LEGISLATIVE ASSEMBLY FOR THE AUSTRALIAN CAPITAL TERRITORY

STANDING COMMITTEE ON PLANNING AND ENVIRONMENT

(Conference on renewable energy and sustainability)

Members:

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CANBERRA

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Secretary to the committee:
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By authority of the Legislative Assembly for the Australian Capital Territory

The committee met at 9.06 am.

THE CHAIR: We do have a spaced-out but heavy program today. It is under the auspices of the Planning and Environment Committee that you have been invited to speak or attend today.

On 11 April this year the Legislative Assembly referred to the Planning and Environment Committee the possibilities of renewable energy strategies for the ACT and particularly the appropriateness of setting targets for renewable energy and for strategies to reduce consumption of fossil fuels in the ACT.

In contemplating how we as a committee might undertake this inquiry—it will be a fairly lengthy inquiry—we decided that an appropriate way might be to have an occasion such as this where people rather than just come and talk to three committee members have a more open and inclusive process to discuss what is possible for the ACT. We're not saying what is possible tomorrow but in the next 20 to 30 years. We're here today because we want to contemplate the future. I hope that by the end of today we will have increased our interest and passion for the concepts of the ACT becoming a centre of renewable energy.

But before we look to the future and before we contemplate it too much I think we should look back from today. By way of introduction, I'd like to turn back the clock about 30 years. It was about then that a piece of new terminology crept into our collective psyche. It was terminology coined by Alvin and Heidi Toffler. It was future shock. It was a twist of the term culture shock, and the Tofflers described in their best selling book of the same name the mass disorientation caused by technological innovation coming faster than most people could grasp.

The future quite suddenly was not remote; it was not distant; it was not a prospect of abstraction to be contemplated at one's leisure; it was here; it was right in front of us. And we were contemplating that future. We were still grappling with the concept of future shock when the chill wind of a foretaste of a life no longer awash with cheap energy came up to meet us.

In 1974 tension in the Middle East, as always, led oil-producing countries into a price-rising spiral where oil prices quadrupled, fuelling inflation in the developing world and halting development in the Third World. It undermined our sense of certainty. The unfolding scenario drove home to most of us the message that much of our prosperity depended on the exploitation of fossil fuels. We had the energy crisis.

In some ways, variations on that crisis have been with us ever since. It has at least made us more conscious of the need to look ahead, to consider the shape of the future. It raised our consciousness and it raised it suddenly. Not only were those fossil fuels exhaustible and polluting, they were vulnerable to fluctuations in the geopolitical situation, especially when most of our oil reserves exist in the most inherently unstable political region in the world.

The sense of crisis was something we ultimately learned to live with, but it did inspire some creative thinking and invention as to how we could continue to draw energy sources but not foul the earth in the process, nor deplete the fuels we use. We have gradually come to accept the idea of sustainability, not only in relation to energy production but also in relation to the environment and the way we create economic growth.

But what is sustainability? It often alas lacks precise definition. It's become a motherhood term. We know what it is, we know it's good, but we don't know for sure what it exactly entails. And for a moment I'd like to substitute the word "liveability" for "sustainability" because I think that that might give us a better, closer feel for what we're achieving. What we want to be able to do is live comfortably in the world around us. We want to be able to live responsibly in the world around us. We want to bequeath comparable liveability to the generation that follows. We don't want to draw on resources or create hardship and scarcity for those generations and impinge on their expectations of liveability. To make life liveable in a way that will continue to be liveable for those yet unborn is, to my mind, the essence of sustainability.

Some people say that their eyes glaze over when they hear people talk about sustainability, in the same way as people's eyes glaze over when we talk about social capital. If that's the case I think it's the job especially of legislators to address that. If there is a failure of communication on our part to awaken the urgency of the need to protect the future, then we have to try harder to engage the community at large on issues that affect us all.

What we need to do collectively is meet the challenge, call the future and be prepared in such a way that future shock will be minimised or eliminated. We've heard talk, discussions, ideas; we've had reports, surveys and feasibility studies. In a sense, what we're doing today is just an extension of that. But what we need to do today is start to take the next step, to step up the momentum and to begin translating the emergent ideas into reality.

There is a role for legislators in that. I think it's an important role, but it's a role that we have to take on in consultation with the community. Legislators have to play a very real role as custodians of the present and guardians of the future. We have crucial choices to make, which is why we have joined with the broader community here today to look at some of those features. I believe the future is only limited by the bounds of our collective imagination and that the means of determining the shape of the future is only constrained by our political will.

Canberra, though poor in natural resources, is immensely rich in human resources, and I believe that that gives us an edge. We are uniquely placed to do things and to demonstrate what is achievable, not just for the rest of Australia but for the rest of the world.

As I said earlier, when we met the energy crisis in 1974 it had a huge impact on the developing world because the cost of energy sky-rocketed, stymied and halted development in the developing world. One of the things that I would hope that we could see is a beginning of a real sense of our global contribution not only to our own town, our own country, but to creating technology which is translatable into the developing world.

Our role as legislators is to provide the wherewithal, the political will, to enable dreams to become everyday realities. Sometimes that means encouragement and sometimes that means just getting out of the way. It may be naive on my part, but I believe that we have the abilities, the knowledge base and the emerging technologies here in this territory to start some serious thinking and looking at delivering tomorrow within our lifetimes.

Let us look at our starting point. Canberra's environment industry, which concentrates particularly on research and development and the provision of services, has outstanding strengths that are unmatched in Australia. The emerging growth industry has immense capacity to market an ever-widening range of environmental goods and services created by its clusters of public and private enterprises. Canberra itself showcases world-class environmental management and sustainable development. The incoming government has just instituted an Office of Sustainability to oversee and ensure that we do keep to those sustainable development options.

The ACT has acknowledged expertise in such areas as sustainable town planning and architecture, including landscape; the physical and earth sciences; rural sciences; as well as renewable energy, waste water treatment and resource recovery.

ACT leads best practice in environmental legislation, and is the first state or territory to set its own greenhouse targets. It's also the first in the world to set up a bold target of no net waste to landfill by 2010. Canberra is already home to a network of over 200 environmental and technological firms, associations, educational and research facilities and is one of the world's leading showcases of urban environmental solutions.

Our own Actew is an example of world benchmark waste-water treatment installations, environment monitoring technologies and solutions and has developed innovative renewable energy resources already. In some key areas we are leading the way. The export potential of the ACT's environment industry has already been highlighted in recent work in China. Following on from Actew's success in providing environmental management solutions in Shanghai, the ACT has signed agreements with Huangjo and Beijing that will assist Canberra's environment management firms. Acknowledging Canberra's level of expertise in this area, the Huangjo people's municipal government invited Canberra firms to explore business opportunities. The ACT and Huangjo have worked on developing new export and joint venture opportunities.

We have other advantages here that suggest opportunity in the energy field. Unlike other jurisdictions, we are not beholden to vested interest. We have a flat government structure. We are not beholden to a coal industry and a sort of a union and business task force behind it that tries to uphold often outmoded and environmentally inappropriate sources.

Because of the fact that we have the right government structure, we don't have pressure groups leading us; we should be the centre of bright ideas. But those bright ideas shouldn't daunt us because they are new or untried.

In opening this seminar, I am conscious of the fact that we are standing on the threshold of a new era, and I hope that, for all of you, it is a new era of hope and excitement. Despite its many challenges and difficulties, it will be charged with excitement and potential, not only for us, but for the whole world.

I don't think this is a time to be timid. We do have to act with a sense of urgency. Some may say that what we are doing today is too broad in its scope. Indeed, a certain minister not far from this room has scoffed at the very idea that we should be inquiring into such things and has suggested that it may well run contrary to the national energy market.

Well, let me say this: if it proves to be the case that the national energy market will not sustain renewable energy, we have to find new arrangements. If we find that the national energy market is an obstacle to achieving greater sustainability in the way we provide our energy needs, we have to look at other ways of doing things.

Only yesterday, the ACT announced the intention to introduce full retail contestability in the electricity market. This is not a bad thing in itself, but for consumers, in the short term at least, there are elements of uncertainty with which we need to contend. Every day there are increasing pressures to be responsive to innovation in energy generation and energy efficiency.

Let us not rule anything out because we are too cautious, too timid, too afraid of the future and too wedded to the past. Alternative energy technologies that can satisfy thermal power and low-production needs for a wide range of residential, commercial, industrial, small industry and tourist and transportation applications are already at hand.

Let us just look at one, wind power as an alternative source of energy. We are already experimenting with the possibilities at a number of sites across Australia, and I would hope that soon the ACT would be added to that growing list. Wind is a significant and valuable renewable energy source. Wind power is already scientific fact, not science fiction. It is rapidly growing.

Europe, for instance, is in the forefront. Last year, a further 4½ thousand megawatts of wind power was added to the electricity grid, adding to the total capacity, so far, of 17,000 megawatts. This is roughly equivalent to 10 million average European households.

Had that amount of electricity been produced from coal-fired plants, it would have required the burning of 16 millions tons of coal—that is, 160,000 trainloads of coal or 640,000 truckloads of coal. Most importantly, the electricity produced from 17,000 megawatts by conventional power—coal burning—would have produced 24 million tons of carbon dioxide annually. Let's make sure that Australia, and the ACT, is not left behind.

But let us go one better. Let us not become followers; let us become pioneers. While some people are generally wary of setting targets, there is one thing that I hope that we will find out, not just today but out of the entire inquiry, and that is whether it is feasible to set realistic targets for Canberra to become the first major city in the world which is largely self-sustainable in energy. That's a big challenge, but I think that we're up to it.

There are two ways to make the future. One is to simply sit pat and let the future come to you. That's the easy way. But it could also be costly. Another is to anticipate the future, shape it and meet it headlong. The choice is ours. I hope that the deliberations and discussions that will follow would help us to develop a passion for building a sustainable, renewable, liveable future, and I hope that we can go out confidently to meet that future.

While we're having a look at the past—and although we know that most of today is about looking at the future—we should also take some time to look at the present. The first session today is about looking at the present, for the most part.

I'd like to introduce Gary Voss, who is the General Manager, Commercial, ActewAGL. Gary is part of the executive team at ActewAGL, and his role includes development of renewable energy projects which provide sustainable, cost-efficient energy to the people of the ACT. He is currently leading a team pursuing solar, hydro and wind generation opportunities in the ACT and region. Gary's team is responsible for the development of the gas-fired power station.

Gary is an engineer by profession, with an extensive background in energy infrastructure, development and management. Gary and his family are residents of Canberra, and he's strongly committed to helping develop the national capital set standards for energy sustainability in Australia.

One of the things I'd like to say is that back in April, when the Assembly gave this committee the reference, the first person to ring me was Gary Voss, to say, "We're on the job, we're doing some of the work already." He was the first person to offer assistance, so I think it's very fitting that Gary is the first speaker today. Thank you, Gary, and take it away.

Before Gary does, this is a meeting of the Planning and Environment Committee, but it is not a full meeting in the usual sense. At the end of the contribution by each speaker this morning, there will be an opportunity for questions. No-one should feel constrained about this. Your name may go down in *Hansard*, but it's not a dry, stolid meeting, where people talk to members of the committee. They're here to talk to the community, and we want to encourage interaction between the speakers and the community. Thanks, Gary.

Mr Voss: Thanks, Vicki. Welcome one and all. It's my privilege to present to you today an overview of energy sustainability in the ACT presented from the view of ACT's home-grown and part community-owned energy utility. My presentation today will cover the following: an overview of current ACT energy use, mechanisms for change in the way we use energy, and obstacles to renewable usage.

First, an overview of ACT's current energy usage: looking firstly at energy usage by sector, we see the transport sector is easily the ACT's largest consumer of energy—that is, trucks, cars and buses; no trains. Domestic and business sectors make up pretty equally the remainder of our energy consumption.

If we look in more detail at the transport sector, we see that petrol makes up 75 per cent of the energy we use for transport, and that reflects the ACT's love of the private car. Diesel at 20 per cent is quite a way below the national average consumption. That reflects our small geographic size and our small heavy transport infrastructure. LPG, largely in the taxi fleet, makes up 5 per cent. Natural gas for vehicles, or compressed natural gas, doesn't actually make up more than a thin black line on this slide. There are some cars, a couple of buses and some trucks running around on it, but fundamentally we don't have a substantial NGV or CNG industry.

Turning to the domestic sector: we can see that gas makes up the predominant energy source. Electricity is near that, at 45 per cent; and wood, surprisingly, makes up 6 per cent of the energy used in Canberra homes.

In more detail, in the business sector, electricity is far and away the major energy source, with 69 per cent, with gas making up 31 per cent.

Turning now to the end use of this energy: this chart represents the typical use of energy by commercial buildings which in the ACT make up a major part of the business sector. You can see that climate control; if you listen carefully you can hear it now and see the curtains ruffling. Climate control makes up 61 per cent of the energy use in buildings like this and like the ones all over Canberra. Hot water and lifts and other things make up a small amount, and of course lighting makes up to over 25 per cent.

In the domestic sector we see a similar pattern, with heating making up 55 per cent of the energy used by a Canberra home. Hot water in the domestic sector makes up another 26 per cent. So if you add that up we spend over 80 per cent of the energy in a regular Canberra home heating things—heating air and heating water. Cooking, refrigeration, lighting and other things make up a fairly small amount of our energy consumption.

How does this fit domestically with the Australian average? You can see that because of this massive heating load in the ACT we use considerably more energy than the Australian average in our homes.

Having looked at the consumption and uses, the way we use our energy, it's useful to examine the greenhouse impact of the energy we use. You'll note from this slide that electricity makes up about 30 per cent of the energy that we use. However, it makes up over 60 per cent of the greenhouse emissions in the ACT.

Clearly, a major focus in moving forward must be to address the use and generation of electricity. Notwithstanding transport being our major energy user, electricity is our major greenhouse generator.

We've established that electricity makes up the dominant greenhouse gas source in the ACT, so it's useful to look at how electricity is generated. The ACT buys energy through the national electricity market to which we've referred earlier. After analysing the sources of generation in that market, it is evident that the bulk of capacity is from coal-fired, base-led generation, that's 84 per cent. Another 11 per cent is made up from gas-fired generation; and a tiny bit from oil-fired generation. All in all, those fossil fuels make up something like 90 something per cent of our energy generation.

Hydro makes up about another 3½ per cent, but the bulk of that is old hydro, the Snowy hydro. This doesn't include Tasmania, by the way; it would contribute more hydro. But the bulk of our hydro is Snowy hydro which is considered to be, in the market, conventional generation. It's not sold as renewable, not classed as renewable.

So if we were to aggregate all of the conventional forms of generation in the national electricity market you would see it comes to something in the order of 98 per cent. So 98 per cent of the energy on the market is from either fossil fuel or old hydro. Less than 2 per cent of the energy generated in Australia is from new, renewable resources.

How do we compare in the ACT? Well, we're right on track with the rest of the country in that respect. About 98 per cent of the energy that ActewAGL buys to provide to the ACT is market conventional energy; another 0.4 per cent is mandatory renewables through that Commonwealth program. The other renewable energy we buy is to satisfy ActewAGL's green choice program. Basically, we're pretty much in line with the national average.

To conclude on energy use: we use the majority of our energy for transport and heating. Electricity comprises only 30 per cent of our energy use, but produces over 60 per cent of our greenhouse impact. In generating electricity we are pretty much on average with the rest of the country in terms of renewable energy use.

So our imperative—and the second session today deals in detail with this imperative—is to use energy more sustainably, and, as you can see, particularly electricity.

If I can turn now to mechanisms for achieving sustainability. There are a number of mechanisms through which we, as an energy utility, see that energy could be made more sustainable in the ACT. First, we can reduce energy consumption; second, optimise our energy sources, the source of the energy we use; and, third, encourage sustainable electricity production.

I'll deal first with reducing energy consumption. Just given the timeframe, I've stuck to a few high points. Energy-efficient appliances. Clearly if you want to reduce energy the first place to start is with energy-efficient appliances. Most energy-using appliances today are certified as to their efficiency under standard energy-rating programs. There are, however, no mandatory efficiency levels for appliances in the ACT. In fact, there are none in most places. So to make a real impact on the sustainability of our energy use, the ACT could impose mandatory minimum efficiency standards on those high-energy-use appliances we've already identified, like heaters and hot water systems.

The little light bulbs on the presentation with the boxes around them are things which I think could make a difference. There are certainly precedents in some jurisdictions in New South Wales for mandating energy-efficient appliances.

Moving from appliances to whole buildings: there are more opportunities to reduce energy consumption. To its credit, the ACT has a progressive housing energy rating scheme in place, and that's a real achievement for the ACT. Under this scheme new homes require a mandatory four-star rating.

However, there are no mandatory levels for the vast bulk of properties which are the existing properties in the ACT. Perhaps the ACT could mandate minimum housing efficiency standards for major renovations, for things that need development approvals. Perhaps they could even go further and ultimately require minimum standards at change of ownership of properties.

Perhaps the ACT could mandate the progressive introduction of ceiling insulation in all homes in the ACT, in all commercial buildings and particularly perhaps in rental properties where the owner has absolutely no interest in how much electricity the tenant uses, and so they remain uninsulated, for the most part.

A third way to reduce energy consumption is to look at energy displacement. While not actually reducing energy consumption, energy displacement stops us from sucking in that 98 per cent of conventional energy from the grid. Two common energy displacement methods are through solar hot water and photovoltaic solar. The ACT government currently supports the installation of solar hot water systems in the ACT through a rebate. The Commonwealth allows renewable energy certificates to be issued for solar hot water installations, further making it more financially attractive for people. The AGO supports the installation of rooftop photovoltaic solar systems through a very generous subsidy. While these programs are very effective and well targeted, perhaps additional incentives could be provided to encourage all sorts of other forms of energy displacement.

That pretty much deals with ways that we feel energy consumption could be reduced.

Having reduced our energy consumption, we then need to turn to using the optimum energy source for the end application. Different energy sources are well suited to different applications. For example, electricity is a very convenient energy source. Electricity is not a fuel; it is a transport mechanism for energy. So it's very convenient. It's convenient for lighting, for motors, for appliances and for a whole bunch of other things. But it has a very low conversion efficiency and hence isn't really appropriate as a source of heat because we convert the fuel into electricity inefficiently hundreds of kilometres away and then transport it through wires.

Gas, on the other hand, has very high conversion efficiency because we burn it right there where it's used for heating. But it's pretty challenging for many other applications. Gas lighting, gas air-conditioning and the like are things which I do not suggest will take off very rapidly, and it's not appropriate that they do. So choosing the most sustainable form of energy for our end use will lead to a significant improvement in sustainability.

If I could just touch on a case study. Hot water. We saw earlier that hot water uses 25 per cent of the energy in domestic homes in the ACT. Work done by energy partners on behalf of the ACT government has shown that solar hot water and instantaneous gas hot water are both dramatically better for our environment than electric storage hot water.

The writing's very small, but the top three are gas-boosted, solar hot water; instantaneous gas hot water; and electric-boosted solar hot water. The bottom two are electric storage and off-peak electric storage. So there is a dramatic difference in the amount of greenhouse emissions.

On the basis of these findings, the ACT and the Commonwealth both support solar hot water. It's notable that there are no financial incentives for instantaneous gas hot water, even though it is marginally better than electric-boosted solar.

Despite the promotion and subsidising of these much more sustainable forms of hot water, 67 per cent of ACT homes still use electric storage. Even now many new electric-storage hot water systems are being installed, particularly in our massive, high-density unit developments, simply to reduce the development cost by perhaps a half of one per cent.

If we're to make a real improvement in energy sustainability in the ACT, given that hot water is such a major user, there must be mandatory requirements for the installation of solar hot water or instantaneous gas hot water in new high-density developments, if not in all new dwellings. The cost is insignificant to the developer—hundreds of dollars in a $200,000 unit. The operating cost is lower to the buyer. The environmental benefits are undeniable. There are a number of precedents for this sort of mandatory standard in other jurisdictions. While we've examined hot water as a case study here, transport and heating could also use detailed analysis and optimisation as two even greater users of energy in the ACT.

So having reduced our energy consumption, having optimised our energy sources, we'll always have a need for electricity. So it is very important that we look at the sustainability of our electricity production. Ways to encourage sustainable electricity production include promoting sustainable fossil fuel generation, promoting renewable generation, and developing regional renewable projects.

First, encouraging sustainable electricity production. With fossil fuels generating over 95 per cent of our electricity, it is reasonable to say that we can't do away with base-load fossil fuel for the foreseeable future. It's therefore essential that we make this energy source as sustainable as we possibly can by promoting low emission generation.

Some jurisdictions have already moved in this direction. Queensland has introduced mandatory gas-fire generation requirements, New South Wales has introduced mandatory reductions in greenhouse emissions through retail electricity specifically targeting increased gas-fire generation. The ACT could consider at least following suit, if not taking the lead, by mandating more sustainable forms of fossil fuel generation, particularly gas-fire generation.

The second method of achieving sustainable energy production is to promote renewable generation. We know that renewable generation makes up less than 2 per cent of current generation Australia wide, and in the ACT, and that needs to be cranked up. Clearly, significant incentives will be required to encourage renewable generation.

To this end ActewAGL promotes our green choice product through which any customer in the ACT who chooses to can buy renewable energy at the market price. To promote development of renewable energy production the federal government has introduced the mandatory renewable energy target scheme where we, as an energy retailer, must include a certain amount of renewable energy in the energy we sell every day. That's quite separate to the green choice program.

To take the lead in sustainability, the ACT could mandate that an additional proportion of renewable generation be included in ACT consumer's electricity mix over and above the mandatory Commonwealth targets.

Another way certainly that ActewAGL is encouraging sustainable energy production is through the support for regional renewable generation projects. ActewAGL is the ACT's principal energy supplier; we're also half owned by the ACT community so we are committed to finding renewable projects in our region and delivering them to the people of the ACT.

Our current renewable projects include purchasing the output from landfill gas generation at both ACT landfills—it is two megawatts of generation; investigating biomass generation opportunities using waste fibre, forest waste from our forestry, agricultural waste from the nearby regions. We have developed mini hydro projects. The Mount Stromlo hydro on our water supply is currently operating. Googong hydro is in design; that will go onto Googong water storage. Other regional hydro opportunities are being explored by ActewAGL.

We have developed residential, commercial and school-based photovoltaic solar programs, and a revamped residential PV solar program will be announced shortly.

As our chair, Vicki Dunne, mentioned earlier, wind energy is a major renewable energy opportunity. ActewAGL shares this view and we're actively pursuing in this region wind energy opportunities. We are out there, as we speak, looking for wind resources, analysing them with the CSIRO's computers and trying to get up a large-scale wind development in this region.

We've explored a number of options available to the ACT in terms of improving energy sustainability, and in particular the need to increase our user renewable electricity. There are, however, a couple of significant obstacles to short-term improvement in our renewable energy profile. These obstacles, as you might expect, relate to cost and access or availability.

First, the cost: renewable energy is expensive to generate. This table shows the relative costs of generation per megawatt hour of conventional and renewable electricity. You can see that all forms of renewable electricity command a considerable premium—and this is the cost of generation—on average about $40 more than coal-fired power, which is itself $40. So that's a 100 per cent premium effectively on our conventional energy sources as the cost of generating renewable energy.

This is reflected in the price of a renewable energy certificate, the certificate that says that energy is renewable. They command $40 on the market premium to conventional energy. So what this suggests is that renewable energy costs double conventional energy. That's the cost of generating it, whether it's wind, biomass, biogas or mini hydro. Photovoltaics is an order of magnitude higher again.

The ACT domestic load, at 1,100 gigawatt hours a year, if supplied all through renewable energy, would require a $44 million a year premium. That is $340 per customer in the ACT per year. If every customer in the ACT paid an average of $340 a year extra we could get 100% renewable energy. But I'll touch on the availability shortly.

In business we would need a premium of $65 million a year to buy renewable energy on market or to build our own generation of renewable energy. So that would be, in all, $110 million a year premium or impost on the ACT economy for being right now 100 per cent renewable. That's the cost of generating these things using current technology.

Are ACT consumers prepared to pay this price at present? Well, we can get a clear answer to this through ActewAGL's green choice program. Through this program ActewAGL sells renewable energy, 100% renewable energy, to consumers at near purchase price. We have some administrative costs in there, but it is at near purchase price.

Anyone who wants to pay the market price for renewables can buy renewables in the ACT. To date we've sold that product to about 3 per cent of our customer base. We actively promote this; it's one of our core objectives to increase the use of renewables. We put enormous resources into keeping the momentum going and reinforcing this program. So I think it is fair to say that, at current market prices, there is no unmet demand for renewable energy in the ACT because anyone who wants to buy it can buy it at market prices.

The second significant obstacle has to do with the availability of renewable energy. The graph on the left shows the total quantity of renewable energy certificates registered in the 2001 calendar year via the office of renewable energy regulator. 882 gigawatt hours of energy has been registered as renewable in that year.

The ACT's electricity load is 2,740 gigawatt hours. Of the 882 gig registered, solar hot water, which is not actually generated energy, makes up 23 per cent. So in terms of actual generated energy, there is less than 800 gig generated. In Australia at the moment less than a third of our energy load is generated through renewables.

If we look at the mandatory renewable energy targets that the Commonwealth has set, these are the targets for renewable energy production in Australia which have to be met just for every retailer to scratch up their couple of per cent. You can see that there is almost exponential growth in the need for renewable generation, and that's just to meet the minimum targets. If the ACT wants to exceed that by providing any great proportion of that 2,700 gig we have to exceed the amount of renewable development that already has to happen in Australia to meet the minimum standards.

I was asked to talk about the obstacles. I don't mean to sound down because I'm very committed to increasing renewable use, but there are those obstacles of price and availability in the market which we have to work hard to overcome.

Conclusion: there are a number of mechanisms available to improve energy sustainability in the ACT: reduce energy consumption, optimise energy sources and encourage sustainable production. The most immediate impact can be made through mandatory energy efficiency and optimisation measures in ACT homes and businesses. We can do that immediately, effectively and practically.

Longer-term impacts can be achieved by mandating increased use of sustainable and renewable energy generation. The cost and availability of pure renewable energy are a significant barrier to rapidly increasing renewable energy usage in the ACT, but there's no barrier to long-term increasing of that energy usage. ActewAGL is actively pursuing a number of local renewable projects to try to overcome these obstacles, to try to make renewable energy more accessible and more cost effective for the people of the ACT into the future.

Thank you.

THE CHAIR: Thanks very much, Gary. At the end of the session we'll have a time set aside for general questions from the audience.

In the meantime, to allow Gary to draw breath and have a drink of water I'd like to introduce Bill Logan who is from Environment ACT. Bill is the manager of Environment Planning and Legislation within Environment ACT. In a former life, when I used to be an environment adviser to one of the former ministers for the environment, I first came across Bill in a number of capacities. He has a substantial background in ACT government and its predecessors and in the area of natural resources, management, biodiversity and conservation policy. He currently heads the team which is responsible for co-ordinating and implementing the ACT greenhouse strategy.

I'd like to invite Bill Logan to talk to you about that. Thanks, Bill.

Mr Logan: Thank you, Vicki. Well, I'm from the government and I'm here to let you know what we're doing presently in relation to greenhouse matters and reducing greenhouse emissions. At the end of this presentation, I'll talk a bit about the future.

But first of all, the ACT government is committed to reducing greenhouse gas emissions and promoting renewable energy. Although only a small contributor to national emissions, the ACT believes it has a responsibility, as the nation's capital, to show leadership in reducing its own greenhouse emissions.

In November 1997 the ACT government announced a target for stabilising greenhouse gas emissions attributable to the ACT at 1990 levels by the year 2008 and reducing these emissions by a further 20 per cent by 2018. These targets are designed to encourage an overall reduction in energy use and a transfer to renewable energy from conventional energy sources. As we heard earlier, the ACT is the only state or territory government to have set its own greenhouse targets.

In 1998 the first ACT greenhouse gas inventory was developed, based on the methodology used for the national greenhouse gas inventory. The ACT inventory departs from the national inventory in that it includes emissions from electricity generated outside the ACT that are related to electricity consumption in the ACT. The most recent comprehensive inventory is for the year 1999.

By 1999 emissions had increased by 14 per cent over the 1990 levels. In 1990 they were estimated at 3½ million tonnes of carbon dioxide equivalent, including emissions from electricity generated outside the ACT. By 1999 it was up to 4.03 million tonnes carbon dioxide equivalent, a 14 per cent increase; and electricity comprised 58 per cent of the ACT's total greenhouse emissions for that year. I hope you're corresponding with the consumption figures as to the emission figures. There should be some consistency there.

Sources of ACT greenhouse gas emissions differ from those of other jurisdictions, primarily because the ACT has virtually no heavy industry and a very small primary industry sector. In 1999 the commercial sector generated 32 per cent of the ACT's greenhouse gas emissions. That was the major contributor.

In decreasing contributions, residential contributed 30 per cent; transport, 27 per cent; waste, 8 per cent; land use and agriculture, 1 per cent; and the ACT government, 3 per cent. The commercial sector also includes the emissions from Commonwealth government facilities in the ACT.

In trying to tackle this problem, in January 2000 the ACT greenhouse strategy was launched. It establishes the framework for managing the ACT's approach to reducing greenhouse gas emissions. It details the ACT emissions profile and describes a range of measures that will assist in reducing emissions to the agreed targets, an immediate target being the 2008 target.

They are grouped by sector—that is, energy supply, residential, commercial, ACT government, transport, waste and land use management—and are presented in categories. The measures that are in place now include national measures that influence the ACT's emissions; measures being introduced from 2000 on—and some of those are the consequence of the greenhouse gas strategy; and potential measures under investigation.

The emission savings projection figures for 2008 and 2018 were drawn from the ACT greenhouse gas inventory of 1997-98 and were projected by Environment ACT using its own methodology, including community and business take-up rates for proposed measures and linking that to changes in population and other data that was available. The measures include a mix of voluntary and mandatory measures.

I'll go through a few of those more significant measures. The ACT greenhouse strategy's objective in the energy supply sector is to reduce greenhouse gas emissions per unit of energy supply to end users and to promote alternative energy sources that produce fewer emissions. It's a strong link with the retail business.

A number of local measures have been implemented promoting renewable energy. They include providing funding assistance, through the ACT research and development grant scheme, to the Australian National University Centre for Sustainable Energy Systems. They're building a pilot installation of their linear concentrated solar-heated power system—and I'm sure there's someone else in the room who can talk about that—but it heats water and generates electricity.

The ACT government purchases all the renewable electricity produced from Mugga Lane and Belconnen landfills. Methane is captured from these two landfill sites and used to generate electricity. It amounts to about 13.3 gigawatt hours per annum or approximately 12 per cent of total government electricity consumption.

The ACT solar hot water rebate program was launched in April this year. It gives a rebate of between $500 and $1,300 to residential installations of solar hot water heaters. To date, about 125 rebates have been approved, and the rebate varies depending on whether they go for electricity or gas in their heating system—a bigger rebate if you go for gas solar.

The ACT is working with the Commonwealth to promote installation of photovoltaics, which in turn encourages the long-term use of photovoltaic technology to generate electricity. In the year 2000 the ACT government signed an agreement with the Commonwealth and the Master Builders Association to enable the Energy Advisory Service to administer the three-year Commonwealth photovoltaic rebate program. The Energy Advisory Service, I should explain, is an ACT government-sponsored program to provide advice to the residential sector on the best way to manage their energy.

To date, 18 rebates have been offered through the photovoltaic rebate scheme in the ACT. Fifteen of these have been installed on homes and connected to the electricity grid; two are stand-alone systems; and one has been installed on a community building. In September 2001 the Canberra High School, which is a bit of a partner with us in the photovoltaic business, installed 21 voltaic panels on their roof, generating 300-kilowatt hours per annum that is fed back into the grid. The school has also incorporated renewable energy into its school curriculum, so it's an important part of the government approach to getting people on side to provide money, provide that incentive and provide information and assistance as well.

Last year a plan to recycle green wastage renewable energy and clean-burning firewood substitutes was announced for Canberra. It's being developed as a pilot study, being supported by the Commonwealth, through the Australian Greenhouse Office, and it's essentially using green waste to create a charcoal product which can be used as a heating fuel and, during the process, generating electricity.

Linking back to the national picture, the ACT government also supports national renewable energy initiatives such as the mandatory renewable energy targets and accredited green power. As an active member of the National Green Power Accreditation Program Committee, the ACT government is pleased to see that green power subscribers in the ACT are higher than the average, and that's encouraging.

The greenhouse strategy has been in place for a couple of years. While we're doing some interesting things, spending some money, we need to know how it's going; so we're now entering into a review phase of the measures in the greenhouse strategy. It will identify the level of accuracy of the original projected emissions savings for local measures; it will evaluate the effectiveness of measures introduced to date; and it will identify any further measures that will be cost-effective to introduce. So we come up with some numbers on our emissions. We have some targets which are other numbers. We try to get the two together.

But things change; technology changes; methods of measuring things change. Part of this process is to go over those original figures and the projections, incorporate more recent data on energy use, see what the implications are as a measure of how successful we have been to date in implementing the greenhouse strategy, and what are the challenges that still need to be addressed.

Until we have finalised the review a discussion paper will be released to seek public comment as to the most appropriate measures that the government can pursue to continue to reduce the ACT's greenhouse emissions. From comments arising from the discussion paper and a detailed analysis of all proposed measures, the current ACT greenhouse strategy will be replaced with a new implementation plan outlining the government's proposed actions in forthcoming years. Measures to encourage the uptake of renewable energy will be considered within this process.

So it's really very timely that a conference like this is being held. We are now embarking on a review process of how have we gone so far, what do we need to do, what will we be doing in the future, and the changes even in the last couple of years have been quite significant. I look forward—and I can speak, I'm sure, for the government on this—to the outcomes of this inquiry as a valuable input to the review of the ACT greenhouse strategy.

Thank you very much.

THE CHAIR: Thanks very much, Bill.

We've now come to the time that we've set aside for questions from the audience of our speakers, Gary Voss and Bill Logan. If you have a question, please use the microphone so that the questions can be recorded for posterity. When you approach the microphone, please say who you are if you represent an organisation. We'll see how we go with answering the questions. We're shy, it's early.

Mr Abbott: Derek Abbot, I'm actually secretary to the committee. As Gary pointed out, transport is the big consumer in many ways, but the one hardest to deal with. Can I perhaps ask Environment ACT: as an energy consumer, how do you deal with transport and making effective savings there?

Mr Logan: Well, I can only talk in general terms, I think. But there is a master transport plan, either in place or being developed, for Canberra. The area of that that I'm familiar with is the travel smart program, looking at several components of any new initiative. You need some ground rules; you need some incentives to encourage change; you need community support; and quite often you need to change the culture of a community, particularly in relation to transport.

There's some initiative being developed there at the moment, some pilot studies being developed, in conjunction with the Commonwealth, on providing a personal travel program for commuters—look at where they live, what the transport options are, where they work, whom they work with and where they live—and design a travel program for a group; compare that with an equivalent group which doesn't have a travel program. They've done it elsewhere and there have been some quite significant changes in people's behaviour in terms of public transport. That's an area I have some familiarity with.

I don't have an answer for the bigger picture, other than it's a major challenge, and we've only got to look at the issues that appear in the paper, on a day-to-day basis in the ACT, on transport, private car versus public transport, highways versus railways. Of course, it's a major use of energy and a major source of gas emissions. So it's a multi-pronged approach, and I don't see any easy answers.

Mr Walker: I'm Rob Walker. I don't represent any agency. I've got a question for Gary. You made a statement about the energy efficiency of electrical appliances. You said that there are no mandatory standards for those appliances in the ACT. I'm under the impression that there have just been some amendments made to the electrical safety act, to introduce those sorts of standards which will match those of the MEP scheme. Are you able to comment on that?

Mr Voss: Yes. The question was about my reference to the absence of mandatory efficiency standards for energy-consuming appliances. I'm not aware of the changes to the relevant regulations that make those sorts of efficiency standards mandatory.

I guess I'm looking at the broader picture, right across the market, for electrical and gas appliances. As best I can judge, there weren't any mandatory standards. So if I've got that wrong, then I apologise. It's good to see that mandatory standards are being brought in.

Mr Smedley: Denis Smedley from the AGO. Perhaps I can just add a little to that. I don't know a lot about it; it's not my area; but the standards to which he referred, mandatory energy performance standards, are gradually being introduced but only on a limited range of things—for example, electric motors. There are minimum standards for performance and efficiency that will be introduced, that'll hopefully reduce the energy consumption of any appliances that use electric motors. I think that was what was being referred to. They are gradually being ranked up, and new targets are being sought.

THE CHAIR: So, what sorts of appliances?

Mr Smedley: Refrigerators, air-conditioners, anything that uses an electric motor.

Mr Ridley: Derek Ridley, I'm from Nature and Society Forum. I've got questions for both speakers. Firstly, Mr Voss. I understand the windspeed in Canberra is a bit too low to support wind generation electricity. Our other speaker mentioned the building of the pilot plant, I think it was at Mugga tip. Is it a good thing for Australia to be burning, by pyrolysis, green waste when we have a terrific soil deficiency? Should we be burning organic matter to produce electricity?

Mr Voss: On the first question: the ACT is not the windiest place in the country, by a long shot. You only need to travel around the south-west of Western Australia to find the windiest place in the country. The coast of South Australia, some of the more western parts of the Victorian coast are all wall-to-wall with wind-farm developers because those are the big wind resource areas in Australia.

Australia in toto is not a particularly windy place, when you compare it with Europe, where there are gigawatts of new wind energy being installed, as best one can judge. I qualify that. Australia is not windy in the places where we need the energy. It's very windy in some places where there are no people.

In the ACT we're committed to finding the wind. There is wind; there are marginal wind resources available in and around the ACT, and we are committed to finding those and, if it can be done, making commercial wind farms out of those wind resources.

THE CHAIR: Do you want to answer the question about burning biomass?

Mr Logan: Yes. Just in relation to the question about should we be burning organic material to generate electricity: this is a pilot study, and it's using putrescent material that otherwise might go to landfill. There would be alternative uses for such material, I'd imagine, such as going into composted material for use elsewhere.

I think if you look at it overall, it's an advance in a small area where technology's being explored. It might need to be incorporated into other uses of organic waste and considered against alternatives which are also being considered for electricity generation, such as burning woodland timber or other non-renewable material. It's a part of the picture.

I don't have the answer directly to your question, but I expect it to provide more options to consider.

Dr Blakers: My name's Andrew Blakers, from the Centre for Sustainable Energy Systems at the Australian National University. Europe is a pretty windy spot, but Australia knocks the socks off Europe in terms of wind resources. Just to illustrate this: the half-million square kilometres of south-west Western Australia has got enough land at conventional wind-generated spacings for 50 or 100 times our current electricity production. We have an extremely long coastline in the roaring forties, far longer than the European continent has, and we really have a phenomenal wind resource.

It's certainly true that we are unlikely to be able to transport electricity from Western Australia. Fortunately, however, there's a very large coastline also in Tasmania, South Australia and Victoria, and in many of the elevated parts of inland Australia there is a large wind resource.

If Australia chooses to develop wind generators on a large scale, we could phase out the coal industry altogether. This is not likely to happen any time soon. There is a cost problem of course, but the resource is not lacking.

Mr Voss: Yes. I saw you wincing when I mentioned that, and, pretty much, you're right. The issue, however, is that there are very few people in that million square kilometres. The challenge we have is transporting that amount of energy that distance.

In terms of phasing out base-load generation using wind generation, one could spend days and weeks discussing that. The fact is: we don't want our electricity to stop when the wind stops blowing. Therefore we would need fabulous diversity, seasonal and geographic diversity, to actually phase out the base-load power, simply because we're not prepared to face energy cuts when either the sun stops shining or the wind stops blowing.

These are very difficult issues for the industry, and ones we're committed to solving, but it goes some of the way to explain why only 2 per cent is generated from renewables at the moment.

Mr Weir: Jim Weir, I'm from the Nature and Society Forum. I have a question for our colleague on the left on market cost for green electricity. I have been a subscriber to green electricity. At some stage recently the bulk of the charge became a fixed charge rather than a unit charge, and the premium for green electricity went onto the base charge. I'm a very small user of electricity, being something of a conservationist. I received a bill for $73, which is perhaps minuscule to a lot of people, and $45 of that was the surcharge for green electricity. When that was taken away, the charge was $28. How the green power is at the marginal purchase price, I fail to see, actually.

Mr Voss: In the green choice program we pass through 100 per cent renewable energy to customers. Until, I suppose, 18 months ago we passed that through as a proportion of usage or just as a premium on each kilowatt hour that went through the meter. It was recognised that that was administratively very challenging.

About 18 months ago the program was changed so that, in effect, you have two options with green choice. In each option you buy a bundle of green energy. I forget the exact numbers, but there are two options. One is about a third of household energy, and one is about a half of normal household energy. So you actually buy a block of greenness, if you like, of those renewable energy certificates, and you pay for that in one lump.

If you use a very small amount of electricity I would suggest that that probably creates something of an issue because you're probably, as you describe, buying more greenness for your electricity than the actual electricity you're using, because the minimum package is about a third of normal electricity. So I think that for very small electricity users you could in fact be overbuying the green because there are only the two packages that are on offer.

I recognise that could well be an issue. We'll have to think about it.

Mr Weir: Yes. But it hardly encourages conservation.

Mr Voss: Yes. But can I just touch on the pricing. We sell green energy for about $49 a megawatt hour. You buy the premium for about $40, and built into that is the administration. As we've said, there are only 4,200 customers. Administering it is quite a large cost. We do actually not make anything out of that green choice product.

Mr Weir: But the premium does not go onto the unit charge.

Mr Voss: No.

Mr Weir: It's a nonsense.

Mr Voss: On the electricity market you actually buy a certificate which makes your electricity green; that's the way the commercial market works. Clearly, we can't buy green electricity.

Mr Weir: Yes. You spoke of a gas-fired power station. What sort of plant is that going to be? Is that going to be a stand-alone plant, with heat through the cooling tower?

Mr Voss: As I mentioned in the presentation, there will, for the foreseeable future, be a need for fossil fuel generation of electricity. Therefore, we need to make that fossil fuel generation as sustainable as we can. Gas is a far more sustainable fuel than coal for fossil fuel generation. So we're looking at whether we can make commercial a gas-fired power station in or around the ACT.

That would be a grid-connected power station that would trade on the national electricity market because one is compelled to do that in the national electricity market if you're on the grid. But we would make the necessary commercial arrangements so that the energy from that power station would be brought predominantly into our ACT load.

Mr Weir: Yes, but you wouldn't consider co-generation for instance?

Mr Voss: The type of power station we would install would be a high-efficiency gas-fired power station. If a base-load power station is built it would be what we call a combined-cycle power station where you use waste heat. Co-generation is very challenging in the ACT because co-generation implies that you use the heat for something else.

Mr Weir: Yes, indeed.

Mr Voss: We simply don't have the industry to use the heat. So it probably wouldn't be co-generation, but as a base-load unit it probably would be a combined-cycling unit, which is high efficiency.

Mr Weir: Thank you.

Mr Wills: Ray Wills, I'm from that windy place in Western Australia. I'm actually here on behalf of the Economics and Industry Standing Committee of the Western Australian parliament, as a researcher. I'm interested in the fact that the electricity utility is combined with water. I'm correct in that assumption?

Mr Voss: We manage the water assets, but the water assets remain owned by the ACT people.

Mr Wills: Sure. I attended a water forum in Western Australia over the last few days, and one of the issues that came up was the question of desalination. Of course, the solution to that problem needs to be driven by energy. The integration of these two utilities here provides some interesting perspectives, I guess, on how you manage for both resources in terms of energy consumption. I just wondered if you had some thoughts on that, particularly to do with desalination.

Mr Voss: Well, we're very fortunate in the ACT, albeit at the present moment there is something of a crisis in regard to our water supply, that we have a substantial water supply. That it is a very low-energy water supply, if you like. The rain falls in the surrounding hills. For the most part, apart from our Googong facility, the water flows into Canberra without any energy. In fact we extract hydro energy from the water flow into Canberra from our Cotter catchment dams. So the issue of energy use in our water supply really hasn't ever been one that we've had to face.

Mr Kerans: I'm Garry Kerans from Integrated Ecovillages. We're private consultants in the water and energy industry. I have a question in regard to co-generation basically and the likelihood of linking through a localised co-generation plant. Because of the requirements in the ACT for a heat load in winter time, there's the necessity to back up both solar and wind during the times when those items aren't on supply. The utilisation of wood and wood waste, or something like that, in a more renewable system, links through to the sewage disposal that ACT has a problem with.

So you're actually generating trees, growing the trees, utilising the carbon dioxide and then using that resource again to produce energy on a localised basis, without the transmission losses. Has any work been done on that at the moment, Gary?

Mr Voss: It takes a bit of getting one's head around. The work has been done and work is being done now by our organisation, along with a number of developers, to create sustainable environments in and around the ACT, sustainable developments on a whole new suburb and development basis. However, I don't think that any significant work has yet been done of the type you describe.

We are mainly looking at making small communities self-sustaining—that is, using solar hot water, putting photovoltaics on the roof and then buying in green energy to top up, to make them energy sustainable. We're looking at water recycling, at capturing storm water and capturing waste water, recycling those to put them back onto open spaces and the like. We haven't yet looked at the type of thing you describe, which is a much more integrated approach.

Mr Kerans: Yes, we'd suggest that gas also has a fairly short shelf life in geological time and it still is a greenhouse gas; so it's not going maybe far enough in terms of looking at a fully renewable strategy in the long run anyway.

Mr Voss: No, gas is a fossil fuel and it's a very valuable fuel because of its high conversion efficiency. But we don't have a lot of gas resources on this side of the country. We have some pretty substantial gas resources in PNG, in the straits and over in Western Australia, all of which are a long way away, and that puts a price premium on the east coast that will certainly constrain their use.

So we treat gas as a very valuable commodity. That's why ActewAGL, in selling electricity and gas, is in a position to strongly push this optimisation proposition that I described. You only use gas for things gas is ideal for; you only use electricity for things electricity is ideal for; and basically you fill the gaps. You start being as energy efficient as you possibly can. Certainly we don't want to see gas burned simply because it's there, because it's too valuable a resource to be wasted.

Mr Kerans: Just one further comment. I understand CSIRO are undertaking research into wood gasification as well. That may be a supplementary resource for top-up as well.

Mr Voss: I'm unaware of what you're describing, wood gasification. The burning of wood and cellulosic matter to create energy is a fairly difficult issue, for a whole raft of stakeholders in the energy business. It's very emotive to take wood, whether it's from a tree, the forest floor or anywhere else, and burn it. It's a challenging issue for us.

It is renewable; you can keep growing wood and putting it in the fire, but it isn't a zero-emission energy source. There's a clear difference between zero-emission energy, with the wind, solar, waves and so on, and renewable, which is when you are burning your wood to create energy and the like, because those still have greenhouse emissions. The whole issue of pure zero-emission renewable versus renewable fuel but not zero-emission is quite a challenging one, and wood is right up there.

Mr Kerans: Yes. I also note the Swedish authorities are supplying gas wood pellet co-generation plants in quite large numbers in the cities because it has very low emissions. If the emissions are constantly recycled there are no emissions; there's just a loop occurring.

Mr Voss: Yes, that's the wood sink taking everything else.

Mr Kerans: The wood sink, yes.

Mr Voss: It's a complex issue.

Dr Schuck: Steve Schuck from Bioenergy Australia. If I can just come in on the tail end of that question. In my presentation I'll be providing quite a bit of information on life-cycle carbon dioxide emissions of bioenergy, and it can actually go negative.

Mr Voss: I stand corrected.

THE CHAIR: I think, from what we've seen so far, there are many questions to be answered, there are many issues to be considered and, although we're all sort of on the one path, there are still a few divergent tracks that we need to bring together. We need to actually spend a bit of time and a bit of energy on getting all our facts in order. I hope that this has been the beginning and the rest of the day will help us down that path.

Thank you very much for your attention.

The next session will be chaired by my colleague from the Planning and Environment Committee Roslyn Dundas. So she'll welcome you back after morning tea.

Short adjournment

MS DUNDAS: Thank you all for returning. As Vicki said, I'm a member of the Planning and Environment Committee of the ACT Legislative Assembly. We've heard earlier this morning about what's currently going on in the ACT and why it's so hard to change that.

Now we're going to move on to the imperatives of change and why we do actually need to overcome those hurdles that we've discussed and move forward in finding new solutions for how we use energy in the ACT. We have two very well-researched and prominent speakers to discuss this with us this morning.

First off, we have Dr Hugh Saddler, who is the Managing Director of Energy Strategies, which is a Canberra-based consultancy company. Dr Saddler is an economic energy consultant, an analyst who has been fully engaged in the analysis of major national energy policy groups, both here in Australia and in the United Kingdom, as an academic, a government employee and a consultant for many years, with a consistent emphasis on the long-term environmental, social and economic sustainability of energy systems. He is a prolific writer in this area, writing many books, over 50 scientific papers, monographs, articles and conference papers on energy, technology and environmental policy, as well as any number of reports.

Energy Strategies, the company that he's managing director of, employs scientists, engineers, building designers and communication specialists and is nationally recognised for its expertise in greenhouse issues, energy management and science communications. I'm quite pleased to have Dr Saddler here with us today, as he is a member of the ACT Sustainability Expert Reference Group and the ACT Environment Protection Technical Advisory Committee, as well as many other things that he seems to do with his time. We're very glad that he could join us today.

The paper that he is going to be presenting has been drawn on from his work with the Energy Policy Group of the Australian CIC for renewable energy, but he does not speak on behalf of this group; it's just part of his background information. Dr Saddler.

Dr Saddler: Thank you very much for that introduction. As Roslyn mentioned, I've been in this game for a very long time. When Vicki Dunne was giving her introductory speech, it reminded me that the very first energy policy related study that I worked on was in the UK; it was a long-term study of the future of the UK transport, done by a sort of informal non-government group, chaired by a bishop, I might say. That's the way they do things in the UK.

I was working on the energy part of it, and we were doing that in the latter part of 1973. While I was halfway through talking about oil and so on, the first oil shock happened. So that was an extremely dramatic introduction to me as to the way things can change.

As Roslyn said, I have drawn, in part, on the wisdom of my colleagues on the ACRE policy group in preparing this paper. I was also asked to convey the apologies of the Canberra group of the Australian Institute of Energy's Ross Cowper who apologises for not being able to get along here today.

My talk this morning is in three parts. First of all, I'm going to spend a few minutes just talking about the fundamental issues of why we think about the sustainability of the energy system; then I'm going to give a little bit of information about relative costs of different ways of becoming more sustainable; and then I'm going to give a very thumbnail presentation of a study that I've been involved in on a long-term scenario for a low-emissions energy future for Australia.

First of all, the reasons why our present energy system is not sustainable. I think we all know these basically. There three fundamental reasons. First of all, it's based on non-renewable fossil fuel resources that are ultimately finite. Interestingly, in the 1970s, the oil shock era, the concern about those resources was the driver for everyone getting interested in sustainable energy.

Secondly, there is CO_2, climate change and so on. That, of course, is the main driver these days for the need to move to renewable energy systems, sustainable energy systems.

Thirdly, all the time, when you look at all the other environmental pollution and environmental impacts of energy, in general, you find that an astonishingly large proportion of pollution-type impacts on the natural environment are associated with different parts of the energy supply system, particularly the fossil fuel-based system. The less fossil fuel energy we use, as a generalisation, the less all these other impacts—from air pollution; water pollution; pollution of the seas from oil spills and so on; and so on—will be.

While we need to do something now—and it's so good and important that the committee is having this inquiry—we should be concerned about the inertia of all the systems that we try to influence. The global climate system, as we know, has a time span of centuries for the changes we're talking about. Even if we didn't put any more CO_2 in the atmosphere instantly now, some sort of climate change is just going to work its way through over decades, if not centuries.

For energy supply systems and investment in energy supply systems, the infrastructure is very long lived. There are parts of those systems that are 60, 70, 80 years old and still functioning. That's also true for the energy-using equipment and systems. I can mention examples of bits of energy-using equipment that are still in use. there are actually very large electric motors at the Port Kembla steel mills, which they keep on rewinding and rewinding, but the frames have been there since the mill was set up there in the 1930s. I think there are even some that they moved down from Lithgow that were older than that.

But think about roads and railways. They're all part of the energy-using system. Most of the railway systems, of course, are well over a hundred years old—the permanent way, the alignments.

Turning to the ACT and what's happening here: we've already heard a lot about this, so I'll just go through this quickly. The ACT government does have a strong commitment to sustainability in general, as you know. It has made, as we heard from Bill Logan, an undertaking with respect to its own emissions and greenhouse gas levels.

There is a national undertaking by the Commonwealth government that Australia's emissions will be restrained to the Kyoto protocol level, even though we're not actually going to join the protocol. The consequences of not ratifying mean that the sum opportunities that might be available internationally, through various trading and flexibility mechanisms under the protocol, actually won't be available to Australia to offset some of our emissions.

If things become more formal or more mandatory in terms of emissions down the line, in Australia there is certainly no sort of logic, in a policy sense, in a target being allocated and divided up geographically by jurisdiction. In general, if you look at the prospects for the growth in emissions, it's going to be much harder for some states—and I mention there Western Australia and Queensland because they have a lot of new developments in the process industries. A lot of these are actually exporting energy, including low-emission fuels like liquid natural gas. So they're growing a lot more.

If Australia's got to have an overall restraint, you might think that areas like the ACT would have to have a somewhat stricter constraint. Being cautious and precautionary suggests we should be doing something here.

For the second bit of my talk I drew very much on Alan Pearce, who's an extremely well-known expert energy consultant, a member of the ACRE policy group, for this very useful table on the relative costs of the different ways that you can reduce CO_2 emissions. This is sort of related to energy. This is in the context of, say, a business, a manufacturing company, that will need to reduce its emissions.

You've probably heard quite a lot about .sequestration in forests, buying credits from trees, and so on. That is \$5 to \$30 a ton of CO_2. He worked that out on the information that was available. If there were a trading system, the sorts of prices that people talked about for permits ranged from \$7 to \$50 a ton of CO_2. Some people have said they'll be much higher, but of course the price of the permits depends on the severity of the target that they're designed to meet.

Green power works out at that sort of price, if the premium that you're paying for green power is 3c a kilowatt hour. It's a little bit more, I think, on average in the ACT. That's correspondingly high. This is assuming you are displacing your average New South Wales pool electricity. That's how you get your savings from the CO_2.

Co-generation: just assume, as the nominal price, that it costs 1c a kilowatt hour more than buying the electricity. On a lot of projects, co-generation might cost more than that. But if it does cost 1c per kilowatt hour, that equates to about \$10 to \$15 a ton of CO_2.

Then at the bottom, there are three energy efficiency options. This data was developed for presentation to businesses which are reviewing their options. Obviously, that depends on the return on the efficiency investment, expressed in terms of payback—seven years, five years. At about the six-year payback, it's a sort of zero cost. At a short-term payback, effectively, your CO_2 abatement has negative cost. What that means is that the energy efficiency is, what is termed in jargon, a no-regrets measure; that it's justifiable on its own right, and that any CO_2 reduction that it achieves is a complete bonus.

The significance of all this, in talking to business and industry, is that there are lots and lots of businesses out there that won't actually look at energy efficiency investments on any scale, or will do so only when they have a one to two-year payback. In fact, they could very well get a return at a much longer payback period than that.

What have been the policy implications I think there are a number. First of all, the obvious point that I've just been making is that, in the short-run, energy efficiency is the lowest cost option that a business would have to reduce its emissions if there's going to be a penalty on CO_2. In the long run, though, it's unavoidably true that both energy efficiency and renewable energy will be needed; and that will be seen very much in the third part of my presentation.

Renewable energy: the key point about it is that it does have a lead time. We've got to build up the industries as well as develop the technologies. Therefore, it's important to start now. In other words, the two—renewable energy and energy efficiency—do need to be pursued side by side.

The fourth point, which is extremely important and which is often overlooked or not specifically stated, is that if you're having a renewable energy project it's absolutely essential that you also use that energy with the maximum efficiency that you can. Another way of putting that is that, as Gary Voss' figures showed, renewable energy at the moment is generally more expensive than, say, grid-purchased electricity. If it's more expensive, then you can justify a higher expenditure on improving your energy efficiency. So a higher level of energy efficiency becomes cost effective.

That, in turn, means that you don't need as much renewable energy or renewable electricity to do the same services, the same useful things, that energy does for us, as you would if you were purchasing the much cheaper or the somewhat cheaper grid-type electricity. So they're essential partners for each other.

The final point, which I expect we might hear a bit more about from some speakers later today, is that both energy efficiency and renewable energy provide more local economic benefits than doing things like buying credits in a training market or possibly buying sequestration credits from elsewhere.

These are my recommendations, for what they are worth, based on that sort of analysis. If we do have a goal to reduce greenhouse gas emissions in the relatively short term now—2008 is when the Kyoto commitment period starts, and that's not a very long way off—increasing energy efficiency just has to be given top priority in the short to medium-term reduction of greenhouse gas emissions. It's undoubtedly the case that there are some renewable energy technologies and projects which are cost effective right now alongside energy efficiency. Solar hot water of course is a very good example of that.

Looking to the slightly longer term: beyond the first commitment period, you need to undertake investments now in renewable energy, for strategic reasons, because it's going to be so essential in long-term sustainability of our energy systems, for all the reasons that I talked about earlier.

As regards sequestration projects, that is, planting trees and leaving them there: I think it can't be justified at the moment as a greenhouse abating strategy on its own. I think it is a potentially very valuable adjunct to revegetation forestation activities. Our forestation activities that are taking place have been driven primarily by other reasons, other environmental reasons: protect the environment, protect agricultural soils, reduce salinity and all the other reasons that I think we're pretty familiar with.

It can also have financial drivers on farms and diversify farming. Some trees, which you harvest, will make it sustainable so that you can harvest, replant and protect. You can get some CO_2 credits for that. A CO_2 credit is really a bit of bonus.

I'll go quickly through the third part of my talk. This is based on a study that's been done through the Australian Institute. That's a think-tank located near Canberra. This study is actually at the printer now; so it will be available, probably, next week I would suspect a copy can be made available to the committee. The four authors of this study are here.

There are a few points about it. It's actually a greenhouse study; it's not a sustainable energy study. The goal was to see how emissions could be reduced in total, and that included emissions from non-energy sources such as agriculture and livestock. You'll see that they actually account for a very large proportion of the total when you have much-reduced energy sector emissions.

We set ourselves, as the end point, 2050. It's a kind of a 50-year study. It's important to say that this is just a pilot study. We call it a pilot study because we just get a snapshot. We said: can we imagine a future in Australia which has these very low levels of emissions? What we did not do, and have not done yet, because it's a much, much larger research project—and we would certainly like to thank the Australia Institute for this study; we'd certainly like to get funding to do it—is study the transition all the way through, say, at five or ten-year intervals because that tells you much more about what sorts of policies you need to start implementing now to get to the end point.

This study now is just, if you like—another way of putting it—a vision of what could be. This is how it was done: projections were made for economic growth going right forward for that period; projections for sectoral shares of emissions and all the different sectors of the economy; what shares they would make up in 2050, as opposed to now, because different sectors of the economy have different emission intensities, so that changes in the overall structure of the economy have implications for what the emissions might be.

We picked the greenhouse intensive sectors—various sectors of manufacturing, other bits of the energy sector, some areas of agriculture and so on—and we did a reasonably detailed review of what the technical possibilities were, what technologies could be in place by 2050. Then we also looked at the costs and put it all together. Some assumptions were made in doing that. As I said already, a 50-year time horizon was envisaged. We didn't think about the paths because that is a much bigger study.

We also made a couple of other key decisions that we would not assume any energy technologies that don't already exist. They are known to be technically feasible and potentially could be made commercial. So there is no magic solution that's going to pop out because it does mean that we use technologies and assume technologies that are really in their infancy deployment now—all the renewable technologies that we'll be talking about today; the so-called land-locked fuel cells, both in transport and in residential and buildings, and so-called micro-turbines, which are all technologies which are just beginning to come in now.

We also assumed that the unit costs of delivered energy to the consumer would not be higher than they are in Europe at the moment. On average, they're two to three times what they are in Australia. So if you take it across the EU: if you look at the price of electricity and the price of transport fuels, you get extremely high levels of taxation and two to three times what we pay for the different fuels. It is possibly not so high for gas; they are a bit less for gas. It's all in the paper, when it comes out.

But we thought that was also a constraining assumption; in other words, we're not talking about something which is completely outlandish. We also assume that the rest of the work isn't moving to cut emissions at the same time.

That's just quickly to show we didn't assume the methodology. We assumed that GDP, which is the top line, was going to keep on growing and that GDP per worker, which is the second line down, also was going to show a relatively modest growth in the work force and hence in the population. I won't expect you to be able to read the detail of that.

The main sectors, reading down, are: the blue one at the top is transport. Then there's construction. Waste is small. The big dark brown one is agriculture land-use change, forestry. The ones at the bottom are the energy sectors—residential and commercial, mining or manufacture. You can see we didn't shrink agriculture as much as the other sectors.

If this were just seen as an energy sector study, of which a number have been done in Europe and, to some extent, in the US—and I should say that this study was partly modelled on an approach adopted by the UK a year or two ago—actually, in terms of energy, what we did here was actually a much harder or a much stricter reduction than the European ones because almost all the greenhouse gas emissions in most European countries were to do with the use of fossil fuels for the energy system. They have negligible net agriculture sector and land-use emissions. In some European countries the energy emissions are more than 100 per cent of their net emissions. In some ways—and this is in regard to energy—we did allow something more than a 70 per cent reduction.

They are the changes in the energy supply system. I won't go through all that on the left-hand side; that's current systems, current sources of energy. I'll just point out the big changes on the right-hand side. We've got a lot of heat associated with co-generation projects and then we have the various renewable energy sources; plus we do have a large chunk of natural gas still which is the big greyish looking block at the bottom of the two columns on the right hand side. Both show gas as a fuel for industry and power generation. That is a final-consumption fuel. So natural gas is still very important as an energy source.

Coal, which is the big, dark block on the left-hand side, is being almost phased out because it is, of course, a very high emission source of energy. It's the same for the electricity generation and the big sectors over there. We do have a lot of biomass energy in the electricity generation sector. That's the hatched one in the third column over. Stephen Schuck will doubtless be talking about this afternoon.

We also have a lot of co-generation. As a source of final energy for industry, we've made some pretty, I suppose, rather heroic assumptions about the extent of co-generation, which is the big, hatched looking block in the final energy on the far right-hand side. We're assuming that most of industry has co-generation, that is, the heat is generated or produced in association but also is generating electricity, which gives much greater efficiencies overall.

From there, we have the actual proportions of renewable energy that we had in our mix. There's a very large amount of biomass, which does present big challenges, and a lot of wind, as you can see. There are some issues that we saw around wind. The second point, in particular, I think is key and is already getting to be an issue now. There's not a coherent process. Some states are better than others, but there are still a lot of problems and local opposition to wind farms because there isn't this overall strategic approach as to where they can be and where they may not be.

Photovoltaics: we assumed that it was still going to be more expensive than the other sources of electricity, so it doesn't have a huge share.

There were some issues about biomass. That's what we saw as the implications of what we had then. Biomass, in those scenarios, was actually being used in three ways: firstly, it was being used to generate electricity, but mostly in co-generation. We assumed that a lot of it was going to be gasified and used as a fuel for industry in a gasified source. It's also a major source for transport fuels, whether that be ethanol or some other sorts of liquid fuels made from biomass. I think this is probably the most heroic set of assumptions that we had to make.

Since we actually did all these calculations a few months ago, the drought has got more severe. I'd be really interested to know what Stephen Schuck thinks about this because it does make me wonder whether we're really just being too optimistic or too heroic in the assumptions in biomass production, which depend on the land and on the rainfall.

That's just more data about biomass. The last point is interesting, though: the total amount of biomass energy in our scenario was less than they actually produce in Brazil today. Of course, Brazil has got far more high-quality agricultural land area than Australia does.

Some brief conclusions to the study: we think it is feasible to cut emissions by 60 per cent and the energy-related emissions by about 80 per cent at a reasonable cost, but it does require some radical, huge changes. I think there are going to be environmental trade-offs. This may be a point where there is a slight difference of views among the various authors of the studies as to how extensive these might be, but there are issues to do with wind generators, with biomass implementation and with forests.

As I said, that study will very shortly be published in full detail. Thank you very much.

MS DUNDAS: Thank you, Dr Saddler, and thank you for that sneak preview of a report I'm sure we're all looking forward to reading with interest.

The next speaker on our agenda is Dr Andrew Blakers from the ANU. He is the Foundation Director of the Centre for Sustainable Energy Systems, which is a group of staff and PhD students working on various aspects of solar energy. Dr Blakers has a physics degree from the ANU, his PhD from the University of New South Wales, is a Humboldt fellow at the Max Planck Institute for Solid State Physics in Stuttgart and has held ALC, QEII and senior research fellowships prior to becoming an academic at the ANU.

Dr Blakers: Thank you very much. I'm going to focus on what I think the ACT should do to meet its targets. I think the ACT can meet its targets without a great deal of sweat, and I'll tell you why in about 20 minutes.

Beforehand I want to give you a little bit of background on energy technology and some of the details of the solar energy R and D work that we do at the Australian National University. The energy sources available to humankind are just four: fossil fuels, that's oil, gas and coal, nuclear, at the moment confined to fission but fusion is a 50-year-distant prospect; solar, which I'll come to in a moment; and then a bunch of others, tidal and geothermal being the principal.

We don't do nuclear energy in Australia and we have no tidal or geothermal in Australia. There is some prospect for hot rocks, but really I think solar and fossil are what we've got.

Let us look at what solar energy actually means. It comes in two basic classes: direct, which is when the sun shines directly on your collector; and indirect, where the sun does something to the atmosphere generally or to the sea and causes energy then to be available for harvesting.

Let us look at the direct, low-grade heat. This is what you would have in a well-designed solar house: photovoltaics, which is well known, of course; and solar hot water. These sources of energy are very widespread and are available in the ACT and throughout Australia.

Within the ACT there is also a moderate potential for solar thermal electricity, where sunlight is focused and converted to steam which drives a steam turbine; and solar thermo-chemical energy storage, which is closely related. Wind energy in the ACT is essentially zero, but in the ACT district there are some prospects for a substantial amount of wind—but nothing near as large as direct solar. There are very little prospects for additional hydro in the ACT area and not much prospect for biomass; we don't have very productive farmland in the ACT area. We have no waves and no ocean thermal, of course.

I'd like to differ very markedly from the previous speaker on the long-term future for solar energy in all its forms. In my view, the only two technologies that, in the long term, can provide really substantial sources of solar energy are photovoltaics and solar thermal electricity; there is no other technology even remotely on the horizon that can match these two. There is one reason why that this is the case, and that is that the energy conversion efficiency of these two technologies is in the range of 10 to 20 per cent, whereas the energy conversion efficiency of biomass is in the range of less than one per cent. This means that the amount of land required for biomass will be 10 to 20 times larger for a given energy output than for direct solar conversion. This is a crucial point when you're starting to talk about replacing all the fossil fuels in the 50-year time frame. Direct solar will win out easily over biomass; they do not have the fundamental conflict between biomass production for energy and biomass production for food and forestry.

Turning to what we do at the ANU—and I'll go through this fairly quickly just to give you a flavour: with 42 staff and PhD students, we have an annual turnover of about $2.5 million, mostly driven by commercial projects. There's been a complete withdrawal of federal government support for renewable energy research and development over the last five years, and the only sources of money that we can now access are the Australian Research Council and private money. This has led to the collapse, one by one, of all of the renewable energy research groups in Australian universities bar two: the one at the ANU and the one at the University of New South Wales. There is a really severe, long-term problem here. But that's another story.

The centre is divided into two areas: one is the photovoltaic group, which works on three commercially-oriented projects; and the second is the solar thermal group which Keith Lovegrove will talk a bit about later this afternoon. We are about 80 or 90 per cent commercially sponsored. A list of our current sponsors is on the right-hand side.

Looking at photovoltaic production: this is the graph that makes us all really excited. It shows a growth rate of about 30 to 40 per cent per year, and it's not difficult to show that in the year 2048 the entire surface area of the earth will be covered by solar cells.

One project that we are heavily engaged in, with a company called Origin Energy, is the epilift project. I can't talk much about this, but this project has gone super well and there is a very good chance that it's going to end up in a large-scale manufacturing plant somewhere in Australia. We're still talking about that. There might well be an announcement in mid-November on that score.

Another area that we work in is with BP Solar, Australia's current only solar cell manufacturer, based in Sydney, where we have a brief to sneak their efficiencies up without them having to spend large amounts of capital.

The third area that we work on in photovoltaics is the solar concentrator systems, in conjunction with Solarhart and Rheem; they're the same company now. This is the Rockingham project that we constructed in Perth. It consists of sun-tracking mirrors that focus light up onto a receiver. I'll continue to talk on; hopefully, the projector will come back on. I was going to show you the solar cells that we produce at the ANU and are used in this system in Rockingham. We have a program to commercialise those solar cells, in conjunction with a certain private company.

I'll come back to some pictures of our work if we get the projector working again. I'd like to turn now to what Canberra can do to meet its targets. Canberra has a target, I believe mandated by the Assembly, of getting back to 1990 levels by about 2080 in terms of carbon dioxide emissions and being 10 or 20 per cent below another decade later.

A really important point to make about this is that Canberra differs from all other jurisdictions in Australia. Canberra has no electricity production, no coal mining, no oil production, no gas production, no heavy industry, no net land clearing and hence no vested interests in the generation of greenhouse gases, apart from ActewAGL which has a vested interest in that it is a wires business. So Canberra has a jurisdiction which does not require an intensive lobbying effort in order to introduce strong greenhouse emission controls.

The second point I want to make is that Canberra, because it has no vested interest in greenhouse gases emissions, has substantial economic benefits to gain from controlling greenhouse gas emissions. If we reduce our greenhouse gas emissions, then that implies that we have reduced our energy consumption. All of our energy is imported. Therefore, we are able to reduce the export of money to pay for our imported oil, gas and electricity; so we're back in line.

I'll just run through a couple of pictures of further Revell work and I'll come back to the point I was making in a few minutes. This is the combined heat and power solar system that we are currently producing at the ANU. It's basically a sun-tracking mirror system. These are parabolic mirrors that reflect light up onto these receivers. On the underside of these receivers are solar cells looking down at the mirrors; so the sunlight is reflected up to the solar cells and they convert about 20 per cent of the sunlight into electricity. The remaining 80 per cent of the sunlight is converted to heat, and that's removed by water flowing behind the solar cells. We push cold water in one end, and we pull solar hot water and solar electricity out the other end. The hot water is stored in a conventional solar hot water system tank, and the electricity is fed back into the national grid.

We're going to build a 300-square metre demonstration system on the roof of a new building at Bruce Hall at ANU next year, with support from the Australian Greenhouse Office, Rheem Solarhart and the ACT R&D scheme. This is a picture of a one-twelfth scale of the system that we will construct. You can see here the receiver running at the focal line of these mirrors, and the whole thing traps the sun in one direction. There's going to be a grand opening at this very spot in about two weeks time. and a number of people in the audience will probably receive invitations shortly if they have not already done so.

We also have a domestic version of this system. Once again, we have a receiver which collects both solar hot water and solar electricity. It sits on your house roof. The car comes free.

Turning to the solar thermal electricity systems: this is the so-called big dish at ANU, which generates steam at the focus of the receiver. Solar thermal electricity will not be cheaper than photovoltaic electricity, for the very simple reason that at the focus of the big dish you can put either a steam generator or a photovoltaic panel.

The cost of the system is the same. The cost of the receiver is about the same. Therefore, the cost of electricity will be about the same. So concentrating photovoltaic and concentrating solar thermal electricity are much the same in total, long-term energy cost.

You would have to store solar power if you're going to have 24-hour power. Once you get beyond 10 or 20 per cent penetration of the state grid you need to think about energy storage for when you don't have solar energy available. Of course, the wider geographical distribution and having different sorts of solar energy, such as wind power and solar thermal electricity, give you diversity and minimise the chance that the wind's not blowing or the sun's not shining anywhere in Australia, which means you've got a problem.

At the ANU we work on an ammonia storage cycle where the solar energy cracks ammonia to make nitrogen/hydrogen which can be easily stored. When you need the power, perhaps in the middle of the night, you can put the nitrogen and hydrogen back together again; you get heat and you can then make electricity. So you can image many big dishes creating ammonia; the ammonia is stored in natural gas pipelines and pumped to cities where the heat can be recovered in a co-generation system.

Finally, another area that we work on at ANU is phase change energy storage, where heat is collected during the day and used to melt certain materials. During the night the multi materials resolidify and release the heat, and you can store a very large amount of heat in a very small volume in this way.

Coming back now to what we can do in Canberra to solve our greenhouse target problem: the important thing to realise is that electricity is the major greenhouse gas emission source in the ACT, with transport a second-place villain in the piece. I reiterate the point I made: the ACT does not have any vested interest, apart from ActewAGL, in preventing the reduction of greenhouse gas emissions.

These are the technologies that will get us most of the way: solar water heaters available off the shelf, cost effective right now; photovoltaic—not necessarily in such a nice place as this, but photovoltaic on your house roof is not yet cost effective but I have little doubt that in another 10 to 20 years it will be marginally cost effective and in 20 to 30 years fully cost effective with any other generation source; house insulation, the number one thing, the easiest thing that we can do that will generate really large reductions in greenhouse gas emissions.

Let's look at how we're going to reduce electricity consumption in the ACT. This is the largest greenhouse emission source. Electricity is used as space heating and cooling. We need to go to 5 to 10-star buildings. We need to extend the star range, not just nought to five, but nought to 10. We reward houses and buildings that are really well constructed. We need to convert to solar heating. There's no reason at all that solar collectors cannot be used both for hot water, heating and for space heating, particularly in conjunction with energy storage devices such as phase change materials or thermal mass. We can convert to gas for a short-term gain, but in the long term we have to convert away from gas.

Water heating: we go to solar water heaters with gas backup. That's the obvious way to go.

Electrical appliances: once again, we need to extend the star range out to 10 stars and have really efficient fridges, really efficient lighting. All of this is just standard technology; it's mechanisms to introduce the technology that are the key.

Once we've done something about electricity, then gas will be a larger source because a lot of our electrical loads will have been shifted to gas. Once again, efficient buildings, solar heating and public transport will be the way in which we can reduce gas consumption.

Obviously, oil consumption is mostly used for transport and really we have only one option here, and that is to use public transport and stop building freeways. We can't continue to be dependent on the car; we have to stop at some stage.

A really important point is that greenhouse action creates employment in Canberra. At the moment we export money to import electricity, gas and oil. If we do something in Canberra—solar water heaters, insulation and the like—then we export less money and we use that money to pay for jobs in Canberra.

One thing about renewable energy technologies is that they are all more job intensive than oil, gas and electricity production. What's more, they are local jobs, Canberra jobs. So the winners, employment wise, from Canberra adopting strong greenhouse measures are building insulation installers, solar water heater installers, energy efficient designers and builders, public transport operators and solar energy R&D.

The losers are coal miners and gas and electricity workers in other states. Sorry for the Hunter Valley coal miner, but you don't vote in Canberra. Another set of losers are electricity production in other states and road builders here.

Greenhouse action helps the economy. The reason for that is that we're importing jobs by reducing the export of money to pay for imported energy. That means more jobs in Canberra, by definition.

We're spending the money somewhere, either on energy technology and infrastructure in other states or on local people to replace that energy import. The losers are oil, gas and electricity companies in other states. Sorry, they don't vote here .

If we want to reduce ACT greenhouse gas emissions by 50 per cent or so, how are we going to do it? Well, how about we retro-fit every house, every building in Canberra with floor, wall and ceiling insulation? I bought a one-star house not so long ago and I did this. I've cut my energy consumption by half. It's not very difficult. My house is now rated a four-star house, simply by putting in sensible house insulation in the floor, in the walls and in the ceiling.

How about we put solar water heaters on every building which has reasonable solar access? That's perhaps 50,000 solar water heaters. We weather-proof and zone houses. That means we block up the holes under door cracks, in vents and the like in the house. This is just stock standard technology. We install air vent systems progressively in houses—initially the houses of those who have more money than they actually need and can do it optionally and later, as the price of heating comes down, it's strictly on an economic basis. We save ourselves $50 million or $100 million a year, depending on how aggressive we are with this program in energy imports, and generate 500 to 1,000 new jobs in Canberra.

But who will pay and what is the mechanism for this? I propose a very practical scheme that recognises that the key problem has nothing to do with technology. Solar water heaters exist; it's a large industry; there's nothing space age about them. Fibreglass insulation, you just go and buy by the tonne; there's nothing magic about it.

Why isn't it done? It is nothing to do with the technology, but everything to do with the social and economic barriers to it. The number one problem is the fact that a householder looking at a $10,000 investment to do a really good job on the house isn't sure that they will even be living in the house in three years time. Canberrans do move house rapidly and they're not sure that they'll be in the house long enough to recoup the investment that they made.

The tenant has no incentive to put insulation in the house because he doesn't own the house. The landlord has no incentive to put insulation in the house because she doesn't pay the energy bills. There are a whole host of reasons why these simple measures are not taken up.

I would like to propose the establishment of companies that I'll call, say, Solarisation Pty Ltd, but it could very easily be Actew Solar Pty Ltd. It would consist of a consortium of a financier, the person who puts up the, say, $10,000 per house that would be required to do the job; a billing agency to recover that $10,000 at normal commercial rates of return over 12 years, which is the guaranteed life time of a top of the line solar water heater; a solar water heater installer, like Solarhart for instance; and an insulation installer. There would be some small seed funding from the ACT government, which will get its money back in payroll tax from the additional people employed in Canberra to do the work.

Solarisation Pty Ltd would advertise aggressively in the papers and on TV, with government support, to install solar water heaters; to come to your house and give you a quote on installing solar water heaters; to retrofit really good insulation right throughout the house; to retrofit other energy saving measures; to retrofit PV installations—if you've got an electric heating system convert it to a ducted gas system; and to do all the other things that can be used to reduce your energy bills. It would recover its investment over 12 years in the normal way, through quarterly instalments.

On your left you've got the old style account which you might get from ActewAGL and ActewAGL and other companies as of some time next year, I believe. You would have a gas account which might be, say, $400 in the winter months and an electricity account which might be, say, $250. The electricity account is primarily for water heating, that is, off-peak, for refrigeration and for other things that are on-peak at the moment.

The new style bill has a much-reduced gas component because you've really thoroughly insulated your house. The domestic load is down because you've got more efficient white goods. The off-peak load is greatly down because you're only using it for backup for your solar water heater.

Then you've got a solarisation bill, and this bill keeps coming for the next 12 years. This solarisation bill belongs to the house, not to you. If you move house, then the new owner also has this bill. It belongs to the house, just like rats.

The social benefits: well, landlords are winners because they will have warmer, quieter housing. One good thing about insulation is that it reduces noise. The tenants have warmer housing and lower electricity bills and lower gas bills. House owners get more comfortable houses, instead of iceboxes which take forever to heat up as they do with a bar radiator. They have a comfortable house that quickly reaches 19 or 20 degrees.

Building owners have low operating costs, if you do the same in commercial buildings. Everyone realises that they're doing their bit, and it adds to the warm and fuzzy feeling.

Where are the losers? Well, I'm not quite sure where they are. Successful greenhouse programs cause large reductions in greenhouse gas emissions, and this one will.

Cost-effective actions: well, this is using off-the-shelf, cost-effective technology right now. Without doubt, the solar water heaters and house insulation pay for themselves in Canberra's cold climate well before the solar water heater gives up in 12 or 15 years. It's a mixture of regulation and incentive, mandating higher and higher star ratings on your house, jacking it up by half a star every couple of years.

There's very little call on ACT government funds. What I would propose is that the ACT government tender for two or three Solarisation Pty Ltd companies to bid, and the winners of the tenders would be those companies that guarantee to solarise more houses for a given subsidy from the government seed money to get the scheme off the ground. For instance, the government might put up $1 million just to find out whether this scheme is going to work, and the winning tender might offer to solarise 1,000 houses if it gets this $1 million subsidy. In other words, the subsidy is $1,000 per house.

If this scheme works, then the ACT government might choose to put up $3 million or $4 million in a second round and so on. It puts a little finger in to find out whether it's going to work; and if it works it continues. If it doesn't work, then it stops.

Importantly, ACT government support will send a clear signal to everybody that it is the long-term intention of the ACT government to retrofit on a really mass scale. Doing something about new houses is fine; the fact is that the existing housing stock is where most of the energy is used and will still be used in the year 2020. We have to retrofit if we're going to do this seriously.

Transport, of course, is another issue that has to be dealt with. That's a bit harder. I would like to propose a rather simple alternative to new freeways such as the Gungahlin Drive extension. What I would suggest is something like a single, bus lane running from Woden to town, Belconnen to town, Tuggeranong to town and Gungahlin Town Centre to Civic.

In the morning the buses travel inwards along this single-lane road; and in the afternoon they travel outwards on this single-lane road. The important thing about the buses travelling on this road, the crucial thing, is that they would have traffic-light control. The traffic lights would switch to green before the bus arrived. That means the bus sits on 80 kilometres an hour all the way from Gungahlin to town, a 10-minute ride. This reduces the time for commuting from 30 or 40 minutes down to 10 minutes; it triples or doubles the speed of the bus, which means you have only half as many buses to move a given number of people; and it's the lowest possible capital cost for moving large numbers of people.

In summary, a really determined retrofitting program will yield more jobs in Canberra, less export of cash to pay for energy, and significant social benefits and can help us to easily meet the greenhouse targets that the ACT has set itself. The key feature is that retrofitting is required; and the other key feature is that it's not the technology that is required, it's the mechanism for investment of $10,000 per house to thoroughly solarise every house. That is the key feature of a really successful retrofitting program. Thank you.

MS DUNDAS: Thank you, Dr Blakers. That is definitely a step above what I was learning as a first-year physics student at the ANU about building the inside-out solar house. We're going to move onto questions now. Again, it is the same process. If you have a question, please step up to the microphone.

Mr Ridley: I thoroughly agree with everything that Andrew has said. I've been spending the last few years in retrofitting my own house, and there is no question that a mass exercise like this is absolutely essential. I have, however, come up with another idea which I know is very cost effective, and that is the use of solar reflectors on the southern side of the house which will reflect unused solar energy into the southern side. With the reflectors that I've got, I'm getting something like three megawatt hours of heat into the house over a heating season. The reflectors are much more cost effective than photovoltaics because they're doing different jobs, and at a ratio of 1 to 70. So the cost efficiency of these reflectors is very high indeed.

But there is one problem that we're going to face in the ACT, and that is we've all been busy planting large trees around our houses. You look at almost any house in Canberra—and I've been doing this—and a lot of roofs are shaded during the day. If you're going to put equipment on roofs we've got to solve the tree problem.

I've written to Lincoln Hawkins about this. I think it's in his too-hard basket. I don't think people know what to do about it. It is a problem, and it's something that we've got to solve.

I've just entered a solar house design competition down near Griffith. It is quite possible now to have sunshine in every room throughout the house all day long if you design properly at the beginning. It can be done by the use of windows in the right places, of course, and by the use of reflectors. So a lot of this is quite possible if we just bend our minds to it.

MS DUNDAS: Professor, do you have any comment on those things? Any other questions? Yes, please step forward.

Dr Schuck: Steve Schuck from Bioenergy Australia. Not so much a question as a comment. I dispute taking, let's say, the simple conversion efficiencies of photovoltaics and solar thermal as 10 and 20 per cent and comparing it to photosynthetic conversion of solar energy to biomass at under 1 per cent. I think one needs to have a look at the whole energy system, including the energy that went into the production of those photovoltaic or solar thermal technologies, and then looking at what happens with that biomass in its conversion, which could well be at 30 per cent.

I think it's a little bit simplistic to just say that one's a 10 to 20, the other is at SM1; therefore, one is superior. I think there's a great linkage between solar energy and biomass, and I've got some documents I can show you on that.

Dr Blakers: Yes, I'd certainly like to respond to that. The important point is the availability of well-watered and reasonably fertile land for biomass. One can imagine putting biomass out in the desert, but that doesn't work, for the reason there is no vegetation out in the desert; it's not a good place to grow things.

The fact is that the amount of land you would require for a given energy, whether that's heat or electricity, from biomass will be more than 20 times greater than from direct solar. The energy pay-back time for solar thermal systems is under one year. The energy pay-back time for instance for the epilift technology that we are about to introduce is under two years for photovoltaics. The energy convert pay-back time of photovoltaics within 10 years for all photovoltaic technologies will be trivial compared with the lifetime of the systems, a good deal less than 115.

MS DUNDAS: Any other questions? Any questions for Dr Saddler, any questions at all?

Mr Wills: Ray Wills. Just thinking about issues to do with climate change: I just wonder whether either of the speakers have considered the CSIRO climate change models. One of them is the potential for wind production or impact on wind production, which means that, as climate change increases, the wind zones are actually shifting in either hemisphere, south or north—in our case, south. There is the potential for a movement of that wind belt. I don't know whether that's ever been considered in relation to this issue.

MS DUNDAS: Dr Saddler, do you have any comments?

Dr Saddler: No, I don't really have any comment on that. It's obviously a serious matter to think about in terms of the long term that we're talking about and it's just an example of the complexity of the systems that we're addressing.

Mr Smedley: Denis Smedley, Greenhouse Office. If I could just add to that perhaps that one of the beauties of the wind turbines is that they are moveable. If climate does change, you can actually move them. It's already happened in Western Australia. They've sold off some of their original, old wind turbines and moved them to a new site. It's not a good thing but it's not a total disaster.

MS DUNDAS: Did you have any comment, Dr?

Dr Blakers: Wind energy is unlikely to go beyond 10 or 20 per cent in Australia's total electricity production. The European Wind Energy Association has a target of 10 per cent of the world's electricity from wind generation by 2020. I think you might be able to jack that up to 20 percent if you really worked very hard at it. So a relatively small change or loss in wind output would not be a major problem in the scheme of things.

I reiterate my original point that the only truly large-scale energy-producing technologies are the direct solar technologies, where there's very little environmental trade-off.

Mr Kerans: Garry Kerans. Just in regard to the environmental consequences of purely PV technology, which I advocate in many respects: in terms of growing biomass in the environment and replacing some of the forests that have been denuded by development off the site, there may be considerable feedbacks on the environmental consequences for the food industry, which may be also an essential service in the near future, based on the water cycle.

We're cutting down our trees; that's generating less of a cyclical arrangement, possibly, and reducing the water drop on the country, especially inland. The feedback mechanism there hasn't been accounted for within any sort of mechanised approach, to say, "Go technology," with the energy consequences of establishing that infrastructure versus going back to where we were in terms of the easier ecosystem approach. I just wonder whether that's been taken into account.

Dr Schuck: I don't know if I heard the whole question, but let me say this in terms of some of the, I suppose, core values of biomass: particularly in Western Australia where there are large dry-land salinity problems, although these are in very low rainfall areas, there's actually too much water but it's below the ground. Part of the problem is, basically, rising water tables driving salinity to the surface.

One of the ways of addressing this—and it's been very strongly advocated by the likes of Conservation and Land Management in Western Australian and many others—is growing things like a lot of mallee trees, with a very deep root, which basically gets into the water table. The problem is really caused by clearing those mallees in the first place and planting shallow-rooted annuals such as wheat.

You then have the multiple benefits, I guess, of basically controlling salinity problems by planting a lot of mallees, for environmental reasons, Landcare-type reasons, and then having, I guess, the multiple benefits of biomass.

Sorry, I wasn't necessarily following your question entirely. So I'm not quite sure if that answers it.

MS DUNDAS: It's definitely a topic that I think will come up again this afternoon, so we can discuss it further on. Were there any more questions?

Mr Voss: Not so much a question. Gary Voss from ActewAGL. Andrew, I found your vision very exciting, and I would be very pleased in fact to take back to my office the concept of ActewAGL funding or becoming a financing organisation for things like your solarisation program where somebody picks up the tab up front and then recoups the money over time. So I'll take that back to my office and start work on it.

MS DUNDAS: Our work here is done.

THE CHAIR: I was just wondering: can you actually explain for the technological dummies—and I put my hand up to being a technological dummy—how the solar thermal chemical or steam generation process actually works, for the lay person?

Dr Blakers: Keith Lovegrove, who is in charge of that program, has a presentation on that this afternoon.

MS DUNDAS: Are there any more questions?

Mr Abbott: Derek Abbot. I just wanted to ask about the transport question again, which is what interests me. I know you're not focusing on energy and houses and fixed positions. How do you actually get people-only public transport? It is probably the million dollar question.

Dr Blakers: I don't think it's a million dollar question. I think it's about a $25 question—the price of an all-day parking sticker in Canberra. The ACT government has in its power to raise an astonishing sum of money by jacking up the price of parking in the town centres by 10 per cent above inflation forever. At the same time it will be reducing the use of the private car to commute to work. One has to then think about what you're going to do instead.

I would recommend to everybody here the idea of traffic-control buses. This is not space age technology; this is not difficult technology. I commute by bus. I get really annoyed when I sit in a bus, with 39 other people, in a traffic jam caused by single-occupant cars. This is outrageous, in my view. You need to get the buses on a different road from the rest of the cars—either a lane at the edge of the highway or one down the middle.

Gungahlin to Civic sounds to me dead easy. A single lane down the middle of Northbourne Avenue, with the buses sitting on 80 kilometres an hour because every traffic light they see is green, puts them between Gungahlin and Civic in 10 minutes.

MS DUNDAS: Other questions?

Ms Wayne: Fiona Wayne, Environment Business Australia. One of the other ways of getting people on public transport is actually to make it pleasant. There have been a number of studies in British Colombia and London. I did one for British Rail too many years ago to remember. What I'm about to say might sound fatuous, but every bus ticket could be a lottery ticket at the same time. It's a great incentive.

One of the other things I'd like to mention is that CEDA ran a retrofitting program for fast food restaurants and had terrible problems getting the franchisees to buy in at the same time as the master company, until they came up with a lease financing program. Retrofitting in small fast food restaurants costs in the order of $15,000. These guys knew they'd make the money back in between two and three years, but they just didn't have $15,000 to put on the table right now. They were not going to participate, but the minute that a lease financing program was put together they could track month by month what their savings were versus what their expenditure was. Everybody signed up. I think you're absolutely on the right track.

Dr Blakers: The key point of this is that you have to remove the up-front cost to the householder or the building owner of the cost of solarisation. ActewAGL would like to build a gas-fired power station. ActewAGL is not going to send a bill to every Canberra electricity consumer with the full up-front cost of that power station; they're going to recover the cost bit by bit over the next dozen years or so.

Why on earth should it be different for your solar water heater and your house insulation? It's risk-free for the company that does this solarisation because the solar water heater is guaranteed by the manufacturer for 12 years; house insulation is guaranteed, I think, for 100 years. The only requirement is that someone get their act together to do it.

Mr Wills: Ray Wills. Just on that point: I guess in some ways it's decentralising the energy generation onto the roof of people's homes; so in a sense it's actually the energy company owning the energy generation facility on your roof, and you're just paying your lease costs based on that.

Can I backtrack a bit to an old, pet idea? I'm not sure how popular it would be. In relation to public transport one thought I've always had—and I, as a public servant would benefit from this as well—is that maybe all public servants, instead of getting car bays at their work facility, should be given an annual bus pass. The companies would then also be making savings on FBT that's associated with assigned car bays and so on. So there's probably a bigger economy of scale than saying, "Well, it's just public transport", but there are also savings on FBT associated with allocation, if that becomes a way of providing for transport in that area. It is just a thought, and I don't know how popular it would be.

Dr Saddler: If I could also just make a personal comment about that: there's an issue about the planning and building regulations there. Being autobiographical again, I was working in London in the early 1970s on some transport studies. That was the time when the planning authorities in London ceased to require a certain number of underground car spaces associated with new commercial building developments. Well, that's 30 years ago now. London was a much bigger city then than Canberra is now.

I think they are still required in Canberra and I think they're just now talking about changing that in Sydney. That is certainly one thing that's very much within the control of our city planning. That is actually encouraging people to commute to work.

MS DUNDAS: At this stage do we have any further questions? Okay, I'll wrap it up here. We have this afternoon some very exciting presentations in terms of facing the challenges and addressing the imperatives that are being put to us on what is practical and what we as legislators and committee members will need to do.

We will reconvene at 1.30. We will continue with our discussion this afternoon and come up with some real and practical solutions to the problems that have been put forward to us today. Thank you.

Luncheon adjournment

MS DUNDAS: This afternoon we'll be looking at real improvements and real alternatives—I guess finding the practical solutions to the questions that we've raised this morning. Our first speaker for this afternoon is Dr Keith Lovegrove. He is the Chairman of the Australia and New Zealand Solar Energy Society, and he's a specialist in high-temperature conversion of solar energy using concentrated systems. He has completed a PhD and has been working as a lecturer in engineering at the Australian National University. He is currently Deputy Director of the ANU Centre for Sustainable Energy Systems. He serves on the board of the Conservation Council of the South East Region and Canberra.

The Australia & New Zealand Solar Energy Society is a non-profit organisation of renewable energy professionals and interested members of the community that seeks to promote all renewable energy technologies—hence we're quite thankful to have them here today—and is a regional section of an international solar energy society.

Dr Lovegrove: Thanks, Roslyn. As Roslyn says, I'm actually a researcher with Andrew at ANU. I want to spend my talk today telling you why we don't need to do any research, which is really a bit of a shame but anyway. What I'd like to do with my half hour is go right back to what Vicki introduced at the beginning which was, as I understand it, the vision behind this whole inquiry, which was to see if the ACT could be—your words were—self-sustaining in energy. I'd like to show that, indeed, in a technological sense it absolutely, definitely could be; and today's technology will do it.

I would say, though, that I would interpret it as self-sustaining if we get all our energy from renewable energies. But let's not fix on the borders of the ACT. If it makes more sense to build the wind farms somewhere else, that's fine. Bear in mind that Actew is responsible for Googong Dam, which is not within the ACT's borders; so it doesn't matter if we do our capital works projects somewhere else—wherever it makes the most sense.

First of all, what is ANZSES? Just so that you know, it's a solar energy society. But we interpret solar in the general sense because all renewable energy, if it's truly renewable, is essentially solar energy; we don't just mean solar hot water and PV; we include biomass, hydro, wind. That is all solar energy to us.

It is interesting to know that the society was actually established in August 1962; so we've just had our 40th birthday, which isn't too bad for a non-government organisation. There's a magazine that comes out quarterly. We'd love you all to join up. You can have a look at the website and see what it's about if you like.

Let's put the whole discussion in the context of Australia and what it actually means, what we consume and so on. Apparently there are 18 million of us. If you look at ABS statistics, they talk about primary energy consumption. By that they mean they count the coal rather than the electricity. If you see statistics called end use, it means you use electricity, you use gas; but the electricity basically came from coal in the first place Apparently we use 5,000 pettajoules, which is 10 to 15 joules per annum. The interesting thing about it is what they're actually measuring is only the bits we pay for; they're not counting the sun that's drying the clothes on our line and warming our houses and things. So essentially it's 5,000 pettajoules of fossil fuels.

Where are the politics coming from in Australia? We are the world's biggest coal exporter; it's our biggest source of income. As far as I'm concerned, when you look at the debate nationally about greenhouse policy it's about our exports. The issue really is: what's going to happen if our customers actually reduce their consumption and stop buying our coal? It's got very little to do with whether it's easy or not for us to reduce our own domestic emissions.

Despite that, we are arguably the world's worst greenhouse gas emitter. But there are some good things. The EMRAC legislation, I reckon, is the best thing that's happened to renewables in a long time, and I think the polls tend to suggest that most of us would like to ratify; we just to have convince John Howard it's in our interests.

To put it in context: that 5,000 pettajoules per annum turns into 8 kilowatts per person. Imagine 8 kilowatts of something running 24 hours a day, for every single one of you. If you're not sure what a kilowatt is, if you sprint as hard as you can you're personally putting out about a kilowatt. So there are eight of those or eight bar radiators or something running 24 hours a day.

To put that in another way: if you look at the annual radiation landing on a surface in Canberra, you need 40 square metres of Canberra roof space to collect your 8 kilowatts, on average. On the other hand, what you actually use at the moment—end-use energy—is a bit less; so it's about 6 kilowatts per person that we're somehow using. That's made up roughly like this: 700 watts that you actually use in the home; about a kilowatt is your share of driving cars around; and 4½ kilowatts is your share of industry.

Turning to Gary's figures this morning: I think he said 22.4 pettajoules would be end-use energy in the ACT. If you multiply 300,000 people by that average amount you come to a much bigger figure. I think in the ACT figures we're not counting things like the fact that when Canberra people go on an international holiday all that jet fuel gets counted probably in New South Wales; the steel construction; et cetera; et cetera. Quite a bit of our personal share has to be counted in what the rest of the country does.

Apparently we've got 300,000 people. If you multiply that out, that's 83 pettajoules per annum primary energy use, which is a lot more than your 22.4, because of all those things that aren't being counted. I'm just sort of naively multiplying the numbers there. Roughly speaking, I think about 300 megawatts, on average, is our electricity use.

As I say, these sorts of statistics are only really measuring the fossil fuel that we currently use and pay for; they're missing out a lot of things that get taken for granted and that help to put the situation in context.

I know that Andrew, in other talks, has actually argued that, if you look at the total amount of solar energy landing on the continent in a year, what you find is that solar is 99.99 per cent of all our energy needs. That might be stretching it a bit far, but a more conservative approach would be to say that all of us sitting here right now in this room are busily glowing out a nice 100 watts each just by sitting there, that is, energy that's come from the food, from the biomass that you've eaten. As we heard earlier, that's been grown with one or 2 per cent of fission; so effectively quite some kilowatts of solar energy have gone into just keeping you alive right now. We take that for granted; it is solar energy.

Most of us still dry our clothes on clothes lines, even crappy houses benefit from the solar going through windows. If you add all that up we could say we are 50 per cent solar right now; so it's only the other 50 per cent we have to worry about. It's not that we're only using 1 or 2 per cent.

Have we got enough of it? This is a solar radiation contour. Actually, I'd dearly love to get an electronic version of a wind resource map, but, as Andrew pointed out earlier, all the windy bits of Australia are the bits that point down to the south. The wind resources of Australia are well on par with Europe's; so we've got this plus the solar resources.

The solar resource in the ACT is sort of average level. Something I find interesting is that if you look at south-west Tasmania, which is not the most famous sunny place in the world, it's actually only half as bad as Marble Bar; so it's only a factor of two from worst to best.

Nonetheless, the ACT's average level has about the same amount of energy per year from solar radiation as southern Spain gets—and Europeans tend to think that's quite good. So we've got plenty of sun in Australia.

If we took a national look at the situation now, we could say, "If we wanted to get rid of those 5,000 pettajoules of primary energy, the whole 5,000, could we do it in Australia with existing technology?" Suppose you wanted to find 5,000 pettajoules with conventional photovoltaic cells or solar thermal systems. It's actually not even a logical thing to do, because solar hot water heaters are much more efficient and cheaper. But let's suppose we just took that as an argument as to how big should the power station be. It would be about that big. If you took standard technologies and spaced them out reasonably with roads so that people could service the areas and so on, you'd cover an area of one or two ACTs with standard technology and find the entire 5,000 pettajoules. That's replacing petrol, every bit of gas, everything that we actually use.

Having said all that, what I'd like to show you now is a pictorial scenario of what a 100 per cent renewable energy ACT would look like. I'm not going to spend too much time talking about costs and policies. I have heard some really great ideas about all of the policy measures we can take to start with. Actually what I want to do is show it to you from a consumer perspective.

What would it feel like to live in a 100 per cent renewable energy powered ACT? The point's already been made that the easiest place to start is the way we build buildings. We want passive solar houses. These are houses that have no extra energy needed for heating and cooling, as in zero. That's what we want to live in. They come in all different shapes and sizes.

That is the basic principle, as has already been mentioned, is the number one good thing. We can never do too much insulation; it's the easiest thing to do; it gives a better return on investment than any home mortgage rate. It should just be done.

What are the basic principles of a passive solar house? It is very well insulated. It has a lot of north-facing glass to collect solar radiation during the winter. It's obviously sealed to keep the drafts out. With the large amount of north-facing glass that's collecting the energy, it's only of use if you can actually store that. You do that with a large amount of internal masonry, which basically means things like full internal masonry walls, concrete slab. That's about enough mass to collect all the sun that comes in through a fair amount of north-facing glass, store it and keep you warm on the coldest Canberra night.

Having done all that, we obviously don't want to overheat in summer. So we need to make sure that the sun is kept out during summer. The windows have to be appropriately treated with shading and eaves and so forth. There has to be good night ventilation for houses now; double glazing; well-sealed curtains. That's it.

Principles are incredibly simple. There are really quite a lot of good houses in Canberra now—I don't know the exact number; it must be getting up to maybe even hundreds or so. They come in all different shapes and sizes. One of the things, though, is that most of them at the moment are architect designed, so they tend to be fairly upmarket. But you can build them as simple and as cheap as you want. There are different shapes and sizes.

Most importantly, you can do a lot with an existing house by retrofitting it. This, for example, depicts a 1970s model—three-bedroom brick veneer that's been rebuilt. It does quite well if you're actually thinking of extending, because it can use the extension as an opportunity to convert it into a solar house.

ANZSES actually has a tradition of running solar house tours, and on 8 September we actually had a national event where we had houses showcased all around the country. Have a look on the website if you want to see some of the things we did.

As I said before—and Andrew's made the point as well—insulation's a high priority. This is a fairly gloomy photograph of a guy called Drew Just, who runs Just Right Insulation. On one of our solar house tours he brought his truck around, the truck that can squirt rockwell into wall cavities.

I think most people in the community now have got the idea that having insulation in the ceiling is a good idea. You do it by buying bats and putting them in the ceiling. I think people still don't realise just how simple it is to get their walls done. You ring up this guy and he comes around, he lifts off a tile and he shoves a hose in the wall cavity, and he blows it in. It is all in a day's work, costs $2,000, and there you are; You've got your wall fully insulated.

People who build solar houses often scoff at star-rating schemes because their houses just basically rate off the scale. A five-star energy rating is easily achievable. ACT really led the way with its mandatory for-star. I'm not sure if Victoria have actually done it, but they certainly have a policy of going for five-star, but it could be six-star or seven-star. It's all quite possible. You've got a house that doesn't need heating or cooling.

The next thing's solar hot water. Gary's figures this morning were that the hot water plus the heating are 80 per cent of domestic use. Okay, we've got the technologies to get rid of that stuff. We've already talked about solar hot water.

Aside from the heating, hot water is the biggest appliance-type consumer. What have we got in Australia? We've got about five per cent market share, compared to places like Israel that have done things like making it compulsory. For, presumably, national security reasons, they make it compulsory in Israel, which is an interesting angle on solar energy. They save up their oil to put in the tanks and shoot Palestinians and stuff. Why couldn't we have a 100 per cent solar hot water heater—something that I'm passionate about personally? Drew or someone else put up some statistics.

If you do studies of greenhouse gas emissions, instantaneous gas can actually score less on emissions than electric-boosted solar. This is true, but don't blame the solar hot water for that. If you do your electric boosting with green power, then there are zero emissions. If you buy a solar hot water system, put it on your roof and don't turn the booster on, there are no emissions. The solar hot water has no emissions. The electric hot water has emissions, if you take it from coal. The ACT government subsidies and the federal government subsidies are really helping the industry; they're good. I hope that sort of thing continues.

The point's been made, I think, that you do have to spend more on the capital investment for solar technologies. It's worth making the point for solar hot water. You see that extra capital in extra jobs in manufacturing. There are roughly twice as many jobs per unit of energy produced in renewables than there are in fossil fuel industries. That's where the money goes.

There are other things. Energy efficiency has been discussed already. If you go through household appliances, it is quite obvious that fridges are actually quite high. There are various measures you can take.

In the end, an average householder load at the moment is about a kilowatt. It can easily be got down to 200 watts or so, just by doing these sorts of things. But it'll never be zero. We don't even want it to be zero.

Where do we get our electricity from to start with? I'm going to paint you a picture now of the technologies that are going to somehow deliver 100 per cent. Let's start with electricity. Apparently, it is our biggest source of greenhouse gas emissions. We've just reduced the load by 60 per cent or so, but we've still got to meet what's left. You can go the whole hog if you're a real purist and be completely autonomous. You can put PV panels on your roofs and have battery systems for storage.

This shows a 2.1-kilowatt peak panel system at a house out near Burra, just out from Queanbeyan. It is local. People will be surprised to know that people out there are actually completely off the grid. It is just half-an-hour's drive from Canberra. This gentleman is Jim Atkinson. He owns the house. It had the PV panels on the roof, a great bank of batteries, an inverter that makes 12-volt DC into 240 volts. This guy is not a church mouse. He's living in a very, very nice house, with all mod cons and the same lifestyle, if not better than, most of us. What he had to invest was around 15 per cent of the value of the house. I think that's the rule of thumb.

If you're a rich person with a big house, you're going to need a bigger system. If you're a villager in Africa you need a smaller system, but maybe 10 or 15 percent of the value of your house makes you complete autonomous. It is actually unnecessary to be that autonomous because we've got a grid and we might as well use it. We might as well do the easy things first. Indeed, we have been. We've got the two megawatts of capacity in the landfill gas at Mugga Lane, which is nice.

This is what a bunch of engineering students and a smart alec standing in front of them look like. What's inside them? It's a VH—I've forgotten—or a Cummins diesel engine that's been converted to run on gas. It's a fairly conventional piece of technology sitting there. This is an obvious thing to do, and we've done it. We want to go for no waste in any case. The waste we make is never going to power all our electricity needs, but it's obviously something we should do anyway.

We've got the mini-hydro at Mount Stromlo that's making use of something that would have gone to waste in terms of potential energy. That's a good thing to do. It's a nice thing to visit. But it's not going to power the whole city.

On the other hand, if you drive up the road to Crookwell—next time you're driving to Sydney just take a 20-minute detour up the road from Goulburn—there's a visitors centre there and you can have a look at the wind turbines there. This is the first significant installation at Crookwell. They look very nice on the hill. One of the things you'll notice when you're standing there looking at them is that there are an awful lot of hills which don't have wind turbines on; there's room for one or two more. Indeed, we could easily build quite a lot out there. They're quite big when you actually stand next to them. I can fit about 20 of my students inside the tower.

There are eight 600-kilowatt turbines. The state-of-the-art large wind turbine now is two megawatts. They're already making things three times bigger in capacity. It's a proven industry; it's a major industry, with 30 per cent per annum growth internationally. In the last decade or so Germany installed enough of these, if we transplanted them all here, to run New South Wales. The industry can produce that amount of stuff, and it's still growing at 30 per cent per annum. It will only take two years to produce that amount now, basically.

Other points need to be made. The first is to do with biomass. I'm just going to go through a range of options now for making electricity. Steve Schuck will obviously talk about this in detail. This is a shot of a fairly messy place up in Queensland. It's at Rocky Point. It's actually a sugar mill. It's been there for a while and it actually has a system where it uses the sugar cane waste, burns it in conventional boilers, makes steam, generates electricity.

A key point here is that that can run for 24 hours a day, obviously, and it's quite economic. PV is an option with today's technology, obviously. It's fairly expensive today. It can only get cheaper. If you haven't seen it, there's a 50-kilowatt system at Queanbeyan that's worth a look, one day when you drive past. These are Solarex panels. Solarex is now owned by BP Solar. The shy little man beyond the petroleum sign out the back there is Greg Bourne who's the Asia/Pacific head of BP. He likes to boast that they employ more people making solar cells in Australia than they do in a typical oil refinery. They obviously think it's got a future.

You can do PV at home. We heard from Derek Ridley this morning. He is the proud owner of a home with a grid-connected PV system. Do you know, Derek, how many systems like that there are in Canberra now?

Mr Ridley: Photovoltaic, 18 or something.

Dr Lovegrove: All right, 18. You certainly can do it. These ones don't have batteries; they go straight into an inverter that's grid connected. They feed into the grid when it's sunny. They import that from the grid at night. If you're in the city and you've got the grid there anyway, it doesn't really make sense to fill your garage up with dirty, smelly lead/acid batteries.

Solar-thermal: this is my kind of area. It's a dormant technology at the moment. It had a big flurry back in the 1980's, and now it's sort of sitting there waiting. I hope it's got a future. I think it's got a future. It can be built on a fairly large scale. To get the economies that it can deliver, you have to build it on a large scale. That's the problem; you have to make fairly big capital investments.

But to see it in context, these are parabolic trough concentrators; they are fairly similar to the things the ANU makes for the PV concentrated system, only bigger. There are 354-megawatt electrical systems in southern California that have been running for 15 years or so, just sitting there day after day producing their electricity. In the middle of the day those power stations could run Canberra. Obviously they can't at night, but that's **i**. There's a power station there that could run Canberra.

Being a bit parochial, there's a big dish at the ANU, 400 square metres, which also, as Andrew said, makes steam. It can slot into conventional steam turbine generating technologies, and it's our answer to the troughs in California—and the troughs will do it. We claim this is a bit more cost effective.

The question people always ask is: what actually happens at night? It's actually not much of an issue, because if you have a mix of generation types and you have them geographically spread—and there's no point in isolating the ACT from the rest of the country; we've got this national market, we might as well take the benefits of the national market—we can all share with the grid; you can have wind farms in Cairns or wind farms in Victoria helping you out.

You can use biomass systems for really high-value periods at night. We've got an existing hydro that can respond to peaks quite well. We've already got rid of the heating requirements, the hot water requirements and the air-conditioning requirements, which is a major source of peak demand and so on.

There are other aspects of demand management; you can really optimise demand management. Solar thermal systems, conventional systems, can store just by having hot rocks or something like that. There are actually standard systems for doing that.

As per special request from Vicki about the thermo-chemical energy storage: there is a conflict of interest here. This is my project. Andrew showed the slide earlier. How am I going for time, by the way? I want to get away.

MS DUNDAS: Probably about 10 minutes.

Dr Lovegrove: Ten minutes, okay:, not too bad. Let me explain what this is about. The big dish system that I showed a few slides ago had a receiver that made super heated steam that fed into a steam turbine and generated electricity only when the sun shines.

What do we do? We take that receiver away and we put in, instead, a receiver that looks very similar but is actually a chemical reactor. What we've attempted to do is take ammonia, NH_3, which is smelly stuff that's used to make bathroom cleaners and things, and add energy to it. It splits into nitrogen plus hydrogen.

This little beast here is a heat exchanger. We can feed in cold ammonia and pre-heat it, because it passes next to the hot gases going out which are at the same time getting cooled down. All the solar energy is converted to the chemical change. We can store the hydrogen/nitrogen mix. It represents stored solar energy at room temperature. Everything below that level is just at 20 degrees C, whatever temperature it is.

When we want to recover the energy, which can be continuously or specifically at night, we take the hydrogen/nitrogen mixture, preheat it and put it into another reactor, which combines it back together, gives off the heat again, and we use that heat for power generation. Typically, we might run this one at 700 degrees C, using concentrated radiation. We get the heat recovery over here at 500 degrees C, which is a little bit of temperature difference. That's what drives the chemical process and allows you to reverse it, having that temperature difference.

But 500 degrees C is more than good enough to then make the super-heated steam that goes to a normal power station. We're actually doing this on a laboratory scale at ANU, with a smaller dish. This is it. It looks very similar to the big dish. It's got a receiver, which is a can, and a bit of a cavity; but it's got the chemical reactors. We're rather proud of having got that to work.

Indeed, the vision is something like this: lots and lots of dish concentrators, one big plant in the centre. One of the nice things about this technology is that this ammonia synthesis converter is straight out of the fertiliser industry. Probably the world's single biggest chemical process industry is synthesising ammonia out of nitrogen/hydrogen for use in fertiliser.

You can go out tomorrow and buy one of these, which as big as your house. It will make maybe 1,500 tonnes per day of ammonia. It will come with a boiler built in, because fertiliser plants actually run co-generation systems using the waste heat. It will already come with a boiler. You just go out and buy a standard steam turbine and bolt them together; and then you've got a system that can produce electricity 24 hours a day.

Better than that even, you can sort of wind it up and down and do a little bit of load following with it, so that you can actually fill in the peaks when you need to. You could build this in the ACT if you wanted to, but it probably makes more sense, even with ACT resources, to build it somewhere near Broken Hill, hook it up to the grid and import the energy in that way.

We've dealt with electricity and argued that you can do it. Transport is the big issue. We've had a bit of talk on public transport, and it's obvious that we want this for cities. If you go to Europe on a holiday, you just don't think of going into the city any other way than by public transport; there is no parking; the trains run every two minutes; and you just get on and go there. That's how you do it.

But I want to go on holidays in my four-wheel drive, like everyone else; so we need some other things. Bikes are good, and so too are these funny little things, with pedals, and electric. Yes, you can do some things like that.

How are we going to get around independently? You've probably all heard of solar cars. These are fairly amazing things that race from Darwin to Adelaide in no time at all; car companies are even spending millions of dollars on them; and they've made things that can go well over 100 kilometres an hour. But they're pretty cramped and not much fun. But they're completely autonomous; they're running on the energy from the PV cells on the back of them.

This bears about the same relationship to personal transport as formula 1 racing does to the average car. It's a good chance for companies to showcase technologies; it's a good chance to develop more efficient electric motors and so on; it's a good chance to help put some money into high-efficiency cells.

But that's not how we're going to get around. It's more like the technology that comes from that will go into the making of electric cars, which look like normal cars but which have got batteries, efficient electric motors and what-have-you. Of course, if you didn't already know, there's a Honda Insight or Toyota Prius; you can actually buy what's called hybrid cars now. That's a car with a petrol engine and an electric motor side by side. What they're really saying is: "Well, yes, the electric motor technology's up to it, but the batteries are still a bit lacking." To get the range that we need, they go for this hybrid. But it's already putting electric car technology into the commercial marketplace. These are things you can buy today.

There are other options which require even less change to lifestyles. This shows Martina Calais, who's a lecturer at Murdoch University. This shot was taken in Adelaide, at the solar conference last year. Her husband, Phil, drove this very ordinary Toyota Corolla, a diesel Corolla. He'd actually spent a few weeks making his own biodiesel out of used fish and chip oil that he collected and mixed up in the backyard. He towed a trailer, with 44 gallon drums, from Perth to Adelaide in a car that uses 5.3 litres per 100 kilometres of home-made diesel. It is a standard car. No change to your lifestyle whatsoever, it's just buying a different product—buy diesel!

Ethanol's been in the news lately. Any standard car will run on ethanol. I found last night's news item quite fascinating—this concept of maybe we're going to have to limit the amount of ethanol that's allowed in petrol, and a big fuss that maybe car companies wouldn't honour their warranties. The change that you would have to make to guarantee a car would run on ethanol is, if not zero, so negligible it doesn't even matter. Certainly, quality might be an issue; labelling seems fair enough. But standard cars will run on ethanol. What blew me away was a suggestion that petrol companies are already putting ethanol in and we don't know about it, as if they were ashamed of it; whereas it's really rather a good thing. We can run standard cars on ethanol, on bio-diesel, slightly different to standard cars on electricity. Take your pick; you can have your private transport.

That's it; that's my scenario of how we, as consumers, live 100 per cent renewably. That still leaves all the other stuff—the industry, the infrastructure, so on. As to the energy requirements, it's the same stuff; we just need more of it, a few more power stations, a few more wind farms, a bit more bio-diesel; you can still run industry as well.

What should we do in the ACT? Well, we've heard some fairly detailed policy suggestions. I think most of them are pretty good, but I see no reason at all why we can't progress to 100 per cent solar hot water in the ACT. We should be able to ramp our average energy performance of houses by the sorts of measures that Andrew was talking about and so on. Let's get the average up to five-star, not just the new ones.

Let's by all means have better than average renewable energy, renewable electricity targets; let's think about actually encouraging the infrastructure of getting bio-diesel; let's be proud of our ethanol/petrol mixes; and let's make it mandatory to have at least 10 per cent ethanol in petrol, for example. It would be nice too if the ACT government could lead with its own operations. Let's start by making all the ACTION buses run on bio-diesel, for example.

There you go. I think it's possible, and I think it's achievable. Thank you very much.

MS DUNDAS: Thank you, Dr. That was quite interesting; it was good to see lots of engineering students participating in the future.

Our next speaker on the topic of real improvements and alternatives is Dr Stephen Schuck, who has a strong academic career in engineering. He commenced his career at ESCOM in South Africa, before taking up employment with Pacific Power in 1980 where he worked in a variety of engineering and management positions until he took up a senior management post in private industry around 1996.

In 1997 Stephen started his own consultancy, Stephen Schuck & Associates, which consults in sustainable energy sources and technologies, and through which he manages Bioenergy Australia. Bioenergy Australia is an alliance of some 48 organisations from both the government and the private sectors who come together to foster biomass for energy and other value-added products.

Stephen is also a contributor to and an editor of *Sustainable Energy Innovation, a New Era for Australia*, a fascinating book which I'm sure Stephen has a copy of that we can all have a look at. Thank you, Stephen.

Dr Schuck: Yes, thanks. I'll leave this with ACT Legislative Assembly to have in the library or somehow find itself into the public domain. What I want to do is give you a bit of a whirlwind tour, I guess, of the prospects for biomass energy, which I'll variously call bioenergy just to make it a little bit simpler, and just wrap up in terms of Bioenergy Australia. It's basically a government/industry alliance; it's a little bit different from the industry association model and has, as I say, quite a spectrum of organisations from the private and public sectors, including the likes of the Australian Greenhouse Office and the Sustainable Energy Development Authority in New South Wales.

What I want to do is basically introduce this audience to what is bioenergy, some of its features, some examples world-wide and how that could possibly be applied to the ACT, and specifically to try to talk about that link between bioenergy and sustainability. I guess I'm taking the broader definition of sustainability—let's say the social, economic and environmental aspects.

You've seen this diagram in a slightly different form earlier, but it stresses that biomass fuels are basically derived from solar energy. We have these two strands which I think Andrew Blakers put down in terms of technological connection and natural collection, of which basically the solar energy is integral through photosynthesis in forming biomass.

Just going into a bit more detail: basically, biomass is a product of photosynthesis. The solar energy and atmospheric carbon dioxide combine to form grain matter. It could possibly be things like trees, energy crops, grass or even the grain that then is used perhaps for animals. It kind of goes into secondary biomass products such as animal manures, human sewage and so on.

It's interesting that world-wide photosynthesis produces about 220 billion dry tonnes per annum of biomass. I'm not suggesting this is all fair game for energy, but it's just interesting to note the level of solar energy and how it can be converted, even at fairly low conversion efficiencies, into about 10 times the world's current energy usage. Globally, biomass is the largest renewable energy source. Admittedly, a lot of this is not all that sustainable in developing countries, but it's about 14 per cent of the global energy supply.

It's interesting that industrialised countries such as Austria and Sweden provide about 14 per cent of their energy supplies from this. In Australia, it's under 5 per cent. A lot of that is the gas side and domestic wood; I think there are about 6 million tonnes of wood in Australia used basically for space heating.

Simplistically—and this is how biomass is catered for under the Kyoto protocol—the solar energy is captured in the biomass. It's then converted through various processing forms—it could possibly be by chipping processes or other processing forms—to a biofuel of one description or another which can then be used either for automotive use, as you saw with Keith Lovegrove's presentation, in terms of biodiesel or for electricity. The idea is that, in balance, the carbon dioxide that's emitted through the energy conversion process is recaptured through photosynthesis.

It's quite interesting, when one starts looking more comprehensively at the situation, exactly where one ends up on a full life-cycle basis. Just to calibrate your thinking a bit, this is a study that comes out of the US's national renewable energy laboratory, UNREL. What NASA is to space travel UNREL is to renewable energy, to my mind, in the states. They've done life-cycle studies, taking a cradle-to-the-grave approach, looking at different technologies, looking at the embedded energy in its manufacture and at peripheral energy usages, and going right through to decommissioning.

In this particular study, just to get your bearings, coal-fired power is basically using a fossil fuel. You're liberating carbon dioxide that's been in the ground for an awful long time, millions and millions of years. That's a net addition to the atmosphere, and it's basically the problem causing global warming. In this particular study you can see they've taken into account coal mining, some of the methane that's possibly associated with coal mining, the energy involved in the transportation systems in getting the coal to the power station, the energy embedded in the construction, the energy in the steel, the concrete and so on, and in the plant operation.

This is similar to an Australian-type study. I don't think anybody's done it in quite the same way. Let's bear in mind that this is a US situation and possibly that the technology is slightly different. Their coal-fired power stations tend to be a bit older and less modern than Australia's.

When one has a look first of all at this biomass system, this is basically grain biomass—for instance, previously cleared agricultural land. This is actually growing an energy crop. As noted, there it has a very wide-scale application.

This is using a technology called biomass integrated gasification combined cycle, which I'll be mentioning a few more times. I will call it IGCC—integrated gasification combined cycle. This is where you take your biomass and process it into a combustible gas that then can be run through a gas turbine. The waste heat coming out of the exhaust of the gas turbine can be used for generating steam, which can then produce additional electricity. You have two bites of the cherry, as it were, or two bites of your fuel in producing your energy.

In this particular study, you can see that—and this is taking into account the fossil fuels involved in the fertilisers, the chain saws, the chippers, the trucks in transporting the biomass—that you've got your biomass production, and then your emissions from the biomass production, transportation, construction, power station operation. On a life-cycle basis, you'd end up with just under 50 grams of carbon dioxide per kilowatt hour of electricity. This should be calibrated against, let's say, 900 to 1,000 for a conventional black-coal-fired power station, such as in New South Wales or Queensland. The other way of looking at this is to look at this as a black box, where you put in one joule of fossil energy and you get out 16 joules of electricity, using biomass as some kind of a catalyst.

The next one I want to show you, which is quite interesting—and just bear with me while I try to describe it—is basically using residue. It's, again, on these annual studies. They've taken a situation where they're using residues that would otherwise end up in landfill. I think the other assumption that they made was that the actual electricity that it's displacing, from coal mining, is associated with methane emissions, which is, again, a potent greenhouse gas. I take it that you actually end up with a bioenergy system, with a net sequestration effect of minus 410 grams of carbon dioxide equivalent. A lot of that negative sum is caused by methane that's been obviated.

Just to give you a slightly different snapshot—and they're not all on exactly the same study: this comes out of a study that was conducted for the UK Department of Trade and Industry, using its national energy agency's numbers. In that particular study, they looked at black coal, gas, combined stuff, coal/gas turbines, a range of bioenergy resources. As you can see, that's all hovering about a little bit above zero, from an idealistic or simplistic system. I'll come back in a minute to this solid waste one. But you can see the whole net range of, typically, about 20 to 50 grams equivalent.

I've also, just for completeness, put the sulphur dioxide and oxides and nitrogen emissions as well, which are related to energy systems. It's just interesting to compare it against existing photovoltaic systems.

This particular study turns up a number of nearly 180 grams carbon dioxide equivalent per kilowatt hour. That's because it's taking into account the energy embedded in the silicon, the glass and framing and other things like that. They got very favourable-looking wind emissions. I've seen other numbers where it's a fair bit higher than that. Again, there is hydro.

It is interesting to see how some of these technologies fit together. I guess one of the big drivers has been global warming carbon dioxide emissions. A simplistic approach is often just to look at the operation of technology, but it's important to have a look at these broader environmental issues.

Just to give a slightly different snapshot of how energy plantations work: this particular one comes from a modelling study conducted by the International Energy Agency's bioenergy program, of which Australia's a participant, through Bioenergy Australia. This is actually a joint modelling exercise between the USA and Austria. What they've done is basically set up a 100-year time frame, with a plantation on what previously was agricultural land—basically, a 20-year rotation on the energy crop. This is on a fairly small coop of, say, about 100 hectares. In fact, you can see what the sequestration is; so you think of this as one coop.

What happens is that, basically, trees grow and are used for energy; new lots are planted; and so you go. What's happening at the same time is that you've, basically, got a build-up of carbon in the soil; you've got roots on the forest floor; you've got displacement of the fossil fuel energy. What they've done is netted out the fossil fuel involved in actual bioenergy.

When one goes to a much larger-scale system, say, an order of two magnitudes greater, and you have all this sawn timber staggered, you basically have a building up of carbon, sequestering carbon, and always having a certain stock of carbon in your plantation. The soil carbon is building up the litter, while at the same time you're displacing fossil fuel.

What I'd like to do now is just go to some of the technologies and examples of these technologies. Biomass is quite complex compared to any other renewable energy sources. It varies from fairly dry sources, such as perhaps rice husks, to very wet sources; so you could end up with things like wood, rice husks or something, right through to, let's say, sewage, which could be 98 per cent water.

There are quite a variety of technologies, right through to the energy crop—things like oil seeds. There are a number of ways of processing. I have grouped them into things like thermal processing, which basically involves combustion, gasification and pyrolysis, which are actually very similar. The big difference between them is really the amount of oxygen applied in each process.

Combustion is basically full oxidation. With gasification, you starve the process to force out the combustible gas. With pyrolysis, you basically use no oxygen to force out the liquid biofuel. I'll come back to this in more detail.

The biochemical process is a little bit like landfill gas. You're basically using microbes in a process called anaerobic digestion. Anaerobic means without oxygen. Basically, these microbes operate in the absence of oxygen and produce a gas that's about half methane and half carbon dioxide. The methane, the combustible gas, can run a gas engine, as you saw just now, with Keith Lovegrove's slides on Mugga Lane.

I think we spoke a little bit about ethanol. You can basically have fermentation processes—again, a mechanical crushing of oil to produce oil crops, further processing to produce biodiesel. As you can see, there are quite a wide spectrum of inputs, potential inputs, and quite a range of outputs, in terms of heat and power, transportation fuels, chemical feedstocks.

Just looking at some of these: world-wide combustion accounts for about 90 per cent of the current bioenergy plants. It's interesting that in countries like the USA, which had incentive programs to kick-start their biomass industry, there were something like 12,000 megawatts of in-store capacity. That's about the same order as in the New South Wales coal-fired power industry.

Gasification is an emerging technology. I'll give you some examples in a moment. There are some commercial-scale demonstration plants at the moment. It's reasonably well established. It's got to that next step of, let's say, broader commercial deployment. Again, gasification produces a combustible gas which can be used in gas engines or gas turbines, or applied in this biomass integrated gasification combined cycle mode to these engines, which I could touch on, and fuel cells.

It also has the flexibility of producing a chemical feedstock which can be used in the production of things like methanon ethanol—basically, alcohol fuels, which can be used in things like fuel cells, engines or in other ways, or just as an additive to petrol—to basically provide a renewable energy component to petrol.

Pyrolysis, I mentioned. I'll come back to this in a bit more detail.

Anaerobic digestion. Again, there are quite a number of opportunities there. I'll touch on this a bit later, just to keep this moving.

This is the kind of technology that's applied at the Rocky Point sugar mill in Queensland, which we had a little bit of a view of just now. It's basically a fairly conventional technology—stock standard from way back. It's basically a water-cooled grate which vibrates. The fuel is put on the bed. The whole bottom vibrates, and the fuel shuffles along as it burns; the ash falls out the end; and the heat is used for raising steam and driving a steam turbine. These technologies go back a hundred years in slightly different forms.

Another combustion technology is the so-called fluidised bed combusters. There are two variants I'm showing here. One's called a bubbling bed. You've got a bed of hot sand, at about 850 degrees centigrade. The fuel is introduced in fairly low percentages; it could only be, perhaps 5, 10 per cent. Air is pumped in from the bottom. This whole bed's like a boiling bed; hence, the term "bubbling bed". It has advantages of having a lower combustion temperature and thereby not combining atmospheric nitrogen into the products of combustion, which produce knocks—that brown haze that you get every time you come into Sydney. Circulating through those beds—and this whole bed of sand gets carried over—are the hot gases which are separated in the sand. The heating material is basically returned.

The advantage of the fluidised beds is that they can burn low-quality fuels or very wet fuels. This is the kind of technology that we used at the Tumut Visy pulp and paper mill. They actually got 20 megawatts of power from there, from this company.

This is a cross-section. There's the person standing there. You can see the scale of it. This is a cross-section diagram of the world's largest biomass plant which is in Finland—240 megawatts electrical. This is quite an enormous biomass plant. I guess the message is that fluidised bed combusters are sophisticated and well established. In commercial operations, there are numerous examples world wide. I just wanted to show you some examples of how they could perhaps fit into the ACT landscape.

This is a biomass plant great boiler in Michigan in the USA, heating 6 megawatts, basically using wood waste. I suppose one of the things you can see is that there are no big plumes of smoke coming out of it. Often bioenergy's detractors point out that it's like a smoke stack technology, something from a bygone era; it's not; it's a very sophisticated modern part of technology. But in steam conditions, which rival many coal-fired power plants, the temperature dictates the efficiency; the higher the temperatures—and the pressure follows—the greater the efficiency.

An interesting thing about a lot of biomass is that, unlike coal, which can have ash contents as basically non-combustible material in it—even up to 50 per cent, and some of that includes toxic heavy metals—the actual content of biomass tends to be very low. Pure wood is about 4 per cent. You get very little ash coming out of these plants, number one; there is not a disposal problem.

But the other thing that's interesting is that, within this plant, the ash has an approved soil amendment. There was a question earlier about nutrient loss. Again, there's quite a lot of ash recycling in biomass situations.

This is another biomass plant, again operating, and you can't even see the heat haze. This is in the central valley in California. The fuel in the foreground is actually orchard trees. They uproot their walnut trees every so often, grind them up and use them as a fuel. This plant operates with a whole mix of fuels—urban demolition-type timber, wooden pallets, these kind of things. One of these piles over here is actually just stone fruit pips. I'm just trying to stress that there's quite a lot of flexibility. I'm assured that no sump oil is added to the fuel in these delivery systems. You get about 40 of these trucks roaming through this particular plant a day. That's quite an issue in terms of transportation infrastructure, noise on roads and stuff like that.

Just to show you the range of scales of biomass: it doesn't all have to be big, smelly and nasty. This is basically a Stirling engine. A Stirling engine works on the principle that, when you heat the gas, it expands. In this technology they have provided a very clever area where you basically provide the hot gases and you get a piston to shuffle up and down. As the gas expands, it cools; and you can produce electricity from it.

There are two examples—this one is at a trade exhibition in the United States, and this one is out of Austria. This is a technology that fits into the RECs market.

I'd like to just go onto gasification technologies. This is a plant in Sweden. It is the world's first biomass integrator gasification combined cycle plant. It commenced operation in 1996. It is a combined heat and power plant; it is run for a considerable number of hours, both in gasification mode and in full electricity and heat operation. It's a pressurised gasifier with a number of technical sophistications on it. I just wanted to show you that these plants have been built; they exist; and I guess they could be viewed as the first of a breed.

This is a similar plant in Vermont in the USA. The chimney there actually belongs to a 50-megawatt wood-fired power plant. Next to it is the power plant. This gasifier is piping, as you can see there, the gas into the adjacent power station and using that heat. In other words, they've saved themselves a new turbine and generator by co-firing the gas that comes out of this gasifier. It's a research project, but the eventual aim is to go to biomass integrated gasification and biocycle.

There are more than two of them; there are a whole crowd of them. This is a third one. This ARBRA projects is in Yorkshire, near the town of York. This is an interesting one, inasmuch as about 40 per cent of the fuel actually comes from coppice willow. It's interesting that they have subsidy schemes in the UK to encourage the growth of coppice willow and another kind of energy crop, which looks a little bit like sugar cane and a bagasse-type species. The rest of the fuel is wood waste.

This is a shot of this plant during commissioning, the flaring of the biomass gas. This is the gas turbine. Alston Power, which is interested in biomass, is well known in the power industry with their so-called typhoon gas turbine.

This is a shot of myself. This was taken actually at the time of the foot and mouth disease outbreak in the UK. They actually hadn't been coppicing the trees; they were keeping out of agriculture land.

You can see the idea; it's a short rotation of crop. It doesn't look like a conventional weeping willow; it's a coppicing variety, which means we cut it off at ground level and it sprouts. Every two, three or four years, that's harvested in an agricultural-type method.

It's probably worth while noting that, under the mandatory renewable energy target that's provided in Australia, you actually can't do this and get renewable energy certificates. If you have a dedicated tree energy species, you've got difficulties, because the legislation was framed in such a way that they really only entertain wood waste. As soon as it's a tree, you can only use the waste.

That's a difficulty which I hope will be addressed in the EMRAC review which is supposed to start in January. I think a lot of people were caught unaware when that implication landed up in the legislation, particularly the environmental groups. There are quite huge benefits. Quite a number of studies had been done on the animal habitat biodiversity outcomes in these kind of crops.

This is actually a fourth gasification plant I've just shown you. This is at a place in Austria, and this one uses an engine. The reason it's got an engine and not a turbine is that it was the largest engine the manufacturer could provide. It's a two-megawatt plant.

There you can see basically the ash vents. You can see the ash handling systems on these are very compact. If you've ever been to a coal-fired power station, they have huge ash dams and placements of ash. But one thing that's particularly interesting about this one is that this plant is set up in an economically depressed area of Austria.

One of the things about biomass is that there's a lot of ongoing employment in terms of the fuel collection and supply and infrastructure, unlike some other renewables, such as wind, where you basically set up your wind turbines at the beginning and then have a minimal amount of ongoing operation and maintenance. Some economic studies that have been done—and there are huge economic multipliers—have found that only one-third of the jobs are actually involved in the biomass plant. A lot of it goes out in terms of indirect and induced jobs. I'll come back to some of the employment. I guess this goes to the sustainability of intergenerational equity and this kind of stuff.

I just wanted to show you that these need not be large. This is a, I guess, a home-made biomass gasifier. As you can see, this thing has been put together out of a tractor. Basically there's the dash gasifier, the wood fuel comes in there, the exhaust heat from this generator preheats and dries out the woodchips. One of the issues for biomass is that it can be quite moist and burns much better or gasifies much better if dry. Basically that fuel goes into the gasifier, and the gas goes back to the engine.

I view this next one as a prototype, but it's interesting. I've actually brought along a commercial product catalogue from a French company. Think of that as the engine and as the diesel tank. You can see the heated action now being turned into commercial products as well. I see quite an opportunity in Australia for developing this as a commercial product. Again, it fits quite well into the remote-area power systems, particularly if you've got somebody on the land who's, let's say, got an opportunity to fuel it at no cost. It's based on human capital.

I just want to go on to pyrolysis. Pyrolysis, as I mentioned, is when you heat biomass in the absence of air and produce a slow process called slow pyrolysis, where you optimise the char that comes out of these processes. If you heat biomass very rapidly, extract the vapours that come off it and condense it , you can actually convert about 80 per cent of the mass of the biomass into a liquid product, with combustible properties that can be used as a chemical feedstock and as a substitute for distillate.

So this is a pilot plant in the UK. I just wanted to show you a little bit about this. Pyrolisis oil isn't the nicest stuff. It's very viscous and looks a little bit like coffee grounds, with a pungent smell. But the interesting thing is that it has a heating value of about 60 per cent on a volumetric basis of diesel.

This overcomes one of the big limitations of biomass, because if you transport, for instance, wood chips around, it would have a density typically of only about 150 kilograms a cubic metre. This gets it down to about 1.2 tons per cubic metre. So, it basically densifies the energy.

This technology is an avenue biomass and, world wide, it has been developed only in the last 20 years. It still hasn't reached quite the commercial scale. In the opening address, you were talking about a 30 to 50-year time frame. So it's very interesting in that respect.

You can use bio-oil fairly primitively as a boiler fuel. That's been done in the USA, at a place in Wisconsin. The power plant actually co-fired this pyrolysis oil with coal as a renewable energy component in the fuel.

But other things have been done. This is a large industrial diesel engine. You can see the size of if from the persons. That has been trialled for several thousand hours, introducing electricity in this kind of situation. It also can be used—and I'll show you in the next slide—in gas turbines.

The oil can be upgraded. This is where it gets quite interesting. You can extract higher value products, like food flavourings, pharmaceutical bases and things like that from the biomass. You can produce a whole variety of specialty chemicals. The prospects in the future are going for transportation fuel, though I see that as quite a long shot at this stage, because there are, to my mind, better alternatives.

A large, multi-billion dollar company in Canada—as part of a Magellan aerospace empire—is actually using and trialling 2½-megawatt gas turbines from pyrolysis oil. It's interesting. In the UK, they had a so-called non-fossil fuel obligation, which again is an incentive, mainly for the nuclear industry. But it was picked up by the renewable energy industry. There are actually about 70 megawatts of projects out there on this technology. There are some companies, like Dyna Motors of Canada, that are pushing this pretty hard.

The next step—and it is all done by burning the pyrolysis oil—can produce multiple products. This is really one of the future directions of biomass. This is really a concept of a bio-refinery, where you get your bio-oil and produce heat in getting it and other things to produce electricity. But when you've got your bio-oil, you've got a whole range of things you can do with it. You can produce ethanol from it.

Already patents have been taken out for pollution reduction agents. By using ammonia and reacting it with pyrolysis oil, you can produce a range of fertilisers, using lime that causes a reaction. Use alcohol and react it to the bio-oil, and certain chemical reactions produce fuel enhancers, chemical flavours. Adhesives is quite a large area as well. So is separation. In other words, you can get not just one product but a whole spectrum of products to improve the economics. You take the bio-oil, extract a higher value product, and then use the residual bio-oil as a fuel, creating whole new industries and jobs.

I just want to touch on anaerobic digestion. Opportunities exist for using sewage, animal manures and things like that. In Denmark they're quite strong, not only for their wind industry, but also in biomass. They have centralised biomass plants and get a number of farmers and co-operatives to pool those animal manures. There are huge environmental advantages in over-reduction management of a waste and in producing energy.

I just want to touch on biodiesel to show what a biodiesel plant could look like. This again is in Austria, which is really one of the world centres, of biodiesel. It's an oil mill, using canola or that kind of oil. Here is the biodiesel plant. We weren't allowed to take photographs inside. But it's basically quite simple kitchen chemistry, to my mind.

Each of those bags you see there is about a cubic metre and contains potassium hydroxide, which is a catalyst used in the process. They use about 10 per cent ether/methanol or ethanol/methanol as part of the process.

You have this canola oil going in—potassium hydroxide methanol. About 90 per cent of what comes out the other side ends up as biodiesel and glycerol, which can have a whole range of uses in chemical industries.

Just to show you some of the directions I believe bio-energy's moving in: I think one of the big pushes is really for integrated projects. It's not easy to compare biomass versus something else, because you're not just talking about the energy component of it. Often you are using biomass for a multiplicity of values. For instance, it could be used for putting in the ground for salinity control. There's a particularly huge project going on in Western Australia at the moment, using eucalypts and water tables; and then, by vigorously pumping and removing the water, you coppice this every few years. They're producing activated carbon eucalyptus oil as an industrial solvent and energy. It's interesting that our legislation says that an energy crop has primarily to be for energy. I think it's a bit of a nonsense, because the strength of it is really in these multiple values.

But I see future areas going into this integrated gasification of biocycles—more modular systems. In the United States, as I mentioned, they also have a small modular biomass program: they've got trailer-mounted, small power systems that push quite hard. It was mainly for developing countries.

I spoke about the biomass, the anaerobic digestion, micro-turbines and fuel cells. There a project going on with the CSIRO in Clayton, Victoria, using gasified biomass and a Capstan micro-turbine. That's another area, and that's funded by the HEI. I think it's one of the RSEP projects.

Pellet burners are being used for heating sturdy engines. I didn't mention that overseas there are large industries using biomass pellets for domestic heating. It's blown in to a vent in your house from the street. It is largely used in industry. It's got a lot of potential. It's a very clean-burning fuel. It's a pre-processed fuel and mostly uses things like wood waste. I see important prospects for these fuels and bio-diesel, notwithstanding the political point-scoring that's been in the media this week.

I guess jobs are an important part of sustainable development. It's not only about the environment and ecology, but it's also about society and economics. There've been a number of studies looking at the efficacy of biomass as a job stimulant. There've been various International Energy Agency bio-energy studies looking at the number of jobs per terawatt hour produced.

Homing in on this ACRCRE study: ACRCRE is the Australian Cooperative Research Centre for Renewable Energy. They conducted a study of a variety of energy sources, which included three biomass projects. One was this integrated processing plant in Narrogin, Western Australia, for gaining salinity control with this multiple product thing.

You heard earlier a little bit about the Rocky Point sugar mill, the environmental research project into municipal solid waste and the biomass fraction of that, the Albany wind farm, the large coal-fired power plant in Queensland and a gas-fired plant. Of those projects, the most number of jobs per unit of electricity produced were the few biomass ones, with the integrated mallee project at the top of the list, which has in excess of a thousand person-years per terawatt hour of electricity produced. That's consistent with a number of studies more on the fuel in rather than the electricity out.

It's interesting that there have been a number of job studies looking at biomass as an economic stimulant. There's one that I can provide to the committee that came out of Germany. It looked at the depressed parts of Germany, the former Soviet parts, and at biomass as an economic stimulant. That was reasonably effective. The one big catalyst is that the technology that is manufactured is to be locally sourced. Again, a lot of biomass has fairly conventional pressure parts similar to other parts of the industry.

Just winding up: I believe there's quite a large link of bio-energy into sustainability. I mentioned the greenhouse gas performance side which, in my mind, is pretty capable. Is the management of wastes linked to carbon sequestration and carbon management? To my mind, you could have your cake and eat it in too by offsetting fossil fuel and building up carbon scores. There's an environmental area in terms of salinity control. There is the possibility of future environmental trading instruments coming about, looking at carbon credits and similar things for salinity. There's already a salinity training system in the Hunter Valley, up on the Hunter River.

There is Landcare and weed eradication. The legislation provides for the use of exotic weed species as a renewable energy source. There are those kinds of linkages as well. You build up your biomass stock, your sustainable matter for bio-energy. There are other linkages to animal habitat and biodiversity. There are quite a few studies conducted world wide on that. Again, there are the multiple product streams with, I guess, the environmental and social benefits of that—some liquid fuels.

I find it quite interesting—and it has particularly surfaced in the US in recent times—in terms of fire hazard reduction. Australia could have a bit of a think about this one. They've put out a good book in the United States on this and they have had their "Smokey the Bear campaign" for many, many years. It is a no-fire-at-any-cost campaign.

What happened from their logging operations and so on is that they had a huge build-up of fuel on the forest floors. When there was the inevitable fire there were what are deemed catastrophic fires. Instead of cleaning out the forest in a natural way, these things had actually killed the trees totally. I've seen evidence of this in parts of the eucalyptus species which are real fire hardy species.

It's quite an interesting concept that, instead of having these hazard reduction burns with all the pollutants and carcinogenic smoke going up into the atmosphere, we should get in there and remove some of it for bio-energy. It's obviously going to be a highly contentious issue, but I think it's worth while at least looking at it a bit further.

I've spoken about the jobs in rural development. I guess biomass is often associated with rural and regional areas. There is the need to buy technology, particularly ethanol. There's some interesting work going on developing enzymes that can ferment—not only conventional sugars but a whole spectrum of fairly sophisticated wood-type sugars—and in plant breeding in terms of higher yields and things like that.

One of the things I find very interesting is the dispensability of biomass. Let's compare it to hot water storage. There's about 50 times the amount of energy storage in biomass than there is in your solar hot water system. It has inherent energy storage. It can dispatch it. What you often don't hear with some of these other technologies is the storage. It's often dispatched by nature. You've got longer cycles in biomass in terms of droughts and things like that and agricultural cycles. There is the possibility of renewable energy certificates if you've got the right credentials on the biomass.

Green power is a little bit more stringent, having been set up by environmental movements. There's certainly quite a lot of biomass that fits into that.

Just in parting, let me put in a bit of a plug for Bioenergy Australia. We'll be holding our annual conference in Sydney on 2 and 3 December. It's usually pretty well attended. We pitch our price at about a quarter that of conventional commercial conferences. Thanks.

THE CHAIR: Thank you very much, Stephen. There's so much in that that I think there's an entire thesis or an entire committee report on biomass, if nothing else.

I'm standing in for Roslyn. She's had to nip off because she's travelling overseas on the weekend and she has some last minute things to do. She sends her apologies.

Our next speaker is Garry Taylor. He is the principal electric engineer with Gutteridge, Haskin and Davey Pty Ltd. For 25 years, Garry has had experience in the power generation, transmission and distribution industries. Prior to becoming an engineer consultant with Gutteridge, Haskin and Davey, he worked for the ACT electricity authority in the days when it was just that, before it was Actew, and the Snowy Hydro.

Over recent years he's been involved in a number of renewable energy projects covering areas such as feasibility studies—very important this one—due diligence, design specification and tender analysis. He's also been involved in the process of accreditation of projects for the Office of Renewable Energy, the renewable energy regulator, and has carried out negotiations with electricity grid owners for connection of renewable energy projects.

Technologies he's been involved in are biomass, municipal waste to energy power plants, utilised and fluidised bed combustion—I can hardly wait for that—food waste to energy using biogas to power engines in a co-generation configuration and hydro-electricity generation and waves. He's got the lot. Thanks, Garry.

Mr Taylor: Thanks for that. Today I'll just let you know who GHD is briefly. I'll just go again go through renewable energy. I'm mainly going to concentrate on electricity. I'm not talking about the other sides that have been touched on today, like transport and how it's treated by legislation at the moment.

I will look at some key elements to a renewable energy project and the experience with very various technologies. I'm talking from the point of view of projects that we've actually been involved with in Australia and have been built or not built for reasons which I'll cover—just some experience with the various stages of those projects and what's feasible for the ACT.

GHD, which was referred to a few times there as Gutteridge, Haskin and Davey, has actually dropped the Gutteridge, Haskin and Davey now. We just call ourselves GHD. I know a lot of people probably knew us through that name but we've decided that's the brand that we market to now. We're an international company, engineering consultants basically. We've got offices in Australia, New Zealand, the Middle East, Asia/Pacific, America and here in Belconnen. We have about 2,300 staff at the moment. We're owned by senior staff in the organisation. As you can see there, we cover just about every area of the market conceivable.

We've heard about renewable energy a few times today. It's a source of energy that can be used without depleting its reserves. We've heard those today: solar energy, wind, wave, ocean, hydro and biomass. It's not a new concept, as has been said a few times; it's been around for a long time—wind turbines, water turbines, combustion of wood waste, just to name a few.

To put it in perspective: as we've heard a few times today, renewable energy currently counts for about 11 per cent of Australia's electricity. The reason for that is that we've got a very large hunk of hydro in Tasmania and in the Snowy Mountains scheme. Those figures there are a little bit dated but still give you the idea that the renewable side of things that we've been talking about today, biomass, wind, solar, et cetera, are still a fairly small chunk of the generation of electricity.

Solar hot water is included in there. We've talked about that earlier today as well. It displaces fossil fuels. As a few people have said today, there is federal government legislation in 2000 that the generators of electricity need to produce an additional 9,500 gigawatt hours of renewable energy by 2010. They've set up the Office of Renewable Energy Regulator to oversee the program. This is aimed at reducing the greenhouse gas emissions.

What's eligible under the legislation? They were trying to make sure that only renewable energies were considered. As Stephen's said, there will be a review early next year when some of these things, hopefully, will be looked at.

There's a list on their website, so I don't need to go through all those. They do tell you how they treat a combination of renewable an fossil fuel energy. There are some coal-fired power stations that are putting wood waste into their coal-fired boilers to help with the renewable energy side of things.

I think there will probably be a little more discussion about this in the next session, but the renewable energy market that was set up had created a currency, if you like, of renewable energy certificates. It was touched on earlier by Gary Voss that they have to, under the regulation, produce a certain number of these; otherwise they're liable. At the moment there's a penalty of $40 per megawatt hour if they don't produce these RECs. So the renewable energy power stations sell these renewable energy certificates to people like ActewAGL.

What are some of the key elements to a renewable project to actually make it happen that we've come across? Funding—it always comes up—is a key. What happens is that a lot of the more traditional financiers that weren't interested in these technologies are now becoming more interested in them, particularly with the renewable energy certificates, because of the extra dollars that they can get out of them now to make them financially viable. But a key thing that's happening with a lot of the projects in Australia at the moment is government assistance through the federal government, CEDA and organisations like that.

Technology: the financiers are willing to risk backing in proven technology. Stephen's gone through a number of those. I think the point of what he was saying was that we hear about all these different things—and a lot of them are proven in Europe and in the United States but not necessarily in Australia—but they are proven technologies if the financiers want to go looking at other places.

Environment: obviously that's a key issue. There are lots of things to consider there: noise, aesthetics, air quality, ash disposal, transport of fuel, the fuel sources, make sure that we don't cut down old growth forests, et cetera.

Another thing that often is a sticking point with these projects is the fuel. Is there enough fuel for the life of the project? We talk about the biomass, et cetera. Is it available in the area where you want to actually put the plant? There is also the fuel supply agreement, the power purchase agreement. They're just fundamental things, at the end of the job, as part of the project to make sure that the project can go ahead.

This slide shows their relative cost, dollars per megawatt hour for the different types of technologies. That line is roughly around the $30 to $40 that the coal-fired electricity currently is on the market for. You'll find that a lot of the technologies, the renewables, fall above that line. So the introduction of the $40 for the RECs started bringing this up to around $70 a megawatt hour and put a lot of these technologies in place.

The wind there, on the very far right-hand side, is just on that line. These figures are a little bit old. Those figures could probably come down a little bit. The industries are becoming viable.

I'll just go through some of the experiences with some of the technologies. Some of it's a bit of a repetition of what Stephen was talking about, so I won't dwell on them. Some of the jobs we've been involved in include green waste to energy, food waste to energy, municipal waste to energy and wind energy. I'll just talk in general terms on that.

An interesting project is the CSIRO Energy Centre where they're combining a lot of the technologies as a demonstration centre and showing what can be done in the building for sustainability.

Another project—I guess we won't see these on Lake Burley Griffin, but it is of interest because it's just coming on in Australia; I'll just talk briefly about that—is green waste to energy. Stephen's gone through the various biomass fuels. We're actually involved in a due diligence on a proposed 20-megawatt power station. I won't name these particular power stations. The figures that I give are approximates, because quite often we sign confidentiality agreements with the various developers so that they can keep their competitive edge.

But this particular one was the gathering of biomass from a major city area. They were using the kerbside collections, tree trimmings and domestic foliage and they were going to supplement that with agricultural wastes, transmission line clearance, sawmill waste, et cetera. The process is fairly straightforward. The fuel can be collected in an area commercially viable up to about 200 kilometres away from the centre.

Normally what happens is that it goes to what we call a green waste transfer station where they actually process it, grind it, and turn it into those piles that you saw on some of those pictures that Stephen put up previously. The fuel is fed into bins at the actual power plant and the processing area doesn't have to be at the power plant; they can be a distance apart. Obviously, you've got to transport the fuel to get it there. That normally goes into a fluidised bed combuster or a grate-type boiler, as Stephen showed earlier.

This technology—a fluidised bed combustion, which Stephen went into in some detail—has been around for a long time, over 20 years. It is well proven in the United States, so it shouldn't be something we should be frightened of. The boiler produces steam, the steam drives a steam turbine; that is turned into a voltage that can be transmitted away from the site. Out the other side you get your exhaust gas and areas for collecting the fly ash that comes out in that exhaust. The last thing is that they go up the stack.

There were a number of stacks that were shown on those photographs that Stephen had. Usually the height of those is determined by what happens in the local area. You really need to do a dispersion analysis of the local air currents, et cetera, but typically they could be nine metres in height above any buildings in a 100-metre radius to make sure that you actually get the disbursement out of the stack.

The fluidised bed combuster: I won't go through that again. Basically, as Stephen has said, there's a bed of sand in there. They put the fuel into that; that's where it's burnt. These things actually need to have fossil fuel to start them normally, but once they're started they're self-contained from the material that goes in.

Just to give you some idea of what actually is needed to produce 20 megawatts of electricity from green waste: 28 tonnes of fuel per hour is needed. It is quite low in ash production, but still you do have ash produced and you've got to get rid of it. What does it cost? $30 million to $35 million, and $5 million to $6 million a year to operate it.

Food waste: another job that we've been involved in is actually an area where they're turning food waste into fertiliser. As part of the process, the digesters, as Stephen mentioned, actually put off methane gas. What happened in this particular location was that we were asked to come in and say, "Well, here's this gas; we could just flare it. What else could we do with it?" So we said, "What you could do is put it into a gas-fired engine and you can put it into a co-generation configuration." What would happen with that is that you produce two things from the gas—you produce electricity and you also produce heat that can go back into the process.

They were taking the exhaust gas from the gas turbines and using that as part of their drying process and also recovering heat from the water that was used for cooling the gas engines and using that in the process as well. The advantage of this is that gas engines are normally only about 30 to 35 per cent efficient, but you can double that, efficiency-wise, by going in to co-generation. The reason that that happens is that you're displacing fuels that otherwise would have been needed to produce the heat for that process—either gas or electric heating.

Just to give you some figures there: 200 tonnes of waste per day produce enough methane to run 3.9 megawatts of gas. Municipal waste to energy is fairly controversial. People don't want these things in their backyard; they don't want the fuel transported through their area. They're worried about air quality; they're worried about the ash disposal; and they're worried that what's going to happen to the good things that you can get out of your waste, like your recyclables; is somebody going to turn round and say we won't do that anymore/ we'll just throw it in because we can keep burning it.

The Waste Management Association of Australia produced a paper on this very issue because they believe that there's quite a bit of energy to be had from municipal waste. You can look at their website to get some more information on that.

There are a couple of different methods that you can convert municipal waste to energy. One is, I guess, a non-combustion method using the pyrolysis that we were talking about before. The facility at Wollongong is an example of that. The other is combustion. We've been involved in looking at a combustion plant for burning municipal waste and producing energy. Again, it uses this fluidised bed technology.

The important part of the municipal waste is the actual treatment of the municipal waste to turn it into a fuel that can be used in the fluidised bed, often called RDF or refuse derived fuel. So what this is showing is that you need to have an area that actually treats the municipal waste to turn it into the RDF. Depending on where that particular location is, down the bottom down there you have to transport it to the area where you're actually going to use it, in the waste to energy plant. Once the RDF gets to the plant you've got to process it. It's usually compacted so that you can transport it in reasonable quantities. It's got to be decompacted, it's got to be turned into a size that can go into the fluidised bed combusters.

As to the green waste: it produces steam that drives the steam turbine, and electricity is produced. This tends to cost a bit more because you've actually got to set up a treatment area. So that figure of about $70 million gives you some idea for 20 megawatts. It's probably about $45 million in the actual power plant itself. The plant to produce that consumes about 700 tonnes per day of refuse derived fuel, and there'd be a lot more municipal waste to get to that particular quantity.

Wind is certainly a growth area in Australia at the moment for renewable energy. I'll just talk briefly in terms of wind energy, and refer to a particular project. There's some engineering involved there. The best sites: there was some talk there about whether it is okay in the ACT. Well, obviously the best sites have got the high-average wind speeds. It's essential to do some long-term wind monitoring because it changes with the seasons. You need to get at least 12 months of data to be able to know whether the wind energy is going to be suitable for that site.

Some of the things you need to look at are the capacity factor. That is defined as the actual energies produced in the turbine in a year. It is around the 20 to 30 per cent area. It certainly can't be used as a base load plant. It's really only available when it's available.

Noise issues: people worry about noise issues. They've set some fairly tight limits in Europe which are comparable with the average office-type area. It's quite easy to get these things without producing too much noise.

The location factors: just to give you a bit of an idea of size, that one at Crookwell has turbines which are about 150 metres apart. If they put another set behind them you'll need about another 500 metres behind that. So it's a reasonable-size area to make sure that you maximise the use of the area available.

Other areas include aesthetics. People don't necessarily like looking at these things. Other people are worried that you're going to kill all the birds. So you've just got to make sure that you pick an area that isn't going to be in the bird flight path.

Transmission is definitely an issue. As was said earlier, some of the best wind sites aren't necessarily near where people live. When you start talking at $60,000 to $100,000 a kilometre to start running transmission lines, these projects start falling down pretty quickly. The typical cost of a 600-kilowatt turbine is about $1,500 a kilowatt.

The CSIRO Energy Centre is a demonstration centre for sustainable energy up at Steel River, Newcastle; it's well under way at the moment and it's due to open early in 2003. What they're actually looking at demonstrating there is wind turbines, a building-integrated photovoltaic cell or a battery storage, microturbines and eventually fuel cells. So it's certainly going to be an interesting area to visit.

The wind turbines are not very big, but it shows that you can put wind turbines in areas next to buildings. In fact, we've looked at selecting ones that operate at a very low wind speed. In this particular area, the speed is about 3.8 metres per second, which is pretty low. We've actually found turbines that will kick in under that. With the one at Crookwell, for instance, you'd probably be talking more like seven metres a second just to get the turbines going.

The photovoltaics are built into the building structure, so there's a lot of architecture gone into that. It's part of the building, which is an excellent idea. They're putting in battery storage. Again, we know the sun doesn't shine all the time and the wind doesn't blow all the time. The idea there is that they can put the green energy from the wind and solar back into their building at times when they're not producing it from the wind and the solar.

There are a couple of microturbines going in. Microturbines are run off natural gas, so I guess in themselves they're not a renewable source; they're running off a fossil fuel. But we've looked at putting them in co-generation configuration so that we can use the heat from the turbines for heating. You can also put them through an absorption chiller; you can actually get air-conditioning out of them as well. So it's a good use of a fossil fuel. Again, you are going from the 30 per cent up to the 70 per cent efficiency by doing that.

Fuel cells are in the future. At the moment the technology really isn't there for fuel cells to be commercially viable at the moment.

There's an energy management system that will maximise the use of all these renewable technologies or sustainable technologies to make sure that they don't take any energy from the grid if they can help it, and export energy out to the grid when they can. That's just an artist's impression of what it looks like. So you can see that the solar cells aren't add-ons; they're actually part of the structure itself.

Wave energy: as I said before, you wouldn't see this in Lake Burley Griffin. Jervis Bay is still in the ACT, but I'm not sure that you'd put one of these down in that pristine area. This is actually a job that we're currently working on. It's just an interest. It's an Australian company called Energy Tech that have come in with this particular technology. The guy that's behind it was riding surf boards about 15 years ago and thought it was a great idea. So it's finally coming to fruition.

So concepts can take a long time to come through. It's going to put out about 300 kilowatts, just to give you a scale of things. Across the parabola of those two arms sticking out there is about 40 metres. The idea is that the actual waves themselves get concentrated into this area here. There's a hole underneath, and it moves up and down in a chamber. The air movement that's in there goes in and out of this turbine.

The trick is, as you can imagine with a wind turbine, the wind's blowing in one direction and the turbine turns in that direction. Here we've got, effectively, the wind going one way and then, five seconds later, the wind's going the other way. That's what's behind this part of the technology —to make that turbine be able to move in both directions.

Just some experiences with various stages of the project concept feasibility study, due diligence engineering construction commissioning: as regards the concept, often people come to us with ideas and ask us to engineer them and actually turn them into reality. That wave energy plant is certainly a good example of that.

We certainly have other people with these magic black boxes that come to us that I don't think anybody could engineer into a solution, but that's the way it goes. It's a good thing we've got dreamers amongst us, because some of it gets turned into reality.

Fuel feasibility studies: one of the things to certainly look at is whether there is enough fuel. As I said before, with wind, you certainly need to look at what's happening in the area, at least for a good 12 months before. In regard to the biomass fuel in the area, the particular one that we looked at before, there were a couple of other competing projects in the area and at the end of the day there wasn't enough biomass around there to support all those projects.

We need to, when we do a feasibility study, look at how will the environment benefit. A number of the technologies that we've looked at and that Stephen covered are basically a burning technology; so we need to make sure we look at the disposal of the ash by-products, air quality and their impact on the environment.

What is the suitable technology? We need to look at what's in the particular area and decide what is the best technology. As has been said before, all of these technologies are well proven overseas.

I've talked about previously the location of the electricity grid. It can be a big issue for wind turbines and others, and it can also be an issue for projects, even when they're in the middle of areas. One of the jobs that we're working on at the moment is right in the middle of an industrial area in Sydney. If you look, just off the block, 50 metres away, is an electricity line. We're having to spend $300,000 to actually connect into the electricity grid because that line out there isn't strong enough Don't discount those issues.

Due diligence: I guess this makes or breaks projects from the point of view of financing them. I guess it depends on which way you look at it. From the developer's point of view or from the financier's point of view, we've had some financiers thank us for doing due diligence and actually pointing out that what was being put before them was a big risk and they've pulled out of it. Other times, we've turned around and said that it's all a go and you can sign them off as well.

I went through these briefly before: proven and understood technology; fuel supply agreements; power purchase agreements; how long are they in place for; make sure that the company that's going to build this have taken all the construction risks, et cetera, into consideration, particularly if the technologies are a new technology; and, once it's been built, somebody needs to actually operate it.

Engineering construction and commissioning: once you get to that stage, it's reasonably straightforward. Obviously, you need to look at the local conditions, regulations, environment. Other than that, it really is fairly straightforward engineering, like any other project.

Opportunities: I've just listed the one that I talked about before. There was an opportunity to, rather than flare the methane gas, use it for co-generation and producing electricity for export.

Applicability in the ACT: I guess a lot of these things we've heard about today certainly have potential for the ACT. They seem to range from what I basically call innocuous solar panels through to the less-light-type technologies where you're burning combustion. People have a lot of problems with those sort of areas.

You really need to have a look at issues such as fuel source, environmental impact; you need to start thinking about what are the regulations in the ACT. Some of the projects that we've been involved in, if they tried to build them in New South Wales, they'd never go ahead. But they build them in Queensland, and it's not a problem. So there's certainly not a unified approach across Australia to what happens to the environmental impact, particularly things like air quality, noise and those sorts of things.

It sounds like, from what I've heard this morning, ActewAGL have been certainly looking into some of these technologies and whether they can or can't go. You need to look at what's out there, what's feasible, what can go, statement of opportunities for people to see if they're interested in putting their money into the ACT. That's it.

THE CHAIR: Well, as inevitably is the case on these occasions, we always run out of time. But we can't have gone through such a wealth of information and ideas and innovation without getting some questions from our audience. I'd like to thank the speakers. Are there any questions from the audience?

Ms Wayne: I'm glad you're all lining up, because I've got a question for everybody. Fiona Wayne from Environment Business Australia. Garry, you mentioned wave power. I know that tidal has nothing to with the ACT, but I thought you might like to talk to people a little bit about the Derby tidal project that I know GHD is involved in, which we've taken a look at and we're really excited about.

Has anybody got any comments on the Enviromission tower? Maybe, Andrew, that's a question for you. I don't know enough about it. I think that's another interesting project.

Hot rocks seem to be coming up as quite an interesting matter. I don't know whether it's applicable to the ACT or not.

Stephen, under the UNFCC guidelines relating to sequestration carbon sinks, do you think there's the potential to renegotiate plantation forestry, given that, if we can have rotation plantation, the root system at least will stay in the ground; and, depending on how the cropping is treated, it either does or doesn't release carbon?

Mr Taylor: I'll just quickly answer the question on tidal. As you say, it's not really applicable to the ACT because you really need to have reasonable tides, which are up in the north of Australia. Derby is certainly one that's been looked at.

The project has been on and off for a long time. I think the thing that people get confused with is the difference between wave energy and tidal energy. What happens with tidal energy, because the tides come and go every six hours, you can actually capture the water as it comes in and as it runs out; you can turn a turbine basically to produce that energy. So that's turning every six hours.

Wave energy actually relies on there being waves to be able to produce the energy. It's not bad. The plant down at Port Kembla has about an 80 per cent capacity factor, so they're expecting to get a fair bit of energy out of it most of the time.

Dr Lovegrove: I can say a few words about what I know technically about the solar chimney, the solar tower. I guess most people have seen the media. There's a company called Enviromission that thinks they're going to get $700 million and build a one-kilometre high concrete tube. The idea is that you cover the ground with glass. It's like a huge greenhouse. It becomes like a huge, flat-plate solar collector. It heats up the air. The air is less dense once it's heated and runs up the chimney. You can actually put a wind turbine inside the chimney.

I couldn't comment on their economics. Of course, everyone thinks their own technology is going to be the cheapest. The technology definitely does work; it has been proven on a small scale. The company is a German engineering company, a very creditable civil engineering company that also had quite a lot of involvement in the solar thermal projects over the years. So you can trust them when they say it will actually work. The dollars remain to be seen.

But I've got to say one thing: I really admire the vision of people going for things on that scale, because that's the scale of thinking that we have to have—the 200-megawatt scale. Does it relate to the ACT? Well, no, you would not build something like that in the ACT; you would build it where they want to build it, which is at Mildura or somewhere around there. But there's no reason why we can't have a financial stake in it and buy the green power from it if it's out there.

The other one was hot rocks. It is a similar story really. I think there's a prototype system going in. The idea is that you go under the earth far enough and find some rocks which are hot. What people don't realise is that it's the decay of radionuclearites in the ground; it's not the heat from the magma percolating up, as you might think; it's the decay of radionuclearites in the ground. What you need is a lump of granite that's not too far from the surface and has a nice insulating sandstone cap over it. Then you drill down a kilometre or two—God knows; don't ask me how you drill a hole a kilometre deep, but apparently they do, standard practice—and find rock that's at 250 degrees C. You pump water down there, get it hot, bring it up, run it through a heat exchanger. So it's a similar thing to the solar chimney. It will be done elsewhere. There's no reason why we can't be buying power from it if they do it.

THE CHAIR: Keith, is Enviromission the same organisation that had the prototype in Spain?

Dr Lovegrove: No. Enviromission is a new company started in Australia.

THE CHAIR: But is it the same concept?

Dr Lovegrove: It's the same concept. They bought a licence to the thing that was tried in Spain, yes.

Dr Schuck: There's a bit of coverage in that book that I put together on that Enviromission project. I'm not going to be too helpful in answer to this one. I don't work for the government and I don't know quite what the odds of negotiating at the United Nations are. Perhaps it's a question for the Australian Greenhouse Office. I really don't know whether that's feasible or not.

THE CHAIR: Any other questions?

Mr Ridley: Two questions, mainly for Stephen, I think. Are any dioxins produced from the combustion processes? Secondly, where you have repeated crops for biofuel and you're getting carbon from the air, et cetera, what about degradation of the soil and depletion of nutrients in the soil? Are you expending further energy and putting them back into the soil or what?

Dr Schuck: The dioxin issue is largely associated, I guess, with biomass and the chlorine attached to it, in one way or the other; so it goes along with PVC plastics and things which are probably not biomass anyway and should be removed. Perhaps you're talking waste energy rather than biomass.

As to the possibilities of somebody foolishly trying to burn marine pilings or something like that in some kind of recycle mode: yes, there's a possibility of dioxins; but that can be well controlled.

In terms of soil degradation and, I guess, the whole sustainability issues: yes, it's a huge issue. It's been looked at over decades by the bioenergy industry. This is one of the reasons why Bioenergy Australia is actually participating in two related tasks in the International Energy Agency's bioenergy program. One is called conventional forestry assistance or bioenergy assistance. They've just produced quite a thick book on sustainable production of bioenergy. There are a whole heap of issues on nutrient cycles, compaction of soils. It's one of these things. Yes, there are certainly a heap of issues in there. They generally can be managed.

You look a bit dubious. I suppose one of the things worth while saying is that, with a lot of biomass, particularly, as I say, forest residues, a lot of the nutrients are actually in the leaves, the needles and the fine twigs, and that's generally left behind. This is a world-wide practice. The stem wood generally is not all that rich in nutrients, but again the ash is often recycled if there's a requirement for it.

THE CHAIR: Can I just take the chairman's privilege and ask a question that relates to that. Garry talked about the height of the tower for the disbursement of whatever. My question was dioxins. I presume that there are scrubber technologies for those sorts of emissions. What are the strategies for dealing with the ash? They have agricultural applications but they're not—

Mr Taylor: As Stephen said before, you're probably talking more about the municipal waste because you start getting plastics and all those sort of things in it. It really comes down to an issue of when you treat that municipal waste in the first place, what you take out of it. Sure, there'd be something left. There are issues to do with the temperature of the combuster and what is produced and not produced. There certainly are scrubber technologies for cleaning all these things, but they cost money.

The project that I was talking about there was, say, $45 million. Could go up to $55 million if you really wanted to scrub everything out of the air?

With regard to the ash, again it's a similar thing; it depends what goes into it. There could be a problem in getting rid of it; that's right. But ash out of the biomass is a lot better; it can actually be used. As Stephen pointed out, he was using it in soil. They can also use it in cement and processes like that. That's how they usually get rid of it

THE CHAIR: You may not be able to comment on this, Garry, but we've already got the precedent of the Lower Molongo Treatment Works using ash for agricultural purposes. The risk with matter coming out of municipal waste is that you still have a whole lot of contaminant-type things there.

Mr Taylor: There is a risk of that contaminant, yes.

THE CHAIR: Any other questions? Andrew.

Dr Blakers: Just a short comment: Steve, in a map, put up the figure illustrating the fairly high amount of CO_2 embodied in PD solar cells. I just want to make the comment that that is almost exclusively associated with the silicon wafer, and most of the technologies that will be in production within five or six years are going to have less than 10 per cent of the amount of silicon per square metre that current technologies have. For instance, both of the technologies that we are in the process of commercialising have less than 10 per cent of the amount of silicon in commercial wafers now.

I'd like to throw up a red herring for Stephen. Okay, you're growing trees for biomass production; you've got your tree mature; you cut it down. What's the best thing to do with it? You've got an amount of carbon embodied in the tree, you've got an equivalent amount of carbon embodied in, say, some coal that you've dug up. Should you leave the coal in the ground and burn the tree or burn the coal and bury the tree? The reason for doing the latter is that the conversion of the carbon in the tree will be much less efficient than the conversion of the carbon in the coal to electricity.

THE CHAIR: There's an interesting friction between competing technologies.

Dr Schuck: It sounds like something over a beer afterwards.

THE CHAIR: I think so. I can recommend a good hostel.

Dr Schuck: I guess that scenario I presented of the biomass was an ongoing thing. It's really like a new industry and a deeper hole in the ground. I guess the carbon sequestration is a complicated issue. A mature tree is actually doing very little for the atmosphere; there's very little carbon dioxide uptake once a canopy is closed. That's one of the drivers for these processes. When they're vigorously growing and young, that's when they're absorbing the carbon dioxide and nutrients. When you've got a stagnated tree, it's a fixed store of carbon. That doesn't quite answer the question.

Dr Lovegrove: I'd just like to add a little bit to Andrew's comment about the embodied energy. One of the things that I think are worth pointing out is that, when you see these studies that say this renewable technology has this much emissions, and it's because of the embodied energy, the fundamental assumption there is that it's fossil energy that has been used to make the thing. If the silicon wafer was actually made from solar electricity there would still be no emissions; you'd still want to get the wafer thinner to reduce the energy payback time. There are fundamentally no emissions from a renewable technology.

Dr Schuck: That's a future scenario.

THE CHAIR: That's the future, yes.

Dr Lovegrove: Yes, but you can't blame the solar cell for what it was made from, in that way.

THE CHAIR: No, I think you need to all go off and have a beer and discuss that one. We are running behind time. Can I suggest we stand up and stretch, take a breath of fresh air and have a cuppa, but come back quickly.

In closing, I thank our speakers in this session, Keith Lovegrove, Stephen Schuck, and Garry Taylor, for some very stimulating and mind-bending presentations. Can I say that the innovative chemist at Burra, who happens to be my own pharmacist, and I compare notes because he and I both have pisé houses. One of the great things about having a pisé house is that people keep coming to you and asking you whether it has fallen down yet.

The roof has burnt off mine once, but it's still standing after 15 years. It still costs nothing to heat. It is in the centre of Belconnen. It is a great way to live. The man off the grid does have a great house and a great lifestyle just like yours or mine. Thanks very much.

Ms Schaeffer: Can I just speak on that please?

THE CHAIR: Okay.

Ms Schaeffer: I'm Michelle Schaeffer, a representative for Greenpeace. Katherine Fitzpatrick couldn't make it; she had a conflicting meeting. She's the renewable energies campaigner. It's a general comment. The EMRAC review is coming up in January. Greenpeace thinks that the target that the federal government has at the moment of 2 per cent is a little bit modest, and a little bit low, and we'd like to push them to try to take it up to maybe 10 per cent. There is backing from companies, BP, Origin Energy, Australian Wind Energy. That's all I wanted to say. If you can put any pressure on them we'd like to raise it just as a small step to start off, because a lot of these projects are going to take many, many years to come to fruition. This is a short-term, right-now thing. Thanks.

THE CHAIR: The comment that will be in *Hansard*, and we'll able to take into account.

Short adjournment

MS GALLAGHER: We might kick off the final session today. Just by way of introduction, I'm Katy Gallagher and I'm the Deputy Chair of the Planning and Environment Standing Committee of the ACT Assembly.

The fourth and final session today, which we'll use to wrap up the conference, is about achieving change. We'll have two speakers.

The first is Mr Alistair Walton from M-co, the Marketplace Company, and Alistair is the marketing and communications manager. As a background, Alistair Walton worked as a journalist for a number of television programs, including *The Investigators*, *Four Corners* and *A Current Affair* before taking on various senior executive positions in the New South Wales government.

Since early 2001 he has held responsibility for planning and managing stakeholder communications for the implementation of two recent energy markets, the green electricity market and the New South Wales and ACT gas retail market. Recently, Alistair was part of the M-co team providing advice to the New South Wales government in regards to the design and implementation of the electricity greenhouse gas abatement scheme. M-co, the Marketplace Company, designs, implements and operates markets in the energy and environmental sectors.

M-co in Australia presently administers the green electricity market, the New South Wales and ACT gas retail market and the renewable energy certificate registry. Overseas M-co operates the New Zealand wholesale electricity market, the Singapore wholesale electricity market and is advising the South African government on reforming the electricity sector.

So if we could make welcome Alistair Walton, thanks.

Mr Walton: Thank you, Katy. Just to give you an outline of what I'll be speaking about today: it will be about the movement to markets, a relatively new dynamic in policy and industry interaction with government; environmental instrument training, another new policy outcome; and models of understanding. There are some models starting to appear about markets, environmental markets and, more importantly, Australian developments.

The reason I want to speak about those things is that the aim of what I'm trying to say rather than what I'm going to be saying is to emphasise two keys points that I've heard run through every presentation today, despite the diversity of the topics. The two really key points I heard a lot of were incentive for change and investment to enable that change. The market allows and fosters those issues of investment and incentive.

I want to talk about how a market modelled and designed can deliver incentives to create change in people and businesses. The best way to do that is to allow them to get some benefits which allow them to invest in making changes. Everything we've heard today is going to cost money.

No matter how small or how large the projects or the policy outcomes will want to be, someone is going to have to pay for them—either the taxpayer or private investors. The market mechanism is a great way to let people decide who is best suited to make those investments and what sorts of rewards will they get. that in itself will then, hopefully, deliver the change, deliver the new technologies or deliver the change in behaviour, more importantly.

A rundown on M-co: you've heard most of that. Certainly of interest to people in the ACT is our role in running the gas retail market for New South Wales and the ACT. Basically what that means is that it allows you a choice of who your supplier of gas is. ActewAGL are a member of the company we work for, the gas market company. They're not a member of the green electricity market, although AGL is.

But we also, in relation to this town, helped run the renewable energy certificate registry, which is a registry that allows the tracking of the ownership and the movement of renewable energy certificates. We'll talk about that later. We're also advising a range of governments on the energy and environmental markets.

The movement to markets, as I briefly touched on earlier, really is a phenomenon that has occurred specifically from the 1990s onwards. I think it was a reaction to a lot of policy that occurred in the 1980s around the world where economic policies tried to create change in behaviour, both in business and in society. We went through various things like privatisation versus government ownership.

All those things were very blunt policies. They all seemed to be very black and white, and there wasn't a lot of public or economic thought or policy debate about the details: sure, privatisation might be good, but what does that really mean? A lot of the debate was really caught up about privatisation versus government ownership and things like that, especially in the utility area. In my view, that was a red herring and an emotional argument.

In the end, it wasn't so much about who owns the assets; it was the market that would allow the exchange of the goods, create price signals, create the ability to exchange the goods, which is the most important aspect of what we're trying to talk about. So it's really the design of the market.

You can have a market that could be all government-owned assets, but if it's operating in a badly designed market you're going to get bad outcomes. So the ownership really does not help affect the outcomes. It's really about the design of the market, which will facilitate the exchange of the goods and create an investment, which then creates outcomes—which we should be interested in, rather than ownership of the assets, though that is a worthwhile argument to have of itself. But let's not think that that argument is the one that's going to deliver the outcomes.

Public policy objectives have in recent years been met through something regulators are starting to call incentive regulation. The mandatory renewable energy target which a few people have talked about today is certainly an Australian example of incentive regulation. Basically, it rewards people doing good things and creates penalties for those not doing good things. There's an incentive in that regulation to reward people as opposed to a regulation that just penalises and does not reward.

Basically, we're talking about bringing in a reward mechanism as a formal part of the policy and of the regulation—to get away from the big stick and see, especially in trying to change the behaviour of business, whether they react better, quicker, when there's a carrot rather than a stick. But that doesn't mean you don't have the stick behind your back ready to use it when you need it.

Pricing is an investment, a very important part of this movement to markets. There was, especially in the energy industry, a lot of investment in building of power stations, whether they were the right power stations and whether they were even in the right place. It was very distorted, because all those decisions were made not so much on pricing and investment but on whether that was a swinging seat or not and whether a good way of saving your seat would be by building a power station nearby. Certainly around the world there's a view that you can't keep on making large investments like that; you need to have sense and bring in investment that's going to pay off. You need price levels for that.

We also need to transfer the portion of risk to industry. Especially in the utility area, government, the taxpayer, was carrying all the risk for how the utilities operated. Who was really getting the reward out of that market place? If industry was getting the rewards they should be carrying more of the risk. The movement to markets is a mechanism for trying to transfer risk away from taxpayers to industry who really are in the end benefiting, we hope.

It's also about linking environmental outcomes to government policy objectives, and we might get to that. Some key things about establishing market mechanisms: certainly in the environmental area it's all about policy and it's all about delivering policy outcomes. You therefore need some legislation to provide a framework from which everybody understands what is the framework they have to operate in—whether it's a business, whether it's the regulator or whether it's consumers who need some rights to be protected. The enabling legislation is essential.

A few drivers of markets: we need to define a property right. An example of the markets I'm talking about is the mandatory renewable energy target where, for the first time, they created the renewable energy certificate. That, basically, is a property right. That certificate is a piece of property that has value, which someone can own. You can't dispute that ownership once you identify that you're the person who created it. If you've transferred it to another owner, they can demonstrate that they own it. It's a piece of property.

Renewable energy certificates are just like shares; they have a life of 20 years. You could buy them now if you're a speculator. Who knows what they might be worth in 20 years time. But that's not how the market's operating at the moment. But an important part is to find that property right. It took policy and legal people a long time to overcome a lot of issues there. Property rights are probably one of the barriers in the movement of markets into issues like how you create markets in the areas of salinity, biodiversity and some of those other environmental areas which are under a lot of discussion at the moment. We'll see some progress there, I'm sure.

Water rights is a big issue at the moment. Who owns the water? It is certainly a very contentious and emotional issue for everybody there—the policy makers, people who use water, the farmers—but it is a key driver, as you can see, for the market.

The allocation of the liability of obligation. We're not going to have a market unless we have some people who need to exchange something, and the best way of creating those buyers and sellers is to create a person who's liable and has an obligation—therefore they need to buy some certificates—and create someone who wants certificates and then sell them to a liable person. We might talk about liabilities and obligations later.

In the end, though you need, a regulation and regulators. You're not going to get away from that. What's important is setting up the framework to allow the regulator to have a role, which is about ensuring the outcomes. The focus, in our view, is not so much the process but the outcomes, because that's what we're setting these markets up for.

Very simply, the market mechanism is this: you have a policy objective, you have enabling legislation, you create some liable parties—whether they're people who use too much electricity and not enough renewable energy, or whether that liable person uses too much water or clears too much land or uses their car too often in a week. You can create and define a liable party and you can do that anywhere in the ACT and New South Wales, Sydney, Melbourne.

The qualifying activity: you've go to balance it out. The person who decides not to use their car and to catch the bus, might get rewarded. The person who plants the forest which sequates the carbon and is stored for 30 years or 100 years in those trees is rewarded through that qualifying activity. You have large-scale energy efficiency, especially in large buildings, government departments. If they can demonstrate that, through some policy or activities, they have been very efficient in the use of energy, that might be rewarded and that might be qualified in the legislation.

In the end, they're creating offsets to what the policy objective is—whether it's to use less energy, create less greenhouse gas. The liable parties have to meet an obligation. They have to increase renewable energy production or buy more renewable energy.

Developing the market mechanism: this is just determining the policy objectives. No matter what decisions the ACT Legislative Assembly may make, they're going to determine some objectives that might have to be met over the next 5, 10 and 20 years. They need to be clearly spelt out. They then may want to define a compliance method which creates certificates to reward good behaviour. They have to identify liable parties. They have to set obligations and penalties. Then they'll have to determine models of how this would all work.

As you would have heard earlier, M-co designed, built and now operates the renewable energy certificate registry for the Office of the Renewable Energy Regulator. Basically, that registry is all about capturing the millions of certificates that will be created over the next 10 years as this policy operates. The ownership of those certificates—who owns them at any one time—is a very important part of measuring the effectiveness of the policy, measuring whether the electricity retailers who will be the liable parties have met their obligations year by year. The registry is a key part of regulation. It's a key part of establishing the market. That registry in the end, though, is simply a piece of software that captures some details about a certificate and will store that information forever more.

Exchange mechanisms: in the end we're all about creating investment in the technology. Whether it's wind farms or solar hot water heaters on your roof, you're going to have to create an incentive for ActewAGL or any company that you may want to bring into the market. You're going to have to ensure that they're going to be interested in investing and, more importantly, that the bank's going to be interested in investing in these wind farms, because they're not cheap.

How they do that, as was discussed earlier, is that wind farms, under the mandatory renewable energy target, can sell electricity into the grid. They would have got $30 per megawatt. But what made them viable for the bankers who then decided they would spend money on creating the wind farms is that they got another potential income by the creation of a renewable energy certificate.

The renewable energy certificate rewarded the Green activity. It rewarded the fact that they were creating renewable energy. That in itself was seen as important and should be rewarded—not just the fact that they were creating electricity and that the certificate had some value that could be bought and sold in a market. That therefore meant they had $70 for each megawatt hour. That got the banks interested. That's what got the banks and their number crunchers saying, "Well, this business is viable. We should be investing."

That can be applied to any policy objective. The ACT Legislative Assembly could be quite willing to go out there and create some bold initiatives—"Brave decision, Minister" type stuff. But it's no use having a brave policy if they're not going to get investment and the bankers aren't going to back them up; you're not going to be able to make your Solarisation Pty Ltd come to fruition.

This market mechanism is about trying to create liable parties who have to buy certificates and creating people who do good things; the ability to create the certificate so they can sell and get money to invest in their good behaviour—whether it be solar hot water heaters or the fact that they're buying renewable energy off somebody.

Environmental markets are operating in a number of areas. There is the mandatory renewable energy target. I'll go into the Queensland Gas certificate later. The New South Wales greenhouse gas emissions abatement scheme will start operating from 1 January in New South Wales. That's all about making mandatory the reduction in greenhouse gas emissions related to the production of electricity in New South Wales. Green power is all about selling the renewable energy through retailers like ActewAGL and Origin Energy Australia.

The Dutch have an environmental market; the UK does; Austria does; Europe does; California does; Texas does; Japan does. In all of these markets—and that's not the whole list—some of the common factors are: they're all pretty new; these things have all only been happening in the last few years, so they're all young and formative; and there is no one model that's coming out to be shown as the right one. No two markets are alike. There may be good reasons—to suit the local needs, to suit the local, political, economic and social issues and objectives.

There's a mix of investment tax, subsidies and trading in all those schemes to make them operate. It's very hard to compare them in regards to what works better the most. There isn't enough research that's been done yet, and these regimes have not been going for long enough to make some real, hard, cold decisions. But there are a lot of similarities.

You could say that, in the end, they're all about rewarding good behaviour and penalising bad behaviour in regards to the use of renewable energy and the creation of renewable energy. Certainly, that last point, low cost, is critical to regime and success; there's no use introducing any policy if it's going to cost a fortune just to implement the process. Businesses aren't going to be interested. It's only going to distort investment signals. Certainly we would say, no matter what, the low-cost implementation of the market is a very critical factor for its success.

The Texas renewable portfolio standard: you could say that the Texas market is not a stretched issue; it's going to be easily met by the retailers and it's setting up an ability for people to trade certificates related to renewable energy that's been created. They've got a regulator. Because there hasn't been a stretch in the policy objectives, you're not really stretching the participants—the retailers in Texas. Your prices for the certificates are going to be low. We saw that in the renewable energy target last year in Australia.

The UK renewable obligation certificates are quite new. I haven't heard a lot personally about what's been happening since it commenced in April. It's still early days. You find that, in the first 12 months of any of these market regimes—it's a funny war—it's really hard to tell what's going on. Participants in these markets are still getting their processes in place. You need at least 12 months to know how that market is going, its progress.

Europe had a renewable energy certificate model recently. That is a non-mandatory. The government's not legislating for that one. Basically, you've got a lot of companies coming together and saying, "Let's do something; let's be in front of government policy. Let's not wait for the European Union to set this up; let's just go out and do." M-co was involved in a trial last year. We set up a trading platform that was used by over 130 traders over two weeks, playing out a model of trading renewable energy certificates over 20 years. The success of that simulation led to the participants thinking it was a good idea; they would then progress; and these energy companies and trading companies are investing money in setting up this regime.

The Austrian tradable certificates scheme is really about trying to get small-scale generators, create investment in small-scale hydro generators. Once again, as you can see, the legislation was only promulgated in December 2000—a young market.

In Australia, we've got EMRAC, which we've been talking about. Then, as the Greenpeace representative said earlier, with a 2 per cent target, you're not really stretching people that hard, although some of the participants here may think differently.

Certainly the Australian Eco-Generation Association, of which large energy companies like Origin are a member, believe that that target could easily be stretched out to 5 per cent, to increase renewable energy from 10 to 15 per cent, over the next 10 years. Certainly, it was an issue that was debated in the lead-up to the last federal election, by both parties. I'd say that's something that could hot up in the next couple of years. Certainly, I don't see the present government changing that target at the moment. There are a lot of people knocking on their doors to do so. You never know. I would say that, after 2005, there could be a lot of calls to see that target stretched to at least 15 per cent, which is still under the 10 per cent Greenpeace and other environmental NGOs are calling for.

But it's those targets which also determine the viability of a market. If that target's going to be easily set and easily met, there hasn't been a stretch by the participants. The market becomes a bit of a side issue. It's too easily settled in bilateral agreements and you're not really going to get any investment, because there's no need to invest anything new. So the success of the market will be tied, also, to the objectives. Are you stretching the participants? Are you creating need to invest in new ways and change behaviour? If you're not, nothing will change.

The Office of Renewable Energy is the regulator. The market is the RECs. That $34 to $40 range is quite interesting. The Australian Eco-Generation Association came out with a report a few months ago that one of the problems with the act was that it made it too easy for Tasmania Hydro, which is a large power company in Tasmania, to create RECs and therefore earn about $30 million a year, just by not really having to change its behaviour very much at all.

While they thought the whole objective of the renewable energy target was to create investment in new renewable energy, like wind farms, solar, biomass, co-generation-type issues, the Australian Eco-Generation Association put forward an argument that the bulk of the money that's coming through the cycle of the market is going to Tasmania Hydro, who aren't investing that much in renewable energy. They've been able to take the bulk of the $30 million a year, which is therefore robbing the opportunity for investors to invest in other renewable energy outside of Tasmania.

It is very much a contentious issue, but it's certainly something to be aware of. In the setting of any objectives and policy, some issues or baselines or settings, which may seem to favour a participant more than others, can distort the market or the outcome of the objectives.

As a result, though, of the bulk of those renewable energy certificates being made by Tasmania Hydro, the market for renewable energy certificates is quite tight at the moment. The retailers, who are the liable parties under the target, are finding it hard to buy renewable energy certificates at the moment.

The new environmental market has come out, that is, the greenhouse gas abatement scheme in New South Wales. The bill will be tabled, I've been told by the minister's office, on 22 October. That's all about creating a mandatory time for the reduction of greenhouse gas emissions that relate to electricity generation. A certificate will be created, and that certificate will reward good behaviour, such as abatement of electricity through carbon sequestration, energy efficiency and a couple of other activities. Those certificates will be able to be created and traded in the market.

The Queensland Gas Energy Certificate is progressing quite well from the policy end of things. That market will go live. The aim of that market is to increase the use of gas for electricity generation. Certainly, the Australian Gas Association is always willing to come forward to say that gas is a lot more environmentally friendly than coal-powered generation. The Queensland government took up an aspect of that debate in the creation of that scheme.

Some of the operational issues in markets are the role of the government regulator. Is the regulator just going to be a regulator or are they going to be operating? There are some issues there. There are certainly some issues about the Office of Renewable Energy Regulator. Are they more than just a regulator? Are they, in fact, a market operator? There are arguments for and against what they're doing and if that distorts the market. Policy objectives in legislation are very important. The regulatory stance is it to be light-handedly interventionist. The compliance method will be flexible, very prescriptive. Centralised will be centralised.

There are some models that seem to be appearing at the moment. I won't go into too much detail on this one, but I do have to flick through it, unfortunately. Basically, M-Co believes that we can see two models at the moment. One is the M-red model. The regulator has a large role in the market, in an operational sense. The New South Wales abatement scheme may be moving to a more decentralised model, which means the regulator will play less of a role in the operation of the market and will very much display the typical regulator role, which is just a monitor, and allow industry participants to be the ones who decide how the market might operate.

The philosophy of it is that it might be more flexible, it might be more efficient, therefore more low cost, which therefore means there may be more successful outcomes. It also puts more pressure on the industry to come up with initiative.

A role where the regulator does a lot of the work in the market means that the industry just has to turn up maybe once a year with their report, we've done this. It mightn't have created enough initiative or enough reason for the industry to try to be more proactive. I won't go into detail here. Certainly, if people are interested, they can get a copy of the presentation.

We believe there are some costs and risk factors about market implementation operation between the two models at the moment, which means that centralised ones are more expensive to operate and implement, and decentralised or hybrid models are more low cost and therefore should be more successful.

My conclusion is that certainly there are a lot of models to choose from in markets, and there is no definitive model at the moment. The important thing is that stakeholder consultation can lead to the design of the market. Low costs are critical to the success, which I talked about. The compliance method, if flexible, reduces costs. I've talked about industry buy-in.

Certainly the green electricity market is a decentralised model where industry—basically, 13 power companies, Australian energy companies—have set up a market; they govern it themselves; they pay fees which cover the costs of the market; and they use that as a way of facilitating how they interact with the renewable energy regulator.

In summary: more of these offset mechanisms, these market-based instruments, are being used in policy creation and implementation. They send market signals which create investment. They hopefully lead to better capital allocation and take away the risk from the public sector and transfer it to the private sector. The last point is a philosophical one. Thank you very much.

MS GALLAGHER: Thank you, Alistair.

The final speaker today is Mr Denis Smedley from the Australian Greenhouse Office. Denis is the Acting Manager of the Energy Supply Team at the Sustainable Energy Group at the Australian Greenhouse Office. He's responsible for programs designed to reduce greenhouse gas emissions from Australia's stationary energy supply in an environmentally sustainable manner. These programs include the renewable energy commercialisation program, which has provided funding to support a number of innovative projects in the Canberra region.

Mr Smedley: I'll try to keep it short, to finish close to time. Thanks Katy. My normal job, in fact, is project manager of the renewable energy commercialisation program. Apologies from Mark Walsh, whom I've substituted for. He, poor soul, is in England at the moment. He asked me if I could give this presentation. I think he's probably going at the right time of year.

The topic of the talk is the Commonwealth's programs to support and develop renewable energy. That's Australia wide. I've tried to do it in such a way that it focuses a little more on what might happen in the ACT or what has happened in the ACT.

But essentially what we do is based on an Australia-wide thing. So hopefully, it may give some background or some lead to the ACT in what they might think of and do. I should mention that a year ago I was working for the Office of Energy in Western Australia, so I've actually got a state government background for about 12 years, the last five being in the Office of Energy. I do have some appreciation of the difference between state or territory governments, and they way they operate, and the way in which the Commonwealth operates. It has taken a little adaptation but I'm slowly coming to terms with it.

Basically, what I want to talk about are these things. I suppose it's fair to say that the main drive behind the AGO's program is reduction of greenhouse gas emissions. What we do, I suppose, stems from that, in that renewable energy is a good way of reducing greenhouse gas emissions. At the same time, it has a lot of other drivers, like building the industry, and, in some cases, jobs and regional opportunities.

A lot of the stuff I'm talking about, in fact, has probably already been covered by other speakers, so I'll skim across where that applies, except where I can claim credit for some of the stuff they've been talking about. Support for renewable energy actually stemmed from two things. Primarily, it goes back to the Prime Minister's statement in 1997, the safeguarding the future statement. That statement actually was the gestation of the Australian Greenhouse Office. A couple of years later, there was the measures for better environment program, which gave us some more funding.

The total figures I'm talking about here relate to renewable energy itself. Up to $377 million has been provided for a range of programs to support the development of renewable energy in Australia. These programs are managed by the Australian Greenhouse Office and are pretty much aimed at commercialising and deploying renewable energy technologies, as I've said.

The programs include a range of commercialisation programs, for which the total was $76 million. There is the photovoltaic rebate program, which has been mentioned here before. I'll come to that shortly in terms of the ACT. But the other one that doesn't apply to the ACT at all, unfortunately, though I'll still mention it in passing, is the renewable remote power generation program, which is the big dollars. The reason it doesn't affect the ACT, of course, is that that funding comes from diesel excise based on off-grid generation. There's none of that in the ACT, so there's no money for the ACT; or Victoria, I should add. New South Wales get a very small amount. It's been a very good program for developing the renewable energies industry of Australia.

Lastly, the renewable energy industry development program was some money taken out of the commercialisation program to assist industry. There were effectively three arms to this program, the first one being the actual commercialisation program. Six rounds of that program have been run, and it's actually committed all of the funding that we had. There've been 51 projects supported, with some of the grants being up to a million dollars. There has been some fairly substantial assistance to companies and institutions through that program.

The showcase program supports a few leading-edge projects, and the size of the grants was significantly greater—some of them up to $3 million. The last one there, the renewable energy equity fund, is some Commonwealth funding that's been put into an equity fund operated by a private company, CBC Reef. It's a 2 to 1 program, where $17.7 million worth of Commonwealth money is being matched by half that in private sector funding.

A few of the projects that the ACT has benefited from here are all virtually in the renewable energy commercialisation program. The first one was a grant. I have to confess that I have yet to visit this. I haven't even seen this project, but I believe it was a very successful one. Out at Tidbinbilla, the business centre was a $120,000 grant. It showcases some renewable energy technologies and energy efficiency.

Sustainable Technologies Australia is just across the border in New South Wales. I've included it here. It's in Queanbeyan. That's actually a completed project now. They've developed this titaneous cell for wall panels and special solar cells.

I think Bill this morning mentioned—and it's been mentioned since—this project at Mugga Lane tip, which is still going at the moment with DEST and Novera Energy, developing a system that will use green waste. I've actually tried some of the briquettes that have been created as part of this project, not here in Canberra but in the laboratories in Sydney, and I have to say that they do burn extremely well. They catch fire almost immediately, there appears to be virtually no smoke, which is what the aim of the project was. I can't get enough of them.

The predicted price at the moment is still going to be close to, if it works out—and of course that's the whole point of the project—the cost of conventional wood. But of course, you need to guarantee it is dry. It's very dense. In fact, they're very heavy to lift. So that's a good project which, hopefully, will produce the power as well.

Three other projects were talked about. Someone said they really like the idea of hot dry rock. We have funded two hot dry rock projects under this program, one of which involved the Australian National University. That has led to the formation of a new company, Geodynamics, who are doing their work in the Cooper Basin now.

I think Andrew mentioned earlier Origin Energy at the Australian National University. It is a very good project to utilise these phase-change materials to reduce the heating costs in homes. In a town like Canberra—I lived in Perth for 15 years—I have to say you need it.

The ANU and Solarhart were mentioned earlier—this so-called CHAPS program, the combined heat and power system. This very innovative project has got a lot of potential for commercial buildings and for high-rise, high-density dwellings, because of the ability to produce both power and hot water.

A couple of other projects: I think Andrew mentioned Epilift. ANU are involved in that, although it is Origin Energy in Adelaide who received the grant. That's another project that, like Andrew, we hope to see the location closer to home than others would.

The solar sailor project I'll mention because some of you may know of that project. I think it was physically launched around the time of the Olympic Games. I would think it would be a really wonderful thing to have a ferry like that on Lake Burley Griffin. When there's no wind and solar it uses LPG, which, again, is very low emission. That launch has led to a couple of potential overseas bits of business for that particular company. It's a very good project. It's very attractive as well. If you could mandate that no fuel be used on the lake, that would be a good way of doing that.

There've been a significant number of projects under the program related to photovoltaics, involving BP Solar, Pacific Solar, a company called PB Solar Energy. Most of those are aimed at improving efficiency and reducing the cost of PV, which is what we really need to drive a little more development in that area.

We've also funded four building integrated PV projects. Someone mentioned the project in Newcastle. I think it was Garry. There's one in Sydney going on at the moment that Kogarah Council are building—a building that involves some building-integrated PV. There is a commercial building in Brisbane, and a private one in Melbourne University. There's another one that's yet to really get off the ground at Victoria Markets. It involves using building-integrated PV in a heritage building. It's testing the water there.

Steve Schuck mentioned the Narrogin project which, again, was funded under this program. There's been a solar ponds one in northern Victoria. He mentioned environmental benefits. There are three that we cite regularly: salinity has been in at least a couple of these projects, including the one at Narrogin where it addresses the dry-land salinity problem.

There have been a couple of waste minimisation projects and two involving weed control. The environmental benefits of some of these renewable energy projects are quite well worth while. The camphor laurel is a pest tree in northern New South Wales and southern Queensland. They're actually killing them, drying them and using them in a sugar mill.

There's a woody weed in the Northern Territory which is threatening to take off and invade some of the heritage areas. This project is involved in eliminating that weed.

Energy tech was mentioned before. The wave power one at Port Kembla has also received funding under this program. It's been a very well worthwhile program in terms of what's done, we believe, for the renewable energy in Australia.

I should add, though, that at this stage it's still early days. As I say, there were 51 projects offered funding under that. About nine of them are completed, including some of those as I mentioned. But it'll be a fair while before the rest are completed. The real success, we'll have to wait and see.

The photovoltaic rebate program has been mentioned. The figures are there for you. Someone here has already got one, or maybe more than one here has got them. The figures I had I got from the person who runs this scheme in the AGO. He said there were 16. I can tell him now it's obviously 18. The reason for the discrepancy of course is that this program is administered by the states on behalf of the AGO. They know about some of these before we do.

I might add that, although it sounds small at 18, that's really 22 and I guess you'd add about another 3 kilowatts to that. It's still the second highest per capita for grid connected in Australia, behind Victoria. The take-up rate in the ACT, despite the fact that it sounds small, is actually quite high.

By way of comparison—and to indicate the fact that PV is probably far more cost effective off grid where connection to grid can be expensive—is that, in looking up a couple of postcodes, there are only two systems installed in postcode 2620, which is Queanbeyan; but in 2622, which is Molonglo and Braidwood—and I don't even know where Molonglo is; you people probably will—there are 43 installed systems. Off grid obviously makes a big difference to the take-up.

I'll skip through this one very quickly because, as I said, it doesn't really apply to the ACT. Suffice it to say that this is the big money. Mainly it will go to help to reduce the dependence in remote areas on diesel generation. Anyone who's been through Northern Territory or north-west Western Australia will know that carting diesel those sorts of distances is a real problem; so reducing their dependence on diesel will make a big difference to the generation in those areas and will improve the quality of life. If you've been to places like Meekatharra and you stay there, you hear the diesel thumping all night; it's really quite a disturbance. If you can get some of these renewable projects going—it might not stop the noise at night, mind you—certainly you'll improve the quality of life in those areas as well.

Bush light is a fairly new program aimed at supporting remote indigenous communities. It's got a three-fold prong which includes education, development of standards and making the system much easier for those communities to use. I had better move on.

Under the industry development program, as I mentioned before, $6 million was taken out of the commercialisation program at the time the measures for better environment were introduced. It's aimed at industry support. The sorts of things it's funded are development of standards, some training for TAFE colleges.

We've talked about wind before and the problems that wind's facing. You can see that some funding was put into developing some best practice guidelines, and some money is being used at the moment to address the issue of connection to inter-grids. As was mentioned earlier, the moment the wind drops, all of a sudden somewhere some power station's got to take up that load. If you get significant amounts of wind, as they're talking about on the Eyre Peninsula, that drop-off of wind when the wind suddenly drops means that, somewhere on the eastern grid, some power plant's got to take up that load pretty quickly. The coal-fired generators don't start up very quickly at all. Gas turbines are a little better, but not a lot. This study, which is partly funded by this and partly funded by South Australia, is looking at the issues of integrating wind into the network. These are the sorts of things this program has helped to support.

I'll mention just very briefly the renewable energy action agenda. It's a government initiative, but it's working with industry. It will look at these various issues and come up with ways to overcome some of them. If people want more about this, there's a website at the bottom. The document's about 270 pages. I'd suggest it's a good winter time reading task, not summer. I'd say that it's probably worth knowing about that, certainly if you're not aware of what the action agenda is doing.

It has a high-level CEOs group which involves some of the big names in industry, including the man who was mentioned before who heads up BP Solar. I probably don't need to mention too much about this because it's been covered by many people today—the mandatory renewable energy target. The thing that's probably important, as has been mentioned here today, is that it will be reviewed early in the new year. It's likely that that'll be an opportunity for people to input to what they see needs to be changed with the system. One of the common calls I've heard is this desire to increase the level of the target. I'd imagine that will be something that will have to be focused on.

Others have also mentioned energy management. It's interesting that the AGO basically took over this role from the old industry. In those days it would have been Industry, Science and Resources. In fact, it goes right back to the days when the states impolitely called it DOPIE, which was Primary Industry and Energy. Some of these things have been going on for a long while, particularly the national appliance and energy efficiency program.

Just to clarify something that was mentioned before. I don't think it was clarified. Someone—I think it was Andrew—mentioned we should raise the bar to 10 stars. Effectively that has been done for some appliances in that the algorithms that are behind the determination for the star rating have actually been adjusted. What was a four-star or a five-star refrigerator a year ago is probably now a two-star. That's been done because a lot of the appliances actually got to the stage where they were at the top of the rating and they had to start all over again, effectively, to increase the efficiency of those appliances.

The Building Code of Australia. I mentioned to Katy earlier that, in my old job in Western Australia, I used to envy the fact that the ACT had a mandatory four-star rating scheme for buildings here from 1995 onwards. I spent five years in my department trying to convince government we should have a mandatory scheme in the West.

The ACT has actually led Australia in some of those issues. The one at the top there "improvements to the Building Code of Australia" is to bring in energy efficiency through that building code, and that will be done on an Australia-wide basis. The Building Code has to be passed.

I think someone mentioned the fact that legislation in the states is required for appliance rating. The same applies to the Building Code. Nevertheless, the national committee on that will implement some energy efficiency provisions into the Building Code early next year.

I will just mention the dreaded coal-fired generators. That generator efficiency standards program is a voluntary program of the AGO where the big generators in Australia sign up to voluntarily improve their energy efficiency of their power stations. The majority of the big power generators in Australia have now signed up to that. There are certain milestones they have to meet, like improving their efficiency by a certain amount, unless they're retiring those power stations within a short period of time.

Other funding programs: I couldn't put it on an overhead because it just wouldn't fit. I'll just mention that one of my staff has recently completed a paper that identifies sources of funding available from Commonwealth, state and territory governments to support renewable energy development. It's on our website; it's quite detailed in that it has a table attached that shows where the funding programs are available. Actually, it's a continuum that goes from bright idea to commercialised and available product and shows where the funding is available across that range. I'll leave a few copies if people are interested in it.

If you got to that website address you can download that particular paper. It gives a good guide to where things are. We would look for feedback on that. I've already had one comment today from the ANU that they believe there are some inaccuracies in that. Obviously, it's pretty hard to pull together something that involves all the states and territories. That's perhaps a useful resource in terms of identifying what may be available. If the ACT government is keen to have programs in addition to the knowledge fund you might get some ideas from that about where the gaps might be and where you might assist local industry.

Anyway, I think it's fair to say that we think at least we have been working with industry and with academia as much as possible to achieve some of the renewable energy goals. EMRAC has been a big driver, I think, to giving industry an achievable target in bringing in new renewable energy systems.

Certainly the wind has benefited; others would benefit. There's still a long way to go. Steve may have gone, but my understanding is that at least RECs trade at different values. One of the things that are disappointing is that biomass RECs trade, I understand—and you may be able to confirm or deny this—considerably lower than solar and wind RECs. So there is an educational campaign involved if we're going to try to convince people like Andrew that there is a place for biomass in the world as well.

Basically, that's all I've got to say. I'm sorry we're close to your time, but thanks very much.

MS GALLAGHER: We've got a few minutes for some questions if people have any, to either Alistair or Denis. Or is it the wrong end of the day?

Mr Walton: Well, I can answer the question from Dennis to me.

MS GALLAGHER: Okay, there you go.

Mr Walton: About the biomass renewable energy certificates selling at a lower price than other ones. Certainly I think the main issue behind that is that some of the energy companies are positioning themselves to be seen as leaders in regards to environmental issues, triple bottom-line citizens of business.

Similarly, there were some issues about the use of native wood waste—not so much native wood trees but native wood waste in co-generation. In regard to native wood waste, the green environmental NGOs see that as non-renewable. It's seen as very much as a hot political issue in the environmental. Therefore, would-be buyers of RECs did not want to buy those RECs because they wanted to distance themselves as citizens who are very conscious of green issues. Therefore, when you're automatically taking players out of the market that's going to affect the demand.

Mr Walker: Rob Walker. My statement is not directed towards the speakers but more towards the committee. We've heard today about different forms of energy, different forms of projects that are going on. I wonder if it's a role for the committee to consider developing a register of existing sites that use alternative energy or renewable energy within the ACT. I think the committee would do well to identify those sites that currently use an alternative energy, and that would provide a snapshot view of what is occurring within the ACT now. It would bring together like-minded organisations and would enhance the promotion of using alternative energy sources.

The experience that different organisations have gained can be disseminated through to the other organisations that are just entering the consciousness of alternative energy. It would provide details like the type of technology that's being utilised, the financial implications and the reductions in environmental emissions that can be achieved. Thank you.

MS GALLAGHER: Thank you. We'll have that in the *Hansard* so that we can refer to that when the inquiry progresses. We may need to call on you for a submission to the inquiry to that effect.

If that's it, my job is to wrap up. You'll all be pleased to know that I've got a 27-minute speech to give. No, I'm only joking; I'm going to give that to my daughter tonight. The Planning and Environment Committee would like to thank all the speakers today for their expertise, their ideas and certainly their generosity with their time. The committee system here and in most parliaments relies greatly on the work and contribution of others, especially members of the community. Today's presentations have certainly provided that to the committee.

This conference is the first step in a longer inquiry that the committee is conducting into sustainable energy use in the ACT. I'd invite anybody who has views that they'd like to put to provide that in a written submission to the committee. Once the committee meets after this day we'll be working out where to next with the inquiry.

Also on behalf the committee, I take the opportunity to thank Derek Abbott, Lesley Wheeler and Judy Moutia of the committee office for establishing today; Ray Blundell for the technological expertise; and Larry who sat here and recorded for Hansard to assist the committee's deliberations.

I know it's 5 o'clock on a Friday—it's past beer o'clock—but, from my point of view, having a public conference rather than a public hearing was an excellent way to start the inquiry. It gave the opportunity for speakers and the audience to participate at a much greater level than would have been possible if we'd just had a formal committee hearing. It's been fantastic today, and I'd like to thank everybody, including the people who came along today as members of the audience. So thank you.

The committee adjourned at 5.02 pm