the role of foreign companies.

INDC of Japan

Background

In 2011, the devastating Japan earthquake and the Fukushima-Daichi nuclear accident disrupted the evolution of Japan's energy system. As a result, all nuclear power stations were shut down for a safety evaluation and a new, independent regulatory authority has been created. Uncertainty continues about the rate at which nuclear power stations will resume operation, but the INDCs reflect that intention. Meanwhile renewable fuels in power generation are being promoted. While most nuclear stations are not yet back in operation, gas (LNG) and oil imports are supplying the shortfall, though the demand for both has passed its peak.

The electricity market is in the process of reform to increase resilience of the system and to reduce costs – through better interconnections and protocols for sharing supplies, full retail competition and unbundling the transmission system.[45]

The external context is also changing. The rapid expansion of oil and gas production from US shale has changed international supply possibilities. Global demand growth is diminished by lower prospects of economic growth, especially in China, the rapid expansion of renewable energy in many power systems, and commitments on GHG reduction included in the Paris Agreement.

Current policy and strategy

The context of the INDC is that the Japanese 'Third Strategic Energy Plan of 2010'[46] has been replaced by the fourth plan (in 2014) and a new 'Long-Term Energy Supply and Demand Outlook'.[47] These policies may develop further, though the pathway is not yet clear. This is reflected in the apparently modest scale of the INDC. The underlying principles do not change: safety is a higher priority, otherwise the guiding principles are in regard to the 'three Es': Energy security, Economic efficiency, and Environment.

Japan faces particular challenges in formulating its long-term GHG emission reduction plan, namely:

- Limited success in resolving Japan's macro-economic difficulties;
- The Japanese economy is already less energy-intensive than most developed economies: GHG emissions per head are also lower than in the United States and South Korea;[48]

[45] METI: Electricity System Reform, http://www.meti.go.jp/english/policy/energy_environment/electricity_system_reform/ (accessed 6 May 2016).
[46] METI: Strategic Energy Plan (April 2014, provisional translation) http://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/4th_strategic_energy_plan.pdf (accessed 6 May 2016).
[47] METI: 'Long-term Energy Supply and Demand Outlook (July 2015), http://www.meti.go.jp/english/press/2015/0716_01.html (accessed 6 May 2016).
[48] Arima, J., Hombu, K. and Tachibana, Y. (2015), 'Is Japan's INDC "underwhelming"?', IEEJ Energy Journal, November 2015, http://ieei.or.jp/wp-content/uploads/2015/11/special201511003_e.pdf (accessed 6 May 2016).

- The power generating system is already in a transitional phase aimed at liberalizing the market, extending consumer choice and containing prices;
- There is an Asian 'triangle of uncertainty' about the market shares of generation of nuclear, renewables and coal;
- The suspension of nuclear generation, since 2011, increased the demand for gas and oil in the power sector. This demand will not be sustained as nuclear stations resume service.

The key issues

The government consulted widely on public attitudes towards nuclear power and this was taken into account in the 2015 Long-Term Energy Supply and Demand outlook. This statement highlighted two main points:

- Safety: There will be tighter regulation and more voluntary action from oil and gas as well as the renewables industries.
- Energy security: The goal is to achieve 25 per cent self-sufficiency from a combination of renewable energy and nuclear power.

Reducing demand

There will be tightening of regulations applying to fuel users based on the 'front-runner' principle (by which regulations are tightened at intervals to raise the average efficiency across users to the efficiency of the best 10 per cent of users achieved at the review points). The new policies will particularly affect the residential sector.

The Ministry of Economy, Trade and Industry (METI) envisions that electricity demand will be broadly flat to 2030. After taking into account improved conservation and efficiency, demand for electricity will make up a larger portion of the total annual final energy demand. By 2030, this will fall by 45 mtoe (13 per cent) from 2013 leading to a 10 per cent fall in total primary energy demand, cutting oil demand by a third and LNG demand by 30 per cent.[49]

Fuel mix for power generation

The 2015 outlook aims to restore national energy self-sufficiency to 25 per cent or more of the reduced primary energy supply, with 10–12 per cent from nuclear and 13–14 per cent from renewables.[50] Restoration of most of the nuclear supply, and the increasing share of renewables in a smaller market, should combine to reduce the overall fossil fuel supply to Japan and reduce the amount of fossil fuels used to generate the country's primary energy. Oil and LNG will both lose out to alternative sources of energy. Compared with 2013, annual oil consumption will fall by about 1.2 million barrels a day and annual LNG consumption will be reduced by 27 million tonnes per year in

[49] Koyama, K (2015), 'Inside Japan's Long-Term Energy Policy', IEEJ Energy Journal, September 2015 (Accessed 6 May 2016).
[50] Ibid. Including hydroelectricity.

the period to 2030. This represents a decrease of about 30 per cent of 2014 consumption in both cases. Authority for restarting nuclear plants is fragmented between central government, regulators, and provincial and local governments, and the timetable may be difficult to anticipate.

Table 3: Change in primary energy in Japan 2013–30

Primary energy supply	Change in annual figure from 2013 to 2030	
	mtoe	% share of primary energy supply
Nuclear	+40	+10
Renewables	+20.5	+6
Oil & LPG	-63.5	-11
Gas (LNG)	-33.5	-5
Coal	-11	0

Sources: METI Outlook (2015), Koyama (2015), author's conversions.

The combination of energy efficiency and a cleaner power sector reflected in the INDC would reduce Japanese imports of oil by about 1.2 million barrels a day and LNG by about 26 million tonnes per year by 2030, compared to 2013. Timing would depend very much on the speed of the re-commissioning of Japan's nuclear power stations, and the scale would depend on the success of the energy efficiency programmes but the implication is clear.

Environmental sustainability

This extends beyond local environmental conditions to the ambition of matching the GHG reductions of the EU and the United States in the Paris Agreement on climate change.

There is a baseline issue: the Japanese government prefers to take 2013 as a baseline as this more closely represents the present situation than 2005 (Copenhagen) or 1990 (Kyoto). Japan targets a 26 per cent reduction in emissions between 2013 and 2030 (including GHG emissions outside the energy sector, and increases in absorption in land use changes). Comparable figures for the US would be 18–21 per cent to 2025 and 24 per cent for the EU to 2030.[51] Therefore, with a 2013 baseline, the Japanese government can claim they are meeting the objective of broad comparability with the EU and the United States. The 2013 baseline allows Japan to portray the restart of its nuclear industry as part of its 'new' emission reduction contribution. Compared with 2005, by 2030, Japan would be accomplishing what the United States is preparing to achieve by 2025 and significantly less than the EU is aiming for.

Japan has defended its position by pointing out that it is starting from a lower level of energy intensity and carbon intensity than most industrial countries.[52] Japan also reserves the right to take credit for joint implementation projects in developing countries in order to minimize domestic

[51] Koyama, K (2015), 'Inside Japan's Long-Term Energy Policy', IEEJ Energy Journal September 2015 (accessed 6 May 2016).
[52] Arima, J., et al. (2015), 'Is Japan's INDC "underwhelming"?'.

GHG reductions (this facility has a smaller role in the Paris Agreement than it had in the Kyoto Protocol).[53]

The INDC sets out estimated emissions of CO_2 in the energy sector and in the non-energy sector for methane, nitrous oxide and fluorinated gases, and the use and effect of carbon sinks. Regulatory measures of each gas are specified without quantifying them separately.

Table 4: Change in Japan's GHG emissions, compared with other major emitters

Change in GHG emissions	Compared to 1990 (Kyoto benchmark)	Compared to 2005 (Paris benchmark)	Compared to 2013 Japan INDC
Japan: draft INDC (fiscal years)	-18% (2030)	-25.4% (2030)	-26% (2030)
US INDC	-14–16% (2025)	-26–28% (2025)	-18–21% (2025)
EU INDC	-40% (2030)	-35% (2030)	-24% (2030)

Source: Koyama, K (2015), 'Inside Japan's Long-Term Energy Policy', IEEJ Energy Journal September 2015 (accessed 6 May 2016).

Challenges

For Japanese policy-makers

- The priority is to shore up the future of nuclear generation, without which the structure of the country's electricity industry will remain in stasis.
- Government guidance is important in striking the right balance of fuels for power, given the importance placed on diversity of supply as the foundation of energy security.
- To complicate things, there is an ongoing challenge to complete the reform of the electricity market to increase competition.

For the oil industry

- As mentioned, the Japanese market for oil and oil products will shrink substantially.
- In the 2014 Strategic Energy Plan the oil industry is expected to continue promoting diversification of supply sources for security reasons, cooperation with oil producing countries, enhancement of crisis management, including stockpiling, effective utilization of crude oil, diversification of fuels for transportation and the utilization of oil thermal power to balance loads.
- In view of the shrinking market and surplus refinery capacity, private sector foreign companies are likely to regard the Japanese market as non-core. It will be a challenge to replace the diversification these companies provide by a comparable spread of special relations between Japanese downstream companies and exporting national oil companies (NOCs).

[53] There is a detailed critique of the Japanese INDC as 'inadequate' in the Climate Action Tracker assessment of 22 July 2015. Climateactiontracker.org/countries/Japan.html (accessed 5 May 2016).

For the gas and power industry evolution

- The Japanese power sector, and the market for gas within it, is in transition. According to the government's Strategic Energy Plan (2014) and Long-term Outlook (2015), the power sector will improve its resilience to disruptions and accidents by increasing physical and commercial interconnections. Furthermore, it will accommodate expansion of distributed generation based on renewable fuels, supported by feed-in tariffs.

- The prospects for the LNG market depend on the balance in the squeezed market remaining after the expansion of renewables, restoration of nuclear, energy security and maintenance of the coal share of fuel in power generation as outlined in the INDC.

- Depending on how the INDC and underlying policies are carried out, the demand for imported LNG is likely to diminish and become less predictable. Japanese gas companies and their suppliers will need to adapt to this, while maintaining diverse supply sources and developing pricing systems reflecting the new and more complex relationship between the competing fuels.

- The energy strategy foresees government intervention in promoting new forms of participation in the supply chain to reduce the importance of the end destination restrictions (no reselling), and to delinking gas pricing mechanisms from oil prices.

For company managements and investors

- Companies and investors will continue to struggle to find adequate returns and attractive investments in stagnant markets.

- Investments from NOCs in countries that export oil and gas to Japan are likely to continue, reflecting their competition for markets.

INDC of Saudi Arabia: a country with special considerations

Saudi Arabia identifies itself under the UNFCCC as one of the countries deserving special consideration if it is called upon to make 'disproportionate contributions'.[54] It also claims to qualify for special consideration of special needs under article 4, 8(h) as one of the countries 'whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products'. By implication its contribution cannot therefore be measured in the same terms as those of economies not dependent on fossil fuel exports.[55] The INDCs of Iran and UAE similarly flag their case for special consideration.

Status of the INDC

Formally, measures specifically mentioned in the Saudi INDC are 'co-benefits' of the kingdom's overriding aim to diversify its economy, not objectives for their own sake.

The National Transformation Plan, announced in April 2016, will assume that the country continues to grow with robust contributions from oil export revenues and without disproportionate or abnormal economic burdens.[56]

Context

Some reforms have already begun.

In 2015, prices rose for fuels, water and electricity, as well as ethane for the petrochemical industry, as subsidies were reduced, though prices remain well below international equivalents. Further increases are planned over the next five years.[57]

The 2016 fuel standard for light vehicles is intended to improve average mileage efficiency from 12 km per litre to 19 km per litre (about 45 miles per US gallon (mpUSg)) by 2025.[58]

On 15 May 2016, the Saudi Aramco hierarchy of authority changed. The Supreme Petroleum Council, formerly chaired by the king, now no longer exists. Saudi Aramco accountability is to the Economic Development Council, chaired by Deputy Crown Prince Mohammed bin Salman. We do not yet know the final relationship between Saudi Aramco, the Economic Development Council, and the Ministry of Energy, Industry and Mineral Resources (which incorporates the former Ministry of Petroleum and Minerals).

[54] UNFCCC, Article 3, para 2.
[55] See Climate Action Tracker, Saudi Arabia, http://climateactiontracker.org/countries/saudiarabia.html (accessed 6 May 2016).
[56] UNFCCC (2015), *The Intended Nationally Determined Contribution of the Kingdom of Saudi Arabia under the UNFCCC*, http://www4.unfccc.int/submissions/INDC/Published%20Documents/Saudi%20Arabia/1/KSA-INDCs%20English.pdf (accessed 6 May 2016).
[57] Financial Times (2015), 'Saudis face fuel price jump under new austerity plan', 30 December 2015, https://next.ft.com/content/fbbc4b56-af00-11e5-993b-c425a3d2b65a (accessed 8 May 2016).
[58] AME Info (2015), 'Saudi Arabia to launch fuel economy standard in 2016', 23 December 2015, http://ameinfo.com/energy/oil-gas/saudi-arabia-to-launch-fuel-economy-standard-in-2016/ (accessed 6 May 2016).

Reform of the electricity sector has been underway since 1998 (though before the 2015 price reform subsidies were still running at US$15 bn per year[59]). The Saudi Electricity Company (SEC) – the shares of which are 20 per cent listed – is to be unbundled; regulated prices will remain for distribution and the wholesale price will be set by competition. The SEC will be split into four generating companies and the distribution system will be maintained as a regulated monopoly.[60]

Ramping up electricity supply to match the hoped-for economic development requires a more sustainable electricity system, with price incentives, regulation and a greater use of renewables.[61] Half of the country's electricity consumption is in the residential sector and, overall, 70 per cent is attributed to air conditioning with daytime peak loads.

The National Transformation Plan (NTP)

Some aspects of the plan were made public in April 2016.[62] The plan reflects 'Vision 2030', published in the official Saudi Gazette on 26 April 2016, and approved in June 2016 by the cabinet.[63]

The key theme of the NTP is to reduce dependence on oil revenues (42 per cent of the country's 2015 GDP was from oil revenues) through economic diversification: including investment in high-value-added sectors, such as financial services, medical services, tourism, education, renewable energy and energy efficiency technologies.

These are not energy-intensive sectors. The relaxation of bureaucratic controls and measures would stimulate these non-energy-intensive sectors. This would not require participation in massive projects by foreign companies. The intention is to categorize enterprises into groups of companies in which the public investment fund will hold all the controlling shares. Enterprises providing services to ministries, such as health and education, will be organized as corporations and wholly or partially privatized. Companies providing services to Saudi Aramco may also be spun off and wholly or partly privatized.

Restructuring of state enterprises

The intention is to organize enterprises into groups of companies in which the public investment fund will hold controlling shares. Enterprises providing services to ministries, such as health and education, will be organized as corporations and wholly or partially privatized. Companies providing services to Saudi Aramco may also be spun off and wholly or partly privatized.

[59] Nachet, S. and Aoun, M. (2015), 'The Saudi electricity sector: pressing issues and challenges', IFRI, 30 March 2015, https://www.ifri.org/sites/default/files/atoms/files/note_arabie_saoudite_vf.pdf (accessed 6 May 2016).
[60] Statement by Abdullah Al Shehri, vice governor for regulatory affairs at Saudi Arabia's Electricity and Cogeneration Authority in Arabian Business.com (2015) http://www.arabianbusiness.com/companies/saudi-electricity-company-66578.html (accessed 5 May 2016).
[61] Lahn, G. and Stevens, P. (2011), *Burning Oil to Keep Cool: The Hidden Energy Crisis in Saudi Arabia*, Chatham House Report, London: Royal Institute of International Affairs, https://www.chathamhouse.org/publications/papers/view/180825#sthash.Zjonl9n3.dpuf (accessed 6 May 2016).
[62] Bloomberg interview, 4 April 2016, http://www.bloomberg.com/news/articles/2016-04-04/saudi-arabia-s-deputy-crown-prince-outlines-plans-transcript (accessed 6 May 2016).
[63] National Transformation Plan, Vision2030, http://vision2030.gov.sa/en/ntp (accessed 6 May 2016).

The NTP states that spinning off businesses will convert Aramco from an oil and gas company to an industrial and energy company, although it does not clarify what that means. The deputy crown prince has confirmed that Saudi Aramco itself will be brought under the scope of the Public Investment Fund, and that possibly 5 per cent of the shares will be offered to the public in 2017 or 2018.

The Saudi government also has plans for managing the budget deficit. These include:

- New taxes on revenues from non-oil sectors of the economy, which may include VAT, fees and taxes on luxury items;
- Reducing the gap between budgets and actual spending; and
- Financing budget deficits largely by local bond issues, rather than a cut in Saudi Arabia's foreign reserves.[64]

Prince Mohammed has also mentioned expansion into the minerals sector (though this is not mentioned in the INDC). This is not a new idea. Western Saudi Arabia has a variety of mineral resources, including phosphates, bauxite and silica as well as gold and zinc, but they are largely undeveloped and their contribution to GDP is less than 3 per cent. Expansion into finance by the creation or acquisition of regional banks is also on the table in the restructuring.

The eventual transformation is expected to increase the employment of Saudi nationals within the private sector, shift many activities from the state to the private sector with resulting improvements in productivity, and boost the population's household income.[65]

It is difficult to judge how opposition and inertia may frustrate the achievement of these drastic changes across the economy. Funds available for investment in renewables and energy efficiency are also uncertain because of volatile oil revenues (or, in the new system, revenues available to the sovereign wealth fund) on which the economy still depends.

Avoided emissions

The actions outlined for Saudi Arabia seek to avoid emissions of 130 million tonnes of CO_2 equivalent by 2030 through contributions to economic diversification and adaptation. These are contingent on the kingdom's economy continuing to grow and diversify, robust contribution from oil export revenues,[66] and no disproportionate or abnormal burden on the kingdom's economy from international climate change policies.[67]

[64] JADWA Research: The Saudi Economy in 2016, http://www.jadwa.com/en/researchsection/research/economic-research (accessed 6 May 2016).
[65] For a review, see Lahn, G. (2016), *Fuel, Food and Utilities Price Reforms in the GCC: A Wake-up Call for Business*, Research Paper, London: Royal Institute of International Affairs, https://www.chathamhouse.org/publication/fuel-food-and-utilities-price-reforms-gcc-business (accessed 6 May 2016).
http://climateactiontracker.org/countries/saudiarabia.html
[66] An example is given in McKinsey Global Institute (2015), *Saudi Arabia Beyond Oil: The Investment and Productivity Transformation*, http://www.mckinsey.com/global-themes/employment-and-growth/moving-saudi-arabias-economy-beyond-oil (accessed 6 May 2016).
[67] The baseline for the 130 million tonnes is not clear: 130 million tonnes is roughly equivalent to the increase in emissions over 2005–20 (135 million tonnes) and corresponds to 60 per cent of 1990, 33 per cent of 2005, and 24 per cent of 2010 emissions.

Finance

Implementation is not contingent on international financial support, but there would be a need for technology cooperation, which might involve financial commitments.

Target list

The Saudi INDC lists a number of projects and programmes related to energy efficiency:

- The development of renewable energies, such as solar; a pilot (40 million cubic feet per day (mmcfd) carbon capture and storage plant for recycling at the Othmaniya oil reservoir;
- Increased use of gas, dependent partly on development of shale gas; minimizing flaring; better wastewater management;
- Metro systems in Riyadh, Jeddah and Dammam;
- Contra-desertification schemes;
- Coastal management planning and infrastructures;
- Early warning system for floods; and
- Integrated water planning.

Comparisons with Iran

The Saudi INDC is comparable with those of Iran, the other major emitting country in the Middle East that is also a producer and exporter of oil.

Both countries merit 'special consideration' in the UNFCCC because of their dependence on oil rents (average percentage of GDP 2011–15: Iran 23 per cent; Saudi Arabia 44 per cent[68]).

- Saudi CO_2 emissions in 2010 were 533 million tonnes compared to 572 million from Iran.[69]
- Compared with developed countries, from 2011–15, Iran had higher emissions per capita than the EU on average and the United Kingdom, Italy and Spain in particular, while Saudi emissions were more than double those of Iran.
- Both countries look forward to the diversification of their economies and the reform of the energy sector organization and pricing.
- The Saudi INDC appears to imply an avoidance of emissions roughly equivalent to 11 per cent of what might be the case under business as usual, with no external finance but with external

[68] World Bank Development Indicators, http://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS
[69] Ibid.

technology. The Iran INDCs offers 4 per cent unconditional avoidance and a further 8 per cent conditional on investment (without sanctions and with investment funds, transfer of clean technology and bilateral or multilateral implementation – such as CDM or carbon trading). The Iran INDC spells out a need for adaptation policies with a possible bill of US$100 billion.

Implications for oil and gas

The first implication, which applies to both Iran and Saudi Arabia, is that a successful programme of development and diversification of their economies would be the bedrock of future oil and gas supplies, not only to the region but to the world. Both countries have the potential to increase supply in the short and medium-term before any long-term structural shrinkage of the oil market occurs. Nevertheless, the urgency of diversification and the stress of social costs are exacerbated by the likely reduction in scale of the global oil market, as a result of climate mitigation policies.

Such a complete transformation of an economy is challenging in all aspects: laws and regulations, resources (including human resources) and business culture. The oil and gas industry is expected to fund this transformation, while being significantly restructured itself and facing a demand curve that does not support strong rising prices. Added to this is the risk of political changes, both in Saudi Arabia and Iran, individually and conflicts in the region as a whole. The more successful the transformation, perhaps, the more the population may buy into the process, which may mitigate some but not all of the risk. The monitoring and reviewing progress will depend on there being a good level of disclosure.

Challenges

For policy-makers

- As for all the special cases, policy-makers need to establish how their claims to special treatment can be accommodated.
- The Saudi INDC is based on an extremely ambitious transformation of the economy, and it is far too early to judge its success or wider impact.

For the oil and gas industry

- The changes embodied in Vision 2030, would result in the reduction in demand in Saudi Arabia and overall globally.
- How the supply side will respond is unknown and a matter of conjecture.

For investors

- Restructuring of industries always throws uncertainties into the mix. Investors will need to judge the risks posed to investment opportunities.

INDC of the United States

The US INDC is based on the current policies of the administration, and existing legislation. A change in the presidency and the control of the Senate in November 2016 could significantly alter US intentions.

Context: The Climate Action Plan (CAP) of 2013

The US INDC is based on the administration's Climate Action Plan (CAP). The CAP extended previous policies on fuel efficiency for transport, namely the corporate average fuel efficiency (CAFE) standards (initiated in 1975) to reduce oil imports for security reasons. These have been harmonized since 2009 with limits on GHG emissions. The CAP incorporates the Clean Power Plan (CPP, 2015) for new and modified power plants, and proposed for existing power plants. In August 2016, the CAP remains suspended by the Supreme Court.

To achieve its INDC, the administration will initiate a task force of state and local leaders to prepare for climate change by identifying risks, taking them into account in major investment decisions and developing resilience to disasters. Individual states have a variety of policies for the use of renewables, vehicle emission standards (California) and emissions trading. These would all fall under the umbrella of federal policies expressed in the INDC. About half the savings of CO_2 in the US INDC derive from the EPA's proposed complex rules for emissions from the power sector in the CPP. This rule is currently suspended awaiting court decisions. The CAP also commits the administration to international cooperation on climate change such as agreements made with China 2014, India 2015, Brazil 2015, and the Paris conference. There is a focus on volatile organic compounds (VOCs) and hydro fluorocarbons (HFCs). At the same time, the administration is introducing stricter regulations of leakage of methane and VOCs.

Policies for transport

In 2007, the Supreme Court[70] ruled that the EPA has the authority and obligation, under the Clean Air Act (1990), to regulate CO_2 – and other GHGs – that 'may reasonably be anticipated to endanger public health or welfare.' In 2009, the EPA administrator determined that GHGs do endanger or contribute to the endangerment of public health and the welfare of current and future generations and that new motor vehicles contribute to these dangers.

Efficiency requirements and emissions limits for vehicles are now set jointly by the Department of Transport (for efficiency) and the EPA (for GHG emissions). Their legislative bases are different. Theoretically, one set of standards could be changed without alterations to the other, but the more restrictive of the stipulations would be binding.[71]

[70] Massachusetts et al. versus EPA, 26 July 2007, http://www.c2es.org/federal/courts/clean-air-act-cases (accessed 6 May 2016).
[71] The Energy Policy and Conservation Act (EPCA) of 1975 mandates the Department of Transport reduce oil consumption for security reasons. The Clean Air Act of 1970 delegates wide powers to the EPA to protect the health and welfare of US citizens and residents.

Fuel efficiency: CAFE standards

The Energy Policy and Conservation Act (1975) requires that the Department of Transport set minimum mileage standards (CAFE) for new models of cars and light-duty trucks (and a raft of associated controls on other gasoline using equipment). For cars and light-duty trucks, the standard was set at 27.5 miles per US gallon. Standards have steadily tightened. The key standard for cars and light-duty trucks was increased in 2007 to 35 MPUSG and is now set for 55.3 MPUSG (23.5 km/litre) for model years beginning 2021. This corresponds to 48.7 MPUSG after using various flexibilities relating to vehicle weight, size, engine power and other technical factors. Standards for heavy-duty trucks were introduced on a weight-related scale for models in 2014, requiring an increase in MPUSG of about 10 per cent. A second round of tightening (around a 16 per cent further reduction in fuel usage) is under consultation for model years 2021–27. Both standards extend into the INDC period (2025) and are referenced in the INDC.

Biofuels in transport

Biofuels are not mentioned in the INDC, but the United States has a legacy of policies that affect the demand for gasoline. Policy has developed along two tracks, both aimed primarily at substituting renewable fuel for oil as part of an original national security drive to reduce oil imports. To complicate matters there is a shifting complex of tax breaks, since 1978, and financial incentives for the production of corn-based ethanol, linked to specific quantities to be used by refiners. These increased slightly in 2015.

Renewable fuel standards (RFS) were first set by the EPA, under the Energy Policy Act of 2005, and extended by the Energy Independence and Security Act of 2007. There are federal RFS, but individual states may set different standards to recognize the circumstances. RFS require an increasing volume of renewable fuels (ethanol) to be used in gasoline. Because the standard is set as a volume, its share of total gasoline consumption depends on the demand for gasoline. The majority of vehicles and retail outlets can use conventional renewable fuels (such as E10) in a blend of up to 10 per cent of fuel. A smaller proportion can accept blends (E85) of up to 15 per cent.

However, it is not all straightforward:

- These measures do not necessarily reduce GHG emissions so to benefit from the mandatory blends, reductions of GHGs must be proved by biofuel suppliers. Part of the demands from the RFS is to be met by advanced (e.g. cellulosic) biofuels.
- Production of all biofuels is small: in energy terms, renewable fuel contributed 6–7 per cent of motor fuel use (up from less than 1 per cent in 2000).
- The 2016 volumes of biofuels on offer exceed both of these, and a settlement will need to be negotiated with the suppliers of the excess biofuels.

Impact on transport fuel demand

The CAFE standards, combined with the technological responses of the vehicle manufacturing industry, have almost halved the fuel used and CO_2 emissions per mile in new cars and light-duty

trucks since 1975.[72] From 2005 to 2014,[73] US transport energy consumption has fallen by 5 per cent and the petroleum share of energy consumption has dropped by 5 per cent. Most of the changes required so far are due to the improved efficiency of the internal combustion engine and diesel vehicles. The share of hybrids in transport in the EIA 2015 reference projection for 2040 shows a slight decline in fuel demand of 0.4 million barrels per day (mbd) from 2013 to 2040. Hybrid electric vehicles, plug-in hybrids and electric vehicles are beginning to make their mark.

The demand for driving has also changed. The distance driven by light-duty vehicles, after decades of growth, seems to have plateaued, below the peaks of 2001–06; any future growth will be offset by fuel efficiency so that demand for fuel for transport may not grow.[74] Annual fuel consumption per person, per licensed driver, and per household has followed a similar pattern[75] and teenagers are delaying getting driving licences. As a result, there may be a mismatch between the administration's projected demand and the coming reality.

The CAFE standards already in force are estimated to reduce oil imports by 2 million barrels a day and GHG emissions by 40 per cent by 2025.[76] The proposed additional heavy-duty vehicle standards would eliminate 1.8 billion barrels of oil demand and 1 billion tonnes of GHG emissions over the life of the affected vehicles.[77]

Power

Emissions from power generation are approximately a third of total US GHG emissions. The CPP highlighted in the INDC, together with earlier policies, would cut emissions from the power sector (since 2005) by about 26 per cent by 2020 (of which 10 percentage points have already been achieved by 2011[78]) and by 45 per cent in 2040.

The Clean Power Plan

The Clean Air Act (CAA) of 1970 established the EPA with very broad powers. It initiated regulations on air quality, GHGs from mobile sources (see above) PCBs (polychlorinated biphenyls), the use of lead, and water quality and disposal of toxic waste. The act was amended in 1977 and 1990. A cap-and-trade system to control sulphur dioxide emissions[79] was introduced in two stages in 1993 and 2000.

[72] Figures adjusted for real world performance .EPA (2015), *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 – 2015,* https://www3.epa.gov/otaq/fetrends-complete.htm, (accessed 5 May 2016).
[73] US EIA Monthly Energy Review Jan 2016, www.eia.gov/totalenergy/data/monthly/pdf (accessed 05 May 2016).
[74] EIA Annual Energy Outlook AEO 2015, www.eia.gov/forecasts/aeo/pdf/0383%282015%29.pdf (accessed 8 May 2016) http://www.eia.gov/totalenergy/data/annual/i
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[76] Center for Climate and Energy Solutions: *Federal Vehicle Standards,* http://www.c2es.org/federal/executive/vehicle-standards (accessed 16 Feb. 2016).
[77] EPA (2015), *Cutting Carbon Pollution, Improving Fuel Efficiency, Saving Money, and Supporting Innovation for Trucks*, https://www3.epa.gov/otaq/climate/documents/420f15900.pdf (accessed 6 May 2016).
[78] US State Dept. (2014), *Climate Action Report 2014*, http://www.state.gov/e/oes/rls/rpts/car6/index.htm?utm_content=bufferab67 (accessed 5 May 2016).
[79] For a full list, see *Milestones in EPA and Environmental History* http://www.epa.gov/aboutepa/epa-history (accessed 5 May 2016).

- In 2015, the administration launched the CPP to be administered by the EPA under the Clean Air Act.[80] This issued two basic rules to regulate emissions from the power sector. New and substantially modified power plants are required (under RIN 2060-AQ91) to use the best system of emission reduction (BSER). For steam generation from coal this means pulverized coal plus post-combustion partial CCS with a maximum emission of 1,400 lbs of CO_2 per megawatt hour gross (there is some flexibility). For combined cycle natural gas turbines (CCGTs) the limit is 1,000 lbs. These limits must be achieved by 2027, although CCGTs meet the standard even without regulation.

- For existing power plants (RIN 2060–AR33) the EPA will set individual targets for each state, aggregating them to achieve a 32 per cent emissions reduction by 2030. This leaves each state to work out (by 2018) how to meet its target by a system combining increasing efficiency in existing coal-fired plants, re-dispatching from higher emitting coal-fired plants to natural gas, and increasing generation from zero-emitting sources (wind and solar). States may choose whether to allocate allowances, auction them all or use some combined system. If a state fails to produce a reductions plan the EPA may impose one. Emissions trading between states will be permitted. California and the north eastern states already operate (separate) GHG cap-and-trade regimes.

Legal problems

On 9 February 2016, the Supreme Court imposed a stay of implementation of the CPP while it was reviewed in lower courts (the plan's regulations are currently under review in the Washington DC Appeals Court. The Supreme Court decision was by a five to four majority, one of whom (Justice Scalia) has since died. It is unlikely that his replacement will be appointed in the near future.[81] With no replacement, a tied decision may be expected. This would leave the lower court's decision standing, whatever it may be.

The EPA's duty to control GHGs from stationary sources has been accepted by the Supreme Court in several earlier judgments. There appear to be two main issues in this complicated case.

- The proposed CPP rule for existing power stations requires a combination of measures across a state integrated electricity system. It is arguable that the rule can only be applied 'within the fence' to individual generator sites, not on a wider system. If the plan is reduced only to site regulation, without mandating use of low carbon fuels and demand measures, more severe and complex site regulations would be needed to achieve the same GHG reductions.

- The underlying CAA legislation has bizarrely contradictory provisions about the overlap between regulation of the source and regulation of the pollutant: one interpretation is that if coal plants are regulated for any other reason they cannot be regulated for GHGs.

While the EPA regulations are suspended, states may continue planning for GHG limits on existing state power stations and many appear to be doing so.

[80] In 2012, the Supreme Court ruled that the EPA's duty to regulate GHGs (affirmed in 2007 for mobile sources) applies also to stationary sources.
[81] The replacement needs to be nominated by the president and approved by the Senate.

Impact of the Clean Power Plan

The EIA assessed for Congress the impact of the CPP on the projections in the Annual Energy Outlook (AEO) 2015,[82] with variations for the treatment of new nuclear power in the performance calculations, extending and tightening performance standards beyond 2030, and the effect of higher economic growth or higher oil and gas resources (the former tending to tighten fossil fuel prices, the latter to relax them). The model used is not necessarily a close fit to the CPP. Results must be viewed broadly.

Emissions

Projected power sector emissions for 2030 are lower by between 484–625 million metric tons relative to baseline projections (i.e. without the CPP): 29–36 per cent below 2005 emissions. A further reduction of 200 million tonnes of CO_2e might be achieved if the president's additional target of 20 per cent non-hydro renewables is applied (the CPP envisages 12 per cent). There are details to be resolved in the treatment of nuclear energy in the formulae for calculating emission reductions.

With the CPP, the projected power sector emissions level in 2030 ranges from 1,553–1,727 million tonnes across the cases, reflecting a reduction of between 29–36 per cent relative to the 2005 emissions level of 2,416 million tonnes – about half the emissions reduction in the US INDC.

Fuel shares

The analysis shows that the CPP would lower the demand for coal, and that coal prices will slide as a consequence. Coal demand will fall by 15–21 per cent in 2020 and 16–38 per cent in 2040. Wind generation capacity should double by 2025 and treble by 2040. Variations in energy efficiency interact with renewables capacity to create more or less space for carbon-based fuels in the power generation market.

The CPP should drive an increase in natural gas use in power generation until around 2020. Thereafter the performance targets will be met mainly by renewables. Natural gas use will not change very much between the different cases in the EIA analysis quoted above except that it is higher in 2040 by about 15 trillion cubic feet in the high oil and gas resource cases with lower gas prices (close to $4 per million Btu), compared with $8 in the reference and CPP cases. The price of natural gas, compared with the price of renewable fuels is the key determinant of their relative shares of the power market. The relative prices vary from state to state, depending on their endowments of coal and natural gas.

[82] EIA (2015), *Analysis of the Impacts of the Clean Power Plan*, www.eia.gov/analysis/requests/powerplants/cleanplan/pdf/powerplant.pdf (accessed 5 May 2016).

Impact of the INDC

- The INDC reflects the administration's aggressive GHG policies of the last two or three years and leaves room for tightening when the US will be under pressure in the 2018–20 UNFCCC review period of the Paris Agreement.

- The power sector is not being restructured. Emissions are cut initially by energy efficiency and substitution of coal by gas. In the long run, post 2020, substitution switches to renewables rather than gas, unless gas prices remain low (e.g around $4 mmbtu).

- States have discretion in setting how their power sector target should be met and what incentives should be given for energy efficiency and renewable energy. More regional co-operation is likely but there is no great mismatch with existing electricity markets.

- Vehicle emissions are expected to meet their target mainly by continuing technical improvements. Meeting the targets does not require rapid penetration of electric vehicles or further weakening of the underlying demand for transport. These are treated as risks rather than deciding factors.

Challenges

The most fundamental challenge to all concerned with the climate and energy policy in the US is uncertainty about the results of the next presidential and Senate elections. A different presidential policy could change the many administrative measures taken by President Obama within the framework of existing laws; a change in the control of Senate would affect the appointment of the next Supreme Court judges and therefore possible decisions on the CPP.

For policy-makers

- The main challenge to the CAP is the suspension of the CPP by the Supreme Court. However, the reasons for the suspension appear to be procedural, not fundamental, and do not necessarily indicate what the final ruling of the court might be.

For the power and gas industries

- States will have different fuel mixes, based on their specific resources and markets. The CAP and CPP are implemented at state level so decisions may vary.
- There will be economic incentives to improve interconnection between states to allow optimization of the power generation base. This will be critical as renewables become more prevalent.
- As the use of renewables grows, channels must be found to fund investment in smart grids within states.

For the oil industry

- Demand for transport fuel will continue to shrink as investment in electric vehicles radically changes fuel demand.
- A shift to lower cost projects, which are less time intensive, may make success in US shale the key a differentiator between companies' success.

4. Conclusions

Oil

Policies directly affecting oil through the transport market are mainly extensions of existing policies on emission levels and fuel efficiency for new vehicles. An additional policy change – not highlighted in the INDCs – is the removal or reduction in subsidies in developing countries (including oil producers) that will reduce per capita oil demand (typically 2.5 times higher in countries with fuel subsidies than in those without). In 2015, subsidies were reduced for petroleum products in Angola, China, India, Indonesia, Iran and the UAE.[83]

Demand for oil will not peak before 2030 in China and India. It has already peaked in the US, EU, Japan and the OECD as a whole. The shift of demand growth to developing countries is not new, though the INDCs suggest the balance between developed and developing markets will change even more rapidly, challenging those companies whose downstream markets are mainly in developed economies.

In emerging and developing economies rising living standards will involve increasing personal mobility, but this need not necessarily be met through individual ownership of vehicles. In the growing cities of China and India air pollution as well as planning policies will drive the use of better public transport and electric vehicles as alternatives to gasoline and diesel.

For upstream producers, lower overall demand pushes producers towards prioritizing low-cost projects and challenges the specialization of the major European and American majors in high cost (e.g. deep sea offshore, Arctic) sources. Managements in the sector must adjust their expectations and investment plans to the reduced demand and price growth trajectory. High-cost projects may not be developed in the foreseeable future unless there is government support based on security considerations.

The private sector companies may well consolidate and it is arguable that they should decapitalize, returning excess capital to shareholders rather than investing in diversification, and thus let the financial markets reallocate capital. State-controlled companies may fragment, with increasing scope for private sector partners.

Prospects in the downstream will favour state-owned companies (NOCs), as the market divides between the ex-growth developed markets, where there is excess capacity, and the developing markets, especially in Asia. Private sector companies are primarily represented in the former and denied access to the latter.

[83] IEA*: World Energy Outlook 2015:* http://www.worldenergyoutlook.org/resources/energysubsidies/ (accessed 5 May 2016).

Different managements will negotiate these changes with different levels of success; in other sectors that have gone through major transformations, companies able to be adaptive have fared better than companies with a fixed vision, or those in denial of the extent of change.

Gas

Prospects for gas depend on the policy intentions for the power market in different countries. In some countries, these are reasonably clear but only as a residual of policies (which may change) for promoting renewables, limiting coal, and promoting or banning nuclear power. In these countries, the restrictions imposed by government interventions in the market have upset the profitability of many sections of the power industry and their ability to fund future restructuring (e.g. smart grids or new cleaner generation). Whether the gas industry can co-ordinate with governments to gain a better than residual position in the power sector remains to be seen.

Where increased use of gas depends on imports, the ability to fund the infrastructure is undermined by the uncertainty about the scale and profitability of the import market. There is a vicious circle between uncertainty about the market in major potential importing countries, and the unwillingness of investors to support major new LNG (large-scale long life) infrastructure (and the supply behind it).

In some major electricity markets, policy is still in a state of transition to renewable, intermittent and decentralized generation. In a number of countries this involves changing from a system based on central generation and strictly economic merit to something that is more flexible but recognizes the need for capacity payments and more proactive grid management. This is challenging the regulatory and business models of the existing power generating and network companies. For gas, these problems are immediate for investments aimed at 2030 and beyond. Limits to the power market for gas will create incentives for enlarging markets for power (substituting for direct burning of fuel) and gas (substituting, for example, fuelling vehicles or via electricity through the vehicle powertrain). The long-term ambition of decarbonizing the transport sector depends on the availability of cheap electricity with a lower carbon content than the present generating mix.

There is potential for expanding markets for gas in regions that have gas, avoiding the high cost of transportation for export. This may require smaller scale operations, and needs high enough pricing to attract investment but can provide gas for power in markets where there is a need for more generation and where cheap coal might be seen as an alternative.

Next steps

The review process agreed in Paris stipulates that countries individually and collectively reassess their policies in light of new information and clearer political preferences. Because the Paris INDCs do not place global emissions on a path likely to meet the agreed climate target, it is inevitable that the review in 2018–20 will aim at tougher policies.

- Policy-makers need to consider how to respond to the review requested from the IPCC regarding a 1.5°C warming limit. Further considerations include how to balance priorities between early

reductions with more or less known technology and systems, against the uncertain possibility of more options later; how to review progress by procedures that share best practice as well as vilifying failure; and, not least, to balance ambition and realism for the longer term.

- The oil industry needs to adjust to the increasing impact of existing negative trends on demand especially in the longer term when tougher policies, cheap electricity and battery technology, and potential use of gas in vehicles, could have a very significant impact. This has implications for investment needs and capital returns to shareholders.

- For the gas industry, the challenge of restructuring the power sector, particularly in Europe and Asia, will have a great impact on the prospects for gas and therein lie very serious issues concerning structure, regulation, allowable returns, policy stability that impacts investment in generation and the infrastructure needed to expand the use of gas at the expense of coal.

- Major private-sector oil and gas companies have yet to demonstrate complementary strategies for the relatively clear medium-term future for oil and a relatively uncertain medium-term future for gas.

- Investors should challenge company managements about capital allocation and, where appropriate, demand that capital be returned to shareholders who can reallocate it rather than the company investing in unnecessary projects or very risky diversification.

- Across the global economy, consumers of energy in all sectors will continue to improve fuel efficiency and reduce waste (investors can and should demand transparency and comparability of data to track this). This may create stranded assets for many existing industries but will also create expanding markets for companies offering new technologies and services that avoid the use of carbon based fuels or electricity derived from them.

- Advocacy groups should pressure governments to aim for more aggressive long-term global objectives (1.5°c); stronger implementation of INDC medium-term policies in key sectors and countries; monitoring and reviewing the progress of the wide variety of strategies and policies across the various countries, and to strike a balance between climate change mitigation and increasing access to energy for poor people.

Although the diverse nature of the INDC structure enabled a very broad buy-in at Paris, it is the very diverse nature of those plans that makes them challenging to monitor and review. It is vital that this process is rigorous and successful. The INDCs of the developed economies are largely an agglomeration of existing policies (extensions at best). Those of the developing economies are very general (economic growth with less carbon intensity). In order for Paris to have been truly effective, the INDCs must be the start of a dynamic process in which new technology, better regulation, experience, process re-engineering, and sharing of best practice are all drawn upon to harness the innovation and flexibility of the private sector rather than restricting progress.

The process is already attenuated; if the attitude of most participants is more concerned with how little they can get away with contributing rather than how much, before the 2020 review, then our chances of limiting climate change to 2°C, let alone 1.5°C, are small indeed.

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Cover caption: Climate change demonstrators hold up a sign with the text 'system change not climate change' in front of the Eiffel Tower.

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