



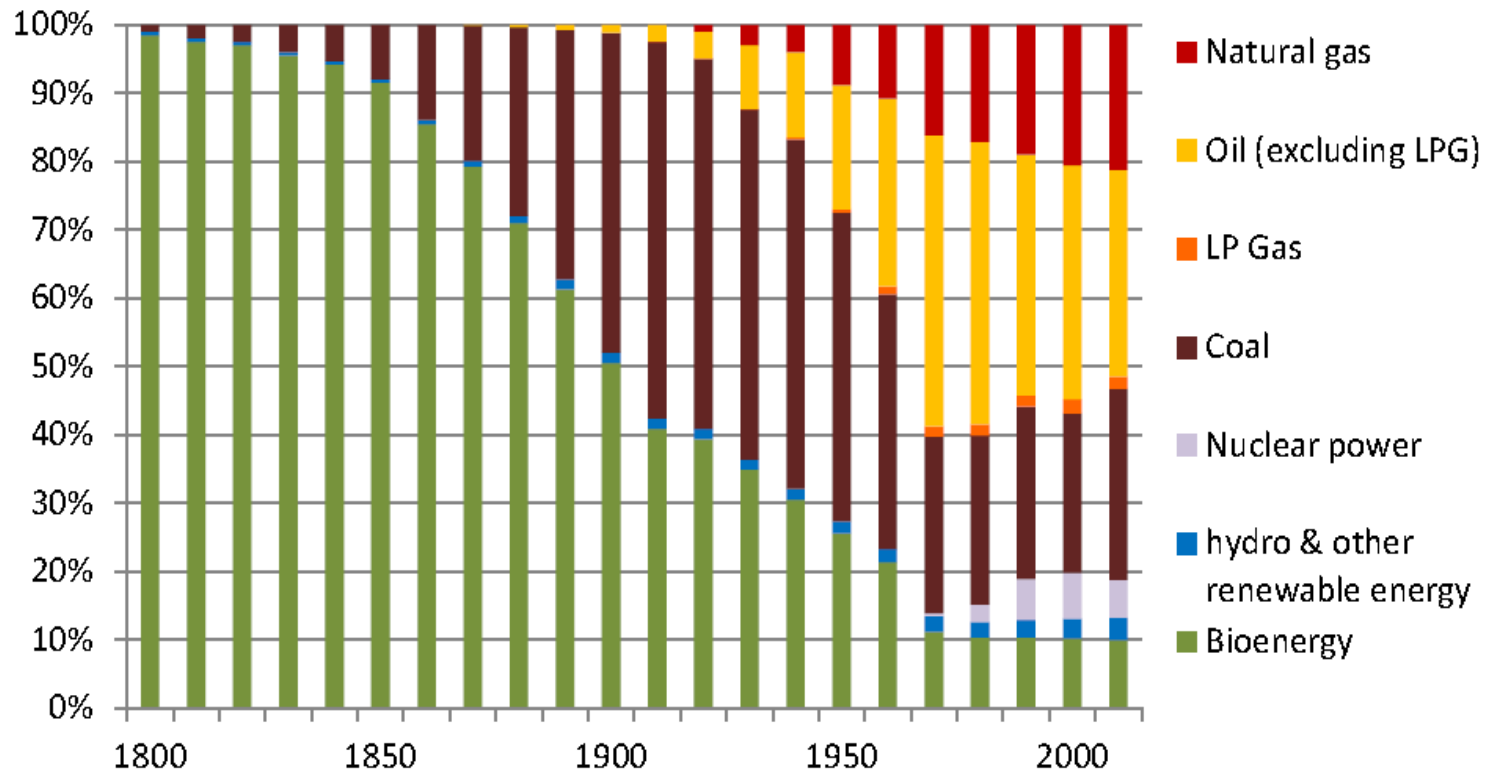
LPG – Where to from Here?

Albert de Geest

Agenda

- LPG demand in a world favouring renewables
 - World energy mix history and future
 - New Zealand energy mix
- Technology Developments
 - Appliances and devices
 - Distribution
- Risks and Uncertainties

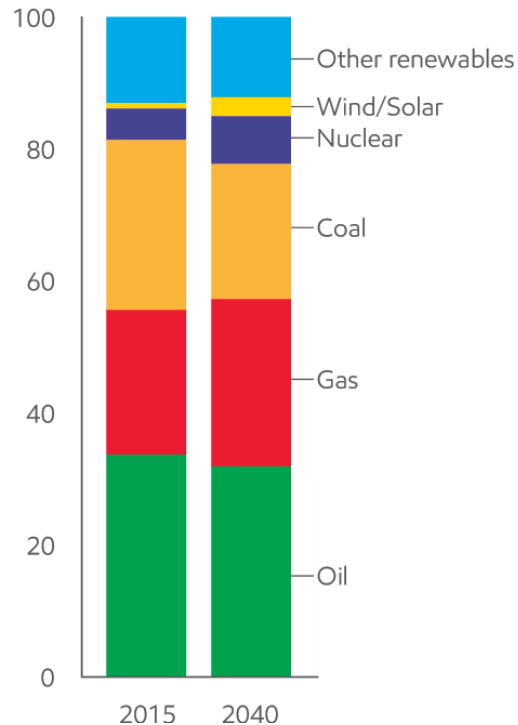
World Energy History



Future World Energy Mix

Global energy mix evolves

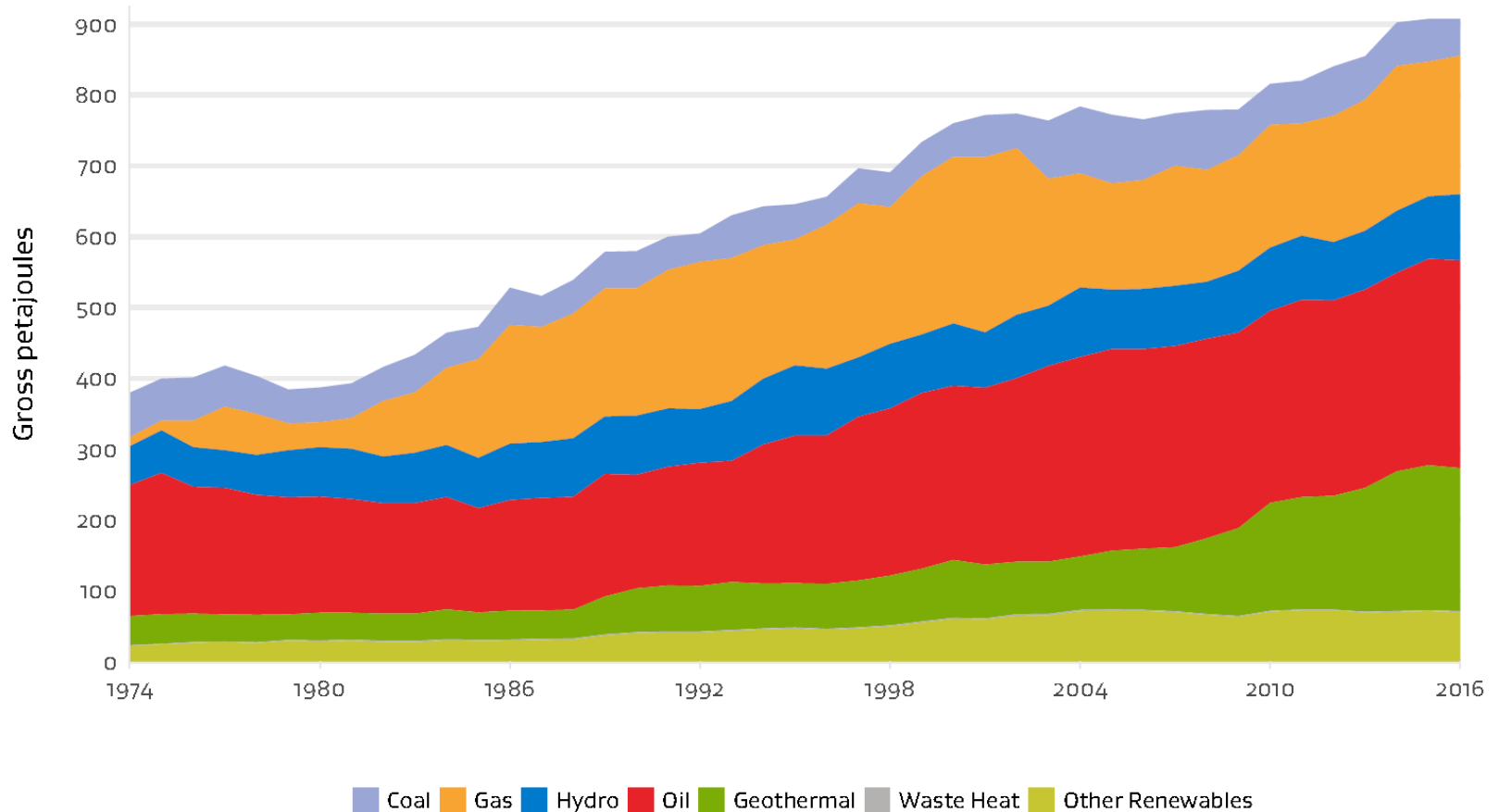
Share of primary energy



- Lower carbon sources replace higher carbon sources
- Natural Gas grows by 45% more than any other energy type
- There is a lot of oil and coal to displace before gas comes under pressure
- Nuclear and renewables also see strong growth
- Coal and oil remain important in 2040

Transition may be a lot slower than many currently believe

NZ Primary Energy Supply by Fuel



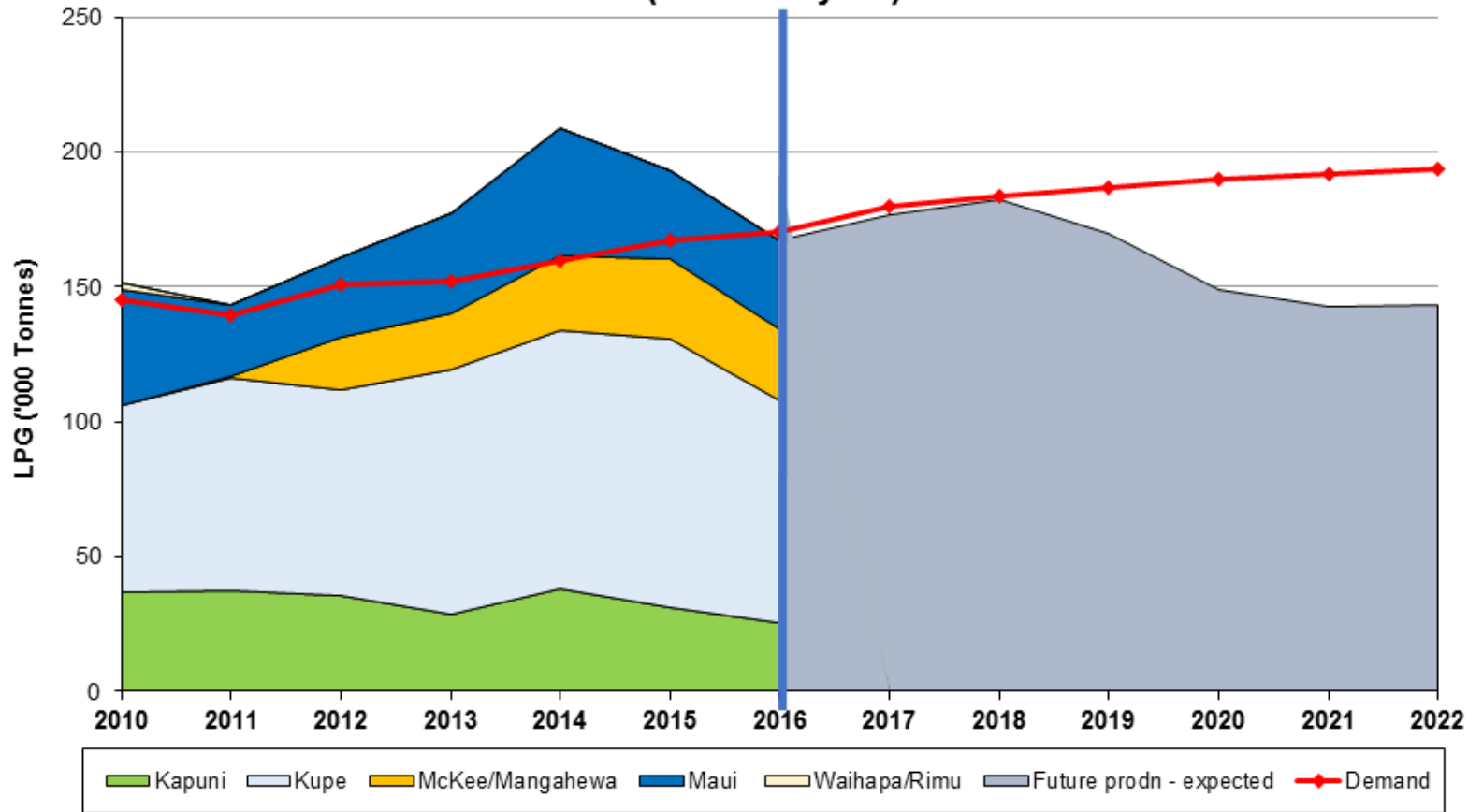
NZ – World Energy Comparison

- New Zealand energy supply is about 33% renewable more than twice the world figure
 - Gas at around 20% is similar
 - Oil is also similar at around 30%
 - Coal at about 5% is much lower than the world average of 29%
 - LPG at 9 PJ is about 1% of the total in NZ and closer to 2% worldwide
- The amount of high carbon fuel in NZ is much lower at 35% vs 60%
- There are still opportunities for LPG to replace coal and diesel in process heating applications

World LPG Demand

- LPG Demand will rise with Natural gas demand replacing higher carbon fuels
 - Increasingly LPG is produced via natural gas processing
 - Still a tiny proportion of overall energy usage
- LPG demand expected to grow by 37% to 380 million tons by 2024
- World LPG demand likely to continue to grow for 20 years or more

LPG Production and Demand to 2022 (calendar year)



N.B. Expected production based on Natural Gas 2P Reserves & production profile as at 1 January 2017

New Zealand LPG Demand

- Growing fast at around 5% and likely to continue to grow albeit at a lower rate
- A clean alternative to other fossil fuels but:
 - Domestic supply is reducing, leading to
 - Increasing imports
 - Risk of higher prices approaching import parity
- Development of existing domestic LPG resources is important for maintaining our competitiveness



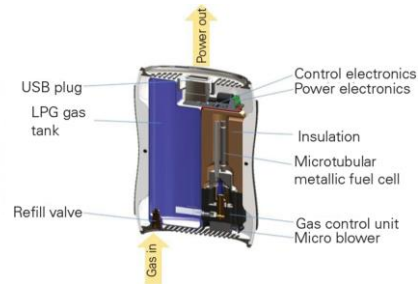
LPG Technology Developments

- Customers
- Distribution
- Bulk

Technology – End Use

Fuel Cells from very small to industrial scale

10 Watts



Fuel cells are a proven technology in many applications such as CHP, remote and back-up power and transport, but costs are currently too high for widespread application.

- LPG/Gas fueled heat pumps
 - Household to commercial scale



- Micro turbine 30 -250kW
 - Remote power
 - Fast start back-up for renewables
 - Buses



Developing Technologies

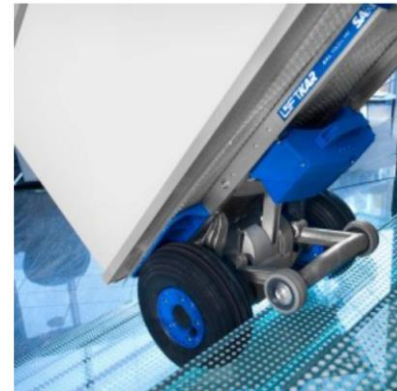
- Appliance controls
 - Electronic control for everything
e.g. gas cooktop temperature
- Internet of Things (IoT)
 - Remote control, geo linked zoning
 - Service notifications
- Industrial scale absorption cooling
- Bio propane from corn or sugarcane

Technology - Distribution

- Internet of things – Sensor on every bottle
- With real time volumes and rate of use data
 - Auto delivery – never run out
 - Customer service reliability and safety – leak detection
 - Optimise customer tariff/service
 - Transport optimisation
 - Location tracking
- App tracking bottle levels
 - Customer view of all bottle levels including 9kg
 - Auto-order flags and set warnings

Distribution

- Volume and rate of use data fed up the chain
 - Combine with weather for more accurate demand forecasting
 - More efficient distribution by truck and ship
 - More effective emergency response
- Automated bottle filling and refurbishment
 - Lower cost
 - Reducing minimum scale
- Semi-autonomous robot assistance for delivery drivers



Bulk Distribution

- IoT Real time monitoring
 - Pressure
 - Temperature
 - Cathodic protection
 - Machine condition
- Data plus AI for:
 - Early warning of failures
 - Optimised maintenance
 - Increased reliability and safety

Uncertainties

- Rate of development of various technologies and when the “leaps” occur in cost, performance and scale
 - Fuel cells, batteries and other forms of energy storage
 - Renewable technologies – solar, wind etc
 - Improvements in existing engine and heating technology
 - Carbon capture/reduction technology
- The relative cost of fuels
 - NZ supply of LPG
- Government policy
 - Carbon charges
 - Production limits
 - Renewable subsidies

New Zealand LPG Conclusions

- LPG is a low carbon transition fuel
- LPG is high energy, versatile and more easily transportable in small and large volumes
- There are a lot of coal and oil based fuels to displace before the pressure really comes on to limit gas and LPG growth

New Zealand LPG Conclusions

- NZ has large accessible renewable resources
- We are also a long, narrow and relatively sparsely populated country with relatively high reticulation costs
- There will continue to be a demand for a cost effective, clean, hi-energy and easily transportable fuel for some time yet
- How long? Well that depends.....