

Why the world needs low-carbon smart grids?

Modern society is dependent on flexible electrical energy, available on demand, at an affordable social and environmental cost. Today, most of our electrical energy is produced by converting the carbon stored in coal or natural gas into heat energy and then via turbines and synchronous generators into 50Hz electrical energy.

To address the challenges of global warming, the University of Manchester Joule Centre is discussing and exploring methods to reduce our reliance on ‘pre-historic’ solar energy stored in fossil fuels, and exploiting ‘real time’ solar energy available via wind, waves, photovoltaic, solar thermal, bio-mass and hydro. To incorporate these green, but often intermittent energy resources, electricity networks will have to become ‘smarter’. Real time information will have to be communicated between the producers and consumers of electricity, the local and national energy stores, and the operators of the transmission and distribution grids. A “low-carbon smart-grid” refers to the balancing of supply and demand without resorting to the conventional burning of coal and gas.

To fully utilise our national renewable energy resources, we need to recharge energy stores when supply exceeds demand and recover the energy when the balance reverses. Expressed financially, a smart consumer or community will buy and store electricity when the price is low, and sell stored electricity when the price is high. However, storage is only part of the solution and energy management systems will be required to ensure energy use is sensitive to supply availability and real-time pricing. For example, ‘smart homes’ will receive information, informing appliances that energy costs are about to go high and unless absolutely necessary they should not operate. This reduces demand by automatically shifting the use of white-goods or storage based heating systems to periods when the wind is blowing, energy use is low or the local network infrastructure is not heavily loaded. The latter is financially important, since it ensures ageing plant can continue to reliably operate well beyond original life expectancy.