Northern Ireland Assembly

Committee for Enterprise, Trade and Investment

# OFFICIAL REPORT (Hansard)

## Electricity Policy Review: B9 Energy Group

7 October 2014

# NORTHERN IRELAND ASSEMBLY

# Committee for Enterprise, Trade and Investment

## Electricity Policy Review: B9 Energy Group

7 October 2014

**Members present for all or part of the proceedings:**
Mr Phil Flanagan (Deputy Chairperson)
Mr Steven Agnew
Mr Sydney Anderson
Mr Gordon Dunne
Mr Paul Frew
Mr William Humphrey
Mr Fearghal McKinney

**Witnesses:**
Mr David Surplus B9 Energy Group

**The Deputy Chairperson:** Briefing the Committee from the B9 Energy Group is Mr David Surplus. You are very welcome, David. Do you want to make your opening statement, and we will follow up with some questions?

**Mr David Surplus (B9 Energy Group):** OK. Hello, everybody, and thanks for inviting me. I would like to open by reminding you about B9 Energy and the relevance of what we have done in the past. We started in 1992 as a wind farm developer. We were one of the most successful of the early pioneering companies and built 10 wind farms altogether in Northern Ireland. In 2006, we recognised that onshore wind farming had ceased to be entrepreneurial — the best sites had gone, there was more competition, it was a bit more difficult to get planning permission and grid access was becoming difficult — so we sold that company and cashed out of onshore wind development. We put the proceeds from the sale into the other emerging renewable energies. We built an anaerobic digestion plant and are commissioning the large digester at Dungannon, which is the largest on the island of Ireland. We also invested in developing solar photovoltaics (PV) projects. We also recognised that energy storage would be needed in the future: the higher and higher penetrations of intermittent renewables on the grid meant that, sooner or later, we would have to store a lot. We also developed an interest in offshore technologies and have worked up projects for tidal energy on the north coast and for offshore wind. We are part of the First Flight Wind consortium that holds the Crown Estate licence for developing the offshore site off the County Down coast.

The recent figures from the Department of Enterprise, Trade and Investment (DETI) suggest that there is a chance of significant curtailment of wind power by 2020 — maybe even up to 9% of delivered energy — because of the lack of load at the times when the wind is blowing. For a very large project like offshore wind, that is a potentially significant barrier to investor confidence etc.

We set about trying to define which of the energy storage technologies would be the most useful in smoothing out the intermittent renewables in the Northern Ireland context. We conducted four years

of in-house research on batteries, compressed air, electrochemical processes, electrolysis, hydrogen methanisation and ammonia. We looked at all of those techniques. We also looked at how to convert electrical energy into heat and at electrode boilers, heat pumps and large-scale water storage. In trying to establish the balance between load and generation, we quickly realised that a new technique of microgrids emerging in the United States, Germany and Denmark would be relevant for the deployment of energy storage. In fact, microgrids need energy storage as much as energy storage needs microgrids, and renewables need the whole lot.

Our energy storage company has now gone down the road of trying to understand how microgrids work — what they are for a start — and how best to try to deploy them in the Northern Ireland context. We really are looking at everything, starting from a domestic house with solar panels on the roof that currently exports all its unused power to the grid. We are looking at allowing it to hold on to some of that power in a battery and use it after the sun has gone down. The investment in an energy storage battery would be justified by the avoided cost of importing power from the grid. Moreover, it is lawful to run a private line to your next-door neighbour, join hands with him and work together. You might have a big roof and no power; he might need a lot of power but have no roof space. So the two of you would work together. That is the first point at which you would consider forming a microgrid.

We are working on a microgrid for the Willowbank industrial estate in Larne, and it will be a grouping of five or six firms. They all have different power requirements and different areas of roof that would be useful for solar. We are trying to integrate them all. We are working with Coleraine Borough Council on a very large-scale urban microgrid and with the Down District Farmers for Renewable Energy, a local community group, on a large-scale rural grid network at Lecale in County Down.

There are difficulties with microgrids, of course, but they promise to strike a much lower price for electricity than you currently have to pay to the main system. A load customer would not pay as much for their electricity, and a generator connected to a microgrid would be paid more for their electricity than the current offtakers pay. So it is a win-win, irrespective of whether you are a load customer or generation stakeholder. Both would benefit.

In Germany, the preference is for social enterprises as the ownership model for microgrids. We have teamed up with the Larne Enterprise Development Company Ltd (LEDCOM), a social enterprise specialist, and are looking at how we can establish the governance of microgrid companies. They would be limited by guarantee, probably have charitable status, and they would be social enterprises. That way you would get the buy-in from the various authorities, including the planning authorities, and gain the confidence of the industrial and commercial customers who would become part of the network.

We are intentionally leaving out the domestic sector from microgrids at the moment because you cannot really rely on them as a source of long-term power purchase agreements. However, once a project is across the line, is financially closed and at construction phase, you would then go to the domestic sector and sell them power. That would be on a shorter-term basis and done through the social enterprise mechanism as a way of reducing fuel poverty. People's ability to pay their bills would be determined and a price given to them that would allow them to have affordable energy. That gives the industrial and commercial stakeholders in the microgrid a good route to corporate social responsibility, which they are very interested in.

That is where we are at. I know that you have some questions, and I am happy to answer them as best I can.

**The Deputy Chairperson:** Thanks very much for the presentation, David. What is the potential scale at which microgrids could operate here?

**Mr Surplus:** On the urban side, the microgrid proposed for Coleraine would contain about seven miles of buried cable, and in the same trench will be a heat pipe. That microgrid would link all the industrial estates, the hospital, the university and the town centre traders under one system. It would have a 33,000 volt network and connect to a 110 kV substation. That is the footprint of an urban system. In rural environments, we were very keen to see the regulations for the single electricity market (SEM), a provision called a demand side unit that allows third parties to take control of the 11 kV networks.

It is not yet fully developed and cannot be done today. However, we thought that, with a bit of development, it would be a good mechanism whereby we could take on board the monitoring and control of 11 kV rural networks and establish those as part of the microgrid. It would terminate at the

33 kV substation. If we were to do that, we would be able to do it another 69 times because there are about 70 such rural substations in Northern Ireland.

**The Deputy Chairperson:** At what capacity could the microgrid that you propose for Coleraine operate?

**Mr Surplus:** We do not know yet. We are writing the strategy document and will present that to the council in November. Provided the council accepts it, we move to the technical and commercial feasibility. Eventually, we would work up an economic appraisal in readiness to send to funders, both public and private, to try to get the money together to build it. In theory, the microgrid would take in just about all of the existing loads in the town.

**The Deputy Chairperson:** In a best-case scenario, how soon could it be up and running?

**Mr Surplus:** I do not really know. It would depend on the complexities of the necessary permissions, wayleaves and planning, as well as the level of support from the local community and the council. So far, this has not really been done in the UK on this scale. It has been done in other countries quite successfully, and we are trying as best as possible to use models already developed in Germany and Denmark, for instance, and adapt them for Northern Ireland conditions.

**The Deputy Chairperson:** You talked about 9% curtailment. Is that for onshore and offshore wind?

**Mr Surplus:** I cannot remember, but it is a big number and way beyond the difference been profit and loss as a wind farm owner-operator. Therefore, a very serious question in the future is whether wind projects will be viable, because power purchase agreements with the offtakers of energy would contain a clause saying that the wind farm is subject to curtailment from time to time. It would not be prescriptive about when it would happen or how long each episode would be. All that it would be able to say is that, over the life of the wind farm, the problem would steadily worsen.

Northern Ireland has one of the highest penetrations of wind on any grid in the world, so we are beginning to get those problems. That high penetration has the potential to bring the wind industry to a halt. Of course, because it is the cheapest form of renewable, it is the mainstay of our moving towards our renewable targets. Rather than curtailing the wind turbines, we want to be able to put a controllable load on to the grid at the right moment and have enough of it so that we can just flick a switch and put on the load, meaning that turbines do not need to be curtailed. That would preserve the revenue streams for the wind farm owners and allow them to have fewer financeability issues. We think that the application of the load at the right moment is, therefore, a very valuable service to the wind farm industry. Of course, it will have to pay for that service. It is probably worth about one third of the revenue from the wind farms at the time when the load on demand is in place. For an offshore wind farm, the fee for providing the load on demand might be around 5p a unit. At the same time, the energy storage, or load managing, company would have to buy its electricity from the single electricity market. However, at the point of curtailment, the market price comes right down to its minimum to try to dissuade new generators from coming on. Therefore, you would be buying your power at 2p or 3p at the same time as somebody was giving you 5p for the service that you were providing. So, to an energy storage company, it could be a negative net cost of electricity. If you start putting that into the economics of batteries, isothermal compressed air energy storage and even into electrolysis, you begin to see that, in this new world, there is a type of economic driver that did not exist in the past. We are trying to identify that, characterise it, quantify it and convert it into revenue streams that would help to monetise the technologies so that we could bring these projects to market.

**Mr Frew:** Thank you very much, David, for your information so far. Your presentation was very informative and very impressive, and you gave it without notes, which is very good. You certainly know what you are talking about. I am intrigued by the concept of microgrids. I certainly have a thirst to learn more about them. Maybe the Committee should look at researching the best models around the world at present. I understand the concept and the rationale, but I still cannot get into my head how it works in practice. I assume from your presentation that, to some degree, you work on that as you go along because it is not yet a complete science. Say, for example, that an 11 kV grid supplies everybody. You have a microgrid and want to lay an almost parallel circuit to pick up everybody in a town the size of Coleraine, and you also want to take control of the 11 kV system. How do the cabling, switch gear and technology work in practice? How can your circuit operate parallel to the grid as we know it?

**Mr Surplus:** There are different types of microgrid. One is off the grid, which is autonomous and separate from the grid. It would be for an area such as a small island and is sometimes called an islanded system. It is self-contained and does not use the existing grid at all.

Another type is a grid-tied microgrid, which sometimes acts on its own and sometimes is connected to the grid so that power can move from the microgrid on to the main grid, and vice versa. The amount of energy transferred across that grid tie is determined by two things: the maximum import capacity (MIC) and the maximum export capacity (MEC), which are different. The existing grid was designed for one-way traffic from the central power stations to all the loads distributed at the end of the 11 kV networks. It was not designed for generators to be embedded into the 11 kV network. If you have an existing grid connection, you can use it up to the maximum import capacity any time you like as long as you are connected and everything is safe. A microgrid would want to do that because most of the wind farms are out in the west of Northern Ireland. They connect in at up to 110,000 volts, and that power can make its way over to the east. So, if you had a microgrid in the east, it could organise itself to put its loads on to the grid at the right time, when the wind was at its peak, and allow the turbines to continue running so that they would not be curtailed. You would import off the grid up to the maximum import capacity every time that happens.

When the wind dies down, that routine comes to an end until the next time. You then batten down the hatches: you have stored some of that energy and converted it into heat. You have compressed air tanks and full batteries, or whatever, and you start to use that internally, not with the grid in mind. You try to consume it in a managed way. Then, if you get to the point at which you are also generating on the microgrid — you might have solar panels and wind turbines connected to your own cables — you might want to export on to the grid, but you really want to avoid doing that because you do not get much money for it. Also, it means that, at another time, you would have to buy from the grid at a high price. Part of the economics of the microgrid is displacing the need to import high-price power off the grid, so that avoided cost is the economic driver. So, you are really looking at one-way traffic off the grid with the minimum possible going on to the grid, and anything that does go on to the grid would be at the peak time of day, between 4.00 pm and 8.00 pm, when energy prices are high. Then the energy storage plant can get involved with arbitrage, which is buying energy cheaply and selling it at a high price. That is one of the tenets of the economic viability of an energy storage project.

A third type of microgrid is one that is on the grid. Commandeering may not be the right word, but you utilise the existing 11 kV network as if it were a microgrid and manage it in a way that microgrids are managed. You use the same technology. In fact, the technology for managing a microgrid is exactly the same as the technology for managing the main grid anyway. General Electric (GE) has its UK headquarters in Bracknell, London, where it demonstrates all electrical control systems for 110 kV and the 33 kV systems. It does that for just about all of the utilities in GB, and it does some work here in Ireland as well. GE would simply give you an 11 kV version and monitor the voltage, principally, and the frequency on the system and ensure that the generation and load were always in balance. It would do that not only by curtailing the generators, which is one method, but that is the last option. Before you do that, you put as much load on to the system as you can, and the secret is to have as much controllable load as you possibly can.

That is where Coleraine is so good, because it has the River Bann and a heat pump that would produce a lot of background heat for a district heating system taking in the whole town. On to that exact system, you put electrode boilers, which are very small and cheap but consume vast quantities of electricity to produce great quantities of hot water in a short time. They can keep going hour after hour after hour. It all depends on how big your water tanks are. In Coleraine, we propose to put in something in the order of 20,000 tons of hot water in five big tanks, each 20 metres in diameter and 20 metres deep. That very large thermal store would heat the town for days on end, even when the wind dies down. Coleraine is also particularly attractive because it has tidal farms feeding into it. Although intermittent, they are completely predictable, and there will be times when there is just too much power coming from the tide, and Coleraine would act as a sponge and soak that up.

**Mr Frew:** So you need technology, storage capacity and generation, whether from solar farms, wind turbines, tidal or thermal, all of which come at a cost. Who pays for it?

**Mr Surplus:** Broadly speaking, it is about the infrastructure: cables, wires, transformers, pipes, tanks, conversion devices, batteries and storage tanks or air. In Germany, microgrid companies are established as social enterprises, with, typically, a council and an electricity utility company coming together. All other stakeholders, be they load customers or generator customers, become shareholders in that social enterprise company. The company would then develop, own and finance

the project, meaning that people connecting to the network do not have to pay for the capital expenditure or the grid connection.

**Mr Frew:** What about with standard controls and rules of engagement, for want of a better word? Here in Northern Ireland, there is periodic price control, and NIE is a massive instrument in that, as is the System Operator for Northern Ireland (SONI), in monitoring and controlling the grid. Where do they fit into it all? Where is the cost burden or profit for them? What part do they play in the infrastructure?

**Mr Surplus:** If a 33 kV private network is built as part of a microgrid, it has to be handed over to NIE to be the owner-operator. NIE would be responsible for it, and it would become its asset, but the trading over that network would be done by the microgrid company. The control system would have to meet the approval of SONI and all the other grid codes. It would all have to be approved and be compatible.

**Mr Frew:** Did the Utility Regulator miss a trick in the most recent price control with microgrids? Was it aware of microgrids in the most recent price control? Was that a factor?

**Mr Surplus:** I do not really know about that. We have been looking at microgrids for about three years now. That is fairly normal for the UK. They have been around for a few years longer than that in Germany, Denmark and the United States. It is all new stuff. A lot of people need to get up to speed before we can press any "go" button. Of course, that is what we are trying to do now.

**Mr Frew:** Chair, I think that Fearghal wants to come in with a supplementary question, but my last question is on the Frost Valley project in upstate New York. Are you aware of that project?

**Mr Surplus:** I am not.

**Mr Frew:** My question is this: would having microgrids here be more to do with security of supply or more to do with the cost and generation of electricity?

**Mr Surplus:** In my book, it is to do with avoiding the curtailment of wind farms. Of course, microgrids offer a duplicate source of energy to people who are concerned about security of supply and reduce the cost of energy to industrial customers, who are the ones particularly affected in Northern Ireland at the moment by high prices.

Microgrids will solve different problems for different people. In the United States, it is about resilience, because of storms like Hurricane Katrina coming through. Where there is a tendency for there to be blackouts, only parts of the grid will go out, while other parts will be preserved. America is also very concerned about the threat of terrorism. Some of the big central substations could be taken out, which would black out large areas.

**The Deputy Chairperson:** David, do you have any idea what financial savings a microgrid could offer against curtailment costs?

**Mr Surplus:** For the wind farm owner, it means that you would continue with your revenue streams.

**The Deputy Chairperson:** No, I mean from the point of view of an electricity consumer.

**Mr Surplus:** I do not really know what the overall effect would be. What I do know is that we would see more of our home-grown energy used, rather than not used. That, in the round, would mean that we would import less gas to the power stations.

**Mr McKinney:** This is just a small point, but it was raised last week, and it could be a big point, depending on what way that you answer. If a microgrid is off the grid, that advantages, for example, Coleraine, but it disadvantages consumers elsewhere, because we will still be left with the bill for the connections etc, which Coleraine is not now paying for. In the narrow sense, it is valuable for the locale, but, in the wider economic sense, it still has the potential to disadvantage, does it not?

**Mr Surplus:** I come back to the point that I made that we would still be using the existing grid to a large extent to pull in wind off the system when turbines would otherwise be curtailed. There would be

that one-way traffic of energy into the microgrid, on into the future. That would allow more turbines to be built. When it is windy, those grids would be fully utilised in the way in which they were originally intended to be used. There are no real restrictions on that. We would be sucking all that power into the microgrid and holding on to it. Then, when the wind died down, we would try to use it.

You are right that, at that point, we would not just be taking it off the grid willy-nilly but be using our own microgrid sourcing. If we had excess energy stored up, we would want to export back out on to the grid between 4.00 pm and 8.00 pm when the prices are high. That would mean that the Ballylumfords and Kilroots of this world would not have to carry so much spinning reserve for that peak in the evening. A microgrid would reduce the peak of generation in the evenings. Those are some of the benefits that we would give back to the main grid.

I understand what you say. There would be an element of those customers who found themselves without the benefit of a microgrid having to begin to shelter quite a bit of the grid's running costs. It may not be as big an effect as you first might think. Of course, part of the feasibility studies would have to go into all of that and define and quantify it. At the moment, it is all kind of conceptual. If it did have the effect of putting electricity prices up, all that that would mean is that it makes it more viable for people to go down the microgrid route. They could do that in the context of their own house as well.

Companies such as Bombardier have now decided that they should do this themselves and effectively form a microgrid. I do not know whether they are calling it that, but effectively what they would be doing is taking their energy provision into their own control. For other companies, if the electricity price continues to go up at 7·5% a year, which is much more than the retail price index (RPI) — our power purchase agreements (PPAs) in a microgrid are index-linked for 20 years, and there is only RPI uplift — more and more businesses will make the decision to go down that route either on their own, in their industrial estate or in their town.

**Mr McKinney:** In the absence of analysis, what you are saying is that there could be a big impact on the widest population not on that microgrid, notwithstanding what you are saying about the flows backwards and forwards, work to be done, modelling, etc. The concept of Bombardier leaving has an impact. The concept then of a load of people leaving has an impact on all those who cannot leave, because they do not have the connectability, the resource or whatever.

**Mr Surplus:** I think that it is right to say that it has an impact. The impact, in our view, has not really been explored properly yet. We need to determine whether it is true to say that there will be a big impact.

**Mr McKinney:** Those are important questions to answer, and should they not be answered before the development of other systems? Should the modelling not be done first to allow people to make confident decisions? The discussion that we had last week was on government's responsibility to look after the widest population and to ensure that the system is robust, in that it has the strength to take load, and all the rest of it, and is economically viable for as many people as possible, thus opening the door for everybody to take the low-hanging fruit, if you like. That is a pejorative term, but you know what I mean. It would allow people to take the advantage for themselves. Otherwise, from a social-justice perspective, swathes of the population would be unable to make decisions when faced with a bill.

**Mr Surplus:** I accept that a lot of analysis needs to be done. All sections of society need to become involved in that. The only way in which we see that being done is through pilot projects and by trying to use the project environment to flesh all of that out. All the approvals that we need to go through allow everybody to ask those questions and get the answers that they need to hear. The industry is certainly minded to go down that route now. Of course, it does have a social agenda, but it is not perhaps at the top of its list.

**Mr Dunne:** Thank you very much for coming in. I understand that NIE is issuing revised heat maps, and we have heard a lot about the need for them. What is your opinion on that? Do you think that they will help developers with their decision-making for future projects?

**Mr Surplus:** The heat map is really a visual representation of the modelling that NIE does on its system to show what effect there would be on voltage and thermal ratings when generators are applied or not applied. Rather than having to ask NIE every single time about every single case, the heat map has been a useful tool for developers. From the colour on the heat map, they can make a

decision without having to ask NIE. Therefore, it saves time and effort on the part of NIE and the developer. Most developers have to recognise that they take a development risk, as there are no guarantees that their project will be built, and there are a lot of hurdles that they have to get over. Developers would have to understand the constraints that there are with grid connection and take a view as to whether they want to develop a particular project. The heat map is a very valuable tool with which they can begin to do site selection.

**Mr Dunne:** What about your experience with NIE? How have you found it with regard to renewable projects and making connections?

**Mr Surplus:** We have worked with NIE for 20-odd years. All our wind farms are connected to the NIE system in the North. We have had a very good working relationship with NIE, and we have sat on various committees together. From an engineering point of view, we have had no difficulty with it. NIE limited the size of our wind farms at the beginning, because it was not sure what effect we would have on the voltage and the frequency. However, the operating experience was that wind farms did not have such an adverse effect as NIE was worried about, so it allowed the wind farms to be bigger.

The wind farming world is fine with it, because all the clustering, new substations and reinforcements out in the west to bring on the big wind farms is a well-established process that is working very well. Some people may have issues with it, but I think that, generally speaking, it is working very well. The problem that I have noticed is that, when you come down to the smaller farm-scale devices and try to connect to the kV network, because it is dumb and blind — there is no monitoring and control — NIE always runs the risk that the voltage may rise above the statutory limit if there is too much wind at a time when there is not enough load. Therefore, typically on a summer's night, you find that there is a big risk that the statutory limit will be exceeded, and NIE is not allowed to tolerate that happening.

That is the background, but the solutions are not simple either. In some cases, the connections can be done straight away, while, in other cases, you have to put the turbine next to an existing load, such as a dairy farm or chicken farm, to try to provide the balance. However, in our Lecale microgrid project in County Down, there is virtually no prospect of a cost-effective grid connection any time soon, yet the airfield at Ballyhornan could have up to 30 MW of solar PV. It is a very good solar resource, landowners want to do it, government incentives are in place and targets are there to be met, but Lecale cannot do it because there is no grid. Rather than export the power from the site, we propose to bring the load into the site and establish chicken farms, fish farms, hydroponic —

**Mr Dunne:** On the site?

**Mr Surplus:** On the site. Bring in new agro-industry that would provide —

**Mr Dunne:** At Bishopscourt?

**Mr Surplus:** Yes, at Bishopscourt. Lighting, heating, ventilation and pumping of water need electricity, and we build up the electricity at the same time as building up the new businesses. That is really because we are not able to go on to the 11 kV network with microgrids.

**Mr Dunne:** Briefly, what would you do with any surplus electricity from that project?

**Mr Surplus:** We would put it into very large hot water tanks probably.

**Mr Dunne:** You would use it all.

**Mr Surplus:** We would use that in the fish tanks, chicken houses and hydroponic tanks, and we would also hook up to the housing developments in Ballyhornan and provide them with heat.

**Mr Dunne:** OK. Thanks very much.

**Mr McKinney:** Can I ask about the storage issue again? There is the economics argument that has been touched on around storage, but, in practical terms, how effective is, for example, compressed air storage compared with batteries?

**Mr Surplus:** There are several types of compressed air energy storage. There is a very big project being done at Millbrook in Larne by Gaelectric, which is a wind farm developer, and that is using salt caverns. A surface compressor compresses air into the ground and into the cavern that is made, and that air then comes out and goes through a gas turbine to generate electricity. Gas is being consumed, but, overall, because the compressors are running when wind farms are running, it is an environmental benefit to do such a project, but it is constrained to being put only where salt cavern reservoirs are. It cannot be put just anywhere.

The more versatile technology that we have decided to focus on is called isothermal compressed air, which is technology that is emerging now from California. It is very small in scale, but it is modular, and, like Lego bricks, it can be built up into whatever size you want. You can put it at power stations and substations, and it can be done for end users, in whatever configuration you need to get round the bottlenecks on the grid and to avoid grid-upgrading. We are talking about constraints rather than curtailment now. It is basically a device that is a compressor/expander, and, when the wind is blowing, it runs as a compressor and compresses air into a tank. It also stores the heat of compression, and that is typically where inefficiency creeps in with compressed air. It stores the heat of compression in the hot water tank, or warm water tank, and then, later in the day, from 4.00 pm to 8.00 pm, the unit becomes an expander. It takes the air, the expander drives a generator, and you export on to the grid. To prevent it freezing into a block of ice, you use your warm water. There is 95% thermodynamic efficiency, and that means that you are getting very high return-trip electrical efficiencies of around 60% or 65%. If you locate links to a waste heat source and make the warm water into hot water, you can increase the efficiency further. We are looking at doing trials at Lecale and Coleraine with isothermal compressed air.

There is adiabatic compressed air as well, which allows the temperature to rise up to 400°C. You still store the heat, but you are storing it in molten salt rather than warm water. The two are just different technologies. They are competing against each other to get to market first, and we are talking to both industries. The projections are that the cost of energy storage through that method would be about half the price of electrical/chemical batteries, and the beauty of that is that you disassociate power with energy storage. For instance, in a battery, if you want more energy storage, you have to have more power. If you want more power, you have to have more storage capacity. They are inextricably linked, whereas, with this, you have the compressor/expander, which is your power unit, and you can make that whatever size you want. Your energy store is just tanks and pipes underneath the ground, and you can make as many of those as you like. It is very important for us to match the storage capacity to the length of time that the wind farms run for. They can run for 24 hours at full power. It does not happen that often, but it does happen. It is no good your batteries being charged after one hour or two hours. What are you going to do then? You will still have to curtail the turbines anyway. We need something that you can keeping running hour after hour after hour. Isothermal compressed air allows you to do that. The energy then comes back as electricity. If you have electrode boilers, you can do it hour after hour, but you are making hot water, so it can never come back as electricity. You need a load for the hot water at that point.

**Mr McKinney:** I have no concept of the scale. How small could a unit be that would be still effective in delivering hours of electricity?

**Mr Surplus:** The current technology is using reciprocating compressors. A 500 kW unit would be in a 20-foot container. If you need 2 MW, you will need four 20-foot containers.

**Mr McKinney:** Is it transportable? Could you take that energy in compressed format to a site that does not have a wind farm and power something there?

**Mr Surplus:** You could in theory, but, you would not do that in practice. You would establish the power units where the grid needs them to be — where you need the load and generation.

**Mr McKinney:** You need to offload the extent of power that you have saved. You have another area that does not have a wind farm and has a weakened grid. Why would you not transport it?

**Mr Surplus:** Transport the compressed air?

**Mr McKinney:** If it were the size of a 20-foot container, why could you not put it on the back of a trailer with its compressed air and take it to somewhere that needs it?

**Mr Surplus:** You would just put another one in. They are distributed, and you put them all over the place. Wherever the grid needs it, you would put a new one.

**Mr Frew:** Travel on the grid.

**Mr McKinney:** From what you are saying, some form of the compressed air is the more efficient system for storage and return of energy at a higher level of loss.

**Mr Surplus:** Yes. The projections are that it would be more efficient and cheaper. You cannot buy the system today, as it is still being developed, but an awful lot of money is being spent on doing that. Energy storage is one of the key things for the future of the renewables industry and our whole effort to combat climate change. It must be a success.

**Mr McKinney:** It may answer some of the issues around what we were talking about earlier about the microgrid, because that is your return to the system.

**Mr Surplus:** Yes. It is just like a big spring, storing up energy.

**Mr Agnew:** Thank you very much, David. Over the years, I have been very impressed with B9. It is great to see, because, obviously, I am somebody who tries to promote the renewables industry. However, a local company is now showing that we can do it here. You mentioned the 10 wind farms that you have developed. You are part of the consortium involved in the first offshore project, and there are now microgrids as well, so you are a local company involved in innovation in a global industry, which is great to see. It is also great to see that you are successful in doing so.

The microgrid idea is quite new to us as a Committee. We are still getting our head around some of the ramifications of it. Everything to date that we have looked at has been about the big grid, with the interconnector being the huge issue, but even projecting forward, there is the idea of a Europe-wide interconnected grid. Does this in any way run contrary to that, or do you see both things needing to happen simultaneously? Is this an alternative? Could we just have a series of microgrids? Perhaps we would not need that interconnection because we could have much more localised containment, or should the two be operating in tandem?

**Mr Surplus:** They are complementary. They would operate in tandem and become part of a new hybrid system, in which you need the large-scale grid for large-scale transportation from big, central power stations, which, in theory, we still need because of inertia in the system and to keep the frequency correct. There may be ways around that in the future, but they are pretty embryonic at the moment. You need to be able to connect to the old style of centralised generation and have access to market for those power stations. At the same time, the way in which renewables are coming up now, a lot of them are distributed on a very small scale. You may as well deploy those, after you have done energy efficiency properly, and use that generation locally, because you will not then incur $I^2R$ losses from transmission distances. The efficiencies would be better if you were to use them locally. However, small-scale generators are not, by and large, as efficient as the big ones. Large wind turbines are much more cost-effective than small wind turbines.

**Mr Agnew:** When you said "centralised generation", I suppose I was thinking of fossil-fuel generators. Would you consider a large wind farm to be, to some degree, a centralised form of power production?

**Mr Surplus:** They are becoming so now. A large offshore wind farm would connect to the 275 kV network and sit alongside conventional power stations.

**Mr Agnew:** So, even if we move away from fossil-fuel generators to 100% renewables or whatever, you will still need the large interconnected grid.

**Mr Surplus:** Yes, and you would still need to use it in the conventional sense for which it was designed — the one-way traffic, and the large central generation down to the extremities of the customer base. The difficulty arises when customers try to send power back up the other way. The transformer is not designed for reverse power flowing. That is the difficulty, and we have to understand and allow for that, try to remove the problem areas and, at the same time, create new value. In a funny sort of way, out of the mist, these microgrids look like they could do that. We just need to get some projects done so that we can really get into the nitty-gritty and find out what the problems might be for universal deployment.

As a developer, we always have to ask this question: "What would stop this project?" You have to find that out as soon as possible, so that you can give up and not waste your time or money. So far, we have not come up against any showstoppers on microgrids.

**Mr Agnew:** OK. Which of your microgrid projects is more advanced and likely to come to fruition first? Is it the Lecale project, and you mentioned Coleraine? You said that you had to get one off the ground to see what is right or wrong for the others. Are any of them particularly further ahead?

**Mr Surplus:** No, they are all running fairly well in parallel. I would like to get them all done, because we have chosen different sorts. We have large rural, large urban, small urban and a sort of domestic-level thing. We are trying to get all those done, so that the representation of the market sector —

**Mr Agnew:** Which is a pilot in its own right?

**Mr Surplus:** Yes. Some of them will be more potent than others. Which one will be successful first depends, in my view, on how much drive comes from other stakeholders in the project. Coleraine Borough Council, which is driving the microgrid up there is, in my view, the most proactive council in Northern Ireland. It is seeing that bolstering its enterprise zone status with low-cost electricity, which is greener in an environmental audit and has longer-term price security, is good and will provide a differentiator in the enterprise zone arena.

**Mr Agnew:** You mentioned rural, which kind of, comes back to Fearghal's point. You described that as a win-win. Our concern is that it is win-win within the microgrid, but that everybody externally loses. You touched on that. Is it more difficult to do? Would you anticipate the possible scenario of having separate microgrids for rural areas where, I think, you have a more domestic but dislocated population and no big industry and where rural areas end up paying for the cost of the larger central grid?

**Mr Surplus:** It is still difficult to comment on costs. There will be a rural problem if NIE continues to not allow microgrids to adopt part of the 11kV network. Then, farms, or agri-industrial plants such as creameries that you find in the countryside, would be fairly stranded. They would be on their own and would have to provide their own generation. It would be more like a self-generation situation, and it would only be if, fortuitously, a neighbour had a wind turbine that they would be able to hook up.

If you had a lot of people wanting to join in to that microgrid, they would all have to live next to one another so that the private line that goes from one property to the next would be uninterrupted. It would be much more difficult to see how that could completely satisfy rural demand, but, of course, it is early days in this. I fully expect that NIE, at some point, along with other distribution network operators in GB and the Republic of Ireland, will simply jump on to this and start doing it. I expect that they will bring forward projects that will utilise their networks in this intelligent way. It is not a technical challenge really because that level of monitoring control is present at 33 kV. It is just that it has never been seen as something that was needed in the first place and that was then justified. At the end of the day, there is a small number of very small generators compared to the big wind farm situation. So, it is a cost and an effort that somebody has to go to at the moment that no one is particularly minded to embrace. That will change, I think.

**Mr Agnew:** Finally, I want to come back to the issue of ownership, which I think Paul mentioned. When the UFU presented and talked about Lecale, they talked about the existing infrastructure and, effectively, using what is there. How much is this about developing new infrastructure and how much is about developing the existing infrastructure? You said that in the case of using NIE's infrastructure and developing your own, NIE and SONI would be the owner-operator. How does that work? I am not sure about ownership, who pays, and who runs the grid ultimately. We are used to NIE and SONI, and we kind of understand that. This is different.

**Mr Surplus:** Yes, and the existing situation is that if we build a wind farm with its own substation on top of a hill and then have to put in 5 kilometres of new line to get to an existing point in NIE's system, where we could either tee in to a line or connect to a substation, our wind farm project would have to pay for the turbines, the substation and the new line all the way down. We would develop that, and it would be our cost. However, from the point of common coupling at the substation on the wind farm, the NIE side of it, with its protection units, transformers, and all the rest, would be handed over to NIE as an asset. So, it comes into NIE's ownership, and NIE is responsible for its maintenance. However, we would have to pay for it in the first place. In my view, that would be true of any infrastructure on a microgrid that was at 33 kV or 11 kV. The way the regulations are, it is about the body tasked with

keeping health and safety correct, and it would have to do that. You cannot argue with the regulations on health and safety regarding electricity. It is very dangerous stuff.

The project would pay for it, but it would go into somebody else's ownership in the fullness of time. If some of these pieces of cables and wires go across stakeholder boundaries, they can be in private ownership. They are behind the meter. It is just like if you want to run some extra cables from your house down to the bottom of your garden for a summer house. You can do that, and you do not have to tell NIE about it. You have your meter and you have your fuses, and everything is OK. Similarly, a large industrial complex could put in new load and new generation. As long as it is all protected by the G59 relays for over-under voltage, over-under frequency and rate of change of frequency, then the grid is protected against any fault you might create. For instance, there is a 500 kilowatt wind turbine at the Antrim hospital, and everything it generates is absorbed in the hospital. It never exports to the grid. Therefore, the hospital's grid connection did not have to change.

**Mr Agnew:** Is it just when it hits the substation? I am still trying to understand when NIE says it is theirs. You used the example that it can run between two neighbouring farmhouses and that that can be done privately. I suppose, essentially, it is when you connect into the main grid, and there might be a two-way connection. Is that it?

**Mr Surplus:** Yes, I think that 11 kV would be the threshold.

**Mr Frew:** Just on that, there was an issue around dual connections, particularly for farmers who had a turbine, which was that you cannot have two connections — one grid connection and a connection from another source — due to health and safety reasons, because if something had to be isolated, there would still be a live feed. Has that been resolved? It was not so much about ownership; it was a health and safety issue. The Ulster Farmers' Union told us last week that it was resolved, but I am not sure how or when it was resolved.

**Mr Surplus:** I do not have any experience of that. I know that the farming world had to make a separation between farming and non-farming activity to attract grants.

**Mr Frew:** The same principle will apply here. If you have another grid, and the load is going in and out of houses, factories or whatever, and there is a dual connection as opposed to the ordinary grid, you will still have the same health and safety issues.

**Mr Surplus:** Yes, absolutely, but the responsibility for health and safety would lie with the microgrid company on the private network side, behind the NIE meter. The point of transfer of responsibility is at the G59 panel or at the point of common coupling to the grid. That is how health and safety would be demarcated. Both parties have to comply with the grid code and all other relevant regulations.

**Mr Anderson:** Can I ask a quick question? I am sorry for having to nip in and out. What is the utility operator's position on this whole thing? Does it have an opinion?

**Mr Surplus:** I think it is generally supportive of the view that microgrids have the potential to provide some benefits and solve some problems and is open to support proposals that come forward in any way it can. There has been a series of conferences on microgrids in Belfast in recent years called Acumen, and they have been very well attended by distribution network operators from GB. It is a very high-profile event, and the regulator's office was present at last year's conference. We heard presentations from microgrid operators in New York city, Austria and Denmark. All the people who were there were thinking that there is something in this. I am sure, like everything else and everybody else, it is still early days. We are all just trying to understand how to get this thing to move in a way that suits everybody, that there are only winners and that there are really not any losers. If there are people who lose out, then there are fights and disagreements, and that is counterproductive to getting where we need to be, which is a much higher penetration of renewables on the system so that we can meet and exceed our targets and help to solve climate change.

**Mr Anderson:** I think that I said utility operator when I meant the Utility Regulator, and you picked up on that. Do you hope to have more conversations with the Utility Regulator as this rolls out and as you bring it forward?

**Mr Surplus:** Yes.

**Mr Anderson:** You said that the regulator is sympathetic to the process as a way forward. How much more conversation do you hope to have?

**Mr Surplus:** Provided that Coleraine Borough Council approves the strategy document we produced for it, we will be tasked with socialising the report to the various stakeholders, including industrial people, commercial people and residents' associations in Coleraine. We would also go to the Utility Regulator, NIE, and others who would have a bearing on the successful outcome of the project.

Socialising the report would be a two-way discussion with the regulator. It would be to say what we feel could be done, based on the examples from Germany, in particular, and Denmark, and give our take on the opportunities that are on the ground in Coleraine, some of the shortcomings we foresee already and the barriers to doing it that we identify. We would then let the regulator come back to us with more questions. The next step includes technical and commercial feasibility. We need to populate a big list of tasks that the feasibility study would undertake. The regulator is very welcome to define a lot of the challenges and questions that we need to ask ourselves. That is, you could say, consultation.

**The Deputy Chairperson:** David, will you tell us a wee bit more about Project 40? The Ulster Farmers' Union raised it with us last week and it is something that members would like to gain better insight into.

**Mr Surplus:** I have not had any direct involvement with Project 40 and do not actually know the full technical details of it. Like you, I have heard about it second-hand through the Ulster Farmers' Union, which is involved in the project. From the outside, it looks to me as if it is really a question of curtailing the smaller embedded generating wind turbine. Of course, in any microgrid situation involving those machines, if you get to the point where you have not got a load to put on to the grid to make the balance happen, you must curtail the wind turbine. So, every microgrid will have a piece of logic to say, "switch the turbines off". Self-curtailment will be in it. Project 40 looks like it is going to do just that bit of microgrid logic, where, if the voltage rises to some threshold, you can switch it off. That would be a welcome step forward. It would allow some more turbines to have connectivity. Whether it goes far enough to satisfy all farmers who are currently stranded remains to be seen.

**The Deputy Chairperson:** How advanced is the project in Larne?

**Mr Surplus:** At the moment, Larne is applying to do a scoping study through the INI collaborative network programme. The stakeholders involved, including several factories, would apply for funding to form a collaborative network. That gives a background piece of money to start looking at how the project could be defined. It would pay for some days of consultancy in each of the factories to look at load profiles, energy usage patterns and things, and at beginning to flesh out how long a cable would be and what storage methods would be used.

A fundamental question is this: do you want to have autonomous capability? We heard from the regulator in DETI a few months back that, from 1 January 2016 — when there will be a change in the situation at Ballylumford, with three final sets going into retirement; when there will be a restriction at Kilroot, due to the large combustion directive; when the North/South interconnector will not yet be live and when Moyle may still be running on 50% capacity — the reserve generation in Northern Ireland will be pretty thin and, they say, there will be a higher risk of blackouts. If you are an agrifood company with full fridges and lorryloads of meat, you cannot afford to have outages like that. A microgrid can be designed to operate autonomously so that, if the main grid has a blackout, you would open the breaker where you connect to the main grid, and the microgrid can be kept live. It would have its own diesel generator backup, as well as batteries and things, to ride through the period that the main grid is blacked out. We would be trying to get those definitions into the Larne specification very soon.

**The Deputy Chairperson:** David, thanks very much. We might put some questions to you at a later stage. Would you be happy to answer those in writing?

**Mr Surplus:** Yes.

**The Deputy Chairperson:** Thanks a million.