

The Future of Wind Energy in Australia

Chair:

Anna Skarbek

Speakers:

Graham White

Ken McAlpine

Panel:

Jonathan Upson

Kate Redwood

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Transcript

Wind power is a rapidly growing source of energy globally and is now becoming a significant source of power in countries such as Germany, Spain, Ireland and Denmark. As one of the lowest cost zero-carbon energy sources available to date, this seminar explored wind market trends in Australia and internationally. It looked at the current size of the industry, its current and future generation costs, and how we are learning to integrate large amounts of wind into the grid while maintaining reliable electricity supplies. The expert panel will explore global market trends, the impact that a large penetration of wind power has had on various OECD economies, and the social acceptance issues that have been dominating the wind energy debate.

Chair: Ms Anna Skarbek, Executive Director, ClimateWorks Australia

Speakers: Mr Graham White, Regional Manager – Pacific, GL Garrad Hassan
Mr Ken McAlpine, Director of Policy & Government Relations – Asia Pacific, Vestas Wind Systems

Panel: Mr Jonathan Upson, Senior Development Manager, Infigen Energy
Ms Kate Redwood, Director, Hepburn Wind

Closing: Ms Susannah Powell, Melbourne Energy Institute

AUDIO: This is a podcast from Grattan Institute, www.grattan.edu.au.

ANNA: He's worked on projects throughout Australasia, Asia, Africa and Canada and he has coordinated due diligence work on many wind farms, and has experience in advising owners and investors on a range of large projects. He's also been involved in R&D for a variety of other power plants and has been involved with renewable energy industry associations in Australia and New Zealand for over 20 years, as well as writing extensively on renewable energy topics. So tremendously well experienced person to speak with us.

Garrad Hassan are the kings of due diligence from my experience. They're one of the industry leaders and when you need to go to your bank and raise your funds, as a banker I've tried to do that. You first go to Vestas and see if your client has ordered the turbines and getting a good quality one. And then you go to Garrad Hassan and get them to do the due diligence on the wind farm site. How windy is it, what can you expect, what sort of revenue forecast is that likely to generate. And so they've become global businesses for good reasons, that it is a global industry now and we're very privileged to hear what Graham has to share with us this evening. Thank you.

GRAHAM: Thank you very much Anna. I can probably skip to the major slides and go by the introduction. As Anna was saying, we're a global company. We're in 22 countries, 42 locations. And we're now up to about 850 engineers around the world. And we do all the technical tasks involved with wind energy, and now solar energy.

Wind is not new, and the utilisation of wind is not new. Society has been using wind for thousands of years. In many cases to explore the world, to actually move people around, and to do transport of goods and services. So it's not new. And also the use of wind to produce power to actually do work is not new either. There's many examples and there's lots of stories and lots of material and literature to show that windmills have got a very long history. And this is one example of a windmill from Crete, probably about 1,000 years old, the original design. Also Dutch windmills have been around for centuries. They've been used throughout Europe to pump water and for milling.

This type of windmill, which is a water pumper, has been instrumental in opening up many areas of North America, South America, Australia and New Zealand to allow homesteads to move to places where there is no useable ground water. And they've been around for 150 years.

The very first electric machine was in 1888. So in fact the history of electric power generation from wind is quite old. This actually worked, it was quite a huge machine. It's only 12 kilowatts but it worked. In the late 1890s, a dame by the name of Paula [Curer 03:35] produced these turbines, also electric generators. And the technology slowly evolved, probably very slowly. This is one of the first turbines which we could consider to be the Danish concept, which is basically three blades upwind, and it's got tip brakes. Now from this particular design, the modern Danish turbine evolved.

This is a slightly more modern one in the 1970s. And then we had a whole series of different types of technology evolve, mainly induced by research grants which were bought into place because of the oil crises in the 1970s. Nassau got involved in the 1970s and '80s. This is one of their turbines. It's a downwind two bladed machine. The big commercial break came in the 1980s when California introduced taxation incentives for the investment into renewable energy. And wind was the big winner during that time. And during the 1980s there was thousands and thousands of wind turbines built and constructed in California. These are Danish wind turbines. It's ... California really propelled the Danish technology into the marketplace. This is really where they got the commercial edge on everybody. And many of these turbines which were installed in the early 1980s are still running today.

These are some 300 kilowatt turbines in the UK. Note they're two-bladed. This is an interest ... not a very good photograph, but this is from the very first wind farm in Australia. It was in Esperance, six 60 kilowatt turbines designed and manufactured by Westwind in Perth. And this wind farm operated for 15 years very successfully. There is still one of these units down in Beenleigh in Victoria.

We went into ... the technology went in all directions, all kinds of weird and wonderful designs came about. This is a vertical axis machine with variable geometry blades to control power output. Sort of a ... quite a fantastic looking machine. This is another Nassau induced machine built by Boeing actually in Hawaii, 3.2 megawatts. Huge machines. This was the most successful commercially vertical axis machine. This is a Darrieus turbine built by Flowen. And they actually constructed thousands of these in California in the '80s.

This is a diffuser augmented wind turbine. It was designed and manufactured in New Zealand in the 1990s. Basically this diffuser helps to accelerate the wind through the rotor and increase the energy density. If you thought that all turbines were three-bladed, we even had one-bladed machines. Quite a few of these were built in Italy and in Spain, and you don't actually have to have two blades or even three blades to have a rotor. Obviously it's in balance, it's got a counterweight. And these actually worked ... there was some good reasons to have them and ... but there was other reasons why they weren't so good.

This is a two-blader. This is a very interesting turbine. This has been designed and manufactured in New Zealand. And so far they've manufactured about 100 of these units. They're actually all in New Zealand. But it shows you that if you have an entrepreneur with a bit of get up and go and some backing by a couple of utilities to actually purchase them, you can get a manufacturing base off the ground. Now New Zealand's got 3.5 million people and we've got 22 million people here and we have no manufacturing at all. And yet the amount of installed megawatts in wind in Australia far exceeds New Zealand.

This is probably the best example of what the Danish concept has received by 2000. Three-bladed upwind variable speed turbine, fairly elegant machine. And basically all new turbines look rather similar to this one. Certainly in the last 10 years. And here's some Enercon turbines in Queensland, and just to show some people that it doesn't spook the animals all the time. The cows seem quite happy. And in the last decade of course we've moved offshore. Certainly in

Germany and other parts of Europe where there's not all that more space on land for turbines, turbine and wind farms are going off shore.

There's a whole plethora of small turbines as well. This is a stylised vertical axis machine on a building in the United States. This is another vertical axis machine. These are all small. That's a horizontal access machine from the Newcastle University. And this turbine is the maximum six kilowatts, and if you go down to Docklands any day you'll see six of these up on the ANZ Bank building in Docklands, and they've been there for about a year.

Now, technology over here. The basic technology which is being manufactured today is along this concept. It's got a rotor in the front, three-bladed. It's got a main bearing to hold that rotor in place. It's got a gearbox and it's got a generator. And these are now generally variable speed, variable pitched turbines. Shows a little bit of the history, this is similar to Ken's graph which shows the growth over the last 30 years from about a 15 metre diameter rotor, we're reaching now 50 metres today. But one of the turbine manufacturers of blades is now producing 75 metre long blades.

Offshore it's not going to be nearly so constrained and one of the major reasons is impact on the environment. Noise is not a problem off shore, so in fact the rotor will be able to be going at higher speed. They'll probably go to two blades, and they may be downwind. These things may not be possible onshore, but they will be off shore. And the engineers dream, maybe a 200 metre rotor in the next five or 10 years.

Now where are we moving? Ten years ago, 15 years ago, most of the machines were stall regulated, they were fixed speed, fixed pitched, they had a gearbox and they were fairly simple machines. But what's happened over the last couple of years, we've gone to a more sophisticated generator type. It's called a D-fig, and it's still an induction generator but it's variable speed. And that helps with decreasing loads and basically brings the cost down because the loads are not as high.

We've moved also into fully variable speed machines now and these are pitch regulated instead of stall regulated. And over the last couple of years, we've gone into gearless machines, machines with permanent magnets which are more efficient, and modular. So in other words instead of bringing in the cell which is completely built up in a factory, you ... they're getting so large, they're bringing them in pieces basically and they assemble them on site.

And there's more innovation to come. Now these are really the competing technologies for the future for the basic machine design. Up on the top left is the typical configuration with the rotor, the gearbox and the generator. On the right is a direct drive machine. And these are being manufactured in greater numbers now. There's no gearbox and that takes out one of the key elements for reliability. However it's got a much more expensive and heavier generator. And there's a hybrid in between, which basically has got a two stage gear box instead of a three stage gearbox.

Permanent magnets are certainly finding their way in because of higher efficiencies. And a lot of these machines, such as the full variable speed machines are going to full power conversion. It means that basically the generators produce a C, it's all rectified to DC, and then it ... through a converter it's reversed into AC at 50 hertz. And superconductors are also on the horizon.

So there's a number of priority areas that we're looking at in future. A lot of it's got to do with design methodologies. And the ... basically the models that we're using are becoming more and more sophisticated, so that they're closer to reality. So we've got CFD models and FEA models. And the other thing that we've got to do is validate them with real life measurements. There's all kinds of research and design changes going to bringing the cost of wind energy down. And one of the major criteria of cost is weight. So we need to reduce the weight of the blades, the nacelle, the tower and the foundation. And if we can do that while we're increasing the size, we can bring down the price of wind energy.

And there's a lot of other things we're doing, and I'll skip to the last one. One is standardisation. There's lots of standards and certifying bodies around the world in different countries, who are certifying and telling customers basically whether a product is good or not. And there's some variability in the quality of this certification and standards. And one of the things that the industry really has to move towards, is coming up with a cohesive international standard in which all clients can depend on, so that there's no gaps, you don't have to worry as to who is actually doing the certification, the design is going to last 20 or 25 years, whatever it's been promised to you. And that's an ongoing process.

Now this is the biggest turbine to date. This is seven megawatt. But as we speak, larger machines are being designed, and as I mentioned, turbine blades have just come out now which are 75 metres, which will allow an eight megawatt turbine to be built. And maybe even larger than that. This is in Enercon in Germany.

How are we going with time? We're done, okay. I've got some market information, but I understand that my presentation is going to be available through the societies in a .pdf format, so there's just a bit of market information after this. So thank you very much.

ANNA: Thank you very much, Graham. So you've heard now what goes into making a wind turbine, and you've heard about the development and the history of all of that componentry. Now we're going to hear from two people who help bring those wind turbines to wind farms in Australia. And we're going to hear about what is it like to take that technology and actually bring it to life in the form of a power station. That is, on a site, in this country, in amongst a community.

And so we have now the opportunity to have a discussion with two people who have really got their hands dirty, and have a number of successes and stories to tell around what is that like to really make this happen. So firstly, we'll hear from Jonathan Upson. He's the Senior Development Manager at Infigen Energy. And that means that he currently manages the develops of several wind energy proposals. It means that he handles a lot of the government and regulatory affairs including giving evidence to wind farm enquiries, and has worked on a range of wind energy developments that have succeeded in being granted development approval, and has worked across other proposals in four Australian states. His history includes 12 years in the gas turbine field working for General Electric, as well as time with Hewlett Packard. And he is also qualified in mechanical engineering and has an MBA as well.

Jonathan we're hoping that you might share with us some of your experiences in bringing these wind farms to life, bringing them to the market, and in particular what you think you might describe as the largest practical barriers to the wind farm roll out at the local level.

JONATHAN: Well thank you. In my personal opinion, I would have to say the media's inclination to run negative, sensationalistic and sometimes biased stories, with little regard to the facts, is probably our largest impediment. And I'm not suggesting of course that the media should not cover objectives and opinions about wind farm developments. If an objector says wind turbines are large, ugly structures, they're entitled to having their opinion covered by the media. There's no problem with that. However, when anti-wind farm activists make statements of fact such as every wind turbine has a gas turbine inside of it to keep the blades turning when there's no wind, to stop the blades from sagging and breaking, that is not an opinion. That is a statement that is either true or it's false. And you might have noticed in Graham's slides, there were no gas turbine engines inside the nacelle.

So one might think me a little bit naïve or old-fashioned, but I believe the media has an obligation to make some attempt to ascertain whether statements of fact are true before propagating them, particularly when they're as preposterous as that example. Instead, I spend time meeting with numerous neighbours explaining to them ... about trying to counter this instead of real issues. And so I actually explain to them things like wind farm sites rarely have gas reticulation, they rarely have gas pipelines. So you'd have to have a fleet of trucks shifting gas bottles in order to make this happen. You can see wind turbines not turning any day of the week somewhere in Australia. The noise from an aircraft engine could not possibly go

unnoticed, and would be insufficient to turn a 24 ton rotor in any case. And of course, stationary wind turbine blades do not sag and break.

So there's less time spent discussing and explaining actual amenity impacts of wind farm. I mean there are real amenity impacts, we all know that. Instead I'm forced to defend the latest furphy theory on one of the anti-wind farm sites which has then been sold to the local media.

And how about positive stories about wind farms? What about stories about the contracts who are hired, the apprentices who are trained, the regional development and construction. For example, there was a study by SKM that showed that during the Hallett wind farms that are built in the mid-north in South Australia, \$88 million has been spent, not buying turbines from overseas, \$88 million in that local region has been spent building those wind farms. Infigen Energy's Lake Bonney Three wind farm and our Walk Away Two wind farm proposal, when we put our planning applications in we got not one single objection. Were the media interested in running stories about a wind farm which everyone likes? Of course not, that's not a story.

As Ken mentioned, the largest public relations issue for the industry as the moment is the theory of an ex-doctor that infrasound or low frequency noise from wind turbines is likely to make anyone within 10km of a wind turbine sick. This story has been going for well over a year. It has legs as they say in the business. Imagine how quick this story would fade if the media included the following facts every time Sarah Laurie was interviewed. She is not a registered doctor, therefore she cannot legally diagnose any medical condition. There is no published scientific or medical evidence anywhere in the world substantiating her theory. And that's not my opinion, that's the view of the CSIRO as they testified at the recent Senate Committee hearing.

On the other hand, there are Australian and overseas peer-reviewed studies published in scientific journals proving that infrasound levels from wind turbines are far below the levels that human beings can even detect, let alone the levels that could cause any detrimental health impacts. However, the media is uninterested in mentioning any of these facts. It's too complicated, too boring, or dare I say too factual. Instead media personalities fawn all over Sarah Laurie, as Alan Jones did during a recent interview where he repeated and he agreed with everything she said. The media sees fit to run without question or challenge the theory of one ex-doctor, rather than take the time to ask any of the other 70,000 registered Australian doctors who don't share her view.

Many of you by now may have noticed some similarities to my discussion to the current media debate around action on climate change. In essence, I'm suggesting that the media should stop publishing and airing crap. Every TV station showed Tony Abbott last week at a fish market smiling and mugging for the camera, holding a big fish. Did any journalist ask Tony Abbott how an increase of 12c a kilogram for salmon or less than one half a percent, according to Treasury modelling, was going to cripple this industry and close down the fish market? Did anyone ask ... did any of the journalists ask a customer if they would mind paying a half a percent more for their fish, which they would be fully compensated for if they were a lower or middle income person? No.

I would suggest that the current media frenzy about the carbon tax and to a lesser extend wind energy, are related. It's fair to say that the construction of wind farms are perhaps the most visible form of action on climate change. In fact you could say maybe it's the poster child of action on climate change. And this is not lost on the Prime Minister, who opened a wind farm today in NSW as an example of her clean energy future plan. However, if you're a climate change denier, the last thing you'd want to see from your front porch would be a wind farm. And maybe that explains why some of the anti-wind farm people are so committed.

Obviously the dummy-down and the sensationalistic tendencies of the Australian media, are of course a much larger issue than just their coverage of wind energy. Media companies are private enterprises that are managed aggressively to maximise profits, and that means increasing market shares, selling papers, increasing viewership, while at the same time reducing costs, primarily by laying off journalists who then have less time to do a proper job, even though ... even if they were inclined. And I don't want to bag journalists, there are some

journalists who do want to do the right things, but they're under so much pressure of deadlines to be able ... they're having difficulty doing a proper job.

One could view the disgusting phone hacking scandal in the UK as the ultimate in newspaper efficiency. Sensational, riveting, subscription increasing stories, but without even having to leave one's desk. No investigative journalism, no running around London interviewing people and chasing leads. Just sit at your PC and let the day's phone hacking results write the story for you. You didn't think I was going to let that slide, I mean I'm talking about the media on a day like today, I had to get ... I had to mention that one.

The question I was asked wanted me to identify the leading impediment. There are certainly others, and I would not want to leave you with the impression that the wind energy industry is perfect. In my experience, community consultation has improved significantly from when I started work in the industry eight or so years ago. However there still is room for improvement.

However, the media coverage of myths and inaccuracies is making useful and effective community consultation very difficult. It serves to polarise the community such that there's little common ground for rational or thoughtful conversation and discussion, and therefore this does represent a significant barrier for the industry. Thank you.

ANNA: Thank you very much Jonathan, particularly for articulating the frustrations that I know are shared by many across the range of issues at the moment. But fortunately, we can move to a positive note alongside Jonathan's presentation, when we come now to hear from Kate Redwood. Kate is a director of Hepburn Wind, and hopefully many of you are familiar with the wonderful story of Hepburn Wind. But if you're not perhaps Kate can also tell us a little bit about how Hepburn Wind came to be one of the first, if not the first community owned successfully built and delivered wind farm in Australia, and it's right here in Victoria.

Kate's a long time resident of Daylesford. She's been involved in a range of community activities there, including the sports club and a local conservation group. But has also had senior management roles with community service organisations, as well as serving two terms as an elected councillor in the city of Melbourne, during which she chaired the Committee for Environment, Community and Cultural Development.

Kate also sits on a range of boards and has done over the last 20 years. She's currently serving her third term as a director of Melbourne Health, which covers the Royal Melbourne Hospital and other entities, as well as a director of the Walter and Eliza Hall Institute. And she's been a member of the advisory board for the Melbourne Juris Doctor, which is the Melbourne Uni's law school accelerated law course. And she's a director of State Trustees. Her qualifications are in arts and in social work, and she also holds an MBA. She's received a Centenary Medal in Australia for her services to local government and to the community. So I'm very looking forward to hearing Kate's stories, thank you.

KATE: Thanks Anna. I'd like to acknowledge Martin May, the treasurer of Hepburn Wind, who's here in the audience somewhere. I think he carries a heavy weight, but I think probably a bit lighter these days. I'd also like to ask, are there any shareholders of Hepburn Wind in the audience tonight? Yes. Thank you. It's good to have you here. And basically, we're very, very proud of the people who've supported us over the years when we didn't know whether we were really going to make it, but we're very pleased to be delivering for you today.

Hepburn Wind started generating electricity in June and commissioning is almost completed. We're now at the stage where we're delivering the equivalent electricity for the 2,500 households in the Daylesford area. And also, on windy days exporting electricity out into the grid. So it's a big success at the moment and we're really, really proud. But the story begins seven years ago. There'd been discussion of a wind farm in the district at that time, and the community was very negative, very, very not impressed. Pier Bonnard, a Danish guy, an environmentalist living in Daylesford thought something had to be done. He walks into the Harvest Café to speak to his friend Scott Kinnear and says, Scott I want to have a coffee. From there they started running street stalls in the main street of Daylesford. They did this month after

month after month, and gradually things started to turn around. An organisation started, Hepburn Renewable Energy, which still exists today as the environmental group in the district called Share.

From there, four years ago, a cooperative was set up as the corporate entity to develop a wind farm in the Daylesford area. The principles I guess around community ownership was to deal with the ... what's perceived as potentially a problem elsewhere of economic externalities. The aim was to share the benefits with the community as a whole of having a renewable energy facility, to see the economic benefits flow back into the community, to see the benefits in terms of education, in terms of participation, and in terms of involvement in the way that the facility was run, deriving from the community. And so it was quite deliberate that the corporate entity set up was a cooperative, because that was seen as generating greater control locally and greater participation.

We now have 1,900 plus members, and the membership continues to grow. And of that membership, some 60% is local. That's been achieved through having a lower barrier to entry locally than for people who live outside the area. So most of you guys who are members here tonight, I'd imagine contributed more than \$1,000. Whereas for local people, recognising that Daylesford is a low socio-economic area, the minimum entry requirement is \$100, or now indeed \$110.

So how was this done? The card tables in Vincent Street for several years, to answer questions, to basically educate people as to what wind farms were about and to deal with any fears and concerns. Over the seven years, there have now been some 100 street stalls, some seven bus tours to other wind farms, door knocks, discussions, meetings. We now put out an e-newsletter roughly every second month. And the importance of community engagement cannot be overemphasised. And what emerges from that I think is enormous pride from the Daylesford area in the development of the wind farm.

And that flows into support for applications for a planning permit for example, where Hepburn Wind had some 134 letters in favour of a planning permit being issued, and 19 objections. It obviously flows into financial support from the local community, and in order to raise what I guess in the scheme of things is a relatively small amount of money, \$13.5 million, is not great in the scheme of things being discussed here. But for a local community where the average income is maybe \$60,000 a year, raising that sort of capital from a ... that small community is no mean feat. And so it's an enormous achievement that such a large proportion of that money in fact has been derived locally. It also ... I think we see the potential now of moving from a small facility to something bigger, and so what we're looking at is opening up opportunities for that community to extend into other projects, and that's something that we're just beginning to think about.

So the principles here I guess are education, transparency, we're looking to share the information as to how we've achieved the wind farm and what it delivers, so we'll be being quite public about our wind data and the electricity generated. The importance of consultation and engagement with the local community, and of course empowerment through participation in the cooperative. Now since the wind farm actually started generating, we've been doing another round of door knocking in the local community. We have 57 households that are within 2km of the wind farm, and given the attitudes that you'd be aware of through some of the groups opposed, we're at great concern to make sure that the people who live in those households let us know if there are any issues at all. And I can tell you that having personally door knocked lots of them, most of them say no, not at all, they're not at all bothered. There are one or two, and in fact we now ... six weeks into generation have I think two formal complaints, and our way of handling that is a very formal one of taking the complaint and of looking to see what we can do to address it. I'm aware of two complaints about noise, and so we've got noise monitoring facilities in the area adjacent to those houses, and we'll be looking to see empirically what that amounts to.

So at this stage, I guess you'd say that I would want to give immense credit to the people who started seven years ago and who had the passion and the faith to believe that it was possible. I

suspect that if people had known quite how difficult it was, they might not necessarily have persevered in the way that they did. And I guess being the ground breaker, the first at anything always throw up more problems than you anticipate at the outset, and having learned so much in the journey, what has now been done is that Hepburn Wind has developed an organisation called Embark, and Embark exists specifically to disseminate information about how to run community projects of the kind that Hepburn Wind is. And so far, some 45 other proposals have been brought to Embark to discuss. So what I would see is there's an enormous and wonderful opportunity for community owned projects, of the kind of Hepburn Wind, in Australia today. Thank you.

ANNA: Thank you, Kate. And what a great way to bring together the four speakers that you've had, from the global to the local, addressing the barriers, responding to them and forecasting future growth, 45 more proposals of Hepburn Wind look-alikes. So we're now very fortunate to have almost a full half hour of question time, which is now, the opportunity for you in the audience to make the most of this very rich talent that you have before you here in these panellists and their experience, in discussing the future of wind energy. We have some roving microphones in the room, and to make their job a little bit easier, I'll take questions from alternating sides in the room, so that gives the people some time to relocate. And so what I'd like to do is open it up to ... for any of you to ask a question of any of our panellists, about any of the issues that we've covered this evening. Who would like to open up? We have one on this side, and then we'll have the second one here. Yes at the front.

AUDIENCE: Thanks very much to all the panellists for excellent presentations. I'm Roger Dargaville, I actually work at the Melbourne Energy Institute. And my area of research is looking at how we integrate wind with other technologies to deal with the problem of variability in the wind supply. And one of the things I was interested to hear from the panel members is, what kinds of technologies or areas of research are you interested in or are looking at to deal with the problem of intermittency in wind supply, wind power supply? At the moment with only a couple of percent penetration, it gets absorbed into the noise in the power system. But if we go to 20, 30, you know considerable penetration, how are we going to deal with the variability and the unreliability of wind supply ... wind power?

KEN: A good question, and certainly a question we've dealt with in many other markets. Certainly in Europe, there's been a lot of time put into this. But in the US too, there've been significant studies that Vestas and other companies in the wind industry have participated in where ... have looked at how you do integrate large amounts of wind energy into the grid. And the key in many respects, because you've already got a grid and you already have plenty of other generators, is forecasting. We're getting better at forecasting when the wind is going to blow. Really, it's ... I'm almost sick of hearing people talk about wind as being intermittent. It's far more correct to describe it as variable, because you know, it does vary a lot. But all forms of power really are intermittent. The wind might not always blow but at least you can forecast that. But when Veranus Island gas plant blew up in Western Australia a few years ago, no-one forecasted that. Nobody forecasted Longford gas plant in Victoria blowing up and giving us cold showers for a few weeks there. Nobody forecasted your Lorne mine filling up with water when the Morwell River broke its bank. Nobody forecasted Fukushima power station being affected by a tsunami. Well some did, but they weren't heard, and decisions are made on the back of that.

But the key is forecasting for wind. And I can say that in Australia, the Australian energy market operator has already invested a lot of money and a lot of time in some software called the Australian Energy Wind Forecasting System. They're very literal at AEMO. But it works, it's got a very high success rate. It's ... I think they're up to about 95 ... sorry 98% accuracy, and I'm sure if there's anyone from AEMO here tonight they can correct me if I'm wrong. But it's progressed a lot, and it's only been in place for a little while. But that means that in a state like South Australia, you can get up to 20% wind and that's where South Australia is at now.

For Western Australia which is not connected to the national electricity market, I know that they're in discussions. They're looking at employing similar sort of forecasting technology over there as well. It's key for them because they're not ... they don't have interconnectors with other

states. But yeah that's key for me, and perhaps I'll throw to the others to express their views as well.

ANNA: Graham, did you want to add anything?

GRAHAM: Yeah, I think we should realise that the electricity industry has been dealing with variability right from the beginning. The actual load for ... on a grid, has a range of roughly 2.5 to one on a day to day basis, certainly over the year from night time to day time. And as a result of that, there's controls and equipment in place to bring generators on and back them off on a five minute schedule to deal with the varying loads. And loads can change quite dramatically if you've got a large industry which brings on some ... like a megawatt motor or even larger loads than that. So the technology has always been in place to deal with variability. Provided wind doesn't become the dominant and major supplier of electricity, and as an example, stays below say 25% or 30%, it is ... existing technology can deal quite readily with variability of wind. And as Ken said, it's not intermittent like some of the other power stations, which just trip off because of electrical problems or other problems. The variability in wind is fairly gradual. It can be forecast, there's a lot of companies around the world, including our own, which actually do forecasting for wind. And it helps the network operators deal with that variability in advance of what's actually happening.

So there's another issue about spinning reserve, and wind farms do not increase the requirement for spinning reserve because that value is determined by the largest generator on the line. Now in Victoria and in NSW it's in the order of 500 megawatts. So the spinning reserve in the state is 500. Until we have a wind turbine larger than 500 megawatts, we won't be imposing any greater capacity requirement on spinning reserve. So the system already adequately deals with that problem.

ANNA: Thank you. We have a question in the front row here. And could I have a hand up for the second question over there and if the microphone could go to the person up the back, thank you.

AUDIENCE: My name's Rex Niven, I'm an energy user.

ANNA: As are we all.

AUDIENCE: Given that in Victoria it's very hard to get a new site for a wind farm, why do we not see offshore wind farms, for example in Bass Strait? As you pointed out, the economics are very favourable.

KEN: I might kick off again. Well Graham actually talked a little about offshore and the driver for that. In Europe offshore wind has become popular, initially because they don't have so much land, and they don't have as many suitable sites on land. But it's not the only reason, it's definitely not. The yield is a lot higher. The wind speeds are more constant and it's just a richer resource. But equally, the ... there are costs that come with it. And in Australia we've really only just started to look at our best onshore wind sites. It's a big country with a lot of wind and if we can get it connected to the grid onshore, it's going to be a lot cheaper than building it offshore.

The sea is pretty tough on most machines, and that includes wind turbines. So while you may have the advantage of higher wind speed and overall a better resource, you've also got some maintenance issues. You can't just drive a truck up to the base of it and jump inside, you're out at sea. And so all those complications that come with being out in the water, you know they add to cost. And what we're trying to do in the wind industry is bring costs down so it can compete with fossil fuels. And so ... for Australia, it's not the first choice. We've got so many other good onshore wind sites, it's preferable to develop those. But in time, I'm sure it's going to happen. It's just up to the engineers and the bankers I guess.

GRAHAM: I think one of the comments for Australia, in addition to having a lot of land mass, which can be utilised, the continental shelf is quite narrow and the depths that you can put offshore turbines really is up to about 50 or 60 metres. Beyond that it becomes extremely

expensive and uneconomic. The amount of land which is sufficiently offshore not to annoy anybody, but is less than 60 metres deep is tiny. It's really just a little line going along the shore, and it might be quite close to the shore. So I don't think any developers really seriously looked at offshore wind farms in Australia to date.

ANNA: Any other comments from the panellists about offshore? So there's a question at the back on the right, and then from the left hand side there's a question in the middle for the next microphone, thanks.

AUDIENCE: Alex White from Cooper Investments, a fund manager in Melbourne. I've got a couple of questions. First of all I just want a view on where you see wind energy fitting into the overall generation mix. It sort of doesn't seem to fit in ... too neatly into base load or peaking. The second question revolves around the capacity factor of wind farms. Where do they currently sit in Australia at the moment and have the best sites been cherry picked, or is there still plenty of good sites left. And finally, around the costs of building out the grid to wind farms, given that the major cost increase of energy in recent years has been from transmission and distribution rather than the generation costs, what cost imposition would that build out of grid cost.

ANNA: Three questions there, and I did catch them all. So first question is wind base load or peak, or how would you categorise it. Who would like to respond to that one?

GRAHAM: Well I could start with that. It ... wind energy is an energy provider. It can't be on tap at any time, it's obviously only when the resource is there. And what it's going to do is displace a lot of fuel being used. So it's a bulk energy supplier, but on a variable time scale. So that's where it's going to fit in, it's not going to be categorised as base, and it's not going to be categorised as peaking, but it will displace a huge amount of fossil fuels.

ANNA: The second question was have the best sites all gone or is there a lot left in Australia. And perhaps our property ... our wind farm developer might be the best to answer that, Jonathan?

JONATHAN: I'm happy to answer that. There are certainly are a lot of very good wind farm sites that are actually in active development that have a very and excellent wind resource. We haven't found out ... we haven't run out of new sites, that certainly is not the case in a country this large. Finding sites that have ... this kind of drifts into your third question, finding sites that are windy but also have what we call shallow connection costs, in other words not ... the grid connection costs are not excessive, those are ... you know those are getting a little bit harder to find, but eventually what will happen is we'll find really good wind sites that are maybe more remote from the grid, and then maybe have projects work together to build a ... to have maybe a joint transmission built out to those sites. So there are plenty of wind farm sites still available, both in this state and in other ones. And there's also a lot of projects that actually have planning approval that haven't actually been built yet.

ANNA: Thank you. And to the question in the middle with the hand ... if you could raise your hand again thanks so the microphone can be brought to you. And do we have a question over this side for next microphone to be ready? There's one at the back. Thank you. Yes. Sorry I think you might need to switch your microphone on, it was on when it was handed to you if I'm ... maybe the assistant could help, 'cause this is being recorded. Apologies. Working now?

AUDIENCE: Yes, thank you. Okay my name's Sandy Keen. I'm actually a freelance journalist. I think I must be one of the rare ones who actually write positive things about renewable energy. Anyhow, I hope nobody's going to follow me home tonight. I'm getting rather scared about all the threats going on. I was just talking to another editor today who received quite a lot of threats after she wrote what she thought was a balanced view of the latest wind farm, I won't say where it is. Now my question is, look I mean I went onto the Waubra Foundation website, and to be honest I couldn't believe when I saw the symptoms that were listed. I thought gosh if I went to ... did a straw poll in my neighbourhood in the leafy environments of Kew, I reckon most of us would have admitted to at least half of those symptoms.

So you know I thought this ... that really did annoy me. So my question to the panel is, have there been any serious ... has there been any serious research, serious complaints, and I'm talking ... you know we're looking at Denmark that have ... you know where we've had wind farms now for over 30 years, World Health Organisation, has there been any report coming out from the World Health Organisation on effects of wind turbine syndrome or any other syndrome? Better still, what about World Society for the Prevention of Cruelty to Animals? I'm thinking livestock you know, not subject to propaganda, they don't vote, they don't read hysterical writing in newspapers. Anything that makes us sick is going to make livestock sick. I've been combing the web, can anyone help me, has there been anything at all, I'd love to know.

KATE: Anna, I can maybe start the response to this. The number of methodologically sound studies is very small. And certainly we at Hepburn are talking to medical researchers about possibly setting some research up, but it's slow to get moving because of NHMRC and other funding organisations. It's interesting to note that the sorts of symptoms that people complain about are similar to the symptoms when the railways were being put through in the 19th century that people complained of. And one can only assume that a lot of the symptoms relate to anxiety conditions that people develop when faced with something which they feel is new and threatening. And certainly, the cynical suggest that the symptoms reduce significantly when there's some economic benefit.

ANNA: Thank you very much, Kate. I'm also advised that there's a Melbourne University expert on some of these issues. If you wouldn't mind sharing your views on the microphone there?

AUDIENCE: My name's Peter Seligman, I'm a biomedical engineer. I've worked on the cochlear implant project for about 30 years. And I was very interested to see this plethora of complaints and claims of ill health from wind farms. One of the things that I did notice in all of this stuff was people were complaining about something which you can't ... they can't really hear. And when you look at how much infrasound there is in our environment, we are absolutely swamped with infrasound, everywhere we go we are swamped with infrasound. And for example, if you just go to an ocean beach, there's lots of infrasound there, much louder than you get from a wind turbine. And you don't hear too many people complaining of nausea, dizziness, headaches and all those other things when they go to an ocean beach.

So one of the things which was in the Senate submission, 1,000 or so Senate submissions, were people who were saying things like I felt nauseous as soon as I heard that a wind farm was being proposed in our area. So when you've got to deal with people who start feeling nauseous before the proposal is even being put in, then you've got a very big problem, a health problem ... you can't deny that it is a health problem, but it's a health problem created by people who are whipping up hysteria.

ANNA: Thank you. Jonathan?

JONATHAN: I mean as far as the issue with the animals, the second half of your question, as every ... as most wind farm developers and owners know, in the summer time the turbines actually attract animals. The cattle and sheep will actually come to the turbines and get in the shadows to cool off. So they're actually attracted to the wind turbines, so it obviously isn't causing them any problems.

KEN: I might just add to that, the anecdote that Peter mentioned is a good guide to you know, where you ... a good way to look at some of these claims about health. There's a line between annoyance and dislike of wind turbines, anxiety about them, and actual health impacts from the machine itself. I like the look of wind turbines, but I'm a little biased, and I certainly recognise that there are plenty of people that don't like the look of them, and perhaps don't want them in their own backyard as it were, or even within a few K of them. That's fine, and that's certainly legitimate.

What's not legitimate is people making up things, such as complaining of heart attacks up to 10km away from a wind turbine and blaming it on the wind turbines. And that is what we are

dealing with, that and other ridiculous sort of stuff that is getting airplay day in, day out. And to the point where it's come before a Senate committee, and people have gone in and made those claims and are calling for 10km buffer zones, complaining of high blood pressure, and the people making those complaints are ... you know overweight people in their 50s who don't do any exercise. They will say things like I never had these problems before the wind turbine, but I'm wondering when these people ever got it checked before a wind turbine was built near them and that's the nub of it.

The stuff in the media, and the stuff spread by the anti-wind farm groups has caused so much anxiety in the community that it's raised their ... the awareness of symptoms and got people thinking about whether their own ill health might be something to do with a wind turbine. They go and get it checked out, sure enough, yeah they're not as well as they were when they were younger and fitter. But the link, the causation is what's missing. I suppose if ...you know if there are any Landscape Guardian people tonight, congratulations you've done a very, very good job, and you've been dominating the media in the last year and putting out a scare campaign that really puts the anti-fluoride people and anti-vaccination people in the shade, so well done. But it's not based on fact, and I guess the reason I'm, you know happy to work in this industry and optimistic that we will get through this is that we do have the facts on our side.

There are professors of medicine and in particular professors of psychology around the world who are starting to look at this issue more and more as these complaints arise. And backing up the points that the industry has been making, that a lot of this is really based on a scare campaign, that that causation is otherwise not there. There's nothing about the machines that we produce, install or operate that makes people sick.

KATE: Certainly one of the benefits of the community model, is that people have the opportunity to have their questions answered very directly, and to be able to engage in a process of learning and understanding. And so I think that that is very demonstrably why our level of complaint and our level of people presenting as unwell is very low.

ANNA: Thank you. So the microphone I think is with someone at the back already. If ... whoever was it that raised their hand previously. Yes, thank you.

AUDIENCE: How does the cost of wind turbines ... you showed the falling cost as the technology developed, but how does it compare currently with solar ... thermal or solar, photovoltaic and also with geothermal, and how are these things likely to change in the future? In other words, what's the best current buy and perhaps future buy?

ANNA: Why don't we ... sorry.

JONATHAN: Our company, we are the largest owner of wind farms in Australia, but we're very happy to build solar facilities as well. We were partner with a company called Sun Tech, which ... actually the owner is actually Australia, who moved to China 'cause of lack of investment incentives here in Australia. But to make a 150 megawatt PV facility in three different locations in NSW, so we were happy to build solar and wind. The problem with solar is, large solar PV, is it's roughly 2.5 times more expensive. So if you'd like to get ... have your electricity bills go up even more, we could build a lot of solar instead of wind, but it is a lot more expensive than wind energy for every kilowatt hour you get out of it.

Solar thermal is even more expensive still, so it's even another ... I don't know, you know five times more expensive, three or four times. It's a lot more expensive than wind energy. And that's one of the comments that we get a lot is why don't we build solar? And we're happy to build solar, but we need a cheque from the government, we need a subsidy, we need an additional grant from the government in order to build solar, because wind energy is the cheapest. And the renewable energy target scheme is a really great scheme for customers, because it's a competitive scheme. The most cost effective technologies, the most efficient projects get built first. Whereas a feed-in tariff, you set the feed-in tariff too high and you can get lots of projects built, they're maybe making too much profit to be honest. But the RET scheme is

a competitive scheme where you end up with basically meeting a renewable energy target at the least cost.

Geothermal, well I think it's fair to say the hot rocks, geothermal is not proven at this stage. We certainly wish them all the best of luck, but you know they haven't really gotten it to work. The shallower geothermal, my personal opinion is it certainly has a greater chance of working, but no-one really knows what the cost is going to be, 'cause they actually have to get it to work on a continuous basis first.

KEN: That's a good point by Jonathan. The examples you quoted before, we just haven't tried them in Australia before, so they're really just numbers on a page. The one that irritates me the most is the comparison done between coal and gas versus wind. And you'll see charts where someone claims that coal-fired power will cost ... the long range marginal cost will be \$30, \$40 a megawatt hour compared to wind being closer to \$100 a megawatt hour. But really I don't know too many people crazy enough to go near a bank and ask for money to build a coal-fired power station. When they quote those stats, they're talking about the cost of existing taxpayer funded and built coal-fired power stations from 20 or 30 years ago. They're not talking about the HRL prospect down the Latrobe Valley, or the ones that have been recently built in the last decade and supported by the Queensland government in the last decade. Those numbers are quite different, and I didn't include the slide, but Bloomberg New Energy Finance really puts the cost right up there as high as anything that you'd see from a wind turbine. The others we're yet to see, geothermal, hasn't been built to scale. Solar thermal, solar PV, on a large scale in Australia it's all in Australia. So they're just numbers on a page at this stage. It's not reliable.

ANNA: We're getting very close to time. There's one more person that has the microphone already I'm advised, and this will have to be the last question I'm afraid.

AUDIENCE: I'm Ross Gawler from Sinclair Knight Mertz. I do claim that I have helped Hepburn Wind get their project up, because I helped to provide price forecasts early in the planning process. However, my question is about electricity transmission for remote renewable resources. The Australian Energy Market Commission has introduced a new framework and set of rules for what they call scale efficient network connections, which is supposed to enable multiple entities who are developing wind or solar projects in a region to work together to contribute to the funding of a network extension. Now I ... the rules that have come out basically require all those proponents to take all the risks of that extension, and the ability to trade those benefits with other likely customers of that network seem to be rather problematic. I'd be interested to hear from the panel as to whether they've looked at that new policy and whether they see that as being advantageous, or opening up the areas like the Air Peninsula and western NSW and maybe parts of Queensland which have either good solar or wind resources, but otherwise are currently too far from existing networks.

JONATHAN: I'm happy to have a go at that. The Ministerial Council of Energy which is basically the state and federal energy ministers directed the Australian Electricity Market Commission to develop these, what are called SENEs, Scale Efficient Network Extensions. But the principle ... what they told the Market Commission to do was to develop these such that ... say you had four developers in an area who wanted to build a wind farm, four developers equal size. Basically what would happen is when the first developer is ready to go, he'd put up his 25% to pay for the extension to the network, the other 75% would be borne by customers until the second guy came in, and then he'd pay his 25%, the third guy his 25% and the fourth. And then the customers wouldn't actually have any burden at all and the generators would have paid for this new transmission.

That's how it has to happen, that's the only way this system would work, because you can't really have ... expect generators like ourselves to work with our competitors, 'cause that's what they are, to develop things, because the first company that's ready to go needs certainty that the second, third and fourth one are ready to cut a cheque for say you know, \$20 million each. That's not going to happen, and you're not going to have four projects all ready to go at the same time. It's just ... it's an unfortunate ... so what happened was, that was the direction, the

rule that Ross was talking about when it was actually released last month, they've actually put it on its head. And as he said, now the risk is borne by the generators like us.

So you can imagine, you know the chances of us actually taking that risk ourselves, so we could connect our own wind farm, or we could risk our own capital, spend a lot of extra money, and what would happen then? We're risking it, then this guy might connect. And actually when he connects, things happen to the network. We actually have more losses. We might actually get constrained off the network as well. So it's actually a huge risk and there's no way that any generator like ourselves or any other company is going to build one of these until they go back to the original concept for this rule that the Ministerial Council of Energy dictate ... specified. And so we're very disappointed with that result and hopefully at some point they might change it.

ANNA: Ken?

KEN: Yeah just to add to that, and you can see the Infigen and the Vestus submissions on the AEMC website, 'cause we've been involved in discussions over this rule change a lot over the last year. But the short answer to your question is no, the Prime Minister in the last week has used the word turbo charging when she talks about encouraging renewable energy and the various policies that the government has put on the table in the last fortnight are designed to do that. The rule change that you've mentioned won't do that. In fact it's a ... it really seems like a waste of time to me, and we said that in our submission. The Ministerial Council on Energy gave a pretty clear direction I thought about a year and a half ago, and over that same period the Australian Energy Market Commission has chosen to ignore it and gone in a different direction. Which is a little puzzling, because there's one agency that are supposed to set policy for the national electricity market, and that is the Ministerial Council on Energy. And it puzzled me that the AEMC has ignored their direction, gone in a different direction and wasted the time and expense of all the stakeholders who've contributed to that over that same period. I can't understand it and it's not going to do the job. If we're trying to get to 20% renewable energy by the year 2020, that is absolutely going the wrong way about it. It's the faintest signal that leaves all the risk with project developers. And if you can't reduce risks for these sort of projects, then you won't get them built.

ANNA: Alright we're bang on time, and I'm sorry that we're going to have to wrap it up there. There were a raft of other questions and people who would have loved to keep discussing this. And I think that's a credit to the organisers for bringing this experienced group together, and a credit to the panellists for being as interesting and relevant as you have been. So thank you very much from me and I think it's now time to hear from the Melbourne Energy Institute.

SUSANNAH POWELL: On the behalf of the Grattan Institute and Melbourne Energy Institute, I'd like to thank our speakers, panel and Chair, and the audience for your excellent contributions to the discussion this evening. I'd also like to thank Jemma Stefanou, Angela Henderson and Andrew McDonald for all of your work pulling this event together. Our upcoming seminar in August looks at the future of the electricity network in Australia. We hope you can join us then. Also, if you're interested in the business and technology of energy, we ... the University is about to launch a Master of Energy Systems, starting in 2012. There is a program launch in a few weeks on the 9th of August. So if you are interested, please join us then. Information about this is on our website, and there are some flyers around the place this evening. Thank you.

AUDIO: This has been a podcast from Grattan Institute. Want to hear more? Check out our website, www.grattan.edu.au.

End of recording