“Prediction is very difficult, especially if it’s about the future”

Niels Bohr

Thinking Strategically
Investment, policy & scenario development

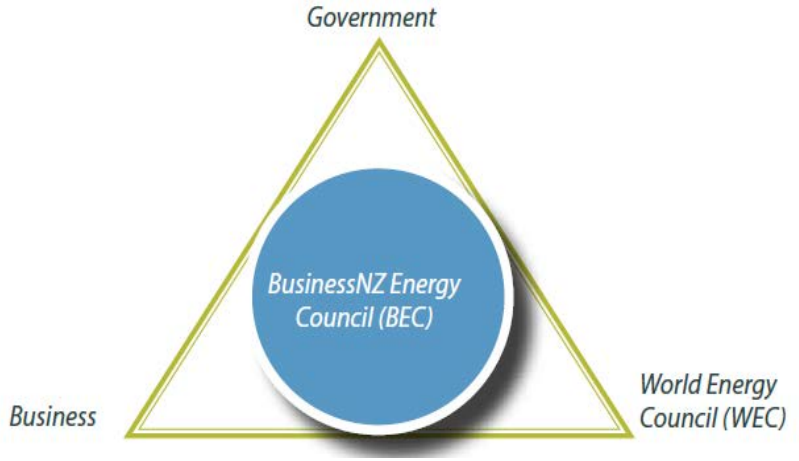
Insights from the BEC2050 Energy Scenarios

John Carnegie, BusinessNZ Energy Council
Auckland University Business School, Energy Centre

Monday 19 February 2018

The BusinessNZ Energy Council

- the BusinessNZ Energy Council ('BEC'):
  - is an apolitical group of New Zealand organisations taking on a leading role in creating a sustainable energy future for New Zealand
  - brings together business, Government and academia
  - is the New Zealand Member Committee of the World Energy Council (WEC)



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Knowing the future

- How do *we* know what New Zealand society and the energy sector could look like in 2050?
- Why do smart people at informed organisations consistently fail to anticipate future trends, disruptions?
- 1985 AT&T hired McKinsey & Co to forecast cell phone adoption by the year 2000
  - their (15-year) prediction 900,000 subscribers
  - the ACTUAL year 2000 number was **<u>109 million</u>**
  - they were off by a factor of 120x

Martin Cooper photographed in 2007 with his 1973 handheld mobile phone prototype

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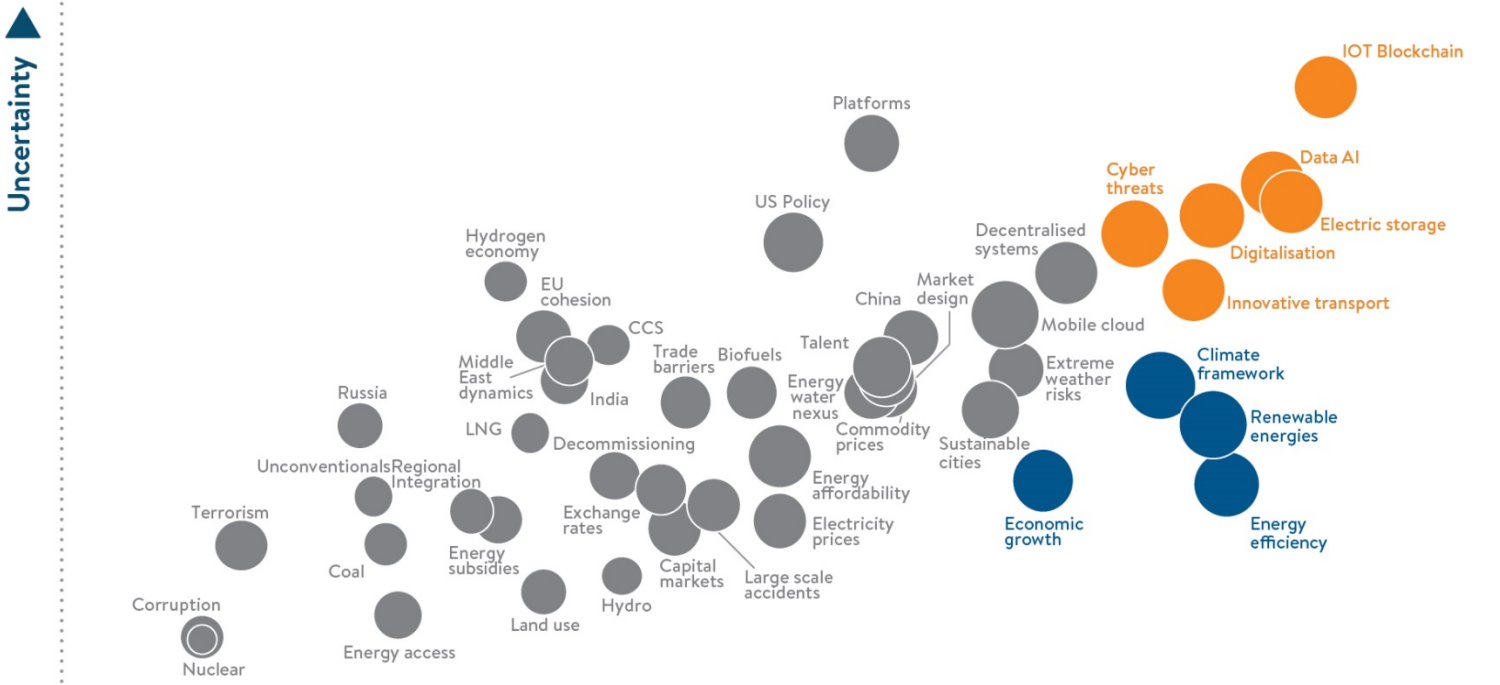
Complexity + speed = uncertainty

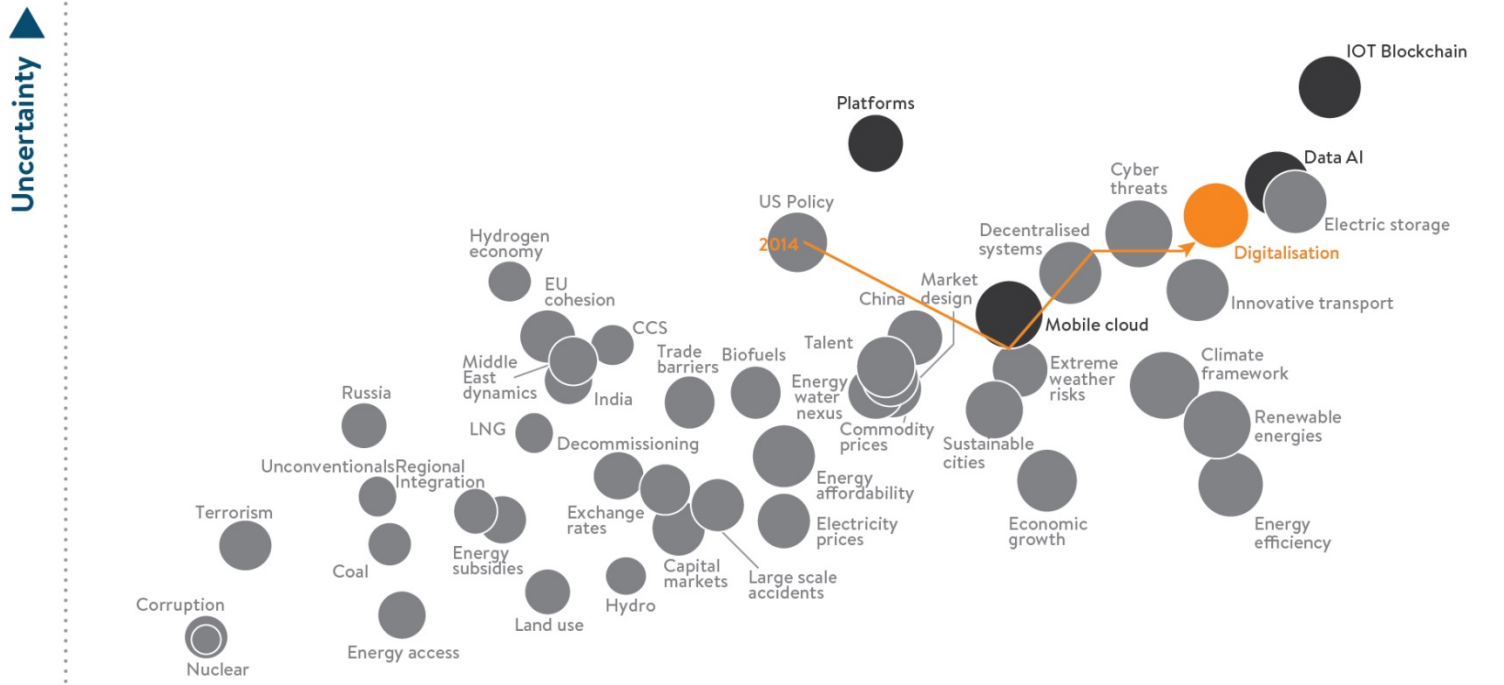
- no longer one investment signal but many
  - still oil, but now multiple regional gas prices, carbon price, solar and battery technology prices
- no more ‘slow’ energy
  - short term was the life of vehicle fleet ~10+ years
  - the impact of US shale oil and gas, collapsing solar and battery prices, rise of the pro-sumer, blockchain, peer-to-peer trading



World Energy Issues Monitor 2018 - New Zealand

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

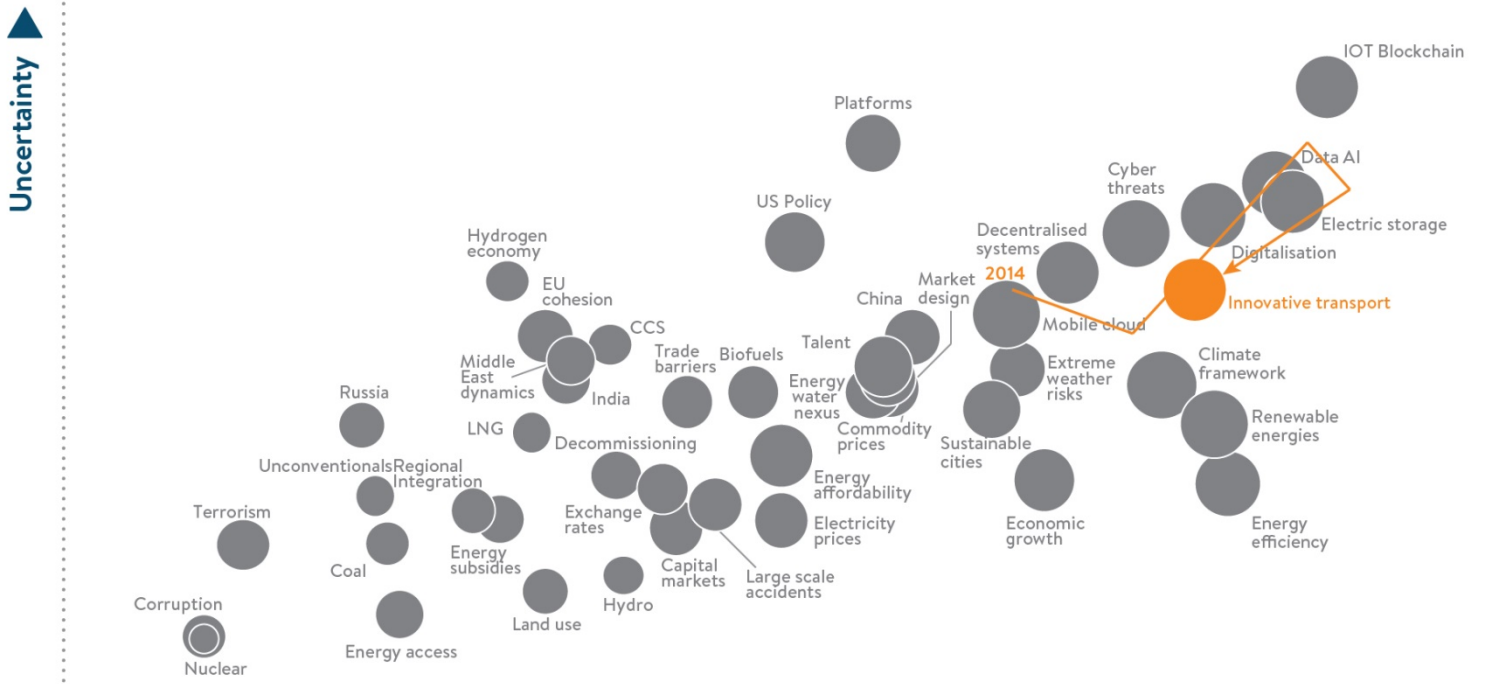
Less urgent — More urgent



World Energy Issues Monitor 2018 - New Zealand - Digitalisation

- Digitalisation: Time tracking from 2014 to 2018
- Associated issues around digitalisation

Less urgent — More urgent



World Energy Issues Monitor 2018 - New Zealand - Innovative Transport

● Innovative Transport: Time tracking from 2014 to 2018

Less urgent ○ ○ ○ More urgent

Uncertainties are non-trivial

- We’re not talking about variables which have a prospect of only a minor variation

- Played out over decades, each of the uncertainties could produce a substantially different outcome
  - the presence of strong or weak climate change action globally
  - the compounding effects of growth in our major trading partners
  - the transformational potential of alternative transport on our energy system

Emerging technology – a case in point

- Trivial or non-trival impact?
  - sensors / internet of things
  - artificial intelligence / machine learning
  - robotics
  - solar PV
  - energy storage
  - 3D printing / visualization
  - mobile internet & cloud
  - big data / open data
  - unmanned aerial vehicles / Nano-satellites
  - crypto-currencies / blockchain

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Our Goals

- Two goals, to
  - develop a set of “New Zealand energy stories”, narratives based on distinct policies and business practices,
  - provide country-specific quantified information to inform future policy and investment choices and trade-offs
- Work was informed by the scenario output of the World Energy Council, and its modeller, the Paul Scherrer Institute

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Scenarios – why?

- scenarios help us to:
  - tell more impartial stories of the future (liberate bias)
  - make “critical” areas of uncertainty transparent
  - be explicit about what drivers we can and can’t control
  - road test policy and investment decisions under different worlds (trade-offs)
- and, with judicious use of modelling, we can quantify this, and bring it out of the “too hard basket”
- **this builds resilience into our future decisions**

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Our starting point

- we've been working on energy sector scenarios since 2014
- our scenarios
  - integrate the inner workings of the diverse energy system
  - for a given set of coherent assumptions ("storylines"), tell you where you're likely to end up; they aren't constrained by a pre-determined outcome
  - by systematically varying the storylines, give insight into which variables (including policy levers) matter in pursuing a particular direction
- this is important given the uncertainty we face

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What scenarios are, and are not

- they are plausible alternative stories of the future

- they are not
  - predictions
  - answers
  - policy prescriptions
  - recipes to follow

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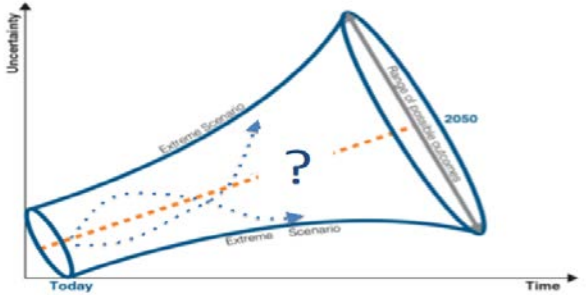
Recognising good scenarios

- Scenarios should be:
  - *plausible* – not a prediction, but a believable scenario about the future
  - *distinct* – to succeed, the narratives have to be different
  - *coherent* – the narratives have to be internally consistent (especially for interconnected sectors)



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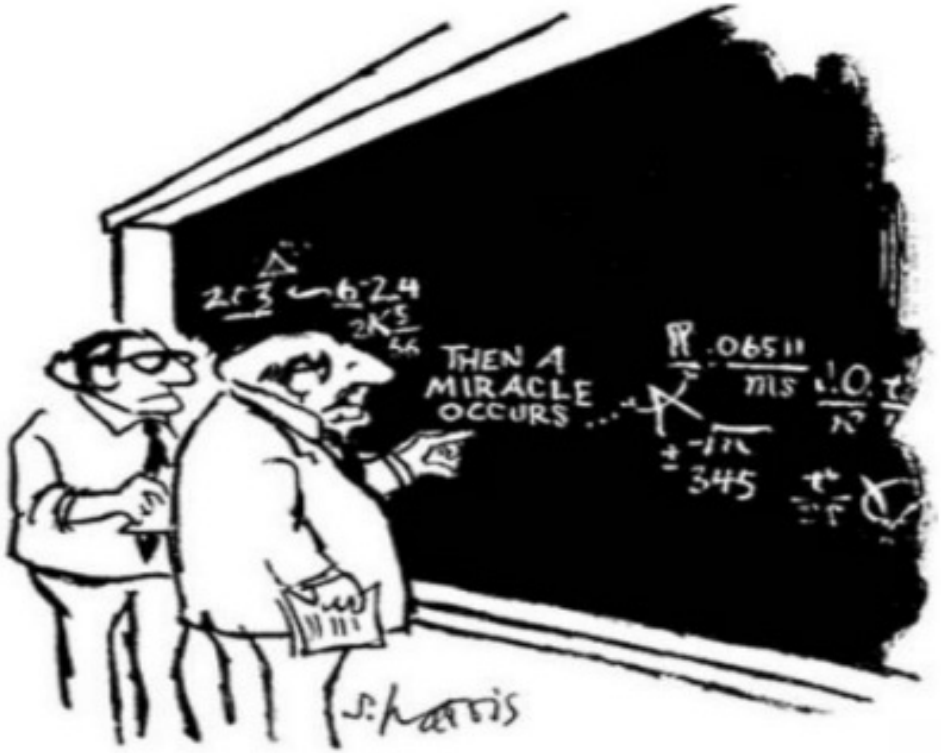
Scenario strengths/weaknesses

- Approaches to scenarios differ as a result of:
  - explorative vs normative
  - internally vs externally developed; breadth of contributors
  - narratives only vs underpinned by integrated modelling (allowing sensitivities)
  - degree to which internal consistency is enforced

Otherwise we get this...



"I think you should be more explicit here in step two."

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Thinking about the future

- what are the critical uncertainties facing the New Zealand society and the New Zealand energy sector specifically through to 2050?
  - the question is based on what you think *might* happen by 2050 not what you *want* to happen by 2050

A thought exercise

- think about:
  - what critical uncertainties would have been written down 32 years ago i.e. in 1986?
  - what changes have you seen since 1986?
- how many of those changes could you have anticipated?

In 1986

- these things weren’t yet invented
  - GPS (1989)
  - Sony playstation (1994)
  - DVD players (1996)
  - MP3s (1998)
  - Google (1998)

Thinking about uncertainty

- while our focus is on the energy system, the process by which we discover critical uncertainties spans disciplines like geo-politics, technology, the economy, politics, psychology and history

- we think about critical uncertainties through the following lens:
  - economics/finance/trade
  - resource availability and access
  - energy system and technologies
  - consumer behaviour and acceptance
  - government policies

BEC 2050 CRITICAL UNCERTAINTIES	1 OF 2 TWO POSSIBLE SCENARIOS	1 OF 2 TWO POSSIBLE SCENARIOS
Impact of climate change on NZ economy and society's resilience	2 degrees - adaptation, manageable change	4 degrees - wholesale mitigation, but risk of vulnerability
International agreement including pricing carbon	Low price (no global acceptance)	High Price (global acceptance)
Extracting hydrocarbons for domestic consumption	No finds	Large finds, extracted
Smart infrastructure, incl domestic scale generation and battery	Low uptake	Full penetration
Vehicle fleet transformation to non-fossil fuels	Total substitution across domestic, commercial and heavy fleet	Low uptake of domestic vehicles
Renewables	0% Carb…	Current trend of mixed thermal vs renewable
Energy efficiency		
International energy markets	NZ self-sufficient	Reliant on imported energy
Econo…		
Disrupted world ec… stability	…hatches ("Fortress NZ")	…economy, trade etc.
NZ's economic structure…	…driven	…y
Population growth	…tant rate of growth	Massive immigration
Urban form/sustainability	Heavily built urban environment	Lifestyle living dispersed
Energy affordability	Affordable for whole community	High level of fuel poverty
Community acceptance of large infrastructure development and resource utilisation	Everything goes	Limited ability to develop large infrastructure
Governance and decision making	Extreme deregulation	"Big Brother"
Nature of digital technology and security	Knowledge economy, universal access	Manipulative control
Environmental standards	Total land/water degradation	"100% pure"

Energy efficiency

Low uptake

High uptake (manu… makes sense, Green consu…

International energy markets

NZ self-sufficient

Reliant on imported energy

…conomic growth

Prosperity

Auste…

Climate

Energy System

Economy

Society and Government

Getting our stories straight

BEC 2050 CRITICAL UNCERTAINTIES	1 OF 2 TWO POSSIBLE SCENARIOS	1 OF 2 TWO POSSIBLE SCENARIOS
Impact of climate change on NZ economy, ecology and society's resilience	2-3 degrees – low impact, adaptation, manageable change	3-4 degrees – high impact, but risk of vulnerability
International agreement including pricing carbon	No global agreement, low ambition	Global agreement, high ambition
Extracting hydrocarbons for domestic consumption	No finds	Large finds, extracted
Energy system related technology development, breakthroughs and adoption	Evolutionary	Revolutionary
Vehicle fleet transformation to non-fossil fuels	Total substitution across the whole vehicle fleet, rail & public transport	Low uptake of light passenger vehicles only
Primary energy	0% Carbon	Current trend of mixed thermal, hydrocarbon and renewable energy
Energy efficiency	Low uptake	High uptake (mandated standards, RoI makes sense, Green consciousness)
International fuel markets	NZ self-sufficient	Reliant on imported energy
Economic growth	4%	1%
Global stability	Stable global landscape, high NZ integration	High instability low New Zealand integration (Fortress NZ)
NZ's economic structure	Higher energy intensity (industrial, primary)	Transformation to low energy intensity (knowledge – weightless)
Population growth	5,700,000 (see Stats forecast or +1% compound)	10,000,000 (+4% compound)
Urban form/sustainability	Heavily built urban environment	Building out – low intensity
Energy equity	High equity	Low equity
Community acceptance of large infrastructure development and resource utilisation	Everything goes	Limited ability to develop large infrastructure
Governance and decision making	Light handed regulation and intervention	Intervention, command and control
Nature of digital technology and security	Productivity transformation	Poor utilisation of potential, high sovereign risk
Environmental standards	Declining air/land/water quality	Towards world class environmental standards
Allocation of natural resources esp. water	Generally locked up, high cost and tradable	Common good generally accessible and low cost

=»

Accommodating new technology

- due to the sheer complexity of what is underway in terms of change (as per slide 11), scenarios needs to be focused in terms of what you're trying to achieve

- trying to account for say, all new technologies, risks either being:
  - incoherent (i.e., assumptions aren't joined up), or
  - ridiculously specific by focusing on one or two assumption sets (of potentially thousands), or
  - impossibly complicated

Two storylines

- created two narratives, unique to New Zealand, but connected to rest of the world

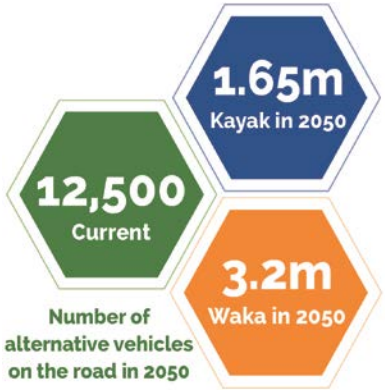
THE KAYAK SCENARIO **NZ in a "rest-of-world Jazz": market-led, modest CO_2 price**

THE WAKA SCENARIO **NZ in a "rest-of-world Symphony": government-led, high CO_2 price**

Narrative 1: Kayak
Narrative 2: Waka

BEC2050 insights

- heavy interplay of electricity, renewables, transport, emissions reductions
  - further emissions reductions in electricity possible, but.....
  - transport can leverage renewable electricity and achieve significant emissions reductions
  - relativity of oil, electricity price, carbon price and technology (battery, solar) costs crucial
- but it's more than just EVs....



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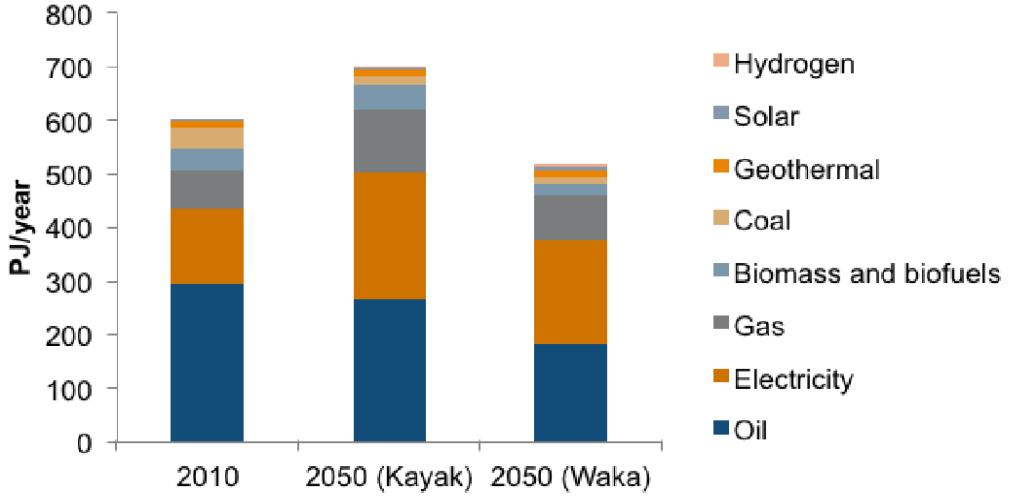
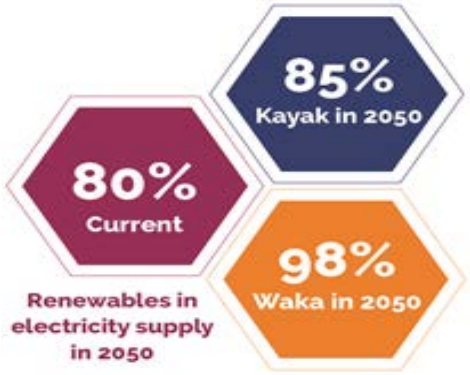
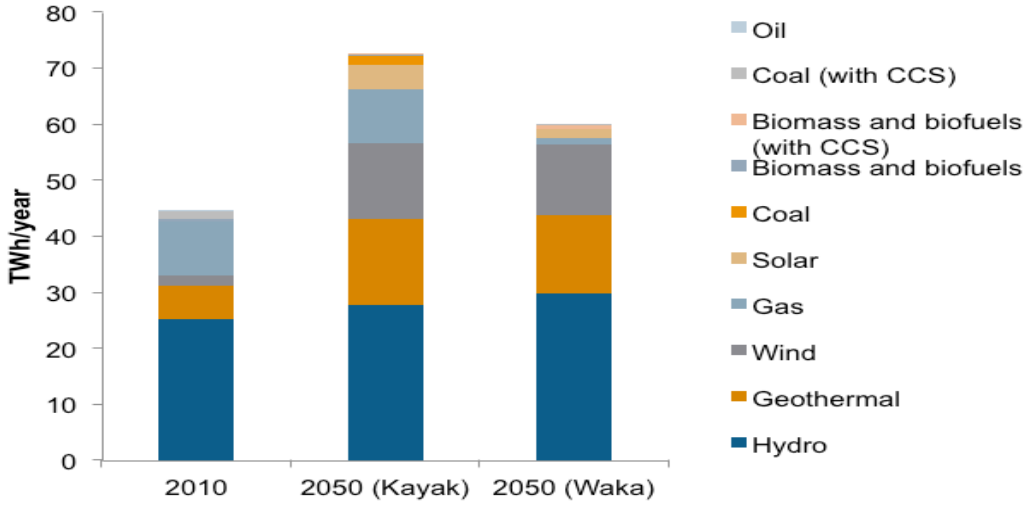
Overall energy demand down?



A renewable electricity future





Proportion of renewables in electricity

80% TODAY

86% 2030

97% 2030

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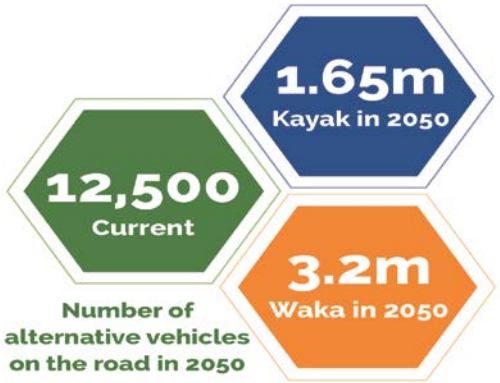
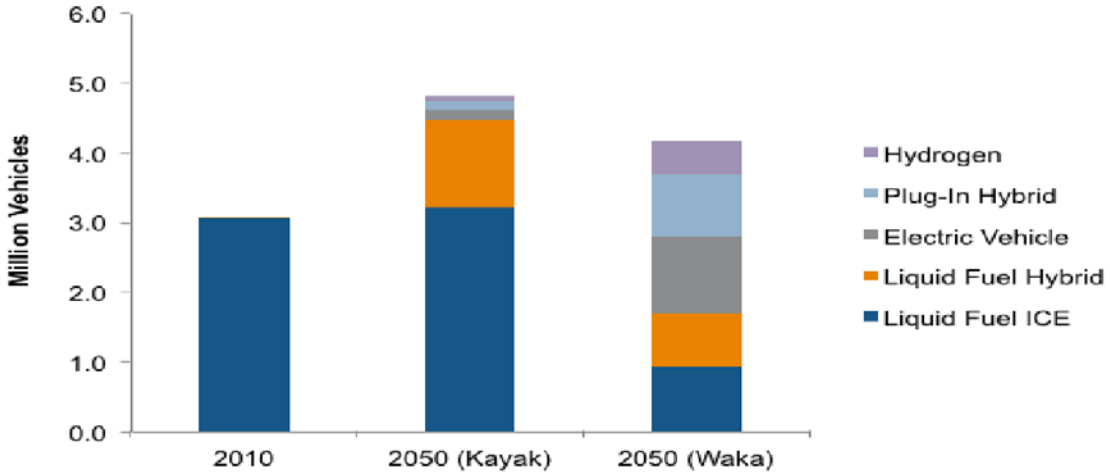
Changing transport modes?





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Key insights/questions

- our work illuminates NZ's key energy sector scenario differences and drivers
- they allow us to pose the 'what-if' questions about things that are genuinely uncertain – e.g. how do we get Waka-magnitude emissions reductions (and more) if we have
  - higher population/economic growth
  - lower carbon prices
  - lower uptake of new technology
  - slower behaviour change
- **what are the resilient policies that will encourage us towards outcomes we seek in light of this uncertainty**

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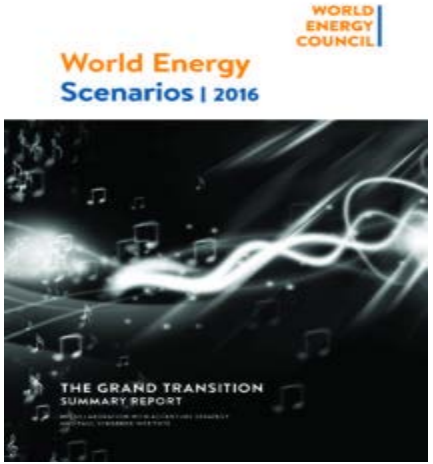
What next: BEC2060

- WEC just released its new scenarios report out to 2060
- three scenarios
  - **Modern Jazz** - a ‘digitally disrupted,’ innovative, and market-driven world
  - **Unfinished Symphony** - a world in which more ‘intelligent’ and sustainable economic growth models emerge as the world drives to a low carbon future
  - **Hard Rock** - a more fragmented scenario which explores the consequences of weaker and unsustainable economic growth with inward-looking policies
- we have just commissioned a whole of New Zealand energy sector model build for BEC2060 scenarios
- BEC2060 energy scenarios and modelling can move to the next level of analysis and insight
  - has detailed modelling capability to assess costs and options



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Summary

- Scenarios
  - are a useful addition to the regulatory and commercial conversation
  - can deliver unparalleled insight
  - are vital to a more strategic approach to thinking about the future energy system

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Thank you

John Carnegie
jcarnegie@businessnz.org.nz
Twitter @JohnCarnegie7, @BusNZEnergy

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