Outline

PART A: Global Economy
   – Global overview – what is happening?

PART B: Economy-Energy New Zealand
   – NZ Economic indicators – how are we doing?
   – Energy & Economic growth

PART C: NZ energy sector
   – Demand & supply

PART D: Policy
A. Global overview

• Primary energy consumption grew at a rate of 1.3% in 2019, down from 2.9% 2018.
• NB: rule of 72/2.9 => doubling ~ every 25 years
• By fuel, energy consumption growth was driven by natural gas, renewables. All fuels grew slower than their 10-year averages.
• China accounted for more than two thirds of the global increase in energy demand, followed by India & Indonesia.
• Carbon emissions grew by 0.5%, compared with 2.1% in 2018.

### World Bank - % change from previous year

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2019</th>
<th>2020e</th>
<th>2021f</th>
<th>2022f</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real GDP</strong>¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-income countries</td>
<td>2.2</td>
<td>1.6</td>
<td>-5.4</td>
<td>3.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Developing countries</td>
<td>4.4</td>
<td>3.7</td>
<td>-2.3</td>
<td>5.2</td>
<td>4.3</td>
</tr>
<tr>
<td>Low-income countries</td>
<td>4.4</td>
<td>4.0</td>
<td>-0.9</td>
<td>3.3</td>
<td>5.2</td>
</tr>
<tr>
<td>BRICS</td>
<td>5.4</td>
<td>4.7</td>
<td>-1.1</td>
<td>6.1</td>
<td>4.5</td>
</tr>
<tr>
<td>World (2010 PPP weights)⁴</td>
<td>3.6</td>
<td>2.8</td>
<td>-3.7</td>
<td>4.3</td>
<td>3.9</td>
</tr>
<tr>
<td><strong>World trade volume</strong>⁵</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.3</td>
<td>1.1</td>
<td>-9.5</td>
<td>5.0</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>Commodity prices</strong>⁶</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil price</td>
<td>29.4</td>
<td>-10.2</td>
<td>-33.7</td>
<td>8.1</td>
<td>13.6</td>
</tr>
<tr>
<td>Non-energy commodity price index</td>
<td>1.7</td>
<td>-4.2</td>
<td>2.2</td>
<td>2.4</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Note: based on 2010 prices, e = estimate, f = forecast

Global economy

Collapse in 2020 – contraction of -3.5% GDP

Differential adverse impacts across economies

Within economies: women, youth poor, informally employed, contact-intensive sectors

Importance of continued policy support

Recovery depends on roll out of vaccine

Oil prices expected to rise with recovery

Carbon reduction: push for green investment, raising carbon prices
Global activity & projections

Sources: CPB Netherlands Bureau for Economic Policy Analysis; Haver Analytics; Markit Economics; and IMF staff calculations. Note: PMI = purchasing managers’ index.

Recovery Scenarios

Source: https://www.iea.org/reports/world-energy-outlook-2020
Key energy indicators, 2020 relative to 2019

Pandemic caused more disruption to the energy sector than any other event in recent history, leaving impacts that will be felt for years to come (IEA, 2020).

Source: [https://www.iea.org/reports/world-energy-outlook-2020](https://www.iea.org/reports/world-energy-outlook-2020)

Note: CO2 back to decade ago, not so for methane
Impact on oil

Global oil demand down by 57%.

Road transport down by 50-75% in regions with lockdowns in place – to around 50% of March 2019 levels.

Refinery production in China suggested reduction in demand of ~20% relative to February 2019

Source: https://www.iea.org/reports/world-energy-outlook-2020
Annual change in coal demand

Source: https://www.iea.org/reports/world-energy-outlook-2020
Reductions in electricity demand

Source: https://www.iea.org/reports/world-energy-outlook-2020
Annual growth in renewables

Source: https://www.iea.org/reports/world-energy-outlook-2020
Global consumption

Oil continued to hold the largest share of the energy mix (33.1%).

Coal second largest fuel but lost share (27%) lowest level since 2003.

Natural gas (24%) and renewables rose (5%) to record highs.

Renewables > nuclear (4.3%)

Hydroelectricity stable at 6%.
Global coal consumption

Coal consumption by country or region, measured in terawatt-hour (TWh) equivalents.

Price of Brent crude US$

https://www.macro-trends.net/2480/brent-crude-oil-prices-10-year-daily-chart#
Oil consumption per capita

**Oil: Consumption per capita 2019**

(GJ per capita)

Legend:
- 0-20
- 20-40
- 40-60
- 60-100
- > 100
Natural gas consumption per capita
Global installed PV & wind

Source: Bloomberg NEF. Note: 1H 2018 figures for onshore wind are based on a conservative estimate; the true figure will be higher. BNEF typically does not publish mid-year installation numbers.

Future Solar Costs by Year

Assumes 30% Learning Rate, 16% Compound Annual Growth of Solar Industry

Operating Cost Range of Already Built Fossil Power Plants

Ramez Naam - rameznaam.com

Year of Operation - Assuming 16% Cumulative Annual Growth Rate of Solar
Global hydrogen projects

Production:
Europe 55% hydrogen projects, Australia, Japan, Korea, China, USA

Demand:
Korea, Japan and Europe: industrial usage and transport application.

Production, demand & cost of hydrogen

B. Economy-Energy NZ

• Macroeconomic measure
  – GDP, imports/exports
  – Structure of economy
  – Energy per unit output

• Energy supply/demand
  – Sector demand
  – Transport

• Energy resources
  – Hydro, geothermal, gas, oil, wind, solar
NZ Gross Domestic Product

2010 US$/capita

OECD
Economy in transition

Note:
1. Growth in services
2. Decline in Manufacturing
3. Slight decline in primary sector
Value of Exports & Imports

Value of exports 2019 NZ$59.3 b

Value of imports 2019 NZ$64.3 b
Energy & Economic Growth, NZ

\[ R^2 = 0.8036 \]
Impact of COVID on GDP

Source: Statistics NZ
Other indicators of disruption

Source: Statics NZ
C. NZ energy

- NZ transitioned from economy dominated by large government departments to an economy in which markets play a key role in resource allocation subject to regulations & government oversight.

- In the case of electricity: progression was from centralised production and price setting to a more competitive framework within a “Light handed” regulatory framework.
Primary energy supply & GHG emissions
Gross GHG emissions per capita

Electricity generation

Electricity generation 2019

- Hydro: 59%
- Geothermal: 5%
- Wind: 5%
- Coal: 18%
- Gas: 13%
Gas

- Gas sourced from Taranaki region
- Distribution:
  - North Island network
- Main users:
  - Electricity generation (including cogeneration)
  - The industrial sector (such as dairy)
  - As a feedstock (i.e. non-energy use) in the petrochemical sector
  - The residential sector
  - The commercial sector
Oil & gas production
Oil products consumption
Gas consumption

Source: Ministry of Business, Innovation and Employment
Coal consumption

Coal Consumption by Sector for 2019

- Industrial: 38%
- Electricity Generation: 41%
- Other Transformation: 16%
- Agriculture/Forestry/Fishing: 3%
- Commercial: 1%
- Residential: 0%
Patterns of energy demand

Source:
Fleet composition & emissions

Figure 1.1: Fleet composition

Figure 1.10: 2015 CO₂ emissions

Figure 1.5a: Light fleet ownership per 1000 population

Source: VFEM (Vehicle Fleet Emissions Model) 2

http://www.transport.govt.nz/research/newzealandvehiclefleetstatistics/#annual
Hydro

- Currently around 5,300 MW of installed capacity (89 stations). Most sites for large-scale hydro developed. Some prospect for irrigation/hydro, high load factor
- NIWA (2009) estimates potential of 66,820 MW but >45% are small and in remote areas
- Storage: Taupo holds 93% of water stored in Waikato system
- Competition for water
- Limited storage ~ 60 days
Geothermal

1,000 MW installed
Potential ~ +2000 MW
Wind Generation

First wind farm 1993 – 225kW
17 wind farms
690 MW installed
2500 MW consented
Load factor: ~30-50%
Auckland solar

LiDAR (Light Detection And Ranging) uses laser light to sample the surface of the earth

Mt Eden vs Pukekohe West
Comparing ratings for best 14m²
D. NZ policy

- Market incentives & regulatory framework to support investment
- No direct subsidies, no opportunity to export
- Requires national benefits of renewables to be fully considered in the consenting process
- NZ’s ETS prices carbon
- Net-zero long lived gases by 2050
- 25% reduction in biogenic methane by 2050
- 100% renewable electricity by 2030
Emissions trading scheme

Emitters buy NZUs

Price: $27

Absorbers supply NZUs

Surrender NZUs

NZUs to absorbers

NZ government
Emission Profile & Recommended Reductions

Source: Climate Change Commission (Draft) Report 2021
Looking forward?

• Global
  – Massive disruption – different impacts across economies & sectors
  – Coal, gas will continue as primary source in many developing economies
  – Short term reduction in global emissions
  – Likely slow down in economic growth
  – Initiatives to foster low carbon growth

• NZ low carbon economy
  – Very ambitious targets
  – Supply: hydro, geothermal, wind, solar, gas
  – Demand: growth, electrification of transport, hydrogen
  – Technology: smart grids, batteries, digital management
  – Uncertainties: investment, impact of climate change, population growth