APPENDIX 1: Workshop Agenda

Energy Efficiency Policy Workshop
Developing Fuel Economy Regulations

Bringing together policymakers and experts to understand and share national experiences on developing vehicle fuel economy regulations to reduce emissions from the transport sector and mitigate the escalating threat of climate change.

18 March 2019
Regal Kowloon Hotel, Hong Kong, China

8:30 - 9:00 Registration

Welcome and introduction to the Workshop

9:00 - 9:05 Brief introduction to the Workshop
Hugh Marshall-Tate, APERC

9:05 - 9:10 Welcoming remarks by the host economy
Vy Ek Chin, EMSD, Hong Kong, China

9:10 - 9:15 Opening remarks by the EGEEC Chair
Mr. Pengcheng Li, China

9:15 – 9:25 Introduction to the Energy Efficiency Policy Workshop series, the topic of vehicle fuel economy regulations, and Workshop agenda
Hugh Marshall-Tate, APERC

Session 1: Context for vehicle fuel economy regulations

9:25 - 9:45 Transport contribution to GHG emissions in APEC economies
Alexey Kabalinskiy, APERC

9:45 - 10:30 Overview of the suite of policy measures to improve vehicle fuel economy
Elizabeth Yeaman, Retyna Ltd, New Zealand

10:30 – 11:00 Tea and Coffee Break

Session 2: Vehicle fuel economy policies in APEC economies

11:00 - 11:30 Chile’s proposed fuel economy standards: the process of developing new legislation and features of the standard
Luz Ubilla, Ministerio de Energía, Chile
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30 – 12:10</td>
<td>Test protocols underpinning fuel economy regulations: the transition to Worldwide Harmonised Light Vehicle Test Procedure (WLTP) and its inclusion in CO₂ policies</td>
<td>Andrew Campbell, Fuel Technology Ltd, New Zealand/Philippines</td>
</tr>
<tr>
<td>12:10 – 12:30</td>
<td>Panel discussion with Session 1 and 2 speakers</td>
<td>Moderated by Retyna</td>
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<tr>
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<td>Lunch</td>
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<td>Session 3: Facilitating low emission vehicles in APEC economies</td>
<td></td>
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<tr>
<td>13:30 – 13:50</td>
<td>Wide scale promotion of low emission vehicles for HK – challenges and opportunities</td>
<td>Ir. Raymond CHOI, Hong Kong Power Company</td>
</tr>
<tr>
<td>13:50 – 14:20</td>
<td>Facilitating locally designed and manufactured electric vehicles in the Philippines</td>
<td>Andrew Campbell, Fuel Technology Ltd</td>
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<td>14:20 – 14:45</td>
<td>Growth of electric vehicles in New Zealand</td>
<td>Elizabeth Yeaman, Retyna, New Zealand</td>
</tr>
<tr>
<td>14:45 – 15:15</td>
<td>Tea and Coffee Break</td>
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<tr>
<td></td>
<td>Session 4: Workshop – Facilitating EVs and other very low carbon vehicles</td>
<td></td>
</tr>
<tr>
<td>15:15 - 16:00</td>
<td>Participants will break into smaller groups to discuss:</td>
<td>All Participants, facilitated by Retyna</td>
</tr>
<tr>
<td></td>
<td>• <strong>Status:</strong> What is the status of vehicle fuel economy policies and policies facilitating low carbon vehicles in your economy?</td>
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<td></td>
<td>• <strong>Barriers:</strong> What are the barriers to introducing or updating policies in your economy?</td>
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<tr>
<td></td>
<td>• <strong>Priorities:</strong> Identify the top three activities that could be undertaken to progress policies in your economy</td>
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<td></td>
<td>• <strong>APEC facilitation:</strong> Identify any activities that APEC could have a role in advancing</td>
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</tr>
<tr>
<td>16:00 - 16:20</td>
<td>Report Back</td>
<td>Facilitated by Fuel Technology</td>
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<tr>
<td></td>
<td>Presentations by breakout session leaders and group discussion</td>
<td></td>
</tr>
<tr>
<td>16:20 – 16:30</td>
<td>Summary of the Workshop, potential next steps and lessons learned</td>
<td>Elizabeth Yeaman, Retyna</td>
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</tbody>
</table>
APEC Energy Efficiency Policy Workshop

Hugh Marshall-Tate
Researcher
Asia Pacific Energy Research Centre (APERC)

APERC was established in Tokyo in 1996 after the Osaka APEC leaders meeting in 1995.

Primary objective is to foster a common understanding of energy challenges facing APEC member economies.

- Through analysis of the supply and demand outlook.
- The development of energy markets.
- Discussion of policy responses.
Workshop Background

- Since 2009 with current format started in 2014
- Previous topics have included
  - Government and donor funding mechanisms
  - Policy and program evaluation
  - Conformity Assessment

2019 Workshop Topic

Transport fuel economy standards

- Testing protocols
- GHG emissions
- Vehicle fuel economy policy
- Policy drivers
- Policies in APEC economies
- Advanced Vehicles
### Todays Agenda

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**APEC Energy Efficiency Policy Workshop**

http://aperc.ieej.or.jp/

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APERC
APPENDIX 3: Transport CO₂ emissions in APEC 2000-50

Energy Efficiency Policy Workshop 2019

Transport CO₂ emissions in APEC 2000-50

Alexey Kabalinskiy
APEC (Asia Pacific Energy Research Centre)
18 March 2019, Hong Kong

APEC CO₂ emissions (fuel combustion) 1971-2016

- APEC CO₂ emissions grew 3x in 45 years, representing over 50% of the world,
- In 1990-2016: China’s share grew from 18% to 45%, while US declined from 41% to 24%

Source: WorldBank, 2018-2019
APEC transport CO₂ emissions 1960-2016

- Since 1971 road emissions grew x3 in line with total emissions, road share grew from 78% to 85%.
- In 2016 China and the US were responsible for nearly 2/3 of APEC's transport emissions.

Source: APEC, 2016; WorldBank, 2016

APEC uses a suite of nine models for Outlook 7th Edition

Key Assumptions

Transport Model

- Domestic
- Road
- Rail
- Sea
- Pip

Industry Model

Residential Buildings Model

Services Buildings Model

Agriculture & Non-Spec Model

Hydrogen Sub-Model

Electricity Model

Heat Only Plants Model

Refinery Model

Other Transformation Sub-Model

Supply Model

Production

Trade

Notes: Methodologies can be found on APERC website (https://aperc.org/publication/report/outlook.php)

Co-impacts
Outlook 7th Edition: transport model

- Transport model projects APEC’s transportation sector (following IEA’s World Energy Balances) fuels demand,
- The model utilizes Excel and GAMS software packages,
- Passenger and freight activity are the key drivers
- International bunker fuels are modelled as f(GDP),
- Domestic non-road transport is split in passenger and freight and modelled top-down,
- Domestic road is modelled bottom-up with five vehicle types and ten powertrain technologies

<table>
<thead>
<tr>
<th>Sub-sector</th>
<th>Passenger</th>
<th>Freight</th>
<th>Approach</th>
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</thead>
<tbody>
<tr>
<td>International</td>
<td>-</td>
<td>-</td>
<td>Top-down</td>
</tr>
<tr>
<td>Aviation bunkers</td>
<td>-</td>
<td>-</td>
<td>Top-down</td>
</tr>
<tr>
<td>Marine bunkers</td>
<td>-</td>
<td>-</td>
<td>Top-down</td>
</tr>
<tr>
<td>Domestic</td>
<td>Y</td>
<td>Y</td>
<td>Mixed</td>
</tr>
<tr>
<td>Road</td>
<td>Y</td>
<td>Y</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>2W</td>
<td>Y</td>
<td></td>
<td>Bottom-up</td>
</tr>
<tr>
<td>LV</td>
<td>Y</td>
<td>-</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>LT</td>
<td>-</td>
<td>Y</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>BUS</td>
<td>Y</td>
<td>-</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>HT</td>
<td>-</td>
<td>Y</td>
<td>Bottom-up</td>
</tr>
<tr>
<td>Rail</td>
<td>Y</td>
<td>Y</td>
<td>Top-down</td>
</tr>
<tr>
<td>Air</td>
<td>Y</td>
<td>Y</td>
<td>Top-down</td>
</tr>
<tr>
<td>Sea</td>
<td>Y</td>
<td>Y</td>
<td>Top-down</td>
</tr>
<tr>
<td>Pipe</td>
<td>-</td>
<td>Y</td>
<td>Top-down</td>
</tr>
</tbody>
</table>

Notes: vehicle types include 2W (2-wheelers), LV (light vehicles), LT (light trucks), BUS (buses), HT (heavy trucks); road vehicle technologies include ICE, EICE, EV, PHEV, BEV, EBD, LPG, CNG, G2L, PHEV, BEV, and FCV

Outlook 7th Edition includes three scenarios

- Business-as-usual (BAU) scenario:
  The BAU scenario reflects current policies and trends within the APEC energy sector. In turn, it largely projects past trends into the future.
  - Road vehicle fuel efficiency assumptions reflect current policy,
  - Otherwise ‘passive’ improvement of new vehicles at 0.5-2.0%/yr until 2030

- APEC Target (TGT) scenario:
  The TGT scenario is driven by APEC’s goals of reducing energy intensity while increasing the share of renewables.
  - Progressively improving Passenger and Freight transportation activity,
  - Accelerated fuel efficiency improvement: current policy and 0.5-1.0%/yr improvement in 2030-40, and
  - Increased share of biofuels

- 2 Degree Celsius (2DC) scenario:
  2DC follows the carbon emissions reductions included in the Energy Technology Perspectives by IEA.
  - Decoupling the transportation activity and economic growth,
  - Reduced vehicle ownership and vehicle mileage compared to TGT,
  - Fuel efficiency and energy intensity consistent with TGT,
  - Support for advanced fuels and vehicles, mode/technology shifting.
Freight and passenger is dominated by road

APEC's Freight activity

APEC Passenger activity

Source: APERC analysis;
Note: units are billion tonne-kilometres (tkm) for freight, and billion passenger-kilometres (pkm).

- Road freight expands under BAU, share of Rail grows in TGT and 2DC
- Road passenger is over 70% of, public transport grows in TGT and 2DC

Gasoline and diesel are key in BAU, electricity grows fastest in all scenarios

APEC transport energy demand in BAU, TGT and 2DC, 2000-50

- Conventional fuels dominate under BAU,
- Gasoline for passenger transport declines in TGT and 2DC,
- Diesel remains strong in all scenarios for Road freight,
- Demand grows 25% in BAU, remains flat (-2.1%) in TGT and drops 35% in 2DC

Source: JRE, 2018; APERC analysis
Gasoline and Diesel are key in BAU, Electricity and biofuels grow in all scenarios

- BAU: in gasoline (-12%),
- TGT compared to BAU: electricity (+52%) and biofuels (+42%); gasoline (-43%) and diesel (-31%),
- ZDC compared to BAU: growth only in electricity (+82%) and biofuels (+13%); declines in other fuels, especially gasoline (-74%) and diesel (-58%)

Although important, domestic transport is not the main source of direct and indirect CO2 emissions

- If CO2 unallocated: transport share is about 19-22%, second after electricity (43-45%); except in 2DC: electricity drops to 11%, and transport (24%) is second to industry (35%),
- If CO2 allocated: transport share is about 21-25% in all scenarios; significant share of buildings (33-35%), except 18% in 2DC; industry is the hardest to decarbonise with 33-39% share
In BAU, economic growth drives the demand, in TGT and 2DC: historical trend is reversed

- In BAU CO₂ emissions grow in the Outlook
- In TGT emissions gradually decline to 2005-level
- In 2DC, 2050 emission level is in line with projections included in IEA’s ETP, and below 1990-level

Source: IEA 2018, APERC analysis

Conclusions

- Strong demand for freight and passenger transport until 2050,
- Under BAU: increasing fuel demand and CO₂ emissions,
- In TGT: fuel demand plateaus, but emissions decline:
  - Through mode switching,
  - Longer-term and wider adoption of fuel efficiency policy,
  - Efficient public transport,
  - Hybrids as transition technology and natural gas as transition fuel,
- In 2DC: opportunities for deep decarbonization:
  - Alternative fuels and techs: hybrids, EVs and biofuels (although limited),
  - Fast and comfortable public transport for cities (80% of APEC residents),
  - Maximise alternative fuels and modes for freight
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APPENDIX 4: Overview of the suite of policy measures to improve vehicle fuel economy

Energy Efficiency Policy Workshop 2019
Overview of the suite of policy measures to improve vehicle fuel economy

Name: Elizabeth Yeaman
Institution: Retyna Ltd, New Zealand
Date: 18 March 2019, Hong Kong

Focus for this presentation
- Investing in public transport, encouraging active modes (walking, cycling) through infrastructure and urban form, land-use planning, and pricing signals are all vital for a low carbon future, which also addresses congestion
- This presentation focuses on the suite of policies that can encourage a shift to more fuel/energy efficient light-duty vehicles (LDV), including electric vehicles (EVs), to reduce CO\textsubscript{2} emissions
The purpose of transport is to help people access goods and services, work and education, family and friends.

Policies which encourage fuel efficient and low/zero emission vehicles should complement other transport policy measures reducing overall CO₂ emissions.

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**Big difference in fuel consumption within vehicle class**

- **Minimum and maximum fuel consumption by class (excludes EVs)**

  - SAV - Large
  - SAV - Medium
  - SAV - Small
  - Car - Very large
  - Car - Large
  - Car - Medium
  - Car - Small
  - Car - Light

  ![Fuel Consumption Graph](image)

Source: [APEC](https://www.apec.org)
Justification for intervention in the market

- **Unpriced externalities:** GHG emissions, air quality emissions
- **Imperfect information:** vehicle buyers tend to underestimate or don’t know fuel costs over the time they own the vehicle
- **Split incentives:** vehicle sellers tend to make bigger profits on larger, less fuel efficient vehicles, but do not pay ongoing fuel costs - the same model of vehicle gets larger over the years with each redesign, as bigger vehicles equal bigger profits

Technology changes have improved fuel efficiency

- Driven by policy, technology changes have resulted in significant fuel consumption improvements for internal combustion engine (ICE) vehicles

<table>
<thead>
<tr>
<th>Year</th>
<th>Fuel Consumption (L/100 km)</th>
<th>Fuel Consumption (km/L)</th>
<th>Fuel Consumption (mpg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>9.0</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>2007</td>
<td>8.1</td>
<td>12.3</td>
<td>29</td>
</tr>
<tr>
<td>2017</td>
<td>6.5</td>
<td>15.3</td>
<td>36</td>
</tr>
</tbody>
</table>
EVs are a step change in energy efficiency

**Electric vehicle energy loss chain**

- Overall efficiency: 57%

**Internal combustion engine energy loss chain**

- Overall efficiency: 11-18%

**CO₂ benefits of EVs with fossil fuel electricity generation**

**Electric vehicle energy loss chain**

- Overall efficiency: 16% with current generation efficiency of 23%
- 31% with planned generation efficiency of 45%

**Internal combustion engine vehicle energy loss chain**

- Overall efficiency: 15%
Suite of vehicle fuel efficiency / CO₂ policies

- **VEHICLE FUEL EFFICIENCY STANDARDS**
  - Introduce and regularly strengthen mandatory standards
  - Establish and harmonize testing procedures for fuel efficiency measurement.

- **FISCAL MEASURES**
  - Fuel taxes and vehicle taxes to encourage the purchase of more fuel-efficient vehicles.
  - Infrastructure support and incentive schemes for very fuel-efficient vehicles.

- **MARKET-BASED APPROACHES**
  - Voluntary programs such as U.S. SmartWay and other green freight programs

- **INFORMATION MEASURES**
  - Vehicle fuel economy labels
  - Improving vehicle operational efficiency through eco-driving and other measures.

Adapted from International Council on Clean Transportation (ICCT), 2013

There are strong synergies between the measures

- Fiscal incentives create market pull - **demand** from buyers for efficient vehicles
- Support from information and market measures
- Vehicle fuel efficiency/CO₂ standards create market push - encourage manufacturers to **supply** lower CO₂ vehicles
- Data underpins everything
Where vehicle fuel efficiency/CO₂ standards operate

Corporate average standards are the norm

<table>
<thead>
<tr>
<th>Region</th>
<th>Target Year</th>
<th>Regulated metric</th>
<th>Unadjusted Fleet Target/Measure</th>
<th>Form of target/corner</th>
<th>Test Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>2017</td>
<td>Energy consumption</td>
<td>1.62 MJ/km</td>
<td>Weight-based corporate average</td>
<td>U.S. combined</td>
</tr>
<tr>
<td>Canada</td>
<td>2016</td>
<td>GHG</td>
<td>217 gCO₂/km km¹</td>
<td>Footprint-based corporate average</td>
<td>U.S. combined</td>
</tr>
<tr>
<td>China</td>
<td>2015-2020</td>
<td>Fuel consumption</td>
<td>6.8 L/100 km, 5.1 L/100 km</td>
<td>Weight-based corporate average</td>
<td>NEDC</td>
</tr>
<tr>
<td>EU</td>
<td>2015-2021</td>
<td>CO₂</td>
<td>130 g CO₂/km, 95 g CO₂/km</td>
<td>Weight-based corporate average</td>
<td>NEDC¹</td>
</tr>
<tr>
<td>India</td>
<td>2017-2022</td>
<td>CO₂</td>
<td>110 g/km, 145 g/km</td>
<td>Weight-based corporate average</td>
<td>NEDC for low-powered vehicle</td>
</tr>
<tr>
<td>Japan</td>
<td>2015-2020</td>
<td>Fuel economy</td>
<td>16.8 km/L, 20.5 km/L</td>
<td>Weight-class based corporate average</td>
<td>JC08²</td>
</tr>
<tr>
<td>Mexico</td>
<td>2016</td>
<td>Fuel economy</td>
<td>39.8 mpg or 140 g/km</td>
<td>Footprint-based corporate average</td>
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<td>Saudi Arabia</td>
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<td>2015-2020</td>
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<td>U.S.</td>
<td>2016</td>
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<td>36.2 mpg¹ and 225 g CO₂/km</td>
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</tr>
</tbody>
</table>

¹ CO₂ emissions limits for light-duty vehicles and fuel economy targets for larger vehicles.
² JC08 is the Japanese Corporate Average Fuel Economy test.

How corporate average standards work

- The average fuel/energy consumption or CO₂ emissions of all light duty passenger vehicles manufactured, sold or imported by one particular auto company must be within a certain level over a set period of time, or they face penalties.
- This incentivises auto manufacturers/importers to develop, offer, promote and favourably price more efficient and lower CO₂ vehicles (including EVs).
- Different to a Minimum Energy Performance Standard (MEPS) as no individual vehicles are restricted.
- Happens “behind the scenes” regarding consumers.

Weight based vs footprint based targets

<table>
<thead>
<tr>
<th>Basis for target</th>
<th>Absolute</th>
<th>Relative</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Weight based</td>
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<td></td>
<td></td>
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- The heavier a vehicle is, the greater its fuel consumption.
- Footprint is a measure of vehicle size defined as the area enclosed by the tyres of the vehicle (wheelbase x track width).
- **Footprint based targets** encourage light-weighting of vehicles.
- **Weight based targets** recognize the utility of different types of vehicles, hybrid/EV battery weight and weight data available.

### Mix of weight-based and footprint-based targets

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<td>130 g/km</td>
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<td>2015</td>
<td>Fuel economy</td>
<td>17 km/km or 140 gCO₂/km</td>
<td>Weight-based corporate average</td>
<td>U.S. combined</td>
</tr>
<tr>
<td>U.S.</td>
<td>2016</td>
<td>Fuel economy/ GHG</td>
<td>36.2 mpg¹ and 225 gCO₂/mi</td>
<td>Footprint-based corporate average</td>
<td>U.S. combined</td>
</tr>
</tbody>
</table>


---

### CO₂ emissions from LDV: historical and current standards

**Figure 2.** Historical fleet CO₂ emissions performance and current standards (gCO₂/km normalized to NEDC) for passenger cars.

How this compares to an economy with no standards

Figure 2. Historical fleet CO₂ emissions performance and current standards (gCO₂/km normalized to NEDC) for passenger cars

Data source: [Link to data source]

CO₂ emissions reductions from standards

Data source: [Link to data source]
Global EV sales are growing exponentially

Cumulative global passenger EV sales, current and forecast

Million vehicles

- 5m passenger EVs sold
- 4m passenger EVs sold
- 3m passenger EVs sold
- 2m passenger EVs sold
- 1m passenger EVs sold

Source: Bloomberg NEF

Norwegian new car sales by fuel type, 2011-2018

Source: Oslo
Strongest policy signal: ICE vehicle ban

<table>
<thead>
<tr>
<th>Economy</th>
<th>Ban commences</th>
<th>Ban announced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rica</td>
<td>2021</td>
<td>2018</td>
</tr>
<tr>
<td>Denmark</td>
<td>2030</td>
<td>2019</td>
</tr>
<tr>
<td>Ireland</td>
<td>2030</td>
<td>2018</td>
</tr>
<tr>
<td>India</td>
<td>2030</td>
<td>2017</td>
</tr>
<tr>
<td>Israel</td>
<td>2030</td>
<td>2018</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2030</td>
<td>2017</td>
</tr>
<tr>
<td>Norway</td>
<td>2030</td>
<td>2017</td>
</tr>
<tr>
<td>Sweden</td>
<td>2030</td>
<td>2019</td>
</tr>
<tr>
<td>Scotland</td>
<td>2032</td>
<td>2017</td>
</tr>
<tr>
<td>China</td>
<td>2040</td>
<td>2017</td>
</tr>
<tr>
<td>France</td>
<td>2040</td>
<td>2017</td>
</tr>
<tr>
<td>UK (except Scotland)</td>
<td>2040</td>
<td>2017</td>
</tr>
</tbody>
</table>

Data source: https://www.fossilfuel.org.uk/fossil-fuel-reduction-in-jurisdictions

Fiscal measures

**Taxes/fees**
- Vehicle sales taxes increase with fuel use or CO2
- Vehicle registration and annual licensing fees
- Fuel taxes and price on carbon
  - Driving restrictions; zero emission zones

**Feebates**
- A fiscally neutral combination of fees and rebates
- May be more politically acceptable

**Incentives**
- Purchase price subsidies for low carbon vehicles
- Exemptions from fees and tolls; free parking
- Infrastructure incentives for EV charging
- Priority access or parking for EVs
### Example: Singapore car registration feebate system

<table>
<thead>
<tr>
<th>Band</th>
<th>Carbon Dioxide Emission (CO₂ g/km)</th>
<th>Rebate</th>
<th>Surcharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>CO₂ ≤ 95</td>
<td>$30,000</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>95 &lt; CO₂ ≤ 105</td>
<td>$15,000</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>105 &lt; CO₂ ≤ 120</td>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>120 &lt; CO₂ ≤ 135</td>
<td>$5,000</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>135 &lt; CO₂ ≤ 185</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>C1</td>
<td>185 &lt; CO₂ &lt; 200</td>
<td>$5,000</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>200 &lt; CO₂ &lt; 215</td>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>215 &lt; CO₂ &lt; 230</td>
<td>$15,000</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>230 &lt; CO₂</td>
<td>$30,000</td>
<td></td>
</tr>
</tbody>
</table>

### ICCT: Elements of a best practice feebate scheme

- A continuous, linear feebate rate line
- A pivot point making the system self-funding and sustainable
- A linear metric, such as CO₂ emissions or fuel consumption per unit of distance
- An attribute adjustment (if used) based on vehicle size, not weight
Information measures

- Vehicle fuel efficiency labels (VFEL)
- Websites, promotional materials

Market measures

- Voluntary sign-up programmes which provide facilitation support and recognition to fleets buying efficient and low CO₂ vehicles and supporting efficient driver training
Summary – vehicle fuel economy standards

- Approved and accepted vehicle fuel/energy consumption data is a vital enabler
- Corporate average vehicle fuel efficiency/CO₂ standards encourage manufacturers to make, sell and promote lower CO₂ vehicles
- Fiscal measures including feebates encourage consumers to buy lower CO₂ vehicles, creating demand
- Information and other measures can provide important support but are insufficient on their own

How standards contribute to meeting IPCC targets

![Graph showing LDV GHG emissions (GDS - ZDS)](https://www.globalfuoeconomy.org/media/66/0044/cp24-update-report.pdf)

This analysis includes a 20% reduction in new car fuel consumption (Lpg/100km) in the GDS, an additional 30% reduction is reflected in the ZDS scenario, reaching the GFEI target.
Thank you
APPENDIX 5: Chile’s path to develop fuel economy standards

Energy Efficiency Policy Workshop 2019
Chile’s path to develop fuel economy standards

Luz Ubilla Bórquez
Ministry of Energy
Date 18 March 2019, Hong Kong

Introduction

- In 2014, it was proposed as an energy efficiency goal to achieve an energy saving of 20% by 2025.

- Development of policies that aim at an efficient use of energy in the transport sector.

- Implementation of minimum energy efficiency standards for light passenger vehicles.
Transport sector in Chile: energy consumption

- Road: 82%
- Transport sector: 36%
- Rail: 1%
- Aviation: 11%
- Sea: 5%

99% Crude oil derivatives

International context

Establishment of standards
Outlook

- More than 350,000 new vehicle per year
- Collaboration between the Transport, Energy and Environment Ministries
- 3CV - Center of Control and Certification of Vehicles.

Proposed bill of law

Objective: To establish an energy efficiency standard for the motorized vehicle fleet.

Standard: Will be set by the Energy and Transportation Ministries together, through fuel economy goals that must be met by manufacturers, importers or their representatives, with respect to the vehicles they commercialize.

Metric: Energy efficiency in kilometers per liters of gasoline equivalent and its equivalence in grams of CO2 per kilometer, determined using the values obtained in the homologation of the vehicle.
How is the standard established?

- At least two years (2016-2017) of a complete universe of light vehicles were studied.
- A common energy unit was taken.

How is the standard established?

- Performance with their respective technologies.
- Electric vehicle is more efficient.
- Wink to electromobility.
Application of EE vehicle standards

Quantifying savings by alternative

- The establishment of standards can contribute between 19.3% and 40.9% to the fulfillment of energy efficiency goals.
- A contribution that is greater than the current proportion of the energy consumption by light vehicles (13.5%).
Impact on supply

- In the segment of smaller vehicles there are multiple options that are above average.
- In the segments of greater weight, it was observed that for each of these there is an alternative that does not require a considerable increase in the price or a reduction in the size of the vehicle.

Conclusion

- Faculties for labeling in all vehicles, we are with light and medium vehicles.
- As of July 2018 we have a technical protocol to obtaining energy consumption in urban public transport buses in the city of Santiago.
Thank you!
lubilla@minenergia.cl
APPENDIX 6: Test protocols underpinning fuel economy regulations: the transition to WLTP and its inclusion in CO₂ policies
Different forms of standards:

- Mandatory
- Industry Voluntary Codes
- Best Practice Codes
- Guidelines
- Examples
- Facebook!

**Level Of Stringency**

- Concepts
- Detailed

**Specificity**

- Since start (wiring rules) "it must be safe"
- Mar '18 RCD detail
- Oct '16 Type 2 Socket Outlet

Standards development (including timing) is an art ...
... require sufficient regulation to gain desired controls but without stifling innovation
Vehicle Testing History

- 1950-60s: US studies identified vehicles as significant source of air pollution.
- 1960s: establishment of environmental agencies in California, then across US, for developing and administering emissions standards for vehicles.
- 1970s: Establishment of similar initiatives in Western Europe, Canada, Australia and Japan.
- Required reference to results from a repeatable test that aimed to simulate typical vehicle use.
- Mid 1970s: tightening emission standards required de-tuning of engine higher fuel consumption.
- Energy crisis of 1970-80s → fuel consumption result underpinned many energy reduction policy initiatives.
- Fuel consumption result now underpins many GHG reduction policy initiatives.

---

Vehicle Emissions (and Fuel Consumption) Testing:

![Graph showing levels of stringency versus specificity](image)

- Mandatory
- Industry Voluntary Codes
- Best Practice Codes
- Guidelines
- Examples
- Facebook

Specificity

Concepts Detailed

$Billions at stake
Vehicle Emissions (and Fuel Consumption) Testing:

- Billions at stake – test must be acceptable industry wide, repeatable and robust.
- Ideally providing a range of speeds and loads (and operating temperatures) representing typical vehicle use.
- Standardised: accurately specified to provide repeatability.
- Despite tight specification and staged development of previous tests:
  - Experienced testers could “game” and get better results.
  - Vehicles could be calibrated to perform well under the specific test conditions.
  - Test cycle specification considered vehicle technology available at the time.
- Over time greater divergence of test results and “real world” results.
- New technologies (e.g., EVs) not well catered for (New European Driving Cycle 20 years old).
- Different test cycles in different jurisdictions. Global vehicle supply more efficient/cost effective with one test (homologation).
  - undermining policy efforts

Introduction of the Worldwide Harmonised Light Vehicle Test Procedure (WLTP)

- Development process began in 2007.
- Developed by the UN ECE GRPE (Working Party on Pollution and Energy) with inputs from wide-ranging economies.
- An approximation of real-world operation.
- Stricter test conditions, higher speeds, longer test duration.
- Consideration of vehicle’s “special equipment”, including weight of A/C units, aerodynamics, and others.
- Consideration of different power trains ... EV technology.
The Test Arrangement

- Control unit
- Dilution air
- Heat exchanger
- Gas analysers
- Exhaust gas sampling bags
- Blower
- Roller bench
- Particle measurement system

HOW DOES THE CAR LAB TEST WORK?

**Ignition**
- The car is started cold, as it might be by a normal driver.

**Engine**
- Must have been run in at least 2000 km, to ensure real-world vehicle performance.

**Oil**
- Standard specification oil for the conditions is used.

**Windscreen**
- A standard reference fuel (petrol or diesel) is specified for the test.

**Gear Shifts & Acceleration**
- Defined by regulation to enable comparability between different cars.

**Laboratory Equipment**
- Apparatus in independent laboratories to ensure compliance.

**Real-world Test**
- Test vehicle including optional or additional equipment to represent real-world conditions.

**Brakes**
- Must be in normal working order and include braking devices.

**Wheels**
- Aligned during setup to ensure that resistance of rolling load is realistic.

**Consumer Electronics**
- Radio, air conditioning, electronic gadgets are turned off, test is fair between differently equipped cars.

**Daylights**
- Must be activated.

**Tyres**
- Standard road tyres, at specified pressure.

**Noise**
- Emissions measured at different levels to account for testing, emission and vehicle differences.
### New European Drive Cycle (NEDC) vs Worldwide Harmonised Light Vehicle Test Procedure (WLTP)

<table>
<thead>
<tr>
<th></th>
<th>NEDC</th>
<th>WLTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting temp.</td>
<td>cold</td>
<td>cold</td>
</tr>
<tr>
<td>Duration</td>
<td>1.180 sec.</td>
<td>1.800 sec.</td>
</tr>
<tr>
<td>Idle time</td>
<td>25 %</td>
<td>13 %</td>
</tr>
<tr>
<td>Distance</td>
<td>10.966 m</td>
<td>23.274 m</td>
</tr>
<tr>
<td>Phases</td>
<td>2 phases: Urban and long-distance trip</td>
<td>Up to 4 phases: “Low”, “Medium”, “High” and “Extra-High”</td>
</tr>
<tr>
<td>Speed</td>
<td>mean: 34 km/h – maximum: 120 km/h</td>
<td>mean: 47 km/h – maximum: 131 km/h</td>
</tr>
<tr>
<td></td>
<td>mean: 0.50 m/s² – maximum: 1.04 m/s²</td>
<td>mean: 0.39 m/s² – maximum: 1.58 m/s²</td>
</tr>
</tbody>
</table>
The WLTC for PEVs, PHEVs and (Non-P)HEVs

Introduction of World Harmonized

From 09/2018

2021 for Emissions

2021

10/2018 modified version

2021

TBA
WLTP Timeframes

Type Approval

Customer Information

Technical Docs (COC)

Labelling and taxation

Implications of Higher WLTP Value:

Tax implications with g/km increase???
OEM obligations with g/km increase???
Consequences of WLTP Introduction

- Vehicle Type Approval data uses WLTP test, but labelling still requires NEDC data → high risk of confusing consumers where both NEDC and WLTP are displayed.
- European Union CO₂ targets for 2021, for vehicle manufacturers, based on old NEDC test.
  - European Commission developed a WLTP→NEDC translation algorithm.
  - Not exact, which has potential for significant cost implications.
- UK as an example of considerations: changes to the label are proposed for April 2020, when taxation will switch from NEDC to WLTP. Yet to be determined how difference in fuel consumption result/tax will be managed.
- EU automotive industry suggesting revision of labelling once WLTP transition complete → harmonised consumer information.

WLTP Summary

- Developed by the UN ECE GRPE (Working Party on Pollution and Energy)
- Part of the Worldwide harmonized Light vehicles Test Procedures (WLTP). The WLTP procedures define a number of other procedures.
- Cycle based on real-driving data with low, medium, high and extra high speed sections → expect closer to real-world fuel consumption.
- Phase-in began 2017. Few light vehicle models/vehicles now not tested to WLTP protocol.
- Introduction of modified form in Japan, and for exhaust emissions in China. Australia, India and South Korea will also implement the WLTP at a later stage.
- Many factors involved in vehicle’s fuel consumption and CO₂ emissions. Despite expected improvements, care still required interpreting WLTP.
- Fuel consumption labelling and other use of WLTP data yet to catch up.
Thank You

http://aperc.ieej.or.jp/
APPENDIX 7: Wide scale promotion of low emission vehicles for HK – challenges and opportunities

ASIA-PACIFIC ECONOMIC COOPERATION (APEC)
APEC Workshops

Wide Scale Promotion of Low-emission Vehicles for Hong Kong – Challenges and Opportunities

Mr. Raymond Choi
General Manager (Customer Services)
HK Electric

Date: 18 March 2019

GHG Emissions – Transport

- Low-emission vehicles (i.e. electric vehicles) are a major component of the 2DS, and vital to achieving “well below 2 degree” ambitions

2°C Scenario (2DS) – an emissions trajectory with at least a 50% chance of limiting the average global temperature increase to 2°C

Source: Accelerating electric vehicle deployment and support policies (2019), International Energy Agency
Global Outlook of EV

IEA Global EV Outlook 2018 (EV30@30)
- EV accounts for 30% new vehicle sales by 2030
- 220 million EVs on the road by 2030

Hong Kong, China

Electrification of Road Transport in Hong Kong

<table>
<thead>
<tr>
<th>As at Dec 2018</th>
<th>Average Daily Passenger Journeys</th>
<th>Licensed Fleet</th>
<th>Electrified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Franchised Buses</td>
<td>4.1 M</td>
<td>6,294 buses</td>
<td>33</td>
</tr>
<tr>
<td>Public Light Buses</td>
<td>1.8 M</td>
<td>4,323 buses</td>
<td>0</td>
</tr>
<tr>
<td>Taxis</td>
<td>0.9 M</td>
<td>18,143 taxis</td>
<td>0</td>
</tr>
<tr>
<td>Private cars</td>
<td>565,213</td>
<td>10,670</td>
<td>~2%</td>
</tr>
<tr>
<td>Goods vehicles</td>
<td>115,804</td>
<td>83</td>
<td>~0.1%</td>
</tr>
<tr>
<td>Motor cycles</td>
<td>54,856</td>
<td>10</td>
<td>~0.1%</td>
</tr>
<tr>
<td>Government &amp; Special vehicles</td>
<td>1,763</td>
<td>91</td>
<td>~1%</td>
</tr>
<tr>
<td>Other Buses/Coaches</td>
<td>7,629</td>
<td>8</td>
<td>~0.1%</td>
</tr>
<tr>
<td>Private Light Buses</td>
<td>3,346</td>
<td>6</td>
<td>~0.2%</td>
</tr>
</tbody>
</table>

Source: Transport Department, HK GOV

Hong Kong, China
Trend of EV Adoption in Hong Kong

- Only a handful of public EV charger was available in 2009
- HK Electric has embarked free EV-charging service since 2009
- As at Jan 2019, there are 2,166 EV chargers for public use

![Chart showing the number of licensed electric private and goods vehicles in Hong Kong from 2008 to 2018.]

Hong Kong, China

Hong Kong – A Perfect City for EV?

- High density of high-rise buildings
- Sub-tropical weather
- Hilly terrain
- One of the cities with the most reliable electricity supply infrastructure
- Longest point-to-point commute is about 60 km (e.g. A to B, C to D)
- Daily mileage
  - Private cars: Few tens of kilometres
  - Public transport: >200/300 km
- Blue print for transforming to a low-carbon smart city
- Well-established fossil-fueled car market and networks of refueling stations

![Map of Hong Kong Major Road Network]

Source: Promoting the Use of Electric Vehicles [Feb 2019], Logica EA Novel

Hong Kong, China
Wider Adoption of EV in HK - Challenges

- High density of high-rise buildings
  - Cars are parked in multi-storey car parks with parking bays either owned or rented by the drivers
  - Existing car parks are not designed for EV charger installation
  - Aged buildings may not have spare communal power capacity for EV chargers
  - Permissions from the building owners and other parking bay owners/users are required for EV charger installation and associated wiring work

- Sub-tropical weather
  - Air-conditioning is a must in hot and humid days, especially during traffic congestion

- Hilly terrain
  - Uphill climbing ability is a must, especially for buses & light buses

- Long travel range for public transport
  - Sufficient top-up/quick chargers or spare vehicles are required for fleet operation

- Well-established fossil-fueled car market
  - Keen competition with fossil-fueled cars on choices, prices and refueling convenience

Hong Kong, China

Wider Adoption of EV in HK - Opportunities

- Aspiration for becoming a low-carbon smart city
  - Policy support for EV development in Hong Kong as one of the means to reduce carbon intensity, improve air quality and transform to a smart city

- High density of high-rise buildings
  - EV as a key means to solve roadside emission problem given buildings are packed along road sides especially in urban areas

- Private cars’ short commute distance
  - Present EVs are able to cope with the driving range requirement; “refueling” frequency can be on par with fossil-fueled cars

- Reliable electricity supply infrastructure
  - Adequate and reliable electricity supply supports the EV charging infrastructure development, especially top-up quick chargers

Source: SmartCity.gov.hk: Hong Kong’s Climate Action Plan 2030+ Investment Working Group, HKAR Government

Hong Kong, China
Overcome Challenges & Seize Opportunities
Governments’ Policies

- First registration tax (FRT) concessions for EVs
- 100% profits tax deduction for the capital expenditure on EVs in the first year of procurement
- A HK$300 million Pilot Green Transport Fund to encourage trial of green innovative and low carbon transport technologies (including electric commercial vehicles)
- $180 million for franchised bus companies to purchase 36 single-deck electric buses
- Gross Floor Area concession for new development with all parking spaces EV charging enabled
- Guidelines for setting up EV chargers
- 2018 Policy Address: consider ceasing the first registration of diesel private cars subject to consultation with stakeholders
- 2019-20 Budget: $120 million to extend the public EV charging networks at government car parks

Source: Hong Kong Climate Action Plan 2050: Environment Bureau, HKSAR Government

Hong Kong, China

Overcome Challenges & Seize Opportunities
HK Electric’s Endeavours

- Supply reliability of > 99.999% since 1997
- Introduced EVs in early 1980’s, > 40% EVs in corporate fleet as at today
- Free EV charging service since 2009
- We Power Hong Kong’s Formula E
- Champion Proposal
- Grid supply capacity checks, site inspections and technical advisory services
- 2016-2018: helped customers install over 150 EV chargers at their premises

Source: Hong Kong Electric

Hong Kong, China
Drivers for Further EV Adoption (1/5)
Advent of Technologies

<table>
<thead>
<tr>
<th>Lowering battery cost, longer range per charge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EV Li-ion Battery Installed Capacity (GWh)</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>4.4</td>
</tr>
<tr>
<td><strong>EV Li-ion Battery Cost (USD/kWh)</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>1,000</td>
</tr>
<tr>
<td><strong>Range of Commercially available EV (km)</strong></td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>1,000</td>
</tr>
</tbody>
</table>

More affordable choice of EVs

Battery Charging or Swapping

2010

50 kW DC Fast Charging

2018

500 kW DC High Power Charging

Static/dynamic Wireless Charging

More convenient “refueling” of EVs

Hong Kong, China

Drivers for Further EV Adoption (2/5)
Autonomous Driving/Vehicles

<table>
<thead>
<tr>
<th>Level</th>
<th>No Automation</th>
<th>Drive Assistance</th>
<th>Partial Automation</th>
<th>Conditional Automation</th>
<th>High Automation</th>
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<tbody>
<tr>
<td>0</td>
<td>MIND</td>
<td>MIND</td>
<td>MIND</td>
<td>MIND</td>
<td>MIND</td>
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<tr>
<td>5</td>
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<td>MIND</td>
<td>MIND</td>
</tr>
</tbody>
</table>


Hong Kong, China
Drivers for Further EV Adoption (3/5)
On-demand & Sharing E-mobility

- BlueSG: 1,000 sharing EVs and 500 charging stations in Singapore (100 stations opened as of Oct 2018)
- VW will provide 2,000 sharing EVs in Berlin starting from Q2 2019
- Ford GoBike added in Apr 2018 250 power-assisted e-bikes to its bike sharing fleet in San Francisco

Hong Kong, China

Drivers for Further EV Adoption (4/5)
Regulations & Policies

<table>
<thead>
<tr>
<th>Region</th>
<th>Ban by</th>
<th>G: Gasoline</th>
<th>D: Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>2025</td>
<td>G+D</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>2030</td>
<td>G+D</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>2040</td>
<td>G+D</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>2030</td>
<td>G+D</td>
<td></td>
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<td>D</td>
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</tr>
<tr>
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<td>G+D</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2040</td>
<td>G+D</td>
<td></td>
</tr>
</tbody>
</table>

Source: Internet research

Incentives for EV
- Tax/levy waivers for owning EVs
- Incentives for EV charging infrastructure
- EV user incentives/privileges

Clarity of policies, legislations, regulations and insurance for personal & sharing mobility

Hong Kong, China
Drivers for Further EV Adoption (5/5)
Energy Transition & Digitalisation

- Continuous decarbonisation of power sector (use of more natural gas and low-carbon means for power generation) further reduces emissions “from EVs” at energy sources
- Electrified mobility devices are becoming distributed energy resources (DERs) using V2G technology, which will be better integrated with the smart grid

Concluding Remark – A Visionary Picture of EV

Integrated solution & key smart city ingredient
Safe
Intelligent
Connected
On-demand/sharing
Environmental
Convenient
Efficient

We see challenges, but we see more opportunities

Hong Kong, China
Thank You
APPENDIX 8: Developing Strategies for EVs: Case Study from the Philippines

Energy Efficiency Policy Workshop 2019

Developing Strategies for EVs: Case Study from the Philippines

Name: Andrew Campbell
Institution: Fuel Technology Limited, New Zealand
Date: 18 March 2019, Hong Kong

The “Upstarts”
Life is changing ...

- Cheap electronics, cheap communications, and cheap data.
- Advances in battery technology and cost reduction.
- OEMs well aware of likely disruption to their business:
  - Flexible ownership and usership: car sharing, fractional ownership, pay-as-you-go.
  - Provision of (single trip) multi-modal urban solutions.
  - “Dynamic shuttles”: near-taxi convenience and near-mass transit price.
- Autonomy from assist to full control (Ford, Uber, Google ... early target is SAE Level 4-capable autonomous vehicle for ride-hailing or ride-sharing services).
Also changing in the electricity supply sector...

• “Important changes underway in the provision of electricity” Utility of the future MIT

• Significant decrease in cost of enabling technology (hardware, data, comms and systems) → available, practical and affordable.

• enablers management of electricity supply network:
  • Shifting demand to times when network use “free”
  • Opportunity for “Mum and Dad” “aggregators”
  • Response to supply-side: voltage and other management, load shedding ...
  • More efficient consumption of electricity (network and local).
  • Greater utilization of lower GHG generation options.

![Diagram of electricity supply, EVSE, and EVs with stages of market maturity and commercialization technology]
Charging requirements changing ...

Today
- 1.7 kW
- 50 kW
- 120 kW
- 500 kW

2020
- 7 kW
- 150 kW
- 200 kW
- 800 kW

Charge Rate (kW)

What Vehicles are Important to Your Economy?

Very important for many Asian countries:
- First and last mile public transport.
- >80% passenger trips
- Currently many 2-stroke
- Large growth expected
- Few "standards"
- ... and few in progress.
DOE E-trike Project Summary

- 3000 e-trikes to be deployed by May 2019.
- Manufactured in Philippines
- Design applicable to many Asian countries.
- Automotive-grade Li-ion batteries ... and supply chain.
- Targeting (first-mile, last-mile) public passenger transport (and removal of two-stroke tricycles).
- Deployed through Local Government Units (who are responsible for setting up charging stations where at-home charging is not sufficient).
- Has stimulated private sector uptake of e-trikes.
Supported by many forms of guidelines

Why e-trikes?

APERC
### Electric scooter giant Lime recalled scooters amid fears that some could catch on fire

#### Time in Life Cycle

<table>
<thead>
<tr>
<th>Electric Vehicles</th>
<th>Charging Infrastructure</th>
<th>Electricity to the Plug/Charger</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td>Standards, tech development, meeting market. Micro, LEVs, NEVs.</td>
<td>Changing and related hardware such as, NZ Inc, plan, compatibility. Connectors Micro, LEVs, NEVs.</td>
</tr>
<tr>
<td><strong>Build</strong></td>
<td>Capacity, market demand, vehicle class.</td>
<td>Capacity, demand by different type.</td>
</tr>
<tr>
<td><strong>Supply</strong></td>
<td>Availability, meeting demand, shipping, import, certification.</td>
<td>Availability, meeting demand, shipping, import, certification.</td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td>Insurance, warranty, registration, identification, WIF.</td>
<td>Approval, site works, certification, industry training.</td>
</tr>
<tr>
<td><strong>In-service operation</strong></td>
<td>Monitoring</td>
<td>Monitoring</td>
</tr>
<tr>
<td><strong>General use</strong></td>
<td>Understanding, best driving practices.</td>
<td>Access, authenticity, signage, availability, NZ Inc, map.</td>
</tr>
<tr>
<td><strong>Charging</strong></td>
<td>Understanding, options, costs, best practice.</td>
<td>Understanding, connectivity, time of charge, billing.</td>
</tr>
<tr>
<td><strong>Servicing/maintenance</strong></td>
<td>Understanding, industry capability and capacity, industry training.</td>
<td>WIF, certification, industry training.</td>
</tr>
<tr>
<td><strong>Accident</strong></td>
<td>1st response, repair, fire re-entry.</td>
<td>1st response, repair, re-cert.</td>
</tr>
<tr>
<td><strong>Retirement</strong></td>
<td>Decision to, reuse of battery/electrics through scrap/recycle.</td>
<td>Decision to, re-use/upgrade through scrap.</td>
</tr>
</tbody>
</table>
Background: APEC Electric Vehicle RoadMap History

- **2014**: APEC Trade and Foreign Ministers endorsed APEC Actions for promotion of EVs.
- **2016-2018** delivery of Roadmap Workshops
- **Identified areas for further work:**
  - Recycling (including protocols for re-use and re-manufacture of batteries)
  - Cybersecurity (hacking prevention)
  - Personal data (including autonomous vehicle routing info, driver info)
  - Emergency response (protocols/manuals, ability to convey help required)
  - Interoperability and related standards (high power, wireless, building/grid integration)
  - Standards for other EV types (2- and 3-wheel, emerging user models)
  - ... and harmonisation of these standards ....

Example: First Response
Summary Position of First Response

• Two-step approach to managing risks:
  • Identify the risk
  • Manage the risk
• EVs introduces new battery types (and makeup is changing).
  ⇒ different response required, for fire and (water) emersion.
• Introduces high voltages:
  ⇒ Need to carefully identify cables if cutting (LV) to isolate.
  ⇒ Poor/no use of high voltage colour coding in 2- and 3-wheelers!
  ⇒ A minimum requirement?
• Several guidelines available (e.g., US: National Fire Protection Association (NFPA), but poor dissemination.

Battery Fire Quiz

Q. What method is recommended to respond to a fire of an electric vehicle?
   a) Dry powder or CO₂ (i.e., electrical fire extinguishers).
   b) Water.
   c) Get out the marshmallows and watch.
Battery Fire Quiz

Answer:

b) Water based fire extinguishing agents best.
   • Suppress and cool.
   • Chance of re-ignition .......... days later
   • Remove vehicle to safe location.

• Gas extinguishing agents and dry powder extinguishing agents are ineffective

Why do we have standards?

• Minimum performance
• Compatibility
• Security
• ...

Safety

Consumer Protection

Environmental
Challenges to EV Commercialization

- **Cost of developing technologies**
  - Low return on investment
  - Limited R&D $$ for multiple technology trajectories
  - Batteries about half cost of EV and development critical
  - Govt support in latter has been critical.

- **Adequacy of infrastructure**
  - Must have interoperable network
  - The grid will be affected at all levels (generation, transmission and distribution) → critical for industries to collaborate.

- **Regulatory environment**
  - Still significant cost difference between EV and ICE
  - Constant updating making standardisation difficult
  - Support from government, universities and industry partnerships critical to make most of $$$ available
  - Regulatory predictability and transparency are key.

Thank You

http://aperc.ieej.or.jp/
APPENDIX 9: Growth of electric vehicles in New Zealand

Energy Efficiency Policy Workshop 2019

Growth of electric vehicles in New Zealand

Name: Elizabeth Yeaman
Institution: Retyna Limited, New Zealand
Date: 18 March 2019, Hong Kong

About New Zealand

- Population 4.7 million
- 3.5 million light vehicles
- Right hand drive vehicles
- Accepts vehicles to four international standards: EU, Japan, Australia, US
- 55% of new entrants to the national fleet are used imports
Advantages of EVs in New Zealand

- 80% reduction in CO₂ emissions compared with petrol vehicles
- Electricity for EV driving ≈ NZ$0.30 per litre (USD0.20/L) compared with NZ$1.80-$2.20 per litre for petrol
- Driving range of entry level EVs meets majority of driving tasks
- 85% of NZ residences have off-street parking
EV policy in New Zealand

Ministry of Transport – EV programme coordination

- Ministry of Transport
  - Overview of programme
  - Staff for transport legislative work
  - NZ emissions targets
  - Electric vehicles Programme leadership support

- NZ Transport Agency
  - Supporting the development of public charging infrastructure
  - Tracking electric vehicles to public vehicle supply
  - Updating the electric vehicle register

- Energy Efficiency & Conservation Authority
  - Nationalwide information and promotion campaign
  - Cost-effective fuel consumption and support for innovative low emissions vehicle projects

- Ministry of Business Innovation & Employment
  - Public private investment in electric vehicles

- Inland Revenue Department
  - Revenue of tax benefits for light electric vehicles

- WorkSafe NZ
  - Providing guidelines and leadership

Some fiscal support for EVs

- Petrol vehicles pay fuel excise at the pump, all other vehicles including EVs and diesel vehicles pay Road User Charges (RUC) for each km driven

- **Light vehicles**: Light EVs (e.g., cars and vans) exempt from RUC until 2021

- **Heavy vehicles**: Heavy EVs are exempt from RUC until they make up 2% of the heavy vehicle fleet

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Definition</th>
<th>RUC rate</th>
<th>Example annual distance</th>
<th>Example RUC exemption saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light vehicle</td>
<td>Under 3.5 tonnes</td>
<td>NZ$52 / 1,000 km</td>
<td>15,000 km</td>
<td>NZ$ 930 / year</td>
</tr>
<tr>
<td>Small delivery truck</td>
<td>Under 6 tonnes, dual rear wheels</td>
<td>NZ$66 / 1,000 km</td>
<td>30,000 km</td>
<td>NZ$1,980 / year</td>
</tr>
<tr>
<td>Medium freight truck</td>
<td>12 – 18 tonnes, 3 axle</td>
<td>NZ$292 / 1,000 km</td>
<td>75,000 km</td>
<td>NZ$21,900 / year</td>
</tr>
</tbody>
</table>

Nzd1.00≈USD0.67
EECA Low Emission Vehicles Contestable Fund

• Funding of $7 million/year to co-fund innovative projects

• Industry are the innovators and can move quickly. Fund is a clever way to encourage this private-sector growth and help overcome first mover risk.

• Foreign companies can be partners in a project in NZ, but the funding application must be led by NZ organisation

• [Link](https://www.eeca.govt.nz/funding-and-support/low-emission-vehicles-contestable-fund/)

Examples of projects supported by the fund

Electric car sharing. A more sustainable New Zealand.
Support for fast charging infrastructure

- Over 90% of charging is at home
- Private investment in public 50 kW DC fast charging with co-funding from the EECA Fund
- Public charging guidelines in place
- Over 150 fast chargers covering 95% of state highway network
- NZTA national public EV charging database “EV Roam” provides API for apps and navigations systems

Promotional activities underpinned by market research

<table>
<thead>
<tr>
<th>PETROL CAR</th>
<th>OCT '16</th>
<th>JAN '17</th>
<th>APR '17</th>
<th>JUL '17</th>
<th>OCT '17</th>
</tr>
</thead>
<tbody>
<tr>
<td>NETT likely to consider</td>
<td>74%</td>
<td>74%</td>
<td>75%</td>
<td>71%</td>
<td>73%</td>
</tr>
<tr>
<td>Why would consider EVs</td>
<td>They're environmentally friendly <strong>52%</strong></td>
<td>They save fuel costs <strong>67%</strong></td>
<td>They're affordable <strong>70%</strong></td>
<td>They can be charged at home <strong>43%</strong></td>
<td>They use renewable energy <strong>42%</strong></td>
</tr>
<tr>
<td>Why would not consider EVs</td>
<td>Not available at an affordable price <strong>51%</strong></td>
<td>Concerns with recharging <strong>68%</strong></td>
<td>Uncertainty about battery life <strong>49%</strong></td>
<td>Charging stations not easy to find <strong>55%</strong></td>
<td>Shifting range not reliable for long distance <strong>30%</strong></td>
</tr>
</tbody>
</table>

Note: Top 7 reasons for considering and not considering shown in charts
Public outreach important part of government campaign

Information resources: www.electricvehicles.govt.nz

I love my ev.

Curious about electric vehicles?

Find information and links to start your journey here.

- Driving electric every day
- Mythbusting - EVs in the project
- EV charging at home and about

ABOUT ELECTRIC VEHICLES WHAT NZ IS DOING WHAT CAN I DO NEXT?
Growth of EV registrations in New Zealand

EVs now over 2% of all light vehicle registrations
NZ's open and competitive electricity system

- Open, competitive, permissive electricity market
- Half-hourly spot market with wide diurnal and seasonal variations
- Markets for frequency keeping, voltage support, black start and demand response; hedge market
- 80%+ voluntary smart meter uptake
- 37 electricity retailers compete, setting their own pricing; annual switching rate over 20%
- 8 major generators, 650 small generators + PV

Some retailers offer special EV tariffs for EV owners

Electric Car Plan

You've shopped around and got yourself a shiny new electric car. Now, all you need is the right power plan to fill it up. You can power your electric car for less, with one of the sharpest EV plans in the market.

[Image of electric car and people with suitcase]

16
Innovation in retailing electricity

- Some retailers offer half-hourly spot market pricing to residential customers, plus fixed margin
- Customers set phones to receive an alert when prices or CO₂ emissions are low or high
- EV owners can use alerts to know when to start or stop charging

Most New Zealanders willing to charge off-peak

http://flick_efect.org/2023/most_new_zealanders_willing_to_charge_off_peak/
What’s coming next in NZ: 100% electric 130 pax ferry

Summary

- 85% renewable electricity generation
- Fiscal support: NZ$7 million/year fund for innovative EV projects and RUC exemption but no purchase price subsidies (previous failures with CNG and LPG vehicle subsidies)
- 95% state highway coverage with 50 kW DC fast chargers
- EVs now over 2% market share with no purchase price subsidies but with used-EV imports at close to price parity
- Electricity retail pricing innovation enabling platform for next generation of charging ... aggregated/managed charging
Kia ora