ThePowerof3
Driving the future further
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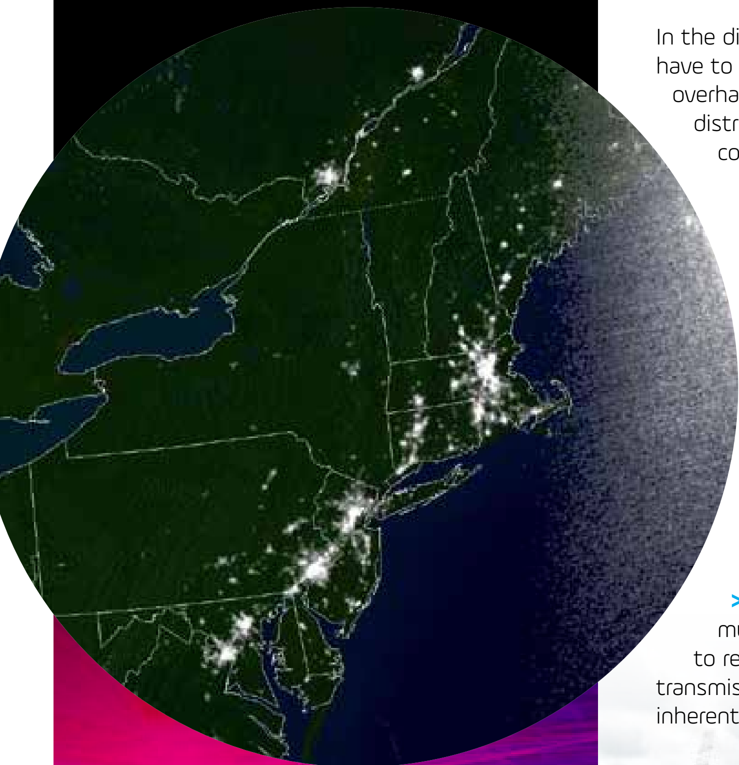
THE ENERGY INTERNET – AN INTERNET OF THINGS

"If you want to go fast, go alone. If you want to go far, go together."

~ *oft-quoted African proverb*

Overview

In August 2003, massive electricity grid failures blacked out huge areas of the US and Canada and, a month later, the entire length and breadth of Italy. In 2006 it was the turn of Germany, France, Italy and Spain, in 2008 Chenzhou in China, in 2009 Brazil and Paraguay and in 2012 India. The latter was the world's largest power outage ever, and the country ground to a standstill. (To this day, acute and recurring power outages occur there).



Blackout in northeastern USA, taken August 14, 2003 [NOAA, US Department of Commerce].

Because power grids are such vast interconnected networks a blackout, once triggered, is hard to contain – the 'domino effect' comes into play, a failure in one section creating a cascading effect down the line.

Imperatives for change

Whether from natural causes or human error, major power outages are harbingers of the need for faster, more intelligent solutions to managing unforeseen and catastrophic disruptions.

Certainly, they highlight the shortcomings of power grids based on mid-20th century technology born of the Industrial Age – technology that's now old-fashioned, lacking in effective communication and storage capacity, expensive, harmful to the environment, vulnerable in terms of energy security and almost willfully wasteful. In 2012 in the United States, for example, more than 61% of all energy input into the economy was wasted ... that's enough to power the United Kingdom for seven years!

In the digital age, power utilities have to embrace change and overhaul how energy is generated, distributed, stored and consumed. They need the ability to:

- obtain and assess real-time information on the state of the grid and, using that data, control the flow of power fast enough to avoid blackouts;
- upgrade their networks so more energy can be pumped through the grid safely, and
- produce and store power much closer to customers, to reduce the need for ageing transmission lines and the losses inherent in the use of those lines.

Technologies capable of achieving these ends have been around for a while, but what's missing are economic incentives to hasten their uptake. One only has to consider the current controversies raging in Australia with respect to power outages, renewables and a perceived unwillingness on the part of the government to eschew fossil fuels to realise the extent of the problem.

But, with the spectres of terrorism (including cyber attacks) and natural disasters (fires, storms, solar flares, tsunamis) looming large, the writing is on the wall: incumbent large-scale, centralised power production, controlled by a few main suppliers, is rapidly reaching its use-by date.

Energy generation needs to be cheap, effective and much more efficient in terms of *not* wasting what's produced. A transition from fossil fuels to renewables will be key, as will modularity and bi-directional power and data flow.

Hooking up

The 'energy internet' is predicated on the notion of distributing electricity in a manner that mimics the workings of the Internet (and, in so doing, matching the latter's lasting impact on communications). The aim is to achieve a comprehensive power supply via multiple coordinated micro-grids rather than a conventional one-way grid.

> *[It's] really the Internet brought to energy and it's a perfect fit. The great economic revolutions … occur when new energy regimes emerge and new communication revolutions emerge to organize them.*

So says Jeremy Rifkin, economic and social theorist and a leading expert on the innovations that will shape the future and solve many of the challenges the world faces.

In his 2014 interview with the *Big Think*, Rifkin explained that:

> *[t]he digital age will allow such a system to be decentralised, efficient and reliable. That's the theory, anyway.*

Again, how energy is produced, transmitted, stored and consumed will be key to the advent of this emerging system, in which no part acts alone; rather, they form a coordinated whole.

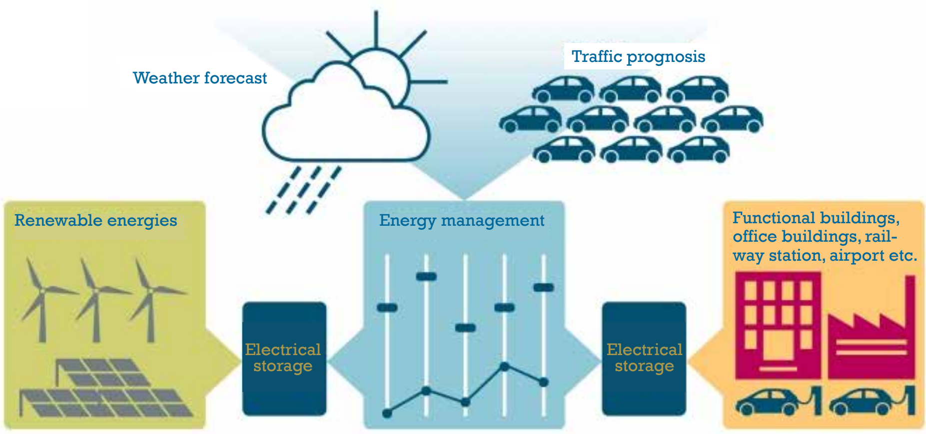
The energy internet is about *things* – buildings, electric vehicles, appliances, electronic devices and power plants, woven into an over-arching whole with renewable energy, traditional power plants and transmission lines, smart sensors and meters, storage batteries and wireless communication. Each *thing* 'talks' to those around it in real time … about, for instance, electrical loads, wind speeds, hours of sunshine and the price of energy, all while sharing power.

Demand for energy fluctuates according to the amount of power available and its price, and availability and price depend in turn on how much power is produced, as well as demand itself and how much electricity has been stored.

At the core of the system are renewable energies; increasingly economically viable, these ensure an energy marketplace ripe for technological innovation. That's why, right now, Europe is leading the energy internet movement.

"We're taking … the whole transmission grid [of Europe] and transforming it to an energy internet using the same technology we used with the communication Internet," explained Rifkin.

Internet of energy for electric mobility

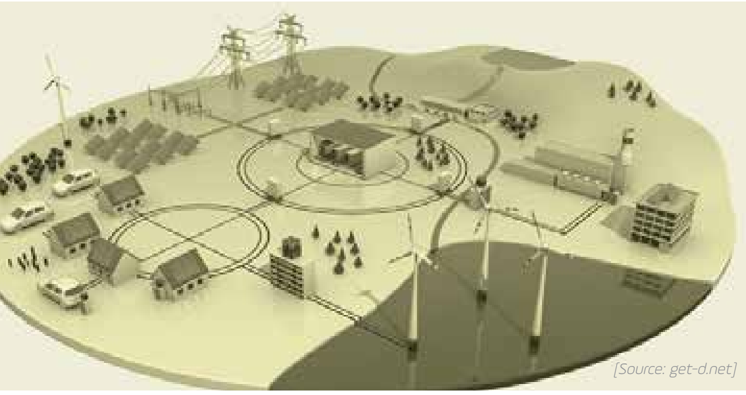


[Source: siemens.com]

With the energy internet, a main power grid is partnered with decentralised generators, ranging from fossil fuel to wind turbines and solar power, to apportion energy to multiple micro-grids within a designated network. Then, depending on load, each micro-grid injects spare power into, or absorbs power it lacks from, either other micro-grids or the main grid.

So, three scales of grid – national, regional and local – are required.

- Nationally, large renewable plants act in concert with coal and nuclear, each backing the other up.
- Regionally, many smaller, local renewables can plug in.
- Locally, every customer can become a player in the energy game – generating and storing power and potentially selling it on.



[Source: get-d.net]

Sophisticated self-learning software (including artificial intelligence) that can minimise human error while utilising and managing data from renewable energy systems, smart thermostats and battery storage systems and other site-specific and grid-connected devices (all communicating in real time and at scale) will be critical for a smooth transition to the energy internet. Some of it's here already, with a lot to follow.

So, as noted in issue 11 of *The Power of 3*, off-grid power generation and storage capacity are merely the forerunners of a revolution that will see the grids of today transform into the energy internet of the future … a future in which machines and devices will be smarter than ever before, where outages are a thing of the past and where consumers of all kinds can produce, store and trade in power to their heart's content.

And finally …

How's this for 'seamless urban mobility' in the coming decade?

At this year's Geneva Motor Show, Italdesign and Airbus unveiled the truly futuristic Pop.Up, a concept 'passenger capsule' that morphs from a self-driving taxi into a vertical takeoff and landing (VTOL) drone and even a passenger module on a Hyperloop-type train. They're saying 10 years from concept to completion. We're saying wait and see.

Which Perth-based company aims to be part of the energy internet equation?

The Power of 3 is sponsored by Lithium Australia. Enquiries to info@lithium-au.com.