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Super grids - Benefits and Challenges

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Abstract

“Super grids” attract more and more attention. They are seen as a mean to transmit large amounts of electrical energy over long distances, connecting remote, clean and cheap electrical power plants to large load centers. In Europe, the best location for offshore wind power is the North Sea; for onshore wind power it is the coastal regions; for solar generation it is the South of Eu-rope; and for hydro power it is Norway or the Alps. In the USA, the best location for wind power is the Midwest. The major load centers are generally not located in these areas. The underlying assumption is that it is "smarter" to install each specific electrical generation technology where this is the most efficient: wind farm in windy areas and solar power plant in sunny areas. This is a way to extract more megawatts for a given amount of investment. (The number of sunny hours per year is 1709 in Munich and 2898 in Seville. The German average wind power capacity factor is just under 17.5% and around 24% in Scotland). “Super Grid” should provide an efficient ac-cess to this clean and cheap electric energy.

The concept of “Super grid” or “Overlay” is generally understood as a new meshed transmission network on top the existing grids. Due to long distances and large power requirements, HVDC links seem the best technological option. This could lead to very costly investments. The defini-tion of new planning methodologies is critical in order to allow a modular approach and to per-form a comprehensive cost/benefits analysis including generation and grid capacity expansion.

There are numerous challenges: technical, organizational, economic, social and political.

On the technical challenges: we could mention the feasibility of meshed HVDC grids; the relia-bility issues: do we have to build a N-1 secure system? If not, what could be the backup solution in case of fault on HVDC grids (DSM?)?

On the organizational issues: for the operation of this “Super Grid”, we should increase the co-ordination between System Operators or ultimately, would we need a new dedicated organiza-tion?

On the economic issues: these “Super Grids” should be integrated in large electricity markets. The “Super Grids” based on HVDC links are certainly more flexible than AC power lines and their operational capacities could be adaptable to maximize the "value" for the market. The oper-ation of the “Super Grids” should not necessarily be the same than that of the AC power grid. The link between electricity markets and grid capacities should be completely revisited.

The social acceptance of large grid infrastructures, having local impacts for a global benefit, is more and more difficult to obtain; perhaps less efficient local solutions with less grid infrastruc-tures could be more acceptable for the general public.

On the political and regulatory challenges: we could anticipate some issues in the decision mak-ing processes. Energy policy remains a mainly national/state question. No state would be ready to accept that their territories should be crossed by grid infrastructures without any direct local benefit or that they could become even more dependent on external electrical supplies. Moreo-ver, an integrated process should be developed in order to simultaneously plan generation capaci-ty expansions and grid capacity expansions over very large regions crossing administrative bor-ders.