

PETROLEUM AMENDMENT BILL 2007

Second Reading

Resumed from 20 September.

HON KEN BASTON (Mining and Pastoral) [8.56 pm]: This is an extremely interesting bill. It is one I am sure will create a lot of interest in the future. The Petroleum Amendment Bill 2007 is a bill for an act to amend the Petroleum Act 1967 and to make consequential amendments to other acts - 21 in all. The bill is to provide for the exploration and recovery of geothermal energy. The bill covers both conventional geothermal energy, such as hot water from geothermal springs - artesian bores etc - and energy contained in hot rocks of high heat producing granites at locations below the earth's crust at depths of three to five kilometres, which is 3 000 to 5 000 metres. The key elements of the bill - I will go into greater detail of how the bill works later - are to provide for a vesting of Western Australia's geothermal energy resources in the Crown. The energy can be found in hydrothermal form and in geothermal hot rocks.

The bill also secures title for geothermal explorers and producers. No-one will invest funds into this energy source without some form of title and security that he will be rewarded for his efforts, especially when drilling to such depths, which requires not only a specialised rig, but also a very specialised person or company to do that exploration work. The key elements of the bill also provide for the coexistence of petroleum and geothermal resource titles. In other words, they do not cross over; they very much allow that if there is a title for petroleum, a company is not in the race for geothermal energy and it cannot be claimed. Vice versa, if a company is drilling for geothermal energy, it is not entitled to petroleum. That is an interesting thought. I am sure the answer from the Leader of the House, when he replies, will be that if someone found oil, he should just plug the hole and come back again later with a different application, or vice versa. I think that the oil well should be plugged and the person who found it should disappear and come back in a few years!

The mechanism for the collection of royalties is most important, hence the Petroleum Amendment Bill 2007 vests geothermal energy resources in the Crown. This bill also amends the title of the Petroleum Act 1967. It will be known as the Petroleum and Geothermal Energy Resources Act and will legalise geothermal exploration recovery in Western Australia. Western Australia and the Northern Territory are the only Australian jurisdictions that do not have legislation to regulate geothermal energy resources. South Australia was the first state to enact geothermal energy legislation through its Petroleum Act 2000. It is interesting that Western Australia has followed the South Australian model. Both New South Wales and Tasmania regard geothermal energy as a mineral and have included the regulation of it in their mining acts, and Victoria and Queensland have separate legislation for geothermal energy. Interest has been shown in the development of exploration for geothermal energy in Western Australia, and WA needs legislation to provide a form of title that will allow people to explore and then secure their investments. As I said earlier, a huge amount of funding is needed to enter into one of these investments. I understand there was some angst about which legislation should regulate the exploration title. Although Victoria enacted separate legislation for geothermal energy, it based it on its Petroleum Act 1998, while, as I said, South Australia, the most active state in developing geothermal energy, used the Petroleum Act.

The depth at which hot rocks are found is well below that at which minerals are normally mined in Western Australia, so the exploration for geothermal energy would not conflict with any of the other extractions that take place. The method of exploration for geothermal energy is very similar to that used for gas and oil wells; therefore, it is fitting that the provisions relating to it come under the Petroleum Act. The bill also addresses ownership of geothermal energy, which I have alluded to, and ownership will be vested in the Crown. However, the bill covers the issues of rights over petroleum and geothermal energy in the same location. They are separate, and to have a title for one does not give a right to the other, and I mentioned earlier the interesting scenario of what would happen if someone found one while looking for the other. Vesting the ownership of the state's geothermal energy resources with the Crown will allow the state to authorise exploration and development of the resources by the granting of exploration permits. Those permits are valid for six years. Lease permits are able to be retained and are renewable after five years, and production licences are renewable after two years. The commonwealth Native Title Act 1993 will apply, and any claim will be subject to the future act process to ensure that the title is valid. If there are issues relating to geothermal energy co-existing with petroleum and other minerals, the dispute resolution mechanisms of the Mining Act 1978 and the Petroleum Act 1967 will come into play. Coexistence is therefore allowed. Exploration for geothermal energy will target different strata from minerals, but if there were a dispute, those dispute resolution mechanisms would be available.

An interesting issue is the release of acreage. There will be two releases each year, the opening and closing dates of which will be advertised. Perhaps the Leader of the House will explain to me how that process will work. It will obviously be a competitive process, but I am not quite sure how the competitive side of it will work

and what the applicants will tender for. The second reading speech made in the lower house and the Leader of the House's speech in this place did not describe how that process would take place. I found that very interesting as a tax or royalty will be charged. I do not know how people will pay for the acreage that they need to achieve their exploration permits.

The exploration licences will cover a smaller area than do normal exploration licences, and will have a maximum of 160 graticular blocks - one block is equal to 80 square kilometres. A petroleum exploration licence has 480 graticular blocks. However, the explanatory memorandum states that the fees will be the same as for petroleum titles. South Australia started with smaller blocks but soon found it needed larger blocks. There is no basis, other than the experience of the South Australian model, for reducing the size of the licence to 160 blocks.

This bill allows royalties to be charged. In New South Wales, the royalties are four per cent; in South Australia, 2.5 per cent; and in this bill they are set at 2.5 per cent. Royalties are measured at the wellhead in a similar way as royalties for gas are measured. The leases have to meet the requirements of the Rights in Water and Irrigation Act 1914. I will explain later how the process works, but, essentially, a lot of water is used to mine for hot rocks, although it is recirculated. I have touched on the exploration permits, which are granted for a period of six years conditional on an agreed works program, to be carried out on a year-by-year basis.

The bill contains a proposed new section covering a geothermal energy recovery plan. A plan explaining how recovery will take place must be submitted to the minister for approval. The plan must include a seismic risk analysis; in other words, the likelihood of induced fracturing causing a seismic event creating earth tremors. The process of extracting geothermal energy occurs by drilling a series of holes into the hot granite and creating fractures between those holes so that the flow of water can go over the hot rocks. These rocks have a temperature of some 270 degrees Celsius. The water is pumped down one hole, or well, and it finds its way through those fractures to the other well and comes back up again, producing the steam and power necessary to drive turbines on the surface. It is a very simple process, but a very expensive process as it is done at huge depth. Seismic risk analyses will be required because the technology was trialled in Basel, Switzerland, and an earthquake occurred, supposedly as a result of the technology, and the trial was not progressed any further. A couple of weeks ago I was at a function with my family, and I met a guy who was involved in drilling all around the world with a very large drilling company. He was drilling in Russia and he was just about to take off again the next day. We talked about this bill and geothermal energy. He had known the fellow who had drilled in that area where it was believed the drilling had caused an earthquake. He certainly believed that it had nothing to do with the fracturing and that it was just coincidental that an earthquake had occurred at the same time, and those people copped the blame for it. However, I guess we will not know until we try it here.

Geothermal energy is heat energy originating deep in the earth's molten interior. This heat energy is responsible for tectonic plates, volcanoes and earthquakes. Obviously, we are dealing with that type of depth. The original heat is generated in the centre of the earth, of course, and the temperature in the earth's interior is as high as 7 000 degrees Celsius, decreasing to 1 200 to 650 degrees Celsius at depths of only 80 to 100 kilometres. I say "only" when talking about those figures. Of course, we are talking about depths of 2 000 to 5 000 kilometres, and the temperature will cool down to 250 to 270 degrees Celsius.

There are two types of geothermal energy. In other countries, there is hydro geothermal energy. In the geysers in New Zealand, water is heated and comes to the surface as steam. There is another type of geothermal energy. The Great Artesian Basin in the east and the Carnarvon Artesian Basin in Western Australia could be used to generate geothermal energy.

The first geothermal power plant was constructed in Larderello in Italy in 1904. This plant had a capacity of 250 kilowatts and used geothermal steam to generate electricity. The second geothermal power station was built in 1950 at Wairakei in New Zealand. This was followed by the geysers in California in the 1960s. In Australia, geothermal energy is being generated at Birdsville in Queensland, where a 120-kilowatt demonstration plant is in operation, using 98 degrees Celsius groundwater from the Great Artesian Basin.

Hydrothermal resources require three basic components. They require, of course, a heat source, an aquifer containing accessible water, and an impermeable cap rock to seal the aquifer. The geothermal energy is usually tapped by drilling into the aquifer and extracting hot water or steam.

The other source of geothermal energy that is probably more interesting to us is hot rocks. This is a source that has not been utilised before. A hot rock is a heated geological formation formed in the same way as hydrothermal resources, but it contains no water, as the aquifers or fractures required to conduct water to the surface are not present. That is what I was alluding to when I said that people would have to drill holes to cause those fractures. The resource is virtually limitless and is more accessible than hydrothermal resources.

The geological profile of Australia is such that there is a large potential for hot rock technology to be used. I believe that the Perth basin is an area that could be used. There is an area out from Balgo, and there is an area

off Exmouth and down to Carnarvon that could have possible hot rock usage. Interestingly, a company called Geodynamics Ltd is operating in South Australia. It has said that the estimated break-even price for electricity from a hot rocks project proposed by Geodynamics in the Cooper Basin was 6.2c a kilowatt initially at demonstration plant stage, but that price goes down to about 4c a kilowatt for a bigger plant. It is quite an interesting and cheaper form of electricity.

I alluded to the costs of geothermal energy. Those prices that I gave are interesting. On 29 October 2007, a media release was put out by Geodynamics, which states -

Geodynamics and Origin Energy Agree On \$105M Joint Venture

Geodynamics Limited will seek shareholder approval for Origin Energy Ltd to farm-in to its South Australian geothermal tenements as part of a \$105.6 million deal.

The two companies have executed a binding Heads of Agreement for Origin to farm-in to 30 per cent of Geodynamics' SA geothermal tenements, along with 30 per cent of its Lightning drilling rig.

The Lightning drilling rig, by the way, is a very special rig that is state of the art. I have not seen one; I have just read about them. Interestingly, I was up at Barrow Island recently, and a state-of-the-art drilling rig was there. These rigs are fully computerised and have virtually no staff on them. They run 24 hours a day. They are quite amazing pieces of technology. I guess it is that movement in technology that has allowed us to look at geothermal energy as a possible source of power for the future. Two companies, Petratherm and Geotherm - they are the main ones - are also drilling in Spain and, of course, in South Australia. Geodynamics has a well in South Australia. Some of its approaches and some of the problems it is facing are interesting. An announcement dated 9 October states -

Geodynamics is pleased to advise that the drilling of Habanero 3 is progressing with the 311mm (12¼") diameter section -

That is quite a big hole to be drilling -

of the well now at 2,616m (8,584ft).

The workers were cementing it, but at around 2 500 metres, they lost the bottom hole assembly comprising the drill bit etc, and five days were spent on fishing out the failed parts and inspecting and modifying the bottom hole assembly. The complications in drilling to that depth are huge. However, with our drilling techniques today, when we can drill holes vertically and then horizontally in oil wells, it is not beyond our technical capacity to drill to that depth.

As I explained, hot rock technology involves drilling one hole down and other holes to come back up. Of course, that can be added to. The more holes there are, the bigger the power plant that is wanted. There is a lot of capability to increase the power supply for the future.

There are benefits of geothermal energy. As I said, geothermal energy is an abundant, secure and renewable source of energy if properly utilised. Geothermal technologies that use modern emission controls have minimal environmental impact. Modern geothermal plants emit less than 0.2 per cent of the carbon dioxide emitted from the cleanest fossil fuel plant, less than one per cent of the sulphur dioxide and less than 0.1 per cent of the particulates. I looked that up and I am not sure what it means.

Geothermal power plants are designed to run 24 hours a day. We have many other renewable energy resources, but they do not run 24 hours a day. Geothermal power is independent of the weather and fuel delivery. It is not necessary to make sure that the gas, oil or coal is delivered to generate the power. As I said, the plants can be expanded rapidly by drilling more holes and injecting more water. The geothermal resource represents what I would call an indigenous supply of energy, providing energy supply security and reducing the need for fuel imports, which would in turn benefit our balance of payments. Geothermal plants also have very low land requirements. Like oil wells, they have a very small footprint. It is a bit similar to the situation of the oil wells on Barrow Island. There are 400 operating wells on Barrow Island and, from memory, I believe some 800 have been drilled altogether. However, they take up only a very small amount of land on that island. In fact, the biggest part is the donkey pump going up and down, which is a bit bigger than the table in the centre of this chamber.

In researching this bill, I became quite excited to learn so much about hot rocks. Others have also become very excited about the technology. An article by Mike Nahan, entitled "Time for WA to get its rocks on" appeared in *The West Australian* on 20 October. It was about hot rocks around Australia, not just in Western Australia. The article reads -

The most promising sites appear to be in the Cooper Basin in the south-west corner of Queensland and South Australia -

That is where Geodynamics is drilling at present -

the Hunter Valley in NSW and, importantly, Perth.

The resource in Australia is so vast that it has the theoretical potential to meet the entire nation's electricity demand. The potential and characteristics of hot rock technology leave all other renewable energy sources for dead.

Wind power is seriously flawed. It only works when and where the wind blows and has a large, visually intrusive foot print.

With all due respect to Hon Paul Llewellyn, I am not a great wind power fan. When I see the turbines from the air, supposedly purring away, I think that wind farms are quite a blight on the landscape. The big one is south of Eneabba, and can be seen from a plane flying overhead. The article continues -

This makes it particularly unsuitable for the Perth region.

Having a large number of wind turbines close to Perth would be unsuitable. I used to own a block of land in Denham, on the top of a hill with magnificent north westerly views. I had a plan of building my dream home there to retire and go fishing. Then a great wind turbine was built very close to it. I went to inspect the block and dream about how I was going to build a house and I saw this wind turbine whooshing away. That was it; I just went straight down and put the block on the market. It sold fairly quickly, and the wind turbine was actually moved somewhere else not long afterwards. I was a little dark on that. That block could be worth quite a few dollars now, but I do not really want to know. That was my first confrontation with a wind turbine. The article continues -

Solar energy and tidal power suffer from many of the same handicaps as wind but are more expensive. Biomass is better but is limited in scale by the cost of transporting its fuel source - agricultural waste.

As such the clean, renewable energy alternatives are simply not up to scratch and will not replace fossil fuel to any significant degree - no matter the size of the subsidies.

Hence the growing interest worldwide in clean coal, LNG and man-made nuclear power.

Hot rocks are different. Hot rocks have the potential to provide continuous base-load power at a price competitive with electricity generated with gas - even without subsidies.

. . .

One of the key ingredients to develop the technology is the establishment of a property rights system which would give holders exclusive rights to explore and to develop a resource in the area.

That is what this bill does. It gives rights to the companies that explore for, find and develop the hot rocks and build the power stations. Exploration is yet to begin in Western Australia, and this will not happen until the people who are going to spend the money are given that title. The article continues -

A large-scale research study undertaken by the Massachusetts Institute of Technology concluded that most of the key technical requirements to make hot rocks technology work economically over a wide area were in place.

It predicts the technology could account for 10 per cent of total generating capacity within the US in 50 years . . .

Imagine that applied in Australia, particularly in the north of Western Australia. We may not have to cart the gas from Karratha to Broome, as we have to do now, to supply the Kimberley. Power could actually be available in the area that we commonly call wilderness. It could be the profitable area of electricity in the north. With hydroelectricity coming from Kununurra and hot rocks power coming the other way, we would not even have to look at the Derby tidal power project. It would be fantastic. I know that it is a long way off, but it is certainly very encouraging. I look forward to posing a few questions when we reach the committee stage on this bill. However, I think it is very exciting. I just mention a few of the advantages I have discovered - zero emissions, cost competitive, baseload power, no water consumption and no legacy. There is no water consumption because the same water is recirculated and not much is lost. I will finish with another quote from the Mike Nahan article that I thought was very good -

So for all you green punters, remember: wind is good when it blows, sun is hot when it shines, but hot rocks are hot all the time.

HON PAUL LLEWELLYN (South West) [9.28 pm]: There is a fair amount of fervour around the whole about the matter of hot rocks technology. It might be something to do with the heat that it is generating. I would like to frame this discussion around a number of questions about geothermal technologies. Why are we doing this? How do we make it practical? How do we make it happen within a legal, institutional and commercial

framework? What will it look like in the future? We do not know. This is effectively one of those fairly unproven technologies. We can hope - indeed, I hope - that hot rocks and geothermal technology will be a major contributor to our renewable energy future, but we are hoping. It is a pipedream, literally, in every sense of the word. Drilling very expensive holes deep into the ground, pumping water down into those holes and then drawing the steam out through production wells is an extremely expensive venture. It is competing with the drilling capacity of our oil industry. As the global oil supply depletes, more effort must be put into drilling for gas. Hot rocks technology will compete hard with the cost of drilling technology. Although it is not the silver bullet that we hoped it would be, I can see that hot rocks technology holds a compelling fascination for Australia because of the flat landscape and our ability to drill. The Greens (WA) and I have given a lot of thought to the renewable technology portfolio that is needed to deal with climate change. We hope that we can realise the full potential of geothermal technologies and that we can make a major contribution. We are going into this with our eyes open with regard to the physical and material capacity of the economy to do this.

I will briefly visit the matter of the principal driver for passing the Petroleum Amendment Bill and a series of other bills to facilitate geothermal technologies. The principal driver is climate change. Other compelling drivers are the population growth across Australia and the world, and our appetite for energy. A consequence of the insatiable appetite for energy and our exponentially growing population is that we have collided with the growth limits for the capacity of the climate to absorb our greenhouse gas emissions. We need to find a technical solution and a major breakthrough in the way we deal with and manage energy.

As part of the work that I have been doing on behalf of the Greens to forge a new vision for renewable energy for Australia, I have done some basic work on the ability of renewable energy to form part of the low-emissions future. I would like to go through that if I have the time, but I will also stick to the intent of the bill. Geothermal technologies have a major contribution to make. However, we should not run the risk of putting all our eggs into one basket. If we are going to have a clean energy future, it will require a major investment in all the technologies that we can bring to bear. We must invest in biofuel, biomass, wind, wave solar and solar thermal technologies. No-one should underestimate the technical capacity of solar thermal energy to meet the mythical baseload task that we have created. The renewable technologies are moving very rapidly. Modelling of wind energy technologies suggests that if wind farms of 3 000 or 4 000 megawatt of installed capacity were built between Geraldton and Esperance, we would level the output of wind generation assets in a way that almost resembles baseload energy because the wind is always blowing somewhere all the time. It depends on the size of the portfolio and the amount of money invested in it. Do not underestimate the capacity for any of the emerging technologies to deliver baseload power.

Hon Ken Baston: I just do not like the look of it.

Hon PAUL LLEWELLYN: I do not like the feel of climate change or the average increase in the earth's temperature by two, three or four degrees. We have had a major impact on the national environment and on the way the landscape looks. Members would be very surprised at the number of turbines that would be required. Some 3 000 megawatts could be generated by 300 turbines. That number of turbines would be lost in the landscape between Geraldton and Esperance. I am not talking about thousands of turbines. It would require quite a number, but not thousands. I do not want to become an advocate for wind or solar technologies. The future of dealing with climate change does not lie in a silver bullet. It is very dangerous for a government to adopt a policy of putting all its eggs into one basket, particularly if the technology is unproven and has not delivered commercial scale genuine electron flows into the grid. Although we live in hope, we have a whole portfolio of renewable technologies, including wind, biomass, solar and solar thermal, and wave technologies that are delivering energy. We must take a balanced approach to our future energy needs.

Having got that off my chest, it is fair to say that the intentions of this bill are clear and good. We must establish a framework that will allow us to tap into the earth's thermal resources. We need a clear, commercial strategy and we must put in place necessary legal architecture to make that happen. This bill goes some way towards doing that.

Hon Ken Baston has already provided a description of the briefing notes that were supplied to us. However, I reiterate that when the geothermal resources are vested in the Crown and we have developed a mechanism for hot dry rocks, thermal resources and hydrothermal resources, of which we have relatively few, it will be necessary to put in place a comprehensive legal structure to provide secure title and to shift the rights of ownership of and the creation of rights for thermal resources. That is obviously the way to go and I do not think it would be a problem to insert that part of the architecture into the bill. We must build into the bill special arrangements for the co-existence of title, which is dealt with fairly adequately in the bill. The final mechanism requires the creation of an entitlement regime and also a secure asset on which we can build the collection of geothermal royalties. The separation of the entitlement to thermal resources from water resources is an obvious and necessary mechanism. However, as I understand it, if we are to believe the hype - there is no reason not to believe it - and the process produces absolutely no water or emissions, and it will be the panacea for all our

energy needs, I am glad that a clear separation of entitlement will apply. I notice that a water licence of some 50 or 100 gigalitres would cost a company something like only \$3 000 a year. Therefore, it is hardly a major consideration from a financial point of view at this stage. However, it is certainly a consideration from the point of view of the proper management of our water assets. No-one has a really clear idea of what this technology might physically look like when we roll it out in the future, because we are, in fact, creating the potential for a totally new industry.

I will deal with the matter of royalties and the Greens (WA) view about even charging a royalty in the first place. This is a start-up industry; it is unproven. It will be nice if it works, but it is an unproven technology that requires massive up-front investment and it is highly capital intensive. This is all in the hope that we will get a stream of renewable energy from the wellhead.

To give some sense of the matter, I understand that companies drill down to 3 000, 4 000 or 5 000 metres. These companies compete for drill time with the petrochemical and petroleum industries at a cost of, I do not know, \$8 000, \$8 million or \$10 million a well. It might take two years to drill one well - I do not know. I do not know how long it takes to drill five kilometres underground into hot rocks and granite to find the resource. It might be a high-quality resource; it might be a low-quality resource. We do not know that. We do not have the information base, so we are going out on a wing and a dream here. How many wells might be needed to produce 300 megawatts of power? We might need 20, 30, 40; I do not know. Depending on the quality of the thermal resource, we might need 40 wells at, say, \$10 million a well, which is a \$400 million investment program in drilling alone, without even building the generation assets at the top of the well. I do not know whether these numbers are right, but I have that sense from the literature. In the hope of getting 300 megawatts continuous power, a company might need 40 to 50 wells. Someone can tell me whether I am right or wrong. This is a very large capital investment. When a company reaches the bottom of the well, it might have a high-quality or a medium-quality thermal resource. The current heat exchange technology requires a relatively high quality thermal resource to get the economy and efficiencies to generate genuine electricity at cost. Therefore, I do not know about this guy from *The West Australian* who says that he is an overnight expert in renewable energy technologies; it sounds to me as though he is just as much of a zealot as any other. However, I will not take *The West Australian* as my starting point.

We have a potentially very expensive renewable resource and we will impose, as many countries have done, a royalty on it. The question that the Greens (WA) asks is: given this massive capital investment upfront, and that we want this start-up industry, why not give the industry a 20-year royalty holiday? Therefore, when the companies make these massive capital investments upfront, they could do so with some reasonably reliable knowledge that they need not pay a royalty. After all, do we charge a royalty for wind power? Do we charge a royalty for the sun? People are saying that this is an endless thermal resource from the centre of the earth that will just well up in perpetuity.

Hon Barry House: We can tax rainfall, so it might be the case.

Hon PAUL LLEWELLYN: We could tax rainfall, so there we go. Do we charge a royalty for bio-energy products? Therefore, why should we charge a royalty if this is a genuinely renewable resource that we have compelling environmental, social and economic reasons to develop? Why put a royalty at the front-end of the whole process, accepting that we need a revenue stream or that we have to administer the licensing arrangements? What is the real cost of administering those licensing arrangements?

The Greens (WA) will put forward an amendment requesting a royalty holiday reflecting the kind of time frame that members would expect for the development and proving up of a resource such as a geothermal power station. This holiday would give the investors in that sector a bit of breathing space. They could then go to their market and say that they know the fixed costs of drilling the holes, they do not know the quality of the thermal resource, and they cannot accurately know the energy content at the wellhead; however, they can tell the market that if they go to this expense, they will not be charged a royalty to the state, which is an incentive to go ahead. If we are genuine about driving this industry and making it happen, we will offer a royalty holiday.

The second issue is exemptions. The Petroleum Amendment Bill 2007 has come on very rapidly; I think we got it only a couple of weeks ago or so. It was read through in a state of excitement: "Let's bang through a bit of geothermal legislation because the Premier is excited about it." It is about picking winners, rather than setting up frameworks to drive investment in renewable technologies. The government wants to pick a winner and try to shoehorn it through. I am not saying that is a bad thing to do, but is it the desirable model of industrial development and our response to climate issues - that is, to shoehorn our favourite technology through Parliament, instead of developing broader renewable energy targets across the whole portfolio of renewable technologies and promoting efficiency technologies? This proposal is instead of investment in efficiency technologies to ensure we would not have to produce as many megawatts of power because megawatts capacity would be produced in energy efficiency and savings. However, if we choose to rush a bit of legislation through Parliament for our favourite technology - I am not opposed to the technology - we run into a small problem. I

think Challenge Stadium has a small geothermal project that heats up some swimming pool water so that it can be given an exemption. Why not give an exemption to any geothermal resource or capacity below five megawatts? What happens if the technology changes to the extent that heat exchanges become so efficient and economically viable that in, say, 10 or 15 years' time, a wheatbelt community might drill down to a geothermal resource, plug in a small-scale generator and be allowed to operate a small-scale geothermal plant unencumbered by any of these arrangements?

I have called this bill the geothermal energy bill, but it is actually called the Petroleum Amendment Bill 2007. Does this bill in its design look far enough ahead? Do we understand what the whole geothermal industry might look like in 10, 15 or 20 years? In Europe people are drilling into geothermal resources at the household and community levels and using them for bulk heating, heat exchanging and so on. Why have we not foreseen the potential for small-scale geothermal energy, given that we know that large-scale geothermal energy works; that is, hot dry rocks? Why are we not assuming that at some stage it might be a resource that operates at a smaller scale when technologies emerge that can actually use it? We know that it is expensive to drill down three or five kilometres with very large drills. However, we could drill, for example, into the thermal resource of the Yarragadee aquifer, which I understand is hot in the northern parts of the Swan coastal plain, and we could develop a small-scale geothermal generator with highly efficient heat exchanges. What would happen if that opportunity presented itself? Under this bill it would be treated the same as other energy resources, because this is the big bill for the petroleum industry. When we think about the petroleum industry, we think big. Big is good because we need a big solution, but it is possible technically to have lots of small resources. We cannot foresee that because we have our hands in front of our eyes and we are saying that this can be only a big solution. A lot of small solutions are big. In Europe large-scale programs are developing small-scale thermal resources that are in the ground. I do not believe we have foreseen this and I do not think that this bill adequately deals with that aspect of the industry's future. Who said we were not thinking about this?

Parts of the bill do not deal adequately with the kinds of technology transformations that might happen over time, although I understand the bill does not set out to do that. A high-quality thermal resource currently might be 200 degrees or 90 degrees. What would happen if a high-quality thermal resource became 70 degrees and we could overcome those thermal gradients to extract useable resources out of lower temperatures? We do not have an effective exploratory and mapping mechanism with this new technology. I do not know what the petroleum and mining industries have been doing when they have been drilling around the place, and whether they have been adequately reporting when they come across thermal resources or heat underground. We do not have a very clear picture of what the prospective resource looks like. In that regard we need to build up an environment that can create the knowledge base for making this technology workable. This bill needs to be able to respond to the changing knowledge base. Currently, the maps that I have seen of the geothermal resources of Australia are pretty broad-brush maps. I do not know where they have come from. Perhaps Geological Survey of Western Australia has some more detailed information. However, at the moment we actually do not know.

In order to address climate change and our need for energy, we need to do everything that we possibly can to facilitate clean energy uptakes. We need to be able to predict ahead of time what the technology will look like and what kind of difficulties we might run into. Hon Ken Baston mentioned the question of fracking, when water injected down into these deep wells effectively generates small seismic events. Those hot dry rocks have to be fractured by pumping high pressure water into them so that they can fracture through to their production wells. There might be three or four wells into which water is pumped but only two production wells. The rock structures underneath have to be fractured to maximise the surface area in which the exchange of heat from the rocks into the water occurs. I know that there have been issues with that technology. I do not believe they were coincidental events, but I think Hon Ken Baston said they occurred in Finland.

Hon Ken Baston: Switzerland.

Hon PAUL LLEWELLYN: Switzerland. I do not know whether they were coincidental events, but we need to look at the liabilities. Who would be liable in the future when we go to large-scale geothermal technologies? Where would the liability lie if, for example, the state owned the resource and allocated it to a geothermal operator who took the resource? What if around Meckering a fabulous resource ended up with a field of geothermal production, source wells and fracking that caused another Meckering earthquake? I do not know. Who would be liable? Who has thought through that issue? What arrangements are there in other places for dealing with seismic events that result in fracking in these kinds of facilities? I do not know, but it is something that is not on the radar of this bill.

As I said, this bill came to us relatively quickly. That is not a bad thing, as we have a big responsibility to find a solution to the energy crisis and the climate crisis. I think the bill has come with a few warts. The planning of the royalty issue comes with the warts of working out where the liability sits in this bill. I do not know whether this is the right place to do it. The bill does not deal adequately with scale. By simply exempting two arbitrary small-scale thermal facilities because we know about them is an oversight in the construction of the bill; it is not

forward looking enough. I would like the government and the Greens (WA) to work on an amendment that adequately deals with scale. To work on that amendment in the next few days would be a good thing. The amendment must provide some sort of exemption for small-scale or semi-commercial geothermal facilities should they become viable in the future. With that, I finish the Greens' remarks on the bill.

Debate interrupted, pursuant to standing orders.