Your rooftop’s solar potential might be limited by high grid voltage, network restrictions or overshadowing. But does it need to be? We consider the issues and solutions.
Our solar stories this issue will help you understand the issues with rooftop solar and high grid voltage, what’s being done about it and how export limits could affect you (p. 38), and show how solar on a roof that’s shaded for part of the year can still work (p. 42).

* This quote may be from an unknown original source, but we found it in a recent e-newsletter from Treehugger, a great round-up of sustainable thinking and news, out of the USA (www.treehugger.com).
Desert Rose
This zero net energy home is also dementia-friendly and designed to stay cool in desert conditions.

What we do now matters more than ever
Lesley Hughes from the Climate Council explains the latest IPCC 1.5°C report.

Z-NET Hepburn
Victoria’s Hepburn Shire is aiming for another first with its zero net emissions transition plan that covers energy, transport and agriculture.

Mythbusting renewables
Mark Diesendorf counters the common myths put forward about renewables.

High grid voltage and solar
How big a problem is voltage rise and how much of it is due to solar—and what can be done about it?
Three-phase SMA inverter

There are not many smaller three-phase solar inverters on the market, but SMA has just added to the available options with their new Sunny Tripower 3.0–6.0.

Aside from three-phase capability, the Tripower is available in four power ratings, with maximum AC output of 3000, 4000, 5000 and 6000 W, with maximum solar array sizes of 6000, 8000, 9000 and 9000 W respectively, to allow for array oversizing.

The Tripower has good connectivity, with wi-fi, ethernet and RS485 connections, and can communicate using Modbus (SMA, Sunspec), Webconnect, SMA Data and TS4-R protocols.

The case has an IP65 rating for outdoor installation and the inverter has a -25°C to +60°C and 100% humidity operating range, making it suitable for use just about anywhere. Weight is just 17 kg, making it suitable for single-person installation.

RRP: POA.

Contact:
SMA Australia
ph: 1800 762 287
info@sma-australia.com.au
www.sma-australia.com.au

Bike stands from plastic bags

While we all need to reduce our single-use plastic consumption, Replas, in conjunction with the REDcycle program, is making good use of this material.

The soft plastic recycled through your local supermarket gets turned into a number of interesting things. One of those is the range of bike racks from Replas.

The racks are designed for use by councils, schools, businesses and even homes that need to provide simple, high-density parking for bikes.

The freestanding racks are available in four-, six- and 10-slot versions, in five colours: black, brown, grey, blue and green.

The racks are virtually zero-maintenance, long-lasting and designed to be easy to install. Plus they are made here in Australia from rubbish that would otherwise end up in landfill, so there’s a lot to like about them. We also expect that the softer plastic is far less likely to do damage to bikes compared to steel racks.

RRP: POA.

Contact:
Replas
ph: 1800 737 527, sales@replas.com.au
www.replas.com.au

Do something kind this Xmas

There are many animal rescue organisations in Australia, and most are self-funded. Helping organisations that help discarded animals of all types can be as simple as buying one of the many cool products they produce to raise funds.

The 365 Days of Kindness calendar from Edgar’s Mission has 14 gorgeous pictures of their beautiful animal residents, along with inspiring quotes to make you think about the stories behind those animals.

The calendar is printed on recycled paper, using vegetable ink, at a solar-powered printing plant—you won’t find many greener paper calendars.

There is also a range of cards, stickers, notebooks, keep cups, water bottles and other eco-friendly, cruelty-free products for true animal lovers to have a browse through.

RRP: $20.

Contact:
Edgar’s Mission
ph: 0408 397 301
www.edgarsmission.org.au
The international Solar Decathlon, a contest for university student teams established by the US Department of Energy in 2000 to encourage innovation in sustainable, renewably powered residential buildings, presents formidable challenges to competing teams. They must not only design but also build and operate a cost-effective net-zero home: one that produces as much energy as it consumes. And this year, they had to do it in the tough conditions of host city Dubai, where temperatures top 35°C every day, humidity is regularly as high as 90% and rainfall is extremely limited.

We reported on the University of Wollongong (UoW) team’s entry in Renew 141 a year ago, when their concept design, aptly named the Desert Rose house, had just been selected as one of the finalists for the Dubai competition. The team designed a compact two-bedroom house within the competition’s strict 90 m² size limit, with a ‘social good’ focus in addition to the net-zero energy goal: they designed a home that caters for the changing needs of occupants as they age, specifically considering design for dementia.

For the past year, the team—over 200 students have been involved—has been hard at work refining their design, researching technical solutions, and building and testing the house.

In October 2018, a 42-strong group headed to the Middle East to construct the house at the Solar Decathlon site and get it ready to compete in the 10 different contests that make up the overall competition.

So what design features and systems did they settle on, and how did the house perform?

Keeping cool
“The biggest challenge was the HVAC: the heating, ventilation and air conditioning system,” explains Brendan Banfield, building services manager for the Desert Rose team. Not only does the competition require the maintenance of strict internal conditions—including temperature between 23°C and 25°C, humidity between 35% and 60%, and a fresh air measure of CO₂ below 800 ppm—but Brendan notes that thermal comfort is extremely important for health and wellbeing: “As the Desert Rose is a dementia-friendly home, maintaining a comfortable and healthy home was one of the key goals from the beginning of the design phase of the project.”

The team used an air-to-water heat pump as the primary source of cooling, coupled with two fan coil units. Technically a type of hydronic cooling, the system involves the heat pump chilling water to around 13°C which then passes through a coil in the fan coil unit. The fan blows air past the coil to cool it, and it’s then supplied to the living spaces. As the humidity in Dubai is surprisingly high, the team carefully considered options for dehumidifying the incoming air to reduce the load on the fan coils, thus requiring less energy. They had planned to design and build their own ‘desiccant wheel’ to act as a continuous humidity exchange system, but the short timeframe made this too much of a stretch and instead the team opted to use a Daikin Desica dehumidifier unit, an Australian first. The Desica contains two batches of silica gel desiccant, one absorbing moisture from incoming air as the other is ‘regenerated’ by being dried by outgoing air.

Of course, the design of the house includes many strategies to reduce heat gain in the first...
Warming of 1.5°C
What we do now matters more than ever

We’re running out of time, and what we do now matters more than ever, was the message delivered by Professor Lesley Hughes when she spoke recently about the IPCC 1.5 report at Renew’s Illawarra branch.

The Intergovernmental Panel on Climate Change (IPCC)’s latest special report, the recently released Global Warming of 1.5°C, makes no bones about what faces life on earth if real change doesn’t become our top priority. “I’ll just tell you right now, the news isn’t very good,” Professor Hughes said at the start of her talk at the Renew Illawarra branch in October.

According to Professor Hughes, as at September 2017, carbon emissions in the atmosphere were at 30% more than pre-industrial levels, which equates to “about a degree of warming over the last century or so.”

The rapidly rising temperatures during the period 1910 to 2016 are illustrated by the red bars in Figure 1. These show the difference between the mean temperature in any one year and the average temperature over the 20th century; red indicates this is greater than zero. The rise in temperature that has occurred, particularly over the last 20 years, is striking. “Since 1977 every single year has been above average,” says Professor Hughes, “and in fact, 17 of the 18 hottest years on record have been in this century.”

Climate change in Australia
The signs of climate change continue to manifest in Australia. “We’ve had double the number of record hot days compared to the 1950s,” says Professor Hughes. “Heatwaves actually kill more people in Australia than any other extreme weather event.” While 173 people died during the Black Saturday bushfires in 2009, twice that number died in the week before due to heat stress, she explains.

The Great Barrier Reef has suffered coral bleaching for two consecutive years in 2016 and 2017. And lest anyone take that as an anomaly, Professor Hughes says attribution studies conducted by the University of Melbourne indicate that the coral bleaching event in 2016 was 175 times more likely to have occurred as a result of anthropogenic climate change.

Professor Hughes noted also that:
• Australia’s bushfire seasons are far longer, hotter and more severe than in the 1970s and bushfire seasons are being declared earlier
• the water cycle is intensifying; in general, areas that are dry are getting drier and areas that are wet are getting wetter
• because the atmosphere is warmer, it is capable of holding more water, which means more extreme rainfall events when we do get rain
• plus there are multiple effects on many ecosystems.

What’s in a degree and a half?
According to Professor Hughes, previous IPCC reports have identified Australia as the developed country most vulnerable to the impacts of climate change. But risks could be substantially reduced if warming is kept to less than 2°C and, preferably, less than 1.5°C. She notes that, globally, we have already warmed by 1°C since pre-industrial times, so an increase to 1.5°C is looming.

Effects of 1.5°C and 2°C rise since pre-industrial times are wide-reaching across many systems, as Figure 2 shows. As Professor Hughes points out, the impacts on warm water corals have been significant, even...
Solar systems pose additional challenges to your local electricity distributor’s voltage balancing act. Excess solar power feeding into the grid is a good thing because it displaces generation by centralised generators, putting downward pressure on electricity prices and reducing emissions. But it is possible to have too much of a good thing if the local electricity network infrastructure cannot properly ‘digest’ solar exports.

We at Renew have had many anecdotal reports of this happening. Some solar households have discovered that their system is not generating as much energy as it should, especially around midday on sunny days. Some households have noticed that at times the voltage of their electricity supply is much higher than the nominal 230 or 240 volts.

We’ve also seen network companies refuse new solar connections because the local area can accept no more solar due to voltage issues.

Renew has been monitoring this issue for several years. Networks have had clear warning of a future problem since at least 2012, when the Australian Energy Market Operator (AEMO) forecast that by the 2030s a majority of suitable roofs might host solar panels. However, planning in this area has been lacking.

Why does voltage vary in my street?
Electricity flows down your street a bit like water down a hose in your garden watering a row of trees via drippers. Your garden tap supplies water into the hose, like your local transformer pushes electricity into the wires. Your transformer is a big grey device, probably up a pole somewhere in your street or around the corner.

The tap supplies water at a high pressure, but as it progresses down the pipe, friction and offtake by drippers progressively reduces this pressure to a low point at the final tree. The electrical equivalent of pressure is voltage, which starts at a relatively high level (e.g. 250V) at the transformer and inevitably drops to a lower level at the final house (e.g. 225V). Your appliances, although nominally rated for a voltage of 230V or so, can tolerate this sort of range.

The natural drop in voltage down the line increases when houses are consuming more electricity, just as the reduction in water pressure would be greater if the drippers were swapped for higher-flow replacements. During an evening heatwave when everyone’s cooking dinner with air conditioners blasting, there’s a risk that voltage at the final house may drop below the minimum allowed value of 216V.

Such low voltages are harsh on some voltage-sensitive appliances and risks wearing them out prematurely. To avoid this occasional issue, your local electricity distributor needs to set the transformer to a relatively high voltage.

However, if the distributor sets the transformer voltage too high, houses close to the transformer may sometimes experience voltages above the maximum allowed 253V, which also risks damaging appliances. Most transformers cannot vary their voltage dynamically—any tweak requires a truck visit and possibly a brief local blackout.

On top of the existing variation in voltage, solar systems pose additional challenges to the distributor’s voltage balancing act.
Solar on a shady roof

For years, Jay Banyer thought his home’s roof was too shaded for solar. But with the help of the latest technology, he’s been able to become a net energy exporter. Jay explains.

Some years ago I was told that our roof was too shaded to get solar. This article explains how, given advances in solar equipment, I analysed the impact of shading and was able to justify going ahead with solar. It also describes the results, one year down the track.

Like many living in the Sutherland Shire, I’m lucky to live in a home surrounded by large gum trees. We love the trees but their shading of the roof posed a question about the feasibility of installing solar. Our house is aligned roughly north–south, with the large roof areas facing east and west. In the middle of winter, the roof is almost fully in shade from a row of trees to the north (plus trees to the east and south), but for six months around summer it is almost fully in sun.

Solar installer says no

About eight years ago I walked into the office of a local solar company and made a casual enquiry. The guy behind the counter entered my address into Nearmap, an online service that provides high-quality, recent satellite imagery to paid subscribers such as solar installers. Using this tool he looked at images of my roof from different times of the year.


When someone who makes their living selling solar refuses to sell you solar because of shading, you tend to listen. So I walked out disappointed, but resigned to the fact that we couldn’t get solar.

Tech options for shaded roofs

Fast forward to 2016 and I started hearing about microinverters and DC optimisers, and how they can help when there’s shading on your solar panels. There was also discussion about the advantages of west-facing arrays (which would suit our roof), as their generation may be skewed to the late afternoon, useful on those scorching summer days when everyone gets home from school or work and cranks up the air conditioner. This timing also coincides with peak electricity tariffs for those on a time-of-use tariff.

We’d also had a tree removed from the southern end of the house. This tree had caused some shading during summer.

So I started thinking: maybe we can get solar. But how do I know if it’s worthwhile?

Environmental motivation

Our household’s main motivation is environmental. Economics are secondary, although still interesting of course. We are primarily interested in how much total energy (measured in kilowatt hours, kWh) a system would produce each year. Every kWh produced by rooftop solar displaces one kWh of predominantly coal-fired energy from our grid, assuming it’s self-consumed or exported to the grid.

If a system on our roof produced a total annual output of, say, 50% of an unshaded array in the same position, is that enough to justify going ahead?

Studies have shown that the energy payback period for solar panels is around one to three years. This means it takes one to three years for a solar panel to generate as much energy as it took to manufacture that panel. A system with output reduced by shading to 50% would take two to six years to repay the energy used to produce it. Since solar panels should last 20 years, it seems to add up environmentally.

So the question became: how do I work out how much the shading will impact the output of a system on my particular roof?
Beat the heat
A cooling buyers guide

There are many ways to survive the summer heat, and even do it comfortably and sustainably. Lance Turner looks at cooling options for your home.

Keeping a home cool can be done through both passive and active methods. Passive methods include things like shading, which prevents heat entering the home, and ventilation, which removes it once it has entered the building envelope. Active methods mostly involve systems such as air conditioning, designed to remove heat once it has entered the house envelope or to cool the occupants even if much of the home remains hot.

As passive cooling generally has no ongoing costs and is often cheaper to setup than an active system, you should always do as much passive cooling as possible to reduce the need for active cooling. Let’s look at passive cooling first.

PASSIVE COOLING OPTIONS
Keeping the heat out can be done in many ways, including shading of walls, roof and windows, painting surfaces to reflect heat instead of absorbing it, insulating the building envelope, including windows, to slow down heat transfer and sealing gaps so hot air can’t leak in.

External shading
Shading can come in many forms, and can be natural shading, such as from plants, or structural shading, such as blinds, pergolas, shade sails or shade walls. It can even be a hybrid of the two, such as a trellis covered in climbing plants.

Using plants for shade has a number of advantages. Firstly, plants are cheap, if you start with seedlings—though it will take a few years until you have a completely green wall or trellis. Plants also produce their own microclimates that help cool their surrounds beyond just shading. They can also provide food: vines such as passionfruits can provide shade, ‘greenness’ and food, all in one.

Trellises and similar structures must be structurally sound and capable of holding the mass of a fully grown green canopy as well as any fruit, plus the wind pressure of rain or snow (if applicable), so either find out how to build a suitably strong structure or hire a professional. Freestanding plants such as trees and large shrubs are another good option, but they can take longer to grow to a good shade-giving size. Some species, such as paulownias are very fast growers and, being deciduous, drop their leaves in winter to let in winter sun. Escallonias, photinias and pittosporums are also useful shade plants, as they can grow to three metres in just a few years and will handle most climates. There are many others: ask at your local nursery for plants suitable for your area or check out ‘Edible Shade’ in Sanctuary 27. Be aware of the potential size of any tree you plant; some can become huge and may need excessive trimming to keep them under control (and prevent them shading your or a neighbour’s solar panels!)

Plants can be used to create microclimates around the home. This can be done using a combination of external shade, leafy shade plants, water features and even water misters. For example, a large area covered with shadecloth, filled with plants with broad leaves, such as monsteras, and combined with a fine misting system, can create a microclimate 10°C cooler than the surrounding areas. I had this system set up in Adelaide, where outdoor temperatures would exceed 45°C. With misters running, the temperature in the shade zone would be far cooler and any breeze brought this cooled air into the home.

Pergolas are another form of shading that can be very effective if done right. Using angled slats on a pergola, you can let in sunlight in winter while creating a large shaded area in summer. Combined with potted plants or other greenery, a complete cooling microclimate can be constructed for a few thousand dollars if you DIY. Pergola kits are available from larger hardware stores. There are also specialist suppliers such as Vergola, who supply adjustable louvre-based pergolas, although the price of these can really start to ramp up.

Other forms of horizontal shading can also be effective in keeping the sun off walls and windows. Most houses in Australia will benefit from eaves on the north side at the very least, but many homes are now built without them. If your home has no eaves, and a pergola seems a little out of the budget, then a shade sail may be the answer.

These are available professionally installed (a must for larger sails, unless you are a very competent DIYer) or in simple kit form. DIY sails are available from hardware stores and can start at under $50 for simple triangular shapes, through to several hundred dollars for larger square sails. Shade sails can be mounted to existing structural points, such as to house or garage walls, or you can fit purpose-made mounts, such as steel posts or tie-down points set in concrete. Note that standard shadecloth sails are not waterproof like canvas: they allow rain to drip through them, so if you need shade and rain shelter, you will need to use a different material.

While smaller sails will not pose much of a wind load, larger sails can place considerable stress on their mounting points in high winds. If you are not sure how to mount your shade sails securely, seek the advice of...
Underground cool

Architect Alvyn Williams describes why and how you might want to take advantage of the more stable temperatures underground to improve passive cooling, heating and ventilation.

Among other research we do at Soft Loud House Architects, each project begins with a detailed analysis of the site’s specific climate. In addition to the usual variables of temperature, humidity, rainfall and wind, we gather data on sub-surface temperatures and their variations over a year to check for opportunities for earth-linked ventilation, heating or cooling.

In our region (southern Victoria), outdoor air temperatures can differ from the thermal comfort zone (typically 18°C to 24°C) by more than 20°C, changing as much in the same day. We have isothermic soils, which can vary between 15°C and 22°C at 500 mm depth, but do not change by more than 6°C annually. Deeper down, temperatures can be more stable year-round (often 17°C to 19°C at two metres depth). By piping fresh air through the ground into a building, we can make use of ground temperatures to pre-heat or pre-cool the air to reduce dependence on active forms of heating and cooling.

Why we look beyond the basics
We use the basic passive design principles of solar orientation, insulation, thermal mass, natural ventilation and glazing performance to improve the energy performance of our buildings.

However, in designing spaces for schools, we noticed that school classrooms did not perform as well. In one build in 2008, we noticed that classroom temperatures remained well within comfort levels with a single teacher and a few occupants, but became less comfortable with 25 students.

In addition, ventilation was only possible by opening the windows, exposing the room to the full brunt of the external climate and making it too hot in summer unless air conditioning was used. Teachers had a difficult choice: let the rooms get too stuffy or open the windows for fresh air and lose the reasonably effective passive thermal benefit of the building.

We started to research different ways that passive heating, cooling and ventilation had been addressed around the world, looking particularly at traditional systems, often from the Islamic world. Some of the methods we have used are discussed below.

 Thermal mass flywheel
The Underground House in Steels Creek is a house we built in response to a catastrophic bushfire. By designing a single-fronted, north-facing, passive solar house, with the other sides buried underground, we aimed to create a home that was both more insulated and more defendable in the event of another fire.

During the energy rating process, the computer modelling programs couldn’t address the unconventional structure and we were required to add insulation between the house and the earth to reduce heat loss into the ground. Instead of adding the insulation at the wall line (which would have been contradictory to passive design principles that recommend linking the house structure with the earth), we added it two metres back into the hillside, creating a massive thermal ‘flywheel’ energy store joined to the structure of the house.

It is still a surprise how effective this design has been, with indoor temperatures typically fluctuating between 22°C and 24°C all year round. When pushed to its limits, for example, when the house is opened up to the external air in hot or cold weather (that ranges from -10°C to 48°C), the house still does not exceed 27°C, nor fall below 19°C, quickly reverting to its stable temperature range once...
DIYs for efficiency
Garage insulation and shutters

Kim Wilkinson describes his projects to reduce heat ingress into the house by improving the performance of the common wall between garage and house, and adding shutters to some windows.

I have a very typical house (for Perth) with a single brick wall separating the house and garage. After getting a thermal imaging device last Christmas, I decided to check out various parts of the house and discovered a significant amount of heat coming through the common wall. I found that more heat was coming in at the front of the house than in the middle, with a hot spot where the solar inverter is located in the garage.

I found that the garage was getting very hot in summer—over 30°C was common—as there is a steel panel roll-up door facing east. This heat was gradually making its way through the single brick wall which separated it from the entry and living space. I found out that the manufacturer now supplies insulated roller doors, but is not able to assist with retrofitting, so I tried a number of steps to 'tame' the garage.

Painting the external face of the roll-up door with insulating paint reduced the temperature between the outside and inside of the door by 10°C.

Installing XPS (extruded polystyrene) board (rated at R1) into the back of the door was the next step. This involved removing the four horizontal bars (one at a time) and carefully measuring each gap so that the board would be a tight fit. I even tried putting a few other materials (like cork) into the space, but this did not make a significant difference, so I used the XPS board for the vast majority of the door.

I placed some spare XPS at the top of the door (inside) to stop the hot air on the outside of the door coming in, which also produced a major improvement in heat reduction.

After insulating the garage door as well as I could, it was time to tackle the common wall.

**Insulating the wall**

Based on some advice from Renew’s Lance Turner, I decided to convert the single-leaf common wall between the house and garage into a reverse-brick veneer wall. To minimise the increase in thickness of the wall, I selected a polystyrene board which is 30 mm thick and has an R-value of 1.

Construction started with putting up 50 mm x 30 mm dressed treated pine studs at 600 mm centres and trimming the boards to fit tightly between the studs. As it was not possible to completely remove the solar inverter, I put some 7 mm thick cork behind as much of it as possible.

I then attached sheets of 7 mm thick fibre-cement board to the timbers to cover up everything, and painted the board.

Thermal images before and after revealed a significant reduction in temperature and a far more uniform temperature along the length...
DIY: Visible mending

Visible mending is easy, fun, gorgeous and keeps old clothes from landfill, writes Kasia Zygmuntowicz.

I’m not a professional seamstress, tailor or textile artist, but I’ve always been a bit crafty. I like picking up skills, taking a course now and again, but I’m a magpie about it—a bit of this, a go at that, never really settling or perfecting, going for the next shiny thing. Unfinished projects are stacked high in my back room ...

One thing that has stuck with me, however, is my love of saving and reusing, re-purposing and re-making things. This all came from my super-creative parents who taught me to use what’s at hand and to think laterally; to see a matchbox as a handy drawer for a doll’s dressing table or that if you cut a slit in an old blanket you get a poncho, or a very swishy skirt or a tent!

All this came in handy when my son was a toddler. Not only could I build a mean box cubby and cool dress ups, but I had also amassed some skills that helped me in a more pragmatic way.

Kids grow out of their clothes really quickly, but not before they manage to wear holes in the knees of their trousers. So I patched them. My way. I crocheted a circle and stitched it over the hole in the knee, and then patched behind it with an old sock that had lost its partner. Patches were often re-darned and re-stitched over and over in patterns and different colour threads. Ever so soft and easy on the knees.

That was it really; that’s how I started on the visible mending journey.

Visible mending can also be camouflage. Kids are messy and sometimes stains just won’t wash out. So I started covering stains with patches to match the t-shirt image; maybe a cloud drifting past Snoopy’s World War I flying ace on his Sopwith Camel Kennel. T-shirt saved, child happy, no textile waste (you can’t op shop a stained piece of clothing).

I darn and patch and embellish my family’s clothes, including my own, mostly because it’s fun, but also to slow the garments’ descent to the giant textile waste heap.

Clothes can be saved, re-interpreted into a new garment. Keep that comfy familiar well-loved cardigan and give it a new character. A frayed collar can be crocheted over, buttons replaced and holes darned or felted with funny little patches. Now you have a less familiar cardigan and a story to share.

Visible mending has been around for a long time, and it’s a broad church. It can include everything from my colourful crazy patching to the Japanese tradition of Boro mending. It can be fun and cheeky, drawing attention to a hole rather than covering it up. And it can be thoughtfully designed and meticulously executed like the works of Tom of Holland or Erin Lewis-Fitzgerald.

An internet search on ‘visible mending’ will lead you to some exquisite examples and tutorials on how to start from scratch. If you aren’t into online tutorials and prefer a one-to-one hands-on style of learning, find your local Repair Cafe. All sorts of repairs are going on there—by the community, for the community, for free! Most Repair Cafes do sewing repairs and some do visible mending too.

I find the best way to try something new is just to start. Find an old pair of jeans you love, that are a bit far gone for anything but gardening and bummimg around the house. Do they need a patch?

Gather your materials:

- Find an odd sock to use as a patch. Cotton or easy-care machine washable wool is best—100% pure wool will shrink in the wash and pucker-up your patch.
- No sock? Any fabric will do for your first experimental patch—it’s a learning adventure!
- Find another piece of fabric for the outside patch if you want to ‘sandwich’ the hole and make a thick patch.
- Thread—general sewing cotton to sew on the patch and maybe a heavier embroidery cotton to embellish and bring your patch to life.
- Sewing needles—small eye for general cotton thread, larger eye for thicker embroidery cotton.
- Pins to keep the fabric in place while you’re sewing.
- Or forget all that and get some fusible adhesive webbing stuff and iron the whole lot together. Quick, but not as much fun. And it may eventually need stitching to keep it from de-laminating.
Electrification of the trucking fleet: not far off, and likely to happen fast

Will Tesla have the electric trucking field to itself or are there competitors in the wings?
Bryce Gaton investigates.

When Tesla first released its electric Roadster in 2008, it took competitors until late 2010 to even begin to respond—and it could be argued that it's only this year, in 2018, with the release of the electric Jaguar I-Pace, that a true competitor to the Tesla range has arrived. When it comes to trucking, though, is it a different story? First up, let’s look at what we really know about the Tesla ‘Semi’.

**Tesla Semi: known details**
The electric Tesla Semi is undoubtedly a game changer for trucking. First announced in November 2017 with an estimated production start in 2019, the Semi is planned to have a range of 800 km, with a Tesla Megacharger giving 640 km of charge in 30 minutes. The Megacharger design is not yet finalised but is expected to be in the 1 MW or greater class. The Semi can also use on-site 150 kW charging, taking six to eight hours. Currently, the test Semis are charged using multiple Superchargers at the larger Supercharger stations (each Supercharger charges at 120 kW).

Acceleration from 0 to 96 km/h is just five seconds for an unloaded Semi and an amazing 20 seconds fully loaded to 36 tonnes GVM (gross vehicle mass), representative of a typical truck weight. A typical diesel truck can take more than a minute to reach this speed fully loaded. The Semi can also climb a 5% grade at full highway speed, something a diesel semi couldn’t hope to do. The Semi will have a 1.6 million km warranty; existing trucks have widely varying warranties, but are often limited to three years with either a set distance or unlimited kilometres. You can only do so many kilometres a year—to do 1.6 million km in three years would mean 1460 km a day, clearly impossible.

Additional features include a central driving position for best visibility, an anti-jack-knifing program using the multiple individual wheel motors, and a ‘platooning’ feature that enables Tesla Semis to slipstream each other in a driving train, which reduces energy use of the entire train. By alternating which truck takes the lead, range can be extended.

We all know that while Tesla is famous for delivering what it says it will, it is also well known for missing its deadlines. So perhaps it will be 2020 or 2021 before we see Tesla Semis in any numbers. Given that, what are Tesla’s competitors planning?

**The rivals**
The closest reported rival is the Daimler eCascadia. This will be a more conventional-looking truck with a range up to 400 km and a 90-minute-to-80% recharge time using the 350 kW ultrafast chargers currently being rolled out in Europe and America. Expected production date is 2021, after the estimated Tesla production date. But the 350 kW chargers for the eCascadia will be in place, unlike the Tesla Megacharger network which has yet to be defined, let alone built.

Other truck manufacturers are not far behind with planned models. These include:
- Mercedes eActros, currently in trials. It is...
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