

APERC Annual Conference and special Anniversary  
Joint Symposium 2016

# **Balancing Market and Policy Drivers in Scenario Development**

WEC Energy Scenarios  
Composing Energy Futures to 2050

**Rob Whitney**

Executive Chair World Energy Scenarios to 2050  
Emeritus Chair BusinessNZ Energy Council

# Questions

- Government and business cooperation for technology development
- Good market and policy balance for economic development and for climate change mitigation?
- Challenges/effects of liberalisation of energy markets?
- How do the WEC scenarios differ from those developed by IEA, EIA and APERC?
- Is industry moving ahead of governments in terms of addressing climate change?
- What are the key policy barriers?

# WEC 2050 Scenarios

## Deriving the scenario stories

Two Scenarios stories, exploratory, different and equally feasible rather than good and bad. Measured by the WEC Energy Trilemma metric not just CO<sub>2</sub>

- **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

# 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

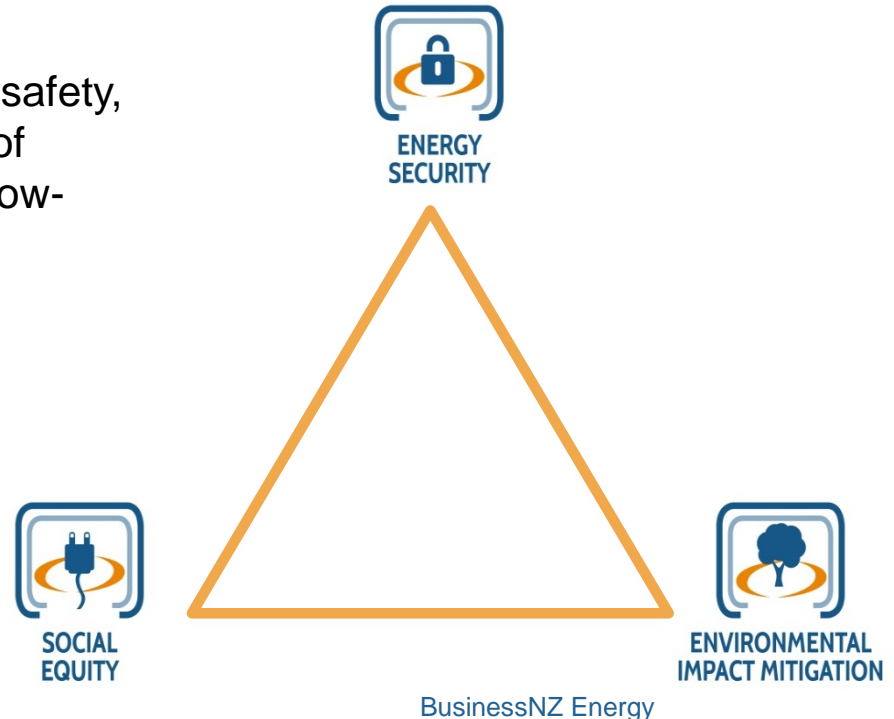
CO<sub>2</sub> emissions, Water, Land use, nuclear safety, Energy efficiencies and the development of energy supply from renewable and other low-carbon sources

**UNFCCC 2° C 450ppm CO<sub>2</sub>**

## Social equity

Accessibility and affordability of energy supply across the population.  
1.2 billion without access to electricity, energy poverty.

**UNSE4ALL by 2030**



# Brief outline of the two scenario stories

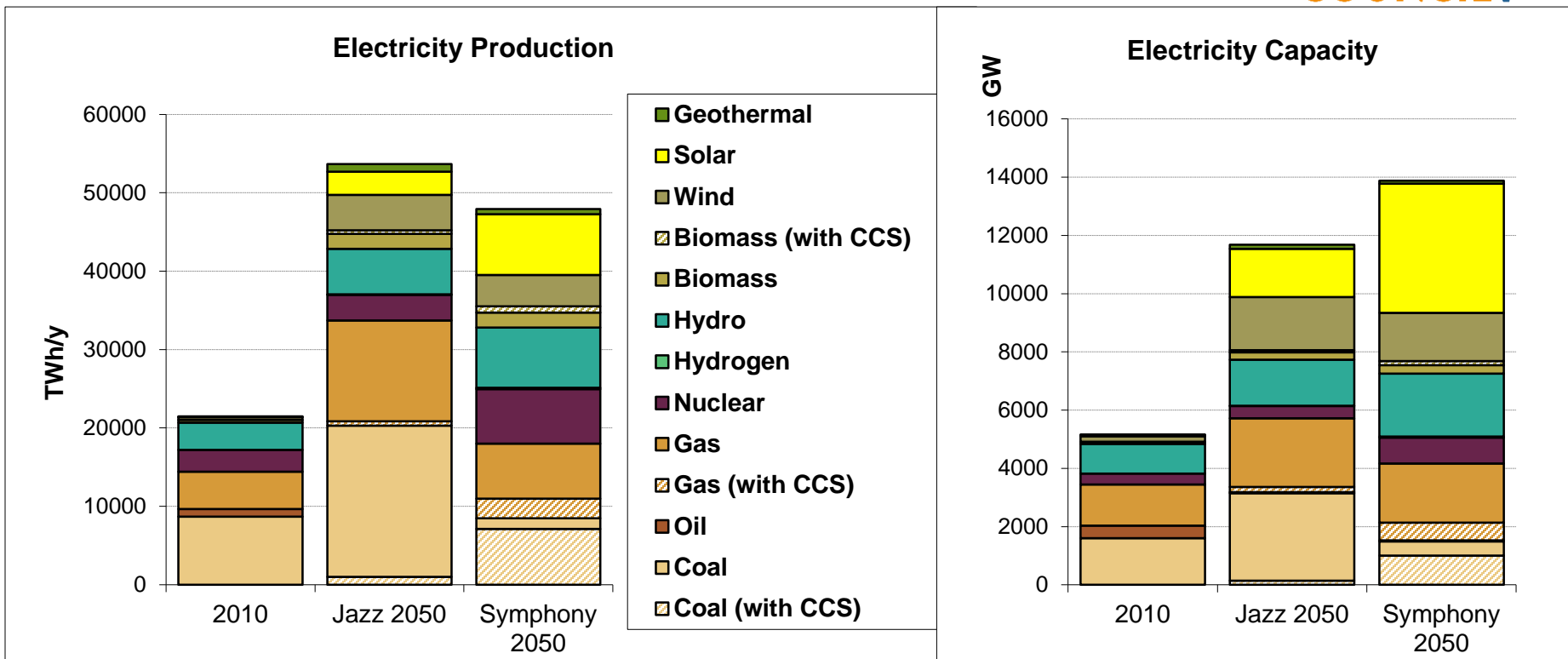
Jazz	Symphony
Price-conscious consumers	Environmentally-minded voters
Competitive markets pick technologies	Governments pick technology winners
Higher GDP due to efficient market practices.	Lower GDP due to non-optimal economic policies
Increased exports due to free-trade strategies	Reduced exports/imports 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

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



# Global Electricity Production and Capacity



## Jazz

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

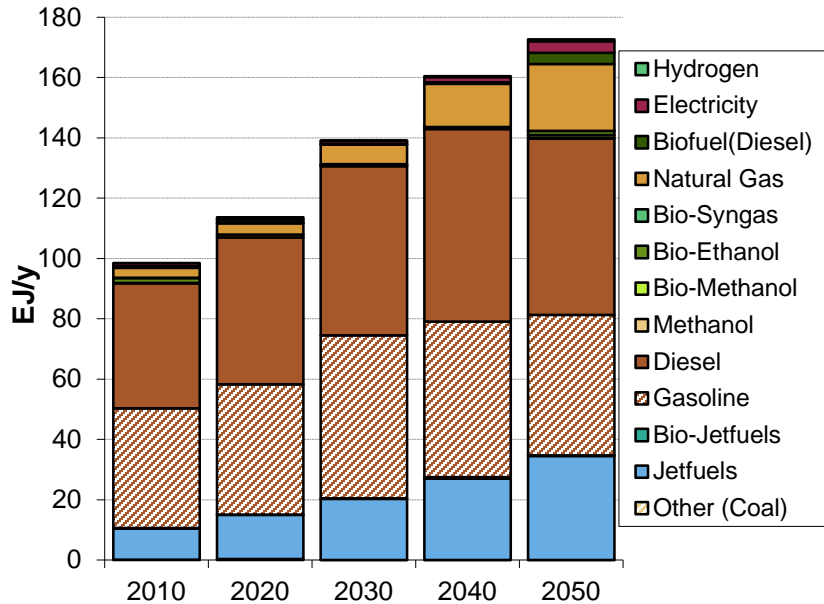
## Symphony

Coal: share drops, CCS increasingly required  
 Nuclear: increasing; led by governments  
 More stable & quicker transition to renewables

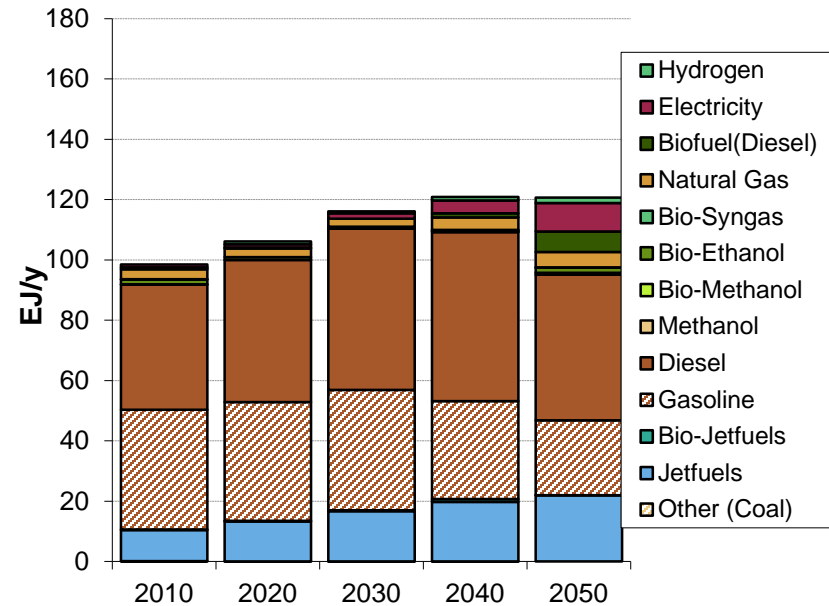


# Fuels in All Transport

Fuels in All Transport



Fuels in All Transport



## Jazz growth leads to higher consumption

Improved access to energy.

Demand increases by 75%

Switch to natural gas

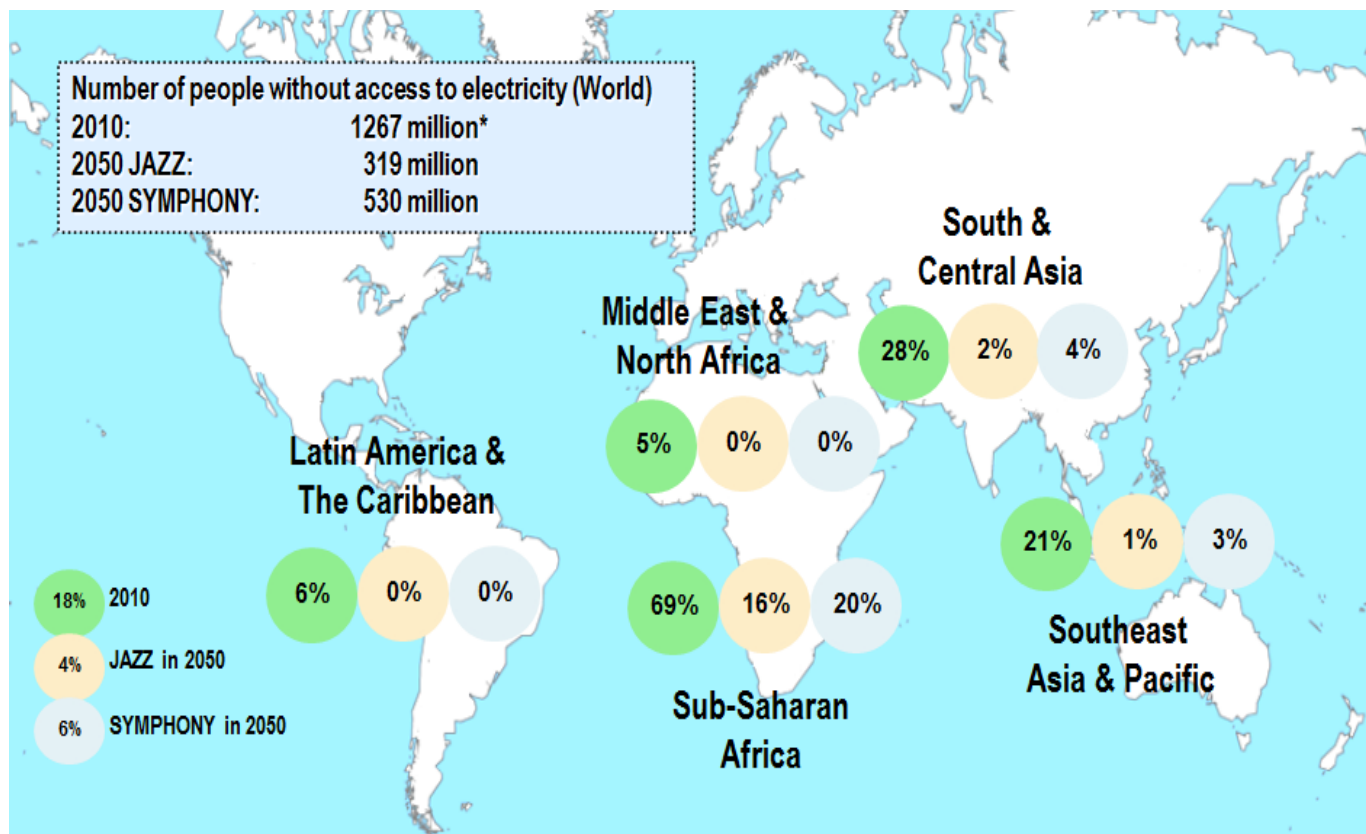
## Symphony +27

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



## **Jazz:** Increase in energy access

Good economic situation; high levels of urbanization,

Electricity access now only a problem in Africa and some parts of Asia

## **Symphony:** Moderate increase in energy access

Government financing of infrastructure projects.

Access improved but is still limited with higher numbers without access.

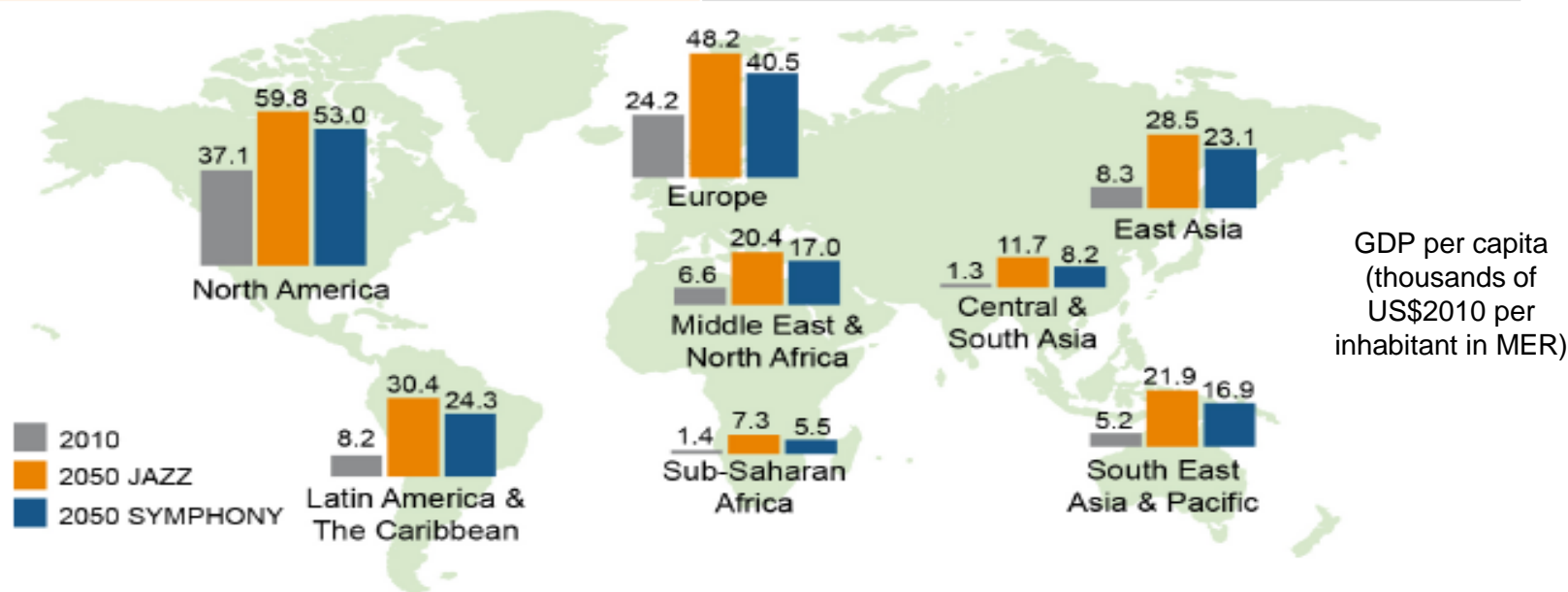
# The WEC Energy Scenarios: Jazz and Symphony

## JAZZ

As an energy scenario, Jazz has a focus on energy equity with priority given to achieving individual access and affordability of energy through economic growth.

## SYMPHONY

As an energy scenario, Symphony has a focus on achieving environmental sustainability through internationally coordinated policies and practices.



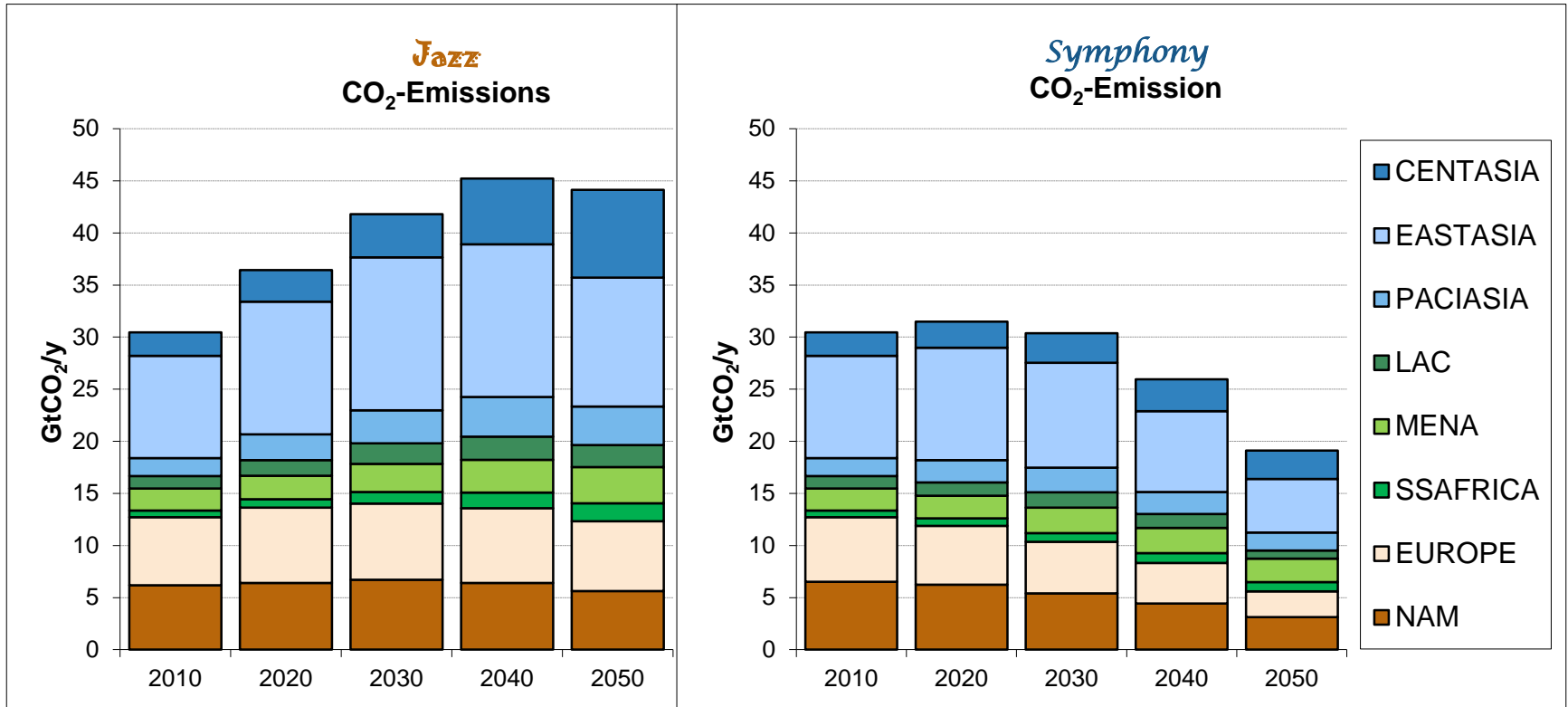
**Jazz:**  
Good economic situation/  
high volatility

World : +2.3% p.a.  
Developed: +1.3% p.a.  
Developing: +3.9% p.a.  
Least developed: +4.4% p.a.

**Symphony:**  
Moderate economic situation/  
less inequality

World: +1.7% p.a.  
Developed: +1.0% p.a.  
Developing: +3.2% p.a.  
Least developed: +3.6% p.a.

# CO<sub>2</sub> emissions by region

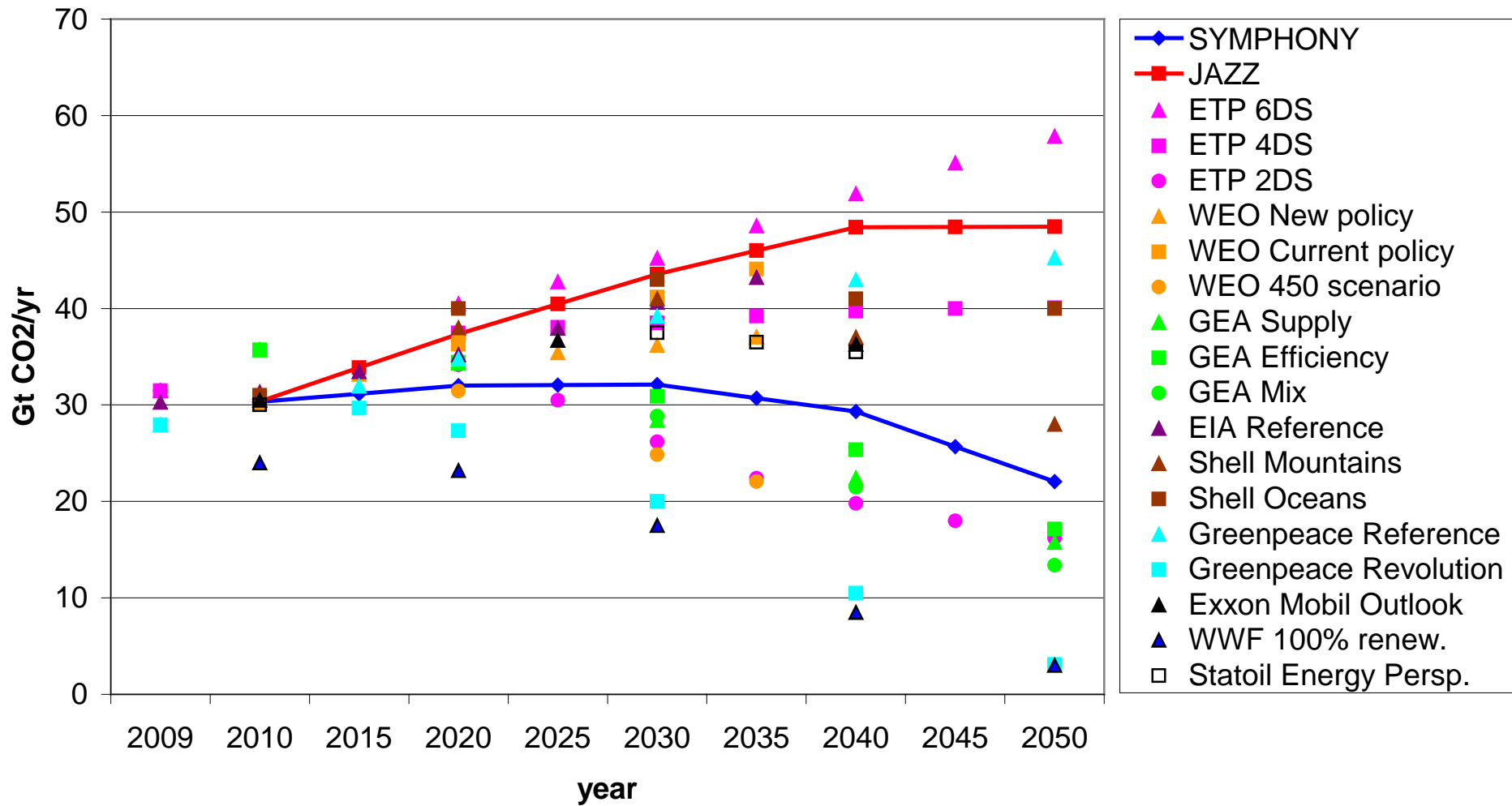


**Jazz**                      **+45%**                      **-37%**                      **Symphony**

Emissions rise and don't peak until after 2040.

Emissions peak before 2030 and drop by over a third  
Still above 2°C target

# CO<sub>2</sub> emissions comparisons





# Energy mix in 2050

- **Energy efficiency** is absolutely crucial in dealing with demand outstripping supply in both Scenarios
- **Coal** remains a dominant fuel in Jazz (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
- **Nuclear** is not a game changer but is important in Symphony
- **Hydro**: great economic potential of hydro electricity generation especially in SSA and LAC
- Share of **renewables** increases in Symphony. Solar takes off.

# New Zealand Country Scenarios BEC 2050

Two Scenarios, unique to NZ, but connected to the rest of the world

- NZ in a “rest-of-world Jazz”: market-led, modest CO<sub>2</sub> price
- NZ in a “rest-of-world Symphony”: government-led, high CO<sub>2</sub> price

**JAZZ**  
**Kayak**



**SYMPHONY**

**Waka**

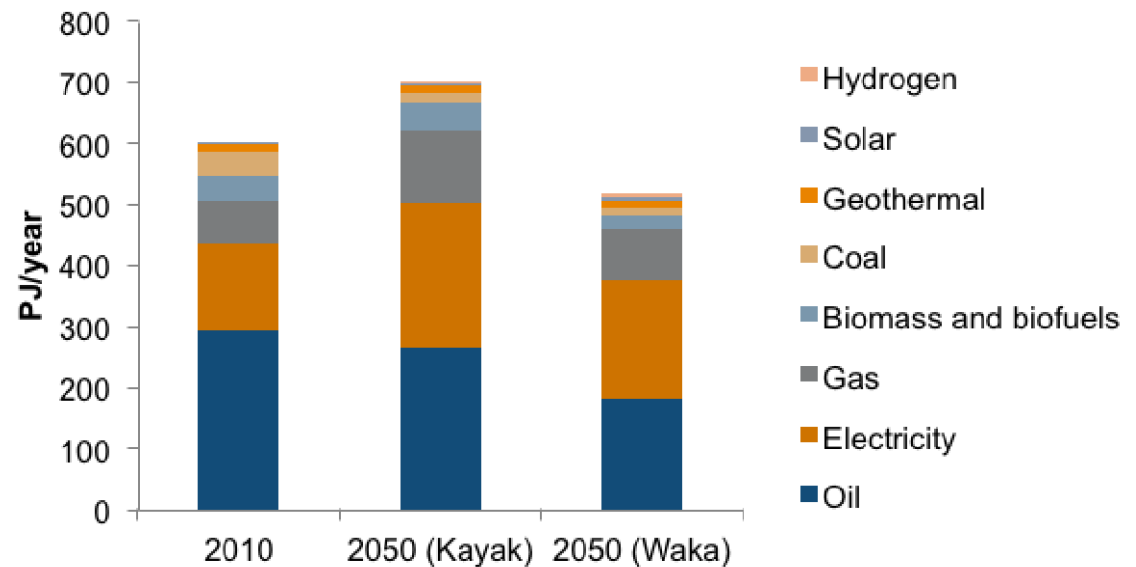


# BEC 2050 New Zealand Scenarios

- Growth in energy demand is not a certainty. Demand rises from 600PJ in Kayak to 700PJ and in Waka drops to 520PJ
- The Electricity mix in 2050 will be mainly renewables,
  - 98% of 600 TWh/y in Waka
  - 85% of 730TWh/y in Kayak
  - Mainly hydro, geothermal and wind, more solar in Jazz because of extra demand.
- Transformative transport sector change is possible
  - 3.2 million new technology vehicles in Waka (out of 4million)
  - Only half as many in Kayak

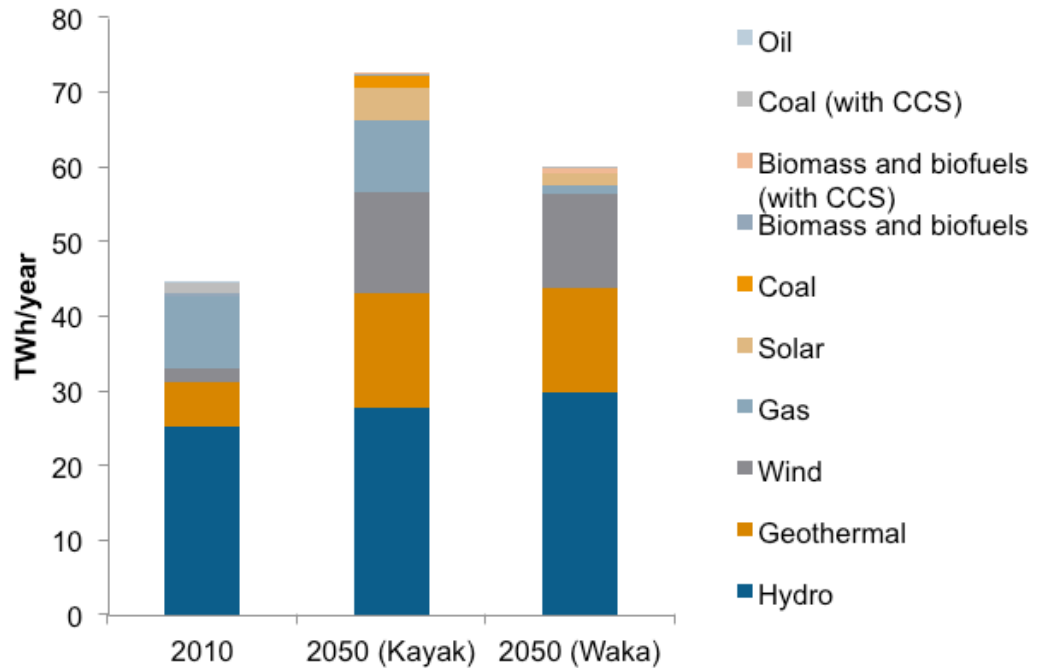
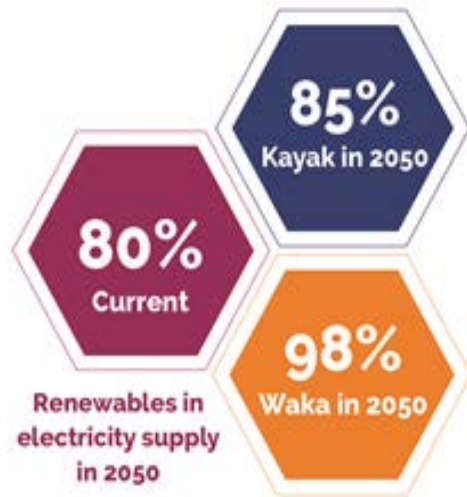


# Growth in energy demand is not a certainty

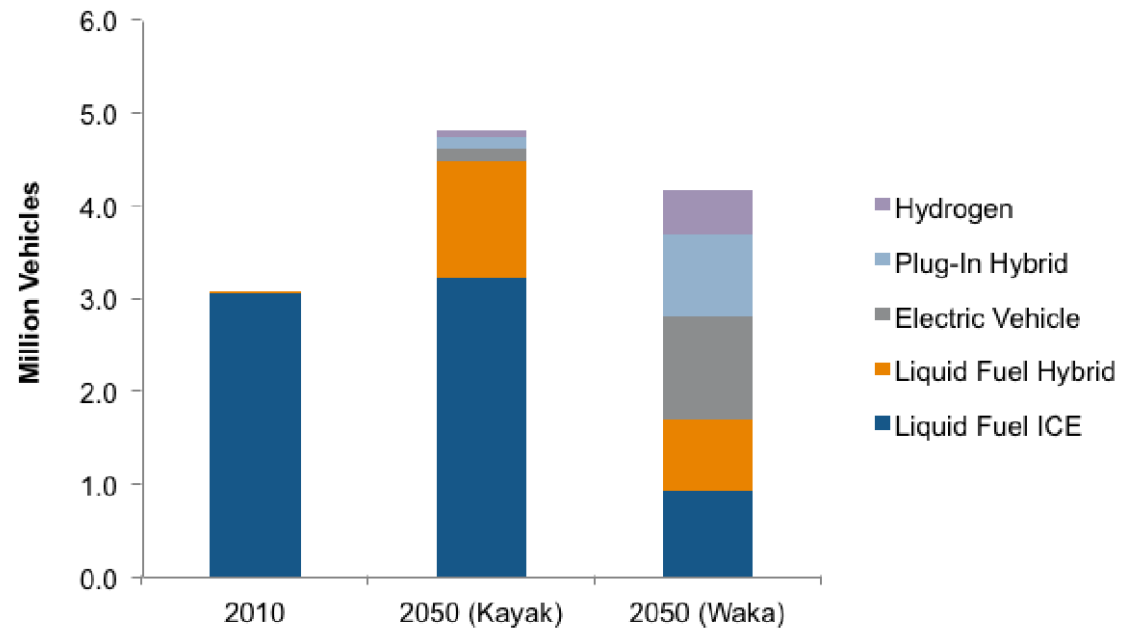
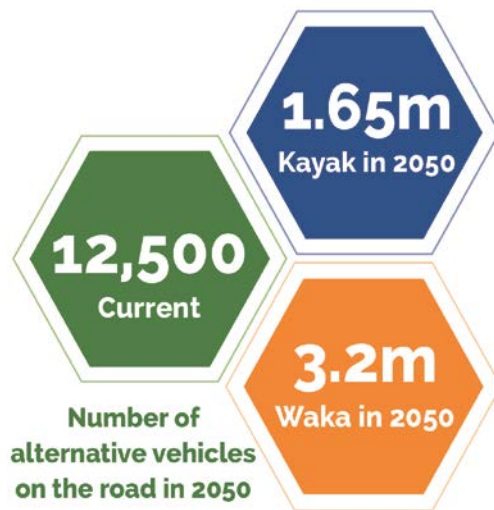




# The Electricity mix in 2050 will be mainly renewables






# Transformative transport sector change is possible



# World Energy Scenarios to 2060

## Key Features

Three scenarios to address the challenges of economic growth, environmental sustainability and geopolitical shifts

	<b>Jazz</b> 	<b>Symphony</b> 	<b>Scenario 3</b> 
<b>Politics</b>	Light touch	Strong governance – climate focus	Weak governance – security focus
<b>Economics</b>	High growth	Moderate growth	Low growth
<b>Society</b>	High energy access Moderate Economic inequity Moderate access to health and education	Moderate energy access Low income inequity High access to health and education	Low energy access High economic inequity Low access to health and education
<b>Technology</b>	Boosts productivity Improves clean energy economics Strong Innovation	Addresses climate change and resilience challenges Improves clean energy economics	Addresses security challenges Improves energy economics
<b>Environment</b>	Moderate de-carbonisation	Strong de-carbonisation	Slow de-carbonisation
<b>Energy dynamics</b>	High demand for energy services Moderate/High Energy intensity High Renewable consumption Moderate Fossil Fuel consumption De-centralized energy systems	Low energy demand Low Energy intensity High Renewable consumption Low Fossil Fuel consumption Centralized energy systems	Moderate energy demand High Energy intensity Moderate Renewable consumption High Fossil Fuel consumption Centralized energy systems



*Embracing New Frontiers*

# 23<sup>rd</sup> World Energy Congress

Istanbul, Turkey 9 – 13 October 2016

## Embracing New Frontiers

Running since 1924, the triennial World Energy Congress is the World Energy Council's global flagship event that enables dialogue among Ministers, CEOs and industry experts on critical developments in the energy sector. As the world's premier energy gathering, the Congress offers a unique opportunity for participants to better understand energy issues and solutions from a global perspective.

Under the theme of "*Embracing New Frontiers*", the 23<sup>rd</sup> World Energy Congress will be held in Istanbul, Turkey from 9 –13 October 2016. The most recent Congress in Daegu, Korea (Rep. of) in 2013 attracted over 7,500 delegates from 123 countries and included more than 50 government ministers.

For further information, please contact Ms. Heidi Reville at [reville@worldenergy.org](mailto:reville@worldenergy.org) and visit the Congress website [www.wec2016istanbul](http://www.wec2016istanbul).

# Conclusions

- Primary Energy increases by 61% in Jazz and 27% in Symphony.
- Lack of access to Electricity decreases from 1.2 billion to 320 million in Jazz and 530 Million in Symphony.
- CO<sub>2</sub> emissions rise by 45% in Jazz peaking in 40's but drop to 63% in Symphony peaking in 20's. We need to do better
- Technology breakthroughs will be the key to reducing CO<sub>2</sub> emissions without compromising energy equity.
- Governments need to take the lead, and then allow the market to drive technology prices down, and incentivise the best technologies.