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Electric vehicles, sustainable mobility

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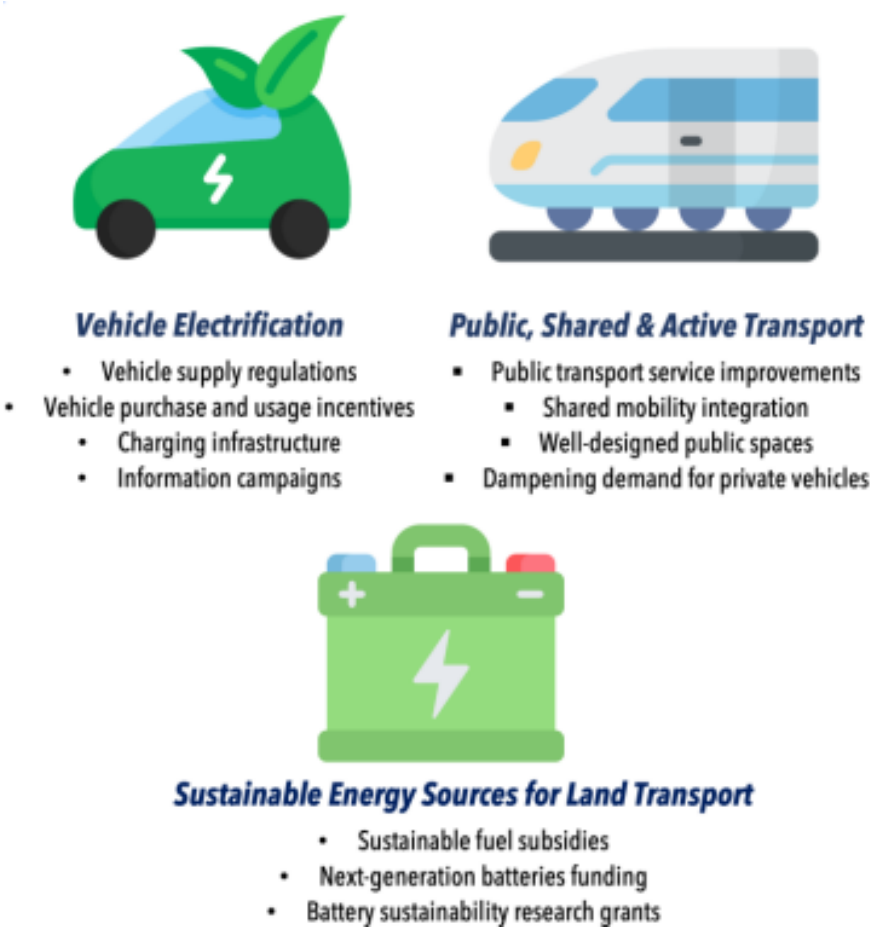
APERC 21st Energy Statistics Workshop

Date: 12-14 September 2023

Advancing Free Trade for Asia-Pacific Prosperity

Towards low- and zero-emissions land transport in APEC

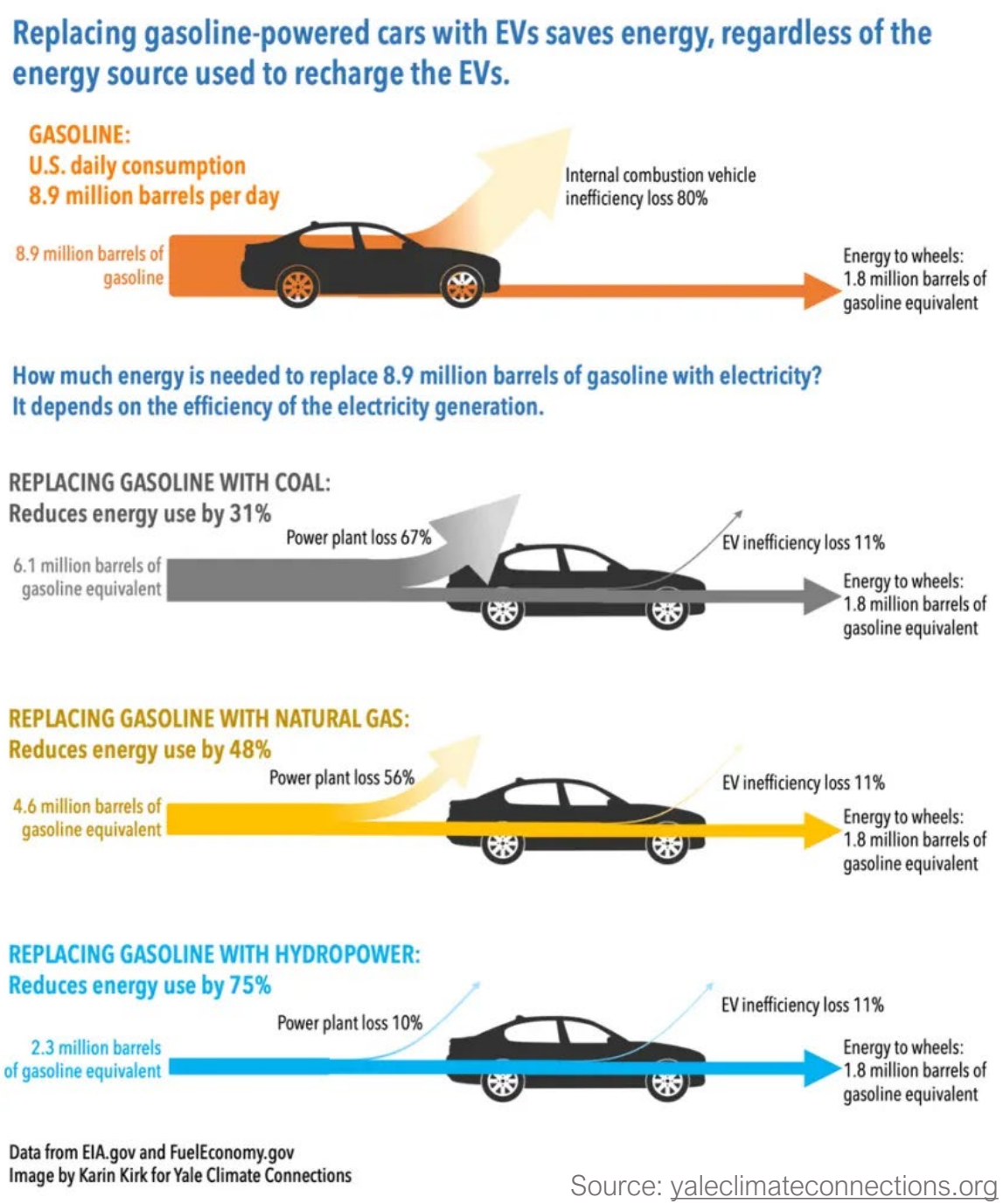
- Climate change is a major challenge to the APEC region, and transport accounts for about a quarter of GHG emissions worldwide.
- Moving towards low and zero-emissions transport is a major focus of the Transportation Working Group (TPTWG) and the Land Expert Group (LEG), including as one of the core pillars of the LEG's 2023 Main Policy Theme.
- The most effective and economically efficient strategy for transport decarbonisation is vehicle electrification, including some use of plug-in hybrids and hydrogen fuel cell electric vehicles, and clean energy production to supply motive energy. Demand side measures (shared transport) will also form part of the puzzle.



Source: APEC Policy Brief 55

Electric vehicle technology and power sources

- Information is out there on electric vehicle technology, including in academic papers about energy consumption modelling.
- Automotive technology is changing and there are different use cases for different low-emission vehicle technologies.
- Electric vehicles are fundamentally more efficient than fossil fuel vehicles. Their input is the electricity provided via the charger, prior to any charging losses.
- Hydrogen fuel cell electric vehicles convert a hydrogen gas input to electricity, via reverse electrolysis, which then powers a motor similar to an electric vehicle.



Source: yaleclimateconnections.org

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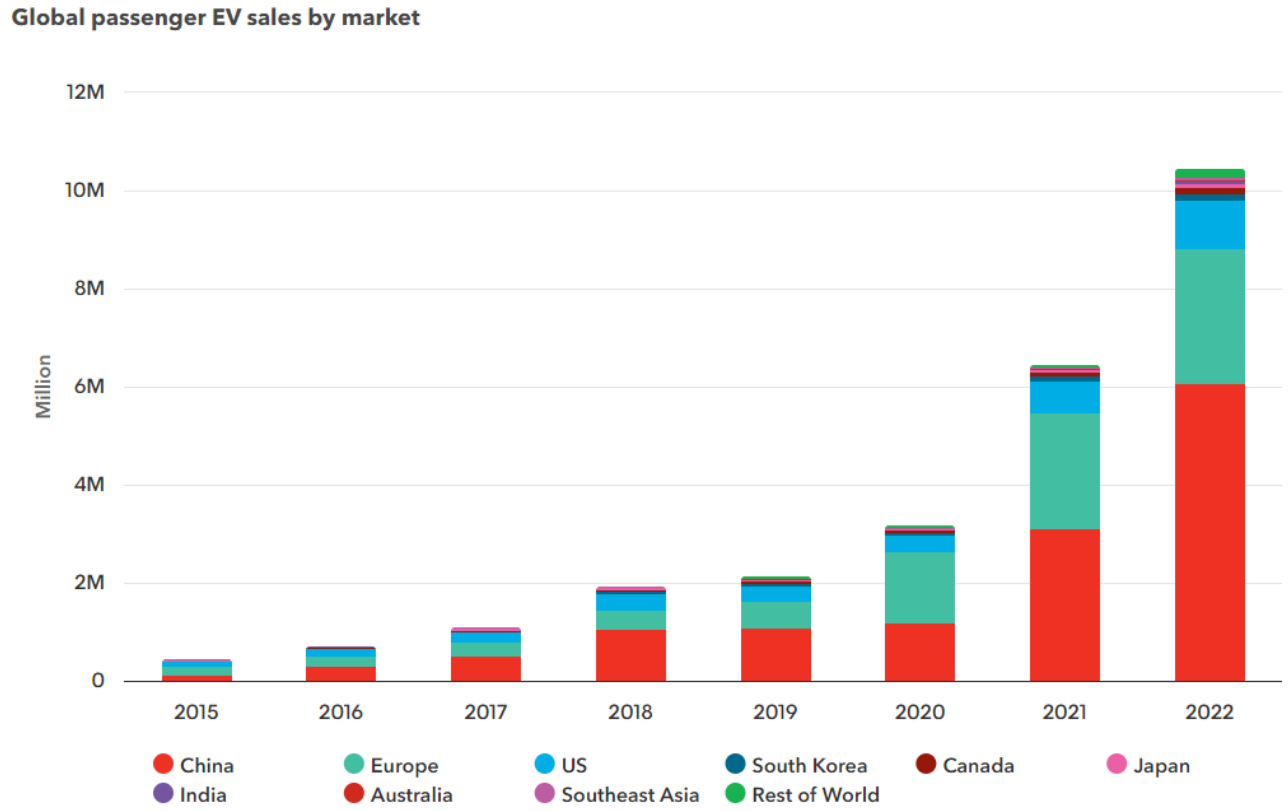
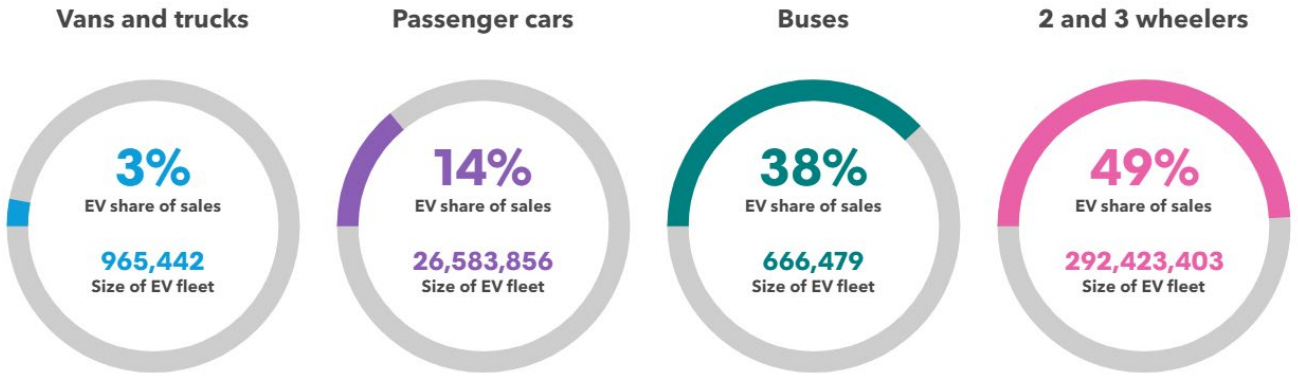
Electric vehicles are coming

- Passenger electric vehicle sales are increasing sharply due to the action of policymakers; as the industry pivots to provide new offerings; the economics of batteries improve; and consumer interest matures.
- Some factors affecting the cost of batteries affect the economics of the competition too.
- All vehicle segments need support to enable net-zero, but especially vans and trucks. Supply of needed vehicles will affect economies differently, depending on their trade patterns and approach to vehicle standards.





All figures 2022
Source: BloombergNEF

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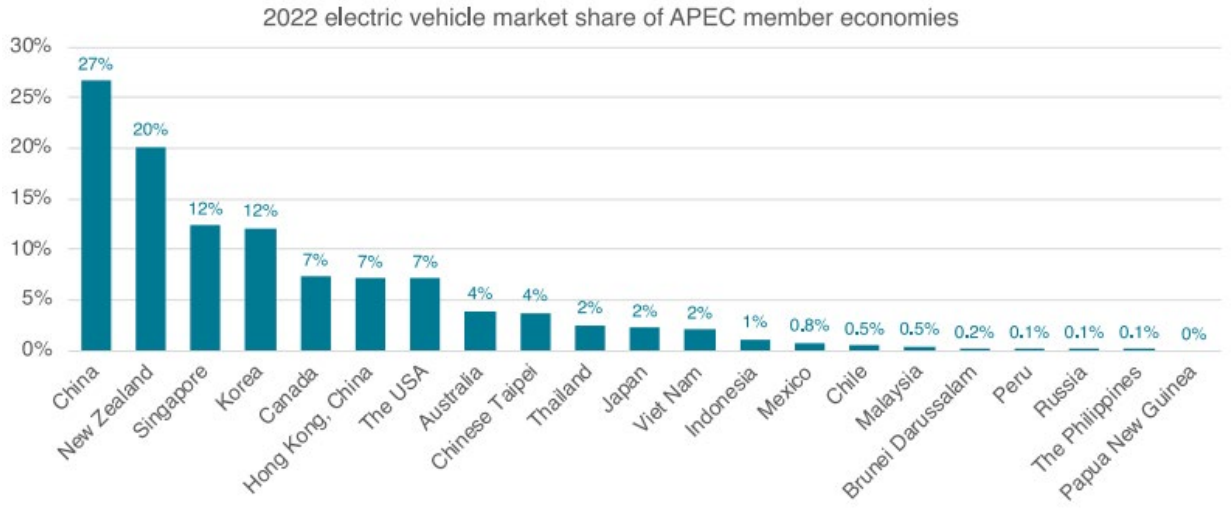
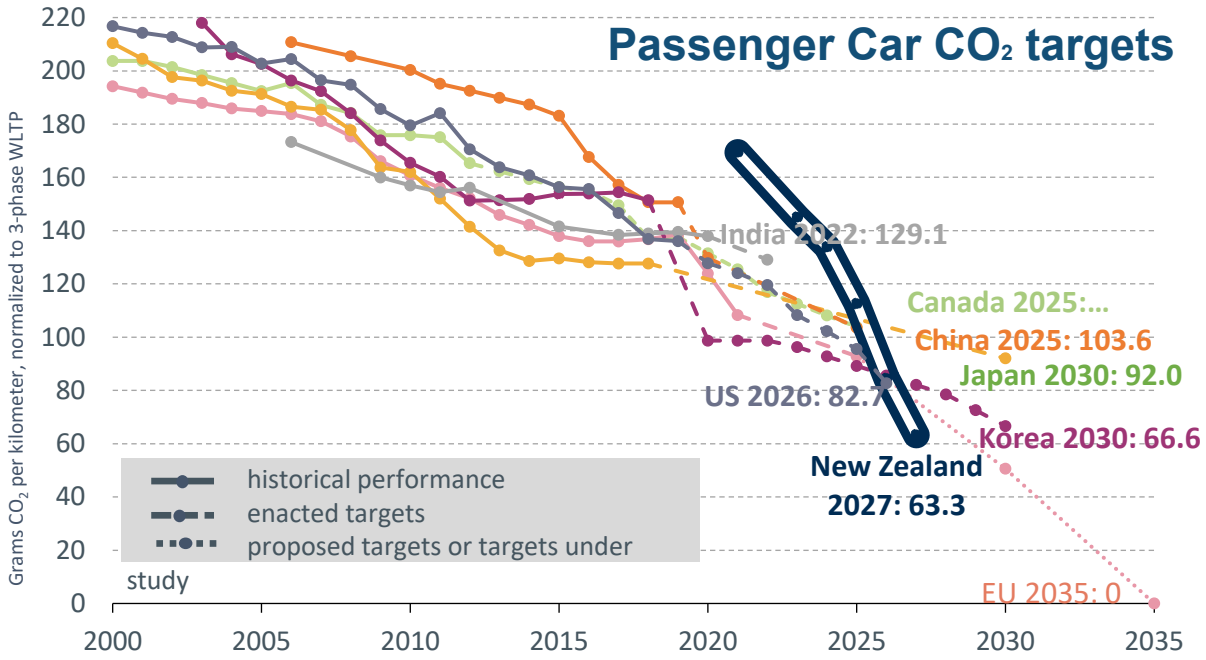
New Zealand's policy pathway to net-zero emissions

- Transport emissions rose more than any other source 1990-2019, by approx. 80%. Transport emissions need to fall by approx. 41% by 2035 (from 2019 levels).
- The Climate Change Response (Zero Carbon) Amendment Act 2019 provides a framework for New Zealand to move to net-zero by 2050. This includes emissions budgets out to 2035.
- The Emissions Reduction Plan targets, by 2035, an increase zero-emissions vehicles to 30% of light fleet; and to reduce freight emissions by 35%.
- New Zealand is a technology and standards taker. However, policy settings put us in a strong position.



Source: ICCT presentation to LEG



Source: Ministry of Transport

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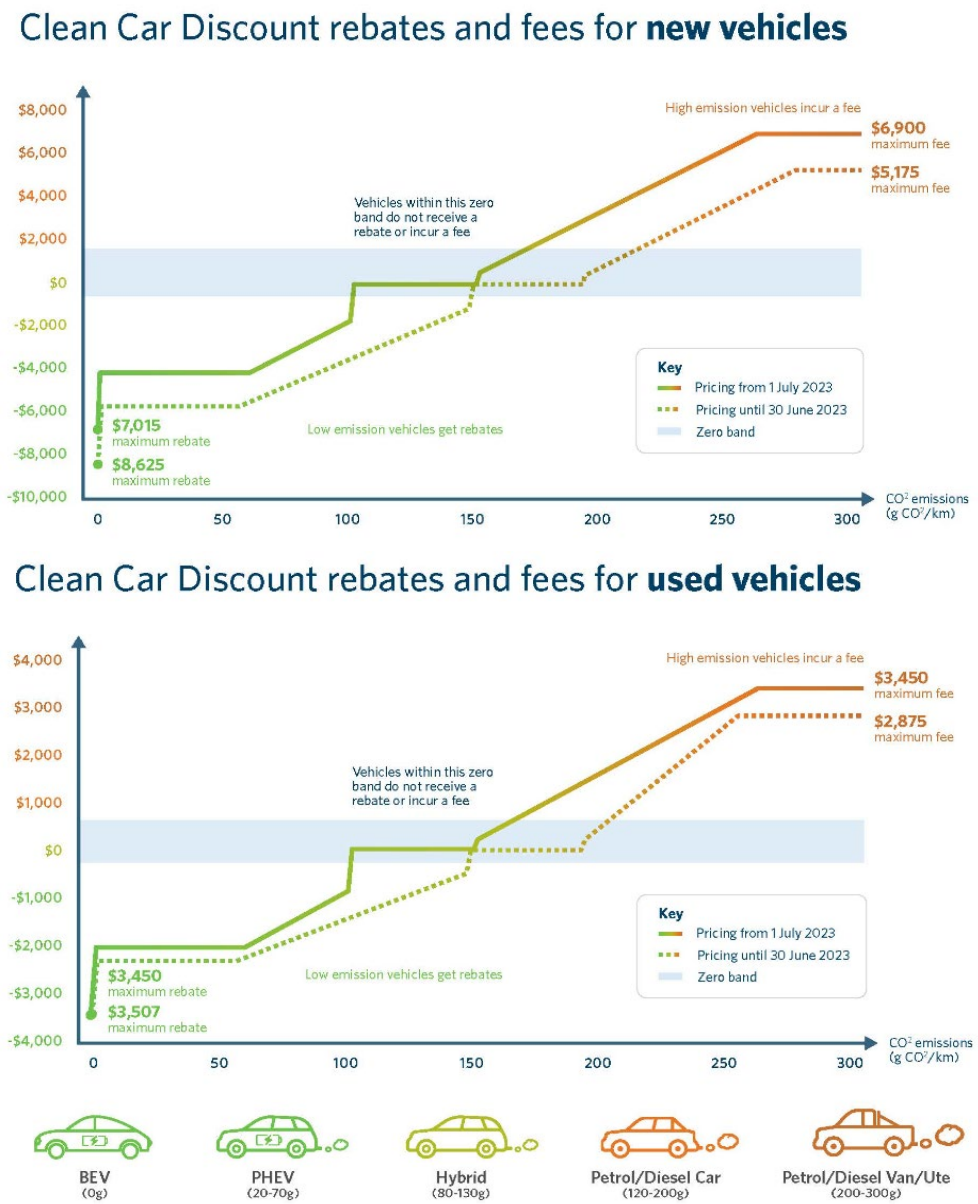
Clean Car Discount feebate scheme

- Introduced in July 2021, phase 1 provided a rebate to light battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV).
- Phase 2 introduced in April 2022, levying fees and introducing a “zero band” for some vehicles.
- Emissions values are based on 3P-Worldwide harmonized Light vehicles Test Procedure results. This ensures the policy gains are robust and measurable. Our monitoring and reporting is based on information in the Motor Vehicle Register.
- Since mid 2022, for the first time, the number of petrol vehicles in New Zealand has begun to decrease.
- Now, refuelling and charging infrastructure is needed to scale at pace.



Source: Ministry of Transport

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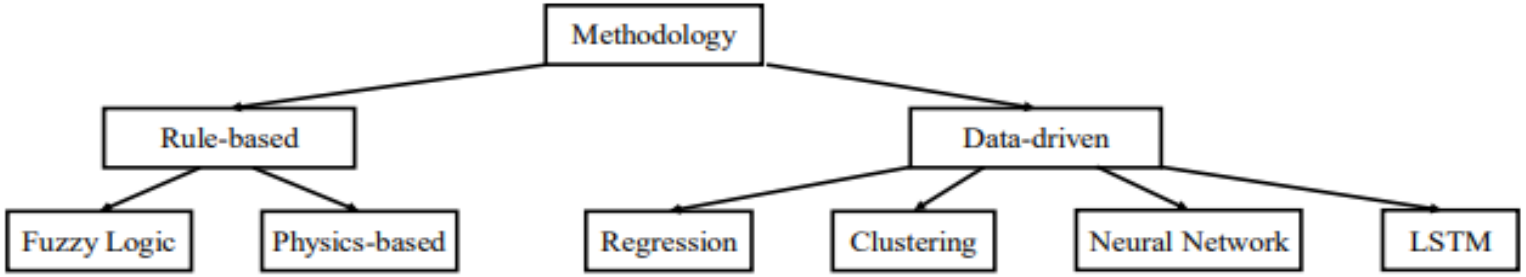
Good energy statistics will help transport decarbonisation

- Good energy statistics about energy consumption of vehicles supports:
  - consumers to manage trip-level and energy consumption choices e.g. how to drive, when and where to charge, choice of route; and alleviation of range anxiety;
  - energy companies to manage peak demand on their assets, and plan for provision of capacity;
  - policymakers to manage the climate transition and provide sufficient infrastructure.
- What is useful data will depend on the model's purpose:
  - WLTP results (refer to GTR 15); manufacturer's vehicle specifications
  - Onboard electronics e.g. the battery management system
  - Energy going into the vehicle (hydrogen gas, electricity passing through the charger)
  - Location data (e.g. vehicle movements, traffic considerations, road characteristics)
  - Demand for energy levied on the energy grid (e.g. for demand response applications)

Modelling real EV energy consumption

- Two basic approaches to modelling real consumption:
  - Rule-based approaches use physical laws to model energy acting on the wheels
  - Data-driven approaches use increasing amounts of in-vehicle data to model energy use and loss
- Consider the fundamentals e.g. scale, periodicity, horizon:
  - Are you modelling trip-level consumption for the consumer, or focusing on grid integration, demand response, or population-level issues?
  - Do you need to understand driver behaviour in real time?
  - Are you trying to control for long term trends, or predict them?



Source: Chen et al. (2021) fig. 4

Influential variables affecting real EV energy consumption

- While the WLTP provides more realistic data than previous tests, it does not necessarily represent the actual emissions and energy economy an individual driver will achieve.
- Actual energy economy varies due to many factors including:
  - vehicle components e.g. drivetrain efficiency, battery health, vehicle weight;
  - vehicle dynamics e.g. speed and acceleration;
  - traffic conditions e.g. congestion;
  - Environmental conditions e.g. weather, season, humidity.

Further pieces of the puzzle, and other takeaways

- The most effective and economically efficient strategy for transport decarbonisation is vehicle electrification. Batteries are getting better and cheaper, and that means electric vehicles are growing in accessibility.
- Electric vehicle uptake generally has positive benefits for human health and wellbeing. Sometimes these are not accounted for fully – but counting them too is important for economic analysis.
- Electrifying private vehicles is part of a solution to the problem of energy-inefficient transport.
- The initial energy source still matters for the climate benefit. But don't forget the wider implications of changes in energy mix and demand.
- Each economy's trade in vehicles and approach to vehicle standards likely affects the range of effective policy options in that economy, and therefore the mix of things that policymakers need to model.
- The future of transportation is not likely to change at a linear pace.

Want to know more?

APEC Policy Support Unit Policy Briefs:

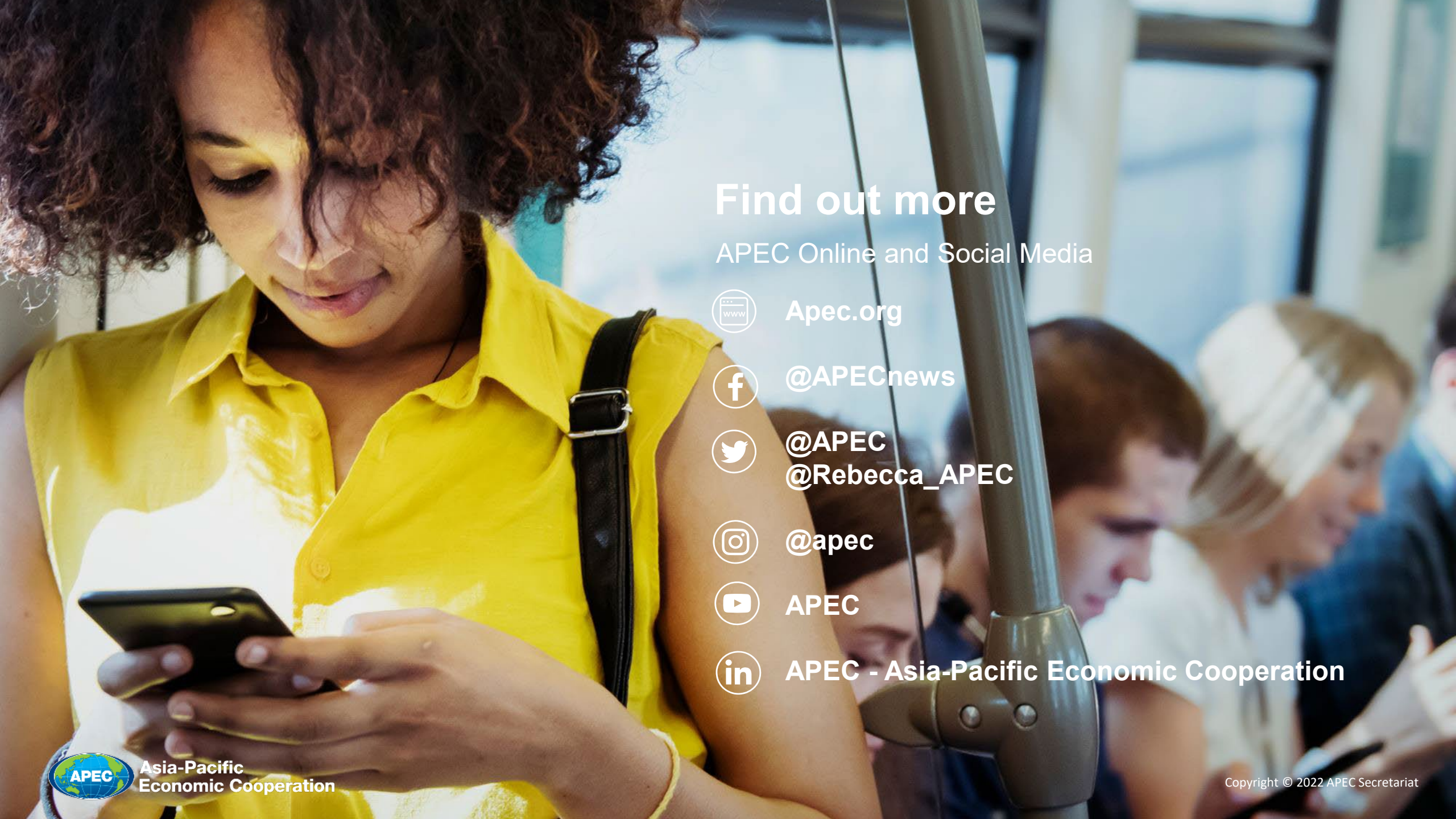
- Policy Brief 48: Policy Options for Decarbonizing Transportation in APEC;
- Policy Brief 55: Paths toward Low-emission Multimodal Transportation in APEC.

Energy consumption modelling (examples):

- Chen et al. (2021): A Review and Outlook on Energy Consumption Estimation Models for Electric Vehicles;
- Miri, Fotouhi and Ewin (2020): Electric vehicle energy consumption modelling and estimation – A case study;
- Croce et al (2021): Traffic and Energy Consumption Modelling of Electric Vehicles: Parameter Updating from Floating and Probe Vehicle Data.

Information on Clean Car Discount:

- Ministry of Transport (2023): Clean Car Discount Interim Report;
- Ministry of Transport: Ngā Waka Mā | Clean Cars.



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