

## STEP INTO YOUR FUTURE! Developing electric vehicles from the ground up つついて



## The new golden age of motoring

Electric cars are driving us towards a new automotive era where nothing is off the table.

#### James Ward

When was the last time your car truly changed?

Think about it. The internal combustion engine was first certified in 1854 and the patent for a "vehicle powered by a gas engine" was sought for the threewheeled Benz Patent Motor Wagen in 1886. It was simple – just one cylinder and a handle to steer with – but it set the fundamental tone for almost everything that would follow for almost a century.

Sure, aluminium was initially used to save weight in 1899, we saw mass production enter the picture with the Ford Model T in 1908, and useability was improved by the use of Bakelite plastic in 1916 and the hydraulic automatic transmission in 1948, but the fundamental design of strapping some seats to an internal combustion engine had not really changed.

Four cycles of a piston, through intake, compression, combustion and exhaust, turned physics into motion for a populace who were hungry for travel.

Yes, that engine improved in terms of power and efficiency. The placement moved from the back to the front, in some cases went back to the back and occasionally ended up somewhere in the middle, but there was always a big lump of engineering somewhere governing where everything else could fit.

Air and fuel in, exhaust and noise out. It was a system that improved every month of every year, but a technology that never really changed.

Make no mistake, electrification (and even nuclear power) was explored with a near parallel timeframe, but the demand for more performance and capability weighed up against lower costs and a need to be fast to market, made the propulsion choice a onehorse horsepower race in favour of combustion.



The Hyundai Ioniq 5 N has an electric driveline that can adapt to different driver preferences and behaviours.

For the most part, this made a car a near uniform proposition.

It came in different shapes, sizes and colours, sure, but even in a fast-advancing industrial world, cars never changed so much that a car from yesterday, or even yesteryear wouldn't fit in on the roads of today.

Yes, design considerations around safety took hold when the protective passenger cell was patented by Mercedes-Benz in 1951, Volvo invented the threepoint seat belt in 1959, anti-lockbrakes arrived in 1971 and the first airbag in 1973, but even with these innovations, the cabin and its constraints were largely governed by evolutionary rather than revolutionary design.

Ideals formed in the pages of science fiction seemed to be forever held in fantasy. Vehicles that would move themselves, offer unique passenger layouts and could travel cleanly and silently were explored, but ruled out as concepts of fantasy.

That is, until now. We have reached the point where the science behind the theory has developed to the point where it can be commercially explored. Technological improvements in lighting, material use and, of course, power delivery are now at a point where science fiction is very much showroom fact.

The most exciting part of this is, car designers are now moving beyond "the way it is" and pushing towards "the way it could be".

It's an opportunity to combine all these modern advancements into a way of rethinking what, how and where we drive.

Electric power means the cabin layout of a car can be considered in a way that doesn't require a large gearbox or transmission tunnel to be factored into the use of space. In the case of the Hyundai Ioniq 5 N, it's the ability of the electric driveline to adapt to different driver preferences and behaviours in a way that almost ignores the limitations of physics.

Why should a car continue to behave just the way it has, when we have the ability to step beyond this?

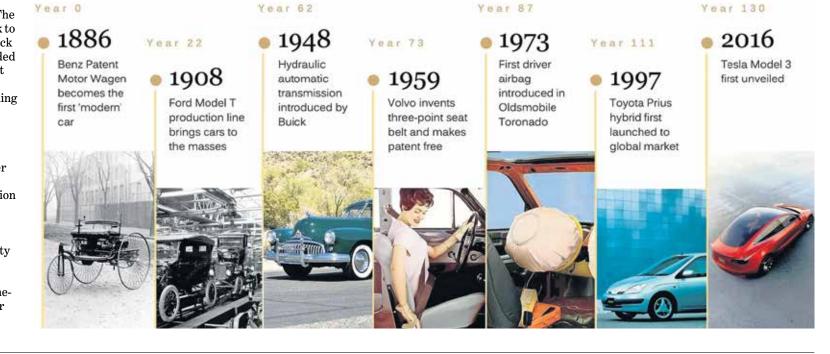
Bright LED lighting allows new "faces" and features to be implemented within the car's exterior elements, and clever technology enables designers to think outside the box more than ever before.

The new Polestar 4 is a highriding coupe crossover without a rear window; the brand taking a fairly wild approach to a traditional feature just because it can.

We are entering a new golden age where nothing need stay as it was. This is a chance for all of us to see what CAN be done, rather than continue down the status quo highway of what HAS been.

Discussions around "jet thrusters", "amphibious functionality" and even being able to hop on the spot are not shunned as comic-book pipe dreams, but simply added to the list of features.

Tomorrow's world is here, so take a step into the future and read on about how the next generation of cars is being considered, designed and produced.



## **HLAP**

The Drive TV team take the Kia EV9 on an epic EV road trip around Australia.

Starts May 11 on the Nine network.





### **STEPPING STONES** The gateway vehicles to electrification

#### **Rob Margeit**

When it comes to electrification, there is more than one way to skin a cat. While the shiny new technology of full electric grabs all the headlines, cars powered at least in part by electricity, have been roaming Australia's roads for over 20 years.

Hybrids have, since the Honda Insight and Toyota Prius launched here within months of each other in 2001, grown in popularity, outselling fully electric cars by significant margins.

According to the Australian Automobile Association's *EVIndex* report, hybrid vehicles accounted for 95,129 sales from the third quarter of 2023 to the first quarter of 2024, outperforming the 69,593 electric vehicles (EVs) sold over the same period.

Sales of traditional petrol- and diesel-powered cars fell by 8.03 per cent over the same period, dropping below 80 per cent market share (78.18 per cent) for the first time.

It's easy to see the appeal of hybrid technology for new car buyers, especially those who are not ready to commit to the full batteryelectric experience.

For them, hybrid technology offers a lot of the benefits – such as lower emissions and savings at the bowser – without the added stresses



surrounding things like range anxiety and charging infrastructure.

Not all hybrids are created equal however, with three distinct types of the energy-saving technology, each with their own pros and cons.

#### **CONVENTIONAL HYBRID**

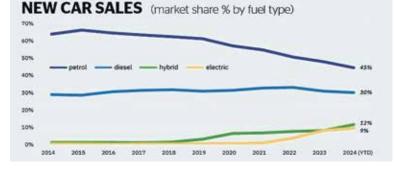
Often referred to as a closed-loop hybrid, this system sees the combustion engine work in tandem with an electric motor to power the car.

At lower speeds, the battery powers the small electric motor which then drives the wheels, allowing the car to be driven for short distances in pure electric mode. Only once speed increases does the combustion engine fire up to support the electric motor.

Additionally, the combustion engine also feeds energy back into the battery, ensuring it will always maintain enough charge to power the car on its own as needed.

Benefits: Better fuel economy, no need to charge the battery Downsides: Can only be driven on pure electric power at very low speeds

Examples: Just about any Toyota



#### **ELECTRIC-DRIVE HYBRID**

Pioneered by Nissan, electric-drive hybrid takes a different approach. Yes, there is a petrol engine, and yes, it's joined by an electric motor fed by small battery pack. But in a major hybrid plot twist, the petrol engine does not power the wheels directly.

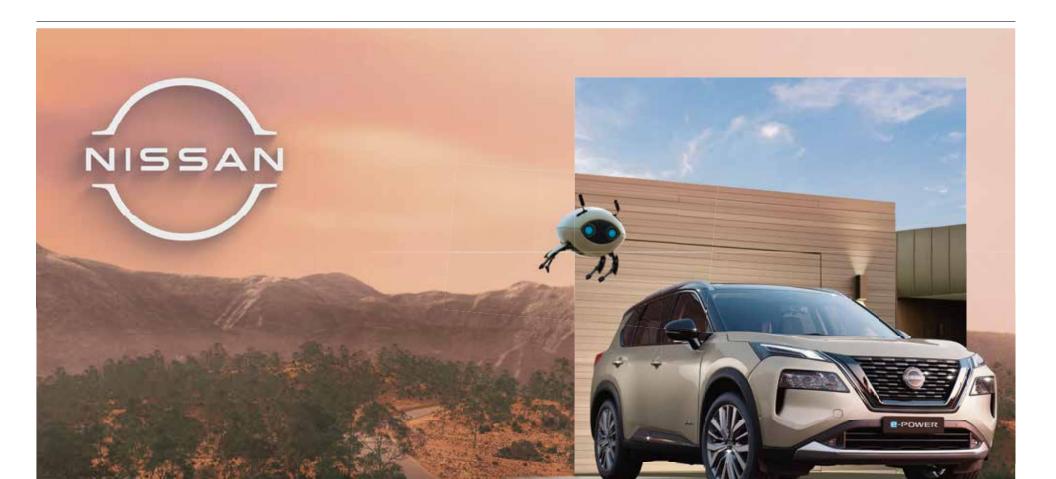
Instead, when called into service, it's used to charge the battery, which in turns sends power to the electric motor, which then drives the wheels. Think of the petrol engine as a mini power generator and you'd be on the right track.

Benefits: Can be driven on pure electric power at higher speeds, the petrol engine only firing up when the battery's state of charge reaches a predetermined low Downsides: No real benefit in terms of fuel consumption and emissions, e-Power returning similar fuel use as conventional hybrids Examples: Nissan Qashqai e-Power

#### **PLUG-IN HYBRID**

A plug-in hybrid electric vehicle (PHEV) features a bigger battery than conventional hybrids, allowing them to be driven on electric power alone for longer distances, as much as 60-70km in some models. And that means for many, daily driving can be undertaken in pure electric mode, with zero emissions and fuel consumption but with the knowledge that a petrol motor and full tank of fuel is on hand to take over once the battery is depleted. Additionally, a PHEV's smaller battery (when compared with an EV) can be recharged overnight at home using only a household socket.

Benefits: Can be driven only on electric power for longer distances Downsides: Needs to be charged daily to ensure the greatest benefit Examples: Mitsubishi Outlander PHEV, Volvo XC60 Recharge, Ferrari 296 GTB



## Nissan X-TRAIL

Driven by electric. Fuelled by petrol. Never need to plug in.

Nissan X-TRAIL e-POWER available in ST-L, Ti & Ti-L grades. Ti-L shown



## The art of the electric car



Electric motor

Spot the difference: The petrol-powered BMW 4 Series Gran Coupe on the left and the BMW i4 electric car on the right sport a similar styling outside but are radically different under the skin.

#### Susannah Guthrie

For the uninitiated, there can be a tendency to view electric cars as futuristic spaceships – a foreign species entirely different to the internal combustion engine (ICE) cars we know and love.

The reality is the two have more in common than many might think.

"When I'm talking to punters at a motor show, standing there with the bonnet up on an electric car, the thing that sparks the most conversation is the 12-volt battery," laughs Ben Warren, National Manager for Digital Experience and Innovation at Nissan Australia.

"Every single person says 'What's that there for? You've got this big battery in there, why doesn't it run everything?'"

loesn't it run everything?'" The reality is that the humble regularly, there's not a whole lot missing," says Mr Warren of electric cars.

"Obviously the driving experience is very different and there's a lot of componentry change under the skin, but they're not the things a customer would usually touch, feel or even see."

Electric cars might do without the engine, gearbox and fuel tank found in conventional vehicles, but they must add things like a battery, electric motors and a charge port.

This switching out of componentry might be challenging from an engineering perspective, but also creates opportunities for innovation.

In particular, car makers are becoming adept at packaging the heavy high-voltage battery of an electric car in a manner that frees up plenty of interior space. Electric cars also provide more freedom in terms of functionality. For example, while both conventional cars and electric cars have heating, ventilation, and airconditioning (HVAC) systems, electric cars can skip a few steps when heating or cooling the cabin.

"In a petrol vehicle the engine needs to run for the air conditioning compressor to work, whereas in an electric car these are standalone systems running off the high-voltage battery," says Warren.

This allows owners of electric cars to remotely cool or heat their cars ahead of time without needing to run a noisy engine emitting exhaust fumes.

On the road, electric cars are lightning quick, not just in terms of acceleration, but also in the execution of key functions. a traditional all-wheel drive car can vary its output to the wheels when it detects slip, an electric car's AWD system can do this 10,000 times quicker."

One of the biggest adjustments for new electric car owners is in relation to how their vehicle slows down.

"We talk about 'regenerative braking' with electric cars and people get really confused because it doesn't actually use the brakes," says Warren.

'Regenerative braking' refers to an electric car's ability to slow itself down using resistance from the traction motor, capture the energy it generates and feed it back into the battery to prolong battery life.

"That resistance is what slows the vehicle down, versus applying the actual brakes. It's the same outcome - the vehicle slows down but it's delivered completely differently," Warren says. Depending on the model you choose, making the switch to electric power might involve a slight learning curve, but a large part of the investment into their development is focused on making electric cars approachable, Although plenty of electric car makers are looking to rewrite the design rule book, for others the highest praise they can receive from customers is that their electric models "feel like a regular

As Warren says: "The whole idea

is not to make these cars a science

car".

experiment."

#### **Electric v ICE**

Not all electric vehicles are the result of white paper design. As this table shows, there's a host of EVs that share platforms and architecture with their ICE (internal combustion) counterparts.

EV / ICE BMW iX1 / X1 BMW iX2 / X2 BMW iX3 / X3 BMW i4 / 4 Series Gran Coupe BMW i5 / 5 Series BMW i7 / 7 Series Ford E-Transit / Transit Genesis GV70 Electrified / GV70 Genesis GV80 Electrified / GV80 Hyundai Kona Electric / Kona Kia Niro / Niro Hybrid

LDV eDeliver 9 / Deliver 9

LDV eT60 / T60 Max

Lexus UX 300e / UX

LDV Mifa 9 / Mifa

12-volt battery that runs auxiliary functions like a car's display screens or lights is just as essential in an electric car as it is in a petrol or diesel car.

"The high-voltage battery does the driving, but if you have an accident in an electric car, the high-voltage battery isolates itself immediately – so how do you lock or unlock the doors and use the hazard lights? All those ancillary systems still have to run off a 12-volt battery," Warren says.

The similarities don't end there. In fact, first-time electric car buyers will likely find their car feels surprisingly familiar.

"In terms of all the features a customer would see, touch and feel

"The battery sits under the floor, so you can play with packaging in a way you never could before," Warren says.

"You can push the wheels further out because electric motors are much smaller than engines and you're not trying to fit a fuel tank in. You don't have a transmission tunnel, you don't need a console between the driver and front passenger and you can achieve a flat floor in the back seat."

In some models, this flexible packaging can translate to a "frunk" or "froot" – a secondary storage compartment located at the front of the car where the engine bay is typically found. "With torque delivery in a petrol engine you have to get the motor up to the peak output – there's none of that in an EV, it's down an electronic wire and the computer is making a split-second decision and outputting power straight away," Warren says.

This immediacy can also benefit things like all-wheel drive systems, where electric cars deliver "an unparalleled response rate".

"In an ICE vehicle you've got one engine powering the vehicle via a transmission, through transfer cases to get power to the front and rear wheels," Warren explains. "In an EV, in a simplistic sense,

[power travels from the] motor to the wheels straight away. So, while Mercedes-Benz EQA/GLA Mercedes-Benz EQB/GLB Mercedes-Benz EQV/V-Class Mercedes-Benz eVito/Vito Mercedes-Benz eVito Tourer/ Vito Tourer MG ZS EV/ZST Mini Cooper SE/Cooper Mini Countryman E/ Countryman Peugeot e-2008/2008 Peugeot e-Partner/Partner Renault Kangoo E-Tech/Kangoo Volvo XC40 Recharge/XC40



### **BUILDING ENERGY** How does an electric car battery work?

#### Susannah Guthrie

The most crucial component of any electric vehicle is the battery. This determines how far your car can travel, how long it takes to recharge and how much it costs to buy.

In the simplest terms, batteries convert the chemical energy of their components to electrical power through a process known as electrochemistry.

Regardless of the chemical elements in a battery, electrons flow from the negative anode to the positive cathode, creating electricity.

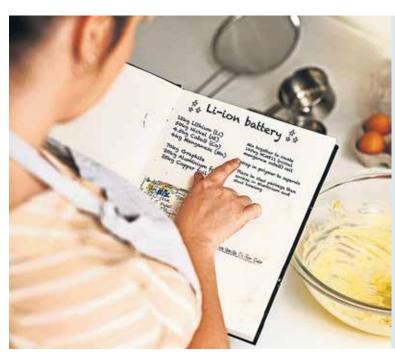
We're familiar with the batteries in our laptops and mobile phones, but what about the batteries in electric vehicles?

"Electric car batteries don't really differ from those in your laptop," says Zoltan Sekula, product stewardship manager at Australian battery recycler EcoCycle.

"But while you normally charge household batteries at a very conservative level, electric car batteries can fast-charge in as little as 20 minutes, which means they tend to heat up.

"That's where the challenge comes in - to make things as safeand quick as possible."

Currently, there are three



dominant types of electric car battery chemistry in use: Lithiumion phosphate (LFP), nickelmanganese cobalt (NMC), and nickel-cobalt aluminium (NCA).

All these chemistries use graphite as the anode, and the other core elements as the

cathode. While LFP is perhaps the most well-known, these days the different chemistries are "really quite even in terms of

representation", explains CSIRO scientist Dr Adam Best.

For example, Chinese-made Tesla Model 3s have LFP batteries, while US-made Model 3s have either LFP or NCA. NMC batteries can be found in the Polestar 2 or BMW iX3.

So, why choose one over the other? It comes down to balancing performance with cost.

"LFP is the cheapest one because it doesn't have nickel or

#### What is an electric vehicle battery made from?

In this example, a Tesla Model 3 75kWh NMC (nickel, manganese, cobalt) lithium-ion (Li-ion) EV battery is made up of 2976 cells, which are constructed in 96 packs of 31 units. The combined resources required are approximately 12kg lithium, 50kg nickel, 4.5kg cobalt and 4kg manganese combined with 70kg graphite, 20kg of aluminium foil and 25kg of copper foil. Each cell has a steel shell and the entire battery is encased in an aluminium and steel housing. Source: Malvern Panalytical

cobalt, which are more expensive," explains Best.

Meanwhile, "NCA and NMC are higher energy, so you tend to see them in bigger, more

performance-focused vehicles." LFP has become the go-to

battery chemistry for manufacturers targeting budget buyers. "LFP packs are not designed for performance, they're designed to bring down the cost of EVs," Best says.

"They have a lower energy density, meaning you'll normally get less range out of them than an NMC or NCA pack. LFP packs will also generally weigh more because they need more cells to reach the right voltage."

One upside of LFP batteries is they are considered safer and their supply chain tends to be more socially conscious than that of NMC or NCA batteries.

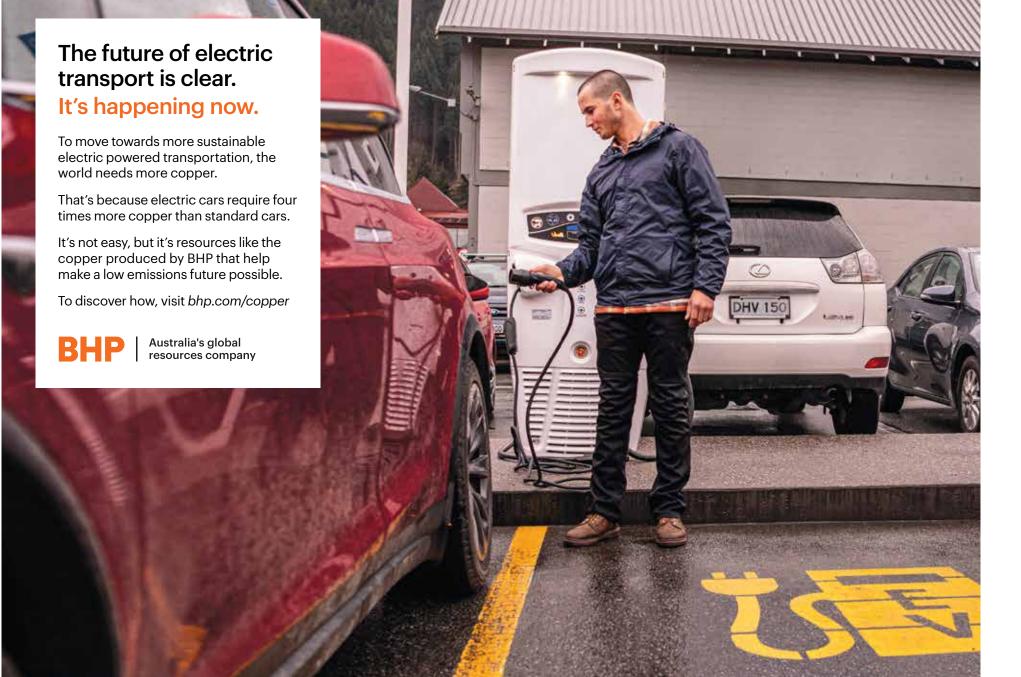
"Unfortunately, cobalt extraction is done mainly in the Congo and the human rights record is not good, so everyone is trying to distance themselves from cobalt," Sekula says.

Best adds: "LFP batteries are more robust and, because they have a lower voltage, they're more abuse tolerant ... plus, in the event of a fire with an LFP battery, it's less likely to be as aggressive as NCA or NMC."

That doesn't mean you should worry about your electric car catching fire, regardless of the kind of battery it has.

"A battery management system governs the amount of energy put out, and can manage every cell in the pack, from their temperature to the charging process," says Best.

As a result, "electric car fires are like hen's teeth compared to internal combustion engine fires".



# A new world of S

New technologies and new goals mean a whole ne

### 2 Production



Special skills are needed to make and assemble electric car parts, such as these Volvo batteries.

Energy use for factories and other manufacturing plants is a key consideration. For example, BMW's Leipzig plant in Germany has wind turbines on site that generate about 20 per cent of the factory's energy requirement.

The process to build an electric car is arguably simpler and faster than that of an internal combustion car, primarily due to the reduction of components required for the engine and transmission. This means factories can be more automated and efficient during production.

However, for a traditional car manufacturer to switch from combustion to electric requires a

rethink of all the components in the car, Kärrberg says. "You have a climate system in an internal combustion engine that is dependent on the heat that comes from the engine.

"That's no longer possible. So you have to change the climate system.

"The air-conditioner needs also to be replaced. So all the systems basically needs to be updated. "So it, of course, requires a competence shift in

the company. "In order to assemble an electric car you need special skills. You're dealing with 400 volts [not 12 volts] and ... an electric car has fewer parts."

### 3 Distribution



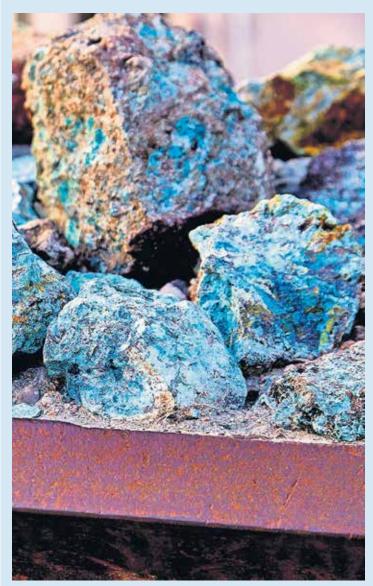
#### **James Ward**

The push for automotive electrification is predominantly driven by a goal to achieve a cleaner world of low- and zero-emission transportation.

While this may often be simplified into catchy "net zero" taglines, making the changes required to reach this state, particularly in the automotive industry, is a huge undertaking that requires a fresh way of thinking at every single step.

To get a broader understanding of what is required, *Drive* spoke with Anders Kärrberg, the head of global sustainability at Volvo Cars, about how the Swedish brand is dealing with the challenge of achieving net zero by 2040.

### 1 Materials



For improved transparency, the sourcing of minerals and metals from ethical suppliers is soon to be regulated in Europe.

The requirement for specific minerals to create the batteries and motors used in electric cars needs to be balanced against the opportunity to investigate more recyclable and lightweight materials to use in the production of those cars.

Sourcing minerals and metals from ethical suppliers is soon to be regulated in Europe, so as to ensure that the companies' public face of sustainability is backed by a transparent layer of due diligence.

New composites need to be assessed by their weight-saving and cost benefits against longterm durability and recyclability (see final step).

"Since we changed so many parts, you bring in a new battery with new metals and minerals with a new value chain for the battery, you have a new powertrain, electric motors, you bring in chargers, inverters – all of which were part of an internal combustion engine car before," Kärrberg says.

"You look at composites, for example, very lightweight, [but they are] terrible for recycling. You can hardly not use it for anything but landfill and that would be a waste." While an EV itself may be more sustainable, it becomes less so if it needs to be shipped across the globe.

Building a new zero-emission car with a responsible and sustainable approach to materials and energy is only part of the net-zero challenge.

If that car is needing to be shipped to a market on the other side of the world, that distribution network also needs to be considered in the emissions life cycle.

Heavy fuel oil, which powers most traditional ships, is one of the most significant single contributors of global emissions, accounting for 3 per cent of all annual emissions alone.

Liquid natural gas (LNG) is an alternative fuel option that emits about 25 per cent less carbon dioxide than fuel-oil, but still has a negative impact on global emissions due to methane and other harmful by-products.

Methanol is being explored as it extracts carbon dioxide from the atmosphere, which dramatically helps on the pathway toward net zero, although it is currently more expensive to produce than other fuels. However, not investing in cleaner options will soon cost money by way of fines, particularly in the European Union where there is an ETS (emission trading scheme) in place.

"Through the ETS, it costs about €60 per tonne to meet the CO2 today – that is likely to happen more," Kärrberg says. "You have [in future] maybe to have to pay for other types of pollution."



# USTAINABILITY

w way of thinking when it comes to building cars.

### 4 Beyond

Part of Volvo's sustainability goal includes a "circular" ambition where every element of the supply chain is assessed for its ability to be recycled and reused down the track.

What's more, due to the high demand for electrification, some of the minerals used in the construction of batteries today could potentially become scarce or expensive, which is why new battery chemistries and power options are being investigated (see page 10).

Battery recycling is key. With the minerals being so valuable at the outset, finding a way to re-use these elements from older batteries is prompting the development of an entirely new industry.

"For us, it's about reducing the use of primary resources, including water and energy," Kärrberg says.

"It's even considering using waste differently – by renovating parts and bringing them back into the business.

"You have to consider recycling from the very start," he adds. "When you design the car, how will this car be disassembled? How do you join parts together? How do you glue them together? Can you use the same material throughout the whole part?

"All this must be decided right upfront." Recycling is key to sustainability if modern car

production is to reach its lofty ambition of net zero. The answer, Kärrberg says, could be staring us right in the face: "The biggest mine for future cars is really going to be the car itself."



Volvo Cars head of global sustainability Anders Kärrberg is heading to net zero by 2040.

#### What does net zero mean for cars?

Manufacturers do their best to remove carbon dioxide (CO2) emissions throughout the production process and, with whatever is left, balance the output by investing in carbon removal projects that pull CO2 from the atmosphere to create a balance of zero emissions.

"You go through all your products, all your processes, all your operations and do concrete actions to actually reduce carbon dioxide," Anders Kärrberg says.

"Zero emissions from the whole company means everything through the socalled value chain, all the way from the mine, to the suppliers, to the assembly operations, the logistics for all the parts, the tailpipe emissions over a certain driving distance, of course, and then the servicing and the final scrapping of the car."

**V O L V O** 

# Meet the fully electric EX30

Our smallest ever SUV. Contact your Volvo retailer to book a test drive.



Overseas model shown. Local features and specification may vary.



#### SAME SAME BUT DIFFERENT

## Shared development under the skin



From left: The Audi E-Tron GT and Porsche Taycan are built on Volkswagen's J1 platform, while the Subaru Solterra and Toyota bZ4X are jointly developed "Toybaru" cars.

#### **James Ward**

Cast your mind back to the 1980s and the Federal Government's Button Plan.

This was a program wherein the government sought to streamline Australia's automotive production by culling more than half the models built on local soil.

So as not to affect showroom line-ups, the new generation of cars built in Australia were able to be sold wearing different badges.

This meant the Toyota Camry was also a Holden Apollo, the Nissan Pintara could be had as a Ford Corsair, and even the Holden Commodore became a re-badged Toyota Lexcen.

While this is one extreme of branded engineering, there is still

an element of cross-pollination within our automotive industry today, although this time it's not driven by marketing, but by a benefit of shared development.

Japanese car giants Toyota and Subaru first started working together back in 2005 and soon started sharing manufacturing facilities, and in 2012 the first jointly developed "Toybaru" car, the Toyota 86/Subaru BRZ sports coupe was launched.

This collaboration has continued to support the development and production of the fully electric Toyota bZ4X/Subaru Solterra vehicle.

Sharing development of the electric vehicle platform is no different to that of the previous combustion-engined vehicles.

Shared investment and knowledge from both brands can bring a vehicle to market faster and more cost-effectively than if each manufacturer started with its own clean sheet of paper.

To take things even further, the Toybaru underpinnings that drive the bZ4X/Solterra twins also support the more luxury-oriented Lexus RZ.

#### **TWINS UNDER THE SKIN**

- Toyota bZ4X > Subaru Solterra > Lexus RZ
- Porsche Taycan > Audi E-Tron GT
- Volvo XC40 Recharge > Volvo C40 > Polestar 2
- BMW iX1 > BMW iX2 > Mini Countryman E
- Cupra Born > Audi Q4 E-Tron > Volkswagen ID.3 > Skoda Enyaq

But the bZ4X/Solterra is not the

only electric car developed in this

 $The \, Porsche \, Tay can \, and \, Audi$ 

underpinnings, and around 40 per

identical. This is largely related to

cent of the cars' engineering is

including the battery, electric

 $E ext{-}Tron\,GT\,share\,the\,same$ 

the electrical components,

Volkswagen-group J1

fashion, either.

- Kia EV6 > Hyundai loniq 5 > Genesis GV60
- Na Evo > Tryundanoniq 5 > denesis 6v00

motors, charging infrastructure and two-speed transmission.

And thanks to the shared parentage of Chinese conglomerate Geely Automotive, the Volvo XC40 (and C40) is the same as the Polestar 2 under the skin. Furthermore, the forthcoming Zeekr 009 luxury electric minivan (also part of the Geely group) is also sold as the Volvo EM90 in some markets.

Sharing these platform components allows the brands to concentrate more on the specific design and development of what sits on top, allows for the futureproofing of battery replacements and makes software enhancements far more accessible.

For buyers, it's all upside as you end up with more choice and variety in the showrooms.





### **TOP EV BUYS** The best of the best

#### **ROB MARGEIT**

With an ever-increasing number of electric vehicles available in Australia, it can be difficult to find out which one is right for you. Buyers have different priorities when it comes to making a new car choice. For a nation brought up on internal combustion, the new world of electric vehicles can be a bewildering one. To help you make an informed choice, these are the electric cars and SUVs Drive recommends in each category. And for more information and comprehensive in-depth reviews of every electric vehicle available in Australia right now, be sure to head on over to drive.com.au.

#### Best Affordable EV: MG4



This Corolla-sized hatchback broke new ground when it landed in Australia with a starting price under the psychological \$40,000 mark. With decent range and a good list of standard equipment, the MG 4 ticks a lot of boxes for those looking for an affordable entree into the world of

electric cars. That combination earned the MG 4 Drive Car of the Year Best Electric Car Under \$50,000 for 2024. For those who love a bit of performance from their cars, the MG 4 XPower, priced from \$59,990 drive-away has all-wheel drive, 460km range and a 0-100km/h time of just 3.8 seconds. Price: From \$39,990 drive-away

#### Best Urban EV: Tesla Model 3



It's one of the most popular electric cars around the world and for good reason, blending in-car technology, a futuristic minimalist interior, and crucially, a driving range that is among the best in today's market. Throw in Tesla's unquestionable brand cache (nothing says "I drive an

electric car" quite like Tesla) and it's easy to see why, in 2024, the Model 3 was crowned Drive Car of the Year Best Urban Electric Vehicle under \$100,000. Price: From \$58,900 plus on-road costs

#### Best EV for charging: **Kia EV6**



The Korean brand's first electric vehicle uses the same 400/800V-volt electric architecture as its crosstown siblings from Hyundai (lonig 5 and lonig 6), capable of using a 350kW fast charger. And that means the EV6's 77.4kWh battery can be charged from the benchmark 10-80 per cent in

a claimed 18 minutes when using a 350kW charger, just enough time to grab a coffee.

Price: From \$72,590 plus on-road costs

#### Best energy efficiency: Hyundai Ioniq 6



The Hyundai loniq 6's distinctive sweeping profile isn't just for looks. Designed to minimise aerodynamic drag, the loniq 6 is among the most efficient electric cars we've tested when it comes to energy consumption. Our realworld testing has shown you can expect energy use

under 15kWh/100km of driving, bettering even Hyundai's own claim of 16.9kWh/100km. Better consumption equals more range, of course. And when it comes to recharging, Hyundai claims it'll take only 18 minutes to top up the battery from 10 to 80 per cent when using a 350kW fast charger. Price: From \$65,500 plus on-road costs

#### Best Family EV: Kia EV9



The Kia EV9 broke new around when it launched last year, the first electric seven-seater SUV designed for larger families. And it made an immediate impact too, crowned the 2024 Drive Car of the Year, lauded for its

interior, clever packaging, an impressive standard equipment list and a surprisingly large towing capacity - with an efficient, punchy, all-electric powertrain are the ingredients that family buyers in this category. And Kia, with the EV9, has delivered. Price: From \$97,000 plus on-road costs

#### Best performance EV: Porsche Taycan



No one should be surprised that when German car maker Porsche decided to build an electric car, it built a very fast one. The Porsche Taycan is everything we've come to expect from the brand, certainly when it comes to performance. That the Taycan is fast in a straight line is a no-brainer

(it's a Porsche, after all), but it's what the brand has done underneath that sets its electric sedan apart from its rivals. Simply, the Taycan drives and behaves like a proper sports car. Price: from \$198,000 plus on-road costs

#### Best luxury EV: **BMW iX**



Big, bold, brash: three words that perfectly sum up the BMW iX. The German brand makes no apologies for its flagship large electric SUV. Brimming with technology, the winner of Drive Car of the Year Best Luxury EV Under \$150,000 in 2024, is more than just a design statement, though,

matching its unashamed presence on the road with the type of performance and driving dynamics BMW is renowned for. Price: From \$136.900 plus on-road costs

#### Best 'fun' EV: Hyundai lonig 5 N



It's part hot hatch, part family SUV, and all fun. The Hyundai loniq 5 N has redefined what an electric car can be. And it's not just about the added performance from Hyundai's N division that slashes the 0-100km/h to just 3.5 seconds, it's about

the entire package that delivers fun to the EV experience. Here, finally, is an EV that can serve as a track-day weapon, while doubling as a comfortable family car. It's a remarkable piece of engineering.

Price: From \$111,000 plus on-road costs

#### Best surprise packet: **BYD Seal**



The BYD Seal arrived here late in 2023 with a blend of style, technology, overall refinement and crucially, sharp pricing, that fired a warning shot across the bows of the Tesla Model 3. Certainly, with a starting price that undercuts the Model 3's

and by some margin, while offering similar equipment and performance, the Seal has emerged as a genuine, more affordable, alternative.

Price: From \$49,888 plus on-road costs

#### Four under 40

Last year represented a seismic shift in Australia's electric car landscape. An influx of more affordable models suddenly opened EV ownership to more people than ever before, with prices dipping below the \$40,000 mark for the first time.

Today, four models are priced under \$40k and the most affordable is the GWM Ora city car. Priced from \$35,990 drive-away, the Ora in Standard Range trim offers 310km of range and cutesy styling that distinguish it from the masses.

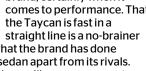
The MG 4 starts from \$39,990 drive-away and brings 350km of range and a conventional hatchback design that wouldn't look out of place on just about any suburban street in Australia

The BYD Dolphin starts at \$38,890 (before on-road costs) and blends quirky hatchback styling with around 340km of range.

The only SUV in the mix is MG's **ZS EV** which, after a recent price cut, parachuted into the under-\$40,000 party. It's now priced at \$39,990 drive-away and brings 320km of range and small SUV practicality.

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## Meet the next big things in energy

#### Susannah Guthrie

Unlike the internal combustion engine, there will be no one power source to rule them all when it comes to cars of the future.

Even the electric car batteries of today could soon be usurped by lighter, more efficient newcomers.

"There are a lot of battery chemistries being researched around the world to find out how you can store more energy per unit of mass," says Dr Adam Best, a scientist at the CSIRO.

Some of these solutions include silicon anodes, given silicon is an affordable, abundant material that can be repurposed down the line.

"The next step up is pure lithium metal anodes, which offer the highest energy density per unit mass of all battery anode materials and would mean lighter, smaller battery packs," Best explains.

Sodium-ion batteries are also in development, utilising the same ingredients you'd find in table salt to bring costs down.

Perhaps the buzziest tech is what's called a "solid-state battery", which replaces the liquid electrolyte found in most batteries with a solid electrolyte, offering a more powerful, lightweight battery pack.

In January, Toyota confirmed it would be rolling out vehicles with



Toyotas powered by hydrogen (above) and solid-state batteries.

solid-state batteries capable of charging in 10 minutes and with a range of 1200km only "a couple of years from now".

"Toyota has been at the forefront of developing solid-state batteries," explains Zoltan Sekula of battery recycler EcoCycle. "The tech is already available in the market but the race is to make them smaller, with higher energy density and more reliability."

Finally, hydrogen-powered cars provide another exciting emissions-free alternative – with Toyota once again at the forefront of development in this space. The gas can be used to power cars in



two main ways: hydrogen combustion, or hydrogen fuel cell.

"The main difference is, in a hydrogen combustion engine you burn hydrogen which produces nitrous oxide so it's not as clean, whereas hydrogen fuel cell vehicles consume hydrogen in a chemical reaction," explains Dr Quentin Meyer, a senior researcher at the UNSW Sydney School of Chemistry.

Hydrogen fuel cell cars provide benefits over and above electric cars – including the speed at which they can be "refuelled". "There's one hydrogen refuelling station in Victoria – you literally take a pump and plug it into your car and it fills with hydrogen," Meyer says.

"In terms of a longer-range application like a truck, a hydrogen fuel cell would also be much lighter than a battery."

While the technology for hydrogen cars is well established, it's still on a small scale.

"In my opinion, we're at least 10 to 15 years off large-scale fuel cell cars. We need more refuelling stations first," Meyer says.





\*\$39,990 is the driveaway price for the MG MG4 Excite 51 MY23 as shown in Volcano Orange, without any options. Offers available at participating MG Dealers for new stock vehicles only, sold and delivered between 01/04/2024 and 30/04/2024. While stocks lasts. Offers not available to fleet, government or rental buyers, or with any other offers. ANCAP rating applies to 2WD MG4 variants only.

#### **COMING SOON**

## The EVs we're most excited about

#### **Rob Margeit**

The world of electric cars is fast-moving. Advancements in technology abound – from improved battery efficiency resulting in longer driving range, to increasingly powerful motors lifting performance to heights previously thought unthinkable, the change of pace means a constant flow of new models from the world's car manufacturers. Buyers are responding, too. Electric vehicles now account for around 8 per cent of Australia's total new car market, up around 160 per cent on the previous year. Still, the 87,000 EVs Australians bought in 2023 represented only a small fraction of the 9.5 million electric cars sold around the world over the same period. With a slew of new models arriving on our shores over the next 12 to 18 months, there's plenty to get excited about.



#### MG Cyberster

With the range-toping all-wheel drive model claiming a 0-100km/ h time of just 3.2 seconds, the 1960s roadster-inspired MG Cyberster will be the quickest MG ever. Expect to pay around \$100,000 when it goes on sale here late this year or early next.



#### Kia EV5

The Korean brand's Tesla Model Y rival has already been spied testing in Australia ahead of its mid-2024 local launch. The EV5, a medium SUV similar in size to the Kia Sportage, is expected to start at around **\$60,000**.



#### Volkswagen ID. Buzz

Think of it as a modern Volkswagen Kombi. Certainly, the retro charm of the ID. Buzz should see it gain an army of devotees when it lands in Australia by the end of 2024. While pricing has yet to be confirmed, VW Australia is already taking "expressions of interest" for the electric reincarnation of one of it most iconic vehicles ever.



#### Zeekr X

A new brand from Chinese auto giant Geely (which also owns Volvo, Polestar and Lotus among others), the Zeekr X small SUV will land in Australia in the second half of this year with a driving range of around **445km**. Pricing is still to be confirmed.



#### Porsche Taycan Turbo GT

It was almost inevitable that the German sports car brand would apply the GT performance brush to its first electric car. The result is the Taycan Turbo GT, the most powerful and quickest production car ever made by Porsche. With a range of **555km** and a 0-100km/ h time of just 2.3 seconds, Porsche's new halo electric car will set you back **\$416,660** when it lands her later this year.





#### **Tesla Model 2**

The US electric car pioneer has been promising an entry-level small car priced from \$US25,000 (**\$38,500**) for several years now. And while company honcho Elon Musk confirmed late last year that development on the small sedan had started, recent reports suggest the project has been cancelled. However, Musk denies the reports and is adamant the Tesla Model 2 is going ahead. For now, we await what could be the most affordable Tesla yet.



#### **Lotus Eletre**

British car maker Lotus, now owned by Chinese auto giant Geely, has promised four new all-electric models over the coming years. The Eletre, priced from **\$239,000** to **\$315,000** is the first. Set to go on sale in Australia this year, the Eletre boasts 460-600km of range depending on the variant and can accelerate from 0-100km/h in either 4.5 seconds or an astonishing 2.95s in the flagship Eletre R.



#### Polestar 4

The Chinese-owned Swedish brand has already opened the order books for its new SUV, the Polestar 4, with deliveries in Australia expected to start in August. Pricing starts at **\$81,500**, which will see the sleek electric SUV go head-to-head against Tesla's popular Model Y.



#### Volvo EX30

The Swedish brand's first ground-up electric vehicle will bring plenty of Scandinavian style and luxury when it arrives later this year. The compact SUV may be smaller than the current XC40, but it delivers the most potent drivetrain in Volvo history – 315kW and a O-100km/h sprint of 3.6 seconds. Pricing starts from **\$59,990** 



#### Hyundai loniq 6 N

Expected here in 2025, the Hyundai loniq 6 N takes the unconventional-looking loniq 6 and applies the Korean band's performance blowtorch. The result? A faster and more powerful electric sedan tipped to eclipse the already stupendous performance of its loniq 5 N sibling, which set the world alight this year with its 0-100km/h time of **3.5 seconds**.



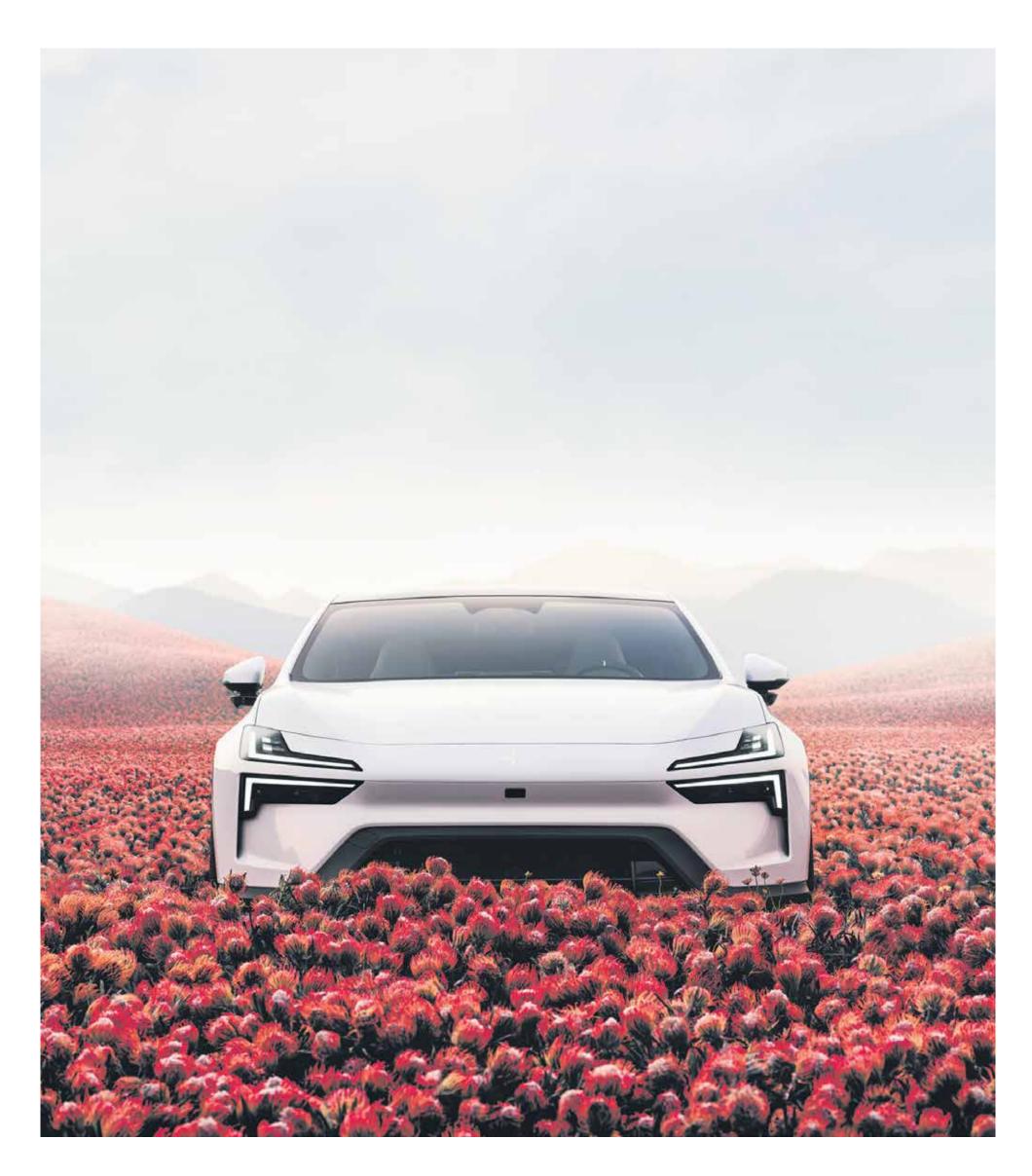
#### **Cadillac Lyriq**

The American luxury brand makes a comeback in Australia with its electric large SUV, the Cadillac Lyriq. Expected to go on sale here by the end of the year, the Lyriq is likely to be the first of several Cadillac models heading our way. Pricing for the large SUV are still to be confirmed.

#### **Mercedes-Benz EQG**

The iconic Mercedes-Benz G-Wagen gets another lease of life by way of the fully-electric EQG that is poised for a late 2024 launch. Expect the same boxy styling the world has loved since 1977 but with a cutting-edge electric platform that allows the big G to perform a 180-degree tank-turn by pivoting on the spot. Pricing is unknown, but it won't be cheap.

# Polestar 4



WLTP: 17.5-20.0 kWh/100 km and  $CO_2: 0 \text{ g/km}$ . Preliminary figures. Subject to final certification.

### The electric SUV coupé