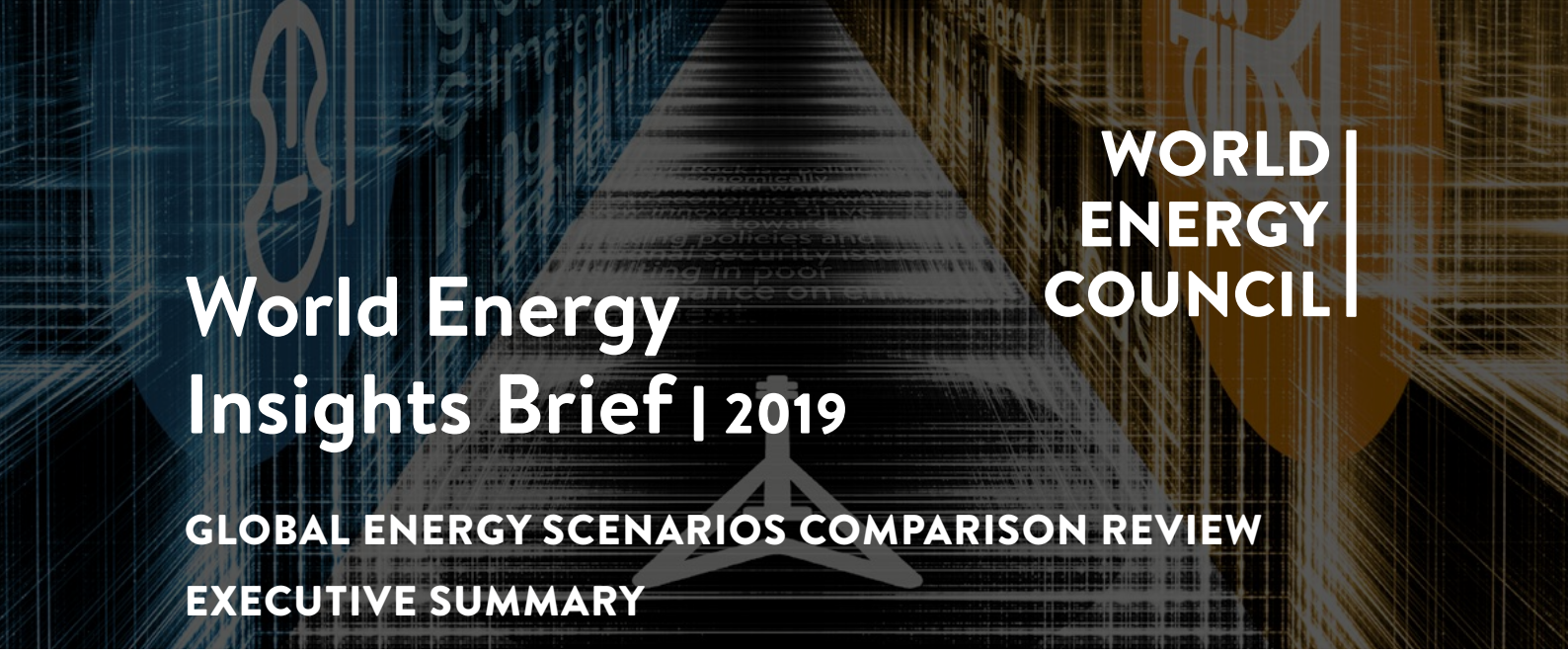

World Energy Insights Brief | 2019

GLOBAL ENERGY SCENARIOS COMPARISON REVIEW

EXECUTIVE SUMMARY

Are global energy scenarios achieving their potential for unlocking new energy futures? Do they support users in accelerating successful energy transition?

STAKES FOR MODERN ENERGY TRANSITION COULD NOT BE HIGHER

Energy is ubiquitous and embedded into every aspect of modern life. Energy transition of the magnitude required to meet the increasing environmental threats of climate change is an unprecedented and immeasurably complex challenge. It is unfolding within a new digital economy, with its disruptions, including significant job losses. This transition can be triggered by crisis or enabled by innovation and accelerated by new forms of flexible cooperation. Energy transition cannot be achieved all at once or by any one actor.

Relying only on better energy modelling and forecasting to guide successful transition will be fatal, even in a data-rich era. In today's volatile context of faster and fundamental changes in how people live, work, trade, and relate, neither short-to-medium supply-and-demand projections, better price forecasting, nor long-term energy modelling are enough. Instead a new leadership approach is required, one that learns with alternative futures and combines top-down, bigger-picture strategic thinking with bottom-up, agile, and adaptive innovation.

As part of its core mission, the World Energy Council (the 'Council') employs a multi-stakeholder engagement process to develop actionable, technology- and resource-neutral global energy scenarios. World Energy Scenarios are one of the five tools in the Council's new **Energy Transition Toolkit.** These scenarios help our diverse global community of members and users to engage constructively with uncertainties in energy systems developments, to be better prepared for, and collaborate in delivering successful energy transition.

HOW DO DIFFERENT TYPES OF GLOBAL ENERGY SCENARIOS COMPARE?

In anticipation of the 24th World Energy Congress, which will convene over 6,000 energy leaders in Abu Dhabi in September 2019, the Council has embarked on a global energy foresight stocktake and refresh. As a part of this project, it has undertaken a **comparison of the assumptions, narratives, and numbers found in a peer group of global energy scenarios of interest to Council members.** The comparative scenarios review has also been analysed in relation to the Council's ongoing horizon-scanning processes, including its annual Issues Monitor as well as interviews and dialogues with international energy leaders amassed throughout 2018.

In this study, the Council distinguishes three main approaches that commonly use the term 'scenario':

- **Plausible scenarios** are generally explicit about societal and political elements in addition to techno-economic elements. Plausible scenarios describe new and alternative energy futures that are already emerging and that are shaped by factors beyond the direct control and influence of any one system actor. An example is the Council's World Energy Scenarios 2060, published in 2016 ('WES2016')

- **Outlooks** tend to focus on techno-economic elements. These evidence-based projections aim to establish a baseline that can be used to evaluate the costs and benefits of additional and/or new policy options. An example is the IEA's Current Policies scenario. Outlooks are also commonly referred to as conditional projections, baseline scenarios, or policy scenarios

- **Normative scenarios** focus on achieving a specific goal aligned to a global vision agenda – for example, avoiding catastrophic climate change (UN FCCC Agenda) or achieving universal development (UNSDG Agenda). These goal-based pathways are developed by back-casting to inform detailed technology and policy roadmaps. An example is the Shell Sky scenario

By benchmarking against peer studies and refreshing its global horizon scanning, the Council's comparative review has validated the continued relevance, plausibility, and challenges of its existing archetypal framework and the benefits of continuing to work with the plausibility-based, narrative-led methodology in maintaining openness to new developments.

Moreover, the comparison of different types of global energy scenarios has helped identify some important gaps in bridging the flexibility of the narrative-led, plausibility-based approach with the rigidity of long-term global energy systems models.

WHAT DID WE LEARN ABOUT GLOBAL ENERGY SCENARIOS?

1 **ALL SCENARIOS ARE GRAPPLING WITH COMPLEXITY:** energy systems are diverse, dynamic, and adaptive, and the evolution of supply is increasingly driven by changes in demand and developments beyond the energy sector. Similar to other plausibility-based scenarios, WES2016 reflects a wide set of drivers of change (technological, economic, political, and social developments) and highlights six future developments: (1) a slow-down in global energy demand growth; (2) an accelerating pace of electrification, (3) including end use; increasing diversity of global energy mix; (4) global demand peaks for coal and oil; (5) an increasing medium term role for gas; (6) and an increasing share of renewables in the global energy mix.

2 **THERE IS A COMMON ASSUMPTION OF ACCELERATING DIGITALISATION** that enhances energy efficiency in most scenarios. However, the question of **whether digital productivity will increase overall long-term energy demand or not** remains unanswered and uncertain. The wider implications of the energy-information nexus are still emerging and include cyber security challenges and new opportunities in digital design, manufacturing, distribution, and maintenance.

3 **EVEN THOUGH THE NEW GEOPOLITICS OF ENERGY NO LONGER PIVOT ON OIL, SHIFTS IN GEOPOLITICS ARE NOT EXPLORED** in many global energy scenarios. The WES2016 scenarios are notable in that they seek to challenge techno-optimism associated with the digital productivity revolution and market liberalism. Thus, they are well designed for exploring the implications for energy transition of a new era of geopolitics of energy shaped by technology, climate change, non-energy resources, and shifts in trade.

4 **NEW AND EMERGING SOCIAL, BEHAVIOURAL, AND ENVIRONMENTAL FEEDBACK LOOPS ARE EASY TO IMAGINE BUT DIFFICULT TO REFLECT IN NUMBERS.** The WES2016 narrative framework is well suited to addressing the emergence of new people power, as well as the role of social cohesion and trust as enablers or constraints on the speed and success of global energy transition. Key challenges remain in quantifying energy narratives that reflect increasing social complexity and new and faster-moving social realities. This can include disruption in energy demand due to new consumer logics, shifting social norms (e.g., travel avoidance in a new mobility paradigm), and behaviours of rapidly aging and depopulating societies. More work is needed, however, to include environmental feedback loops, including implications of climate impacts and adaptation strategies.

5 **THE ECONOMICS OF ENERGY TRANSITION USED IN LONG-TERM ENERGY SCENARIOS MODELLING IS OUT OF TOUCH** with the realities of non-linear energy systems transition. Key economic assumptions include: (1) marginal costs of new energy supply based on historical technology costs curves; (2) links between price of oil and economic growth weaken; (3) the cost of carbon, which is not the only sustainability issue; and, (4) linear discount rates, which overlook social costs and discount rates. For example, the rise of renewables in power generation and transport is assumed on the basis of marginal costs of supply, which are informed by historical technology cost curves. However, the speed of electrification and scalability of distributed and intermittent renewable energy supply is limited by wider factors, such as market design, development of new storage pathways, new data integration, and cyber security challenges, which are either not considered or

not made explicit. Whilst decarbonisation pivots on the price of carbon, the costs of whole energy systems transition include wider sustainability challenges (e.g., global water stress and climate change impacts and adaptation), social benefits (e.g., job losses), and increased system resiliency.

6 **ALL GLOBAL ENERGY SCENARIOS HIGHLIGHT THE ROLE OF MORE INTERNATIONALLY COORDINATED ACTION,** aligned across global to local scales, and supported by agile regulatory frameworks in creating pathways for successful transition. However, whilst the WES2016 make the choice of policy instruments explicit, these and other scenarios do not adequately explore the implications of new approaches to governance in energy systems transition. Clearly, a false dichotomy between states vs. markets is evident in many global energy scenarios. Also, these scenarios seldom mention the rise in global influence of non-territorial networks and non-state actors/new people power.

7 **THERE ARE BIG DIFFERENCES IN ASSUMPTIONS ABOUT DEMAND** between the different types of global energy futures. Generally, outlooks foresee a continuous rise in energy demand that is much higher than what climate targets would prescribe. In the plausibility space, the WES2016 scenarios are on the lower side of demand increases but still do not achieve climate targets. Overall demand is maintained at a steady level (ca. 14 Gtoe/year) in the normative scenarios category. Scenarios with lower demand reflect assumptions about: the slowdown in global population growth; rapid urbanisation in new economies; female education; rapid efficiency gains enabled by electrification of transports and cooking; and recycling in industry.

8 **NORMATIVE SCENARIOS ASSUME SIGNIFICANTLY HIGHER LEVELS OF INVESTMENT** in energy/clean energy infrastructures to achieve goals. Total investment costs in infrastructure and energy transition are not detailed in the majority of scenarios, despite significant uncertainties about closing the trillion-dollar gap in energy investments. The role of financial innovation (e.g., decentralised finance and green finance mechanisms) is not explored in plausibility scenarios, including the WES2016.

THE BENEFITS OF A FRESH FOCUS ON SYSTEMS INNOVATION

It is clear that while a successful global energy transition involves more than accelerating decarbonisation, many global energy scenarios are narrowly focussed on climate mitigation pathways. Alternative stories of new energy futures are emerging in a fast and fundamentally shifting context. Success depends on enabling many and more diverse actors within and beyond the energy system to engage in new collaborative innovation opportunities.

The broader landscape of innovation, with its uneven pace and disruptive potential, has emerged as a critical uncertainty and significant feedback loop in managing successful global energy transitions. However, the conceptualisation of disruptive innovation and the modelling of impacts are challenging. Energy leaders need to redirect their attention to the fuller contours of the energy-information nexus, including energy innovations coming from adjacent sectors, the role of finance, the emergence of new consumer logics, and shifting societal needs.

The Council is refocusing its long-term energy scenarios storylines to dig deeper into disruptive innovations coming from beyond, not just within, the energy system and utilities.

A new set of global scenario storylines are in development for launch at the 24th Abu Dhabi World Energy Congress. These storylines aim to better prepare energy leaders and their organisations to realise new, exponential growth opportunities even with the inevitable disruptions created by the new combinations of innovation accelerators (technological, economic, social, and regulatory) that are already emerging within and beyond the energy system.

MOVING BEYOND SCENARIO REPORTS TO ACTIONABLE INSIGHTS AND IMPACT

The Council also recognises that building actionable global energy scenarios and putting them to effective use is far from straightforward.

Finding ways to better use global scenarios often involves facilitating successful energy transition in response to global and national visions, which are not just about energy. We support our members to make use of our World Energy Scenarios as a platform for leadership dialogue to forge new common ground and catalyse and sustain collaborative innovation.

Benefits reported by energy leaders in using the Council's energy scenarios, include help in:

- harnessing a truly global technology-and resource-neutral energy foresight platform that engages with the common interests of more diverse energy businesses and policy makers.
- maintaining action on decarbonisation without becoming blindsided by a single-issue focus.
- anticipating new feedback loops and learning about systemic risks, resiliency, and nexus issues.
- balancing attention to demand destruction and evolution of supply.
- exploring new interactions between top-down and bottom-up innovation.

To meet the new challenges of delivering energy for prosperity and enabling the benefits of sustainable energy to be shared by all, the Council is **investing in scenarios-application tools and immersive learning experiences** that engage new visions of global energy futures while avoiding the trap of wishful thinking.

With its **global energy scenarios as part of its new Energy Transition Toolkit,** the Council aims to support its members and energy transition stakeholders more broadly in working together to enable and manage successful global energy transition

ABOUT THIS BRIEF

In anticipation of the 24th World Energy Congress, the World Energy Council is refreshing its global energy foresight and updating its global scenarios narratives. The focus is on an 'innovation twist to 2040' and the use of scenarios to explore and navigate new exponential growth opportunities for accelerating successful energy transition in an era of disruptive innovation.

As a part of the refresh, the Council has conducted a comparison study of global energy scenarios in order to test the continued plausibility, relevance and challenge of its own existing scenario set, the World Energy Scenarios 2016, which were launched at the 23rd World Energy Congress in 2016, and explore three alternative and plausible pathways to 2060. The Council is grateful for the support of its scenarios partners Accenture Strategy and The Paul Scherrer Institute.

By comparing the methods, narratives and assumptions of peer global energy futures initiatives and studies, the Council seeks to provide our members with clearer understanding and new insights on energy transition while preparing them to better engage with leadership dialogues which pivot on visions of a new energy future. The review also provides an opportunity to reflect on the challenges and obstacles for utilising global energy scenarios to drive impact, and the challenges in bridging agile and flexible qualitative storytelling with long term, quantitative energy modelling.

ABOUT THE WORLD ENERGY COUNCIL

The World Energy Council is the principal impartial network of energy leaders and practitioners promoting an affordable, stable and environmentally sensitive energy system for the greatest benefit of all.

Formed in 1923, the Council is the UN-accredited global energy body, representing the entire energy spectrum, with over 6,000 member organisations in over 90 countries, drawn from governments, private and state corporations, academia, NGOs and energy stakeholders.

We inform global, regional and national energy strategies by hosting high-level events including the World Energy Congress and publishing authoritative studies, and work through our extensive member network to facilitate the world's energy policy dialogue.

Further details at **www.worldenergy.org** and **@WECouncil**

The full report can be found at **www.worldenergy.org/publications**

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