



Buying an Electric Vehicle? What you need to know about charging

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Australian Electric Vehicle Association

Charging EVs at home



- Context: energy use, battery capacity and charging times
- Terminology and Context
- Charging modes and types
- Charging at home
 - Charge rate
 - Charging options
 - Electrical safety, tariffs
 - Solar, new stuff
- DC Charging: mostly on the road



Some EV terminology

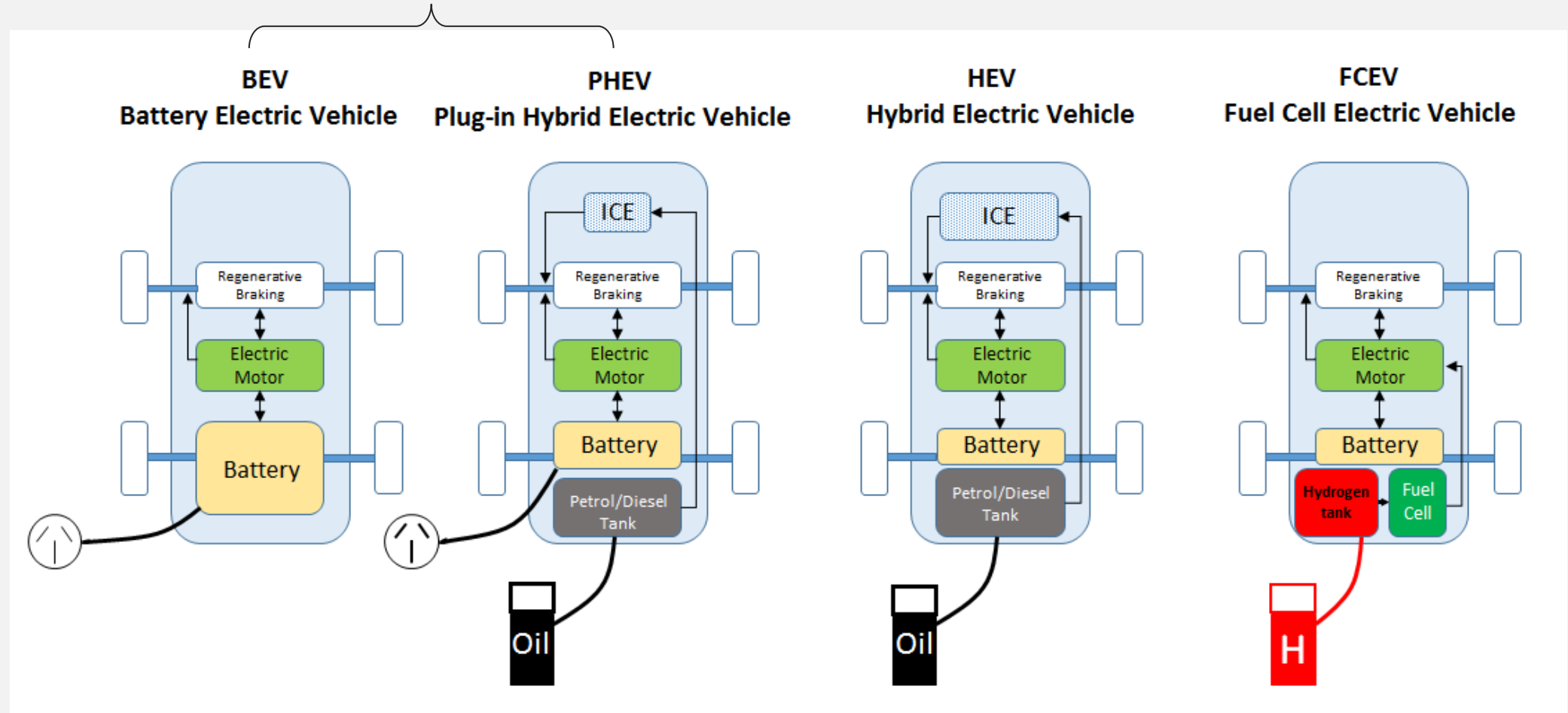


1. EV: Electric vehicle (General term for vehicles with some form of electric drive)
2. BEV: Battery electric vehicle
3. REEV: Range extended electric vehicle
4. PHEV: Plug-in hybrid electric vehicle
5. PEV: Plug-in electric vehicle (includes 2 - 4 above)
6. HEV: Hybrid electric vehicle
7. FCEV: Fuel cell electric vehicle
8. ICE: Internal combustion engine
9. EVSE: Electric vehicle supply equipment



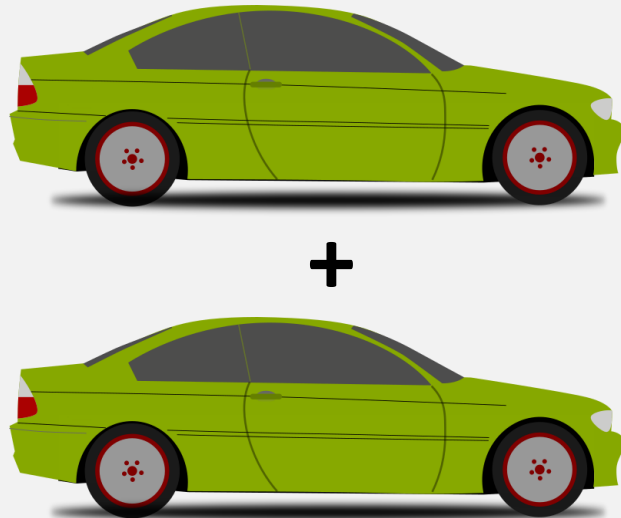
EV vehicle types:

PEV Plug-in Electric Vehicle

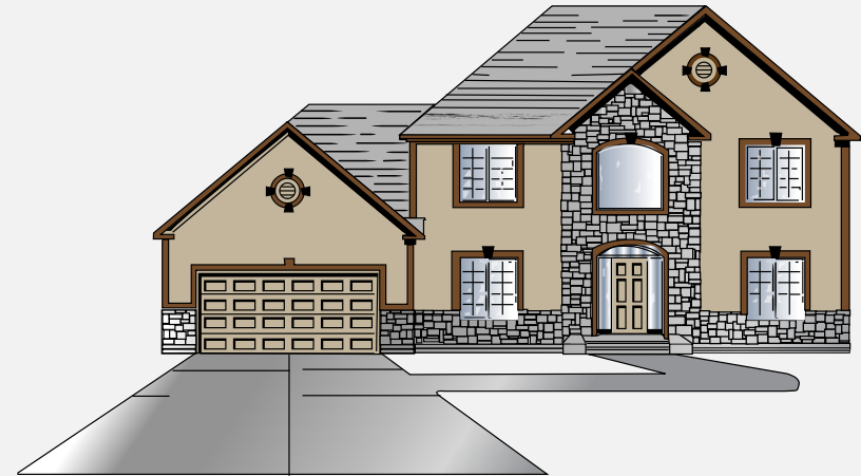


Context: energy use

- An average private car is driven 14,000 km/yr (40km/day)
- EV electricity use approx. $\sim 10\text{kWh/day}$ per car;
- average Tasmanian daily household use $\sim 20\text{ kWh}$
- 2 EVs = a house



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Context: battery capacity

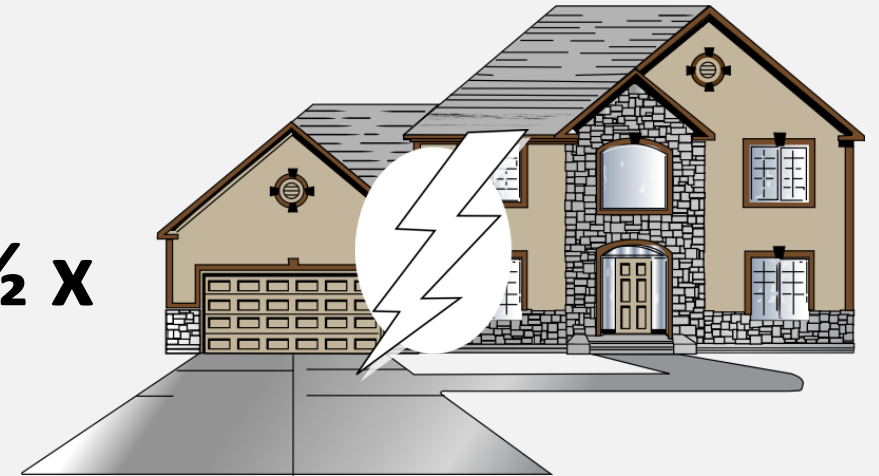
- Battery = 30kWh+ capacity
- Tesla Powerwall2 capacity = 14 kWh, >\$10,000 installed each
- 30kWh EV battery = 1½ x avg hh daily use



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= 1½ x



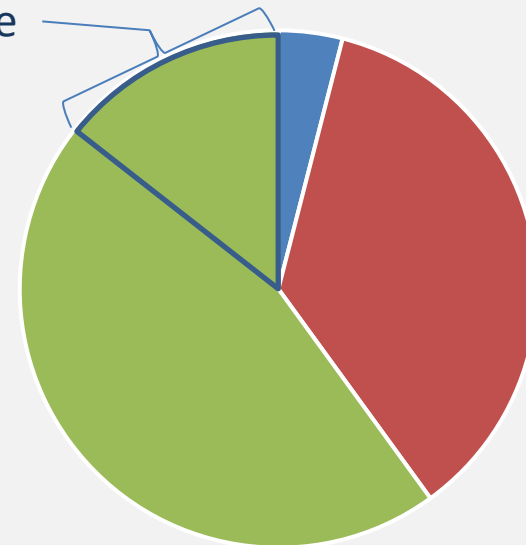
Context: charging time

- Most cars are parked 96% of the time, mostly at home base
- Charging time required (at home): 1-4 hours
 - @ 3.6 kW, average = 2½ h; 30kWh full charge from empty = 8 h
 - @ 7.2 kW, average = 1¼ h; 30kWh full charge from empty = 4½ h
- There is a lot of discretion about charging times







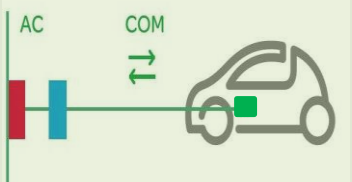
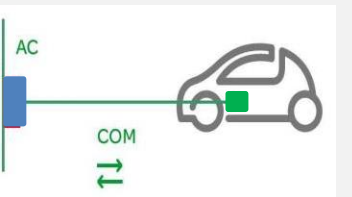
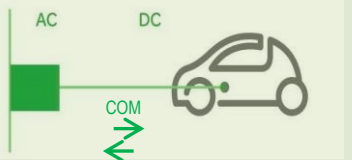
Typical charging time

- Travel
- Parked away
- Parked at home







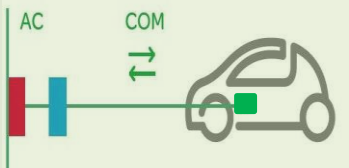
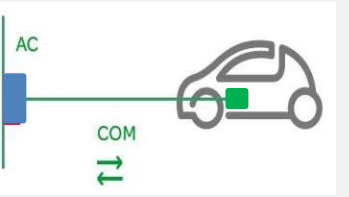
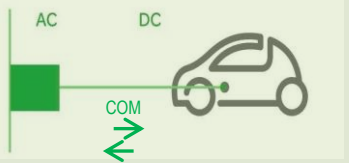
Summary - EVSE charging Modes:

-  AC power socket
-  AC EVSE
-  AC/DC converter

	<p>Mode 1:</p> <ul style="list-style-type: none"> Standard power lead plugged into normal outlet. Charger in vehicle converts AC to DC and controls battery charging rate etc. NB: Mass manufacturer no longer use this mode as lead is always live.
	<p>Mode 2: Plug in AC EVSE</p> <ul style="list-style-type: none"> In-line EVSE control box (blue) is part of lead (e.g. unit supplied by manufacturer) Lead is plugged into normal outlet (usually 15A) Most charge at 2.4kW (10A single phase) some aftermarket at 3.6kW (15A). Charger in vehicle converts AC to DC and controls battery charging rate etc.
	<p>Mode 3: Fixed AC EVSE</p> <ul style="list-style-type: none"> Dedicated wall box with control electronics built-in. Choices between 3.6kW (16A, single phase) to 22kw (30A x 3 phase) and even 40kW (63A x 3 phase) depending on EVSE chosen and EV charging capacity. Charger in vehicle converts AC to DC and controls battery charging rate etc.
	<p>Mode 4: DC EVSE</p> <ul style="list-style-type: none"> Charger is in the wall box/pillar (converting AC to DC). Connects via a different socket (two types) depending on standard adopted by manufacturer, currently providing up to 90kW (CHAdeMO) or 175kW (CCS) Lower power 'home' versions are coming: 5-25kW

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Modes 2 & 3: Two AC connector types

Type 1 or J1772
(N America, Japan, single phase only)

Type 2 or Mennekes
(Europe, single or three phase)

Adaptors available between types:
they use same communication

Manufacturers have agreed on only Type 2 AC for Oz in future

– But used Japanese imports will still be Type 1!

No problem with socket type EVSEs if driver brings their own cable



Charging electric vehicles at home: mostly AC



Consists of:

- A power socket: 10A, 15A, 32A; single / three phase; with a 'charger' (EVSE)
- Type 2 EV connector is used at the car (Type Two will become standard)

Power:

- The rate depends on car's on board AC/DC converter, available supply equip
- Ioniq, Leaf up to about 7 kW (4-5 hours full charge)

Options:

- 10A/2.4kW comes with car, but 11+ h for full charge
- 15A/3.6kW 15A powerpoint + 3rd party equipment EVSE (approx. \$550)
- Hardwired EVSE commonly 30A/7.2kW single phase but can set Amps in most models (Zappi, Delta, many others) \$1,500-\$2,000 installed





What charge rate should I choose at home?

Charging at 3.6kW

- Needs a 15A circuit; Fast enough for most purposes
- Most houses will have the capacity, safe wiring for this: but if old wiring, check first
- 5kW of solar panels can deliver this with some to spare
- Doesn't overload transformers even if everyone on the street plugs in together

Charging at 7.2kW

- Gives faster recharge, useful if quick top up needed in the day
- House wiring should be checked first; upgrade may be needed: \$\$ and delay
- Exceeds typical rooftop solar capacity
- If too many EVs charge at 7.2kW together in one area, local transformers may fail
- If many people have 7.2kW chargers, **some control will be required by the network**



Can I charge faster if I have/use 3 phase power?

- Three phase power can deliver much higher charge rates to **some** vehicles
- The main advantage is if you require relatively fast charging during the day between (long) trips.
- If you have three phase power, you can install a three phase EVSE for not much more cost and be more future proof
- You may get less benefit from solar with faster charging



Where should I put my EVSE?

- In the garage or carport if you have one (IP54)
- Where you normally park, but out of extremes of sun, heat or cold if you can. Extremes can affect charging times (IP65 preferred)



Will my wiring cope?

- For most house under 25 years old, or rewired within the last 25 years: almost certainly, but the electrician **must** do an inspection and maximum demand calculation
- For most houses under 50 years old, yes, but the switchboard may need upgrading if it has fuses, not circuit breakers (\$2,000)
- If your switchboard has no spare slots left, it may need to be reconfigured or upgraded (\$500)
- Older houses without renewed wiring may need to be fully rewired \$\$!

Electricity Tariffs



	current rate	Hobart L'ton return
Standard Tariff 31:	26.43 c/kWh	\$14.25
Time of use Tariff 93:		
• Peak 07:00 to 10:00 and 16:00 to 21:00	31.95 c/kWh	\$17.25
• Off peak 10:00 to 16:00 and 21:00 to 07:00 (and all weekend)	14.88 c/kWh	\$8.00

Tariff 93 works out cheaper overall for 95% of households. Few people have it.

Most charging can occur overnight or weekends on off-peak. With Tariff 93, adding the EV may add ½ to their electricity use but only ¼ to their power bill.

Either way: far cheaper than petrol!



What about solar?

- A 5 kW system costs about \$6,000-\$9,000, depending on site and quality of solar components
- Solar has a typical payback period of 5-6 years (~40% self consumption)
- **Solar** Feed in tariff: 8.54 c/kWh or <\$5.00 (Hobart - Launceston return)
- An electric car can be set up to use 'excess' solar that otherwise would go to the grid @ 8.54 cents/kWh
 - Most summer driving could be @ 8.54 cents/kWh
 - Most winter driving would be on off-peak @ 14.88 cents/kWh
- The car's timer can do this roughly in afternoon/overnight off peak; more sophisticated systems can improve this, even earning revenue

Home/private charging challenges

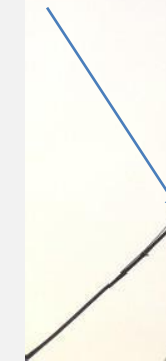


Need to deal with:

- Landlords: to provide charging options for tenants with off street parking (OSP)

CarNewsChina.com

EV charge cable from
7th floor window



- Homes without private off-street parking
 - Public low power charging in residential areas without OSP
 - Discounted/affordable fast charging during off peak periods



Summary

- Cheap system: 15A power point and EVSE from the car
- Lowest cost to charge/future proof system:
 - Hardwired 7kW system (e.g. Delta)
 - Set to 3.5kW
 - Use time-of-use tariff
 - Solar
- Most convenient but higher power costs
 - Hardwired 7kW system (e.g. Delta) – but inspect wiring
 - Standard tariff
- No off street parking: come and see AEVA/Council

Home charging in the future

- Some move to integrate charging with solar/batteries
- Stationary batteries support roof-top solar as many cars are away during the day: battery to battery charging when return
- Expect low power DC charging (5-25kW) with vehicle to home and vehicle to grid
- Grid controlled charging and AI trading 'apps' will become common



Solar Edge inverter charger

DC chargers: Mode 4



Higher power DC equipment is higher cost so fast charging is more expensive

Power:

- 5 to 350 kW now; higher power under development
- Rate depends on car battery size + charger capacity + power supply

Characteristics:

- Recharge fast to continue a journey promptly: **no discretion** about timing
- Places a high demand on the power supply for relatively short periods
- Adds 25 to 300 km (for Porsche Mission E!) per 15 minutes
- 25 kW DC may have a place in some destinations

Formats for DC chargers



Four DC connector types

- Combined Charging System 1 (CCS1) US, combines J1772 with two DC pins
- CCS2, Europe, combines Type 2 AC with two DC pins likely to dominate in Oz
- CHAdeMo (Japanese: Mitsubishi and Nissan; Tesla using an adaptor)
- Tesla Supercharger – Europe/Oz, modified Type 2 AC plug to accept DC



CCS1



CCS2



CHAdeMO

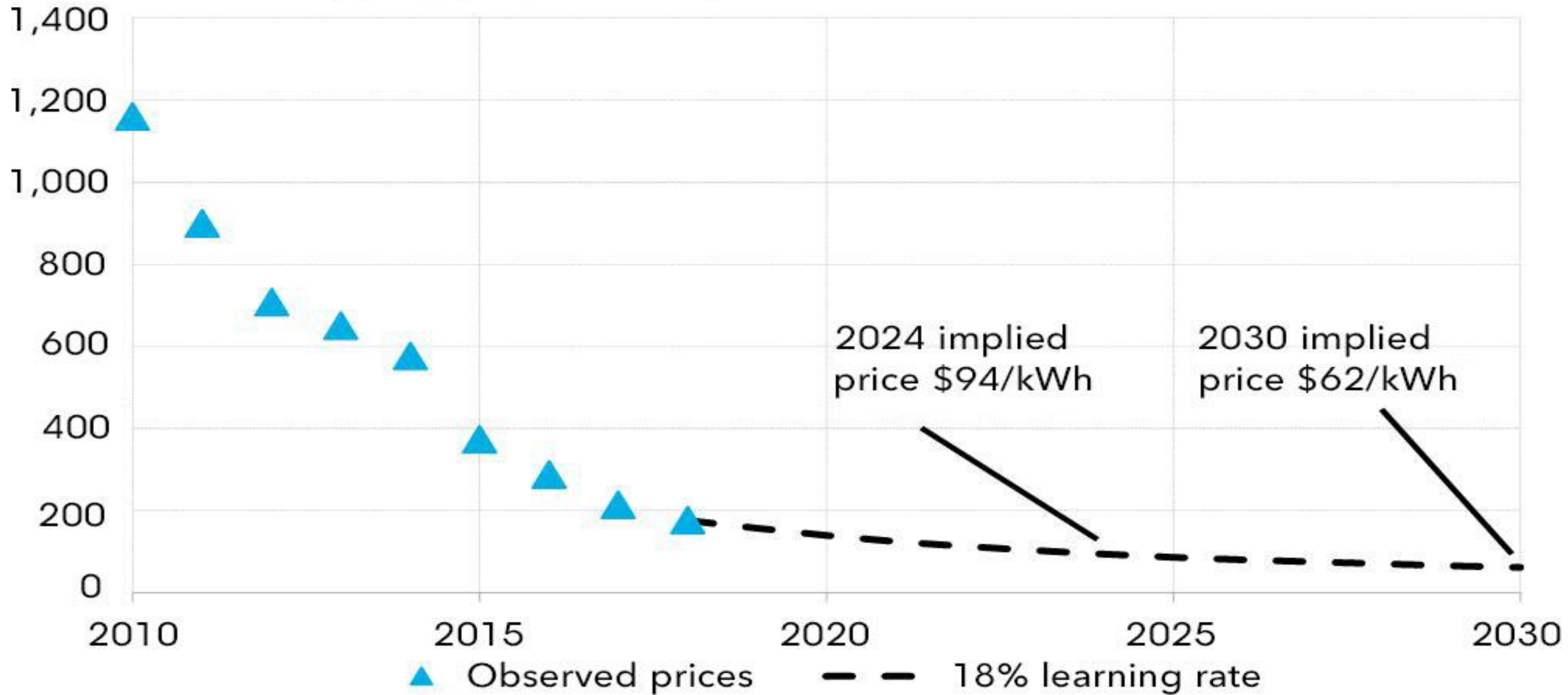
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Lithium-ion battery price outlook

Lithium-ion battery pack price (real 2018 \$/kWh)





Questions?