FOSG proposal for EU specific interconnection objectives to be attained until 2030

Brussels, 27/5/2014

Executive Summary

The EU Council has asked the EC **to propose by June 2014 specific interconnection objectives to be attained by 2030.** Friends of the Supergrid - FOSG therefore wishes to contribute with concrete suggestions to such coming proposal from the EC.

In order to do so this paper will show how existing investments in interconnections have always been economically sound, how new investments would result in increased benefits to consumers as they will bring the opportunity of lowering electricity prices and will give some concrete recommendations on the infrastructure objectives to be attained by 2030, such as:

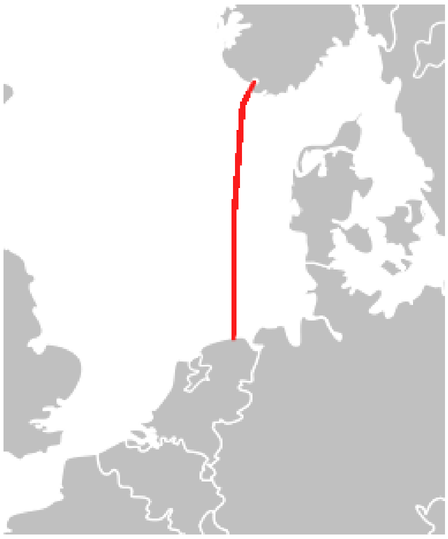
- **A coordinated European planning process for the Supergrid**;
- The introduction of **pan-European mechanisms for cross-border balancing;**
- **Common grid access rules for generation** and specially for offshore wind parks;
- **Member State's obligation to look into the costs of further interconnection versus new generation within its borders**;
- **A European market of RES** making compatible the support schemes and including the possibility for **very long-term capacity contracts;**
- **Removal of obstacles that impede especially 3rd party interconnector projects** according to EU 347/2013 Reg.
- **Specific proposals adapted to the national regulated companies like TSO's** facing:
    - Increasing capital costs (debt and/or equity) due to higher/changing risk profiles,
    - Lack of incentives within the current regulatory framework in most European countries (focusing on lowering tariffs),
    - Relatively low return on investments.
- An **improved risk-reward balance** in general or a different return on investment for prioritized projects;
- **A European common network operation process** according to EU 714/2009 Reg. as amended in 2013;
- **A new EU Regulation** that takes into account anticipation and flexibility.

Investing in interconnectors is a sound economic decision and integrates markets

Existing projects are proving to be very successful

1. NorNed

The NorNed project was initiated in 1994 and given license by governmental entities during 2000 and 2003. TSO's from Norway as well as from the Netherlands, Tennet and Stattnet, worked on the project and manage daily operations. The link was commissioned on 6th May 2008. At 580km long and with a capacity of 700MW, NorNed is the longest HVDC cable in the world.



Financial Performance and Impact

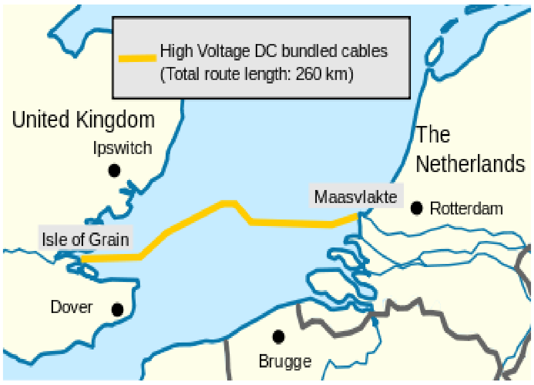
Up until 2013, the project has far exceeded expectations. With 285M€ in revenue, the project has already covered almost half of its installation costs (600M€) in only five years. In the first 12 months, the Return on Investment (ROI) reached a high of 20%. Although the ROI has since reduced, the link is still very profitable.

Socio economic impacts and benefits

- Dutch thermal plants can always be operated on optimal capacity and Norway benefits from highly effective energy trade;
- The Netherlands make use of imports from flexible hydro power production of Norway, whereas the Norwegian market benefits from the Dutch stable thermal market -> favorable efficiency rate;
- NorNed gives access to the high renewable energy potential of Scandinavia;
- A more extensive use of cheapest power production method leads to favorable prices for consumers[1];
- Increased competition in particular on the Dutch side improves prices for consumers;
- Security of supply ensured without higher costs;
- Minimum loss of power.

2. BritNed

The BritNed project mission is to meet consumer and industrial demand for a reasonable price ratio and to connect Great Britain to the Central European market. The HVDC cable is 260km long and has a capacity of 1000MW. It runs from the Isle of Grain to Maasvlakte near Rotterdam. The project is a joint venture between Tennet and National Grid.



[1] http://www.iaee.org/documents/newsletterarticles/208mulder.pdf

Financial Performance and Impact

The project is shared 50/50 among the two parties with equal investments and equal revenue claims. Costs for the whole project were 600M€.

In 2013, Tennet published in its annual financial report that the contribution of the BritNed cable project to underlying EBIT was 14M€ representing the firm's 50 % share. Total EBIT of Tennet in 2013 was 620M€. This suggests total EBIT value of 28M€.

Table 1 shows the financial performance (according to Tennet) of BritNed in 2012 and 2013[2]:

	2013			2012		
Statement of income (EUR million)	BritNed	Other	Total	BritNed	Other	Total
Revenue	70	5	75	36	4	40
Depreciation and amortisation	16	1	17	18	-	18
Other costs	16	3	19	14	4	18
Operating profit	**38**	**1**	**39**	**4**	**-**	**4**
Finance income and expense	-1	-	-1	-	-	-
Income tax expense	-10	-1	-11	-	-	-
Profit for the year	**27**	**-**	**27**	**4**	**-**	**4**
Ownership TenneT	*50%*	*50%*		*50%*	*50%*	
Group's share in profit	**14**	**-**	**14**	**2**	**-**	**2**

Note that revenue increased by almost 52% one year after commissioning of the project.

Socio-economic impacts and benefits

- Smoothes out demand peaks on both sides;
- Less wind curtailments;
- Increased competition;
- Access to British great renewable energy potential.

3. Estlink

Project Description

Estlink is the name for the first HVDC cable between the Baltic States and Finland. Plans to connect the two regions were developed already in the 1990's but final completion of the project was only reached on 5th April 2006. The cable is 105km long and has a power rating of 350MW. The cable is one of the oldest projects in the EU. Total costs were 100M€. Estlink 2 was commissioned in 2014. Its length is 171km and power rating will be substantially higher (650MW) than Estlink 1. The total project costs are approximately 320M€. The European Commission granted 100M€ to the project.

[2] http://annualreport.tennet.eu/2013/userfiles/pdf/TENNET_Annual_Report_2013.pdf

Financial Performance and Impact

The Estlink 1 cable has also been a success. AS Nordic Energy Link made in the last 6 years a net profit of 19M kroons (around 1,2M€)[3] with a share of around 40% belonging to Eesti Energia, 25% to Latvenergo, 25% to Lietuvos Energija and 10% to Finestlink Oy of Finland. The average total profit per annum of the project is 2,75M€.

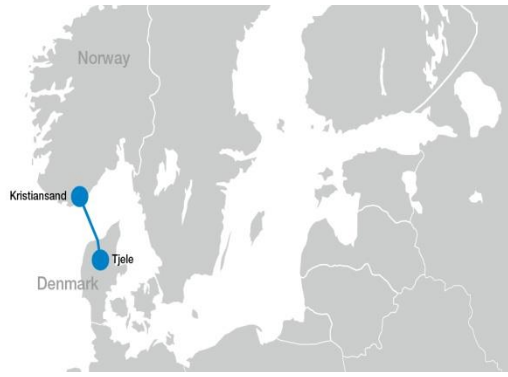
Socio-economic impacts and benefits

Studies show that there are several positive long-term dynamic effects:

- More stable, reliable and secure power supply[4];
- Estonia gets integrated into the “Nord Pool Spot area” with the consequence of less fluctuations and more stable prices in longer time periods;
- Reduction of power dependency from Russia;
- Indirect effect on further investments in the region;
- Access to the renewable energy market of Western Europe and Scandinavia;
- Short term regional employment growth.

4. Skagerrak links (1 ,2 ,3 and 4)

Project Description



The Skagerrak links connect Norway and Denmark and consists of 4 different HVDC projects owned by Stattnet and Energinet.dk. Skagerrak 1 and Skagerrak 2 are bipolar HVDC connections installed in 1977. Both cables have a capacity of 250MW and have been updated in 2007 with the so-called MACH control system. Skagerrak 3, commissioned in 1993, has a transmission capacity of 440MW. The links have a total capacity of 1050 MW. This year, an upgrade of Skagerrak 3 and the installation of an additional HVDC (Skagerrak 4) link will lead to additional power capacity of 700 MW. The financial results as well as the high capacity usage prove the additional link is a sound decision.

Socio – economic impacts

- More power from renewable resources added to the energy mix;
- Reduced balancing costs caused by reservation of transmission capacity;
- Western Europe has access to renewable markets in Scandinavia and vice versa;
- Improves the ability for consumers to chose from different power suppliers;

[3] http://www.vm.ee/?q=en/node/11899

[4] http://ec.europa.eu/energy/evaluations/doc/2012_ten_e_projects_final_report.pdf

- Flow of electricity between the dynamic hydropower of Norway and the static thermal power of Denmark;
- Minimum loss of power;
- "Robust performance" leading to energy security for customers;
- Barely any impact on environment.

5. IFA (Interconnection France – Great Britain)

Project Description

This 70 km line consists of two HVDC cables. The existing cables are bi-directional so both countries can export and import electricity and have a capacity of 2000MW. IFA is an interconnector with an average capacity use of 98%. This is one of the best values worldwide and outlines the links major importance. This link was commissioned in the early 80's. Due to increasing demand of electricity an upgrade is already planned.

Socio-economic impacts

- Additional access to wind energy from Great Britain;
- Less wind curtailments;
- Greater supply reliability for both sides;
- Lower prices as a result of increased number of power suppliers.

New projects will have a major positive impact but are finding significant obstacles

1. BRITIB

BRITIB Project is a major piece for the development of the second priority corridor *North-South electricity interconnections in Western Europe* established by EU Reg. 347/2013 on guidelines for trans-European energy infrastructure. Furthermore, it constitutes the necessary link with the first priority corridor *Northern Seas offshore grid,* enabling a large share of non-correlated RES generation (wind and sun) and back-up capacity between North and South.

It is the **only project interconnecting 3 Member States** within such priority corridor and will allow for direct bidirectional power exchange between any of the electrical systems and direct access to their respective markets or pricing zones (OMIE: Portugal and Spain; EPEX SPOT: Germany, France, Austria and Switzerland; and APX: Netherlands, UK and Belgium).

The project consists of a three-branched submarine HVDC interconnector between Spain, France and UK, with a total approx. length of 1.270 km that will allow the transmission of more than 1000 MW, at a voltage of at least 320 kV. The total estimated **cost** of the project is 2 b€.

The **benefits** calculated by different organizations are shown in table 2 below. They are the same order of magnitude as those obtained in ENTSO-E Vision 1 preliminary assessment of 16 December 2013 according to CBA (cross benefit analysis) version of 14 November 2013 of third party projects TYNDP 2014. The project SP-FR-UK is currently being assessed by ENTSO-E.

Table 2. Summary of Interconnection assessment. Pöyry May 2013, according to ENTSOE Guideline for CBA of September 2012. 1GW ES-FR section only.

Grid Transfer Capability Increase (MW)	Social and economic welfare (m€)	Security of supply (MWh/year)	RES Integration (MW)	CO_2 emissions variation (kt)	Losses variation	Technical Resilience	Flexibility	Project Costs (m€)	Environmental Sensibility
970	5,533	3,800	1,827	597		++	+ > 400MW for balancing	n/a	

Table 3. Breakdown of socio economic welfare benefit. Pöyry May 2013, according to ENTSOE Guideline for CBA of September 2012. 1GW ES-FR section only.

(M€)	Saving over 2017 - 2040	Yearly savings
Fuel Savings	2,535	105
Back up Capacity avoided	1,455	63
Wholesale Price	860	35.8
CO_2 Savings	449	18.7
Capacity Payment (Spain RD 13/2012)	234	10.2
Total Socio-economic welfare	**5,533**	**232.9**

Brief summary of contacts with NRAs, TSOs and involved Member States

The project was supported and partially granted for its feasibility study by the European Commission. BRITIB Project was submitted into TYNDP 2012 and into first PCI list but, despite the very good score obtained in EC West Cluster Ranking, it was not included in the final PCI list adopted.

BRITIB has been presented and discussed with many public entities that will be involved on the project, which have shown, at different times, their support since 2009 (CNE, MITYC, REE, RTE, CRE, Ofgem, National Grid, DECC, ENTSO-E, EC).

2. ISLES Project

The governments of Scotland, Northern Ireland and Ireland commissioned an Irish-Scottish Links on Energy Study (ISLES), part funded by the EU's INTERREG IVA Programme, on the feasibility of creating an offshore interconnected electricity grid based on renewable resources (wind, wave and tidal).

The study concludes that an ISLES cross-jurisdictional offshore integrated network is economically viable and competitive under certain regulatory frameworks and can potentially deliver a range of wider economic, environmental and market related benefits, with the connection of 2.8 GW and 3.4 GW respectively of generation resource and interconnection capacity possible by 2020.

The study also concludes that there are no technological barriers to the development or deployment of an ISLES network. High Voltage Direct Current (HVDC) using Voltage Source Conversion (VSC) technology is proposed as a suitable transmission system for the ISLES offshore network. In fact, the executive summary of the report states that: The ISLES concept does not require the development of new equipment, such as HVDC circuit breakers, but rather builds on the capabilities of current devices. The equipment proposed for the ISLES concept is of a size and scale that can be deployed using existing offshore installation techniques.

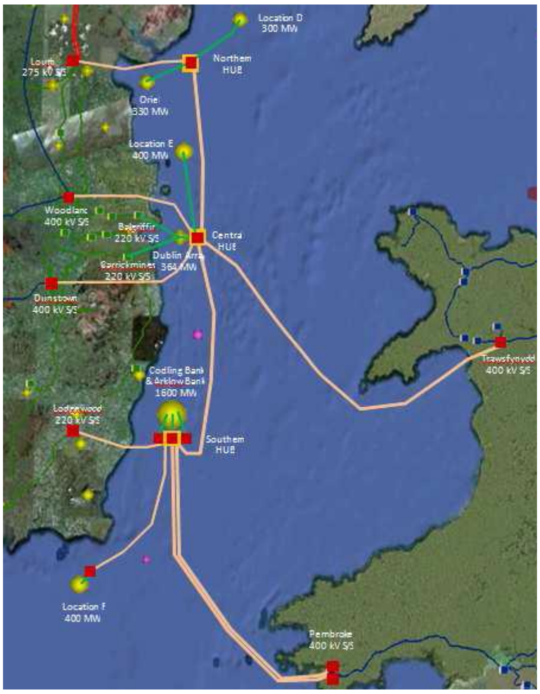


Figure 2-1: Southern Isles Concept

It is recognized however that the cross-jurisdictional nature of the ISLES concept creates significant complexity across multiple regulatory authorities requiring greater alignment of prevailing regulatory models. Key policy/regulatory areas which will need to be addressed for ISLES to become a reality include:

- Creating some form of anticipatory investment model/approach for coordinated offshore build, which allows phased build in anticipation of development, and commitment to future phases to support generation investment.
- Developing a regulatory model which removes/redefines the fundamental distinctions between interconnection and connections for offshore generation.
- Exploring an approach to subsidies where they can be paid for by the consumer state, rather than the state generating the energy.
- A transmission pricing regime which is seen to be equitable and affordable by generators, whilst ensuring that the offshore network owner earns sufficient return.
- Developing an approach, acceptable to the EU, for cross-border contributions to meeting targets.

Interconnection benefits were classified and quantified under the following broad headings:

- Trading benefits (principally wholesale price reduction in the all-island market);
- Improvements in system security;
- Benefits derived from sharing of operational reserves;
- Reduced operating constraints on wind generators in the Single Electricity Market.

The benefits are calculated to deliver cost savings to the Irish Electricity Market and the enhanced network availability provided by an integrated network build will reduce generation developer risk, and hence reduce the long term cost of energy.

3. Energy Bridge

The UK and Irish governments have recognised the benefits of a coordinated approach to supplying renewable energy in the UK with resources from Ireland. In early 2013 when they signed a MOU to assess and design the best regulatory and market arrangements for exporting wind energy from Ireland.

Britain has a demand for wind power and Ireland has the resources to meet it. It is estimated, for example, that Ireland has 345 TWh of wind potential, which is about 19 times its annual electricity consumption, and it is the intention of Mainstream to tap into this potential and to supply the British electricity market by creating an energy bridge from Ireland to Britain. The Energy Bridge concept is designed to exploit this opportunity and deliver up to 5,000 MW of wind energy directly from Ireland into the UK power grid.

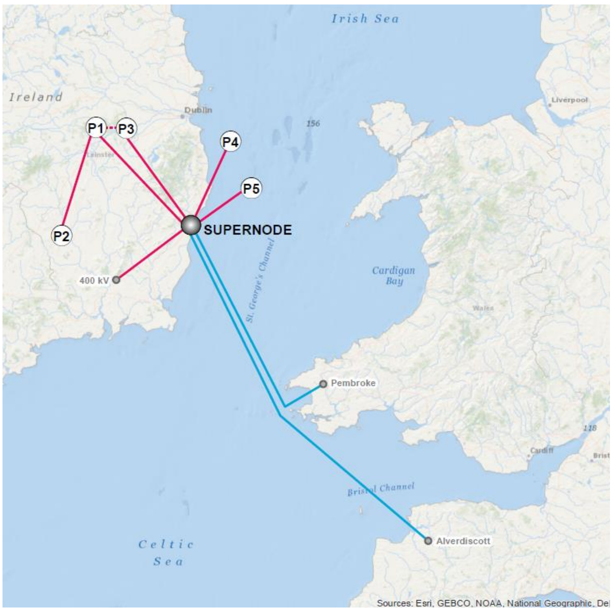


Figure 3-1: Energy Bridge

In addition to Energy Bridge the European commission has designated certain projects in the power and gas sectors as “Projects of Common Interest” (PCI): projects which demonstrate regional cooperation; engagement of Member States, TSOs, the European Commission and ENTSO-E; market integration, competition and system flexibility, sustainability and security of supply. And while Energy Bridge and similar projects are perfect examples for of how Europe could realise its 2020 vision and objectives, delivery is not without regulatory challenges and hurdles. The export of renewable energy form Ireland to the UK requires an Inter Government Agreement (IGA) between Dublin and London. However, recent statements from the Irish Energy Minister suggest that agreement will not be reached to deliver the project before 2020. In April 2014 the minister stated that:

Renewable energy trading has to be designed to work. Following further discussions between my Department and the Department of Energy and Climate Change in the UK since the Summit between the Taoiseach and Prime Minister Cameron in early March, I am confirmed in the view that given the economic, policy and regulatory complexities involved, and the key decisions yet to be taken by the UK, delivery by 2020 of a Midlands Wind Export Project is not now a realistic proposition. http://www.merrionstreet.ie/index.php/2014/04/midlands-energy-export-project-will-not-go-ahead-rabbitte/A key component of the Energy Bridge design concept is an onshore SuperNode, to collect and route the wind power in an optimum way. The SuperNode -a hybrid device with separate AC and DC busbars interconnected by multiple Voltage Source Converters (VSC), maximises asset utilisation of the expensive undersea transmission infrastructure and allows the receiving TSO route power as required.

The challenges to development of the SuperNode include a new hybrid AC/DC multi terminal grid control system; effective and efficient protection algorithms to ensure reliability; modularisation and miniaturisation; and a High Power HVDC Circuit Breaker.

4. Projects of Common Interest (PCIs) and Supergrid

There are a number of interconnection (with and without generation attached) designated as PCIs in the Irish Sea. They include a France – Ireland connection, the Isles Project, Energy Bridge and other direct connections of renewable energy. Figure 4-1 shows how these projects could develop without coordination. Figure 4-2 shows how the Irish Sea PCIs could be interconnected to a SuperNode located onshore in Ireland, delivering and optimised solution for generators and TSOs, demonstrating the technologies needed to deploy the future European Supergrid.

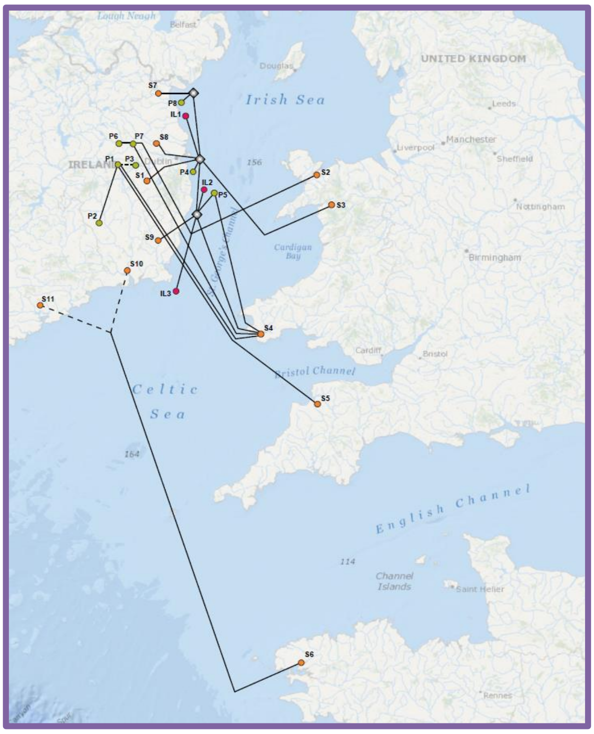


Figure 4-1: PCIs in the Irish Sea

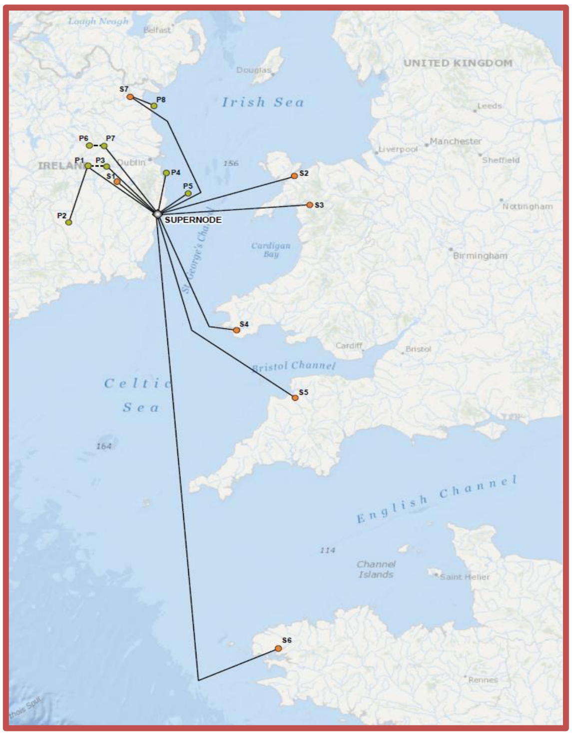


Figure 4-2: Irish Sea PCIs and SuperNode

FOSG study results on "the Supergrid (SG) preparatory phase: review of existing studies and recommendations to move forward"[5]

FOSG has recently completed a study which concludes that there are many initiatives which can be implemented today to help us reach the infrastructure objectives of 2030. The analysis of the existing studies confirmed that although they all have value in adding to the Supergrid debate, there are gaps in the literature. The missing points are:

- *The regulatory framework for sharing offshore resources* (production) and the investment burden of the SG between different countries. This is confirmed by the recent study by 3E et al, for the EC on the "role of support schemes for RES in creating a meshed offshore grid"[6].
- *The legal framework to allow cross-border balancing*. In fact, a high share of non-programmable RES generation can cause situations where within one country it is not possible to balance load and generation (phenomenon of "over-generation").The SG will allow such resources to be shared, provided that mechanisms for cross-border balancing are in place.
- The supply chain analysis *building the industry to manufacture the components necessary to build the SG,* with particular reference to special components such as DC circuit breakers and high-depth submarine cables to cross the Mediterranean Sea.
- The quantification of the technical indicators, with particular reference to *the investigation of the security of the system and the security of supply in terms of energy and power availability in presence of a very high share of non-programmable renewable generation.* Generation from non-programmable RES is normally uncorrelated from the load pattern and, as such, it becomes of utmost importance to assess the reliable available capacity necessary to cover the load taking into account combined uncertainty in load levels and non-programmable RES generation.
- *The cost-benefit analysis and a cross-border cost allocation associated to the new transmission infrastructures covering market, technical and environmental indicators.*

Existing barriers to new innovative infrastructure investments

- Despite Regulation EU 714/2009 all general and well known barriers remain such as on permitting procedures, major regulatory differences, nationally driven market mechanisms or individual and not coordinated security of supply policies.
- There is no regulation at national level in many Member States that allows private promoters to build and own high voltage infrastructure regardless of the regulated/non-regulated regime.
- TYNDP 2012 was opened for 3rd party promoters – many took part, but not one was included although it is expected that TYNDP 2014 will include third party promoters' projects.

[5] http://www.friendsofthesupergrid.eu/fosg-report-on-the-preparatory-phase-of-a-supergrid-3/
[6] http://www.friendsofthesupergrid.eu/northseagrid-the-role-of-support-schemes-for-renewables-in-creating-a-meshed-offshore-grid/

- After 2 years the PCI status cannot be guaranteed and there is no mechanism to recoup development costs already incurred.
- CEF only accounts for 3% of the total budget to achieve the 2020 horizon.
- Member States are in favour of developing interconnections but lack giving the necessary support during the PCI decision making process. National security of supply strategies remain predominant.
- Some Member States are very reluctant to support 3rd Party projects, apparently because:
    - Promoting is understood as an exclusive competence of its TSO.
    - Any support at any prior stage "might" mean future expenses to the system (this concerns also TSOs projects).
- Lack of visibility for the integration of a pan-european transmission grid.

Concrete Interconnection Objectives by 2030

- Development of an EU map with all Member States energy sources possibilities and availabilities together with the main consumption points to define the best **generation optimisation** pattern. Agreed generation scenarios by all MS and stakeholders;
- The "upward" and "downward" **generation adequacy** combined with the contribution of the Supergrid shall be accurately simulated in the mid-long term scenarios to show the feasible operation of a power system with a high share of non-programmable RES generation;
- **A coordinated European planning process for the Supergrid** as an enabler to affordable electricity, market integration, innovation, generation mix optimisation, full RES integration and larger security of supply whilst increasing the mutual support among Member States. Greenpeace has recently supported Supergrid in its latest *report*[7]*;*
- The introduction of **pan-European mechanisms for cross-border balancing** coordinated with the day-ahead and intra-day power markets;
- **Common grid access rules for generation** and specially for offshore wind parks [8];
- Member State's obligation to look into the costs of further interconnection versus new generation within its borders;
- A European market of RES making compatible the support schemes[9] and including the possibility for **very long-term capacity contracts** also as a means to incentivise further investments in infrastructure both by TSOs and private investors;
- Member States should **urgently accommodate their national legislations** to solve the obstacles that impede especially 3rd party interconnector projects according to EU 347/2013 Reg.

[7] http://www.friendsofthesupergrid.eu/greenpeace-power-2030/

[8] http://www.friendsofthesupergrid.eu/northseagrid-the-role-of-support-schemes-for-renewables-in-creating-a-meshed-offshore-grid/

[9] http://www.friendsofthesupergrid.eu/northseagrid-the-role-of-support-schemes-for-renewables-in-creating-a-meshed-offshore-grid/

    - Some of the infrastructure may be well beyond the interest and even the mission of TSOs/NRAs (some in their jurisdiction but not directly benefiting, some indirectly benefiting but not in their jurisdiction).
    - The amount of capital to be sourced is so important that the necessary incentives should be in place to attract new investors.
- **Specific proposals adapted** to the national regulated companies like TSO's facing:
    - Increasing capital costs (debt and/or equity) due to higher/changing risk profiles,
    - Lack of incentives within the current regulatory framework in most European countries (focusing on lowering tariffs),
    - Relatively low return on investments.
- An **improved risk-reward balance** in general or a different return on investment for prioritized projects;
- **Increased powers to ACER** as regards the development of a European project such as Supergrid;
- **A European common network operation process** according to EU 714/2009 Reg. as amended in 2013.

A new EU Regulation is necessary that considers all the above mentioned points and that takes into account anticipation, since infrastructure decisions always have an effect in 5-10 years, and flexibility so that quick changes are made when necessary depending on new circumstances.