Transmission of electricity. March 2014.

It is accepted that the proposed Grid projects may be completely unnecessary but that is a separate discussion. To quote the CEO of the United States' largest energy company ("NRG") last week: "think how shockingly stupid it is to build a 21st-century electric system based on 120 million wooden poles."
Notwithstanding all of this, the following is an attempt to provide information on the underground transmission of electricity.

There is presently a lot of discussion, confusion and incorrect information concerning the **transmission** of electricity - that is to say the transmission of electricity from source of generation to a substation or from one substation to another. [From the substation to house, factory etc is termed **distribution**.]
Regarding the transmission of electricity there are two methods i) overhead via high voltage powerlines using pylons or wooden poles and ii) underground via cables.
It should be noted that presently electricity is transmitted and distributed in alternating current (AC).
It would be unusual in Ireland to transmit direct current (DC) via overhead lines. However the transmission of electricity in DC format is perfectly sensible and is in fact is the most efficient way; it simply needs to be converted to AC in order to distribute it to houses, factories etc.

Underground Transmission

Regarding underground cables there are two types of cable namely

- **AC** (alternating current) cables [see **Europacable Myths & Realities** on www.safelines.ie for more information on transmission of AC]
- **DC** (direct current) cables.

There is a lot of discussion presently about underground cables overheating, being unreliable and continuing to transmit EMF. To clarify this we can state that this could be true if the reference is to underground **AC** cable. In the case of this underground cable, one of the types used nowadays is XLPE (cross linked polyethylene). This cable is copper core, extremely heavy, difficult to install and is really only suitable for short distances underground. However, the **latest** technology in underground cable is high voltage (HV) direct current (DC) cable called 'HVDC Light' and its use can eliminate all of the problems caused by using AC underground cable .

HVDC Light is the most interesting power transmission system developed for several decades. It is a state - of - the art power system designed to transmit power underground and under water and over long distances. It offers numerous environmental benefits, including invisible powerlines, neutral electromagnetic fields, oil free cables and compact converter stations. It increases the reliability of power grids, it is quick to install and provides an alternative to AC transmission systems. HVDC Light cables are light strong, robust and therefore particularly well suited to severe laying conditions both underground as a land cable or along the seabed.

It is now technical feasible and economically viable to expand transmission capacity using underground HVDC Light cable. This not only minimises environmental impact, it also improves the quality of the power supply. It was introduced in 1997. A number of underground and submarine transmissions are in commercial operation and more are being built.

The east West Interconnector between Ireland and Wales is now in place using the *HVDC Light* technology. Ireland has plans to expand wind power generation and this interconnector will provide the ability to export energy to the UK market. [As electricity generated cannot be stored it therefore has to be used or exported]. The cable route length of the interconnector consists of 70kms cable underground and 186kms of seabed cable. The main reason for choosing *HVDC Light* cable was the distance involved, controllability and black start and active and reactive power support.

HVDC Light cables have insulation of extruded polymer. The insulation is triple extruded together with the conductor screen and the insulation screen. In HVAC (alternating current) there has been a change of technology going from paper insulated cables to extruded cables, mostly XLPE. The preference of extruded cables also for application in HVDC has been obvious for a long time. Several reports have been

published in the past, where XLPE has been tested for HVDC applications but without success. One reason has been the existence of space charges in the insulation leading to uncontrolled local high electric fields causing dielectric breakdowns. Another reason has been uneven stress distribution due to temperature dependent resistivity causing overstress in the outer part of the insulation.
The HVDC Light cable development has overcome these problems and has resulted in an extruded cable for HVDC that is an important part of the *HVDC Light* concept. The cables are operated in bi-polar mode, one cable with positive polarity and one with negative polarity. The cables are installed close in bi-polar pairs with anti-parallel currents thus **eliminating** the magnetic fields. This also means that it is both possible and realistic to run telecommunication cables alongside i.e. to rent space to telecom services thus generating income.

Converter Station

'Electricity is converted from alternating current (AC) to direct current (DC) and vice versa in a converter station. This is done by means of high-power, high-voltage electronic semiconductor valves. Although the rationale for selection of HVDC is often economic, there may be other reasons for its selection. HVDC may be the only feasible way to interconnect two asynchronous networks, reduce fault currents, utilize long underground cable circuits, bypass network congestion, share utility rights -of- way without degradation of reliability, and to mitigate environmental concerns. In all of these applications, HVDC nicely complements the AC transmission system. The *HVDC Light* converter station design is based on a modular concept. For DC voltage up to 150kv most of the equipment is installed in enclosures at the factory. For the highest DC voltages the equipment is installed in buildings. The required sizes of the site areas for the converter stations are also small. All equipment except the power transformers is indoors. The stations are designed to be unmanned. They can be operated remotely or could even be automatic based on the needs of the interconnected network'.
(http://new.abb.com/systems/hvdc/hvdc-converter-stations)

Costs

In a document '*LIGHT and Invisible'* from ABB, it states 'increased environmental pressure on overhead transmission lines is both raising total costs and increasing the risk for substantial project delays. New HVDC technology in the form of *HVDC Light* has made underground options technically feasible and economically viable. This is especially so if the new Grid investment is driven by security of supply issues. The conventional view that an underground link will cost five to fifteen times its overhead counterpart must be revised. Depending on local conditions, it is realistic that the cost for an underground high voltage line, are equal to that of traditional overhead lines'. http://new.abb.com/systems/hvdc/hvdc-light

Because the Interconnector between Ireland and the UK is now complete and other interconnectors are planned, it would not be unreasonable to expect that these interconnectors will be used for the export of power from Ireland. This power will most likely come from wind farms and planned wind farms. While politicians and others complain about the reliability of supply in transmission, they seem to conveniently ignore the fact that the electricity in question, coming from wind farms is coming from the most unreliable source namely the wind.

Consider the following…

In the instance of a wind farm, the owner of the land leases the property to the wind farm developer for which rent is received. The developer sells the power to the national grid. The powerline is paid for by the people and is owned by ESB, who in turn rent it to Eirgrid who are the transmission operators. The power is then exported / sold on to UK and/or EU. The general public are forced to live, in a lot of instances, very close to lines and wind farms. The landscape is destroyed thus destroying our tourist industry; devaluing property; creating visual and aural pollution together with adverse health problems from EMF. The general public receive nothing in return; no indemnification; no insurance; no accountability and it is the people who have had to pay, and continue to pay, for the construction of the grid in the first instance. **Surely it is time to face facts and insist that it is the developer who must pay for the grid and not the general public.** Putting the onus on the developer would be sure to produce the most effective and efficient way of transmitting power and at the very least would elicit an independent cost benefit analysis.

In conclusion, the existing infrastructure is more than adequate for the requirements of the population especially as power consumption is decreasing (down 15% in last five years) and while politicians and others say the power is required in the regions it is acknowledged that in fact it is for export especially as it is surplus to requirements and given that it cannot be stored. In the UK they have decided to cease the construction of wind farms because of public resistance and also because they can avail of green energy from Ireland as well as the carbon credits that accompany it. Our CO_2 targets will not benefit from the export of power; in fact we will be worse off than before.

We acknowledge the website of www.ABB.com in the compilation of the above.