Energy Saving, Thermal Comfort and Solar Power Information Sheet

We've prepared this information sheet to help you to minimise energy consumption and energy costs while maximising thermal comfort at home. It also provides background information on solar power, batteries, LED lighting and solar hot water.

Contact details and information about Efficient Initiatives are at the end of this document.

Overview

The way to save money on energy is firstly to minimise your energy consumption and secondly to install a solar Photo Voltaic (PV) system which roughly matches the remainder of your electricity consumption pattern. A heat pump hot water system can also dramatically reduce your energy needs. Our typical recommendations are:

1. DESIGN, INSULATE: orientation for light and winter heat from the sun, thermal mass to hold the heat, double glazing to keep in winter's heat and keep out summer heat and noise, great insulation in roof, walls and floor.
2. LIGHTING: LED lighting to keep electricity costs down and eliminate halogen downlights which generate lots of wasted heat – and prevent good insulation practices.
3. SOLAR PV: A small, correctly oriented solar PV system designed to match your (low!) energy consumption. A 3kW system will match a reasonably energy efficient home, making it close to electricity neutral across the year. If you are installing a PV system now, be battery ready.
4. SOLAR HOT WATER: A heat pump system with solar PV providing the energy is our recommended option in the Melbourne region.

Energy Consumers in the Home – what to watch out for

Your energy consumption – in rough order of cost and usage – will be from:

- Swimming pool pumps – for filtration and for solar water heating. Could use up to 12kWh/day.
- Cooling. Air conditioning is energy intensive (and electricity expensive!). Evaporative cooling is cheaper to run, and great insulation combined with a good house design is free to run! Could use 8-10kWh/day in summer … but if matched with a PV system this may not be a problem.
- Heating. Most houses have gas heating – electric heaters are very expensive to run. Great insulation with a good house design is free to run. Electric heating could use up to 10kWh/day or more in winter. While we've traditionally favoured gas heating, gas is becoming much more expensive now – and reverse cycle air conditioners/ heat pumps are very efficient heaters – particularly if they can be run during the day and "store" heat in the home.
- Hot tub heaters. That Jacuzzi is really expensive to heat. It's all electric… Could use 10kWh just to heat it up.

- Hot water. The cheapest hot water system to run is a good heat pump system with PV panels providing most of the energy. Alternatively, an evacuated tube solar hot water system with gas boost.
- Appliances. Fridges/ freezers, Dishwasher, Washing machine. These should all be 4-5 star, and dishwashers/ washing machines should have timers on them so you can run them when power is cheapest – ideally solar power, see below. A modern dishwasher will use around 1.4kWh for each use, a fridge could use 2-4kWh/day depending on age and a modern washing machine will use about 0.5-1kWh per use.
- Cooktop, kettle and oven. Because these are used intermittently, they are not generally huge energy consumers. Install an induction cooktop – very low energy use and helps to eliminate your gas connection.
- Lighting. If all your lighting is LED, then lighting won't be a large part of your electricity bill. But if you have halogen "low voltage" downlights – watch out! These get VERY hot and use a lot of energy. Lighting should use less than 1-2kWh per day for your house.
- Computers and entertainment systems. LCD display units are not too bad in electricity consumption. Plasma screens are considerably higher. Computers and entertainment will use 1-4kWh per day but you should aim for less!
- Standby power for computers and entertainment systems. Standby power is important to consider. Embertec and similar standby power controllers are available for very low cost (often provided for nothing) but, at the end of the day, standby power is not usually a huge part of your energy bill, perhaps around 0.2 to 0.5kWh/day, and standby controllers often cause more problems than they eliminate.

Design to Minimise Energy Use

Heating and Cooling: The single most important thing you can do to minimise energy consumption, and to make your house comfortable, is to have the house designed to trap heat in winter and to reflect and lose heat during summer. Great insulation, double glazing, orientation to allow solar radiation in during the cooler months but not during the hot times of the year, and thermal mass to capture that solar radiation and release it slowly are the keys to success. A *really* well designed home in Melbourne will not need any cooling and will only need heating during the depths of winter.

Hot water: Efficient showerheads and using cold water in your washing machine are the two easiest means of minimising hot water consumption. Watch out! A low flow showerhead combined with an "instant" hot water system might be a disaster: the flow may not be sufficient to start the hot water…

Lighting: After first making the best use of natural light, a combination of LED lights and some fluorescent lights is ideal – leaning more and more to all LED. Don't install any "low voltage" halogen downlights, these are expensive to operate and generate lots of heat, which means that they cannot have decent insulation packed around them (fire risk).

Embodied Energy: Consider the energy that is “embodied” in the materials and items that you build with and install in or on your home. Bricks are generally VERY high embodied energy items: huge – usually fossil fuelled – energy to create, heavy to transport and heavy to install. Lightweight building materials such as Hebel blocks are much lower in embodied energy. Solar PV panels were once problematic in this sense – but today, solar PV panels produce *more* electrical energy in their first year of operation than is used to make them and to transport them to your home.

About Solar Photovoltaic Systems

A solar photovoltaic (PV) system generates electricity from the action of the sun on a solar panel. There are no moving parts. Solar radiation generates a DC current, which is converted to 240V AC in an Inverter. A solar PV system consists of panels on the roof, cabling, the inverter or inverters, and switches to enable you to safely isolate the system. Comprehensive Australian and International Standards ensure that solar PV systems are safe and reliable – most of the parts should last more than 25 years.

A solar PV system is not cheap – so it’s always best to reduce your energy consumption before working out how much electricity you want to generate.

Solar panels typically need to face north – so that they face towards the winter sun. Increasingly, we’re also facing some panels towards the west so that maximum power is generated later in the day – to match home energy consumption which peaks in the late afternoon/ early evening. Panels should also be angled at 20-30˚ to the horizontal so that they “self clean” - so that you don’t need to get on the roof to clean dust and dirt off.

Shading is a killer for solar panel systems. Even a little bit of shade from an aerial or a chimney can have a dramatic effect on output.

For some homes and rooves, we specify “micro inverters”. These sit under the solar panels (on the roof) so that the output from the roof is AC, not DC. They are a little more expensive than the traditional centralised inverter, but they have some good advantages if there is shading of parts of your roof, or if the roof has lots of bits facing different directions. They are also very easy to monitor over the web. Alternatively we may specify “optimisers” which perform a similar task – reducing the impact of shading and allowing panels to face in different directions.

Having a solar PV system means you still stay connected to the grid. You use much less power during the daytime – because the solar power reduces or eliminates your daytime consumption. You still need the grid at night time and when it's cloudy.

Some rough rules of thumb:

- In Melbourne, each 1kW of solar panels will produce approximately 1300kWh per year. So a 3kW system will produce nearly 4,000kWh per year.
- A typical family of 4 or 5 will consume 10 to 20kWh electricity per day. If the home is really energy efficient, then less than 10kWh is possible. 11kWh per day is roughly 4,000kWh per year.
- On a nicely sloped roof, facing north, each 1kW of panels takes 7m^2 of space, so a 3kW system would take 20m^2. On a flat roof, each 1kW on tilt frames takes around 15m^2 of space (after allowing for space between rows to prevent self shading), so a 3kW system would take 45m^2.
- The 3kW system, if facing north, will produce on average 5kWh per day in the middle of winter, and 15kWh per day in the middle of summer.

Solar panels on tilt frames to face north at 30˚, Inverter to convert DC electricity to AC

So what will a solar PV system save me in electricity costs?

Solar power will reduce the amount of power you buy from the grid. Power from the grid, during the daytime on weekdays, costs around 35c per kWh. On weekends and at night, it costs around 15c/kWh. These rates assume that you are on a variable tariff. If you're on a fixed rate tariff you're probably paying around 26c/kWh.

Assuming that you can adjust your energy consumption to occur during the daytime – when the PV system produces its output – and assuming that 90% of the production of the system is used to reduce your energy consumption (with the other 10% being sold to the grid for 6c/kWh) then a 3kW PV system *could* save you about:

- 90% x 4000kWh/ year x 5 days/7 x $0.35 +
- 90% x 4000kWh/year x 2 days/ 7 x $0.15 +
- 10% x 4000kWh/year x $0.06 = $1096/year.

The above calculation might not fit you. If you are already a very careful energy user, or if most of your power consumption occurs when the sun is not shining, then a 3kW system will probably end up exporting significantly more of its production into the grid for 6c/kWh.

What will a solar PV system cost?

A good quality, well installed PV system will cost – very roughly - $1,500 per kW installed (cost as at Q1 2015). This cost is after the sale of "Renewable Energy Certificates" (also known as STCs or Small Scale Technology Certificates). This means that for the 3kW system above, it'll cost around $4,500 and pay back in around 6 years at today's power prices. HOWEVER electricity pricing structures WILL change so the payback will vary.

What about Battery Systems?

Batteries are the "next big thing" in energy. Batteries enable you to store some of the energy produced by the PV system during the day, and use it during the evening/ at night. All the technology for a battery system exists – the problem at present is that the batteries and associated controllers are still (relatively) expensive so that they typically take more than 10 years to pay themselves off – at least in Melbourne. Additionally, the batteries may need to be replaced after around 10 years. We recommend that you design for and leave space for a future battery system – but wait another couple of years before installing. Costs have started to drop dramatically.

About Solar Hot Water Systems

There are 3 main sorts of "solar" hot water systems:

- Evacuated tube system which captures the sun's heat using a copper pipe inside a tube, then transfers that heat directly to water pumped through a "header" pipe. Good frost resistance and very efficient. The hot water is usually stored in an insulated tank on the ground floor of your house.

- "Flat panel" system which captures the sun's heat directly into the water which is piped around the panel. The hot water is usually stored in an insulated tank on the ground floor of your house. Flat panel systems are usually a bit less expensive than evacuated tubes, but are not quite so frost resistant or as efficient in capturing the sun's heat.

- Heat pump system which extracts heat from the air (not the sun directly), so that it can heat water 24 hours a day. It operates like a reverse cycle air conditioner. Good quality heat pumps are almost as efficient as solar boosted systems, and are generally

less expensive to install – plus the electricity they do use can mostly be supplied from a PV system making them almost “free” to run.

Both Evacuated tube and flat panel systems require a “boost” system to bring the water temperature up to the required level during winter. Typically this is an instantaneous gas fired booster.

A good heat pump or solar hot water system will save a family several hundred dollars per year in gas for hot water – and if replacing an electric hot water system the savings are even higher.

About LED Lighting

LED (Light Emitting Diode) lighting is generally the best technology for lighting today. The technology has been around for the past 60 years, but its only in the last two years that costs have come down and quality has come up to the point that LED lights are really worthwhile. LED lights:

- Come on instantly (whereas fluorescent tubes and compact fluorescents take a reasonable time to warm up)
- Typically last 50,000 operating hours, compared with 10,000 hours for compact fluorescents and 1,200 hours for older style incandescent bulbs
- Can cope with lots of “on/ off” cycles – so a great option for an automatically operated light such as motion or light sensed operation
- Don’t contain any nasties such as mercury which is used in compact fluorescents
- Are still slightly more expensive upfront than other lighting types BUT if installed during a new build or renovation, the overall lighting fixture costs are comparable with other types of lights.

Features	LED	CFL	Incandescent	Halogen
Light Bulb Comparison				
Rated Avg. Life	50,000	10,000	750-1000	3,000
Life Span	Vastly Longer	Long	Low	Medium
Watts	6-18	3-120	3-500	5-500
Cost to Operate	Lowest	Low	High	Medium
Energy Consumption	Lowest	Low	Medium	Medium
Lumens per Watt	45-75	60	15	25

About Efficient Initiatives

Efficient Initiatives (EI) is a specialist energy efficiency designer and project manager. EI works with businesses and homes to help them dramatically reduce energy consumption while improving building comfort. EI takes a sustainable and holistic approach to energy: reducing energy consumption and improving building comfort levels while generating renewable solar energy to enable a dramatic reduction in purchased energy. We work with selected partner companies to achieve a significant dollar and carbon saving for our customers.

Our **Core Competencies** include:

Solar Power Station design, permitting and approvals: high level and detailed design.

Energy efficiency consulting: inspections, audits.

Energy efficiency implementations: project management, procurement and delivery.

Renewable energy consulting

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