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

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Australian Electric Vehicle Association

Charging EVs at home

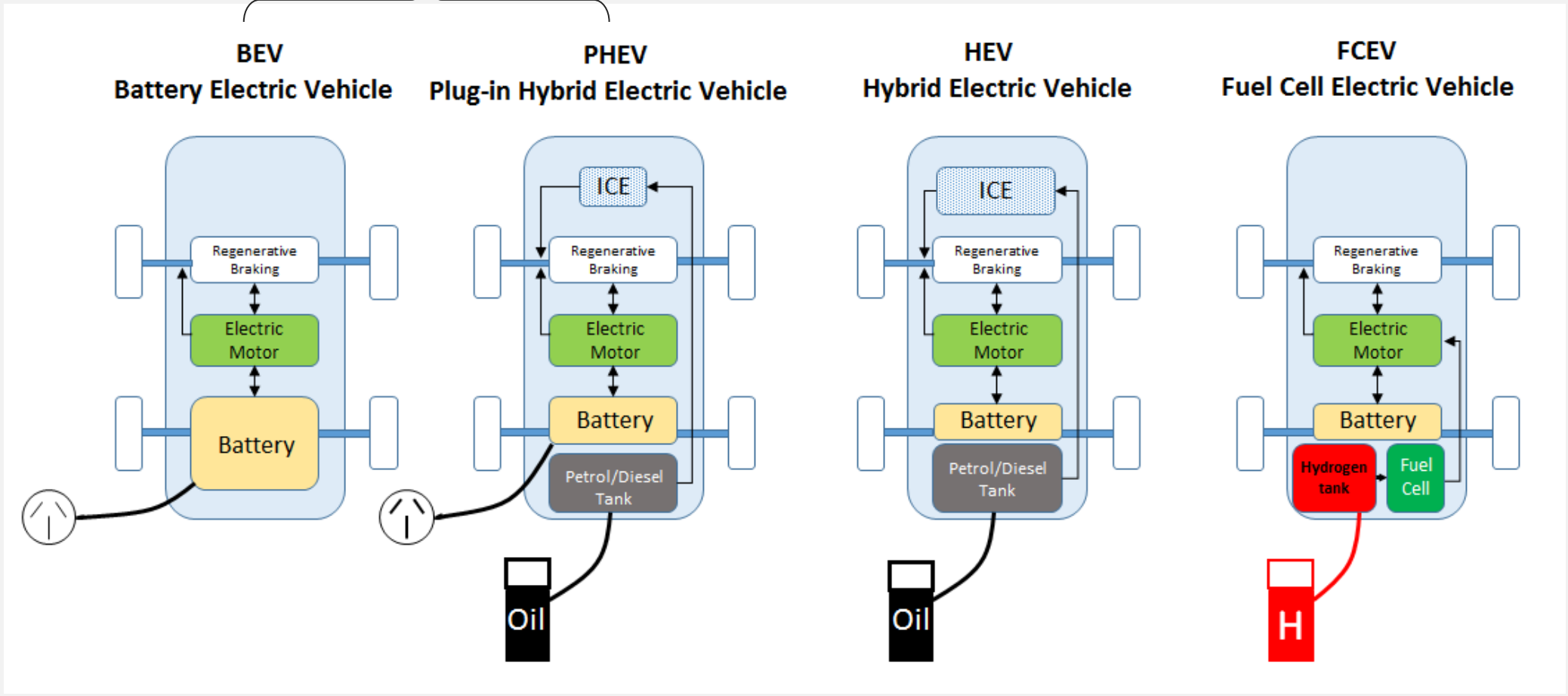
- Context: energy use, battery capacity and charging times
- Terminology and Context
- Charging modes and types
- Charging at home
  - Charge rate
  - Charging options
  - Electrical safety, tariffs
  - Solar, new stuff
- DC Charging: mostly on the road

Some EV terminology

1. EV: Electric vehicle (General term for vehicles with some form of electric drive)
2. BEV: Battery electric vehicle
3. REV: 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

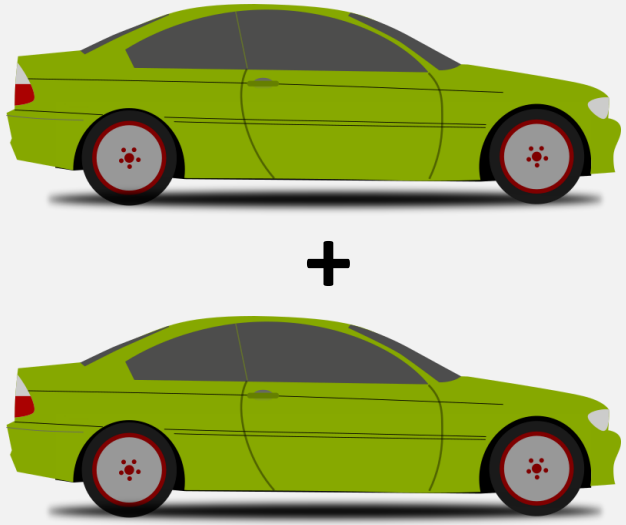
EV vehicle types:

PEV
Plug-in Electric Vehicle



Context: energy use

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



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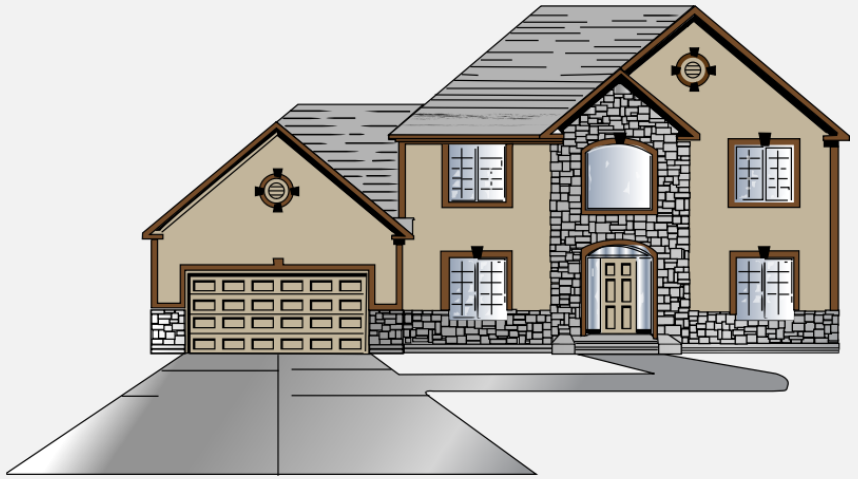

Context: battery capacity

- 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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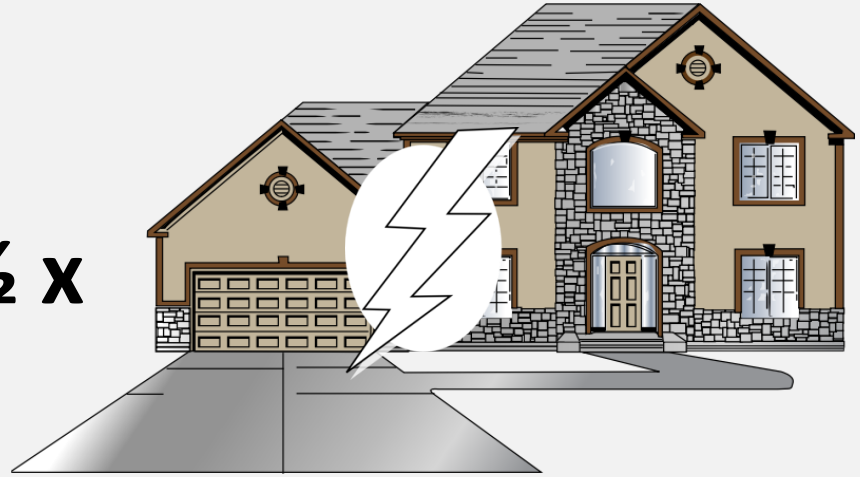
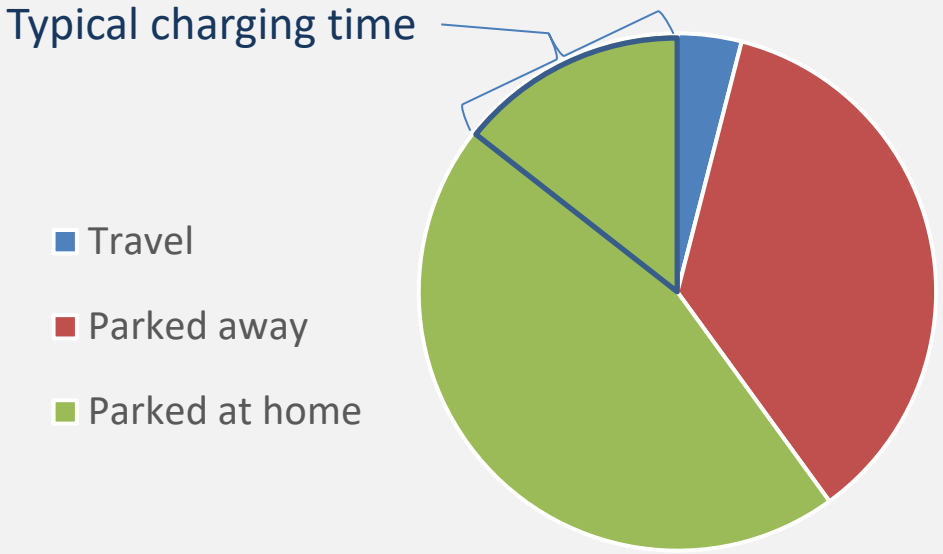
= 1½ x



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

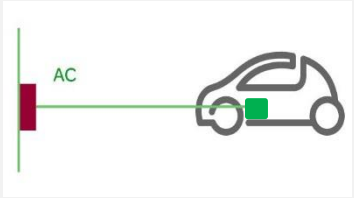
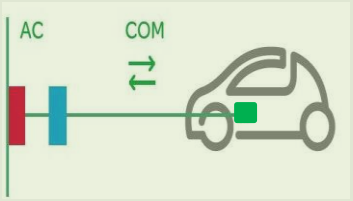
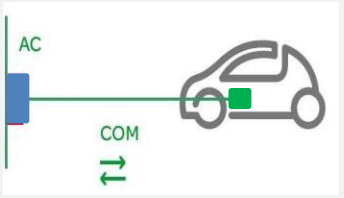
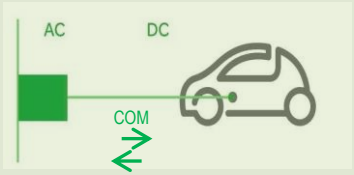


Summary - EVSE charging Modes:

AC power socket

AC EVSE

AC/DC converter

	**Mode 1:** • 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.
	**Mode 2: Plug in AC EVSE** • 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.
	**Mode 3: Fixed AC EVSE** • 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.
	**Mode 4: DC EVSE** • 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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AC EVSE

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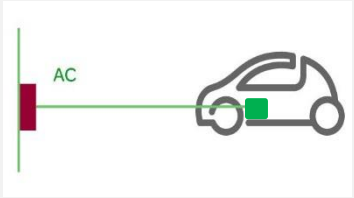
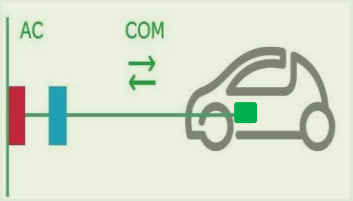
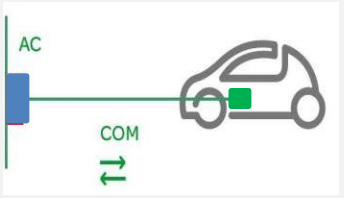
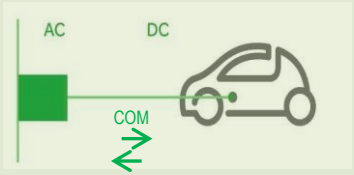
	**Mode 1:** • Standard power lead plugged into normal outlet • Charger in vehicle converts AC to DC and controls battery charging rate etc. • NB: Mass manufacturer no longer use this mode as lead is always live.
	**Mode 2: Plug in AC EVSE** • In-line EVSE control box (blue) is part of lead (e.g. unit 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.
	**Mode 3: Fixed AC EVSE** • 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.
	**Mode 4: DC EVSE** • 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

Modes 2 & 3: Two AC connector types

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

Type 2 or Menneckes
(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 it 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, if 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!

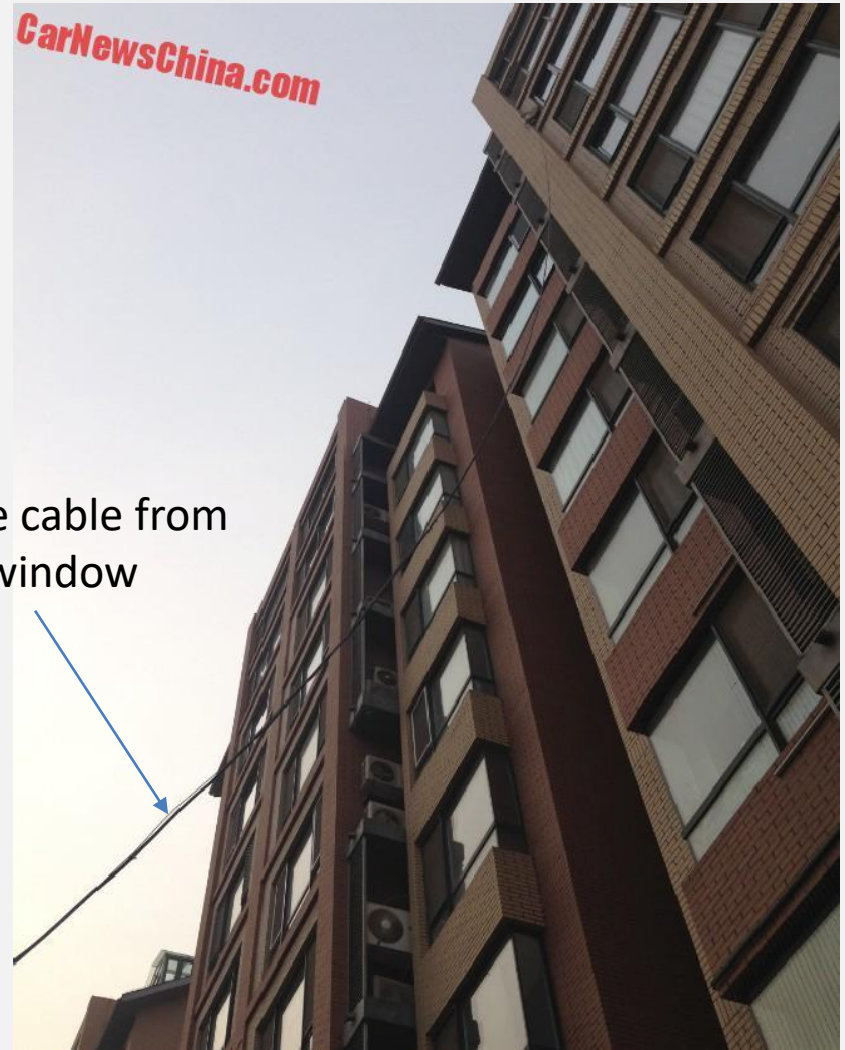
What about solar?

- 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)



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

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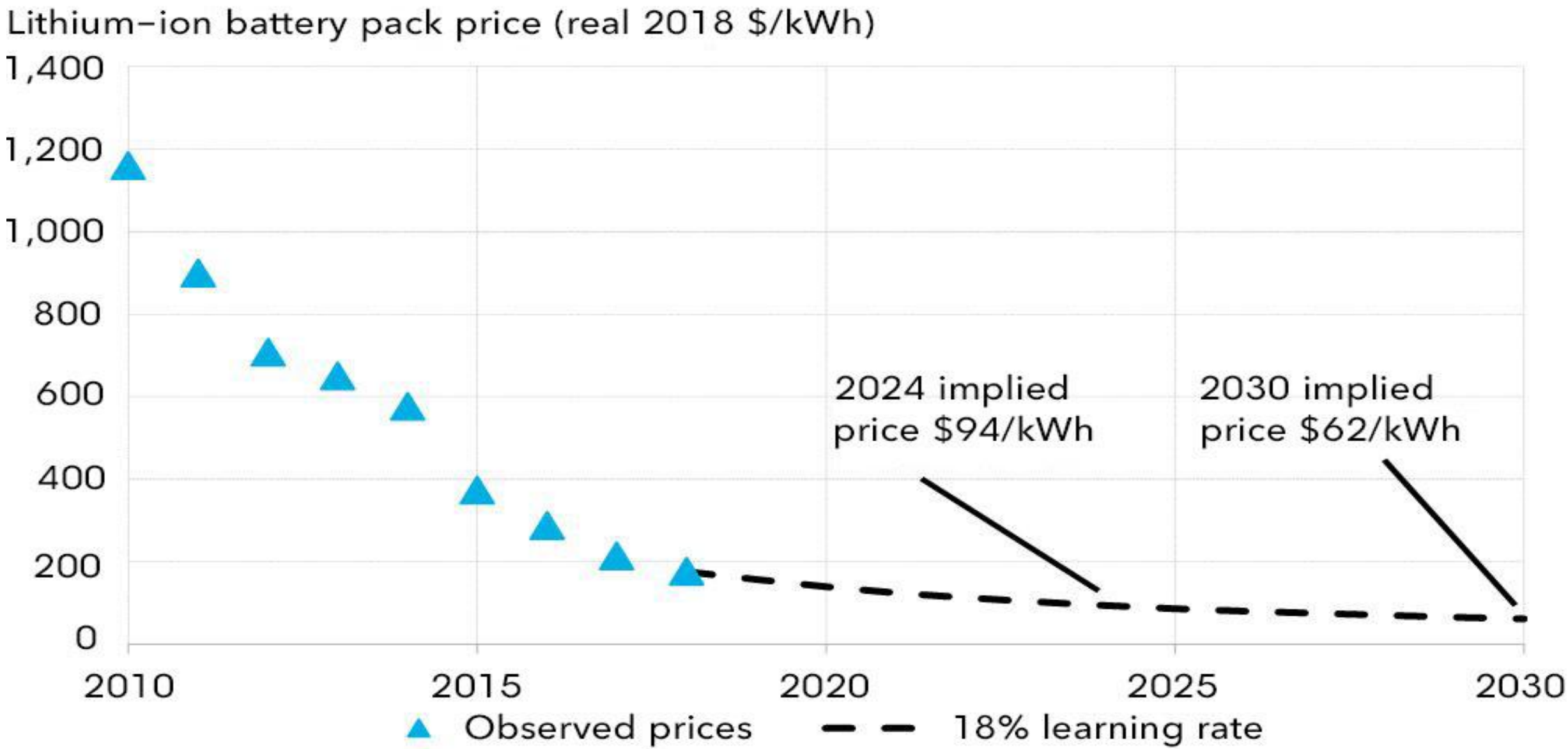
Lithium-ion battery price outlook



Source: BloombergNEF

Questions?