

# Smart Grids Versus Microgrids

Prof. Damien ERNST



# But what is exactly a Smart Grid?

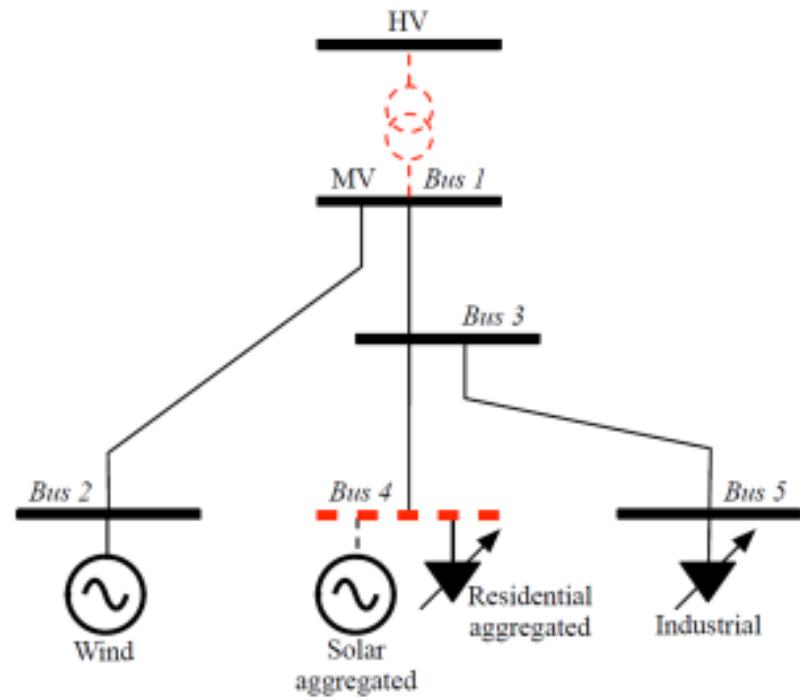
A definition in terms of functionality:

- 1.** Better exploitation of the flexibility of the (many small) load(s) to ensure the balance between generation and production is achieved at the lowest cost.
- 2.** Smart modulation of generation sources, loads and storage so as to operate the electrical network safely without having to rely on significant investments in infrastructure. The **fit and forget** doctrine is too difficult to enforce with the rapid growth of distributed generation resources. Thus, **Active network management** techniques are needed.

# Being smart is difficult. Terribly difficult!

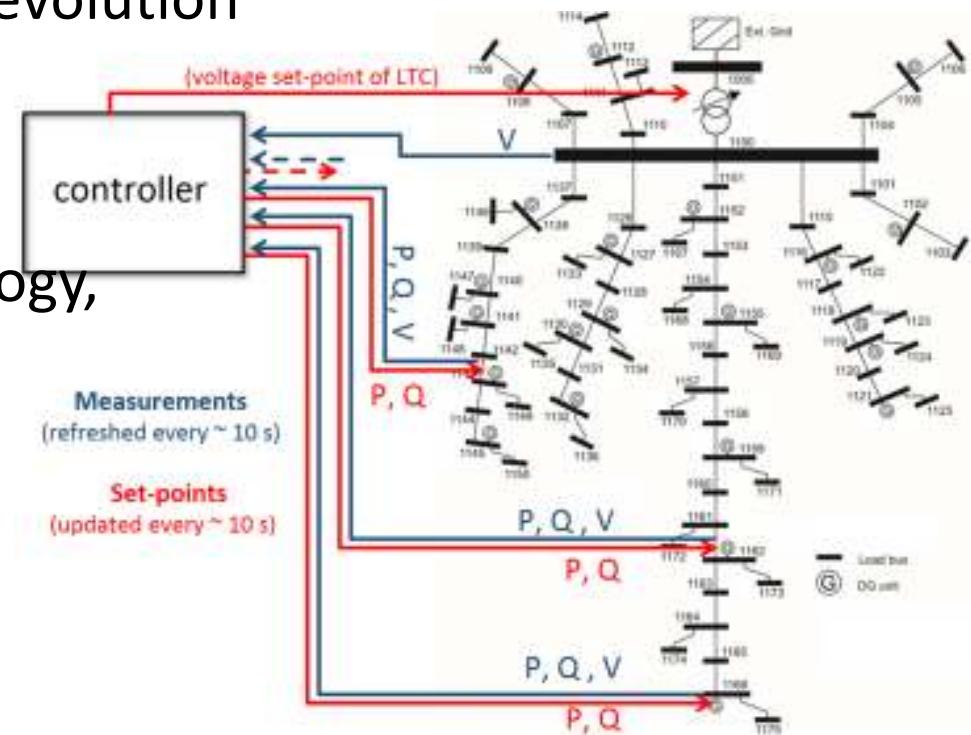
Implies (among others) rethinking the **whole** decision chain used to operate distribution networks. It is composed of four stages:

- 1. Interaction models
- 2. Investments
- 3. Operational planning
- 4. Real-time control



# Specific difficulties

- Complex decision-making problems
- Huge investments needed in monitoring and control infrastructure
- Staff not prepared for a Smart Grid revolution
- New vulnerabilities
- Public procurement procedures needed for acquiring this new technology, which makes innovation difficult.

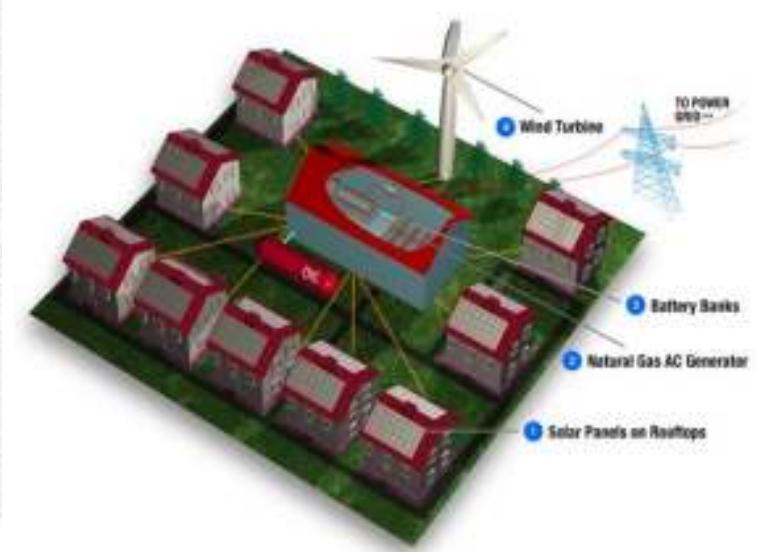
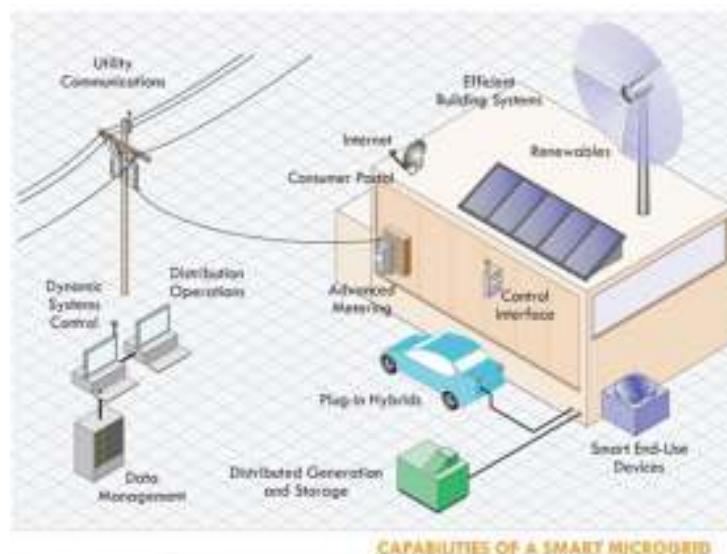


Why not go back to the good old days of the fit and forget doctrine?

1. Every grid user at the distribution level would have access to a **fixed access range**, defined by the maximum power that can be withdrawn from the distribution network, and the maximum power that can be injected into the network.
2. The distribution network is guaranteed to « work well » if all the users stay within this range.
3. Consumption and production peaks are managed locally in **microgrids** that use storage, demand-side management, and smart modulation of production.
4. Possibility of setting up intermediate solutions.

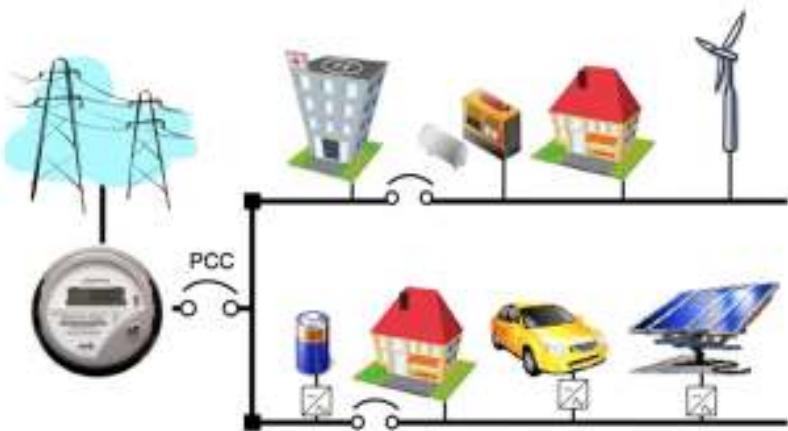
# Microgrids: a definition

A **microgrid** is an electrical system that includes single or multiple loads, as well as one or several distributed energy sources, that can be operated in parallel with the broader utility grid.



# Microgrids (at a community level): why can they help in such a setting?

The answer is because a single access point at a community level (the microgrid) is less optimal than an access point per user of the grid.



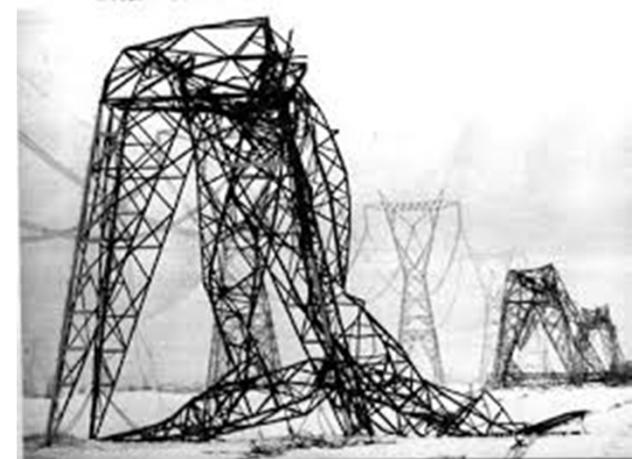
I know that for many DNOs or TSOs,  
microgrids are just pirates of the grid



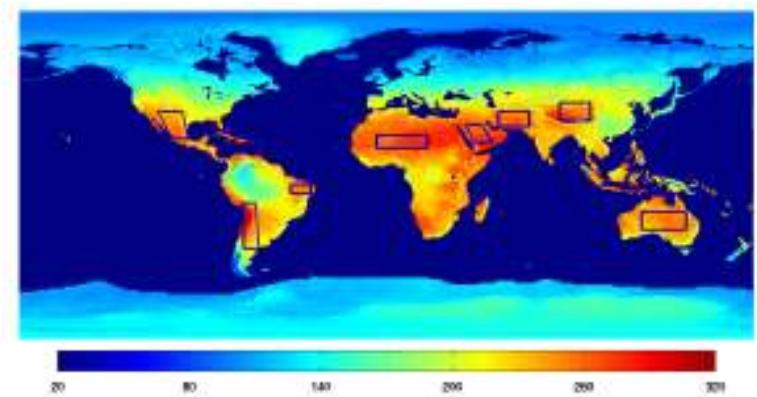
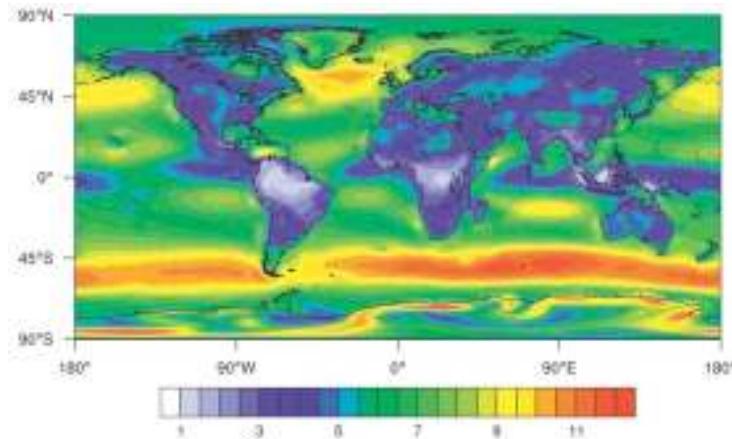
# But they should also consider this

**1.** Microgrids mean local economic activities. Installing/building microgrids will create many local jobs. There is also an opportunity to grow a microgrid-related industry that would export products all over the world. Countries rapidly choosing to support microgrids will be best placed for exploiting it (as Denmark did with wind power)

**2.** An electrical power system with a high-penetration rate of microgrids is a structure which is resilient to terrorist/cyber attacks, technological failures, a global short-age of supply or disastrous meteorological conditions.



**3.** Without microgrids, electrical power production in Belgium is very likely to (almost) disappear in Belgium, with all the consequences that it may have. With microgrids, **energy can also belong to the people.**



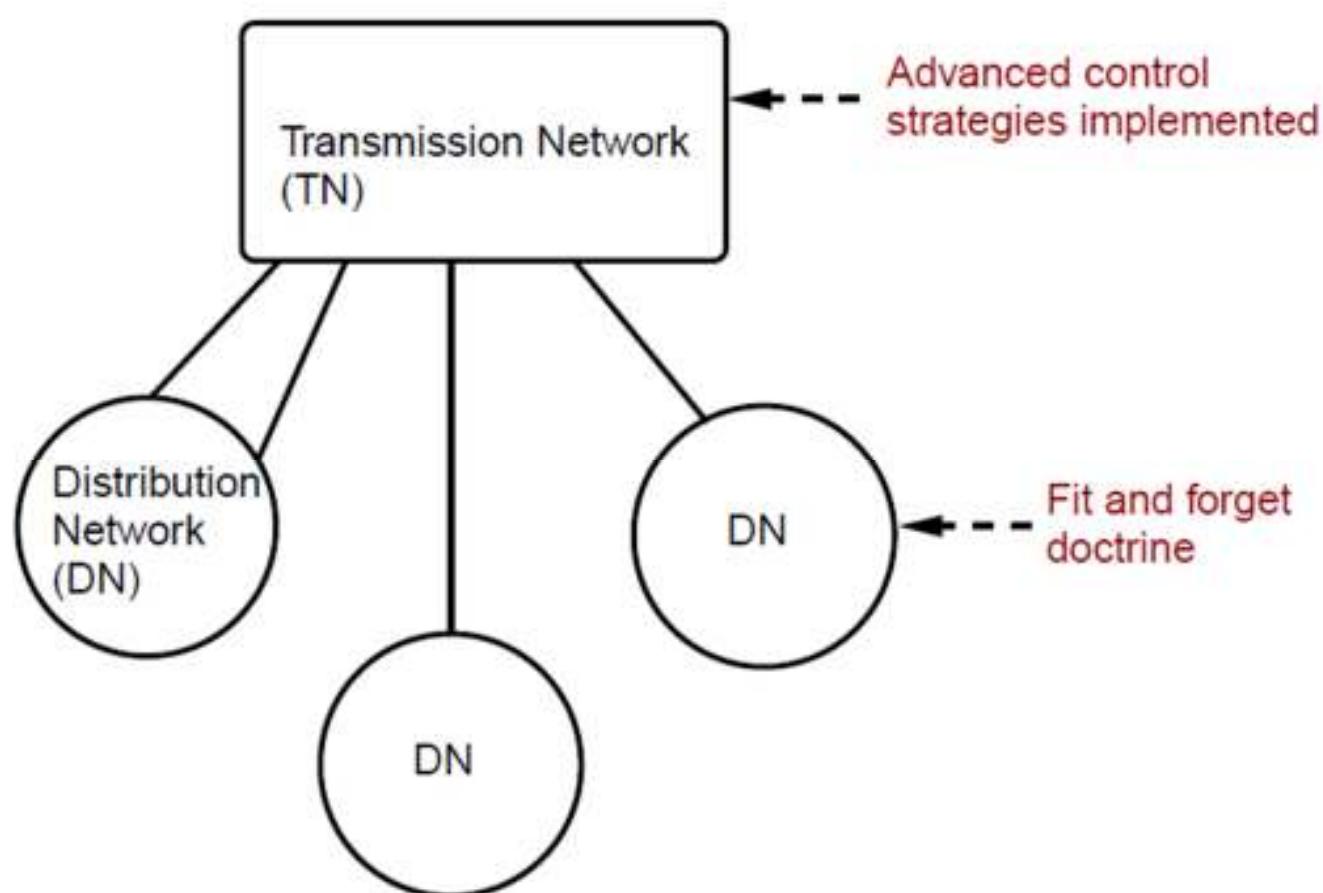
**4.** Microgrids may help to postpone/avoid very costly future investments in an ageing grid, especially at the distribution level. If well integrated, they may also offer very valuable services (e.g., balancing services, blackstart capacity) to the grid that may lead to a decrease in network tariffs.

It is important to remember that microgrids may go fully off-grid... which would result in the **ultimate loss of revenues =>** Important for DNOs to always have a network that has 'value' for microgrids. The value of a distribution network can be increased thanks to improved technology.

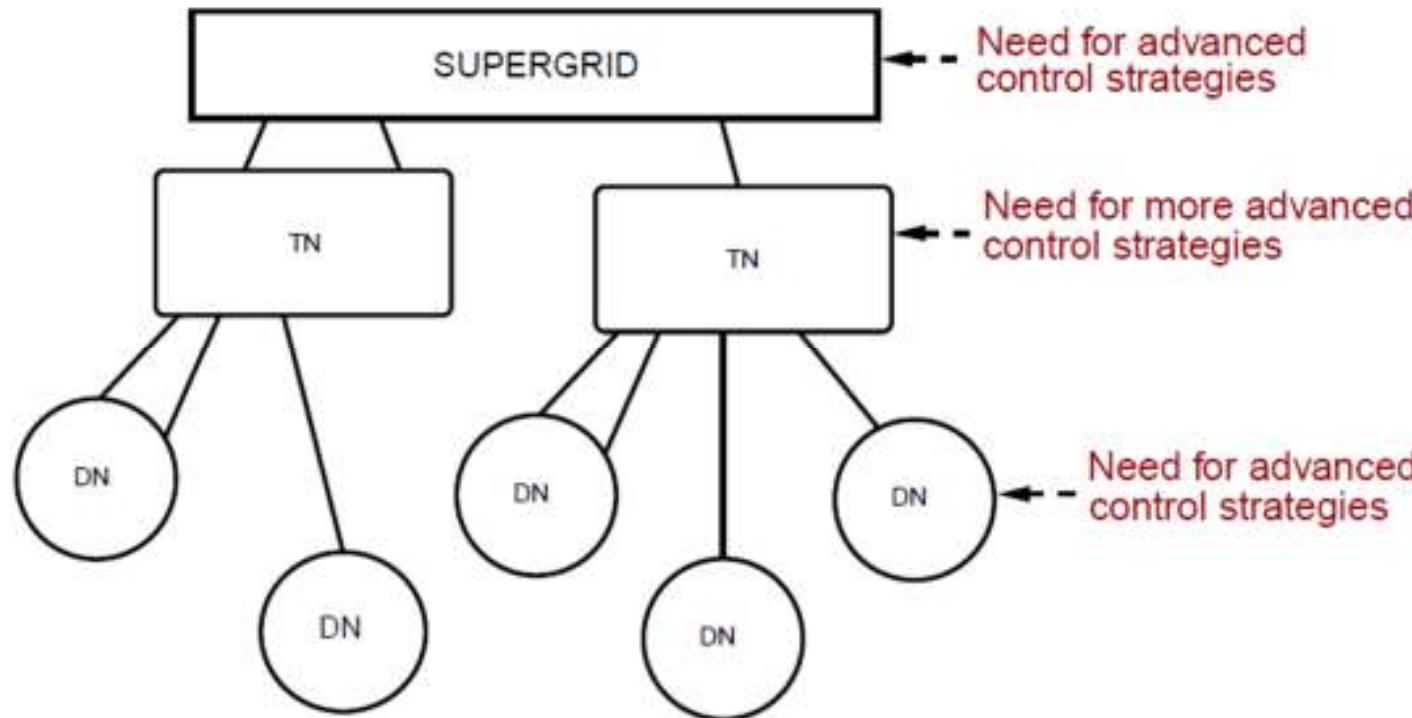


Electricity price < 250 euros/MWh

# The electrical grid as it used to be:



# The electrical grid as it should become:



**Challenges for designing top-performing control strategies and making them work together are **immense**, especially in a deregulated (market) environment. Microgrids (and other alternative models) may help to make things **much simpler**.**