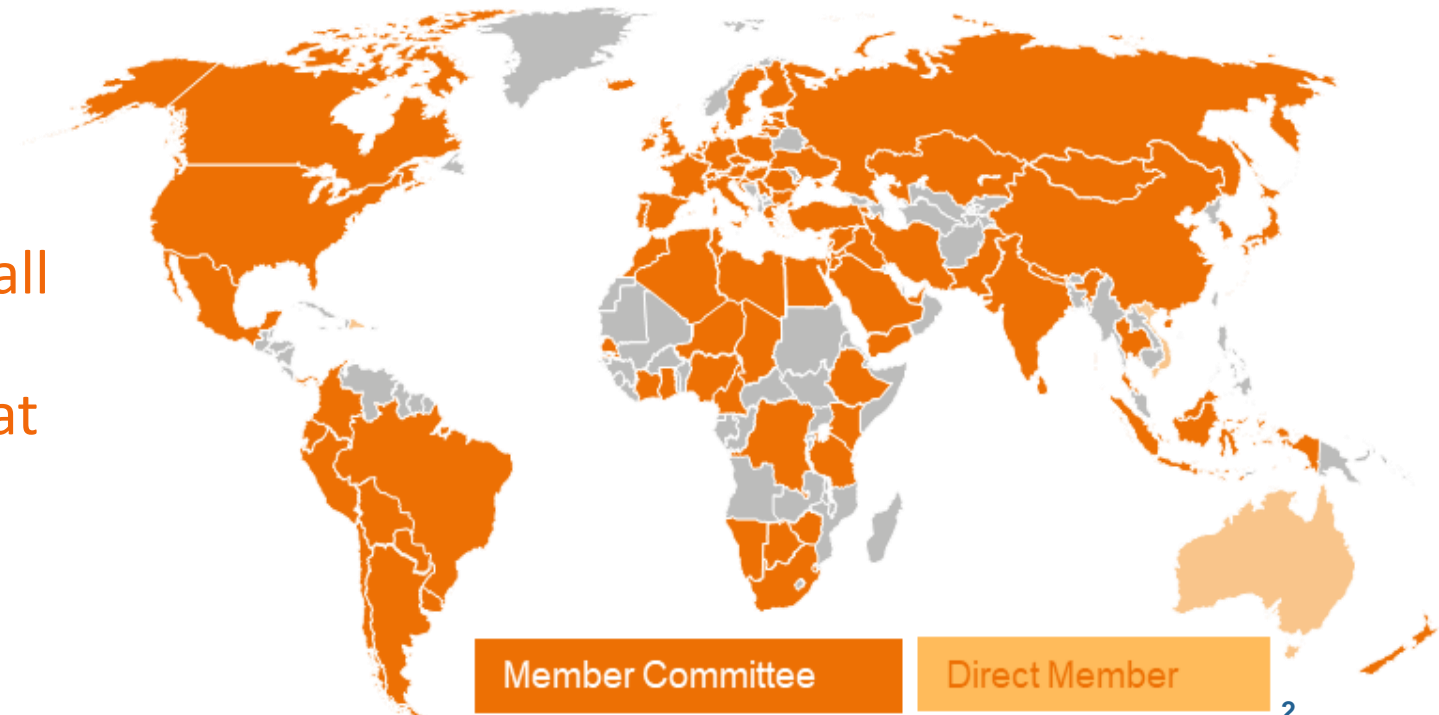




**GRAND TRANSITION, DIGITAL REVOLUTION
& NEW ENERGY REALITIES**

About The World Energy Council

- A registered charity, established in **1923**
- The only **truly global** energy organisation – UN accredited
- An **impartial platform** engaging experts **across the whole energy system and beyond**
- **Promoting robust energy transition**
 - to achieve more secure, affordable and clean energy for all
 - as a foundation to deliver SDGs at large



Balancing the 'Energy Trilemma'

Energy Security

The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand.

Energy Equity

Accessibility and affordability of energy supply across the population.

Environmental Sustainability

Encompasses the achievement of supply and demand side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.



ENERGY
EQUITY



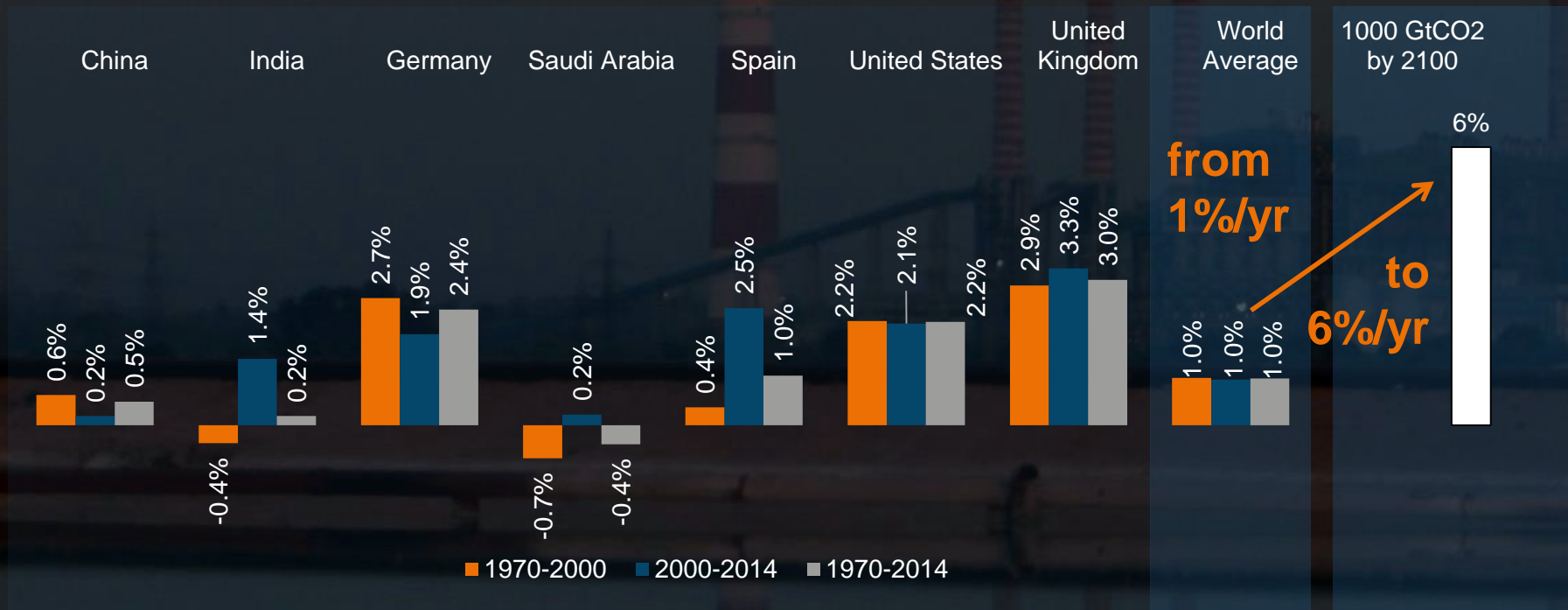
ENERGY
SECURITY



ENVIRONMENTAL
SUSTAINABILITY

Carbon Intensity Reduction 1970-2015

% reduction p.a. 1970-2015
Actuals

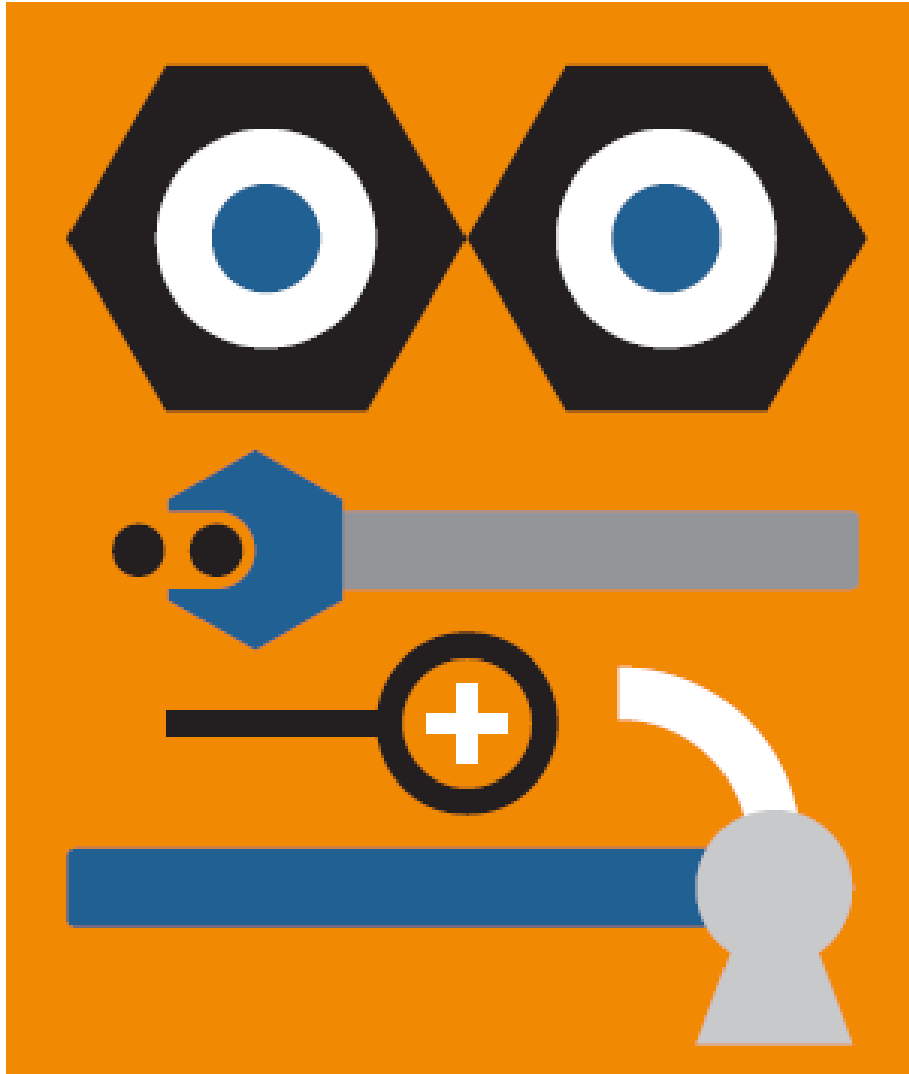


Source: Total Economy Database, BP (2015) Statistical Review, IPCC (2015) "AR5, Synthesis Report";
Note: Positive % changes denote a reduction in CO₂ emissions [Gt] per GDP [USD]

Note: Assumes global GDP growth of 2.6%

Enable Successful Transition Using Our Tools

Developed with and for use by our members



World Energy Issues Monitor: reality check - global, regional, national energy perspective on energy transition challenges



World Energy Scenarios: engage uncertainty as opportunity - global-, regional- and thematic-focused energy futures frames



Energy Policy Trilemma: policy pathfinding to balance security, equity & sustainability performance



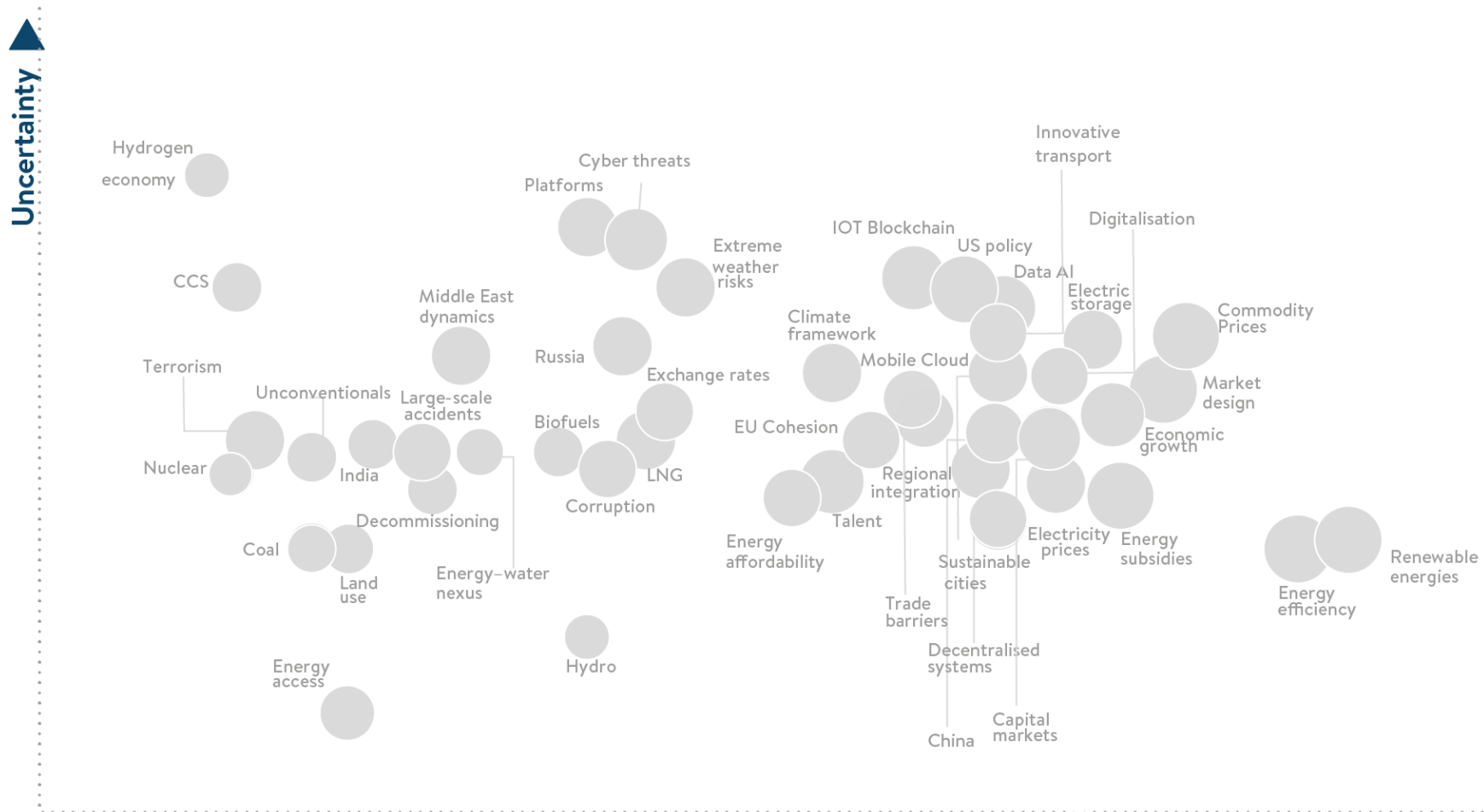
Innovation Insights: moving innovation from margins to mainstream & digging deeper into wide and fast shifting landscape



Dynamic Resilience: better prepared for emerging and systemic risks



What is the Issues Monitor



World Energy Issues Monitor 2019 - Global - 42 Issues

Impact ►

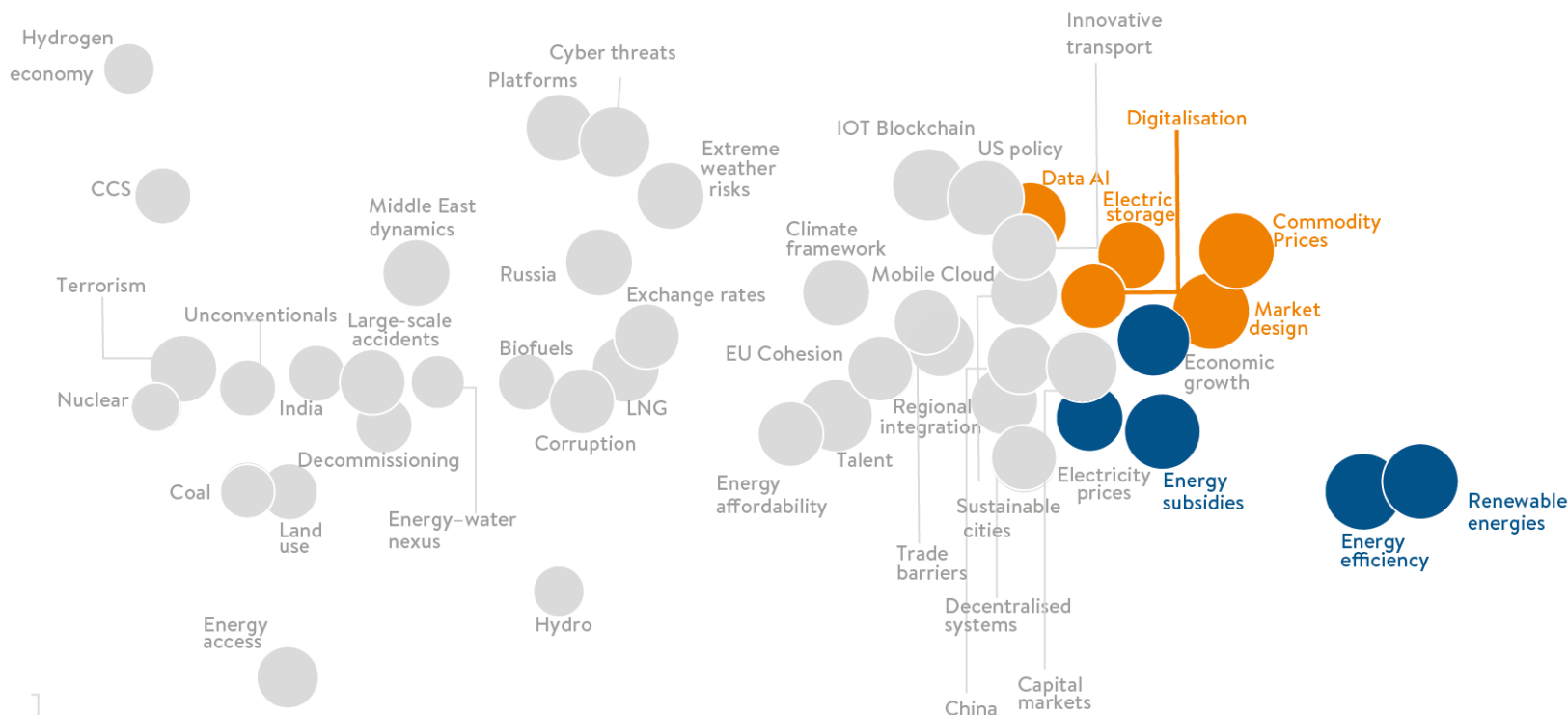
Less urgent More urgent

- The Issues Monitor **assesses 42 issues** in a high-level overview, covering four categories:
 1. Macroeconomic Risks
 2. Geopolitics
 3. Business Environment
 4. Energy Vision & Tech
- The responses are translated into three assessed dimensions:
 1. Impact (x axis)
 2. Uncertainty (y axis)
 3. Urgency (size of bubble)



Issues Monitor - Global Trends

Uncertainty ▲



- Similar picture to last year: **Consolidation of energy transition trends** with high emphasis on renewables and energy efficiency

World Energy Issues Monitor 2019 - Global

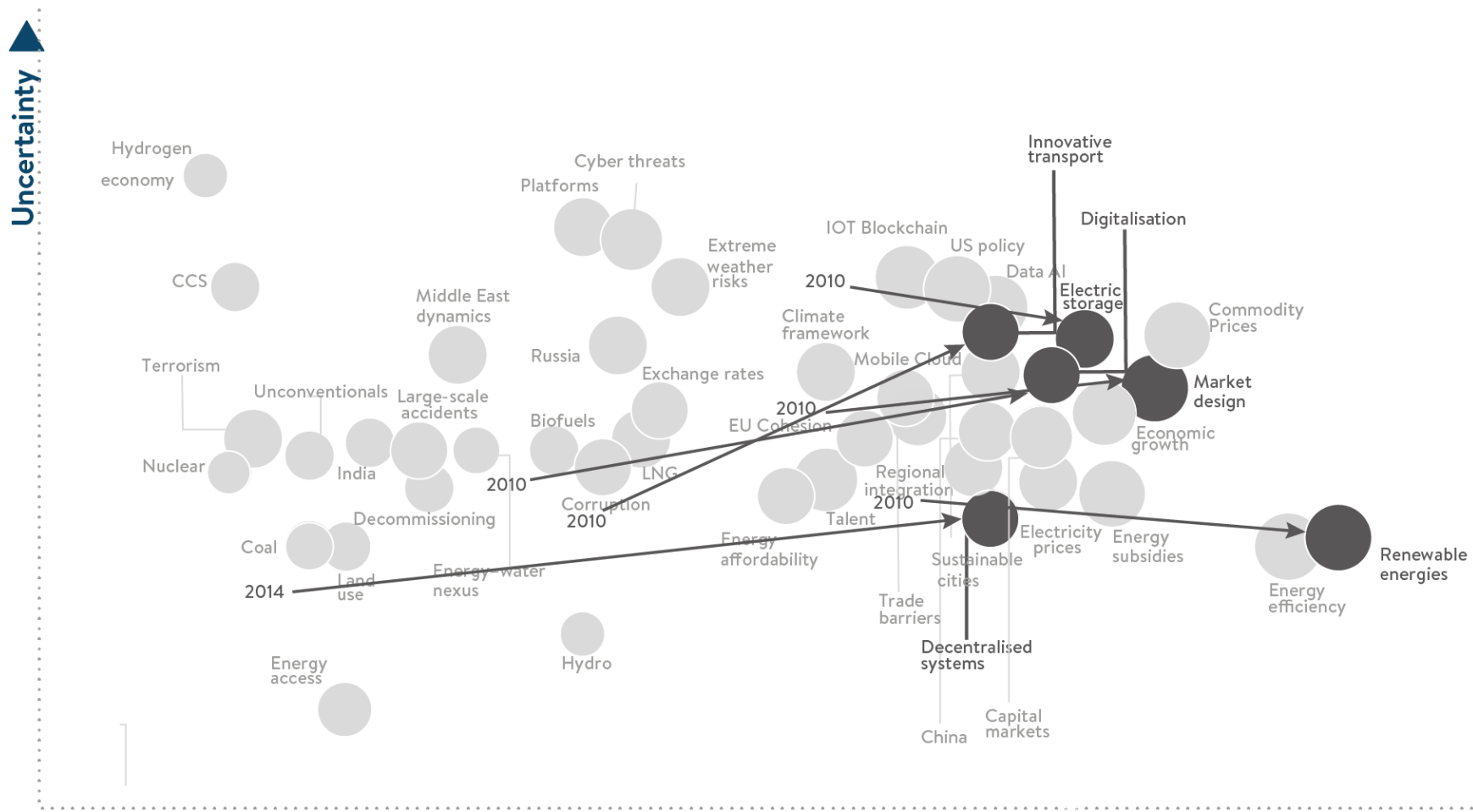
Impact ►

- Critical uncertainties: what keeps energy leaders awake at night
- Action priorities: what keeps energy leaders busy at work





Tracking Innovation since 2010



- Technology innovation clusters of **renewable energies, electric storage, & innovative transport** are moving up.
- This technology push is going hand in hand with **innovation in new market designs and decentralised systems.**

World Energy Issues Monitor 2019 - Global - Innovation

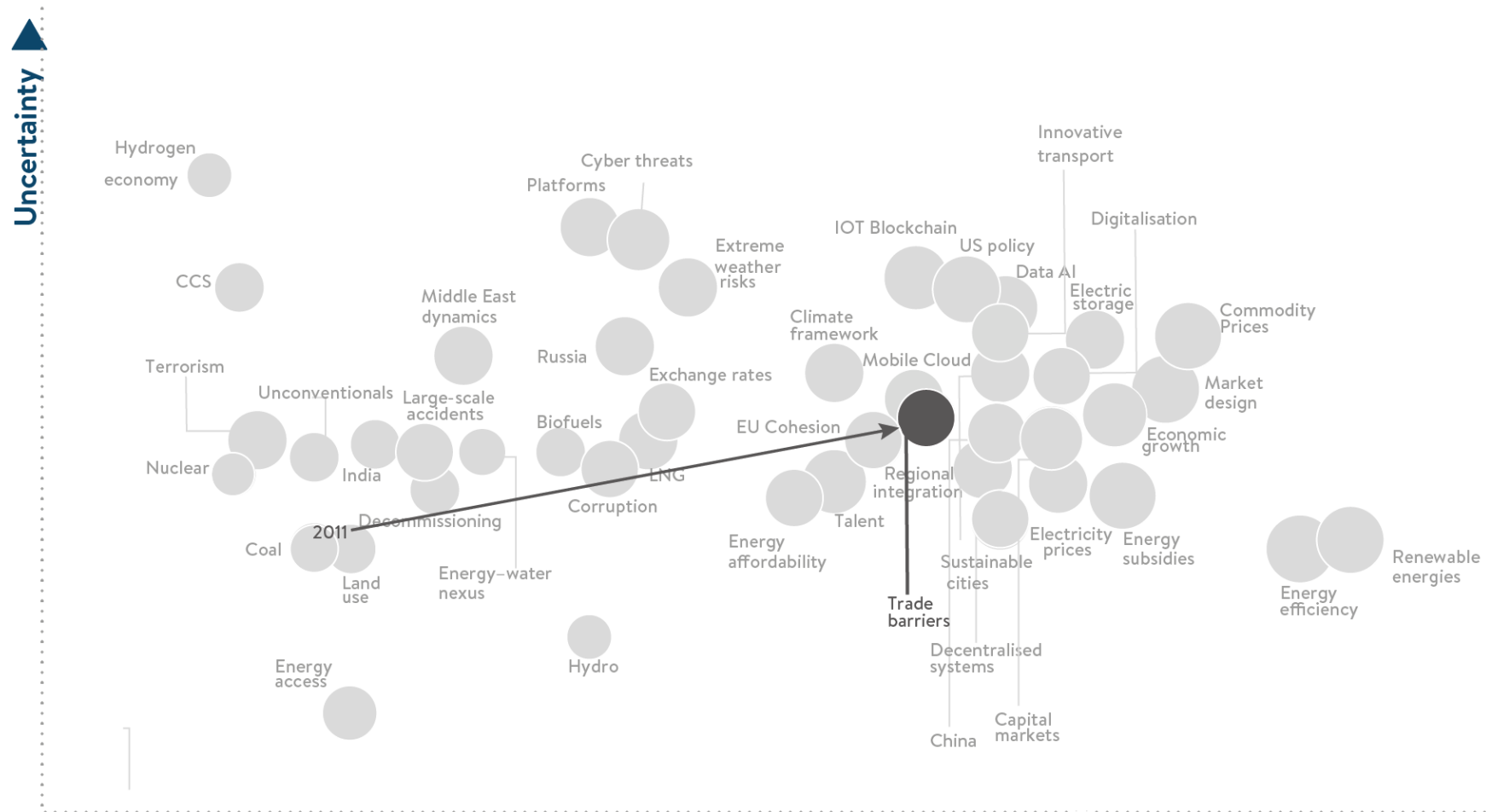
Impact ►

● Timetracking of select issues from 2010 to 2018

Less urgent ○ ○ ○ More urgent



Tracking Trade Barriers since 2010



- **Trade barriers** defined as constraining or enabling green growth (e.g. through technology transfer, tariffs on green goods and services, local content requirements, border tax adjustment) **is on significant upwards move since 2011.**

World Energy Issues Monitor 2019 - Global - Trade

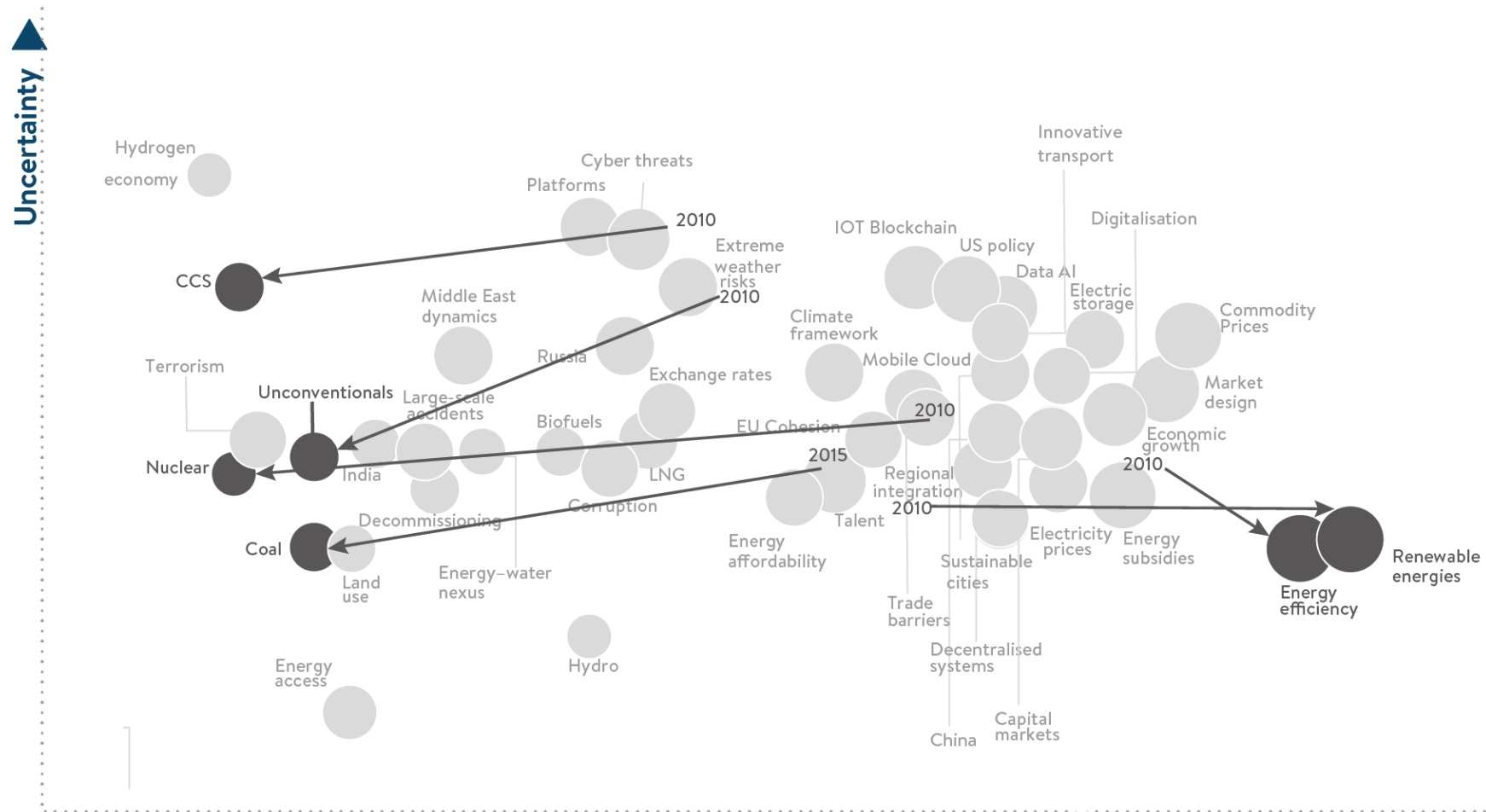
Impact ►

● Timetracking of select issues from 2010 to 2018

Less urgent ○ ○ ○ More urgent



Tracking Centralised issues since 2010



- Traditional baseload generation (i.e. coal, nuclear, etc.) are all very present in the global fuel mix now and in future projections, but **decentralisation** continues its push.
- **Renewable energy and energy efficiency** goals are keeping most countries busy.

World Energy Issues Monitor 2019 - Global - Decentralisation

Impact ►

● Timetracking of select issues from 2010 to 2018

Less urgent ○ ○ ○ More urgent



INSIGHTS: Energy Trilemma Index

Pathways to energy access

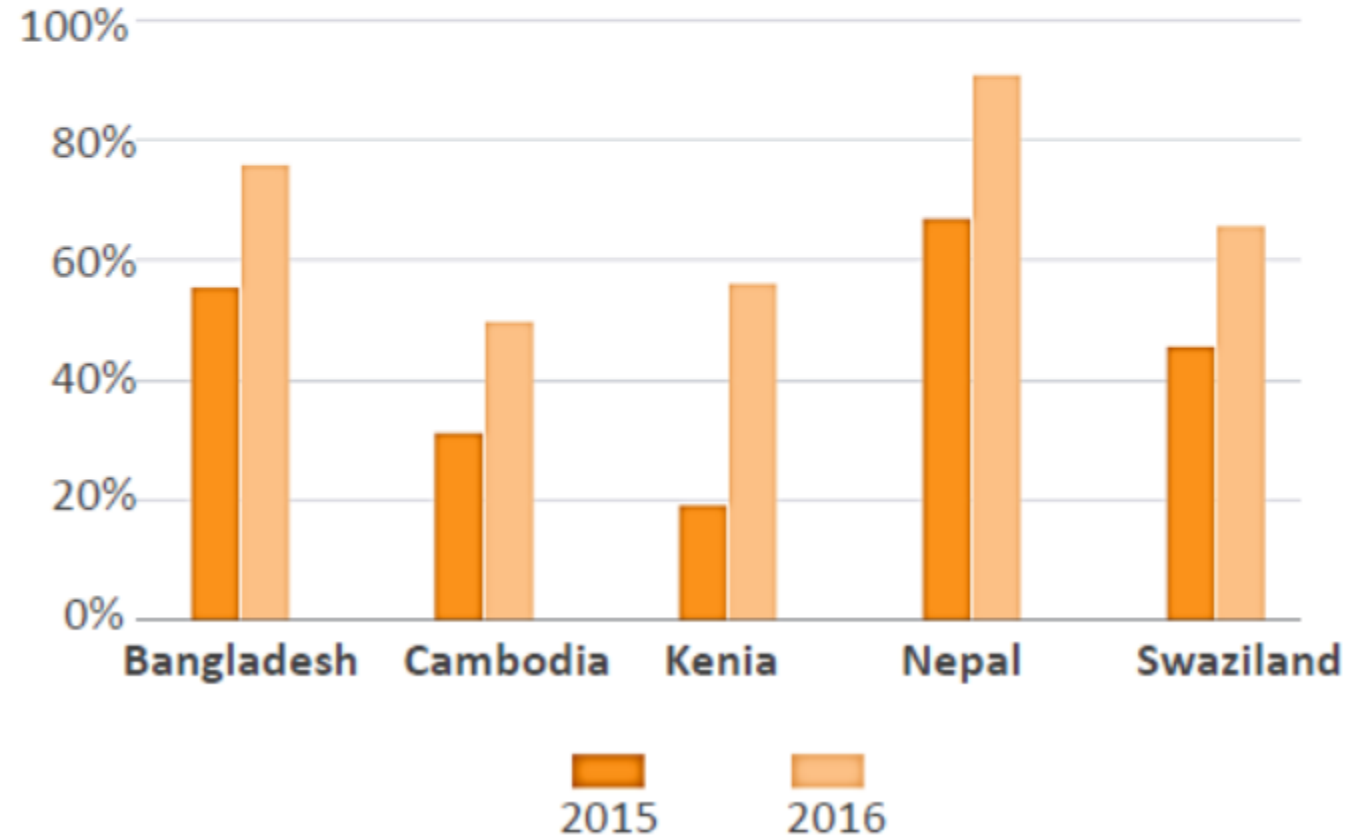
WORLD
ENERGY
COUNCIL

Equity improves with access to electricity

There are different successful pathways:

- Nepal, micro-hydro
- Kenya, rural access / household solutions
- Bangladesh, mini/micro grids/PV

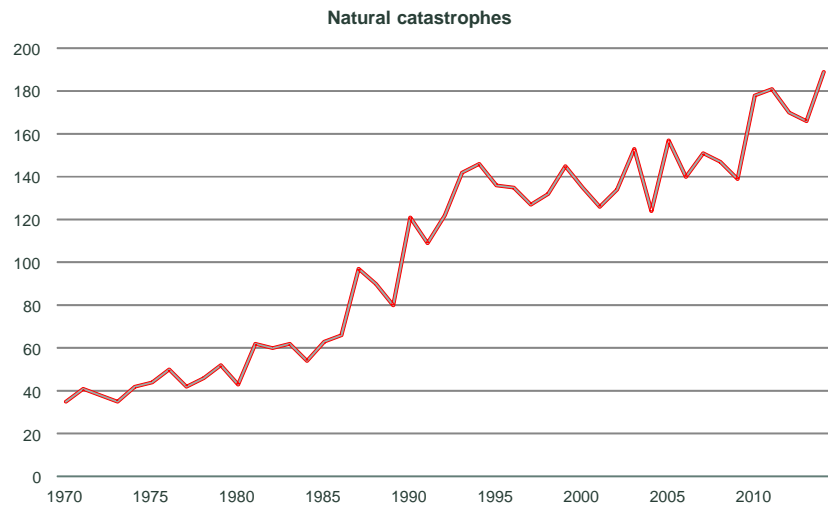
POPULATION WITH ACCESS TO ELECTRICITY



New Risks / Resilience

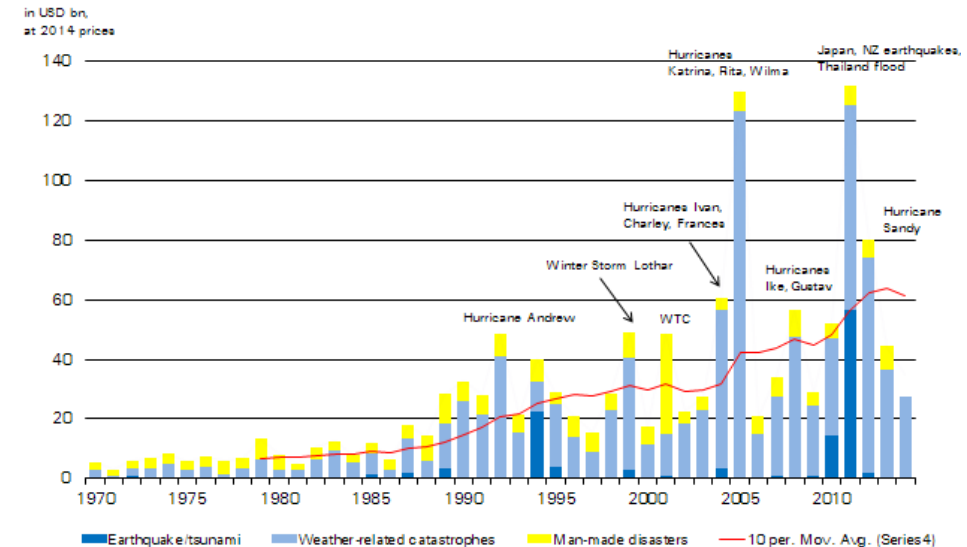
Extreme Weather Events

Number of natural catastrophes,
1970-2014: **factor 4**



Source: Swiss Re Sigma 02/2015

Insured catastrophe losses,
1970-2014



- Comparing the last 5 years to the last 20 years: The occurrence of extreme events has roughly quadrupled; according to IPCC this is largely related to the 40% increase of carbon dioxide in the atmosphere.
- From impact-resistant “hard”/“safe-fail” components to “soft”/“fail-safe” systems.
- The solution appears to be ‘smarter not stronger’.



INSIGHTS: World Energy Scenarios

WORLD
ENERGY
COUNCIL

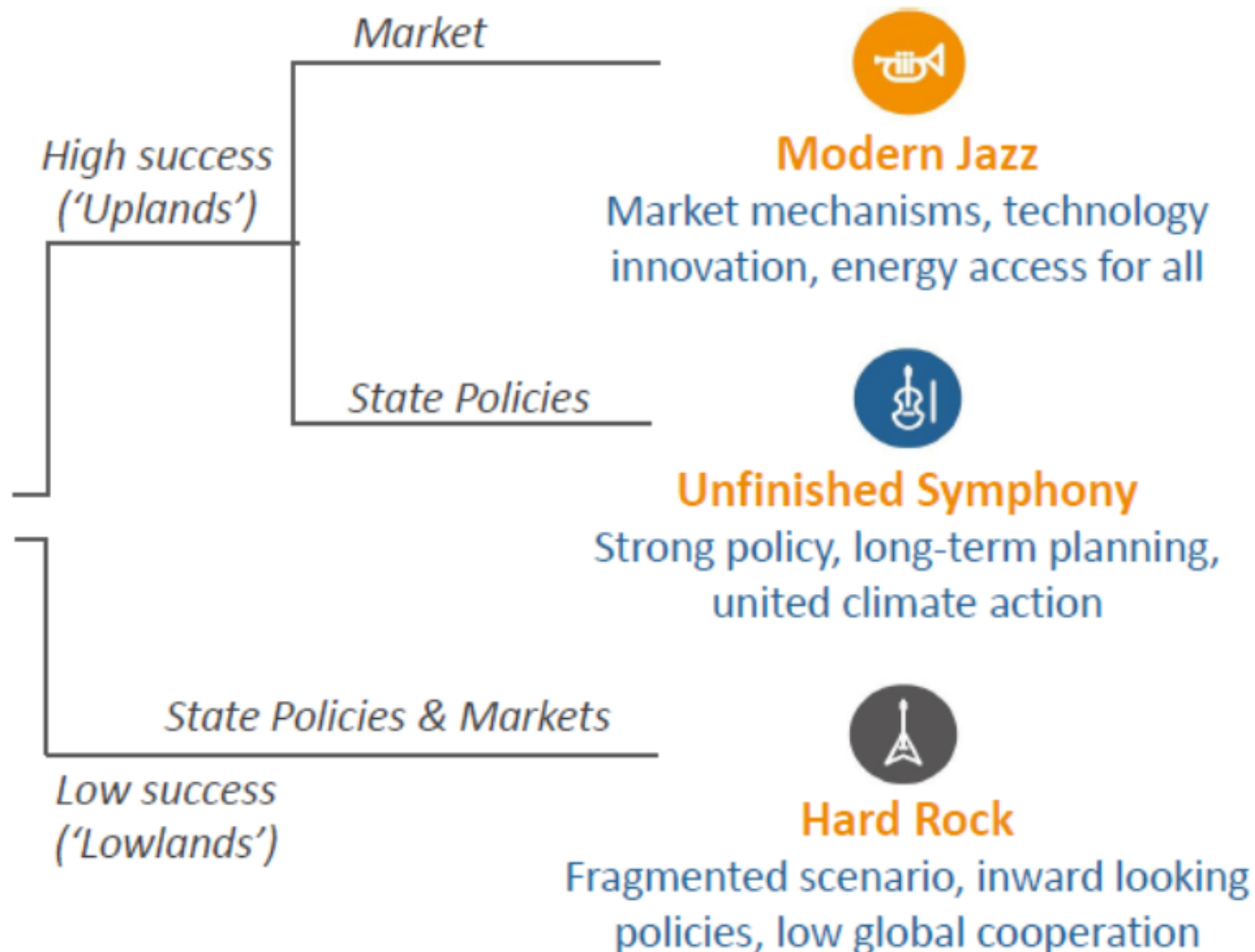
The Grand Transition & Three alternative pathways to 2060

PRE-DETERMINED FACTORS – The Grand Transition

- Slowing population growth
- Range of new technologies
- Appreciation of new planetary boundaries
- Shift in power to Asia

CRITICAL UNCERTAINTIES

- Pace of innovation and productivity
- Int'l governance & geo-political change
- Priority given to climate change
- 'Tools for action' - markets vs state



Scenarios Key Findings



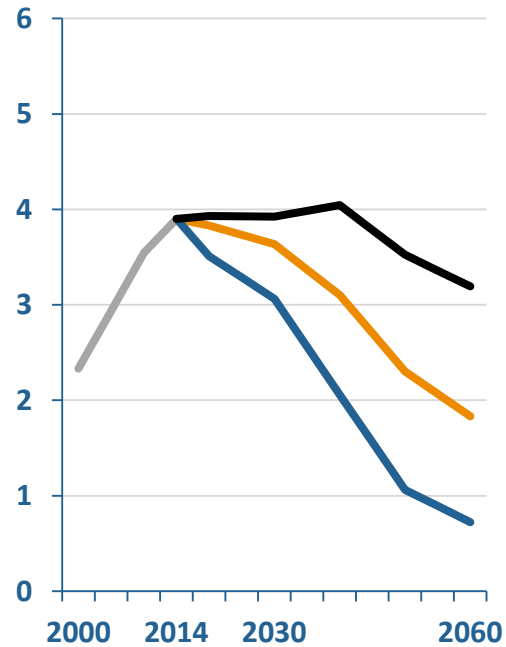
1. The world per capita energy **demand will peak** before 2030.
2. Demand for **electricity will double** to 2060.
3. The phenomenal rise of **solar and wind** energy will continue at an unprecedented rate.
4. **Coal and oil demand** peaks have the potential to take the world from “Stranded Assets” to “Stranded Resources.”
5. Transitioning global **transport** forms one of the hardest obstacles to overcome in an effort to decarbonise future energy systems.
6. Limiting **global warming** to no more than a 2°C increase will require an exceptional and enduring effort, far beyond already pledged commitments and with very high carbon prices.
7. **Global cooperation & trade**, coordinated climate policy and technology innovation are needed to balance the Energy Trilemma.

Demand peaks for coal and oil

... have the potential to take the world from “Stranded Assets” to “Stranded Resources”.

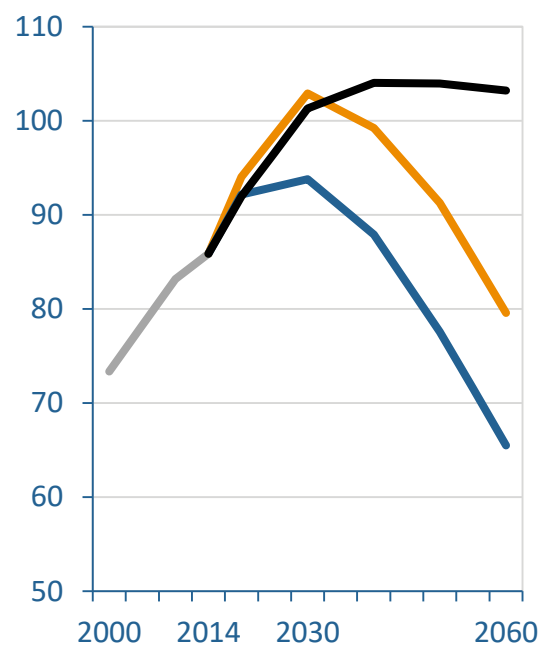
Coal Demand

('000 MTOE)



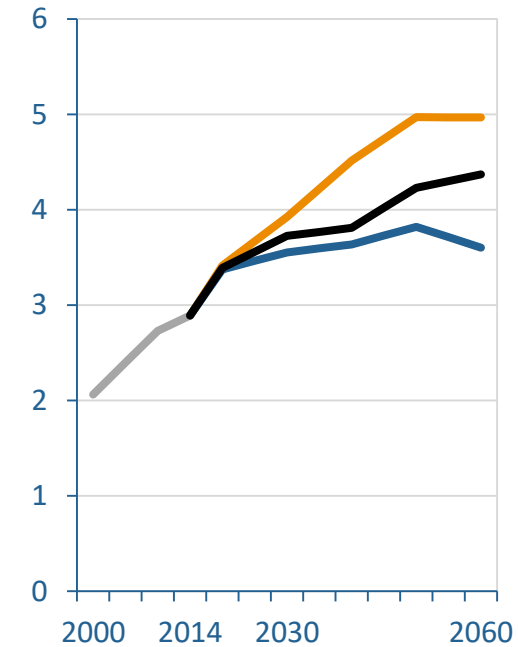
Oil Demand

(mb/d)



Natural Gas Demand

('000 MTOE or kbcm)



— History — Modern Jazz — Unfinished Symphony — Hard Rock

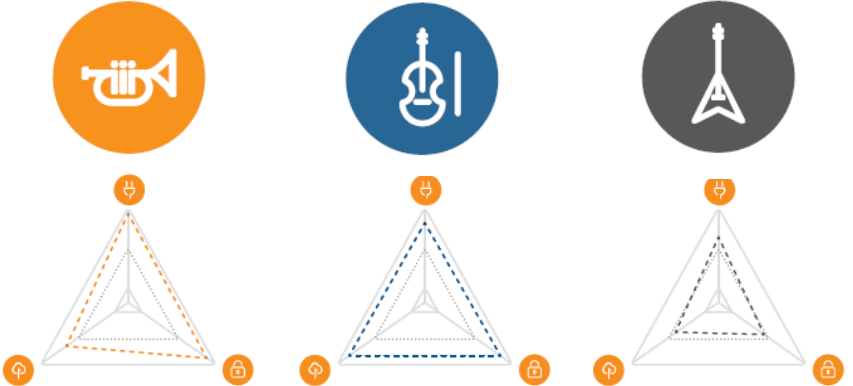
Natural gas: uncertainty in power, shift to Asia, opportunity in transport

By 2060:
+10..70%



- Gas market share in growing power generation is main driver of gas demand growth but with great uncertainty across the scenarios: additional gas demand for power generation between 300 bcm to close to 1,500 bcm
- In 2014, the Asian gas market (710 bcm) accounted for 23% of global gas market. By 2060 we see that volume increase by a factor 2..3, an additional 600 .. 1400 bcm:
- Decarbonisation of the transport sector is one of the most challenging issues of energy transition. Gas contribution is limited and mostly for heavy-duty freight and marine transport, with a potential market share of around 7%-8% of transport fuels by 2060 (up to 300 bcm).

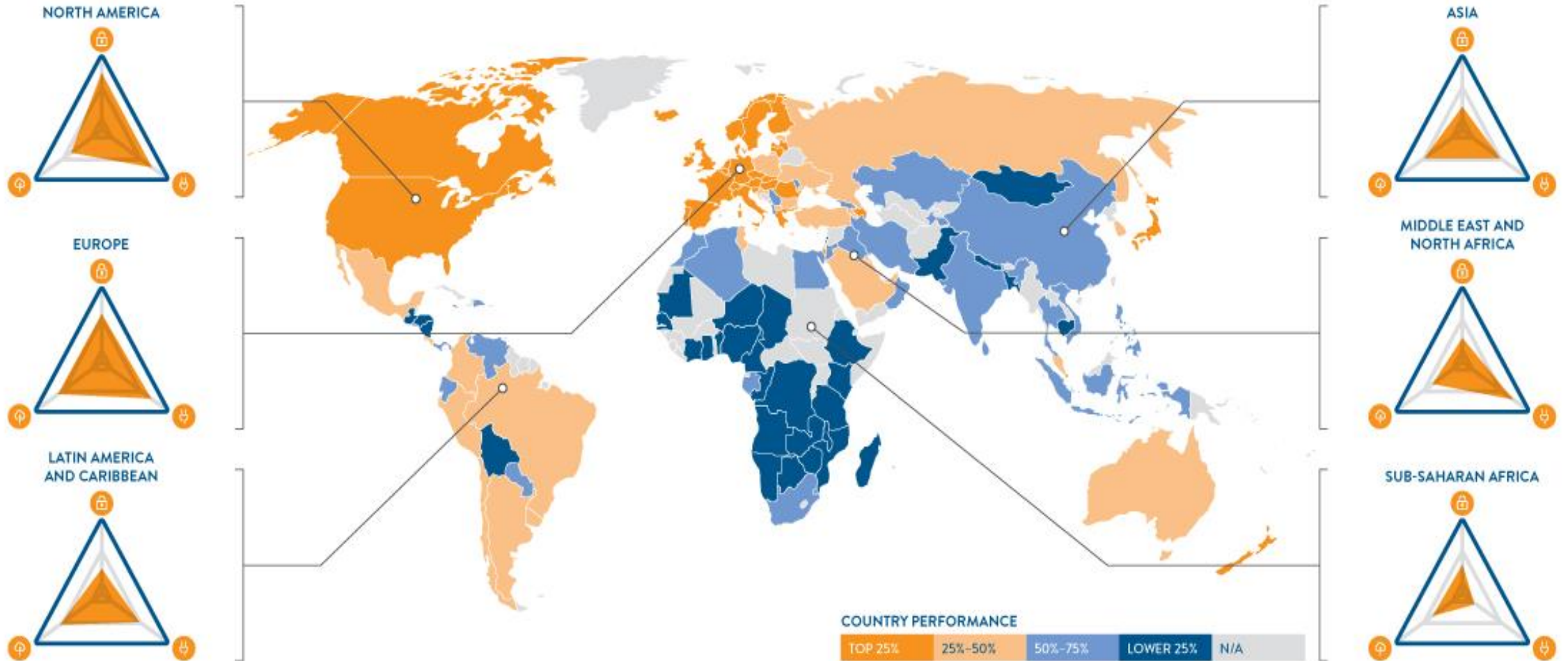
ENERGY TRILEMMA IN 2060



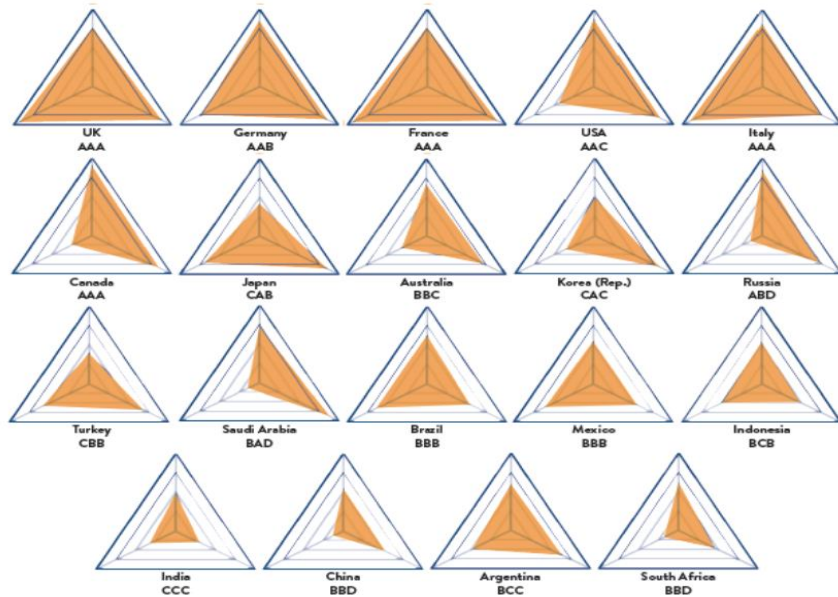
	Modern Jazz	Unfinished Symphony	Hard Rock
Energy Security	<ul style="list-style-type: none"> Higher energy production Greater trading and diversity of international fossil energy suppliers 	<ul style="list-style-type: none"> Wider diversity of energy resource types Government-promoted investment in Infrastructure 	<ul style="list-style-type: none"> More domestic production Lower capacity for funding infrastructure Lower trade
Energy Equity	<ul style="list-style-type: none"> Energy Access for all by 2060 	<ul style="list-style-type: none"> 0-0.5 bn people still lack access to energy 	<ul style="list-style-type: none"> 0.5-1 bn people still lack access to energy
Environmental Sustainability	<ul style="list-style-type: none"> Surpass Carbon budget in early 2040s Emissions fall 28% below 2014 volumes in 2060 	<ul style="list-style-type: none"> Surpass carbon budget in before 2060 Emissions fall 61% below 2014 volumes in 2060 	<ul style="list-style-type: none"> Surpass carbon budget in early 2040s Emissions are 5% above 2014 volumes in 2060

Regional Overviews

 WORLD ENERGY TRILEMMA INDEX 2018:
REGIONAL OVERVIEWS

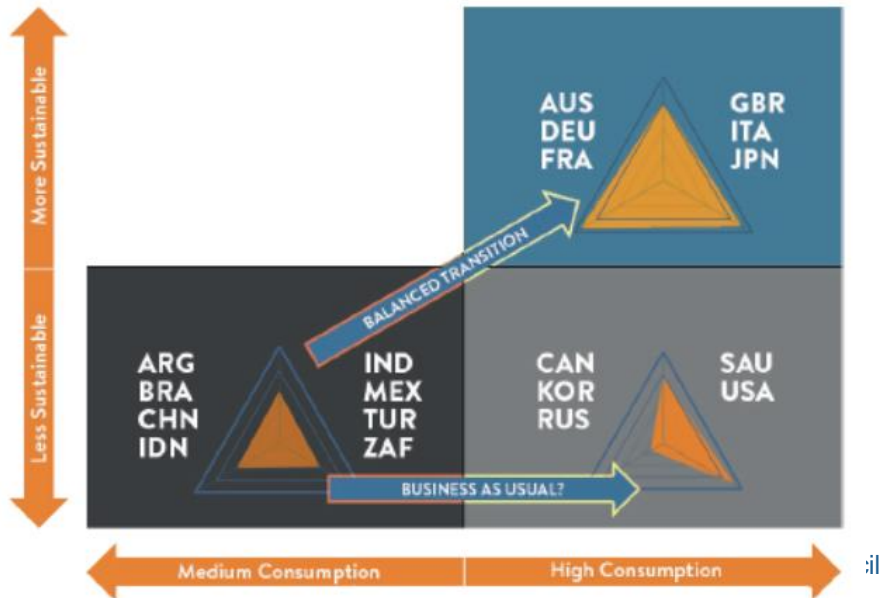


World Energy Trilemma in G20



Achieve “AAA”

- Energy Security: diverse energy mix & strong global relationships for long term supply security are more important than significant reserves or net exports.
- Energy Equity: over 1000 kWh/yr of electricity per capita for 100% of their population; also managed energy affordability and demand growth.
- Environmental Sustainability: few G20 countries (GBR, FRA, ITA) emit less than 750 MtCO₂ /yr, whilst maintaining efficient consumption between 5000 and 10,000 kWh/yr per capita.
- Robust transition pathways balance Trilemma aspects in line with growing prosperity and demand.



Call to action: accelerate the energy transition

INTERNATIONAL POLICY FOCUS

- Trade & transfer of technology
- Carbon pricing and sun-setting of subsidies
- Regional integration in all continents

NATIONAL POLICY FOCUS

- Market reform: support transition developments & ensure digital preparedness
- Focused R&D: system critical innovation & ecosystem creation
- Capacity building: transition skills
- Critical role of cities: local empowerment

MACRO-RISK MANAGEMENT

- Beware of “stranded resources”
- Avoid heavy costs of a Hard Rock scenario

Energy realities are shifting. Faster than ever.

- The D3 driven transition offers a unique opportunity to achieve more secure, affordable and clean energy for all.
- Electricity is the new oil. The digit is the new battery.
- However: The way to Trilemma heaven needs green liquids.
- 100% energy access can be achieved by 2030.

Act now.