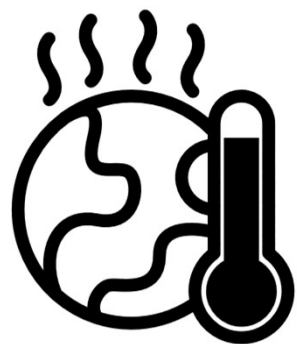


Our Electric Vehicle Future Starts Today

Andrew Campbell



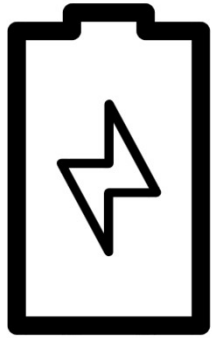
UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



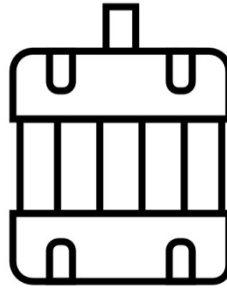
We need urgent
and significant
change

- Climate Change
- Cost of fuel imports
- Local air quality
- (Congestion)

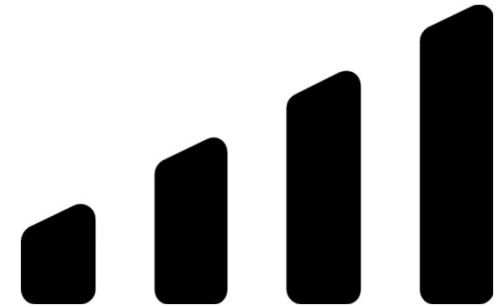




Batteries



Motors



Networks/comms



Smartphones



GPS/satellite tech

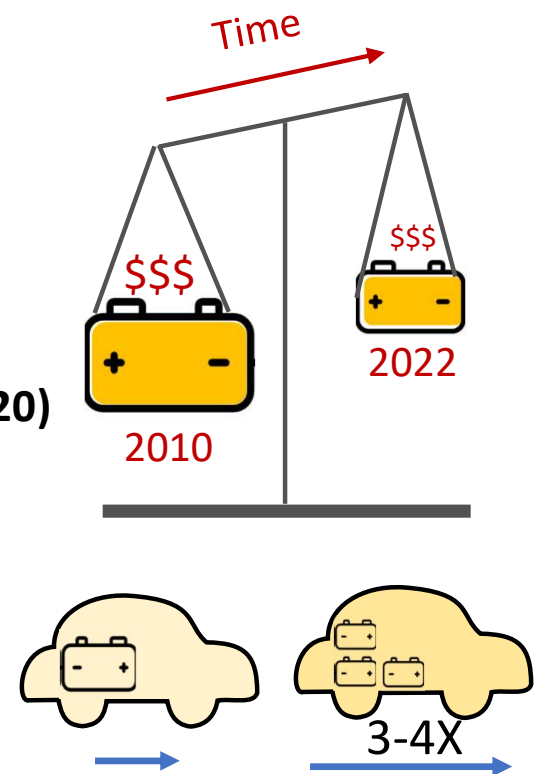
Enablers of change:

Technologies are developing rapidly →

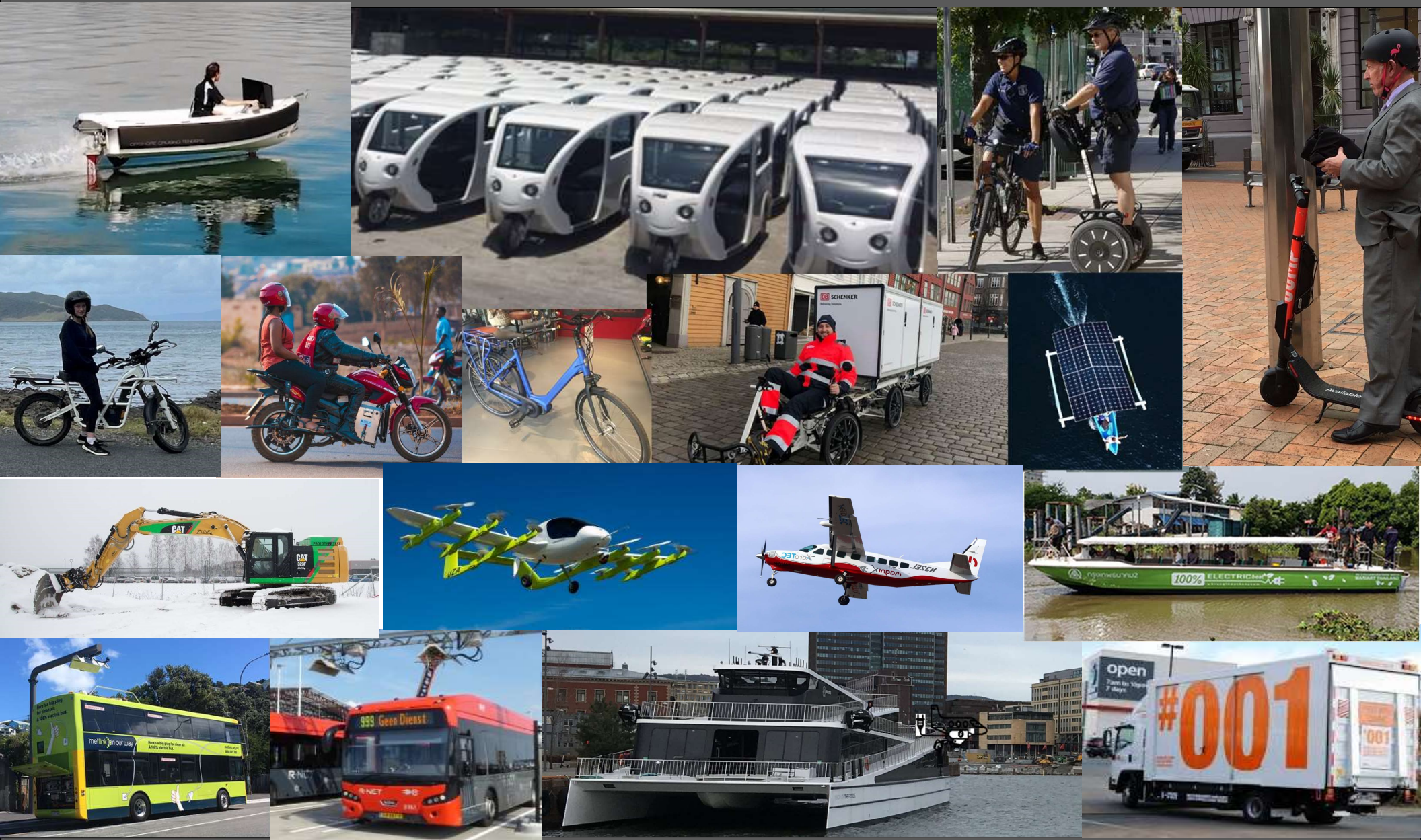
- Falling costs
- Rapidly increasing capability of technology
- Clever combinations = new ways, providing more affordable and accessible transport
 - accelerated uptake of e-mobility
 - micro- and small-format mobility
 - shared vehicles
 - connected, on demand services
 - i.e., mobility as a service (MAAS).

An example ... improvements in battery technology

- For 10 years of battery development (2010-2020)
 - 1/10th cost for same kWh
 - 1/3rd weight for same kWh
 - 1/3rd size for same kWh
- Range 120km (2010)
→ 300-400km (2020)
- 50kW “fast” charging (100km in 20 mins, 2010)
→ ‘supercharging’ at 250kW (350km in 20 mins, 2020)
- Small and light-weight batteries → advances/new micro/small mobility
- Expect far greater battery performance in the future.

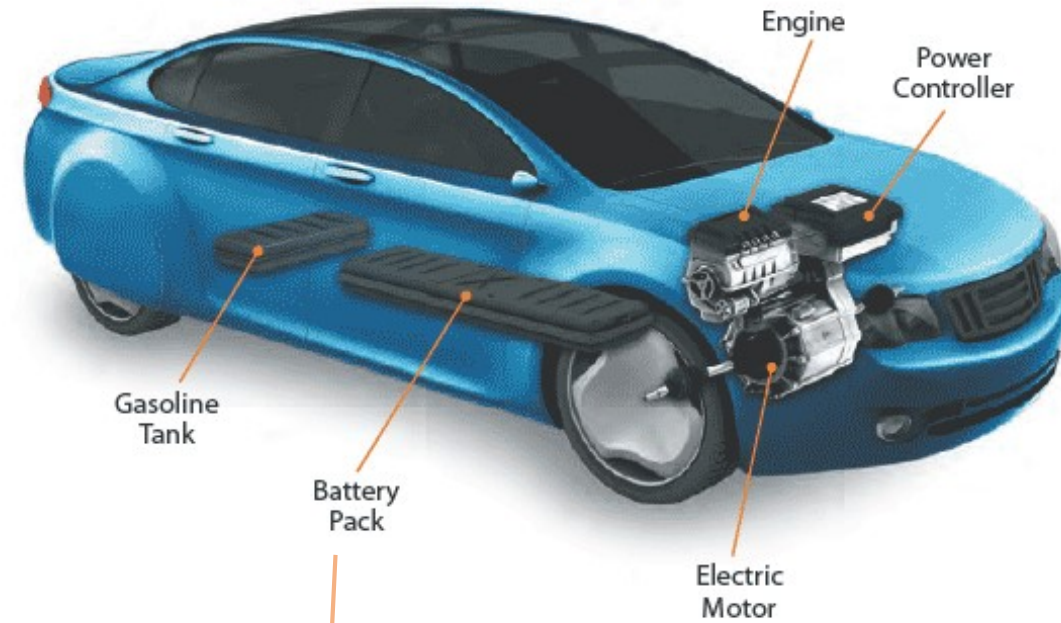


One of many results → expanding e-mobility solutions

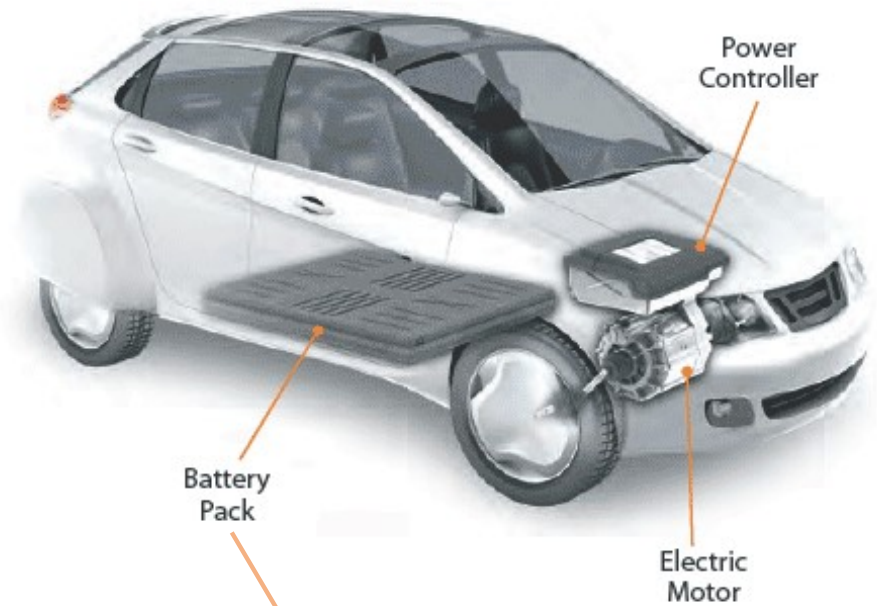


Interest is in plug-in e-mobility

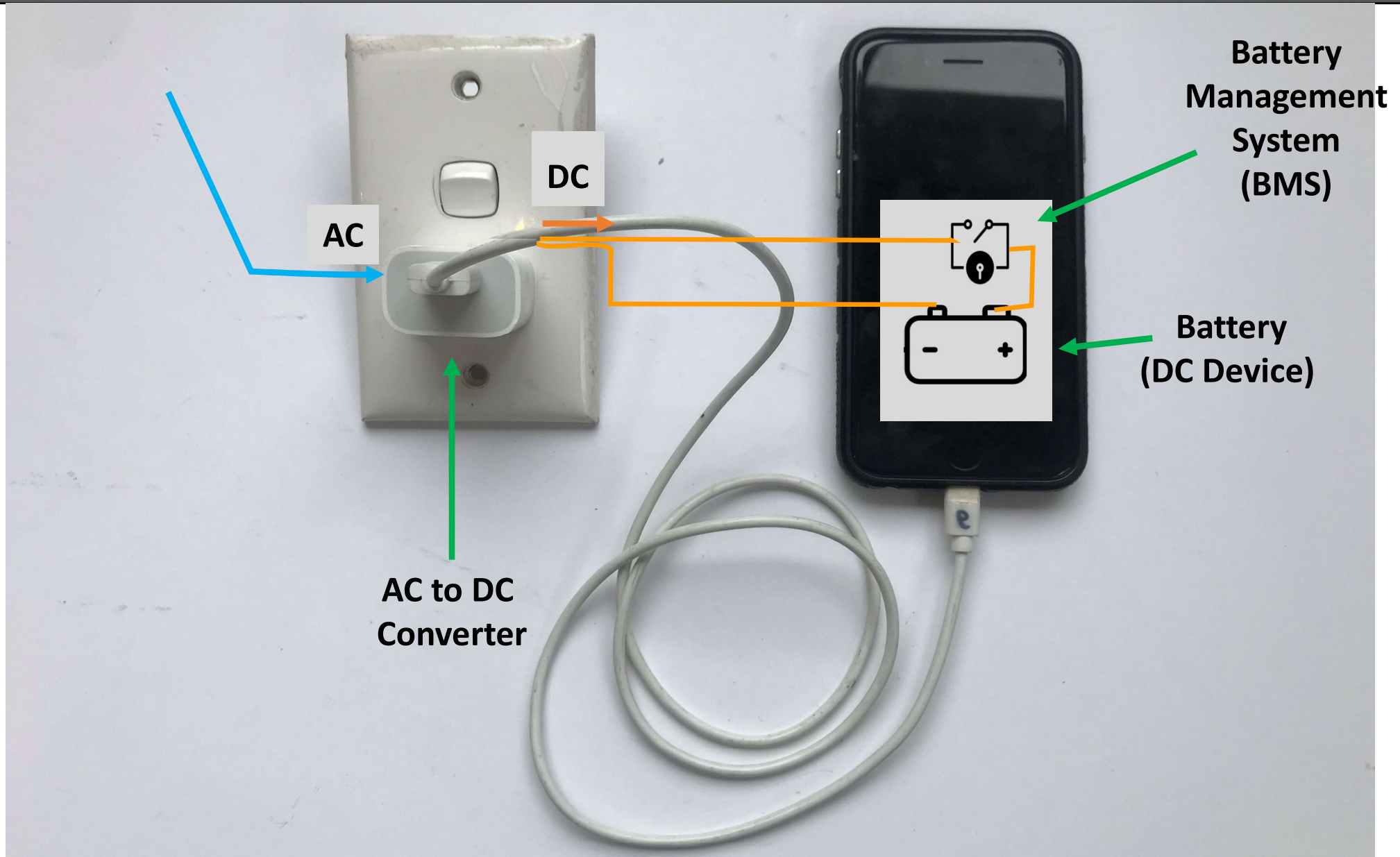
**Plug-in Hybrid
Electric Vehicle (PHEV)**



**Battery Electric
Vehicle (BEV)**

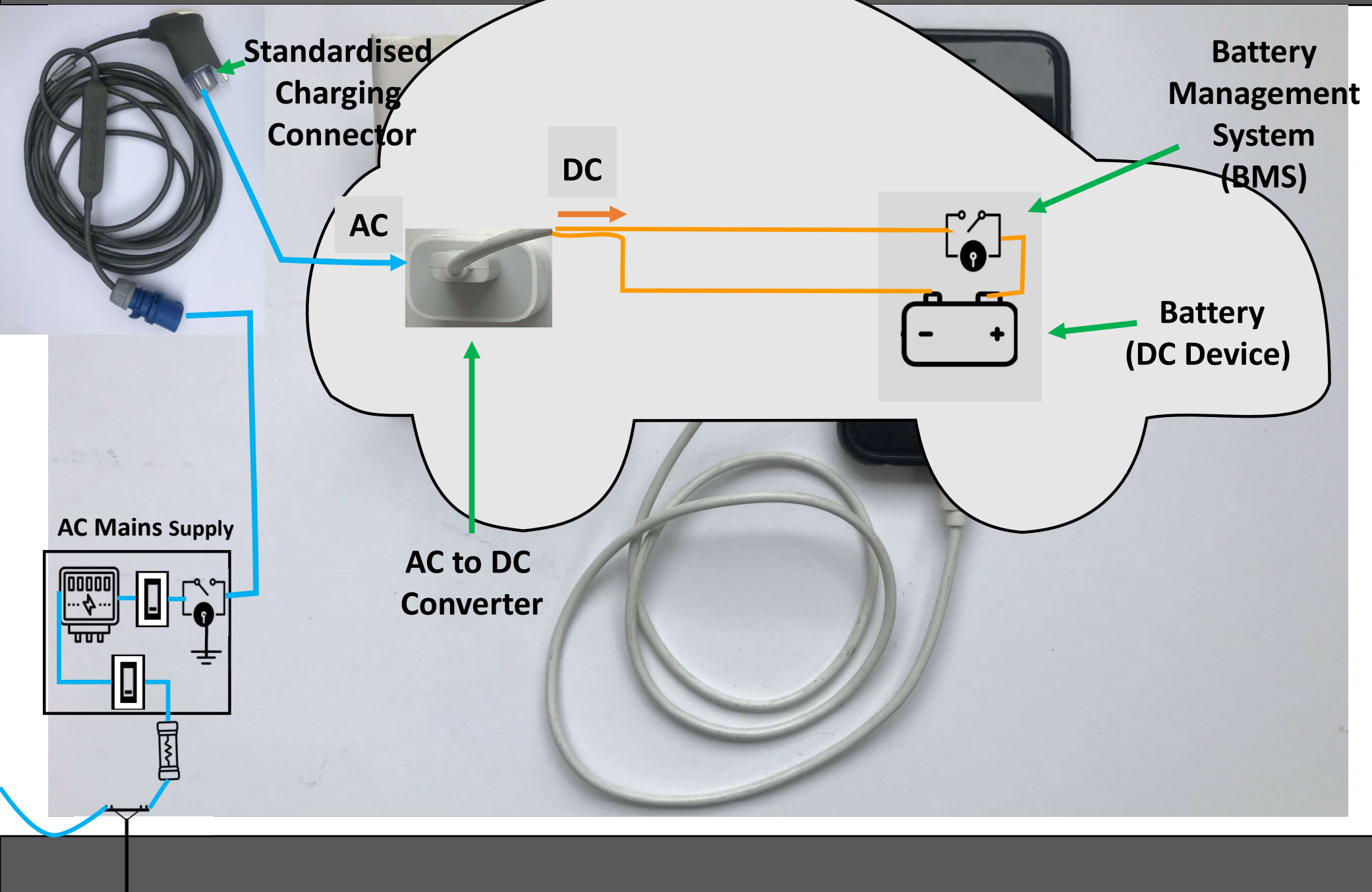


- In common: have an onboard battery charged by an external power source
- Note: an ordinary hybrid (HEV) does not plug in and is often not counted as an EV.



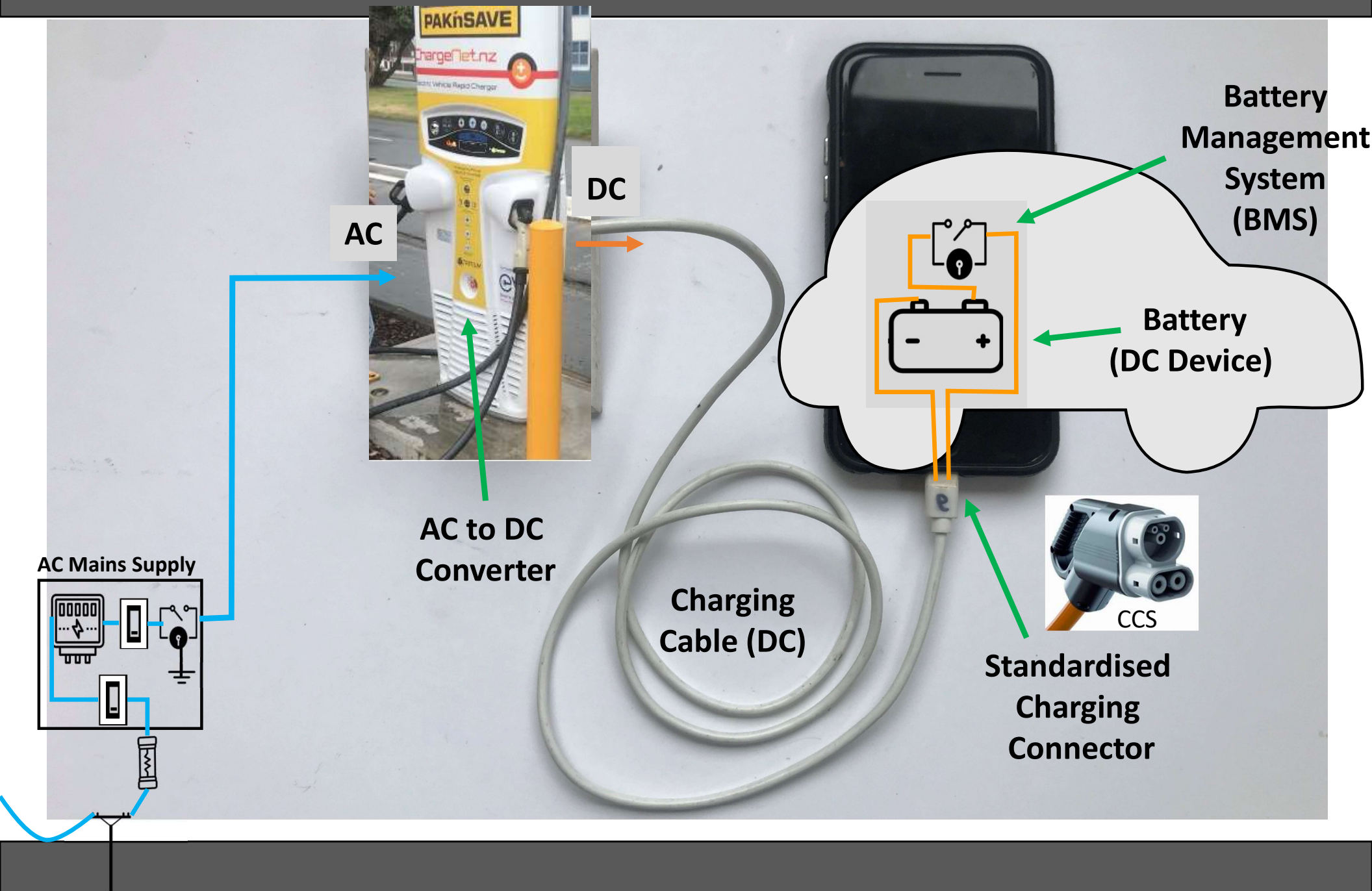
Charging basics ...

'AC Charging'



Charging basics ...

'DC Charging'



Destination

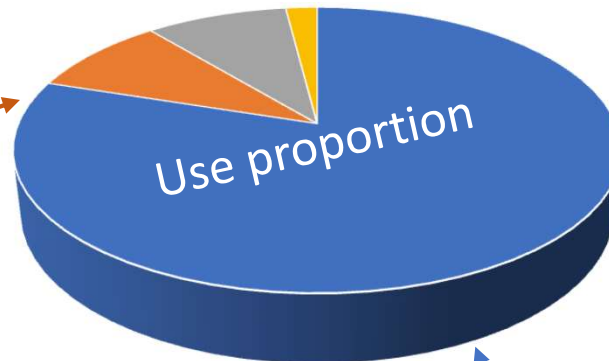


Types of Charging

On the go/journey (and 'oops')



At work



At home



Global incentive schemes for EV car uptake



- Purchase price subsidies and/or

rebates to



With these signals from governments:

- Audi Europe now putting all R&D spend into EVs (NZ Audi Agent)
- Audi Europe stopping internal combustion engine (ICE) builds in 2027 (NZ Audi Agent)
 - starts a process where ICEs will not be supported in the future

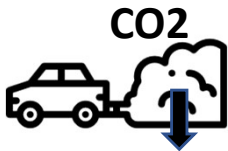
ICES over next 10-30 years (20 countries).



Global incentive schemes for EV car uptake



- **Purchase price subsidies** and/or purchase/regio tax rebates to reduce price gap.



- **Tailpipe CO₂ mandates** → EVs cheaper option for EU manufacturers to meet them.



- **Mandatory EV sales targets** (e.g., California and China).

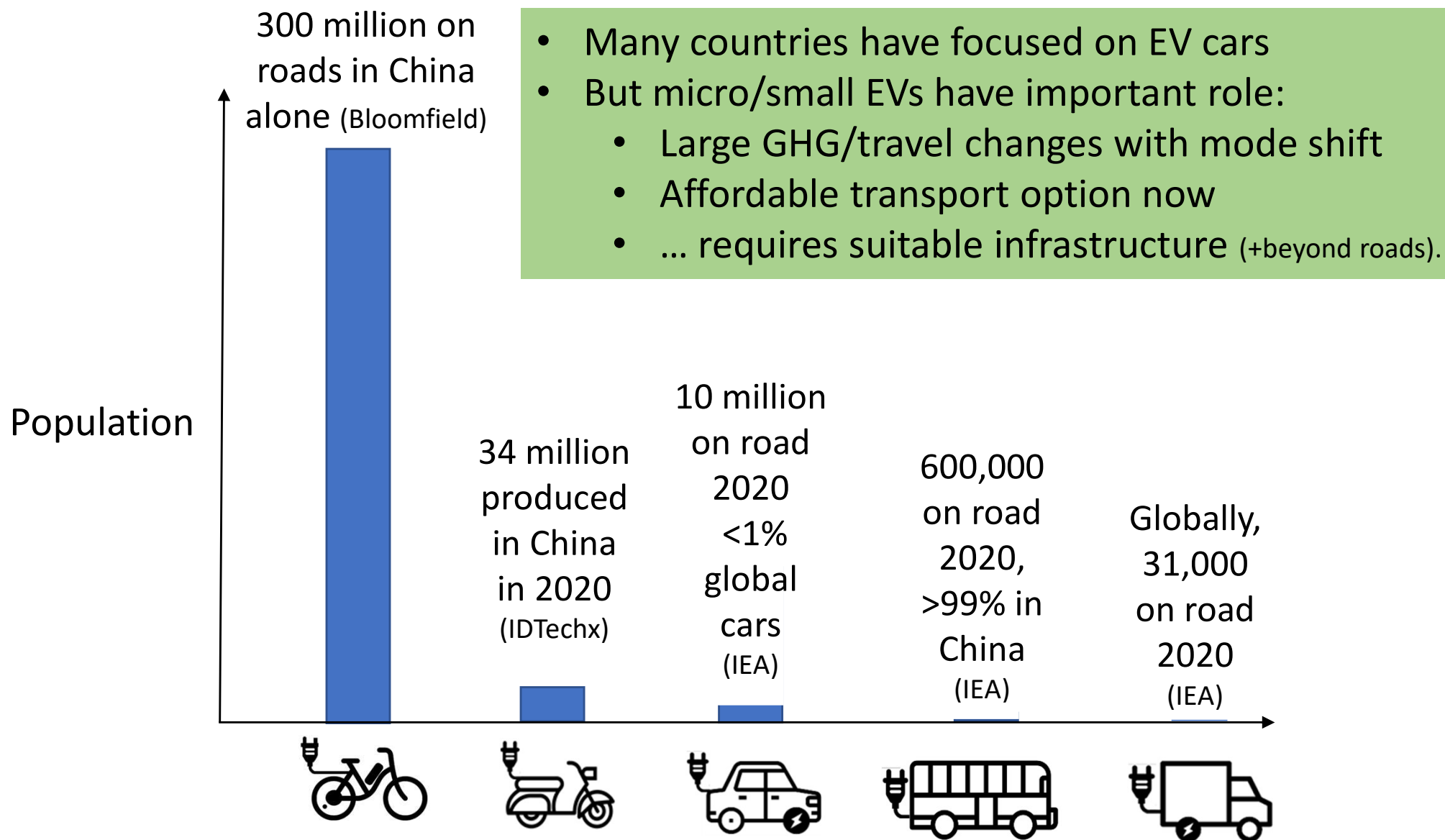


- **Low- and zero-emission zones** (Oslo, China).



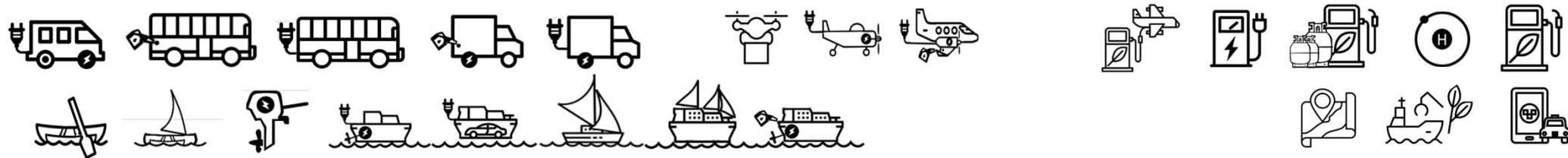
- **Full phase out of ICEs** over next 10-30 years (20 countries).

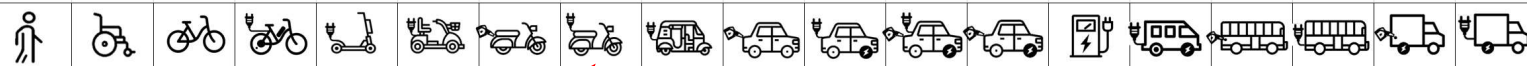
EV Global status





Lets look wider across the
'Technology Catalogue'
of transport options

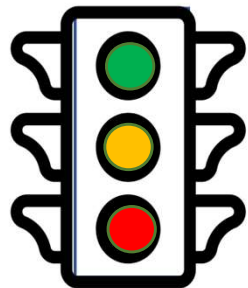




37 Technologies

15 Assessment Dimensions

- Type of journey/ service
- Overall suitability (horizons H1/H2/H3)
- Global tech outlook (feasibility/ availability)
- Affordability/ cost
- Supply/ availability
- Carbon footprint
- Energy security
- Convenience, comfort, safety and accessibility
- Infrastructure & refuelling requirements
- Operation & maintenance requirements
- Waste/ end-of-life disposal
- Environmental & social impact
- Local value chain/ economic opportunity
- Required complementary measures
- Other considerations



Work
Commissioned
by NZ Ministry
of Foreign
Affairs and
Trade (MFAT)

Vehicle/transport option		Non-H2 and Biodiesel Alternative Fuels
Type of journey/ service		Fuel alternative.
Overall suitability	H1	1
	H2	1
	H3	3
Global technology outlook (feasibility/ availability)		Demonstration.
Affordability/ cost	Whole of Life	
	Purchase	\$\$\$
	Ongoing	\$\$\$
	Future TCO	\$\$\$
Supply/ availability		2
Carbon footprint		3
Energy security		3
Convenience, comfort, safety and accessibility		2
Infrastructure & refuelling requirements		2
Operation & maintenance requirements		2
Waste/ end of life disposal		3
Environmental & social impact		4
Local value chain/ economic opportunity		3
Required complementary measures		3
Other considerations		3



Non-H2 and Biodiesel Alternative Fuels

Fuel alternative.

H1
H2
H3

Demonstration.

Whole of Life
Purchase
Ongoing
Future TCO

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













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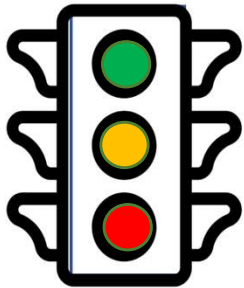
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










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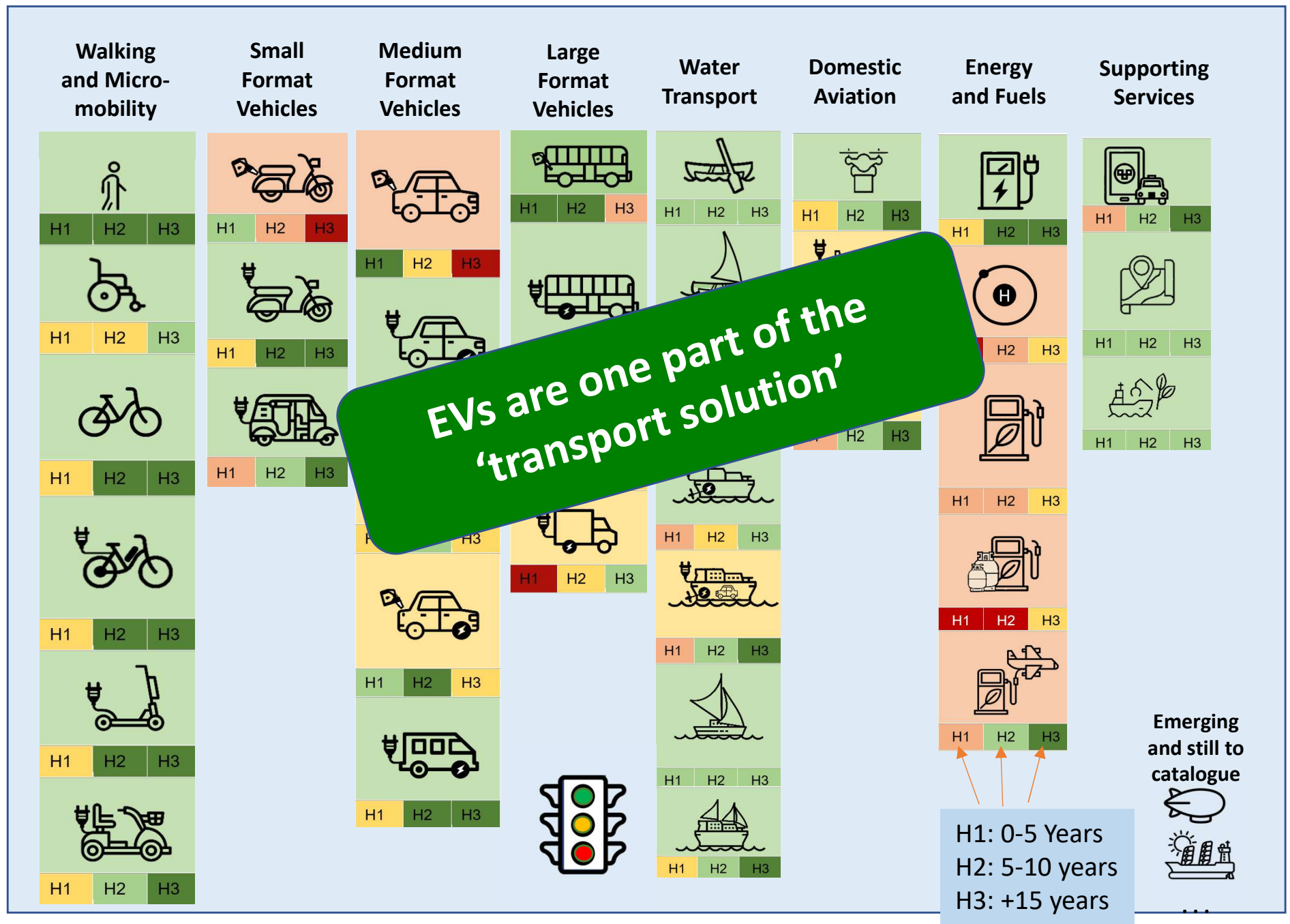
																				
Vehicle/transport option		Walking	Wheelchairs	Bicycles	E-Bikes	E-Push Scooters	Mobility Scooters	Petroleum Two Wheelers	Electric Two Wheelers	E-Trikes et al.	ICE Passenger Car	BEVs	PHEVs	HEVs	EV Charging	Electric Minibuses	Petroleum Fuelled Buses	Electric Buses	Hybrid Truck	Electric Truck
Type of journey/ service		Very short distance, single passenger.	Short-distance, single passenger	Short distance, single passenger.	Short distance, single passenger	Short distance, single passenger.	Walking-speed, short distance, single passenger	Short- and medium-distance, 1-2 passenger	Short- and medium-distance, 1-2 passenger	Short-to medium-distance, multi-passenger and goods	Short-to long-distance, 1-several passenger and goods transport	Short-to long-distance, 1-several passenger and goods transport	Short-to long-distance, 1-several passenger and goods transport	Short-to long-distance, 1-several passenger and goods transport	Charging of EVs	Short-to medium-distance, multi-passenger transport	Short-to long-distance, multi-passenger transport	Short-to medium-distance, multi-passenger transport	Short-to long-distance freight	Short-to medium-distance urban freight transport
Overall suitability	H1	5	5	4	4	3	3	4	3	2	5	3	3	4	3	3	5	2	3	1
	H2	5	5	5	5	5	4	2	5	4	3	4	4	5	5	5	5	4	4	3
	H3	5	5	5	5	5	5	1	5	5	1	5	3	3	5	5	2	5	3	4
Global technology outlook (feasibility/ availability)		Mature	Mature	Mature	Mature and developing	Early adoption.	Mature and developing.	Mature	Mature and developing	Early adoption	Mature and developing	Mature and developing	Mature and developing	Mature	Mature and developing	Mature and developing	Mature	Mature and developing	Mature and developing	Demonstration
Affordability/ cost	Whole of Life	\$	\$	\$	\$\$	\$\$	\$\$	\$\$	\$	\$\$	\$\$	\$\$	\$\$	\$\$	\$	\$\$	\$\$\$	\$\$\$\$	\$\$	\$\$\$\$
	Purchase	\$	\$	\$	\$\$	\$\$	\$\$	\$\$	\$\$	\$\$	\$\$	\$\$\$	\$\$\$	\$\$	\$-\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
	Ongoing	\$	\$	\$	\$\$	\$\$	\$	\$\$	\$	\$	\$\$	\$	\$\$	\$\$	\$	\$\$	\$\$\$	\$\$\$	\$\$	\$\$
	Future TCO	\$	\$	\$	\$	\$	\$\$	\$\$	\$	\$\$	\$\$	\$\$	\$\$	\$\$	\$	\$\$	\$\$\$	\$\$	\$\$	\$\$
Supply/ availability		5	4	5	5	5	4	5	3	3	5	3	3	5	4	3	4	3	3	2
Carbon footprint		5	5	5	5	5	5	4	5	5	3	4	4	4	5	4	4	3	4	4
Energy security		5	5	5	5	5	5	4	5	5	3	4	4	4	5	4	2	4	4	4
Convenience, comfort, safety and accessibility		3	3	3	3	3	3	3	3	3	5	5	5	5	4	4	3	4	5	5
Infrastructure & refuelling requirements		4	2	5	4	4	3	4	4	5	4	3	5	3	3	3	4	2	4	2
Operation & maintenance requirements		5	5	5	4	4	4	4	4	4	4	3	3	4	3	3	4	2	3	2
Waste/ end of life disposal		5	5	5	4	4	4	4	4	4	3	3	3	2	4	3	3	3	3	3
Environmental & social impact		5	5	5	5	5	5	4	5	5	3	4	3	4	5	4	3	5	4	4
Local value chain/ economic opportunity		4	4	5	5	4	5	5	5	4	4	4	3	4	4	4	4	4	4	2
Required complementary measures		3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Other considerations					3			3		3	5	4	3	4						



Work
Commissioned
by NZ Ministry
of Foreign
Affairs and
Trade (MFAT)

																			
Vehicle/transport option		Non-H2 and Biodiesel Alternative Fuels	Hydrogen	Biodiesel	Personal Paddling Watercraft	Personal Sailing Watercraft	Small battery-electric propulsion	Electric Small-Med Boats	Electric Ferries	Sailing Vessels	Wind-Assisted Propulsion	Hybrid Vessels	Energy Efficiency Measures	Green Ports	Drone Delivery	SAFs	Battery Electric Light Aircraft	Hybrid Electric Light Aircraft	Software Services
Type of journey/ service		Fuel alternative.	Provides an alternative to traditional fuel systems	Alternative fuel	Short inshore personal transport	Short and medium distance, personal transport	Short range and slow speed personal and goods water transport	Short range and/or slow speed	Short-distance, multi-passenger and freight marine transport	Short-distance, multi-passenger and freight marine transport	Provide assisted propulsion on existing/new-build vessels.	Short-distance, multi-passenger and freight marine transport	Improvements to existing operations	Improvements to current operations and infrastructure.	Wide ranging, from fast parcel delivery to potentially passenger transport.	Fuel alternative	Fast, short-distance small number passenger travel.	An alternative propulsion system for wide range of aircraft.	Managed logistics of transport services.
Overall suitability	H1	1	1	3	5	5	3	2	2	4	3	2	4	4	3	2	2	1	4
	H2	1	2	2	5	5	4	3	3	4	4	3	4	4	4	2	2	1	5
	H3	3	3	2	5	5	5	4	4	4	5	4	4	4	5	3	4	4	5
Global technology outlook (feasibility/ availability)		Demonstration on.	Demonstration on.	Mature	Mature	Mature	Demonstration on	Demonstration on	Demonstration on	Demonstration on	Demonstration on	Demonstration on	Mature and developing	Individual mechanisms	Demonstration on	Prototype	Demonstration on	Prototype	Mature and developing
Affordability/ cost	Whole of Life		\$\$\$\$		\$	\$	\$	\$\$	\$\$\$	\$	\$\$	\$\$	\$	\$\$	\$	-	\$\$	\$\$	\$
	Purchase	\$\$\$	\$\$\$\$	\$\$\$	\$	\$\$	\$\$\$	\$\$\$\$	\$\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$	\$\$\$	\$\$	\$\$\$	\$\$\$	\$\$\$	\$
	Ongoing	\$\$\$	\$\$\$\$	\$\$\$	\$	\$	\$	\$	\$\$	\$	\$	\$\$	\$	\$\$	\$	-	\$	\$	\$
	Future TCO	\$\$\$	\$\$\$	\$\$\$	\$	\$	\$	\$	\$\$\$	\$\$	\$\$	\$\$	\$	\$	\$	\$\$\$	\$	\$\$	\$
Supply/ availability		2	2	2	5	4	3	2	1	3	3	1	4	2	2	1	1	1	4
Carbon footprint		3	4	4	5	5	5	4	4	5	4	4	4	4	5	4	4	4	4
Energy security		3	4	4	5	5	5	4	3	5	4	3	4	4	5	3	4	4	4
Convenience, comfort, safety and accessibility		2	2	3	2	3	3	4	5	2	3	5	4	4	5	2	4	4	4
Infrastructure & refuelling requirements		2	1	2	5	5	4	2	2	4	5	2	5	4	5	2	4	4	3
Operation & maintenance requirements		2	2	4	5	4	4	3	3	4	3	3	4	4	4	2	4	4	5
Waste/ end of life disposal		3	3	3	5	4	4	2	2	4	5	2	5	4	4	5	3	3	5
Environmental & social impact		4	5	3	5	5	5	4	4	5	4	4	4	4	5	4	4	4	4
Local value chain/ economic opportunity		3	2	4	5	5	5	2	2	4	4	2	5	4	4	3	4	4	4
Required complementary measures		3	2	4	5	5	5	2	2	4	4	2	5	4	4	3	4	4	4
Other considerations		3	2	4	3	5	3	2	2	3	3	2	2	4	4	2	4	4	2

The current catalogue ...



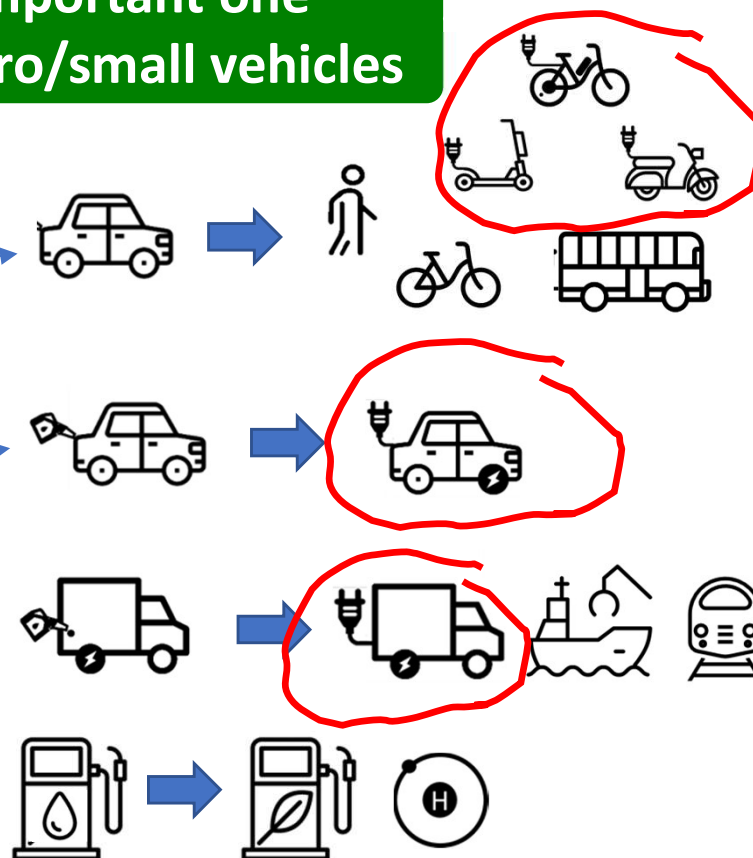
Countries now take a wide look at meeting GHG obligations

Example from
New Zealand

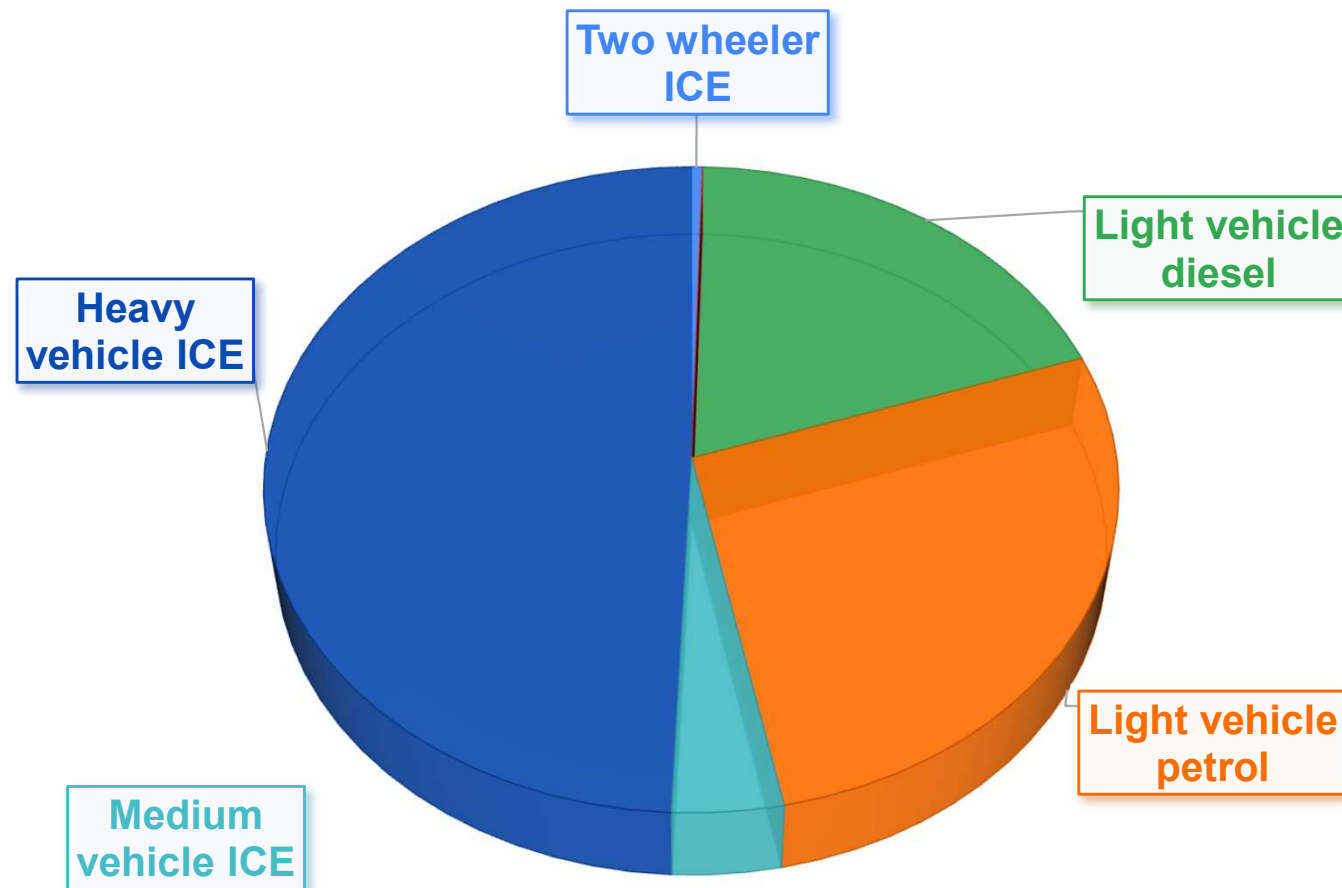
Transport Sector Priorities

- reduce reliance on cars and **support people to walk, cycle and use public transport**
- rapidly adopt **low-emissions vehicles**
- begin work to **decarbonise heavy transport** and freight
- Stay informed about decarbonization of marine and aviation sectors.

EVs are one part of the
'transport solution'
... an important one
... incl. micro/small vehicles

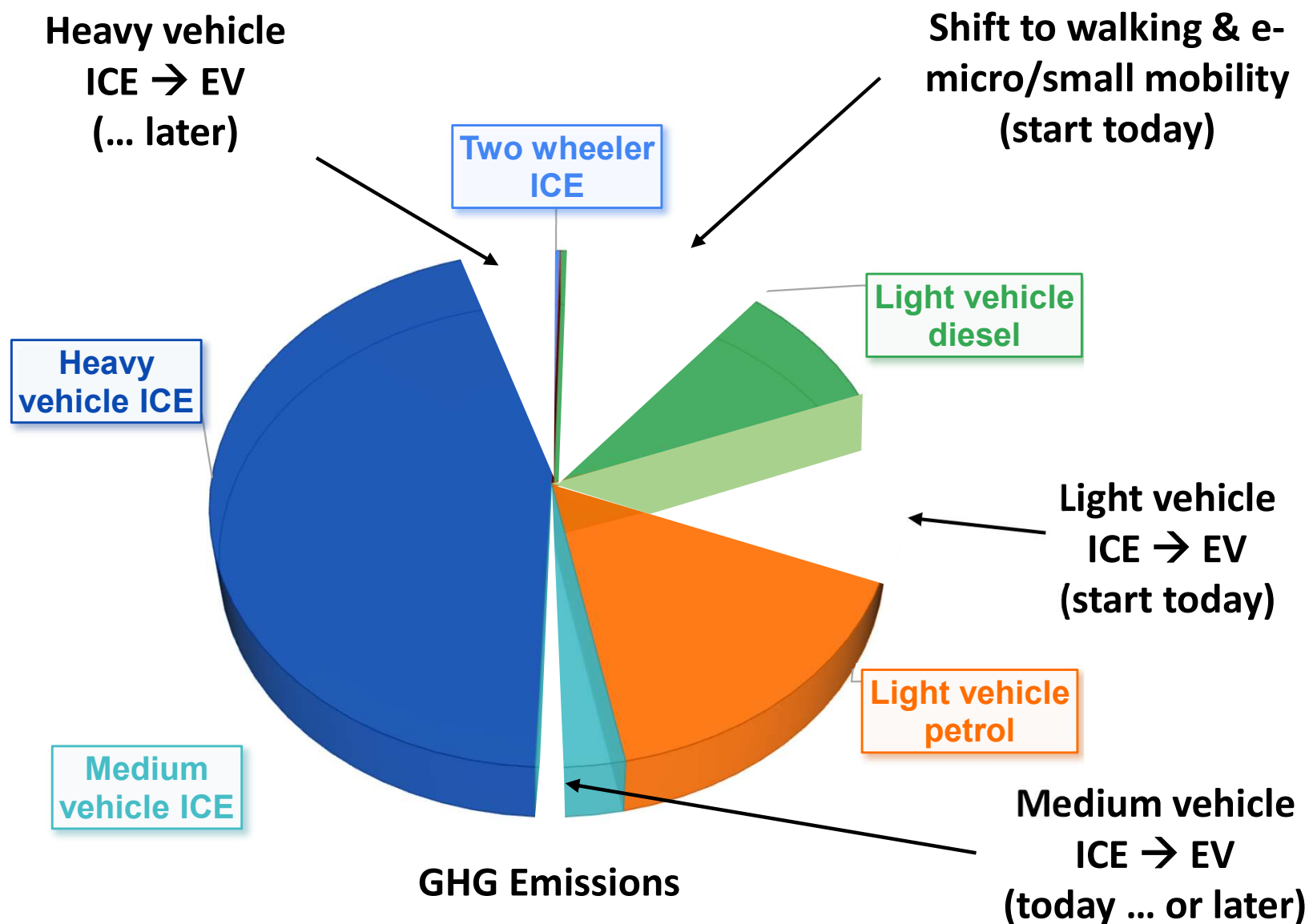


Why multiple GHG reduction pathways are required ...



GHG Emissions

Why multiple GHG reduction pathways are required ...



Key points:

- Require alternatives to the use of non-renewable fuels.
- ‘Pedestrians first’.
- Target: to **become ‘EV-ready’**:
 - Manage **barriers**.
 - Support **capacity building**.
 - Familiarisation with technology important → **early demonstration**.
 - → Work towards ‘**normalisation**’ (required for national-scale change).
 - **Marketing** and **quality information**.
- **Small-format mobility important** – e.g., makes public transport more accessible. Current roading may require change to be fit for small-format mobility.
- **EVs only make sense if high proportion of renewable electricity**.
- Avoid import of low-performance/low quality goods.
- Network communications systems an enabler of many smart transport options (and therefore an important new technology enabler).

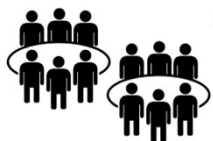
Key points:

- Require alternatives to the use of non-renewable fuels.
- 'Pedestrians first'.
- Target: to **become 'EV-ready'**:
 - Manage **barriers**.
 - Support **capacity**.
 - Familiarisation.
 - → Work towards **EV demonstration**.
(and consider electricity demand)
 - **Marketing and quality information**.
- **Small-format mobility important** – e.g., makes public transport more accessible. Current roading may require change to be fit for small-format mobility.
- **EVs only make sense if high proportion of renewable electricity.**
- Avoid import of low-performance/low quality goods.
- Network communications systems an enabler of many smart transport options (and therefore an important new technology enabler).

Common success themes of EV Roadmaps (from looking across many countries)



- Have a vision of what future is wanted.



- A specific government group and a specific industry/public group responsible for developing EV sector.



- An agreed roadmap across all parties.



- Targets.



- Well thought out incentives.



- Quality, dependable information ... and quality marketing/public management.



- Supporting policy.

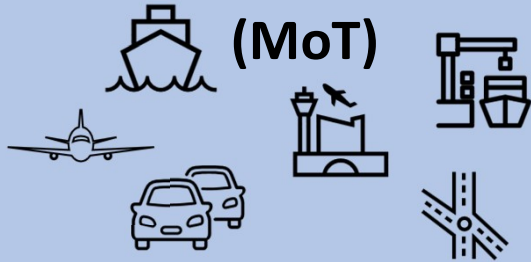
Possible Government Structure ... example from New Zealand:



Vehicle/Roadside-Related

Ministry of Transport

(MoT)



Vehicles and Infrastructure

- EV uptake modelling and targets.
- Standards for EVs.
- Registration of EVs.
 - Including monitoring.
- Public charging:
 - Connectors for public CSs.
 - Roadside access for charging.

Cabinet Office

Execution



Energy Efficiency and Conservation Authority

(reporting to both MoT and MBIE)



Connection with business and community

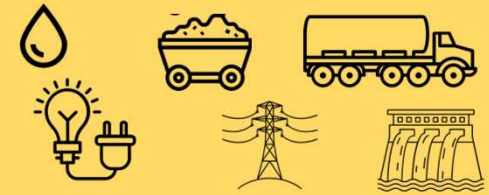
- Monitoring.
- EV marketing campaign.
 - Develop/deliver campaign
 - Develop/deliver quality information.
 - Market surveys.
- Administration of govt fund for supporting EV & public charging uptake.



Electricity Supply and Charging

Minister of Energy and Resources

(Dept: Ministry of Business Innovation and Employment, MBIE)




Energy and Infrastructure

- Safety standards for charging equipment and installations.
- Safety guidelines for charging.
- Modelling and planning supply of electricity.

Together, responsible for developing and maintaining the EV Roadmap

Private sector also has an important role:

- 
- The background image shows an outdoor event, likely a car show or a public demonstration of electric vehicles. In the upper left, there is a green and white sign with a circular logo containing a car icon and the word "ELECTRIC" above it. Several people are visible in the foreground and middle ground, some standing and talking, others walking. A silver car is partially visible on the right side of the image. The overall scene is set in a grassy area with trees in the background under a cloudy sky.
- **Industry groups including vehicle suppliers.**
 - **Community groups:**
 - Automobile Association
 - 'Leading the Charge' ... a community group connecting EV owner/enthusiasts with people looking to buy an EV.
 - **Private sector:**
 - 'ChargeNet' has provided 90% of public fast charging infrastructure (with government assistance in less-financial situations).
 - Shops and malls offer free access to land for charging.
 - Vehicle importers
 - Technicians

Importance of policy and government support



- Require early movers to demonstrate and begin a process of 'normalization' of the technology (... and begin capacity building across the sector).



- EV manufacturers want to see supporting government policy to warrant prioritizing supply over supply to other countries.



- It is expensive for a supplier of new EVs agent to set up support for their first EV model(s) ... and \$\$\$ returns could be slow in coming.



- Risks with importing used EVs without suitable support ... (although risk reducing with availability of 'Technician YouTube')



- Expensive for a charging provider to set up.



- **It is important for government to support these early movers, especially in 'PIC-sized' markets.**
- **Important role of government/policy to manage/remove barriers** (and assist appropriate, early movers).
- **Government-lead information/awareness campaign and marketing critical** (as task too big for early mover individuals).

Organising and EV policy development

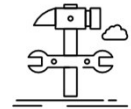
Consider the time in the life of an EV:



- Design
- Build



- Supply



- “Installation”



- In-service operation



- General use

- Charging



- Servicing



- Breakdown



- Accident



- Retirement, end-of-life.



Time in Life Cycle

Electric Vehicles

Charging Infrastructure

Electricity to the Plug/Charger

development, market

Standards, related hardware and IT, overall plan, compatibility.

Electricity supply system, planning

demand by class

Capacity, demand by different type

Gen Co.s/Line Co.s

ing demand, certification.

Availability, meeting demand, shipping, import, certification.

Gen Co.s/Lines Co.s, general information on

information, barriers, for purpose, models

Fit-for-purpose purchase decisions, future-proofing, grid-aligned, compatibility, available models

Gen/network upgrade, generation type switching ... company and country plans

registration, to E

Approval, site works, certification, industry training.

Gen Co.s/Lines Co.s

Early focus areas for EV roadmap:

- **Standards:** EVs and charging.
- **Fitting EVs into vehicle reg. systems.**
- **Awareness/information**
- **Building industry capacity**
- **→ becoming EV Ready**

Background on EV Charging Guidelines and Proposed Charging Guidelines for PICs
Draft: 22 February 2022

Understanding of, options, best practice

Servicing/maintenance Understanding of, industry capability and capacity, information training

Breakdown Guidelines/best practice

Accident 1st response, repair, fleet management

Decision to, reuse of battery/electrics through scrap/recycle .

Decision to, reuse of battery/electrics through scrap

Awareness, controls (pricing and controls)

Retirement

Summing up:



- Many options for EVs ... they are an important part of wider transport plan ... today and tomorrow.



- **Learn from lessons** from others.



- **EV Roadmap** very important, with vision and targets.  



- Require an **across-government** solution for developing and executing policy → form a focus group to manage uptake. And private sector group.



- Look across life of vehicle/infrastructure. Identify gaps and **focus on major barriers**.



- Develop good **marketing and information** campaign.

Questions?



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