Future Pathways to 1.5°C/2°C-Compatible Oil & Gas Majors: Survey of energy outlooks and key uncertainties

Abstract

Major oil and gas companies face an existential threat from the transition to a low-carbon economy consistent the Paris Agreement and a 1.5°C/2°C warming limit. New technologies, uncertain energy demand, rising energy efficiency, competitive resource landscapes, and policy and regulatory changes all have potential to disrupt oil and gas company business models and strand assets. Shareholder value may be better secured by engaging with companies to deliver a managed transition to business models compatible with a 1.5°C/2°C warming limit. With this transition will come requisite changes in oil and gas companies' approach to capital expenditure, dividend policy, and business model diversification.

This paper identifies key uncertainties in the transition of oil and gas company business models to become compatible with a 1.5°C/2°C warming limit. This is done by comparing the energy outlooks, scenarios, and projections of governments, NGOs/thinktanks and private companies. Uncertainties identified include macroeconomic assumptions, total primary energy demand, oil and gas demand by sector, oil and OPEC production, the electrification of light duty vehicles, oil prices, future power generating options, and carbon dioxide emissions. Changes in International Energy Agency (IEA) projections through successive energy outlooks are presented. Discussion considers how energy outlooks may be improved to better inform analysis of and engagement on the energy transition for the benefit of all stakeholders.

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Introduction

The global energy system is critical for supporting economic growth and development, international connectivity and mobility, and high living standards (e.g. Smil, 2010 It also threatens the stability of the climate by producing approximately 70% of global anthropogenic greenhouse gas emissions (IPCC, 2014). A transition is underway to fully decarbonise the energy system by reducing to net-zero energy system greenhouse gas emissions. It is the defining task of the 21st century to transition to a global economy with net-zero greenhouse gas emissions while simultaneously empowering development and alleviating poverty (Stern 2015; UNEP 2015).

This transition exposes companies and their investors to a new suite of environment-related risks, especially those involved in the extraction, processing, and retailing of carbon-based fuels. These companies are exposed to the physical impacts of a changing environment (e.g. Caldecott, Kruitwagen, Dericks et al. 2016); changing resource landscapes (e.g. Stevens, 2015); new government regulations (e.g. Mitchell, & Mitchell, 2016; Littlecott, Pearson, Whiriskey & Skruiung, 2013); new competing low-carbon technologies (e.g. Randall, T. 2016; Cambridge Economics, Poyry & ICCT 2016); changing social norms and behaviour (Ansar, Caldecott & Tilbury 2013); and increased exposure to litigation and statutory interpretation (Heede 2014; PRI 2015).

The scale of financial market exposure to these companies makes their management and governance through the transition a critical concern. As an example, energy, utility, and materials companies comprise 13.2% and 24.5% of the S&P500 and FTSE100 respectively (S&P Capital IQ, 2016). A managed and stable transition is needed prevent large capital write-downs and shocks to the financial and economic system.

There is now an active debate on how investors, companies, policy makers, and other stakeholders can best achieve this managed and stable transition. The imperative to allocate capital efficiently through the energy transition is complicated substantially by uncertainty in what the future energy system will look like. This uncertainty arises from the influence of limited information, stochastic phenomena, and human agency and decision making on the future state of the energy system. Scenario planning can help investors, company managers, and policy makers navigate uncertainty by discretising a view of the future into a single narrative against which they can make decisions (e.g. Courtney, Kirkland, & Viguerie, 1997; Caldecott, Tilbury, & Carey, 2013). Many organisations, including companies, academic bodies, NGOs, and industry organisations, periodically publish their best-informed scenarios of the future of the energy system. These energy outlooks may contain multiple scenarios, reflecting the breadth of the author's belief in realistic possible futures. Scenarios are often accompanied by quantitative projection data for use by analysts. Projection data are developed from mathematical models of the energy system, developed and maintained by outlook authors.

This paper reviews and compares selected energy scenarios. The scenarios shown in Table 1 have been selected for comparison due to their detail and widespread reference and significance. Various other scenarios and projections are included where appropriate and referenced in text.

Table 1: Selected Energy Outlooks

Organisation & Publication	Core Scenarios	Code	Scenario Type[ii]	Reference
International Energy Agency (IEA) *World Energy Outlook 2015*	CPS NPS 450S	IEA-CPS IEA-NPS IEA-450S	BAU CEN 2DS	(IEA, 2015a)
World Energy Council (WEC) *World Energy Scenarios*	Jazz Symphony	WEC-JAZ WEC-SYM	POS POS	(WEC, 2013)
Energy Information Authority (EIA) *International Energy Outlook 2016*	Reference	EIA-REF	BAU	(EIA, 2016a)
Organisation of Petroleum Exporting Countries (OPEC) *World Oil Outlook 2015*	Reference	OPC-REF	CEN	(OPEC, 2015)
The Insittute of Energy Economics, Japan (2015) *Asia/World Energy Outlook 2015*	Reference Adv. Technology	IEE-REF IEE-ADV	CEN POS	(IEEJ, 2015)
Royal Dutch Shell Plc (Shell) *New Lens Scenarios*	Mountains Oceans	RDS-MOU RDS-OCE	POS POS	(Royal Dutch Shell Plc, 2013)

BP Plc (BP) *Energy Outlook 2016*	Base Case Faster transition	BP-REF BP-FAS	CEN POS	(BP Plc, 2016)
ExxonMobil Corp (Exxon) *Outlook for Energy 2016*	"Reference"[I]	EXX-REF	CEN	(ExxonMobil Corp., 2016)
Statoil SA (Statoil) *Energy Perspectives 2016*	Reform Renewal Rivalry	STA-REF STA-REN STA-RIV	POS 2DS POS	(Statoil SA, 2016)

I) Exxon does not explicitly name their central scenario, we call it their "reference" scenario
II) BAU: "Business as usual" scenarios generally extrapolate historic energy system conditions without considering likely new developments in policy, technology diffusion, etc.; CEN: "central" scenarios represent the author's best-informed opinion of how the future energy system will likely be; 2DS: 2°C-warming limited scenarios are explicitly constrained to provide a narrative of an energy system compliant with a 2°C warming limit; POS: "possible" scenarios describe a potential future of the energy system without the constraints of a BAU, CEN, or 2DS scenario.

Key uncertainties in the future of the energy transition are identified from the selected energy outlooks, including macroeconomic assumptions, primary energy demand, oil and gas demand by sector, oil and OPEC production, the electrification of light duty vehicles, oil prices, future power generating options, and carbon dioxide emissions. Year-on-year changes in IEA projections are presented. Discussion considers important elements of the energy transition and how energy scenarios, models, and projections may succeed or fail in capturing them.

This paper pre-empts a series of workshops designed to elicit company and investor responses to the energy transition and to roleplay transition scenarios. The authors invite readers interested in participating in these workshops to contact them. The data for all figures produced in this document and page-specific references are available as an appendix from the authors.

Selected Projections and Critical Uncertainties

The following sections compare the assumptions and projections of the selected scenarios, where available. The differences between the projections of different authors highlights critical uncertainties in the future of the energy system. Data has been obtained from tables and figures in selected publications, see Table 1 for references.[1]

Macroeconomic Assumptions

Through modern history, economic growth has been accompanied by commensurate growth in primary energy demand (Smil 2010). The Kaya Identity (Kaya 1990) (see equation 1) reveals how critical the growth of gross domestic product (GDP) and population growth can be in the projection of total primary energy demand and greenhouse gas emissions.

$$GHG\ Emissions = Population * \frac{GDP}{Population} * \frac{Energy}{GDP} * \frac{GHG\ Emissions}{Energy} \quad (1)$$

Figure 1A and Figure 1B show GDP and population growth projections respectively for selected scenarios.

Figure 1A: Macroeconomic Assumptions - GDP Growth

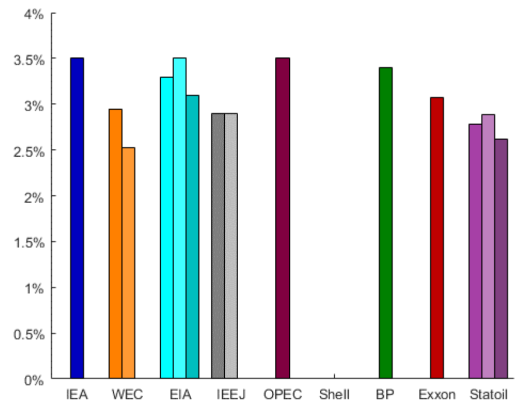
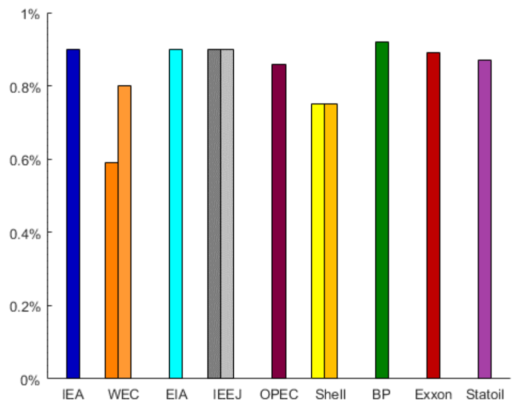


Figure 1B: Macroeconomic Assumptions – Population Growth



Recent research has begun to consider the feedback loops between the energy system and total growth in the global economy (e.g. EIU, 2015). Climate change caused by energy system emissions impairs global growth which in turn impairs total energy demand. GDP growth is endogenously generated by models underlying the projections of the EIA (2016, pp274), WEC (Loulou, Goldstein, & Noble, 2004, pp26), and Statoil (2016, pp13). In the models of the IEA (2015b, pp8), the IEEJ (2015, pp35), and OPEC (2016 pp30), GDP growth is explicitly an exogenous assumption to energy projections. Among the outlooks of Shell, BP, and Exxon, it is unclear as to whether GDP growth has been projected considering the specific scenario in question.

The lowest growth scenarios, WEC-SYM and STA-RIV, have different stimulae. In STA-RIV, conflict causes instability which ultimately constrains investment and growth. In WEC-SYM, environmental constraints prevent rapid growth in pollution-intensive fuels. The upper end of the growth outlooks, approximately 3.5%, is a figure taken from projections by the OECD, Worldbank, and the IMF (see IEA 2015b), and is weighted by greater growth in the near-term and reduced growth in the long-term.

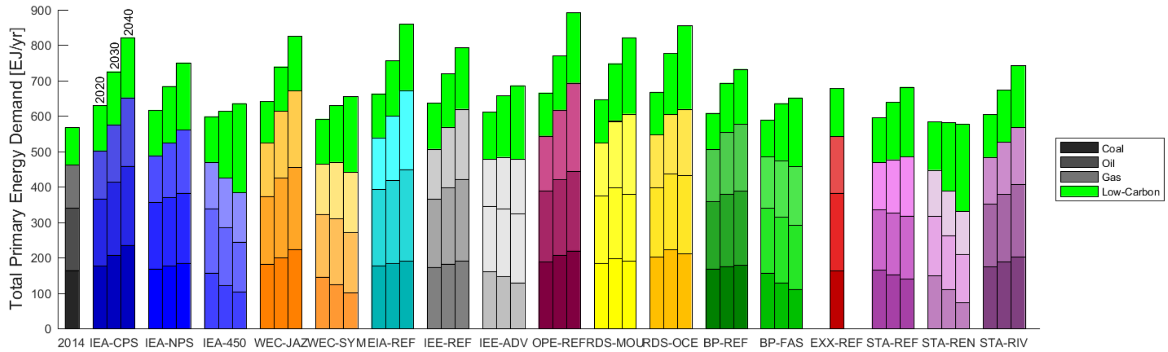
Total Primary Energy Demand and Intensity

Figure 2 shows the total primary energy demand (TPED) for selected scenarios. Most projections show a near- or mid-term increase in the total amount of coal in the primary energy demand, however recent data indicate that the world may have already passed peak coal consumption in 2014, led by the reduction of consumption in

[1] Methodology Notes: i) When capturing data from figures, point-capture software has been used with a typical precision of three significant digits; ii) Unit manipulations are not noted in-text however other assumptions or calculations to enable like-with-like comparisons are; iii) A data appendix with complete page number referencing is available from the authors.

China (e.g. Buckley, & Sanzillo 2015; BP 2016, pp60-64). Common among lower carbon scenarios (e.g. IEA-450, WEC-SYM, BP-FAS, STA-REN) is the rapid displacement of coal as a primary energy source and the approximate doubling of renewable primary energy by 2040. These transition scenarios also show a substantial improvement in efficiency of energy use, with much lower total growth of total primary energy.

Figure 2: Total Primary Energy Demand



Combining regional TPED and GDP projections reveals how the energy outlooks differ in their vision of regional GDP-Energy decoupling. Figure 3A through Figure 3E show regional outlooks of energy intensity for the OECD, China, India, the Rest of the World. For Figure 3B though D, OPEC's projection is for 'Developing Countries' (OPEC 2015, pp43).

Figure 3A: Regional Outlooks & Energy-GDP Decoupling – OECD

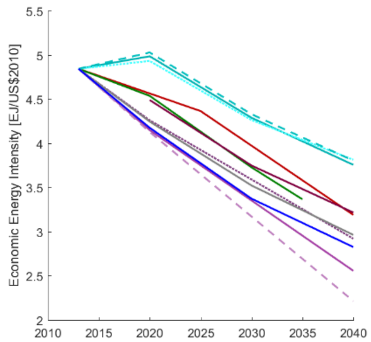


Figure 3B: Regional Outlooks & Energy-GDP Decoupling – China

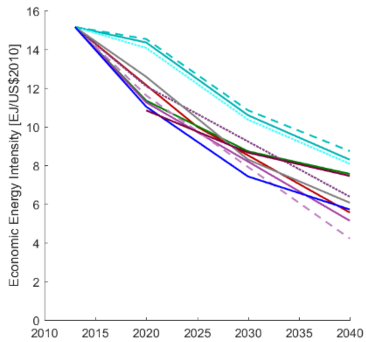


Figure 3C: Regional Outlooks & Energy-GDP Decoupling – India

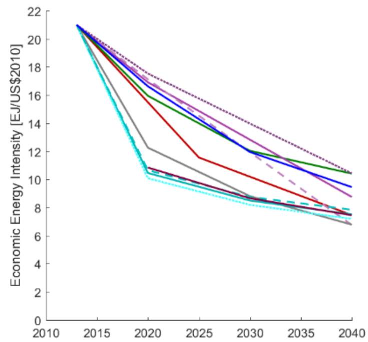


Figure 3D: Regional Outlooks & Energy-GDP Decoupling – Rest of World

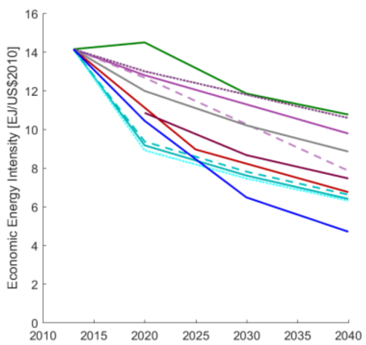
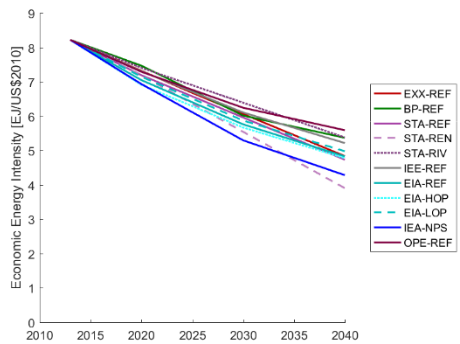


Figure 3E: Regional Outlooks & Energy-GDP Decoupling – World

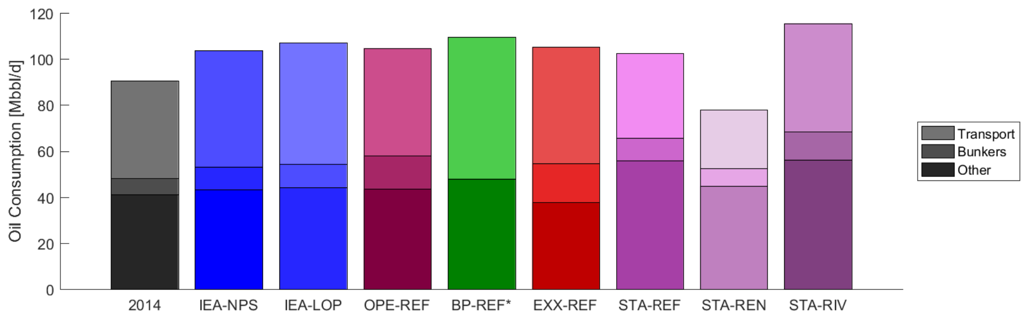


From Figure 3, all outlooks show substantial expectation of decoupling economic growth and energy consumption for all regions. The largest uncertainties are the rate at which India and the 'Rest of the World' decouples energy consumption from growth.

Oil Demand, Price, and OPEC Portion of Production

Energy outlooks for oil are fairly cohesive in their view on the future of oil demand for petrochemicals, products, processes, buildings, power generation, and bunkers, see Figure 4. Biofuels as a portion of transport fuels are expected to rise slowly from 3% currently (e.g. IEA, 2015, pp121) to between 4% (Exxon, 2016, pp62; BP, 2016, pp22; RDS-OCE: Shell 2016, pp83) and over 7% (IEE-ADV: IEEJ, 2015, pp74; RDS-MOU: Shell, 2016, pp82). Outlooks show substantial uncertainty however, in their projections of future oil consumption by light and heavy duty vehicles.

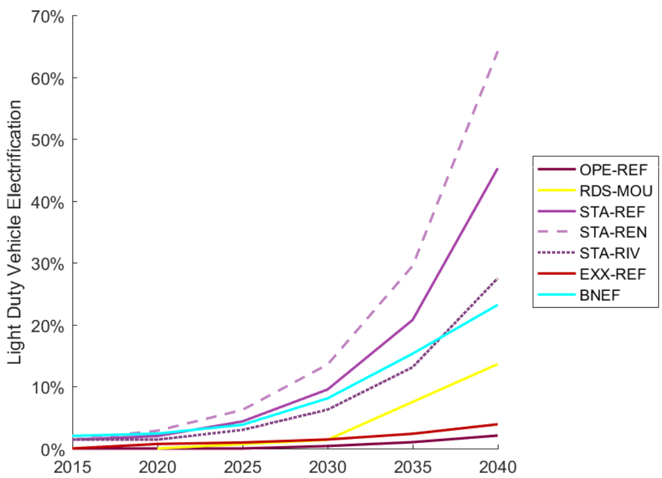
Figure 4: 2040 Oil Demand by Sector



*Bunker fuel consumption comingled with transport consumption for BP-REF

Light duty vehicles consumed approximately 21Mboe/d in 2015, 23% of global oil production (Cambridge Economics, Poyry, & ICCT, 2016). Plug-in hybrid- and battery electric vehicles (EVs) have the potential to substantially disrupt this demand segment. Figure 5 shows selected projections for the penetration of EVs into the global passenger light duty vehicle fleet.

Figure 5: Passenger Light Duty Vehicle Electrification[2]



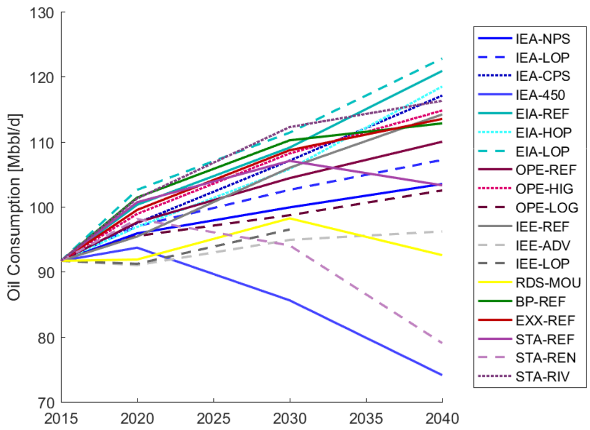
By 2040, Statoil (2016, pp28) projects new light duty vehicle sales will be over 67% EVs in *Reform,* 92% in *Renewal*, and 38% in *Rivalry*; Bloomberg New Energy Finance (BNEF) (2016) projects over 35% by 2040 for passenger vehicles. Exxon (2016, pp19) projects less than 10% new vehicle sales will be EVs. Bloomberg (Randall 2016) reports that at current adoption rates, uptake of electric vehicles could cause a 2Mboe/d oil glut by 2023 – the same scale of oil glut that caused the oil price to drop in 2014 (McCrakken 2016). BNEF's (2016) more conservative model displaces 2Mboe/d of oil demand by electric vehicles in 2028. Assuming rising asset-

[2] Methodology notes: i) projections for BNEF were calculated from a simple stock-depletion model based on US vehicle longevity statistics (NHTSA, 2006); ii) projections for Shell are for passenger-kms which is assumed to be equivalent to the proportional of electric vehicles

utilisation of EVs (e.g. by commercial fleets, car-share programmes, or autonomous taxis) BNEF projects that electric vehicles may displace over 12Mboe/d by 2040. McCrakken (2016) calculates this would add over 2,700 TWh of electricity demand, 11.2% of total generation in 2015. Cambridge Economics, Poyry, & ICCT (2016) report that efficiency improvements alone in light duty vehicles may reduce business-as-usual oil demand by 19 Mboe/d by 2050. The electrification of transport has potential to be a fundamental driver in oil oversupply in the coming decades.

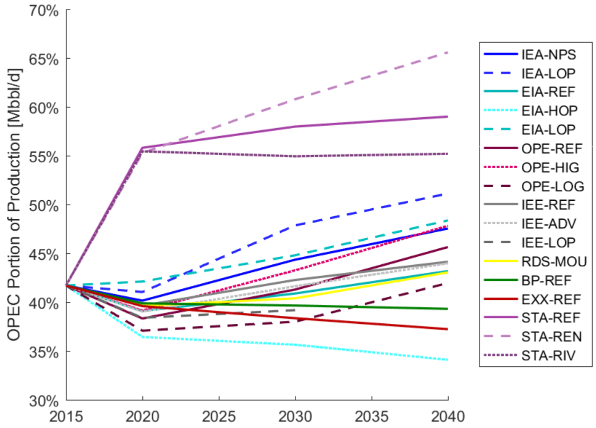
Energy outlooks show a wide range of oil production projections through 2040, see Figure 6. Most authors show at least an inflection in oil production between 2020 and 2040; others project peak oil production will occur during this period. The future of demand over this period is critical for oil and gas company capital planning – overinvestment will destroy value (e.g. CTI 2013; Varro, 2016); underinvestment will risk shareholder value for individual companies. 2DS-explicit scenarios (i.e. IEA-450 and STA-REN) project peak oil production earlier than other scenarios, closer to 2020 than 2030.

Figure 6: Oil Production Projections



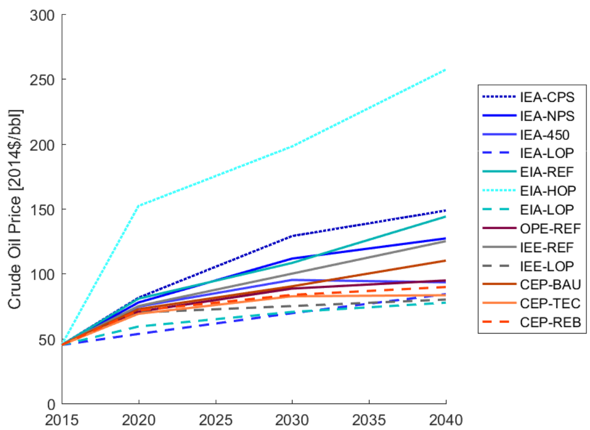
In late 2014, Saudi Arabia, controlling the strategic production of OPEC, blocked calls to reduce OPEC production, causing, among other reasons, a supply glut of at least 1Mbbl/d and the price of oil to halve in eight months (Raval 2015). As International Oil Companies have responded to a new paradigm of low prices, the future of which companies and countries will provide future production has become uncertain. In a period of prolonged low prices, OPEC's low-cost resource base may increase OPEC's share of production, reducing the total available market for international oil companies, see Figure 7. Low oil price scenarios and decarbonisation scenarios indicate that lower oil prices and enhanced decarbonisation efforts will lead to an increase in OPEC market share.

Figure 7: Portion of Future Oil Production by OPEC



A prolonged period of low oil prices will strand reserve assets at the high end of the cost curve (e.g. CTI, 2013). The fundamental drivers of the oil price are diverse and include global oil demand, supply behaviour by OPEC and non-OPEC actors, speculation and money manager hedging, inventories, technology changes (for example in US shale resources), shock events, and theories of exhaustible resources (e.g. Hotelling's Rule, Hubberd's Peak Theory)(Sheppard, 2016; EIA, 2016b; Fattouh, 2007). The recent drop in oil prices, and the potential of a more fundamental relationship between oil supply and prices has prompted several organisations to publish long-term projections of the oil price, see Figure 8. Figure 8 also includes projections from scenarios of Cambridge Economics, Poyry, & ICCT (2016): *Business as usual* (CEP-BAU), *Technical Potential* (CEP-TEC), and *Rebound* (CEP-REB).

Figure 8: Oil Price Projections

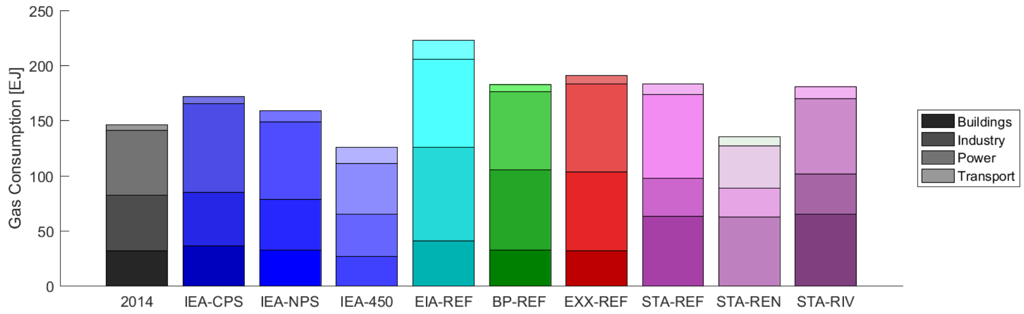


Low oil prices will continue to put pressure on the cash flow and debt coverage positions of IOCs. In February 2016 the ratings agency Standard&Poors reduced its corporate ratings for BP, Shell, Statoil, Total, and Chevron, among others (Mehta 2016). ExxonMobil, which has held a AAA rating since 1949, was downgraded in April 2016 (Gayathri 2016). Under low oil price scenarios, this pressure may continue though timescales on the order of decades – intersecting with decarbonisation time scales.

Gas Demand and LNG

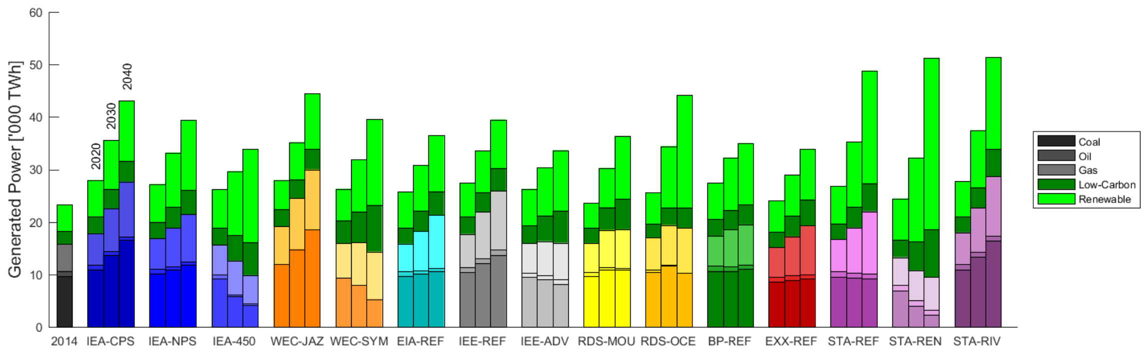
The future of gas demand is less certain still than the future of oil demand. Despite substantial optimism in the future of gas demand on the part of companies, natural gas has yet to prove that it is able to compete against nuclear, renewables, and coal-fired power for a position in global generating mix, and that its outlook is sufficiently stable to justify the necessary investments in import and export infrastructure (Mitchell 2016). Figure 9 shows projected gas demand by sector. Large differences in projections are driven by positive or negative growth in the use of gas for power generation.

Figure 9: Future Gas Demand by sector – 2040



Energy outlooks take different views on the decarbonisation of the global generating mix. While all project the growth of renewables, some also feature considerable roles for low-carbon (i.e. nuclear and fossil-CCS) power and gas-fired power. Figure 10 shows projections of the global generating mix for selected scenarios.

Figure 10: Electricity Generating Options



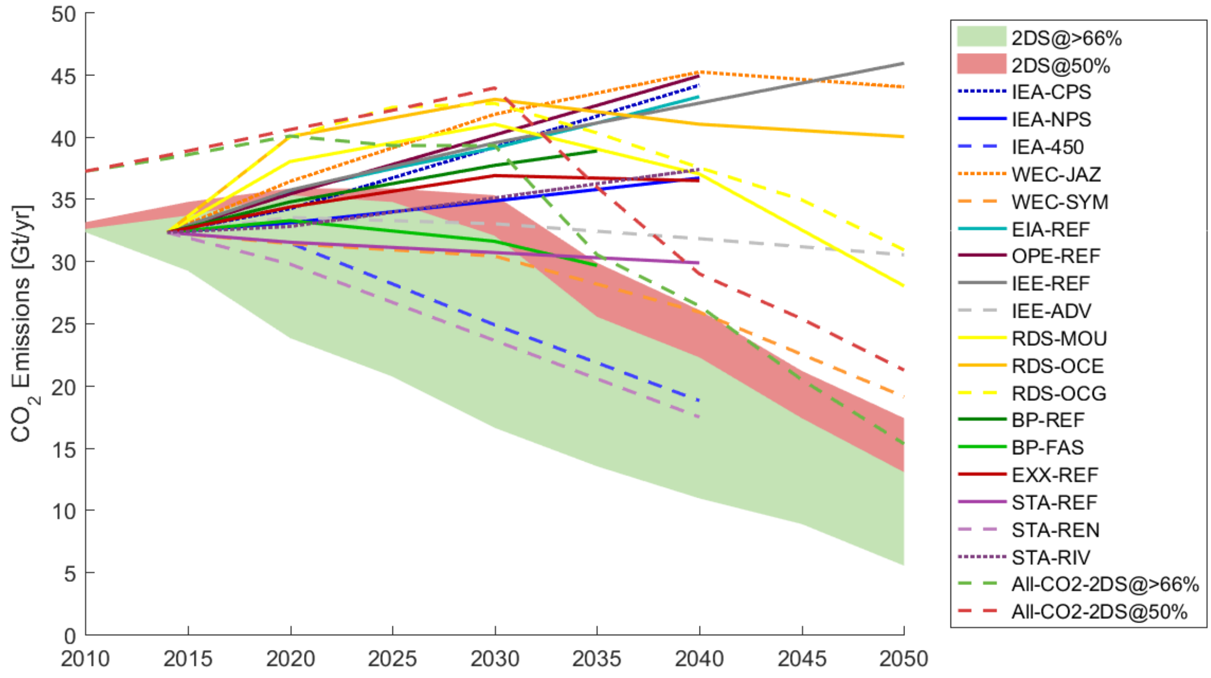
One of the barriers to the development of gas-fired power and the displacement of coal by gas in primary energy supply is the availability of gas import and export infrastructure. Particularly in developing countries with large and growing power demands, the lack of infrastructure prevents the realisation of the displacement of coal-fired baseload power with imported gas. Recent slowing of growth in southeast Asia and the fall in LNG prices commiserate with oil prices has dampened prospects for global LNG projects. Of 26 planned liquification plants, 10 have been cancelled or suspended, as well as 26 of 45 global planned regasification terminals (Global LNG Ltd, 2016). In 2015, global natural gas liquefaction utilisation was 84% (IGU, 2016) and the global LNG market is expected to be oversupplied through 2024 (Dalpane, & Walker, 2016). New sulphur emission control regulations from the International Maritime Organisation could potentially shift demand for bunker oil to LNG in the 2020s (McGrail, 2014).

Carbon Dioxide Emissions

Many of the energy outlooks project rising greenhouse gas emissions in excess of the limit which would give about an equal chance of constraining warming to 2°C. While the global Paris Agreement (2015) calls for "holding the increase … to well below 2°C" with a stretch target of 1.5°C, many of the central energy outlook scenarios still project emissions to exceed this limit. Some of the outlooks (e.g. of the IEA, OPEC, IEEJ, WEC, and Shell) were published before COP21 and the Paris Agreement remains to be ratified. Current INDC commitments would limit warming to 2.7°C (Mitchell & Mitchell 2016) and it will be up to governments to 'rachet up' their policy efforts to accomplish 2°C warming or less. Current outlooks are not optimistic about the ability of governments to do so.

Figure 11 shows carbon dioxide emissions for selected scenarios, including Shell's Oceans – Clean & Green (RDS-OCG). For IEE-REF, IEE-ADV, and EXX-REF, carbon dioxide emissions are explicitly limited to the energy system. For the remaining scenarios, it is unclear whether emissions projected include all CO_2 emissions or are also limited to emissions from the energy system. Figure 11 therefore includes both the energy system CO_2 emissions limit for achieving a 2-degree warming target by the end of the century and the total CO_2 emissions limit. The limits for both 'likely' (i.e. >66% likelihood) and 'as-likely-as-not' (i.e. 50%) achievement of a 2-degree warming limit (see IPCC 2014, Table 6.3) are shown for both the energy system (IPCC 2014, Figure 6.7) and for all CO_2 emissions (IPCC 2014, Figure 7.9).

Figure 11: CO_2 Emissions for Selected Scenarios



Almost all selected scenarios exceed 2°C-warming limits, let alone 1.5°C-warming limits. It should also be noted that all emissions constraints include substantial range of net-negative emissions by the end of the century, up to 15.8 Gt/yr in the most extreme case (IPCC 2014, Figure 6.7; IPCC 2014, Figure 7.9).

Discussion

That many scenarios show scepticism of even a 2°C-warming constraint should be a cause for concern. A 2°C-warming constraint imposes significant change on the operating models and therefore the business models of fossil fuel extractive companies by fundamentally destroying demand for fossil fuel products (e.g. McGlade & Ekins 2015, Varro 2016). While there are investment needs for non-OPEC oil and gas in the near- and mid-term (e.g. Varro 2016; Cambridge Economics, Poyry, & ICCT 2016), oil and gas must enter structural decline in order to meet 2°C-warming constraints. Figure 6 through 8 collect evidence to show that scenarios with carbon constraints also project lower oil prices and increased OPEC market share. Therefore companies and their investors must take steps to be resilient to the changes ahead – and policy makers must consider how best to facilitate an orderly transition, avoiding where possible excessive financial and economic shocks caused by the permanent destruction of capital through asset stranding.

With peak coal demand potentially passed, peak oil demand potentially in the near- to medium-future, and uncertain gas demand, the transition to renewable energy may be occurring much faster than most business-as-usual or central scenarios project. Year-on-year revisions, for example by BP (2016, pp64) and the IEA (2011; 2012; 2013; 2014) indicate that energy outlooks have been transitioning away from carbon-heavy fuels towards renewable energy. Figure 12 shows the change in projections for solar PV and wind generating capacity and CO_2 emissions of successive IEA publications of the *World Energy Outlook* (WEO) for years 2011 through 2015. In all three scenarios, projected solar PV generating capacity is increased dramatically in each successive publication. Wind capacity projections are also increased, particularly for IEA-CPS and IEA-NPS. Despite these increases, hardly any change is seen for CO_2 emissions projections, with the exception of the difference between WEO2015 and WEO2014: 2020-CPS emissions were projected in WEO2015 at the level of 2020-NPS emission projections of prior years.

Figure 12a: Change in IEA solar capacity projection

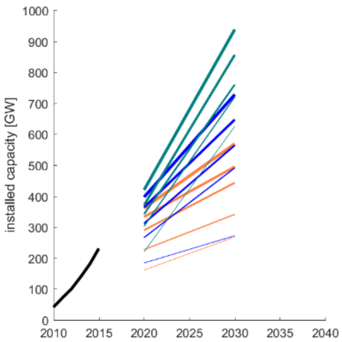


Figure 12b: Change in IEA wind capacity projection

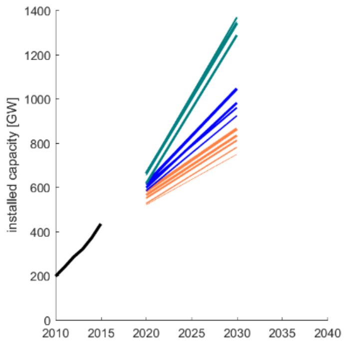


Figure 12c: Change in IEA CO_2 emission projection

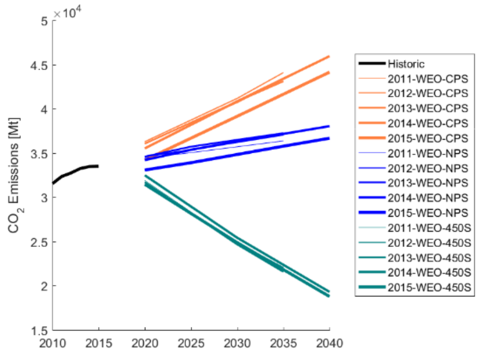
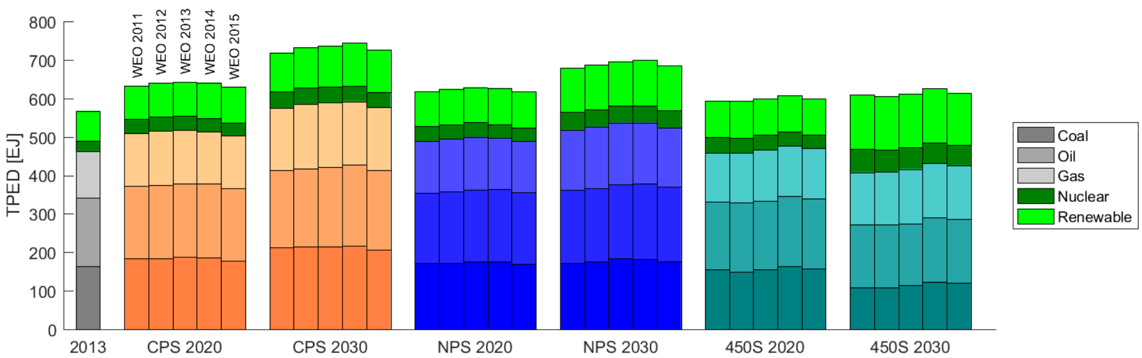


Figure 13 compares the successive projections of total primary energy demand in 2020 and 2030 to identify the 'direction of travel' of energy outlooks. With a single exception, the outlook for nuclear primary energy has decreased every year and in all scenarios. Outlooks for 2020 renewable energy demand have converged over time, however the CPS-WEO2015 outlook for renewable energy has now overtaken the NPS-WEO2011 outlook for the same, and is approaching the 450S-WEO2011 outlook, indicating growing confidence in the continued growth of renewables. Projections for all of gas, oil, and coal grew, peaked, then declined in previous energy outlooks, with a particular reduction of coal projections in the 2015WEO. The IEA's *World Energy Outlook 2016*, the first since COP21 and the Paris Agreement, is expected in November 2016 (IEA 2016a) and will offer a view on how the Paris Agreement may affect future energy demand.

Figure 13: Change in IEA scenario TPED projections



The IEA's World Energy Outlook has been published since the 1970s (IEA 2016b). Other organisations began publishing outlooks more recently, for example Shell (2016) in the 1990s and BP (2016c) in 2011. The emergence of multiple energy models and outlooks represented a change in paradigm from a single, centralised information authority and aggregator to many organisations signalling their view on what the future of the energy system will be. The importance of these outlooks has grown considerably since the implications of the 1.5°C/2°C global warming constraint have become clear.

This constraint increases the strategic importance of these outlooks for companies, investors, policy makers, and other stakeholders. For corporate authors, a conflict of interest arises between the impartiality of outlook projections and corporate strategy and positioning. Corporate authors may also use in-house outlooks to refute the outlooks of third-party organisations in dialogue with company stakeholders. Despite these agency challenges, the diversity of outlooks now available is useful for stakeholders seeking to navigate the energy transition and develop credible proposals of how the transition may be executed smoothly. Among corporate authors, energy outlooks remain a critical tool for communicating management's beliefs about the future of the energy system to investors, potential bias notwithstanding.

Practical recommendations for improving energy outlooks include: unit conversions and standardisation where appropriate (for example, it is unclear where 'passenger-km' technology diffusion is necessarily equal to 'passenger light duty vehicle' technology diffusion); multiple scenarios and the uncertainties of each; the publication of an accessible data appendix with full coverage of all scenarios; standardised or better-defined measurement boundaries (for example, some outlooks have 'road transport' as a sector for oil demand, which is not explicitly the same as the 'light and heavy duty vehicle' segment of other outlooks); standardised or better-defined regional definitions (for example, the combination of OECD-Europe, OECD-North America, and OECD-Pacific excludes Chile, which is an OECD country); and the publication of model documentation. Future energy outlooks may include publicly published models with user interactivity and extensive model documentation with peer review. In navigating the uncertainty of the energy transition, it is no longer the detail level alone of outlooks which defines their usefulness – it is their transparency, how well they measure and communicate the inherent uncertainty of the future, and how well they enable dialogue between investors, companies, and other stakeholders.

Conclusion

Energy outlooks, scenarios, projections, and models play a critical role in communicating the uncertain future of the energy system and in enabling the assessment of risk exposure in fossil-fuel extractive companies. Even at the upper bound of a2^{o}C warming constraint, projections show uncertain gas demand, peaking oil demand and prices, and increasing proportion of oil production by OPEC. Changes in the annual projections of the IEA show progress towards a2^{o}C-warming constrained scenario implying substantial consequences for the operating models and therefore business models of fossil-fuel extractive companies. Most projections of the energy system, however, show emissions exceeding 2^{o}C-warming limits by 2030 – indicating a significant gap between policy making signals and the views of outlook authors. More transparent outlooks, projections, and models will enable companies, investors, and other stakeholders to better work together to deliver an orderly transition to a sustainable energy system.

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