

LEADING THE GLOBAL TRANSITION TO RENEWABLE ENERGY



Oxford University Energy Colloquium March 10th 2015

GRID AND SUPERGRID

A EUROPEAN ENERGY FUTURE

Robert Boyle

The man who foresaw the electric society



The Prolongation of Life.
The Recovery of Youth, or at least some of its Marks
of it, as new Teeth, new Hair colour'd as in youth.
The Art of Flying.
The Art of continuing long under Water, and exercising
functions freely there.
The Cure of Wounds at a Distance.
The Cure of Diseases at a distance or at least by
Transplantation.
The Attaining Gigantic Dimensions.
The Emulating of Fish without Engines by Customs &
Education only.
The Acceleration of the Production of things out of
Seed.
The Transmutation of Metals.
The making of Glass Malleable. (Vegetable)
The Transmutation of Species in Minerals, Animals, &
The Liquid Alkahest and other discolouring Menstrua.
The making of Parabolicall and Hyperbolicall Glasses.
The making Armo^r Light and extremely hard.
The practicable & certain way of finding Longitude.
The use of Pendulums at Sea and in Journeys, and the
Application of it to watches
Potent Druggs to alter or Exalt Imagination, Waking,
Memory, and other functions and appetites, procure
innocent sleep, harmless dreams &c.

A Ship to saile wth All Winds, and A Ship not to be
Sunk.
Freedom from Necessity of much Sleeping exemplified
by the Operations of Tea and w^h happens in
mad-men.
Pleasant Dreams & physical Exercises exemplified
by the Egyptian Elixir and by the Fungus
mentioned by the French Author.
Great Strength and Agility of Body exemplified by
that of Frantick, Epileptick and Hygienicall
persons
A perpetuall Light.
Varnishes perfumeable by Rubbing.

Boyle Papers 8, fols. 209, The Royal
Society

[http://theappendix.net/issues/2014/7/
perchance-to-dream-science-and-the-
future](http://theappendix.net/issues/2014/7/perchance-to-dream-science-and-the-future)

Grid and Supergrid

- Supergrid – the background
- The policy context
- The technology

Mainstream at a glance

Founded
in 2008

Over 120
employees¹.

Active in over
6 countries

Construct,
finance and
operate renewable
energy projects

17,000 MW in
development¹.

334 MW in
construction
and operation

€352 million
raised in
corporate
finance

€580 million in
project level
debt and
equity raised¹.



MainstreamRP @MainstreamRP · Oct 28
Check out a video of our Jeffreys Bay #windfarm - largest in Africal
vimeo.com/106894833 @EngineerIreland buff.ly/1t36MmN

Vimeo



Jeffreys Bay Wind Farm

[View on web](#)

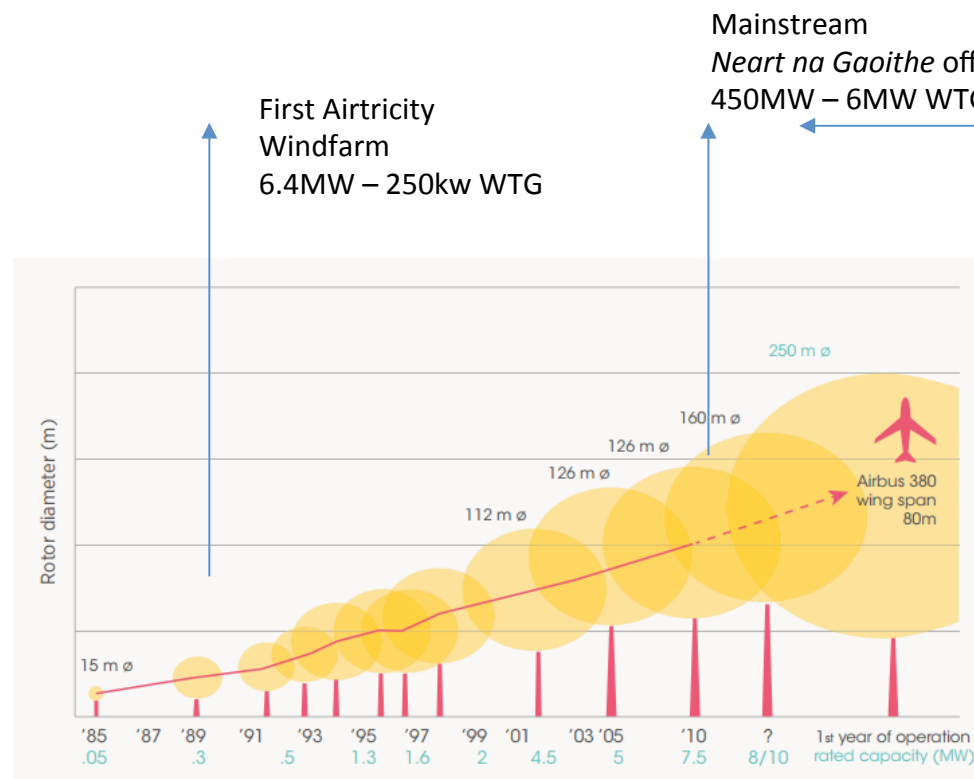
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● Mainstream offices
● Countries in which Mainstream are active

¹. As at May 2014

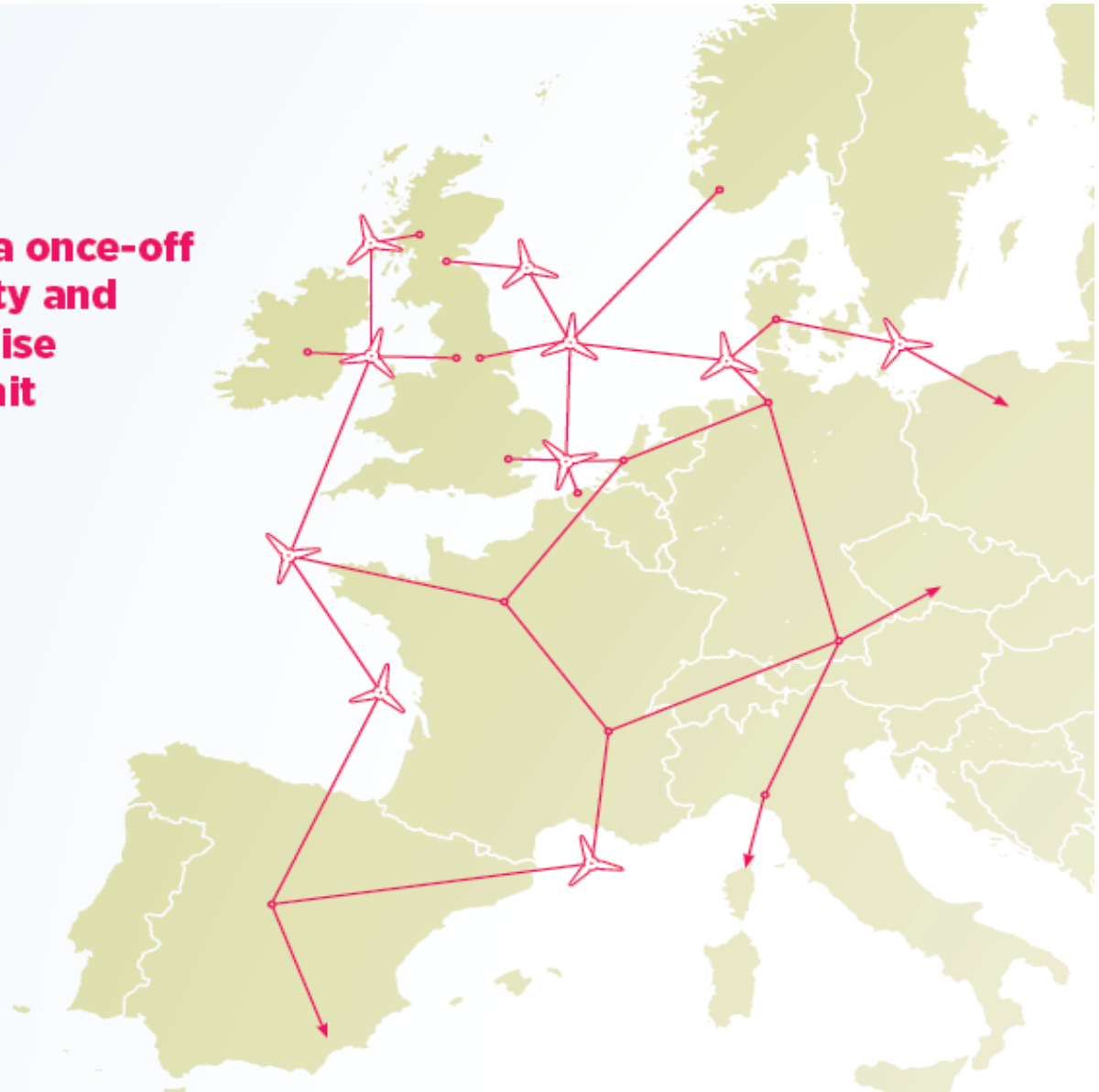
The modern wind turbine

A highly efficient industrial power plant



Supergrid

Europe is embarking on a once-off transition to sustainability and Supergrid will revolutionise how we generate, transmit and consume electricity for generations to come.



Who are the Friends of Supergrid?

A European industrial initiative with a mutual interest in promoting the policy agenda for a European Supergrid:

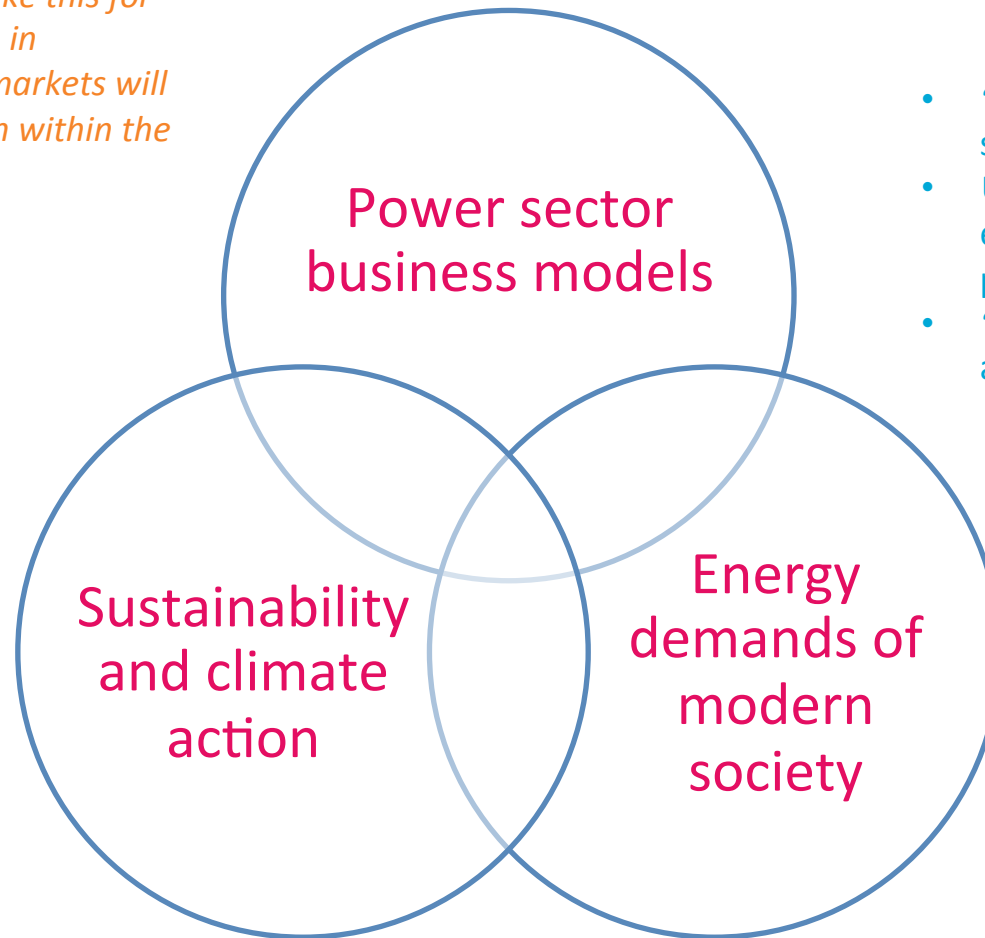


The electric society

the “we have done it like this for a century” value chain in developed electricity markets will be turned upside down within the next 10-20 years.

UBS August 2014

- No new fossil plant
- Carbon taxes
- Large scale variable generation
- Big grids



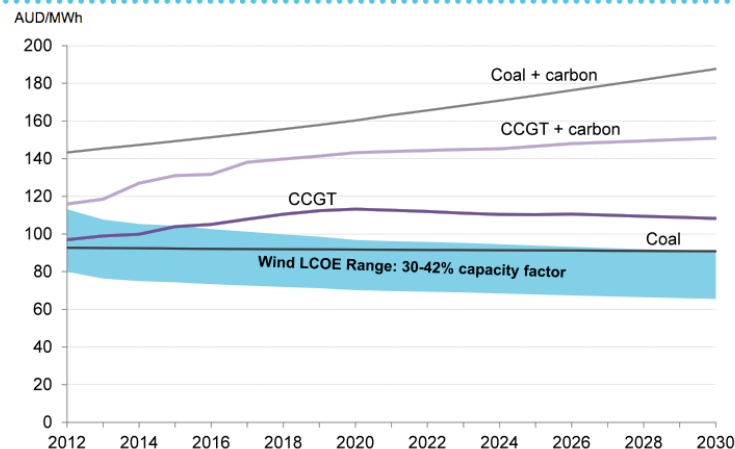
- “Utility death spiral”
- Utilities as energy services providers
- “Intelligent” and active consumers

- Electric vehicles and solar pv
- Domestic/local storage
- Anticipatory technology

Generation

Onshore wind, coal and gas

WIND IS NOW CHEAPER THAN NEW COAL AND GAS LCOE IN AUSTRALIA (AUD/MWh)

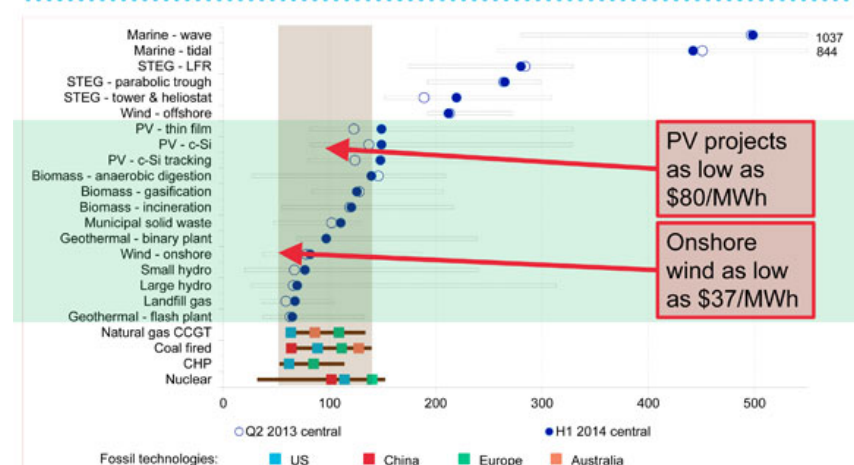


Note: Levelised cost of energy is the dollar per megawatt-hour price for an inflation adjusted, fixed-price power off-take agreement that, taking into account all project specific costs, offers the sponsor and/or project developer the minimum equity return necessary to undertake the project without subsidy. Source: Bloomberg New Energy Finance

Bloomberg /// UNCERTAINTY: THE NEW CERTAINTY, 24 JULY 2013

9

LEVELISED COST OF ELECTRICITY, H1 2014 (\$/MWh)



Note: LCOEs for coal and CCGTs in Europe and Australia assume a carbon price of \$20/t. No carbon prices are assumed for China and the US. Source: Bloomberg New Energy Finance

Bloomberg ///
NEW ENERGY FINANCE

Michael Liebreich REFF Wall Street June 2014 #REFFWS @MLiebreich 17

With thanks to Bloomberg New Energy Finance

What is the Supergrid?

- EU 2030 direction of travel: -
 - EU GHG target
 - EU RES target
 - EU Interconnection target
 - Internal electricity market
- The Supergrid is a pan-European transmission network that: -
 - facilitates the integration of large-scale renewable energy
 - the balancing and transportation of electricity
 - with the aim of improving the European market.



Energy Union

The 2030 package

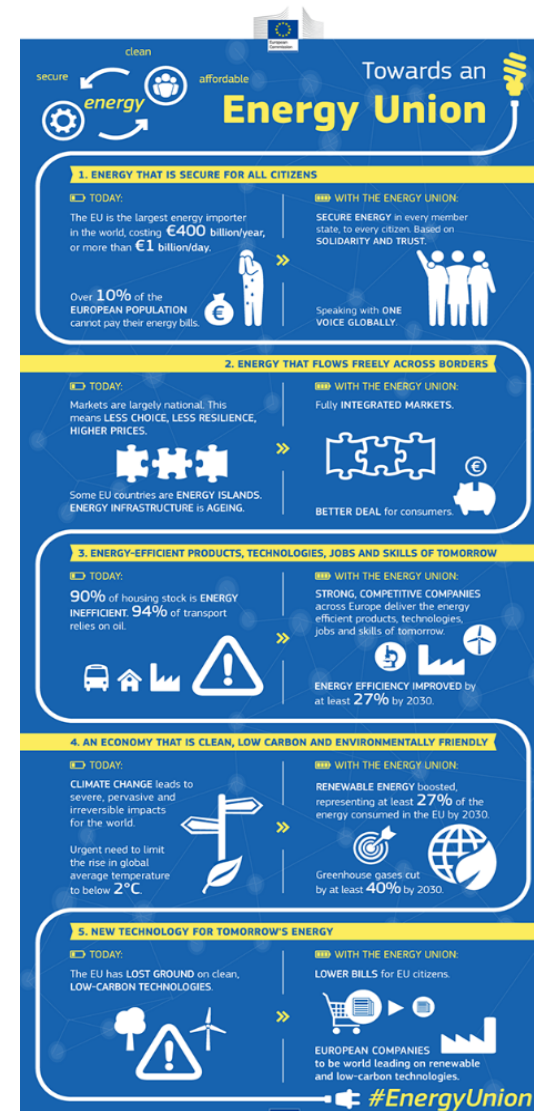


Brussels, 25.2.2015
COM(2015) 80 final

ENERGY UNION PACKAGE

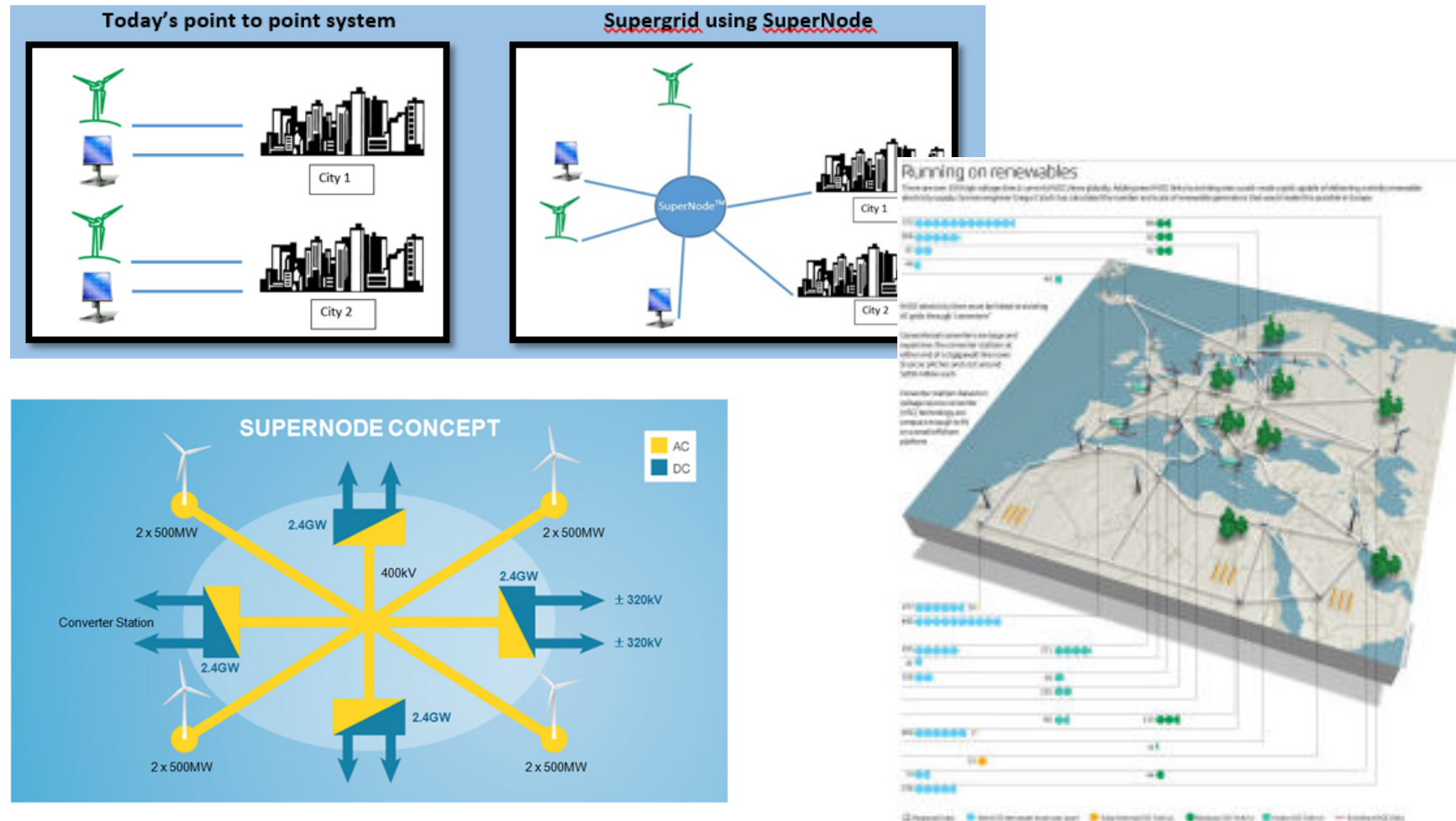
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK

A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy



Enabling technologies

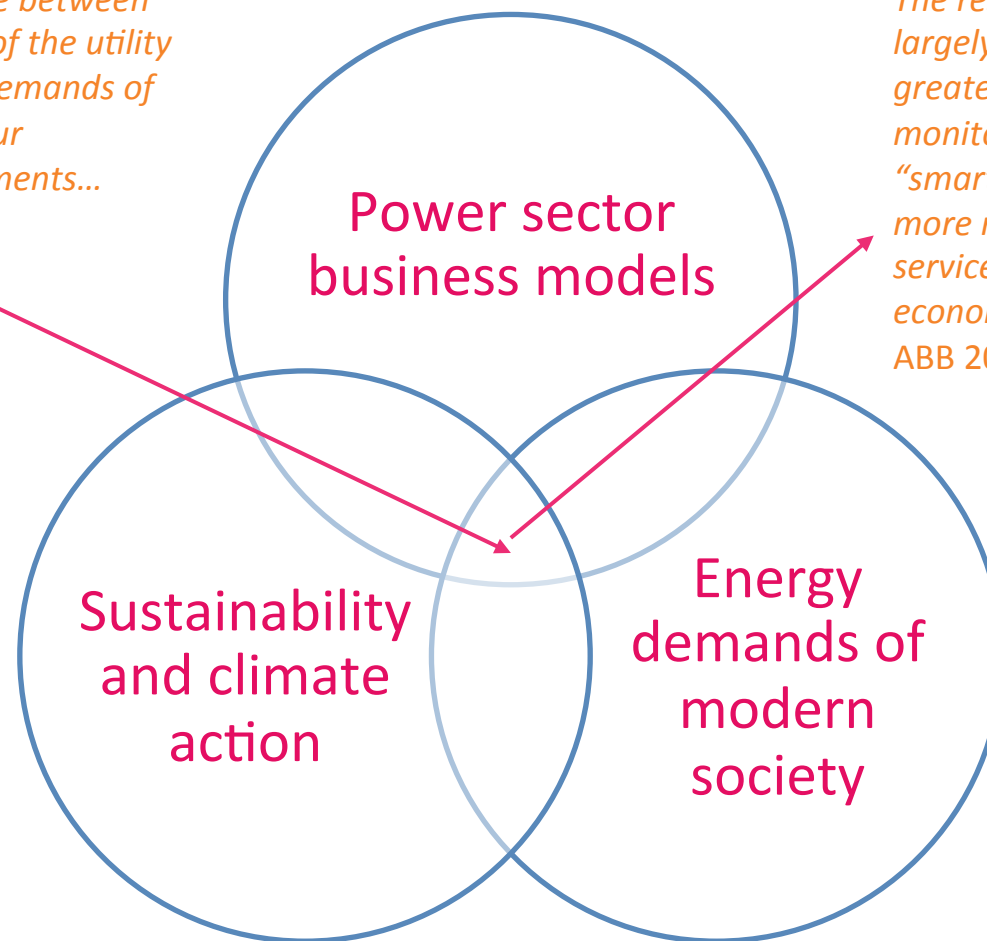
Supergrid and SuperNode



The electric society

There is a convergence between the business realities of the utility industry, the energy demands of modern society and our sustainability requirements...

ABB 2014



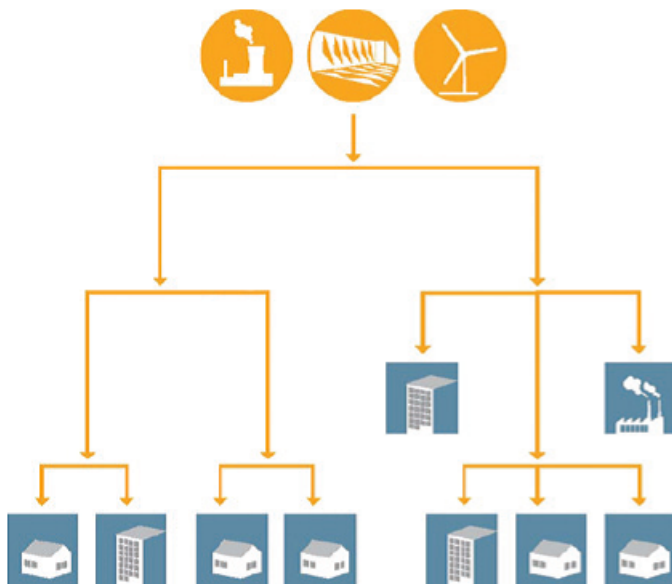
The result will be a grid that is largely automated, applying greater intelligence to operate, monitor and even heal itself. This “smart grid” will be more flexible, more reliable and better able to service the needs of a digital economy...

ABB 2014

Supergrid technology

Down with hierarchies

Today's hierarchial power system



Fully realized smart grid



Schematic of Old and New Grids according to ABB - 2013

Thank you

Dr Eddie O'Connor
 March 2015

www.mainstreamrp.com

@MainstreamRP

MainstreamRP @MainstreamRP · Feb 26
 It will be the first time a UK offshore wind farm of this scale will be built using project finance alone #CfD



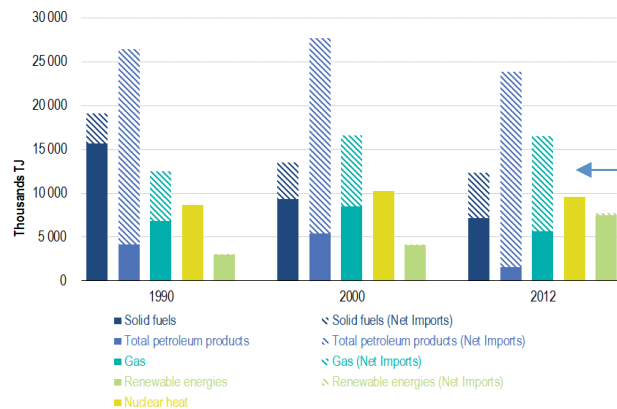
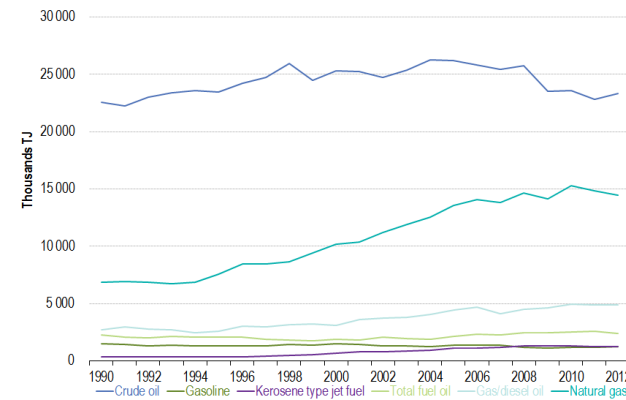
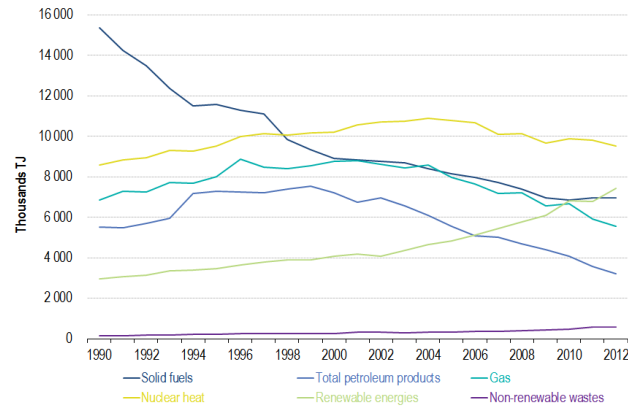
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MainstreamRP @MainstreamRP · Feb 26
 Mainstream's Scottish offshore project wins Government contract in UK's 1st renewables auction goo.gl/zv4ksW



36 12

EU energy trends



1990-2012

Falling demand

Rising imports

Low carbon now largest indigenous EU energy provider

http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_trends