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Secretary
Senate Select Committee on Climate Policy
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Climate change is a serious issue. In this submission, I address the following terms of reference:

(a) the choice of emissions trading as the central policy to reduce Australia's carbon pollution, taking into account the need to:

> *(i) reduce carbon pollution at the lowest economic cost,*
> *(ii) put in place long-term incentives for investment in clean energy and low-emission technology, and*

(b) the relative contributions to overall emission reduction targets from complementary measures such as renewable energy feed-in laws, energy efficiency and the protection or development of terrestrial carbon stores such as native forests and soils;

Solar Energy

The development of solar energy R&D, manufacturing and deployment in Australia requires far larger and longer term commitment from Government than current programs provide.

Solar energy is special. It is vast, ubiquitous and indefinitely sustainable.

The solar resource utilised by photovoltaics and solar heat is hundreds of times larger than all other energy resources combined, including fossil, nuclear fission and geothermal:

- It is indefinitely sustainable;
- It utilises only very common materials;
- It uses a resource that is far larger than required to provide all of the world's energy;
- It has minimal security and military risks;
- It is available nearly everywhere in vast quantities; and
- It has minimal environmental impact over unlimited time scales.

No other energy source can make claims that come anywhere near these. Solar energy is a complete long term sustainable solution. Australia receives 30,000 times more solar energy each year than all fossil fuel use combined. Australia has a significant presence in the worldwide solar energy industry, which can be built upon to create a major export-oriented technology-rich industry. More information is appended ("Solar Energy").

The Australian renewable energy industry has been acknowledged by Government to be in a poor state after a decade of neglect. The new $150 million Energy Innovation Fund (EIF) includes the $100 million Australian Solar Institute. It is a good start, but will prove inadequate to meet the need to both rebuild research in Universities & CSIRO, and to assist companies through the tech transfer, development and commercialisation phase. It expires in June 2012, which time frame is far too short to facilitate dramatic improvements in Australia's ability to competitively innovate in renewable energy.

The new $450 million Renewable Energy Development Program will only assist large scale demonstration (minimum $60 million project size). a primary need of our industry right now is further upstream from large-scale demonstration; namely tech transfer, development and commercialisation.

There are novel technologies emerging from ANU, UNSW and other research institutes. There are fledgling companies with interesting products that need tech transfer development and commercialisation support. Demonstration support, while welcome, is not the only or even the most important assistance they need.

There is little encouragement for local manufacturing of renewable energy products. Neither the EIF nor the REDP helps companies establish factories. In contrast, our foreign competitors receive substantial assistance.

The 20% renewable energy target by 2020 is to be commended. However, long term market pull is required to create a fully sustainable renewable energy industry

I recommend as follows:

- That the Energy Innovation Fund be increased to $1 billion over 7 years. EIF (and ASI) should focus on research and technology transfer. EIF has insufficient funds to support all stages prior to demonstration (research, development, tech transfer, commercialisation, factory development). Assistance to companies should come from other sources, with EIF being reserved primarily for public sector research.
- That a new fund, the renewable energy commercialisation fund (RECF), be established in the funding gap between EIF and REDB, aimed at assisting commercialisation and manufacturing of new Australian renewable energy technologies, with funding of $2 billion over 7 years
- That REDP be extended to 7 years with $2 billion in funding
- Extension of the renewable energy target to 40% by 2030

Energy efficiency in the building sector

One of the easiest and quickest ways to make rapid reductions in ghg emissions is to rapidly tighten minimum energy performance standards. In this submission I deal specifically with the building sector.

Mass retrofitting of buildings is the way in which rapid reductions in greenhouse gas emissions can be achieved in the building sector. This is because the turnover of building stock (demolition followed by new construction) is low. Even if all new buildings have excellent energy ratings, there is only a slow reduction in average greenhouse intensity.

Every building in Australia should be solarized (by retrofitting) to a high standard. Good wall, floor, ceiling and window insulation, good draught proofing and sunshades should be installed in every building. Tight minimum performance standards for all energy appliances should be mandatory. Electric water heaters should fail these standards. Solar water heaters with gas backup should be the norm.

An example of solarisation of a home (my home) to reduce ghg emissions by two thirds is appended (Deep cuts in household greenhouse gas emissions from home). The measures described scarcely impact on lifestyles. It is straightforward to reduce average ghg emissions to below 5 tonnes per annum. It is easy to demonstrate that such measures pay for themselves quickly. In other words, ***halving ghg emissions from buildings is an economic benefit, not cost.***

An effective way of achieving mass retrofitting of energy efficient measures is appended (Solarization). *Federal Government subsidies for solar water heaters and roof insulation reduce the cost of thorough solarisation to around $5,000.* Solarizing 5,000,000 homes over a decade would halve emissions from homes by 2020, and generate about 25,000 jobs. Similar gains are possible in the commercial sector.

A 3kW solar panel will neutralise 5 tonnes per annum of ghg emissions (by feeding excess zero-carbon power back into the grid). An additional 1kW panel will neutralise the ghg emissions from an efficient car. The feed-in tariff legislation should be managed to ensure carbon neutrality for Australia's housing stock by 2020. People wishing to install air conditioners should be required to install the equivalent rating of photovoltaic panels or green power.

A greater level of Government commitment than hitherto displayed is required to achieve deep cuts. Political rather than financial commitment is the principal requirement, by way of legislation and facilitation. The Government's role should be to set targets, amend legislation to remove impediments, provide seed funding, promote concepts, and facilitate the development of appropriate retrofitting consortia.

SOLAR ENERGY

Summary

Solar energy is special. It is vast, ubiquitous and indefinitely sustainable.

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Energy supply options

There are five potentially available energy sources. These are energy from the sun (in its various forms), nuclear energy (fission and fusion), fossil energy (coal, oil and gas), tidal energy and geothermal energy.

Solar energy is available on a massive scale. Collection and conversion methods usually entail few environmental problems. Solar energy includes both direct radiation (photovoltaics and solar heat) and indirect forms such as biomass, wind, hydro, ocean thermal and waves. The direct solar energy resource is far larger than the indirect solar energy resource.

Nuclear energy from fission has substantial problems relating to nuclear weapons proliferation, nuclear terrorism, uranium and thorium deposit limitations, and waste disposal. Nuclear fusion is still several decades away from commercial utilisation, but may make a major contribution to sustainable energy supply in the future.

Fossil fuels are the principal cause of the enhanced greenhouse effect and are subject to resource depletion. Other problems include oil spills, oil-related warfare (for example, the Gulf wars) and pollution from acid rain, particulates and photochemical smog.

Tidal energy can be collected using what amounts to a coastal hydroelectric system. Geothermal energy in volcanic regions or from hot dry rocks can be used to generate steam for district heating or to drive a steam turbine to produce electricity. Tidal and geothermal energy are restricted to a few geographic localities.

Photovoltaics

Photovoltaics (PV) is an elegant technology for the direct production of electricity from sunlight. Most of the world PV market is serviced by crystalline silicon solar cells. Sunlight causes electrons to become detached from their host silicon atoms. Near the upper surface is a "one way membrane" called a pn-junction. When an electron crosses this junction it cannot easily return, causing a negative voltage to appear on the sunward surface (and a positive voltage on the rear surface). The sunward and rear surfaces can be connected together via an external circuit containing a battery or a load in order to extract current, voltage and power from the solar cell.

PV has widespread use in niche markets such as consumer electronics, remote area power supplies and satellites. Now, as costs decline, millions of PV systems have been installed on house roofs in cities. The worldwide PV industry is doubling every 20 months. Production is currently 8 gigawatts per year. Mass production is causing rapid reductions in cost. A solar revolution is brewing.

Most PV systems are mounted on fixed support structures. Some PV systems are mounted on sun-tracking systems to maximise output. Others use sun-tracking concentrators to concentrator light by 10-1000 times onto a small number of highly efficient solar cells.

PV systems mounted on house roofs can be used to achieve household carbon neutrality. A collector area of about 25m^2 is needed to carbon-neutralise a 5 star (energy rating) house with gas space heating, solar/gas water heating and efficient electrical appliances. Such a house exports more electricity to the grid during the day than it imports at night. An additional 10m^2 of PV panel is required to offset the annual greenhouse gas emissions of an efficient car.

Hybrid PV/thermal micro concentrator systems on building roofs are being developed to provide solar PV electricity, solar water heating, solar air heating, and solar air conditioning – a complete building energy solution.

PV panels on building roofs compete with retail electricity prices, which are three times higher than wholesale electricity prices. When the cost of rooftop PV generation falls below the daytime retail electricity price ("grid parity") then the PV industry will enjoy explosive growth as hundreds of millions of home owners adopt the technology. Grid parity is expected to be achieved in many countries within a few years, due to falling PV costs, rising fossil fuel costs, the introduction of carbon pricing and the introduction of time-of-use tariffs. Time-of-use tariffs properly reward PV systems for generating during sunny summer afternoons when peak loads caused by air conditioning, commerce and industry lead to high energy prices.

The efficiency of PV is eventually likely to rise above 60%, compared with the current world record efficiency of 42%. The cost of PV systems can be confidently expected to continue to decline for decades – as has happened with the related integrated circuit industry.

Solar thermal

Good building design, which allows the use of natural solar heat and light, together with good insulation, minimises the requirement for space heating. Solar water heaters are directly competitive with electricity or gas in most parts of the world. Solar air heaters will allow a large reduction in the heating load in many parts of the world, while solar driven air conditioning is a rapidly developing industry.

Solar thermal electricity technologies use sun-tracking mirrors to concentrate sunlight onto a receiver. The resulting heat is ultimately used to generate steam, which passes through a turbine to produce electricity. Concentrator methods are equally applicable to concentrating PV systems. The usual ways of concentrating sunlight are point focus concentrators (dishes), line focus concentrators (troughs, both reflective and refractive) and central receivers (heliostats and power towers).

There is a large crossover between the technology of solar thermal and PV solar concentrators. The concentrating systems are quite similar, with the major technical difference being the solar receiver mounted at the focus: a black solar absorber in one case, and a PV array in the other. Since current efficiencies are similar, then the cost of energy produced by the two types of system is also similar.

An important future application of concentrated sunlight is the generation of thermochemicals and in the storage of heat at high temperature to allow for 24 hour power production. Concentrated solar energy can achieve the same temperatures as fossil and nuclear fuels, either directly (using mirrors) or through the use of chemicals (thermochemicals or bio fuels) created using concentrated solar energy. In the past, heavy industry (e.g. the steel industry) was often located near coalfields, in regions that are relatively poorly endowed with solar energy. Future steel mill could be built in the iron ore and solar energy rich Pilbara region of Western Australia.

Energy efficiency

Hand in hand with the utilisation of solar energy goes energy efficiency. 'Solar energy' and 'energy efficiency' are often the same thing. For example, an energy-efficient building is a building that utilises natural solar light and heat sensibly. Walking rather than driving uses a small amount of solar energy (food) rather than a larger amount of oil energy. A clothesline, solar salt production and putting on extra clothing displaces an electric clothes dryer, fossil-fuel fired kiln drying of salt and electric heating respectively.

Baseload power and storage

It is sometimes claimed, wrongly, that the fact that the absence of sunshine at night means that solar energy cannot dominate energy production.

Options for the provision of stable and continuous solar power include actively shifting loads from night to daytime; wide geographical dispersion of solar systems to minimise the effect of cloud; precisely predicting solar energy output using satellite imagery; diversification of energy supply to include all renewables; the judicious use of small amounts of natural gas; and energy storage. A future large-scale day-night storage option is the batteries of million of electric cars.

Pumped hydro (whereby water is pumped uphill during the day and released through turbines at night to provide energy) is an efficient, economical and commercially available storage option. Lakes covering only 50 km^2 (about 2 m^2 per citizen) utilising either fresh water or seawater, would be sufficient to provide 24 hour storage of Australia’s entire electricity production. In the longer term, intercontinental high voltage DC transmission will further reduce the need for storage.

Environmental impacts

The solar energy industry has minimal environmental impact. About 0.1% of the world’s land area would be required to supply all of the world’s electricity requirements from solar energy. Indeed, the area of roof is sufficient to provide all of Australia’s electricity, using PV panels.

We can never run out of the raw materials for solar energy systems because the principal elements required (silicon, oxygen, hydrogen, carbon, sodium, potassium, calcium, aluminium and iron) are among the most abundant on earth. Old solar energy systems can be recycled without the generation of toxic by-products. Gram for gram, advanced silicon solar cells produce the same amount of electricity over their lifetime as nuclear fuel rods. Per tonne of mined material, solar energy systems have 100-fold better lifetime energy yield than either nuclear or fossil energy systems.

The time required to displace CO_2 equivalent to that invested in construction of a solar energy system is in the range 1-3 years, compared with typical system lifetimes of 30 years. CO_2 payback and price are directly linked (via material consumption), so CO_2 payback times will continue to fall, and will eventually decline to below 1 year.

The future of solar energy

Renewable energy technologies can eliminate fossil fuels.

Roof-mounted solar energy systems can provide photovoltaic electricity, hot water for domestic and industrial use, and thermal energy to heat and cool buildings.

Highly efficient solar cells manufactured from highly engineered materials, and placed at the focus of solar concentrators, can provide much of the world's electricity. High concentration solar thermal can provide electricity, process heat and thermochemicals.

Solar electricity, coupled with a shift to electrically powered cars and public transport, can provide most of the world's transport energy.

Geographical dispersion of solar energy collectors, contributions from many different renewable energy technologies, storage via pumped hydro and other means, and high voltage DC intercontinental transmission, will allow a fully sustainable, zero-carbon future within a few decades.

Grid parity for photovoltaics is likely to be achieved in many countries within 5 years. Direct competitiveness with fossil fuels for wholesale energy supply awaits the implementation of full carbon pricing and the removal of all hidden support for fossil fuels.

Solar energy in Australia

The solar power industry in Australia is constrained by lack of carbon pricing, lack of a time-of-use tariff, and a wide range of built-in (and often hidden) support measures for fossil fuels.

Photovoltaics is an area of real Australian research and commercialisation strength. Photovoltaics is a strong innovation performer, in terms of performance metrics such as research papers, competitive grants and commercialisations. Between them, the solar research groups at the Australian National University and the University of NSW have eight PV commercialisations, including the buried contact, crystalline silicon on glass and SLIVER solar cell designs. Other research groups are also building strength. The solar research groups at the Australian National University, the University of NSW and CSIRO are the core participants in the new $100 million Australian Solar Institute.

The Government has announced a substantial target for the amount of renewable energy to be incorporated into the grid by 2020. Carbon pricing is to be introduced from 2010. These measures have the potential to drive substantial investment in renewable energy. However, the scale of the climate change problem is so large and immediate that further measures will be required to drive very rapid transformation of Australia's energy system to a low carbon future.

It is important for Australia to have a balanced energy portfolio. Greatly increased support is needed for solar energy R&D, commercialisation, manufacturing and market incentives. Solar energy is likely to be a $100 billion per year industry by 2012. Australian Government policy will need to be carefully crafted if Australia is to be a significant player in this vast new industry.

Support for solar energy in Australia should be focused on intellectual property (IP) generation and the export of IP-rich high-value products and services. This strategy would comprise substantial support for R&D, and professional education, coupled with strong incentives for companies to manufacture high value products in Australia for export.

Further reading

Centre for Sustainable Energy Systems, Australian National University, http://solar.anu.edu.au

School of Photovoltaic Engineering, University of NSW, http://www.pv.unsw.edu.au

Deep cuts in household greenhouse gas emissions from home

Would you like to contribute in a practical way to reductions in greenhouse gas emissions? Perhaps you are tempted to buy green power, or a photovoltaic panel. Before you do this, however, there are a range of measure that you can adopt that will reduce greenhouse gas emissions from your home by two thirds - 10 tonnes of carbon dioxide equivalent per year - at modest cost. Even if you don't live in a modern solar efficient home, you can radically reduce your greenhouse gas emissions.

Many of the measures described below cost little or nothing to implement, but can make major reductions in CO_2 emissions. Before we start, I'd like to provide some background information. The unit of electrical power is watts (W). If I use an electric light bulb with a power of 100 W for 10 hours then 1,000 watt-hours, or 1 kilowatt hour (kWh) of energy will have been consumed. If it were left on for a whole year (8,760 hours) then 876 kWh of energy would be consumed. Generation of one kWh of electricity requires the emission of about 1 kilogram (kg) of carbon dioxide (CO_2) by a coal fired power station. In Canberra, ActewAGL currently charges 14 cents for each kWh of electricity. Carbon pricing will increase this to at least 17 cents per kWh within a few years. Gas and electricity bills tell you how much greenhouse gas you are emitting each quarter.

You can measure how much power each appliance consumes by borrowing a power meter. Alternatively, switch off nearly everything and go outside to the fuse box. The metering dials should be scarcely moving. Now turn on each appliance in turn and note how fast the dials turn in response, to work out how much power it consumes.

Suppose that a family of two adults and two children owns a typical 20 year old brick veneer house with electric off-peak water heating and ducted gas space heating. Energy consumed in their house results in the emission of 15 tonnes (15,000 kg) of CO_2. The house is cold in winter and so the gas heater works hard for 6 months per year. The house is hot in summer and they are considering installing air conditioning to make it more bearable. Here is how to avoid the need for air conditioning while saving money and reducing greenhouse gas emissions to less than 5 tonnes per year.

Low cost measures

1. Modern low flow shower heads deliver a satisfying shower while consuming only half the water (8 litres per minute) and half the energy to heat the water compared with a conventional shower head. Installation of a low flow shower head is an effective low-cost measure available to house owners and tenants alike. If your water is heated using electricity then savings of several tonnes of CO_2 and hundreds of dollars per year can be made by this very simple measure!
2. Incandescent light bulbs will be phased out over the next few years, but if you do it sooner then you will save a substantial amount of greenhouse gas and money. Replacing your eight most frequently used incandescent light fittings with compact fluorescent lights will reduce your lighting bill by three quarters, saving around 600 kg of CO_2 and $100 per year.
3. Turn your television off at the set (or at the wall), and not by using the remote. My TV consumes 87 W when running, 82 W when switched off at the remote and zero power when switched off at the set. Turning off my TV at the set saves 600 kg of CO_2 and $100 per year.
4. A computer and monitor consume 100-150 W while running. In the Microsoft Windows operating system there is an option to automatically place the computer in hibernation when it is not used for an extended period ("power options" in performance & maintenance tasks on the control panel). The state of the machine is exactly restored when the computer is woken up. Similarly, the monitor can be programmed to automatically shut off after 10 minutes or so of non-use. This can save 100-300 kg of CO_2 per year.

5. Electronic devices such as computers, monitors, printers, speakers, HiFi systems, DVDs, VCRs and digital clocks typically consume 2-6 W when nominally off. It is often convenient to run many of these devices from a single power board. Switching off the single power board eliminates standby power consumption from many devices. Savings of 20W by this measure will reduce CO_2 emissions by about 150 kg per year.
6. If you are a Transact customer then you probably have a Set Top Box illuminating and warming the room 24 hours per day. The set top box consumes about 33 W and produces about 300 kg of CO_2 per year. Requests to Transact by many customers might induce them to find a Set Top Box that consumes far less power.
7. Your heated towel rack consumes 200W, equivalent to 1,600 kg of CO_2 per year!
8. West facing windows allow the fierce summer afternoon sun to pour into your house. Blinds and awnings can prevent this. Alternatively, heat-rejecting plastic films professionally applied to your windows at a cost of \$60 per m^2 can reduce heat gain by 70%, while lending an air of elegance to the windows.
9. An electric dryer produces 2-3 kg of CO_2 over a typical 60-90 minute drying cycle. A solar clothes dryer (also known as a clothes line) produces no CO_2.
10. Point-heating and zoning in winter can substantially reduce the running time of your ducted gas heater. By closing doors you can confine the heating to the main living area. An electric blanket only consumes 15-30 W for a few hours, and substantially reduces the temperature that your bedroom needs to be for you to feel comfortable. A Tastic in the bathroom does a similar job.
11. When looking to buy a fridge, clothes washer, dishwasher, TV, stereo, computer and other electrical equipment, buy 5 star energy rated machines wherever possible. You can make substantial savings in both CO_2 emissions and money in this way.

These measures together cost less than \$1,000. They will save one third of your greenhouse gas emissions – 5 tonnes of CO_2 per year – and will also save about \$700 per year in energy costs. The next set of measures cost more to implement. However, you will get your money back within a few years.

Water heating

In a typical household the largest source of greenhouse gas emissions is water heating. If you have off-peak or instant electric water heating then this will be causing emissions of 5-8 tonnes of CO_2 per year. A normal (high flow) shower head exacerbates the problem.

You can switch to solar water heating with electric boosting to obtain savings of more than 70%. However, gas boosted solar does even better because gas is much less greenhouse intensive than electricity, and will deliver CO_2 savings of more than 90%. A gas boosted solar water heater will cost several thousand dollars more than a conventional electric water heater, but will pay for itself through energy savings over 3-5 years, particularly by taking advantage of substantial rebates now being offered by Government.

Once you have your gas boosted solar water heater in place, you can connect your clothes washer and your dishwasher to the hot tap (if manufacturer's instructions permit this). This will deliver CO_2 savings of 90% per cycle because most of the energy consumption is for heating the water. This measure will save an additional 600 kg of CO_2 per year.

Space heating and cooling

Heating and cooling houses is a large source of CO_2 emissions. Taking the following steps can halve your heating bills. You are also likely to find that you don't need air conditioning after all.

First, heat your home with gas, not electricity. Electricity is far more greenhouse intensive.

Second, draught-proof your home. Visit your hardware store to view the wide variety of door and window seals to stop air leaking into and out of the house. Cover up any ceiling vents that are not needed, to stop your winter warmth rising up them like smoke up a chimney. Install a draught stopper (available from your hardware store) on the remaining vents. These are simple plastic boxes with hinged flaps that are placed above the vents in the ceiling space, and are closed until the vent fan is turned on. Some designs have motorised flaps that can be connected to a fan or light switch. This allows the hole in the toilet window to be closed off, so that the toilet is considerably less freezing in winter.

The next thing to do is to ensure that there is plenty of insulation above the ceiling, with a rating of at least R4. Rock wool can be injected into the walls of the house between the brick and the internal gyprock to greatly reduce heat transmission though the walls, and also reduce noise transmission. Insulation bats can also be placed underneath the floorboards between the joists using chicken wire to support it.

The remaining weakness in the thermal defences of your home is the windows. A single pane of glass offers little resistance to heat loss and heat gain, and often leaks air around the edges of each window. Double glazing fixes this problem, although it is relatively expensive. Alternatively, secondary glazing can be installed on the sill in front of the existing windows and is quite effective. Curtains, preferably with pelmets, add additional thermal resistance. Focus on the windows in the living areas where the air is warmest and the heat loss greatest. Double glazing makes your home quieter.

Once you have taken all of these measures you will have a much more comfortable and quieter house. Your gas and electricity bills, and associated greenhouse gas emissions, will have been reduced by two thirds. Now if you want to invest in green power or photovoltaic panels, you will be able to offset the remaining CO_2 emissions from your house at modest cost. An additional 1 kW photovoltaic system will feed enough electricity back into the grid to offset the emissions of an efficient car travelling 10,000 km per year.

Making deep cuts in personal greenhouse gas emissions is neither difficult nor expensive. A house can be made greenhouse-neutral at modest cost.

SOLARIZATION

Mass retrofitting of buildings is the only way in which rapid reductions in greenhouse gas emissions can be achieved in the building sector. This is because the turnover of building stock (demolition followed by new construction) is low. Even if all new buildings have excellent energy ratings, there is only a slow reduction in average greenhouse intensity.

Mass retrofitting of roof, wall & floor insulation, draught proofing and solar water heaters to existing buildings ("solarization") will yield large greenhouse gas reductions. In a typical brick veneer house the cost of thorough solarization is $7,000-$10,000. The reduction in energy bills pays for solarization well within the lifetime of the improvements. The barriers to mass solarization are the need for up-front capital and the lack of information on the part of building owners. This paper suggests a practical and commercially attractive method of removing these obstacles.

Australians move houses frequently. An investment in solarization is often not recognised in the sale price of the house. There is no incentive for a landlord to invest in solarization because they do not pay the energy bills. There is no incentive for a tenant to invest in solarization because they do not own the house. How to pay for solarization, up front?

A mechanism for solarization is proposed. Consortia would be established (e.g. "Solarization Pty Ltd") comprising a solar water heater company, a house insulation installer, a billing agency and a financier. Solarization P/L would contract its members to retrofit solar water heaters, insulation and weather proofing in houses and commercial buildings. The company could also install double-glazing, curtains, pelmets, gas heaters and photovoltaic systems.

Ad-hoc delivery of energy services, whereby the homeowner has to deal with three or four separate companies to fully solarise, is unlikely to result in widespread take-up. In contrast, successful solarization will be a service that is provided by companies offering smooth, no-fuss, comprehensive service – eg, one phone call, a single visit by an assessor skilled in all of the energy technologies, easy financing, one contract, rapid & trouble-free installation of insulation & equipment and good after-sales service.

Methods of recovering the solarisation investment include:

- Up-front payment by the building owner. For example, the funds could be redrawn from the house mortgage.
- Increase the standing charges on quarterly gas or electricity bills to allow Solarization P/L to recover its investment (at normal commercial rates of return) over 8-12 years.
- Regular quarterly repayments through a billing agency

House owners (and tenants) would enjoy reduced overall energy costs (comprising gas, electricity and the solarization quarterly repayments) and improved thermal comfort and noise insulation.

Solarization P/L would construct alliances with insulation and solar suppliers that includes the supply of equipment & services at a substantial discount to reflect reduced advertising costs and increased sales volume. Companies involved in solarization will benefit from a low risk investment, because the equipment to be installed has a long guarantee period and the risk of default by the building owner is low.

Initial solarizations could focus on the items with the most clear-cut financial benefit. This would increase the probability that the scheme is commercially successful. In approximate order this would be ceiling insulation, weather proofing, house zoning and low-flow shower heads followed by solar water heaters and wall & floor insulation followed by photovoltaic systems and double glazing.

Solarization will create a substantial number of new jobs in the local community. The scheme fits very well with the building energy rating scheme in several states. Early solarization companies will be well placed to dominate the national solarization market that is likely to develop in a few years time. The risk is low because the debt is secured against the building and is repayable within the guarantee period of the equipment. Large reductions in greenhouse gas emissions are likely.

Solarization can be tested on a small scale in a few suburbs or in a regional centre. Early adopters could be the 2-3% of customers who purchase “greenpower”. Housing trusts for low-income tenants and upper-income, busy professionals are two other groups of potential early adopters.

A large majority of local government districts in Australia have no gas, coal or electricity production. In these districts there are few economic losers from tough greenhouse targets. On the contrary, there are many winners. Solarization reduces the export of money from a town to pay for imported gas and electricity. Solarization is more labour intensive than electricity or gas production, and most of the jobs are local.

Tenants living in uninsulated homes will be big winners, since it gets around the problem that the landlord has no incentive to invest in energy efficiency because the landlord does not pay the energy bills. Solarization is one of the rare occasions when employment, social, economic and environmental objectives are aligned, and is therefore politically attractive, particularly at a local level.

Gas and electricity companies will experience reduced sales of energy. However, solarization will provide replacement revenue and profit. They will have the opportunity to “lock-in” customers for long periods (an important consideration in the era of contestability) and will acquire a large supply of RECs from the solar water heaters. Solarization of 100,000 homes in Canberra over a decade would be worth around $100 million/year and would lead to the creation of about 700 new jobs. Electricity utilities will benefit from mass solarization through a reduction in peak loads, because better insulation will reduce the space heating peak-load in winter and the air conditioning peak-load in summer while solar water heaters will have gas or off-peak electric boosting. Solarization also helps energy companies (eg in NSW) cope with any government requirements that the greenhouse intensity of their products must decline each year.

Government moral support would be valuable, in order to give credibility to this new idea. A modest initial Government subsidy could also accelerate uptake. In return for a modest subsidy Solarization P/L would promise to solarize a specified number of buildings to a specified standard (eg 4 stars). The Government might also include a tender provision that rewards local manufacturing. Alternatively, Councils could offer modest revenue-neutral rate relief that is linked to the star rating of a building.

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QUALIFICATIONS

1979-82 Doctor of Philosophy, University of New South Wales
1974-77 Bachelor of Science, Australian National University

EMPLOYMENT

1999 →	Level E1, (Professor) Engineering Department, Australian National University
1997-99	Level D, (Reader) Engineering Department, Australian National University
1992-97	ARC Senior Research Fellow, Australian National University
1992	Level C (Senior Lecturer), Engineering Department, Australian National University
1991-92	Level B (Lecturer), Engineering Department, Australian National University
1991	Consultant to Department of the Arts, Sport, Environment, Tourism and Territories
1990-91	ARC Queen Elizabeth II Research Fellow (resumed), University of NSW
1989-90	Alexander von Humboldt Fellow, Max Planck Institut für Festkörperforschung, Stuttgart, Germany
1986-89	ARC Queen Elizabeth II Research Fellow, University of NSW
1984-86	Radio Research Board Postdoctoral Fellow, University of New South Wales
1983-84	Professional Officer, University of New South Wales
1979-83	Commonwealth Postgraduate Research Award, University of New South Wales

CURRENT RESPONSIBILITIES AT THE AUSTRALIAN NATIONAL UNIVERSITY

- Director of the Australian Research Council Centre for Solar Energy Systems.
- Director of the ARC Centre for Solar Energy Systems
- Foundation Director of the Centre for Sustainable Energy Systems at ANU, an externally funded group of about 50 staff and PhD students.
- Member of academic staff of the College of Engineering and Computer Science

PROFESSIONAL MEMBERSHIPS AND POSITIONS

- Fellow of the Australian Academy of Technological Sciences and Engineering
- Fellow of the Australian Institute of Physics
- Fellow of the Australian Institute of Energy
- Life Member of the International Solar Energy Society
- Life Member of the Australian and New Zealand Solar Energy Society
- Member of the International Science Panel on Renewable Energies
- Member of the Editorial Board of "Solar Energy Materials and Solar Cells"
- Member, Project Evaluation Panel for the Clean Energy Research Program of Singapore
- Reviewer: Australian Research Council and several technical journals and conferences

PRIZES & AWARDS

- Chairman's Award, "Second Generation Sliver Cell Technology" duPont Innovation Awards (2008)
- Engineers Australia Australian Engineering Excellence Award for Sliver sub module assemblies (Everett, Blakers & Weber, 2007)
- Weeks Award (Achievement Through Action), International Solar Energy Society (Blakers & Weber, 2007)
- Engineers Australia (ACT Division), Engineering Excellence Award (2007)
- Australian Institute of Physics Alan Walsh Medal for services to industry (2006)
- ACT Sustainable Cities Environmental Innovation Award (2006)
- ACT Sustainable Cities Overall Award (2006)
- Banksia Award, Environmental Leadership in Infrastructure & Services, "SLIVER Cells - a Breakthrough in Solar Technology - ANU & Origin Energy" (2005)
- Aichi World Expo Global Eco-Tech 100 Award for SLIVER solar cell technology (2005)
- Australian Institute of Energy Innovation in Energy Science & Engineering Award "Sliver cells – A breakthrough in solar technology" (2005)
- Finalist, Sherman Eureka Prize for Environmental Research (2005)

RESEARCH INTERESTS

- Photovoltaic energy conversion, including both technical and commercial aspects
- Semiconductor physics and technology, in particular as it relates to photovoltaics
- Renewable energy markets, energy economics and energy related environmental issues
- Approximately 200 papers and patents published in the above areas.
- External research funds flowing to projects managed by Professor Blakers since his arrival at ANU in 1991 exceeds $35 million.