

# Electricity Grid

**Lisa Rutledge**

Electrical infrastructure is an indispensable vertebra in the backbone of every developed country in the world. Our ability to transport electricity through a transmission and distribution network, or grid, is vitally important to our sustained development and growth in today's technology-reliant society.

While most of us could survive without electricity in our homes, regardless of the inconvenience caused, prolonged or regular power outages would, undoubtedly, darken our economic horizon. Electricity plays a crucial role in hospitals and traffic control as well as in countless other systems. Take the investment by large multinational companies in Ireland for example; the electricity infrastructure on the island is critically important to the success of their businesses. Companies, particularly those in the high-tech industry, depend on a reliable and sustainable supply of electricity every hour of every day to power machinery, computer servers, lighting and so forth. The reliability of a power supply is one of the key criteria multinationals consider before setting up in Ireland and so it is critical that we grant it due consideration.

Ireland is considered world-leading in wind energy integration, however, factors are emerging that could potentially impede this, and other, development in the Irish energy sector. Some of the challenges we must tackle in order to protect the future sustainability and reliability of our electricity supply are: Increased public pressure on grid operators to lay power cables underground; Technical implications of increased renewable penetration on the grid; Recommendations to freeze capital investment in grid development.

## Underground cables

In accordance with the laws of physics, high voltage transmission lines are the most efficient way to transport electricity around the country. While there are some short stretches of underground cable in cities and other locations overhead lines are not viable, the network as a whole operates as an overhead system. Despite their importance to our electricity system, in recent years, arguments have been made against overhead transmission lines.

Few would disagree that pylons and overhead lines are unsightly. However, the same point could be made against motorways and trucks for transporting goods, yet no one denies their priceless role in the operation of the country.

Some are concerned that the general public are at risk from the line's electric and magnetic fields (EMF). Extensive research has been undertaken into the effects of high voltage lines in past decades, yet there is no conclusive evidence of a risk to health. Both overhead and underground technologies in operation in Ireland comply with all national and EU guidelines on the exposure of the general public to EMF (Parsons Brinckerhoff Comparison of High Voltage Transmission Options Report). In fact, according to the independent, Ecofys report, commissioned by Irish government in 2008, magnetic field exposure directly under a transmission line is generally 80-90% lower in Ireland than the maximum levels recommended in the World Health Organization guidelines. There are many high voltage lines existing in Ireland at present and have caused no recorded harm where not interfered with.

While laying an underground cable can, on average, cost between 4 and 7 times the price of installing overhead transmission, cost is not the only issue preventing the widespread burying of transmission cables.

The following are some of the more prominent issues;

- There are very serious technical issues associated with undergrounding cables. Many experts agree that underground electrical systems are not as reliable as overhead systems. Energinet.dk, the Danish transmission company has clearly and unequivocally stated that it could not, in the present state of knowledge and technology, build long lines underground.
- Due to the increased risk of system instability associated with burying long lengths of cable, no other country in the world has an extensive underground network (longest stretch of underground cable is ~40km). If Ireland were to pilot such a project there would be a high risk that our electricity supply would be viewed as less reliable than that of our EU counterparts. As a result, our economy would risk significant diversion of investment by multinational companies. Ireland could be viewed as a "risky bet" for investment with potentially detrimental results for our already bruised economy.
- If a fault occurs in the transmission system, overhead lines can be fixed within a matter of hours. Underground cable repair could take days, if not weeks, resulting in massive disruption to customers both domestic and commercial.

## Effects of renewable energy development

Renewable energy is a relatively new business in Ireland and has sparked the interest of the general public in many issues relating to Ireland's energy future. One of them, security of supply, is particularly important. Ireland, due to its island status and lack of indigenous fossil fuel resources, relies heavily on fuel imports to power the country. As a result, we are vulnerable to volatile gas and oil prices and political instability in exporting countries. This issue, along with the world wide need to reduce CO2 emissions, is one of the main driving forces in Ireland's quest to exploit our own natural resources.

It is internationally recognised that Ireland has the potential and expertise to be a world leader in the renewable energy industry thanks to its geographical positioning. The New York Times recently carried an article citing Ireland's latest record-breaking high wind energy penetration. The west of Ireland has wind and wave resources envied by many of our EU counterparts and so the obvious step forward is to take advantage of these sustainable resources. This high penetration of renewable energy is uncharted territory for any country in the world and so there are new obstacles we must overcome before we can capitalise fully on this resource.

When our national transmission network was first built, the electricity needs of the country were minimal. As the demand increased, more fossil fuelled power stations were built and the grid was expanded incrementally, like building extensions to a home. This, at the time, was an effective short to medium term solution to the issue at hand. In recent years, however, as wind power has become a significant contributor to our electricity supply, the dynamics of the grid are changing. These changes are bringing with them technical implications for how the system works. Additionally, wind, by its nature, tends to be stronger in sparsely populated areas and so transmission is needed to transport electricity from rural areas, plentiful in wind power, to the large load centres in towns and cities. Due to the shift in generation to significant renewable penetration the transmission system is under pressure and is in need of reinforcement.

## Capital investment in Energy

Not even the electricity sector has escaped the effects of this recession. There has been a notable decrease in demand for electricity in the country over the past few months due to the economic situation and as a result the Irish Academy of Engineering has suggested that capital expenditure in the sector should be diverted to other projects. In 2007, prior to the damaging effects of the economic crisis, it was broadly acknowledged within the

electricity sector that Ireland was struggling to meet electricity demand. The transmission system was old and under pressure. It is widely thought that without the current reduced electricity demand, we may have had difficulty in maintaining a reliable supply of power to consumers. Now that the recession has hit, the "pressure is off", however, instead of using the time wisely to strengthen our system, it is being suggested that investment is no longer necessary.

While it is tempting to freeze capital investment in transmission during this difficult economic time, we must analyse the situation strategically. The economic crisis must be granted due consideration, however, we cannot afford to disregard the energy crisis. Historically, in Ireland, electrical, infrastructural developments have been particularly time intensive due to stringent planning laws and public opposition to transmission lines. If we freeze capital investment now, any attempt to restart such a significant investment would face significant challenges. Although electricity demand in the immediate future is expected to be lower than originally forecast, it *will* pick up again and the short term view to divert investment from the sector seems almost recklessly short sighted. If sufficient investment is not made now, we may well find that, when the economy recovers and electricity demand grows (growth further fuelled by a shift to electric transport), we will be unable to exploit our wealth of natural sustainable resources because the grid is not in place. Such inaction could well cost our already damaged economy when the clichéd green shoots of recovery begin to sprout in the next few years.

The national electricity grid is a key infrastructural element in our islands electrical reliability, sustainability and overall economic security. While there are inconveniences associated with its expansion (e.g. cost, aesthetic impact and so forth) we simply cannot afford to allow these to hinder our country's development. Ireland has the opportunity to take the lead in the energy industry when this global recession eventually subsides. The crucial investment and strategic decisions must be made, by both government and industry, *now* to ensure pole position in the future when the race to recovery begins.

*Lisa Rutledge is a 4<sup>th</sup> year Electrical Engineering student at University College Dublin and a member of ENI 2009, an undergraduate summer research project team.*

<http://eni.ucd.ie>

