

Energy in Transition

NZ in a changing world

BusinessNZ
Energy Council



Member of the
World Energy Council



Rob Whitney

WEC Energy Scenarios 2050 - Executive Chair

BusinessNZ Energy - Chair

CRL Energy - Chief Science Advisor

2014 NZ Gas Industry
Forum, 6 November



WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE

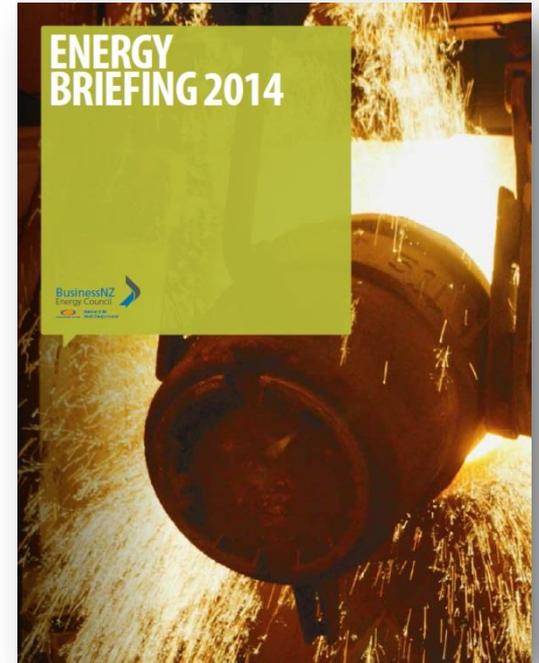
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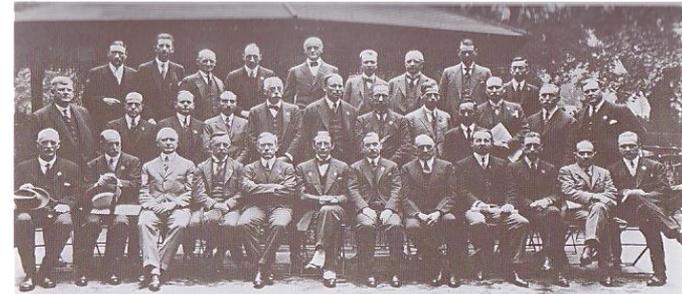
BusinessNZ Energy Council BEC

- The BusinessNZ Energy Council BEC is a group of New Zealand organisations taking on a leading role in creating a sustainable energy future for New Zealand.
- The BEC is the New Zealand Member Committee of the [World Energy Council](#) (WEC). All BEC members are automatically members of the WEC.
- BEC brings together the memberships of [BusinessNZ](#) and the former [Energy Federation of New Zealand](#).
- John Carnegie – Manager, BusinessNZ Energy Council
- The BusinessNZ Energy Council Energy Briefing 2014



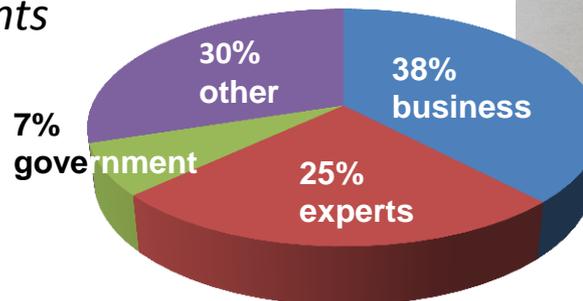
World Energy Council (WEC)

- the **world energy leaders' network**
- promoting an affordable, stable, and environmentally sustainable energy system for all **since 1923**
- truly global
 - **90+** country member committees
- inclusive and impartial
 - OECD & non-OECD
 - **3000+** member organisations from governments, industry, academia, & NGOs
- Informs global, regional, national strategies
 - **authoritative studies**
 - *high-level network & events*
- **World Energy Congress**
 - Istanbul, Turkey



THE FIRST WORLD POWER CONFERENCE
International Executive Committee.
Chairman:- Mr D.N. Dunlop.
July 1924.

10. Executive Council der World Power Conference.



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Marque reports



World Energy Perspective
Energy Efficiency Policies – What works and what does not



World Energy
Composing energy
Project Partner Paul Scherrer

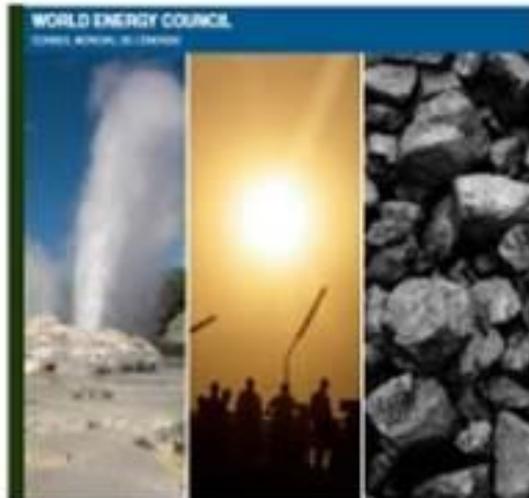


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World Energy Resources
2013 Survey Summary

World Energy Trilemma
Time to get real – the agenda for change
Project Partner GARDINER



Balancing the 'Energy Trilemma'

Energy Security

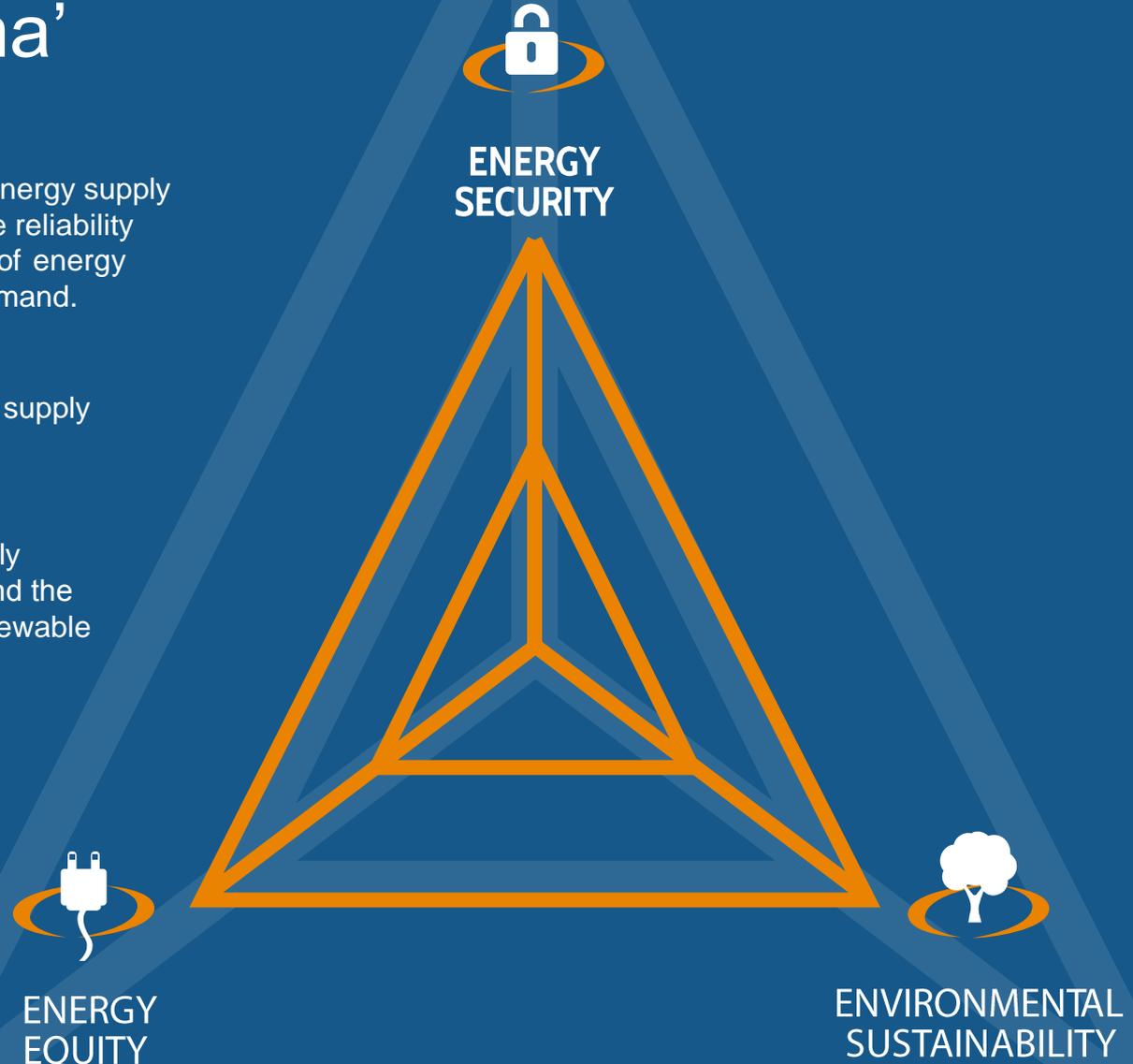
The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand.

Energy Equity

Accessibility and affordability of energy supply across the population.

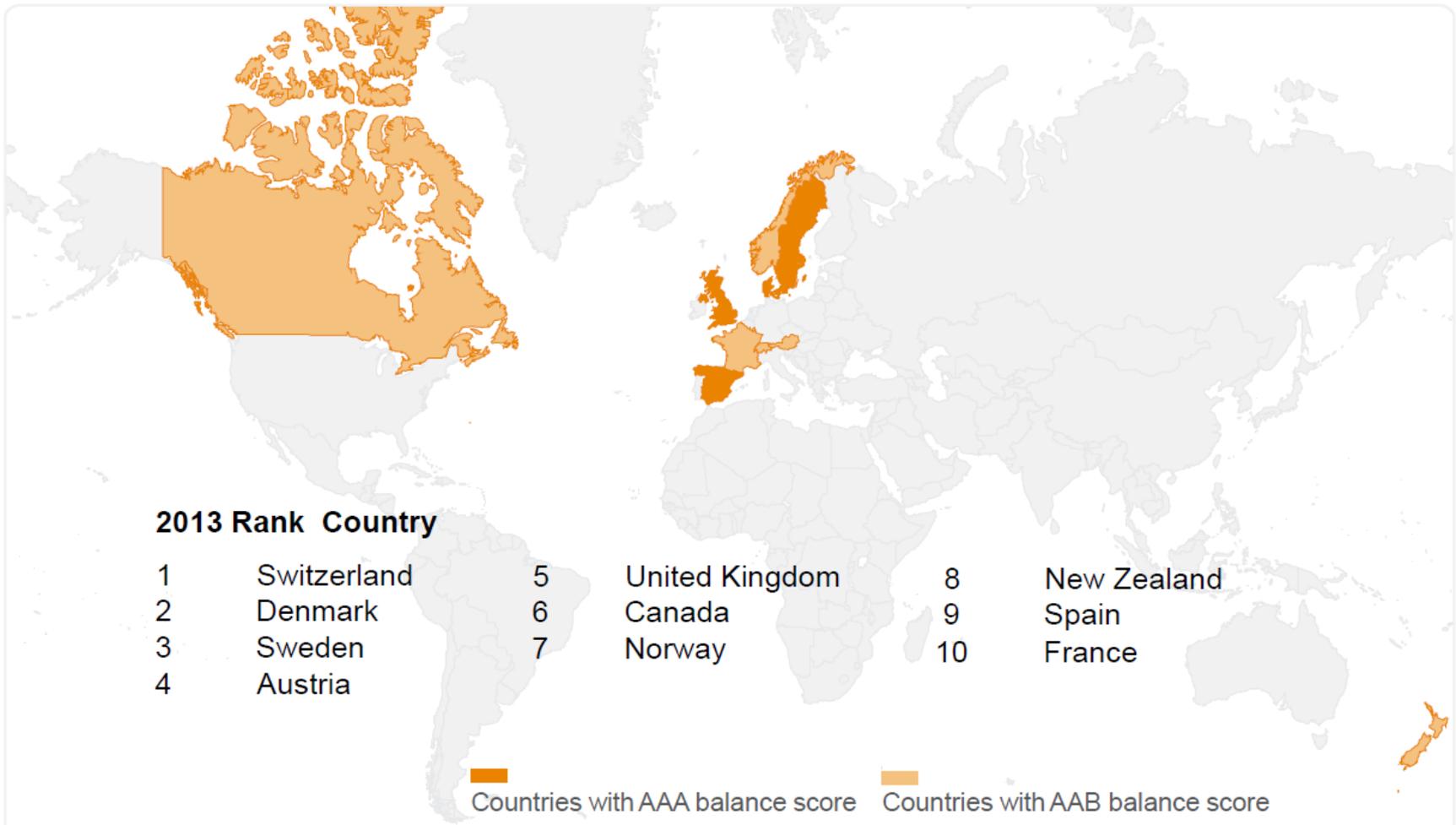
Environmental Sustainability

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

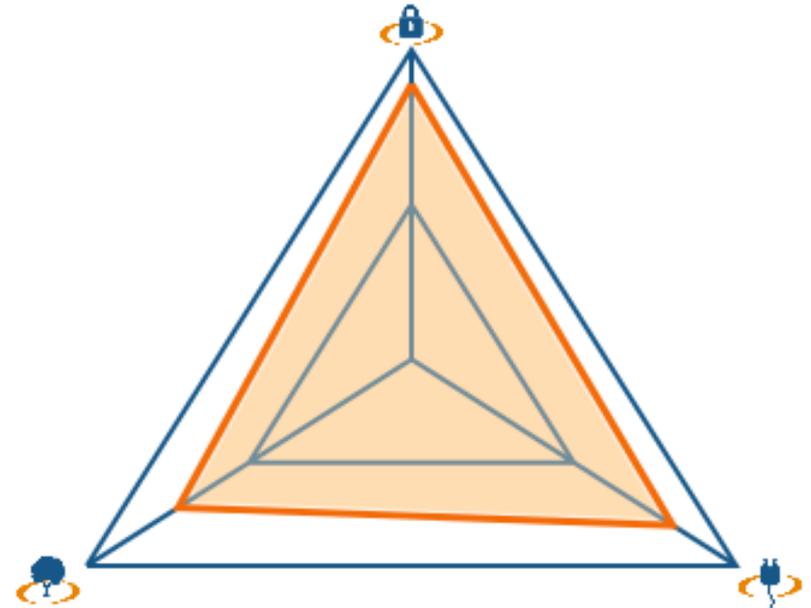


Energy Sustainability Index

2013 Top performing countries



New Zealand on Rank 8



	2011	2012	2013	Trend	Score
Energy security	20	19	15	↑	A
Energy equity	15	18	26	↓	A
Environmental sustainability	40	36	37	↓	B
Overall rank and score	9	7	8	↓	AAB

WEC Issues Survey

What keeps Energy Executives Awake at Night



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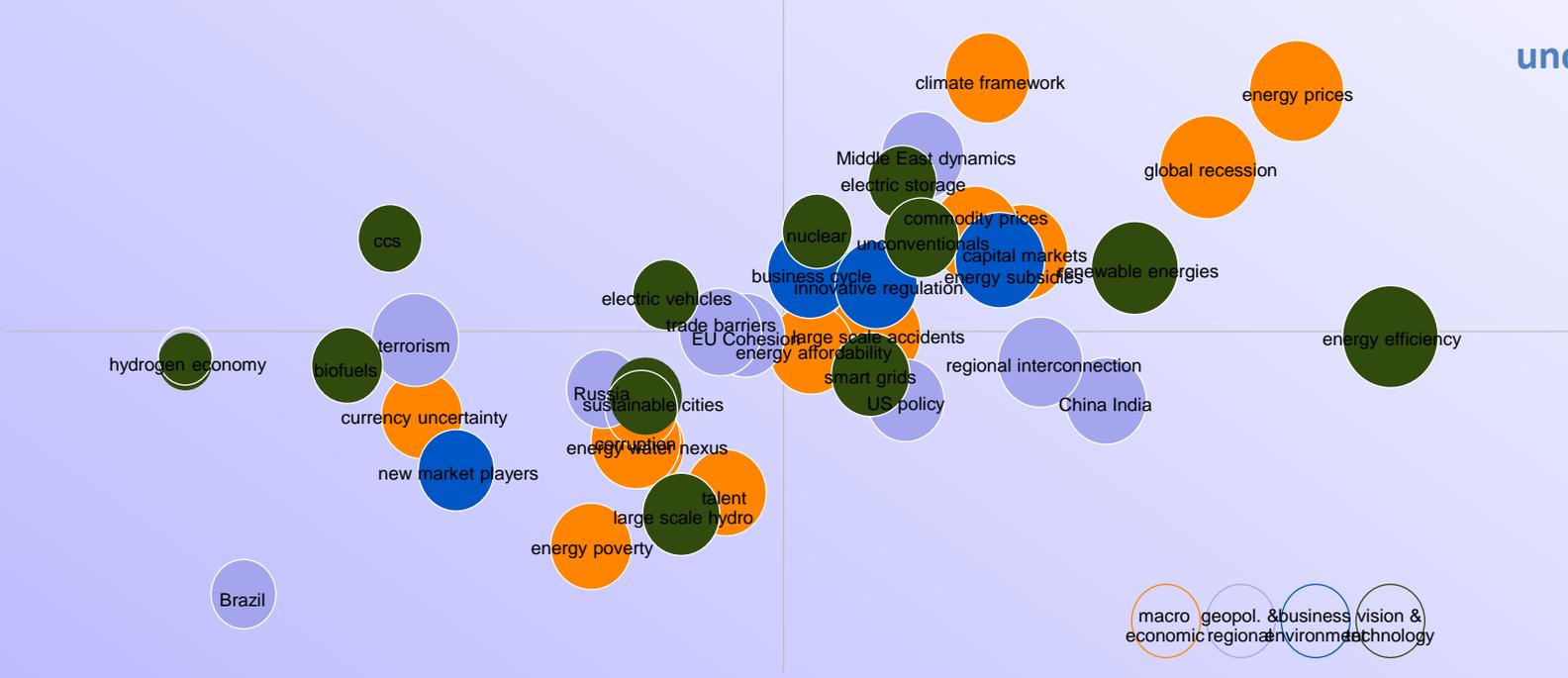
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World Energy Council



uncertainty

**World Energy Issues Monitor
 World,**

**critical
 uncertainties**



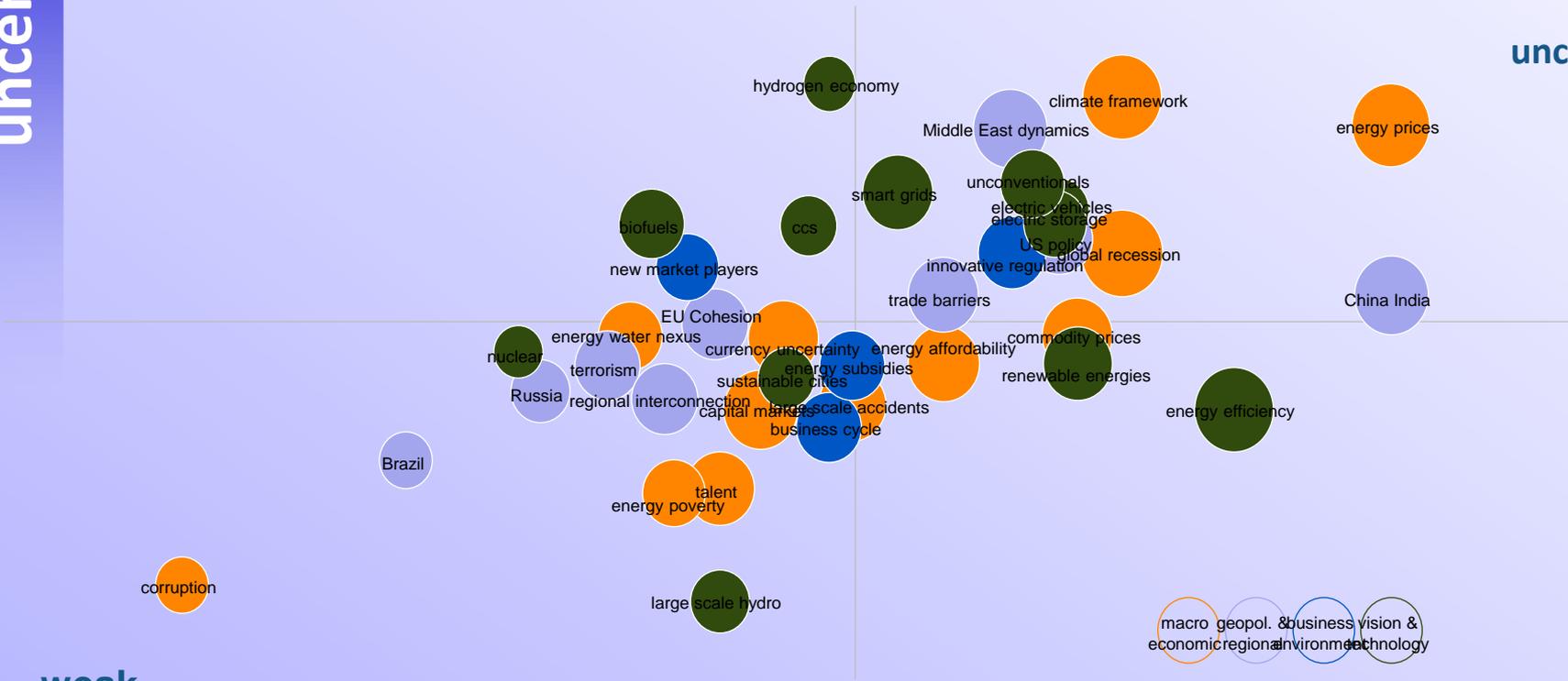
**weak
 signals**

**need for
 action**

uncertainty

**World Energy Issues Monitor
 New Zealand**

**critical
 uncertainties**



**weak
 signals**

**need for
 action**

Key Energy Issues

- **Critical uncertainties**

Issues that keep energy executives awake at night

- Climate framework, energy prices, global recession (W), China and India (NZ)

- **Need for action**

Issues that keep energy leaders most busy at work:

- Renewable energies, energy efficiency, energy affordability

- **Watch this space**

Clustering of opportunities

- Smart grids (including embedded generation), energy storage, electric vehicles, innovative regulation

- **Controversial issues**

- Hydrogen economy, energy water nexus, energy poverty, decentralised systems, CCS -carbon capture and storage



WEC's scenarios study:

Comprises of two scenarios

The scenarios are designed to help a range of stakeholders to address the “energy trilemma” of achieving

- environmental sustainability,
- energy security
- energy equity.

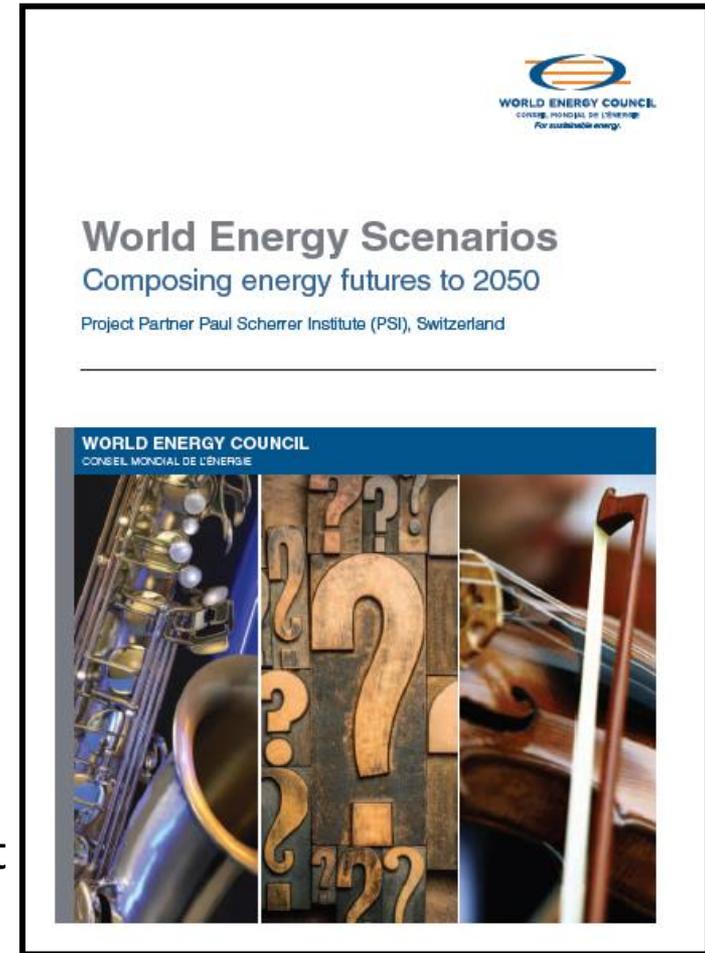
Explorative – not normative

Bottom up – a cast of thousands



Stories quantified by Paul Scherrer Institute (project partner)

GMM (Global Multi-regional MARKAL model)



Balancing the “Energy Trilemma”

“promoting an affordable, stable and environmentally sensitive energy system for the greatest benefit of all”

Energy security

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

No power cuts or queues for petrol

Environmental impact mitigation

CO₂ emissions, Water, Land use, nuclear safety, Energy efficiencies and the development of energy supply from renewable and other low-carbon sources

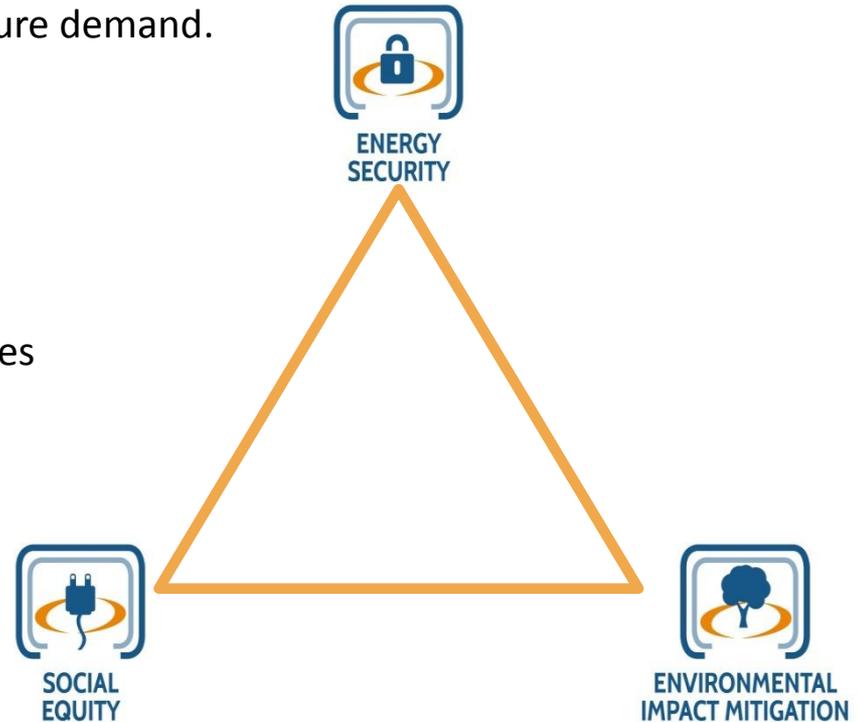
UNFCCC 2° C 450ppm CO₂

Social equity

Accessibility and affordability of energy supply across the population.

1.2 billion without access to electricity, energy poverty.

UNSE4ALL by 2030



What are scenarios?

- Plausible, pertinent, alternative stories of the future which:

- ▶ portray a range of conceivable outcomes and aid the understanding of how different factors can interact and shape the future.
- ▶ identify robust trends; ‘what-if’ assumptions about future. Scenarios are not forecast.

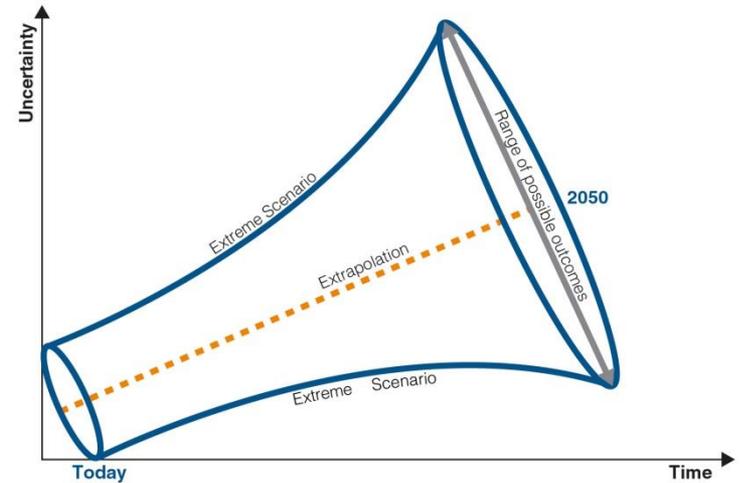


Figure: The uncertainty funnel:
WEC Scenarios are explorative, rather than normative

WEC Scenarios

Deriving the scenario stories

Two Scenarios stories, exploratory, different and equally feasible rather than good and bad

- **Jazz:**
Market & Trade based, consumer driven, focussed on access and affordability, achieving growth through low cost energy, Governments facilitate GHG actions by businesses.
- **Symphony:**
Government led “orchestrated”, voter driven, focussed on environmental goals and energy security, national and regional measures to increase share of renewables in energy mix. Binding international agreement on GHG emissions

Brief outline of the two scenario stories

Jazz	Symphony
Value-conscious consumers	Environmentally-minded voters
Competitive markets pick technologies	Governments pick technology winners
Higher GDP due to efficient market practices.	Lower GDP due to non-optimal economic policies
Increased exports due to free-trade strategies	Reduced exports/imports due to nationalistic strategies
Energy sources compete on basis of price & availability	Select energy sources are subsidised and incentivised by governments
Renewable and low carbon energy grows in line with market selection	Certain types of renewable and low carbon energy actively promoted by governments
Main players are multi-national companies, banks, venture capitalists	Main players are private- and public sector companies, local governments, NGOs
Carbon market grows more slowly from bottom up , based on regional, national and local initiatives.	Carbon market is top down based on an international agreement , with commitments and allocations.

Storyline and quantification assumptions

	Jazz	Symphony
GDP growth	Higher (3.54% pa CAGR, PPP)	Lower (3.06% pa CAGR, PPP)
Population	Lower (2050 = 8.7 billion)	Higher (2050 = 9.3 billion)
Efficiency/ Intensity	Increasing (-2.29% pa (primary, PPP))	Increasing more strongly (-2.44% pa (primary, PPP))
Climate policy	Limited Prices (2050): 23-45 USD/tCO ₂	Stronger Prices (2050): 75-80 USD/tCO ₂
Resources	Better access to unconventional resources	More expensive unconventional
Technology support	Limited; energy choice based on free markets	support for nuclear, large hydro, CCS and renewables
Technology innovation	Further development of CCGT decentralized power, micro-turbines, fuel cells, PV	Focused low carbon R&D programs (esp. CC(U)S, solar PV)

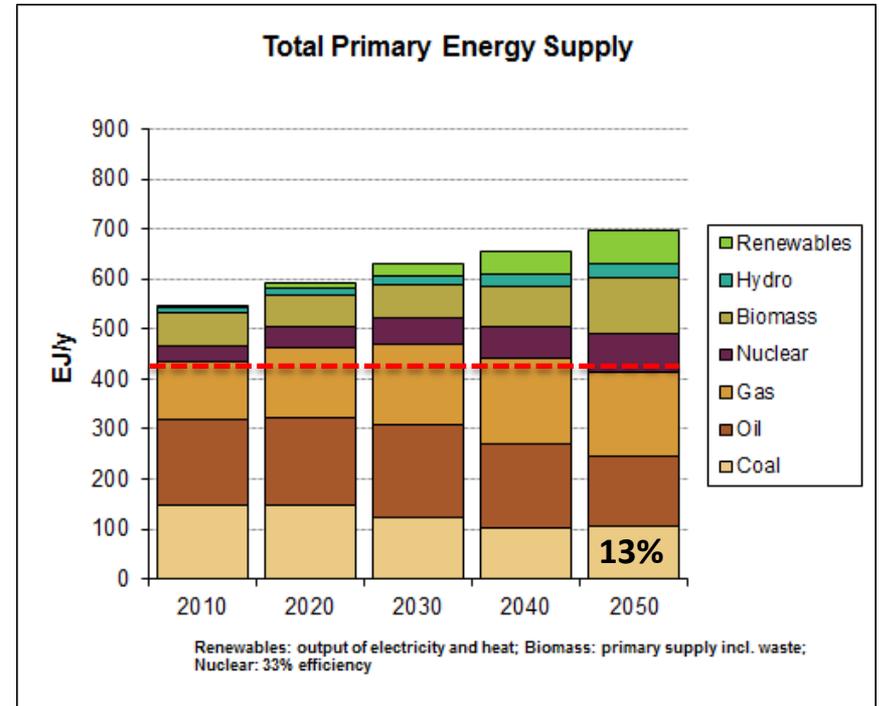
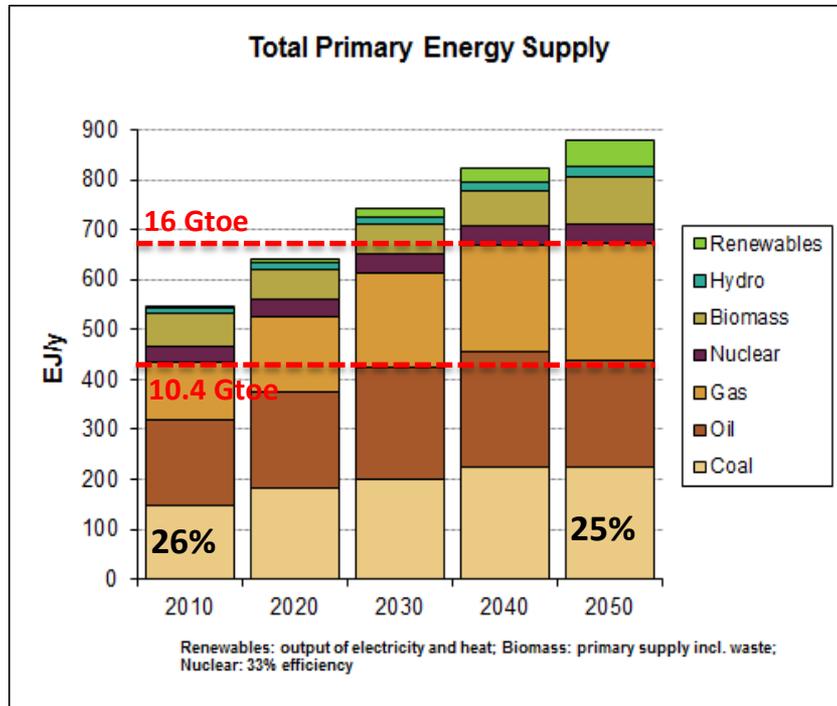
Highlighted results

	2010	Jazz, 2050	Symphony, 2050
Final demand	373 EJ	+69%	+31%
Fossil fuels *	80%	77%	59%
Renewables *	15%	19%	29%
CO2 emissions [Gt CO2/yr]	30.5	44.1	19.1
Solar **	0.2%	6%	16%
Wind **	2%	8%	8%
Nuclear **	13%	6%	15%
Hydro **	7%	11%	16%

* Shares in total primary energy supply

** Shares in electricity production

Global total primary energy supply



Jazz

fossil fuels: +55%/- 5%

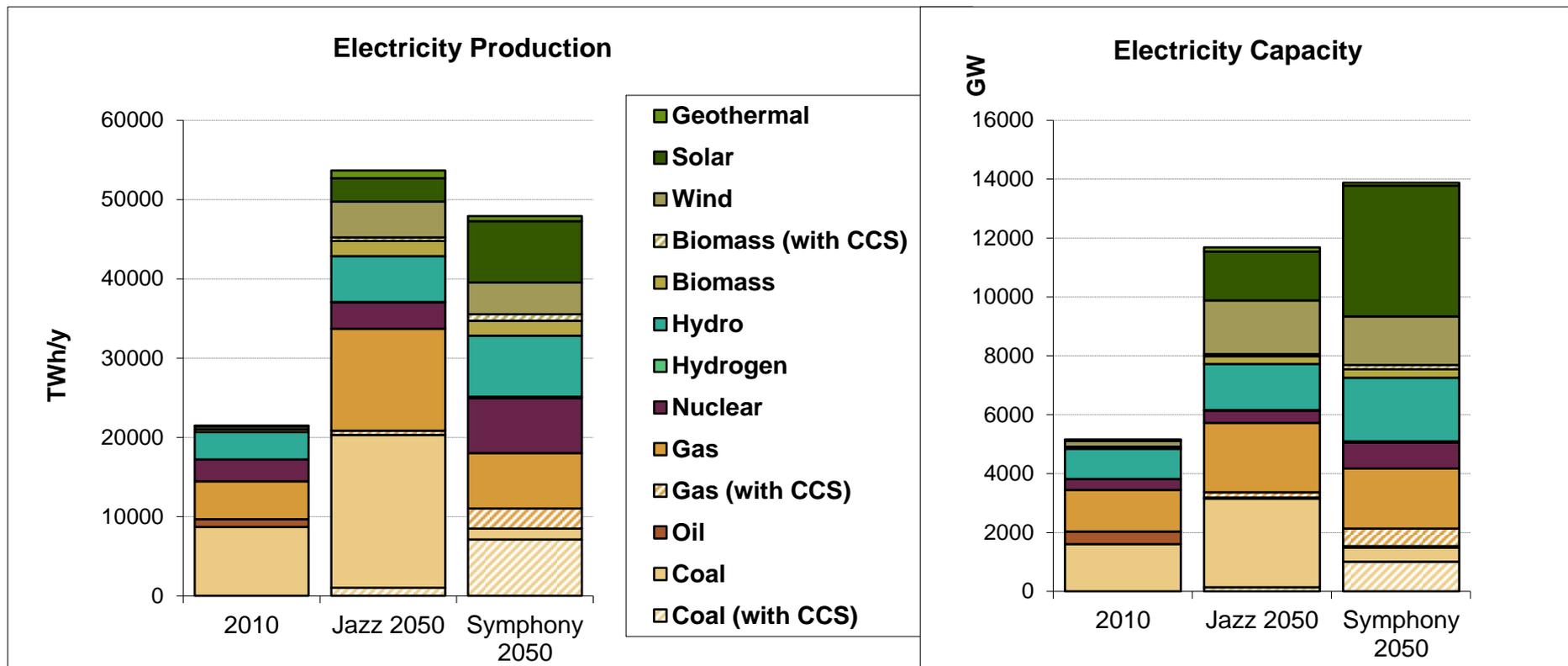
oil: +/- 15%
natural gas: +100%/+50%
coal: +/- 40%

Symphony

Upstream liberalized;
technology development,
supply surge/more producers
Coal remains dominant in some regions

Tighter supply (lower E&P)
Higher infrastructure costs
Energy security drives reduced fossil use

Electricity production and capacity



Jazz

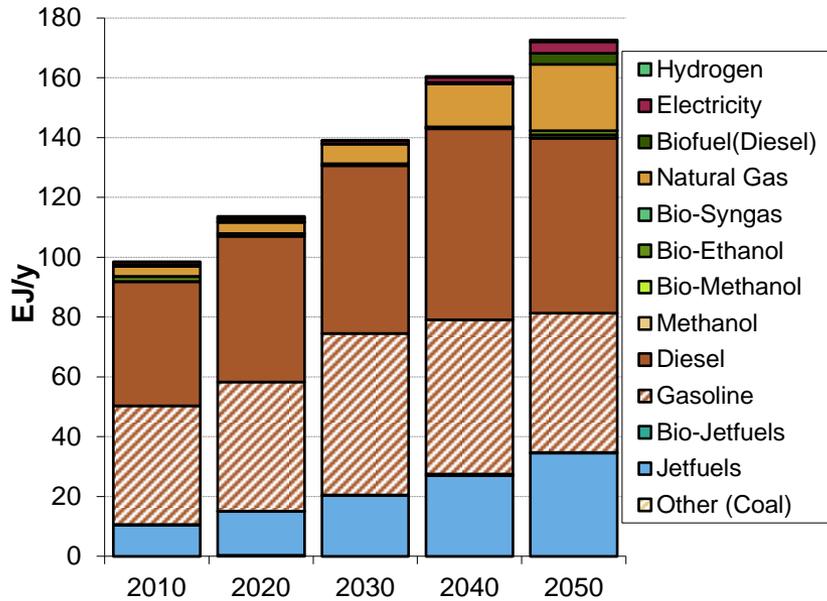
Coal: expected to remain dominant
 Gas: Doubles and share increases (esp. N. America),
 Nuclear: mainly non-OECD

Symphony

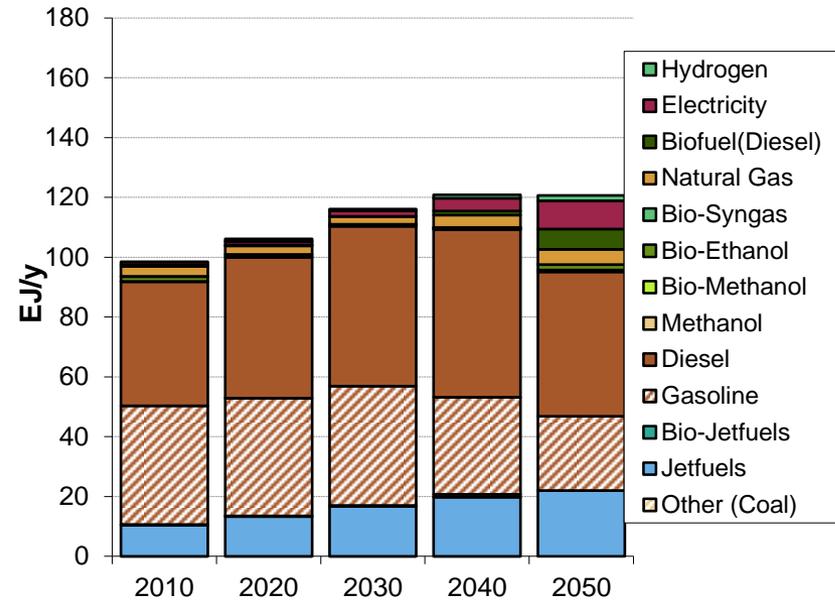
Coal: share drops, CCS increasingly required
 Nuclear: increasing; led by governments
 Quicker transition to renewables
 Solar overtaking gas, hydro and coal

Fuels in All Transport

Fuels in All Transport



Fuels in All Transport



Jazz

Economic growth leads to higher consumption
improved access to energy.

Demand increases by 75%

Switch to natural gas

Symphony

Lower consumption, high impact of energy
saving and lower growth

Demand increases by 22%

Switch away from fossil fuels which peak in
2030

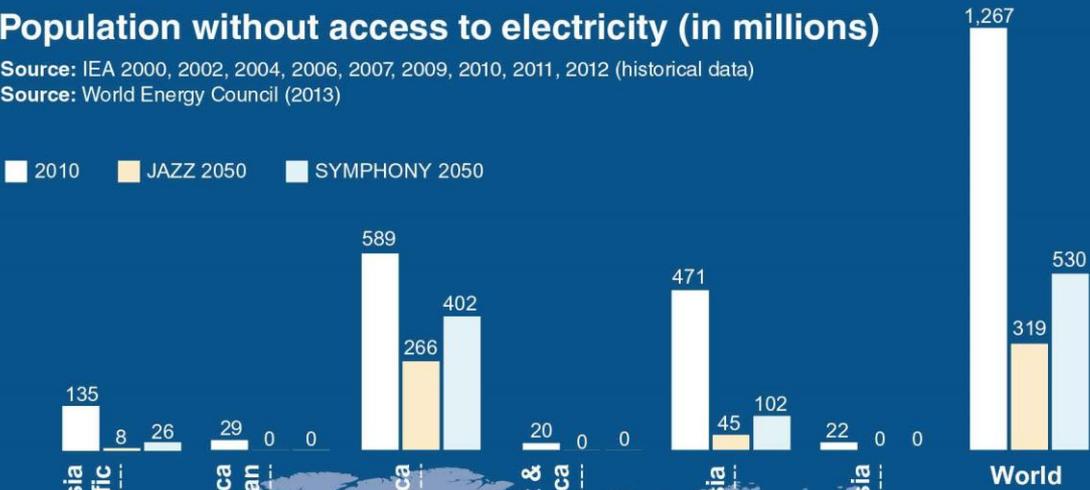
Population without access to electricity

Population without access to electricity (in millions)

Source: IEA 2000, 2002, 2004, 2006, 2007, 2009, 2010, 2011, 2012 (historical data)

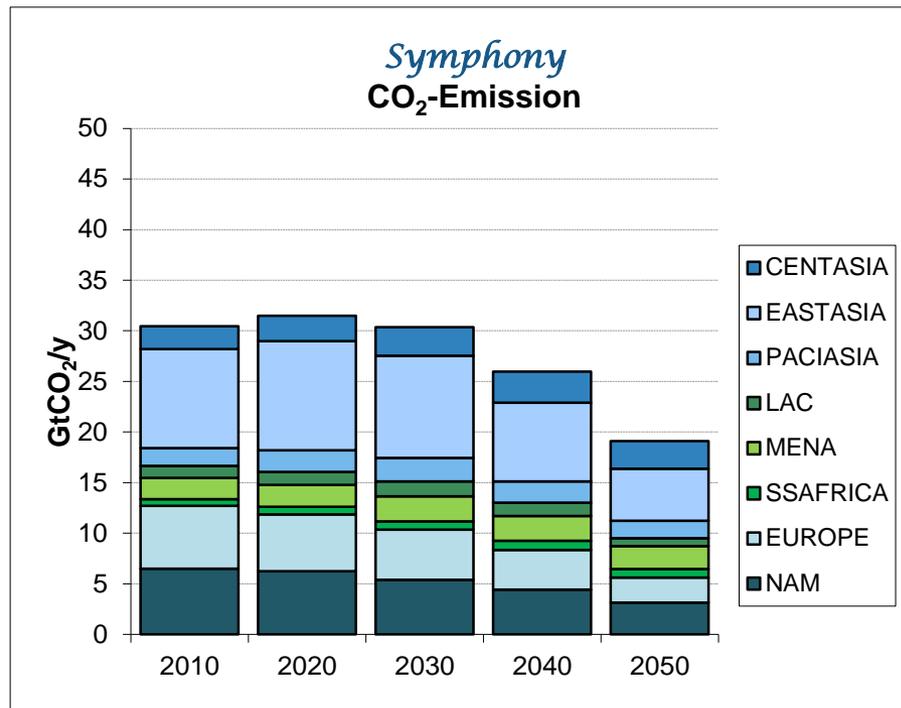
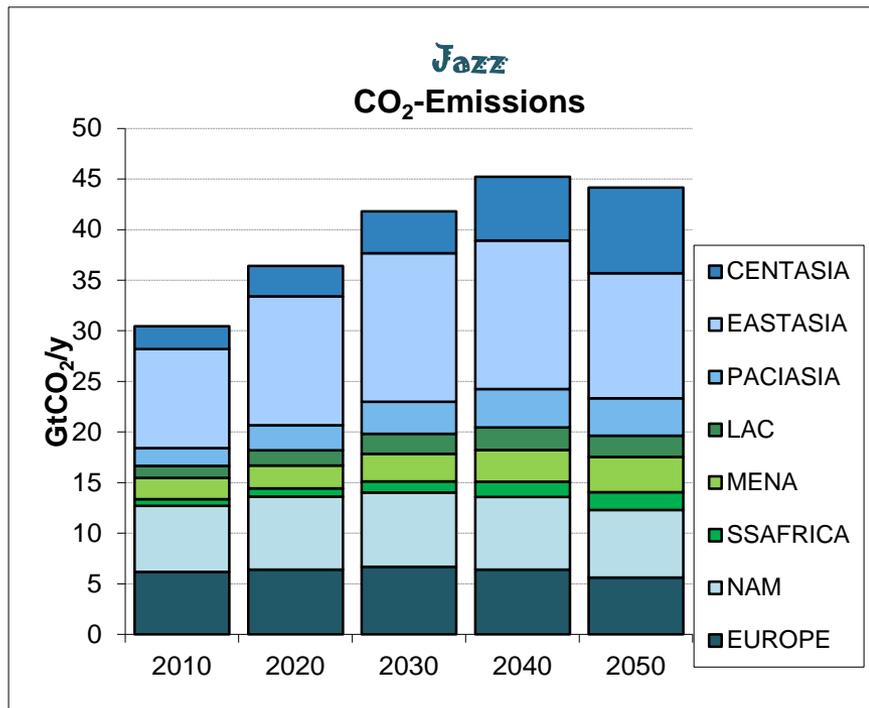
Source: World Energy Council (2013)

■ 2010 ■ JAZZ 2050 ■ SYMPHONY 2050



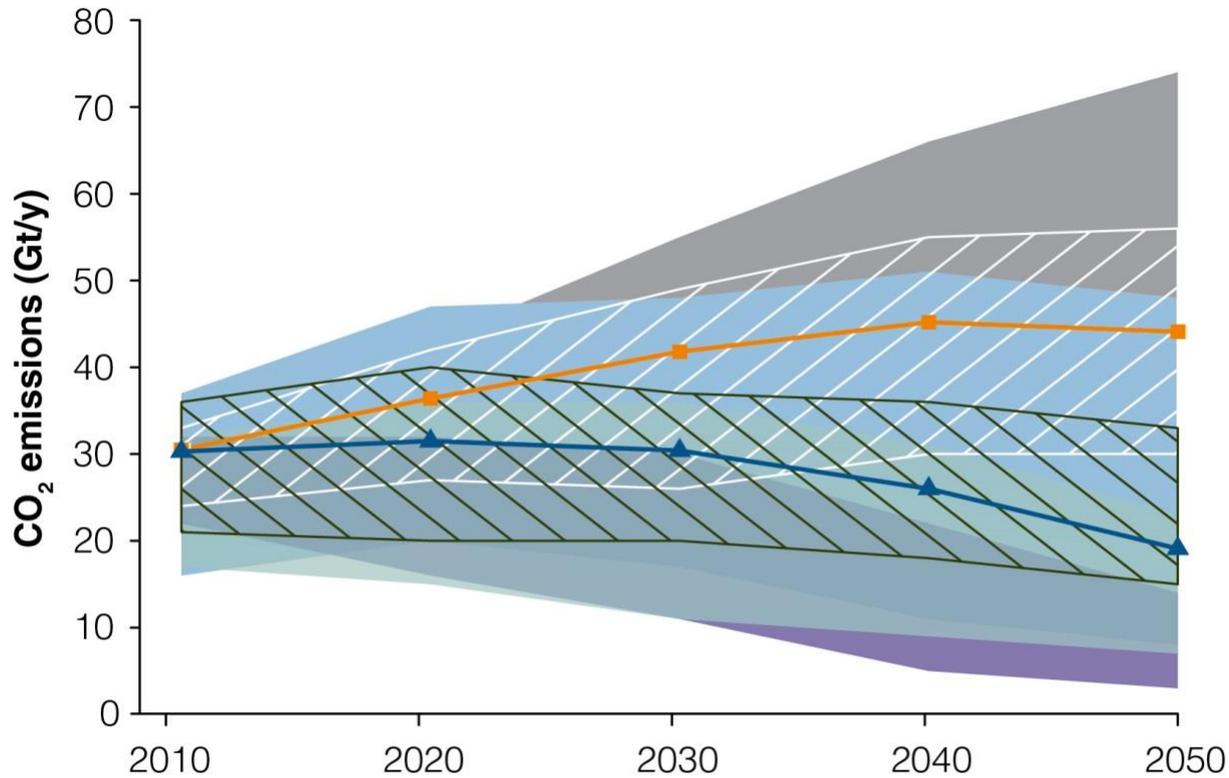
Access to electricity will improve all over the world. Sub-Saharan Africa will struggle having the least.

CO₂ emissions by region



Resulting CO₂ emissions

Emissions trajectories for atmospheric GHG concentrations



IPCC Categories (CO₂ - eq)



Note: assumes over the long term that non-energy CO₂ emissions from industry, agriculture and land use are reduced to insignificant levels in Jazz and Symphony

The global economy will be challenged to meet the 450 ppm target without enormous economic costs

Energy mix in 2050

- **Energy efficiency** is absolutely crucial in dealing with demand outstripping supply in both Scenarios
- **Coal** remains a dominant fuel (especially in China and India), CCS is critical to coal in Symphony.
- **Natural gas** will gain more importance in the energy share especially in Jazz
- **Oil** will continue to be the dominant fuel in transport with growth in natural gas in Jazz and Biofuels and electricity in Symphony
- Share of **renewables** increases in Symphony. Solar takes off.
- **Hydro**: great economic potential of hydro electricity generation especially in SSA and LAC
- **Nuclear** is not a game changer but is important in Symphony

Scenario Conclusions

- Jazz is better for Social Equity
- Symphony is better for Climate change
- Both fall short of the goals set out by the United Nations

What can we achieve with the best of both worlds?

- Governments doing what only governments can do and consumers and business factoring in environmental costs

What happens if we get the worst of both worlds?

- Nimby-ism, inefficient and self interested governments, and corruption



BEC2050: the Project Opportunity

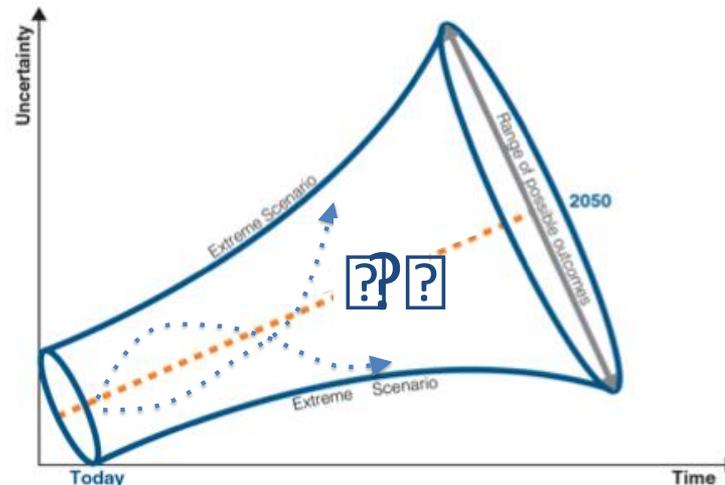
- Using WEC scenarios to grow domestic understanding
- Scenario approach robust, long pedigree ... challenging but informative
- The novelty of WEC/BEC approach
 - an ability to integrate unique New Zealand scenarios into global model
 - to explore the critical uncertainties that we face in New Zealand's energy future

BEC2050 Energy Scenarios Project

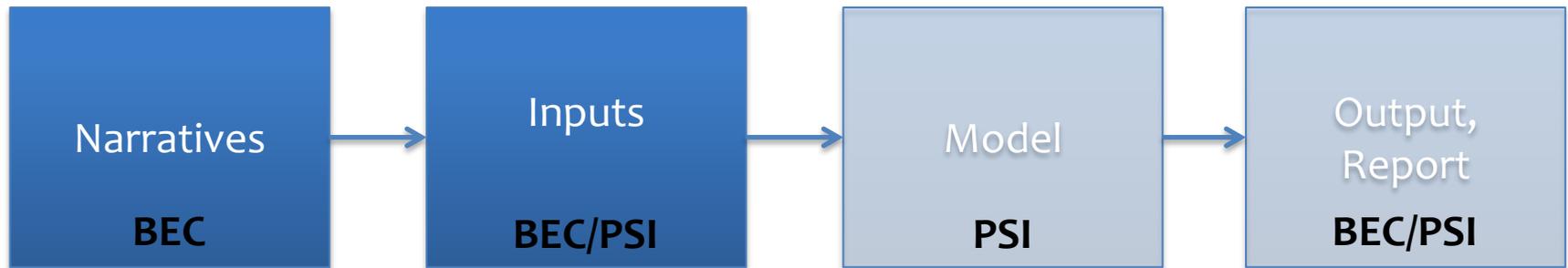
- Saw benefits of applying the Jazz and Symphony scenario framework in New Zealand
- Raised over \$200,000 from 23 sponsors across business, government and academia plus more ‘in-kind’
- Held two scenario development workshops with a third to be held in February 2015
- Working closely with WEC and PSI
- Have started narrative drafting and expect first modelling results back in February
- Project launch around June

The Goal

- The goal of the BEC2050 project is to develop two scenarios that are at the same time
 - *plausible* – not a prediction, but a believable scenario
 - *distinct* – to succeed, the narratives have to be different
 - *coherent* – the narratives have to hang together



Overview of approach



- Opportunity to create two narratives which are unique to New Zealand
- Embedded within global WEC model, hence:
 - Narrative 1 » consistent with “Rest of World in Jazz”
 - Narrative 2 » consistent with “Rest of World in Symphony”
- Need to satisfy consistency check (“boundary conditions”) in each
 - some inputs are determined for us (e.g. global trade of oil, most technology costs, carbon price)

Early Insights

- A great way to
 - galvanise interest amongst members
 - involve those parts of civil society not ordinarily involved in business-led (let alone energy) projects
 - grow understanding of the WEC work
- Data richness – using the WEC framework will give us data at the global, the regional, the sub-regional (Australia and New Zealand), and New Zealand level
- Provides a platform for ongoing strategic planning by government and business



10 key messages to take away

- 1 Energy system complexity will increase by 2050
- 2 Energy efficiency is crucial in dealing with demand outstripping supply.
- 3 The energy mix in 2050 will mainly be fossil based.
- 4 Regional priorities differ: there is no 'one-size-fits-all' solution to the energy trilemma.
- 5 The global economy will be challenged to meet the 450ppm target without unacceptable carbon prices.
- 6 A low-carbon future is not only linked to renewables: CC(U)S is important and consumer behaviour needs changing.
- 7 Solar energy, CC(U)S technology, and energy storage are the key uncertainties up to 2050
- 8 Balancing the energy trilemma means making difficult choices.
- 9 Functioning energy markets require investments and regional integration to deliver benefits to all consumers.
- 10 Energy policy should ensure that energy and carbon markets deliver.