Climate change mitigation

Energy efficient vehicle choices

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Automotive diesel and petrol account for 40% of all greenhouse gas emissions produced in southern Tasmania. Changing the way we power our vehicles therefore has the potential to significantly reduce emissions and to put some of the power to make change in our hands. It is really important to feel that we can make a difference, and shifting to an electric vehicle can save tonnes of carbon emissions annually for each person that does it. The options for low or zero-emission vehicles are increasing all the time. This article provides some basic information about the choices that are currently available for those who may be ready to make the shift.

Hybrid and plug-in hybrid cars

Hybrid vehicles are a good choice for city driving, use a conventional internal-combustion engine together with an electric motor to drive the vehicle. The wheels can be powered by the engine, the electric motor alone, or by a combination of both. The electric motor is charged by capturing energy generated during braking and by the combustion engine. When braking in a traditional car, the kinetic energy generated usually goes to waste, however, in a hybrid or electric car, braking converts and stores thermal energy from brake pads and reuses it to power the car - this called regenerative braking.

In a hybrid vehicle, the electric motor assists with acceleration from standstill, powers the car when idling and provides an extra boost when needed. Many hybrids can be driven on electric power alone at lower speeds for a distance of up to 50km, depending upon the capacity of the battery. Hybrid electric vehicles are less useful for highway driving because the additional weight of the vehicle and the reduced need for regenerative braking to recharge the battery mean that the combustion engine is the primary driver of the car once the battery is depleted.

Plug-in Electric Hybrid Vehicles (PHEV) work in much the same fashion as regular hybrid vehicles, with the additional option of recharging the batteries through a plug-in electricity connection. They are the middle ground between conventional hybrids and full electric vehicles. PHEVs are useful as short range electric vehicles and perfect for those who predominantly drive relatively short distances.

Where, and how often, you need to recharge your vehicle is something to consider. Recharging can be through a household power point which takes up to eight hours for a full charge. A faster charge may be achieved by installing a 'smart charger' at home or at a work place. A single phase 7kW charger may be purchased for around $1300 or a 3 phase 22 kW charger for around $1700 – charging time is reduced to 3-4 hours with these chargers. These chargers can pay for themselves in as little as two years if coupled with solar panels for charging rather than drawing electricity from the grid. Publicly accessible super chargers provide power to the battery at a faster rate which means that some batteries can be charged in as little as 30 minutes.

PHEVs have larger batteries than hybrid vehicles and can be driven further in full-electric mode. PHEVs are quiet, efficient and if used primarily in electric mode will significantly reduce your emissions. The up-front costs are usually greater but electric motors are efficient converters of energy, offer excellent torque and zero emissions, which means efficiency without compromising performance.

Some of the current options are (as at March 2021):

Model	Engine	Efficiency (L/100 km)	Approximate price
Toyota Yaris hybrid	1.5 L 4 cyl hybrid	3.4	$30,000
Toyota Prius hybrid	1.8 L 4 cyl hybrid	3.4	$36,600
Hyundai Ioniq hybrid	1.6 L 4 cyl hybrid	3.4	$34,000
Toyota Corolla hybrid	1.8 L 4 cyl hybrid	4.2	$30,000
Toyota RAV4 hybrid	2.5 L 4 cyl hybrid	4.7	$39,000
Hyundai Ioniq plug-in hybrid	1.6 L 4 cyl plug in hybrid	1.1 (electric range 63 km)	$41,000
Mitsubishi Outlander plug-in hybrid	2.0 L 4 cyl plug in hybrid	1.7 (electric range 55 km)	$48,000

Electric cars

Electric cars function by plugging into a charge point and drawing electricity from the grid. They store the electricity in rechargeable batteries that power an electric motor. Electric cars accelerate faster than vehicles with traditional fuel engines – so they feel lighter to drive.

An electric vehicle can be charged by plugging it into a public charging station or into a home charging unit as outlined previously. Locations of publically available charging stations can be found online at www.myelectriccar.com.au or the 'PlugShare' phone app.

Electric cars have 90% less moving parts than a car with an internal combustion engine and are hence much easier to maintain, cheaper to service and should last longer. The primary components of an electric vehicle are:

- Electric motor - provides power to rotate the wheels.
- Inverter - converts the electric current in the form of direct current (DC) into alternating current (AC).
- Drivetrain – electric vehicles have a single-speed transmission which sends power from the motor to the wheels.
- Batteries – store the electricity required to run the electric vehicle. The higher the capacity in kW of the battery, the higher the range.

The claimed range for electric cars is increasing to the point where there are several options that are beginning to make sense for longer distance commuters. It pays to note that actual range depends on a number of factors including how aggressively the vehicle is driven, how flat the route is, whether there is a strong head wind, how much energy can be regenerated through regenerative braking and coasting, and temperature settings on the climate control.

Some current electric vehicle options and details (as at March 2021):

Model	Efficiency	Range (1 full charge)	Approximate price
Nissan Leaf	17 kWh/100 km	315 km	$51,000
Hyundai Ioniq	12.1 kWh/100 km	373 km	$50,000
Hyundai Kona	14.2 kWh/100 km	500 km	$61,000
Tesla Model 3	15.6 kWh/100 km	568 km	$67,000

How much does it cost to own and charge an electric car?

The total monthly cost of running an electric car is about half that of running a fossil fuel powered car and greenhouse gas emissions can be reduced to almost negligible, depending upon how an electric vehicle is charged - bearing in mind that grid electricity in Tasmania does have a small proportion of coal fired electricity in the mix. Australia's average emissions intensity for traditional passenger vehicles is 170 g CO_2/km which equates to an annual emission of 3.4 tonnes of CO2 if driving 20 000 km annually. For those motivated solely by reducing their personal emissions, owning an electric car will make a significant difference.

The current cost of electricity in Tasmania is about $0.27 per kilowatt, and it takes up to 18 kilowatts to travel 100km, so it will cost an average $4.90 to travel 100km. By way of comparison, it costs on average $16 to travel 100km in a petrol powered vehicle.

The most cost efficient, and emissions efficient, way to own an electric vehicle is if it is powered from a domestic solar photovoltaic system either during the day when the sun is shining or from a storage battery during the evening.

Another consideration when contemplating whether to go electric is the energy and resource extraction required to produce the car. The main processes are ore mining, material transformation, manufacturing of vehicle components and vehicle assembly. The estimated emissions for cars with internal combustion engines in this phase is estimated to be about 10.5 tonnes of carbon dioxide per car, compared to emissions for an electric car of about 13 tonnes (including the electric car battery manufacturing). Emissions from the manufacturing of a lithium-nickel-manganese-cobalt-oxide battery alone are estimated to be 3.2 tonnes. Theoretically it takes about 3 years of driving an electric car before the offset emissions recoup those produced during the manufacture of the vehicle.

There are no easy answers for us in finding the best way to have a minimal impact on the atmosphere from our day to day activities. But looking at hybrid and electric vehicles the benefits appear to outweigh the impacts. The technology is improving all the time and there are emerging options for integrating electric vehicles with the home as mobile mass storage batteries. When the time comes that vehicle manufacture is undertaken using renewable energy then the choice to embrace the technology will become simpler for those of us aware of the life-cycle emissions generated in producing the things that we consume.