

## Business as usual energy modelling workshop: note of discussion

### Workshop details

Wednesday 5th July 2017, 15:30-17:30, Grantham Institute, Imperial College London, South Kensington Campus, London SW7 2AZ

### Context

Over the course of 2016, the Grantham Institute at Imperial College London and Carbon Tracker Initiative analysed the potential implications of rapid cost reductions in solar PV and electric vehicles on the global energy system. The resulting analysis was presented in the February 2017 report “Expect the Unexpected: The Disruptive Nature of Low-carbon Technology”<sup>1</sup>.

During the analytical phase, there was discussion around what scenarios of policy support to consider, including around a reference scenario. Such reference cases are common in energy and climate modelling. In the past, they have most commonly represented a picture of what would or could happen to the energy system and the climate system without specific climate policy. Hence the term “business as usual” to describe such scenarios, given that in the past there has been either no or fairly minimal climate policy – at least not enough to drive the energy system away from carbon-intensive fossil fuel technologies.

In recent years, changes to technologies (specifically rapid cost reductions in some technologies, which may make them cost-competitive with relatively little, or no, climate policy) and the degree of climate policies implemented in a variety of countries mean that the use of reference and business as usual cases should now be closely examined. With a view to doing this, the workshop convened energy modellers, analysts and researchers from a range of organisations (full attendee list below) to explore the following questions:

- 1. What reference scenario should investors, fossil fuel and other energy companies be measuring their assets and operations against?**
- 2. How do we conceptualise cost of mitigation relative to a new business as usual where low-carbon investments and actions are increasingly the norm?**

This workshop note reports the different points made during the discussion. The discussion was conducted under the Chatham House Rule, so that whilst comments have been made available, they are not attributed to specific workshop participants.

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<sup>1</sup> Carbon Tracker and Grantham Institute, Imperial College London, 2017. Expect the Unexpected: The Disruptive Power of Low-Carbon Technology. Carbon Tracker Initiative, London, United Kingdom. Available online at: [http://www.carbontracker.org/wp-content/uploads/2017/02/Expect-the-Unexpected\\_CTI\\_Imperial.pdf](http://www.carbontracker.org/wp-content/uploads/2017/02/Expect-the-Unexpected_CTI_Imperial.pdf)

Question 1: What reference scenario should investors, fossil fuel and other energy companies be measuring their assets and operations against?

On the specific context behind the question:

- Many other energy system modelling exercises may be overly conservative in their use of business as usual scenarios which have no climate policy and see a fossil fuel-intensive future.
- In theory one could do away with the concept of business-as-usual entirely. However, the use of reference scenarios is likely to remain important, given that people and organisations will naturally look to counterfactual or reference points against which to measure their actions.
- The Grantham Institute and Carbon Tracker analysis led to an assertion that the Paris pledges constitute a sufficiently credible level of policy support to include in a reference scenario.
- It is worth questioning at what point a high-carbon business as usual scenario becomes not just outdated but irrelevant.
- There is an acceptance that different modelling and analytical groups will continue to use different conceptions of what constitutes business as usual. However, it could be advantageous to harmonise, and it is certainly important to clarify, approaches, for use within and outside the modelling community.

On the use of scenarios in industry:

- Statoil uses a number of scenarios for its Energy Perspectives, including one which achieves a 2°C limit to global temperature change with 50% probability, based on the IEA's 450 scenario which they deem to be the most robust of the IEA's carbon limited scenarios. This includes greater deployment of offshore wind, for example.
- Clearly not all scenarios will result in the same profitability or returns, but Statoil's investment strategy portfolio is robust to any of its future scenarios. This is important as none of them are predictions on what will happen. It's also important to note that there is still robust oil demand (63 million bbl/day in 2050) in the 2°C scenario, driven by heavy transport and petrochemicals demand. Given current rates of oil field retirement, that still leaves open the opportunity and need for considerable new investment in oil extraction over the coming years.
- The IEA doesn't make predictions either, but sets out scenarios with clear levels of policy effort or support. The IEA are aware of the market-moving influence of their scenarios and analysis, as well as the need to produce scenarios that are relevant to their various member countries. So arguably some caution and conservatism may inevitably follow in an attempt to have "balanced" scenarios and the IEA tends to show a middle ground rather than extremes.
- Many of the oil and gas companies are unlikely to be making their own, detailed projections of electric vehicle uptake, which is not their core business, so some scenarios on developments such as these might come from relatively few places, and reflect perhaps too narrow a range of views.
- There is something of a disconnect between the scenarios produced in academia using integrated assessment models over a lengthy time cycle (e.g. the approximately five year IPCC cycle), which have a very granular level of technical detail, and those produced in industry (including banks) which may be at a higher or more aggregate level but which are produced more frequently.

On the importance of feasibility when considering different scenarios:

- The issue of feasibility is an important one in current discussions around energy system modelled scenarios of future low-carbon pathways. Specifically, there is very little detailed discussion of the real-world technical / economic / political feasibility of scenarios and a relative lack of clarity on underlying assumptions in the energy and integrated assessment models. In some cases, where assumptions are available they are buried in supplementary material. The predominance of as-yet non-commercialised large scale bioenergy with CCS (BECCS) in many scenarios is another key issue which raises the question of feasibility.
- This issue of feasibility is just as important to reference or business-as-usual scenarios as to low-carbon scenarios. In particular, comparing low-carbon scenarios to high-carbon hypothetical (but not realistic) business as usual scenarios can make the required mitigation actions look too challenging.

- On the other hand, it should be made clear that judging feasibility is not really the goal of integrated assessment models. Many factors influencing feasibility, including social, political and economic factors, are not outputs of the models but often form the basis of some of the input assumptions.
- It is important to consider what one needs to believe in order that the scenario comes to pass.

#### On the accuracy/predictive power of scenarios:

- UK energy system model scenarios have tended to be off-track within about 2 years of the start of the forecast period.
- It's therefore important to question why there remains a relatively low level of diversity amongst such scenarios, as well as what such near-term inaccuracy means for scenarios which go out all the way to 2050 and beyond. It is likely we are considering too narrow a range of futures.
- It is also important to be aware of what timescale scenarios are aimed at and why. Academic scenarios tend to be produced for longer-term periods of time on the basis of underlying economics, whereas more practical near-term scenarios may be to 2020, taking into account business decisions, market dynamics and policy cycles. Choosing a cut-off point between such near and longer term considerations can be controversial.

#### On the challenges of modelling technological dynamics:

- Understanding the penetration of different technologies into markets is complex, because this depends not just on physical and technical characteristics (e.g. availability of space on rooftops for PV) but also on how behaviours, regulations, incentives and other policies drive or impede technologies.
- Understanding the factors that might lead to tipping points, in terms of relative technology costs or other driving factors, is also critical. Straight line syndrome is not helpful, and rapid changes could happen.
- It is also important to reflect on what rapid technology penetration rates mean – will 1 GW of installed renewables capacity per day be possible given supply chains and technology availability?
- This doesn't just mean making scenarios conservative, however. We have seen recent examples of unexpectedly rapid penetrations of technologies, with 12GW of solar PV in the UK beyond any predictions made just a few years ago, and Bloomberg New Energy Finance's bullish projections of EV growth now being matched by a number of other analysts. We have also seen scenarios which showed a maximum oil price of \$35/bbl in 2050, with many renewables projected to be cost-effective at this price. Not only was the oil price forecast too conservative, but the cost-competitiveness of renewables at this price may have been overstated.

#### On the utility of business as usual and reference scenarios:

- One oil company recently claimed that a 4°C world – with associated demand for fossil fuels – would be a good outcome for its shareholders. This suggests that some organisations have not yet engaged with how potentially damaging that level of warming might be to the world economy.
- This is in part because there is a very thin evidence base on the feedbacks between such levels of warming and economic growth and development – it is difficult to monetise.
- Business as usual doesn't seem a helpful term given that (in its traditional sense of no mitigation policy) it is probably the most unlikely thing to happen.
- Reference is a better term, but still not hugely useful without careful defining and associated assumptions. It also risks being treated as a "special case" if highlighted.
- Energy system models and analyses will tend to rely on central cases and scenarios, as it is likely to continue to be important to show what is the most likely outcome. These aren't / shouldn't necessarily be higher carbon cases, though.

Question 2. How do we conceptualise cost of mitigation relative to a new business as usual where low-carbon investments and actions are increasingly the norm?

On the need to use business as usual as a counterfactual in mitigation cost analysis:

- There remains a need to consider the cost of different policies, including climate targets, so the requirement to compare government action to “no policy” cases remains strong. This is particularly true when thinking about specific policies.
- That said, it is possible that the low-carbon transition could become self-sustaining in economic terms, in which case it becomes less relevant to compare to “no policy” cases. Of clear relevance to this is the need to understand whether we are likely to see further rapid technology cost reductions in the future and whether we have been lucky with what’s happened so far, as well as systematically optimistic or pessimistic in our forecasting of costs.
- Now that we have the Paris climate agreement, it may be more relevant to assess what investments are required to meet that target, rather than considering costs against a hypothetical counterfactual of no policy action. It’s also critical to understand country-level mitigation costs, not just global.

On the relevance of other metrics in addition to mitigation costs:

- It is also important to consider, beyond macro-level mitigation costs, whether and how costs can be attributed to specific sectors.
- A key cost for businesses and consumers is the unit cost of energy. Similarly, consideration of the costs of delivering different energy commodities is useful.
- It’s also important to consider the costs of specific government policies, such as R&D investment costs which make a contribution to learning and cost reductions in low-carbon energy technologies.
- One metric of potential relevance, though less commonly used than mitigation costs, is the total energy system cost of delivering different climate targets in different ways. The lowest cost strategy can then be chosen without reference to mitigation costs against a reference or business as usual case.
- Marginal abatement costs (MACs) are becoming increasingly redundant, as the baselines against which the MAC of different technologies are measured differ between technologies and studies. Results can also be misleading, as negative cost measures which save very little carbon may look extremely attractive on this metric, but actually be quite insignificant in terms of overall contribution to mitigation.
- Expressing mitigation costs as a % of GDP can be problematic, as this is just the result of dividing a very large number (energy system mitigation cost) by another even larger number to get a small percentage.
- It’s also important to consider individual technology costs in the right way, including not just levelized costs but total cost impact on the energy system (e.g. including associated system and infrastructure costs).
- Overall costs of different mitigation strategies may have considerable uncertainties associated with them. As such, it may be better to compare the difference in costs between different strategies.
- It’s important to consider who the metric(s) is / are for. For example, consumers and businesses might find energy unit costs more relevant, whilst policy makers might find sector-wide or economy-wide costs more relevant.
- It’s also important to consider where mitigation is happening i.e. whether domestically or abroad through credits, where it may be cheaper to mitigate.

On the need to consider other goals apart from cost:

- There are a number of country objectives relevant to energy apart from mitigation, such as energy access, development goals, energy security and air pollution. Each of these criteria may be equally if not more important than simply mitigation costs.
- Different countries will also conceptualise energy costs in a different way, depending on their context and development / growth priorities.
- Normalising benefits and costs is challenging, since some do not lend themselves to monetisation, but multi-criteria sets of metrics and links between metrics can be highlighted.

## Summary of key points for further consideration

- Organisations sometimes use a variety of scenarios to illustrate the implications for their business and policy planning.
- Some form of “no policy” or business as usual reference can be important for specific policy analysis.
- Many forecasts and projections fall out of line with outturn data even over the short-term, which calls into question why the long-term scenario space remains relatively narrow.
- Modelling technological dynamics requires understanding not just the economics of technologies but also regulations, markets and behaviours, over different time-scales.
- Judging the feasibility of any scenarios, whether high-carbon or low-carbon, remains challenging and not something current energy and integrated assessment models can do.
- The wider consequences of high-carbon business as usual scenarios, in terms of feedbacks from the climate, are often not taken into account in business planning.
- Costs of mitigation (including marginal abatement costs) can be misleading if measured against a variety of business as usual scenarios.
- A range of other metrics can be used to assess the costs and benefits of low-carbon pathways, including investment costs required to meet internationally agreed targets, as well as co-benefits or other impacts of low-carbon pathways, such as around air quality, energy security and energy access.
- Transparency of assumptions is critical to ensuring low-carbon pathways analysis is useful for a variety of stakeholders.

## Further details

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## In attendance

<i>Name</i>	<i>Organisation</i>	<i>Role</i>
Adam Hawkes	Imperial College London	Senior Lecturer in Energy Systems
Ajay Gambhir	Grantham Institute, Imperial College London	Senior Research Fellow
Alexandra Howe	Grantham Institute, Imperial College London	Stakeholder Engagement Manager
Alyssa Gilbert	Grantham Institute, Imperial College London	Director of Policy and Translation
Carsten Jung	Bank of England	Economist
Charlotte Wolff-Bye	Statoil	Vice President Sustainability
Clara Heuberger	Imperial College London	PhD Researcher
James Foster	Department for Business, Energy and Industrial Strategy	Head of International Climate Change Economics & Analysis
James Leaton	Carbon Tracker Initiative	Research Director
Jeff Hardy	Grantham Institute, Imperial College London	Grantham Research Fellow
Jenny Nelson	Grantham Institute, Imperial College London	Mitigation Programme Lead and Professor of Physics
Joana Portugal Pereira	Intergovernmental Panel on Climate Change	Senior Scientist
Joeri Rogelj (by phone)	International Institute for Applied Systems Analysis	Research Scholar, Energy
Jonathan Bosch	Imperial College London	PhD Researcher
Luke Sussams	Carbon Tracker Initiative	Senior Researcher
Nicky Dean	Nature Energy	Chief Editor
Peter Taylor	University of Leeds	Chair in Sustainable Energy Systems
Raphael Slade	Imperial College London	Senior Research Fellow
Richard Chatterton	Bloomberg New Energy Finance	Energy Markets Analyst
Samuel Karlake	Department for Business, Energy and Industrial Strategy	Economist - International Climate Change
Sanchia Bailey	Department for Business, Energy and Industrial Strategy	Sector and Whole Systems Models
Sheridan Few	Grantham Institute, Imperial College London	Research Associate
Tamaryn Napp	Grantham Institute, Imperial College London	Research Associate
Thomas Weight	Statoil	Senior Analyst
Yufeng Yang	Energy Research Institute of China's NDRC	Research Professor and Grantham Research Fellow