



New Zealand's EnergyScape

Hydrogen in New Zealand's Energy Future
General Stakeholders Meeting
Wellington

Anthony H Clemens (CRL Energy)
16th July 2008



Structure of Presentation

2000

2005

2030

2050

- The World
- The New Zealand Context
- Scenario Modelling
- An FCEV Uptake Scenario
 - Sensitivity Analysis
- A Future to Aspire to
 - Hydrogen FCEV Uptake
 - Milestones and Research Activities

The World

2000

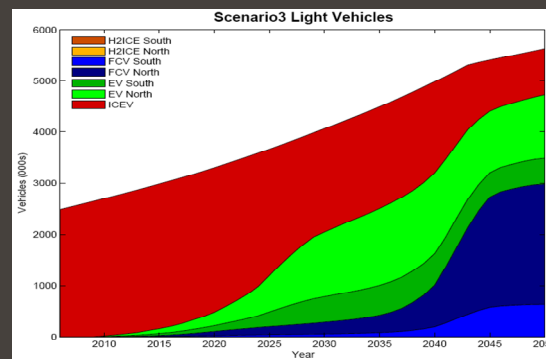
2005

2030

2050

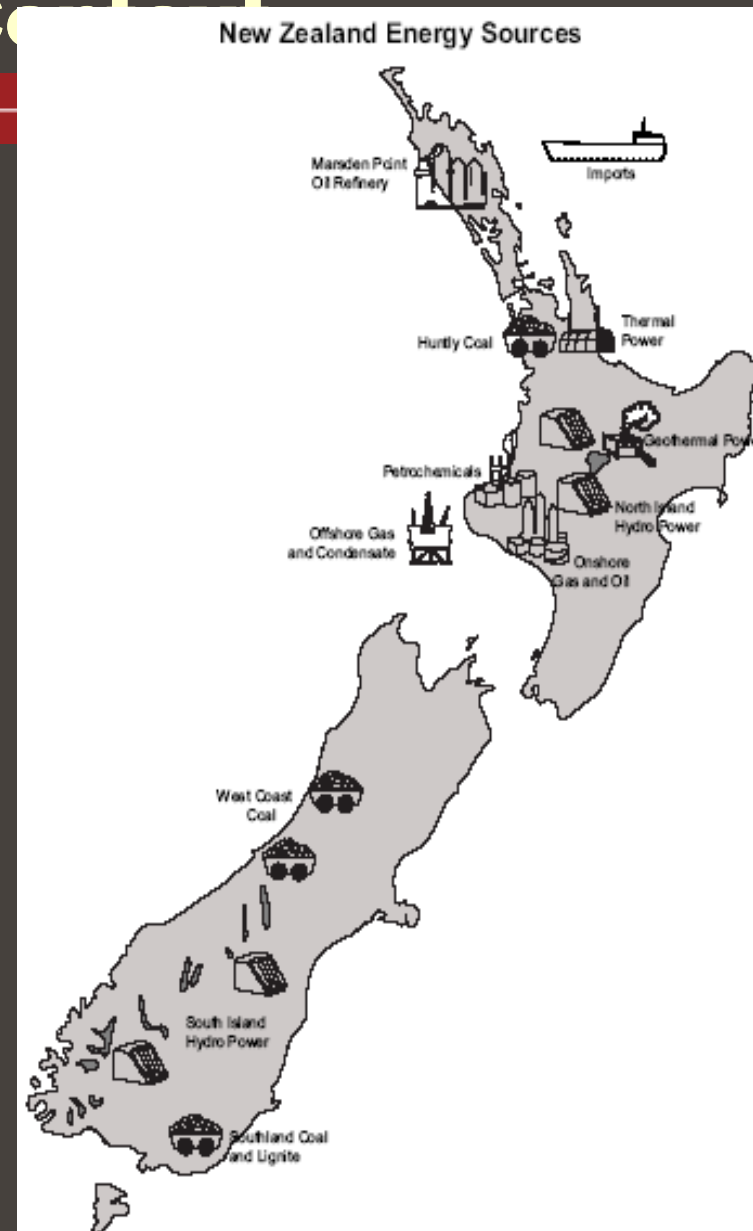
- “Leave oil before oil leaves us.”
 - Fatih Birol Chief Economist IEA May 2008

The contribution of hydrogen FCEVs towards delivering a secure, affordable, low carbon future.



The New Zealand Context

Higher dependency
on imports than
most countries ...
High vehicle
ownership



2050

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Transport Options

2000 2005 2030 2050

- Mechanical Drive
 - Fossil fuel ICE
 - Biofuel ICE
 - Hydrogen ICE
- Electric Drive (plug in option)
 - Fossil ICE hybrid EV (e.g. the Prius)
 - Biofuel ICE hybrid EV
 - Hydrogen Fuel Cell EV
 - Battery EV

Advantages of hydrogen

2000

2005

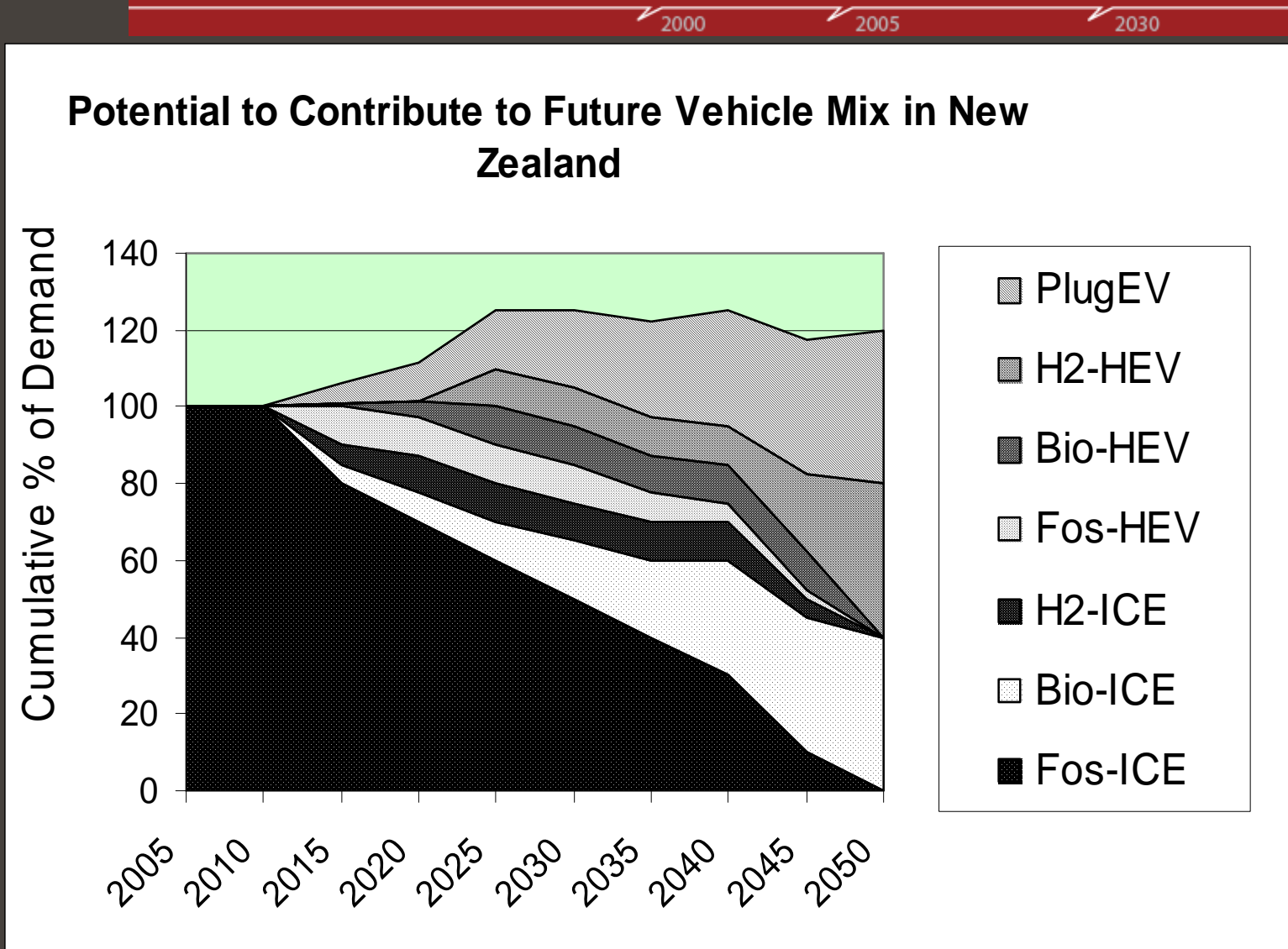
2030

2050

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Transport Options - A Cascade of Potential Solutions





Honda Clarity FCEV Feb 2008

Lease \$600 per month <- Not a reflection of cost!! => Misleading...

60% efficiency

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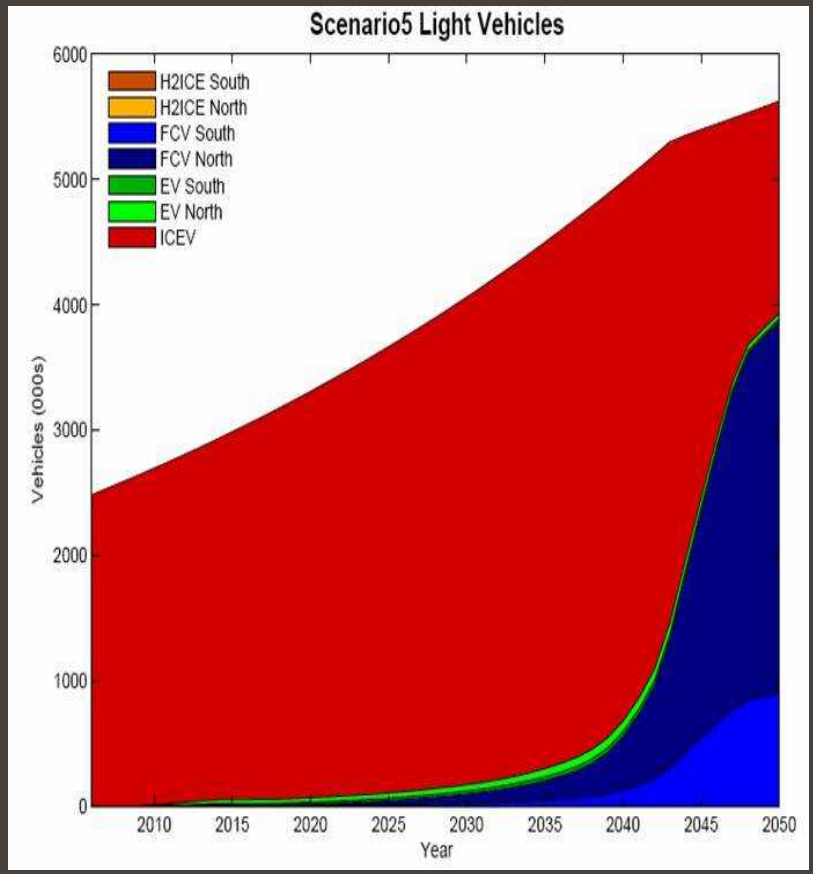
NIWA
Taihoro Nukurangi

Scenario Modelling

2000 2005 2030 2050

- UNISYD – identifies most economic option for meeting scenarios (optimising dynamic equilibrium model)
- Describes energy systems and the impacts of new technologies on them
- Includes a Technology Preference setting capability
- Includes 15% addition for FCEV infrastructure
- Assumes cost parity with ICE vehicle in 2030

An FCEV Scenario



69% FCEV/31%ICEs

Hydrogen requirement 750 kt @
\$4.75/kg <= Feedstock only!!

89% Renewables in electricity mix
(2025)

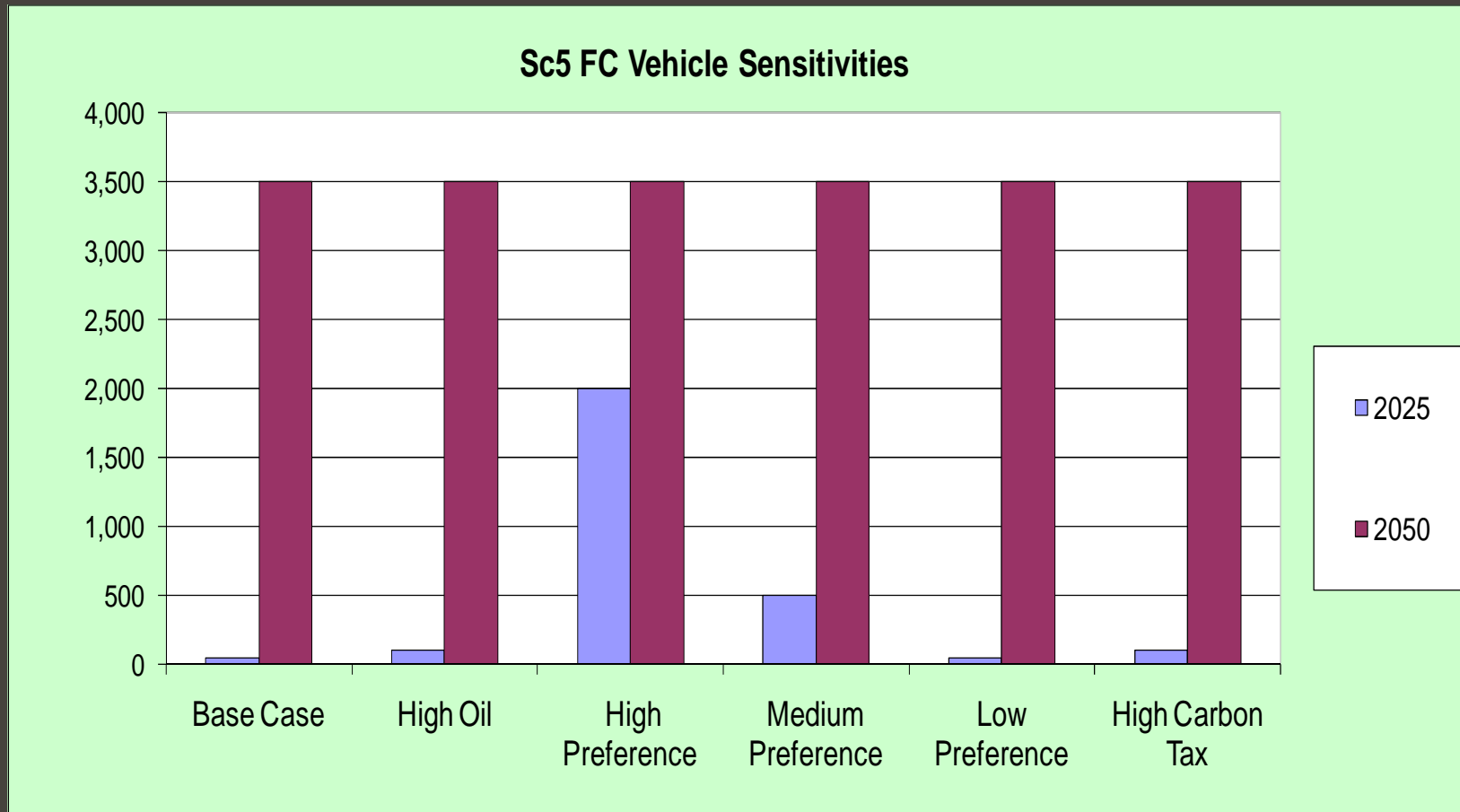
CO₂ emission reductions (2040) up to
40%

Oil Price NZ\$80/bbl

Carbon Charge: NZ\$25 (\$75)/t_{CO2}

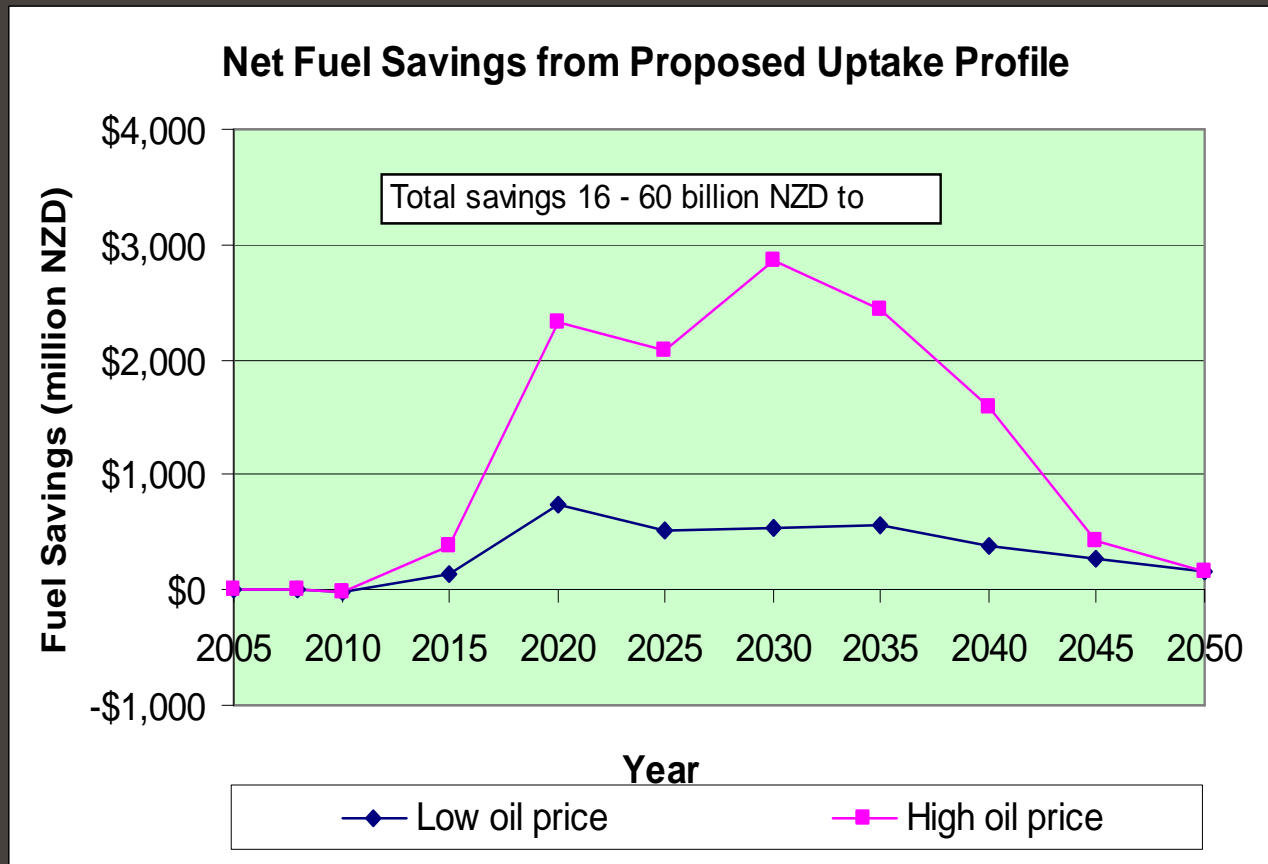
FCV Preference: Low: 60%

FCEV Scenario Sensitivities



Sensitivity Analysis

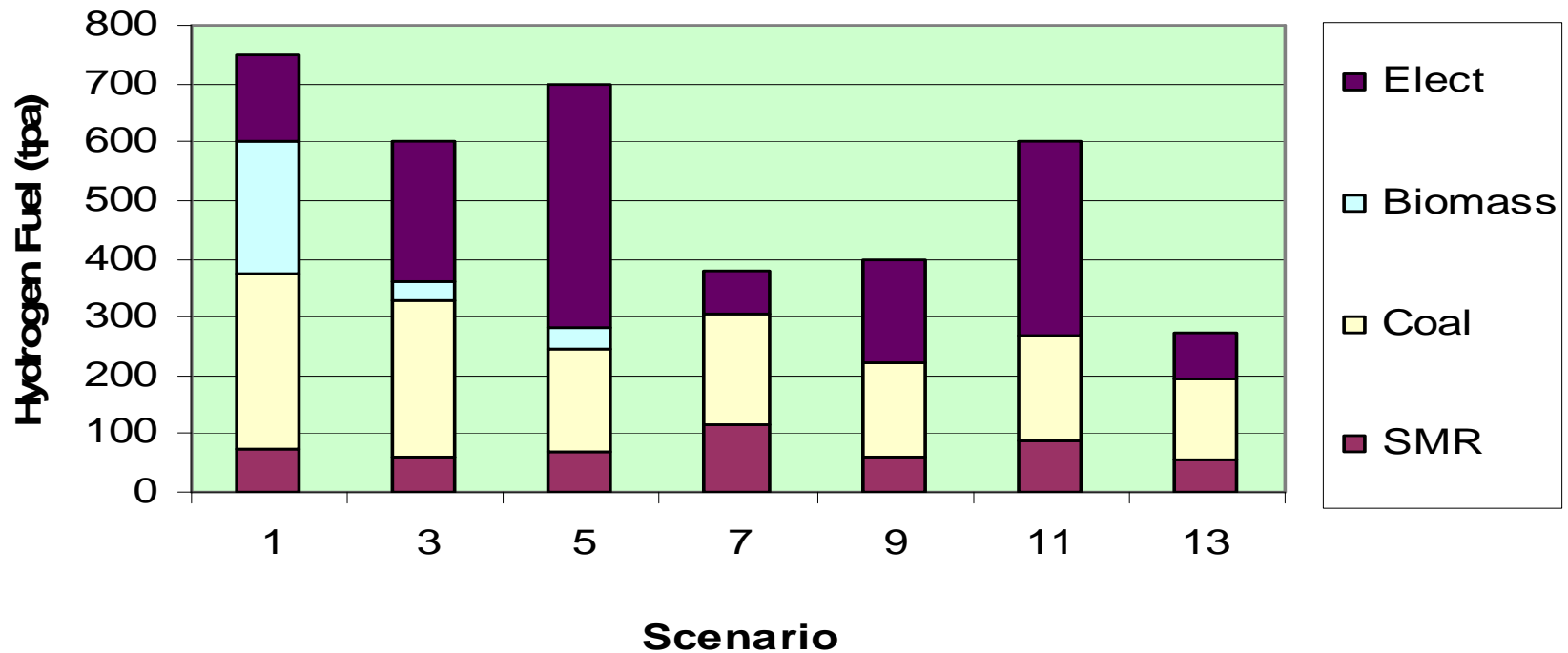
2000 2005 2030 2050



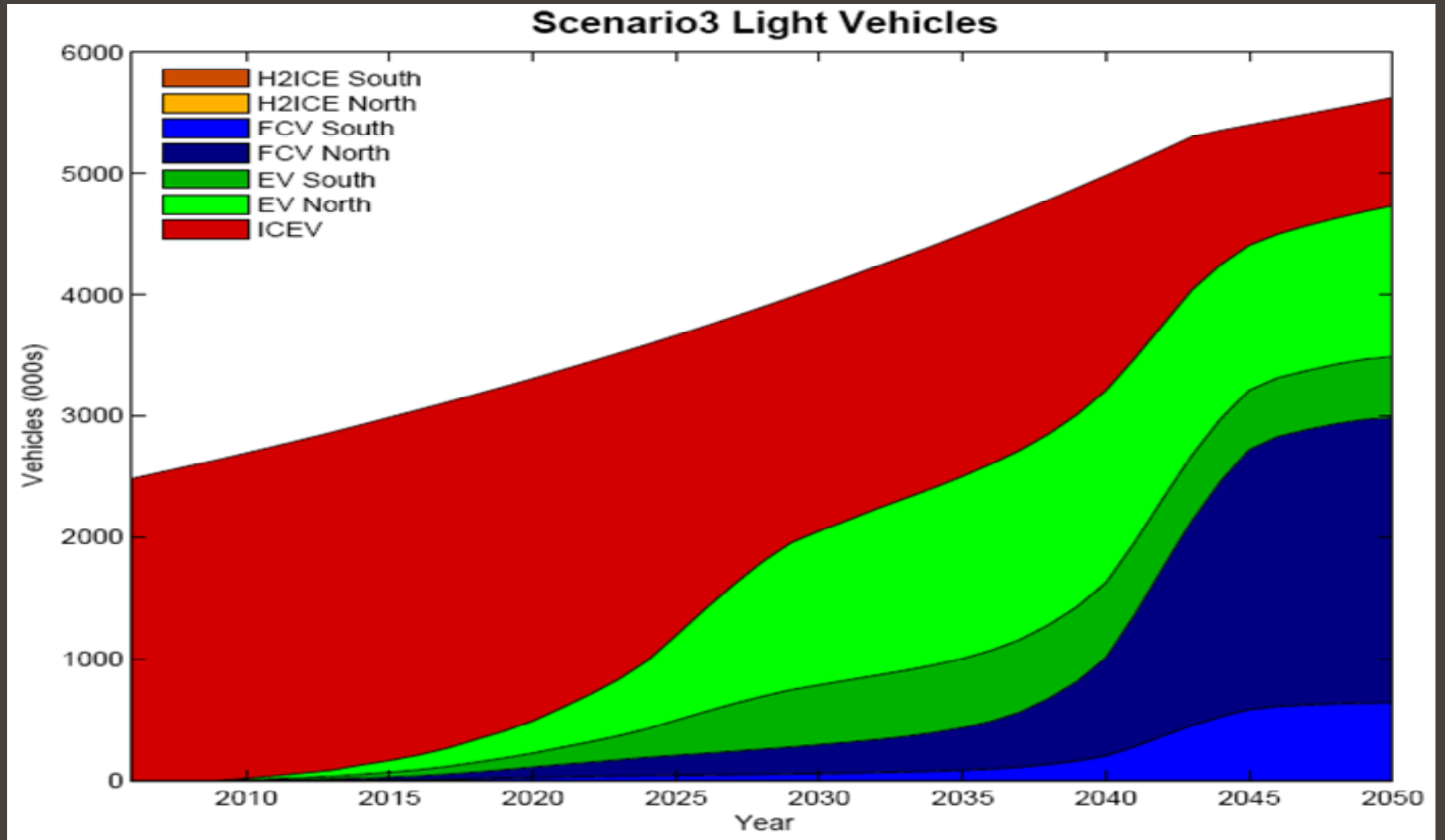
Major Hydrogen Supply Chains

2000 2005 2030 2050

2050 Hydrogen Production Mix



A Future to Aspire to

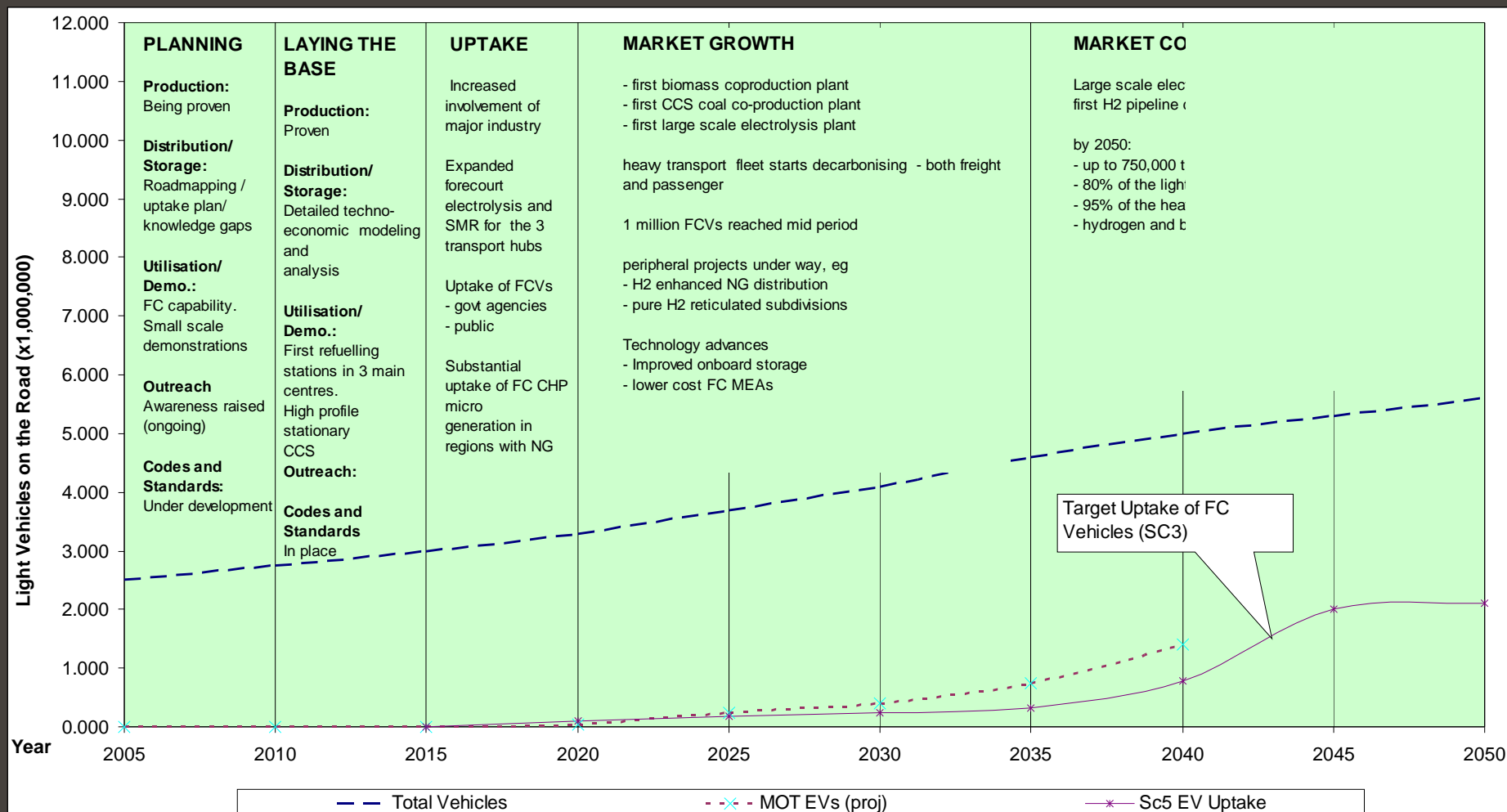


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A Future to Aspire to and how to get there - FCEV Uptake Milestones

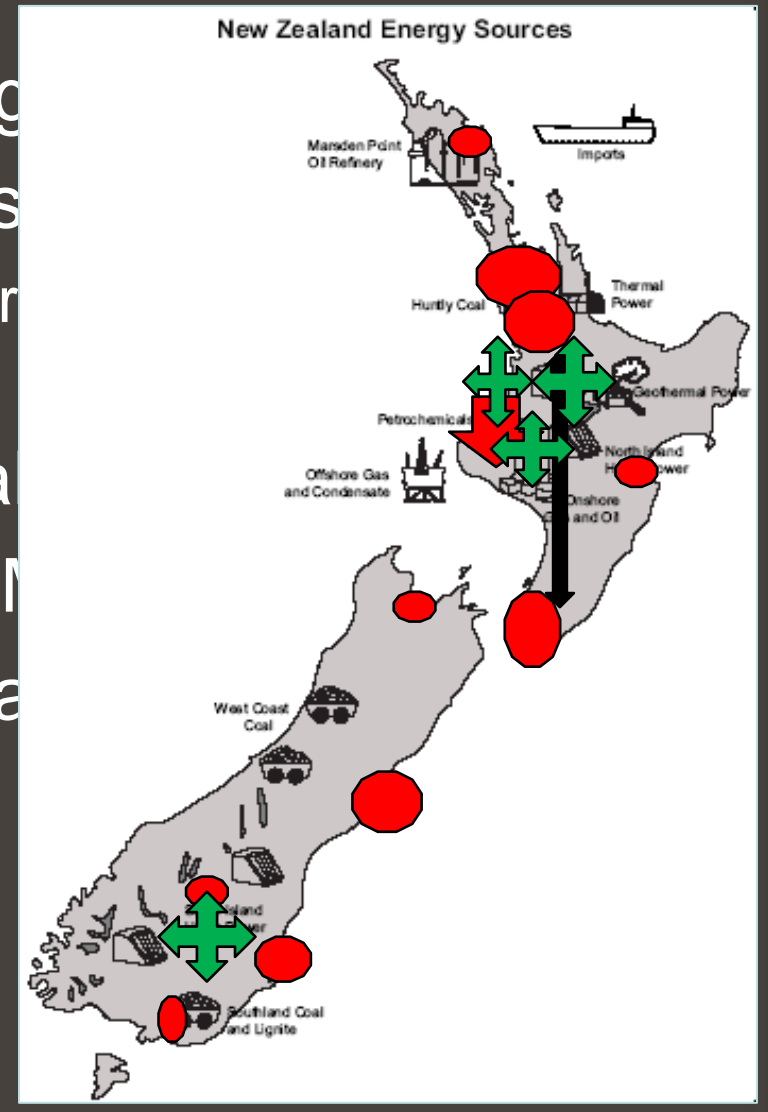
2000 2005 2030 2050



Future aspiration

- First Phase (to 2010) Planning
- Second Phase Laying the Base
 - Government research critical through phases
- Third Phase Technology Uptake
- Fourth Phase (2020 to 2035) M
- Fifth Phase (2035 to 2050) Ma

2000 2005 2030 2050



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Future aspiration (milestones to 2015)

2000 2005 2030 2050

- Steam Methane Reformation and Grid Electrolysis for Forecourt Refuelling (3 cities)
- 30 FCEVs
- 100 residential/ commercial CHP
- Transport (if required) by truck
- CCS demonstration

A Future to Aspire to FCEV Milestones 2015 to 2020

2000

2005

2030

2050

- Refuelling stations upscaled
- 20,000 CHP units in North Island (natural gas)
- 5,000 CHP units in South Island
- Up to 50,000 light FCEVs on road
- 10,000 tpa production (forecourt SMR, electrolysis)

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A Future to Aspire to

FCEV Milestones 2020 to 2035

2000

2005

2030

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- Hydrogen highway services between Wellington and Auckland
- Centralised biomass co-production plant
- Centralised coal (+CCS) co-production plant
- Large scale electrolysis plant
- Transport increasingly by pipeline
- Large scale industrial tri-gen (heat, power, hydrogen) plant
- Growth in residential CHP (10%)

A Future to Aspire to FCEV Milestones 2035 to 2050

2000

2005

2030

2050

- Hydrogen supply infrastructure completed
- Up to 600,000 tpa
- Up to 2.5 million light FCEVs on road

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Taihoro Nukurangi

A Future to Aspire to Research Activities

2000

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PRODUCTION

Proof of Concept

NZ CAPABILITY STATUS

Yes

NZ led - major chains

Niche - emerging routes

DISTRIBUTION/STORAGE

Detailed roadmap/knowledge gaps/
techno-economics

Yes

NZ led

Improved OnBoard Storage Materials

Yes

Niche

UTILISATION/DEMONSTRATION

Refuelling demonstrations in the main centres

No

Fast follower

High profile stationary demonstrations

Yes

NZ led

Carbon Capture and Storage

Yes

NZ led - storage

Niche/ fast follower - capture

CODES/STANDARDS

In Place

No

Fast Follower

OUTREACH

On tertiary syllabus, Information office

Yes

NZ led

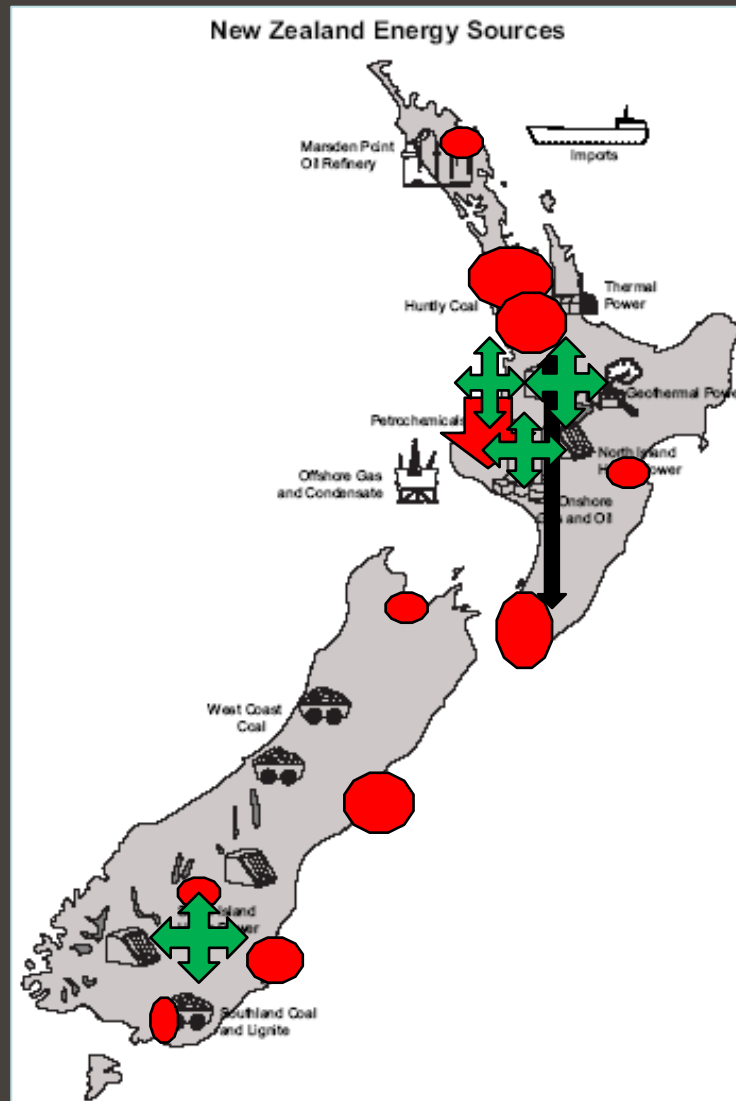
Conclusions

2000 2005 2030 2050

- The New Zealand transport sector must change – options available.
- All options kept open and acted upon now.
 - the sooner we reduce our dependence on oil the more we save.
- Hydrogen and fuel cells offer
 - supply security, affordability and GHG reductions
 - robustness against high oil price and unavailability
 - cost benefits and reduced risk through faster uptake
- Research investment critical (**WHAT ON?**) through 2015

A Future to Aspire to

2000 2005 2030 2050



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