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Evaluation of Smart Grid projects within the Smart Grid Task Force Expert Group 4 (EG4)

Application of the Assessment Framework for Energy Infrastructure Projects of Common Interest in the field of Smart Grids

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Table of Contents

List of Acronyms and Abbreviations

ASC	arc suppression coil
BaU	business as usual
CAPEX	capital expenditures
CBA	cost-benefit analysis
CCTV	closed-circuit TV
CER	Commission for Energy Regulation
CVR	conservation voltage reduction
CVR	conservation voltage reduction
DCC	distribution control centre
DER	distributed energy resources
DG	distributed generation
DMS	distribution management system
DSM	demand side management
DSO	distribution system operator
EG	Expert Group
EMS	energy management system
ENEL	Ente Nazionale per l'energia ELettrica
ERDF	Électricité Réseau Distribution France
ESBN	electricity supply board networks
FOR	facilitation of renewables
FPI	fault passage indicator
GPRS	general packet radio service
HTLS	high-temperature low-sag
HV	high voltage
ICT	information and communications technology
KPI	key performance indicator
kV	kilo volt
MV	medium voltage
MVA	mega volt ampere
MW	mega watt
NAGZ	North Atlantic Green Zone
NI	Northern Ireland
NIE	Northern Ireland Electricity
NPV	net present value
NTC	net transfer capacity
OMS	outage management system
PCI	Projects of Common Interest
PV	photovoltaic
RES	renewable energy sources
RIDP	Renewable Integration Development Plan

RoCoF	rate of change of frequency
RTE	Réseau de Transport d'Électricité
RTU	remote terminal unit
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
SG	smart grid
SGTF	Smart Grids Task Force
SONI	System Operator Northern Ireland
SUPERIOR	Smart Unified Project for Enhancing gRid Integration Of Renewables
TLC	telecommunication
TSO	transmission system operator
TVPP	technical virtual power plant
TYNDP	Ten Years Network Development Plan
UR	Utility Regulator of Northern Ireland

1 INTRODUCTION

1.1 GOAL OF THIS DOCUMENT

This report presents the outcome of the evaluation of smart grid energy infrastructure project proposals carried out by Expert Group 4 (EG4) of the Smart Grid Task Force ([1]). This process was carried out using the assessment framework developed by EG4 for Projects of Common Interest (PCI) in the field of smart grids. This latter and the present document shall serve as guidance for the regional groups when proposing and reviewing PCI, under the trans-European energy infrastructure regulation (Regulation (EU) No. 347/2013) ([2]).

1.2 BACKGROUND

EG4 mission

EG4, established in February 2012, comprises relevant stakeholders from industry (system operators, manufacturers), regulatory authorities and Member State representatives. During the preparatory year of 2012, EG4 worked on an assessment framework for the identification of potential energy infrastructure PCI in the field of smart grids. The resulting methodology was adopted by EG4 on 4 July 2012. It takes into account the technical and specific criteria for the identification of PCI in the field of smart grids, as defined in the trans-European energy infrastructure regulation.

Eligibility requirements

The trans-European energy infrastructure regulation, which entered into force on 15 May 2013 and is applicable from 1 June 2013, defines the following general requirements for project eligibility.

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(1) The mission of the European Task Force for the Implementation of Smart Grids into the European Internal Market (also known as the Smart Grids Task Force (SGTF)) is to advise the Commission on policy and regulatory frameworks at European level, to coordinate policies towards the implementation of Smart Grids under the provision of the Third Energy Package and to assist the Commission in identifying Projects of Common Interest in the field of Smart Grids, within the context of the Regulations of the European Parliament and of the Council on guidelines for trans-European energy (COM (2011)658) and telecommunications networks (COM(2011)657) infrastructure. The Smart Grids Task Force was reactivated on 1.2.2012 and four Expert Groups were set up (see http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm online).

(2) Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009, OJ L115/39, 25.4.2013.

- It should contribute to the implementation of the energy infrastructure priority corridors and priority thematic areas, including smart grid deployment (Annex I (4) (10)).

- It should fulfil the minimum technical requirements as defined in Annex IV (1) (e) of the trans-European energy infrastructure regulation. These requirements were drawn up to select projects that have an appropriate size/scale/level of readiness (deployment, not research and development (R&D)), and substantial cooperation between the distribution system operators (DSOs) and transmission system operators (TSOs). Moreover, PCI need to meet cross-border criteria as specified in Art. 4 (1) (c).

- It should significantly contribute to all six specific functions (these are indicated as 'services' in the assessment framework developed and approved by EG4 ([3])) of the Smart Grid (Art. 4 (2) (c)). Project contribution to the above shall be evaluated against six different (policy) criteria set out in Annex IV (4). Each criterion shall be measured according to key performance indicators (KPIs), as detailed in Annex IV (4). Project promoters will need to convincingly demonstrate their project's compliance to, and extent of coverage of, the six policy criteria.

- Project promoters will be asked to demonstrate the project's economic viability and cost-effectiveness in accordance with the trans-European energy infrastructure regulation (Art. 4(1) (b)), by explaining how potential benefits will outweigh the project costs, and will support their case with a societal cost-benefit analysis (CBA) and qualitative appraisals of benefits that cannot be reliably monetised.

1.3 PROJECT PROPOSALS

A request for information of smart grid project proposals in line with the requirements of the energy infrastructure regulation was launched on 20 July 2012 ([4]).

The following projects were submitted by 30 September 2012.

1. **North Atlantic Green Zone**

(3) Definition of an Assessment Framework for Projects of Common Interest in the field of Smart Grids: see http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm online.

(4) See http://ec.europa.eu/energy/infrastructure/consultations/20120720_electricity_smartgrid_projects__en.htm online.

Member States involved: Ireland and the United Kingdom.

2. **GREEN-ME** (**G**rid integration of **Re**newable **E**nergy sources in the **N**orth **Me**diterranean)

   Member States involved: France and Italy.

3. **SUPERIOR** (**S**mart **U**nified **P**roject for **E**nhancing g**R**id **I**ntegration **O**f **R**enewables)

   Member States involved: Spain and Portugal.

4. **Agricultural farms and smart grid integrated renewable resources**

   Member State involved: Poland.

This report presents the project proposals' evaluation following the assessment framework adopted by the group. The evaluation process is depicted in Figure 1. Fulfilment of the technical requirements is a precondition for further evaluation of a project proposal, according to the policy and economic criteria.

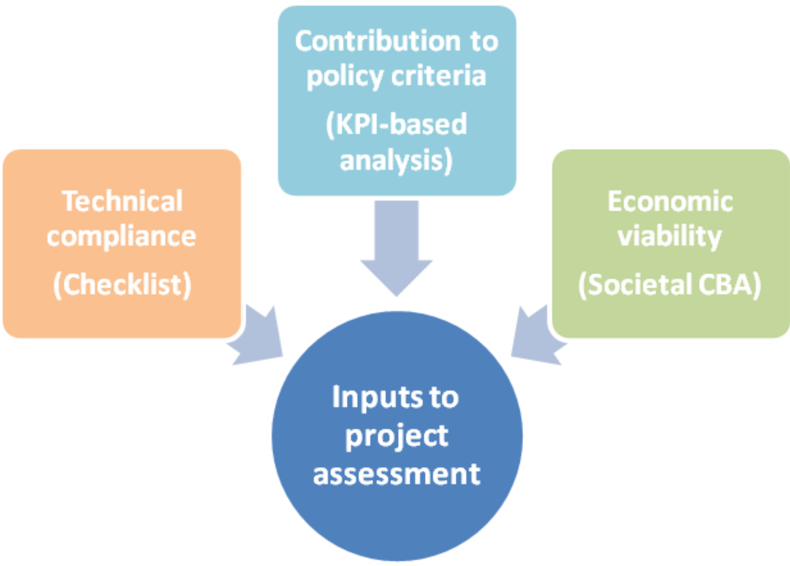

Figure 1 Inputs to project assessment to be included in the project proposal

A colour-coded approach has been used in the evaluation process: three main colours (green, yellow and red) and mixed evaluations between two colours are used, resulting in a scale of five different possible types of evaluation.

Green indicates that a positive impact has been assessed with sufficient level of confidence.

Yellow indicates that some positive impact has been assessed with some confidence; however, there may be uncertainties (either concerning the information provided or the assumptions made).

Red indicates that based on the information provided, limited impact has been assessed, or that a positive impact could not be assessed with a sufficient level of confidence, due to lack of information.

2 EVALUATION OF PROJECT PROPOSALS

2.1 NORTH ATLANTIC GREEN ZONE (Ireland and Northern Ireland)

2.1.1 General overview

Where

The project proposal involves the north-west area of Ireland and the west area of Northern Ireland (United Kingdom). No interconnections with the British mainland are foreseen. Although they are two different countries, the United Kingdom's Northern Ireland and Ireland have constituted a single electricity market since 2007.

Who

The project promoters are the Irish DSO electricity supply board (**ESB) networks,** the TSO and DSO **Northern Ireland Electricity,** the Irish TSO **EirGrid** and the Northern Ireland TSO **SONI.**

When

The project duration is three years.

Why

The project proposal is motivated by the significant ongoing increase in wind generation in the area. Wind curtailment due to the grid's lack of flexibility is expected to be a major issue in the project area.

The goals of the project are therefore:

- ✓ to increase the hosting capacity of distributed energy resources, avoiding typical curtailments due to over-generation from distributed renewable energy resources through new relay setting for frequency control, anti-islanding protection, voltage increase, control of voltage and reactive power flows as well as dynamic line rating;

- ✓ to improve the reliability of the grid (reduction of outage times) through new reclosers, fault sensors and arc suppression coil systems, as well as new interconnectors.

What

The project proposal sets out the aim of increasing the observability and controllability of the medium voltage (MV) distribution network.

The main elements of the project are:

- high-speed communication infrastructure connecting MV lines to the control centres;
- grid monitoring, dynamic line rating and variable wind access;
- reactive power and voltage control by volt/var control at wind farms, online tap changers, installation of reactive resources and conservation voltage reduction (CVR);
- distribution automation (fault passage indicators, switches, reclosers) for dynamic sectionalisation and implementation of arc suppression coil (ASC) systems;
- anti-islanding protection systems (rate of change of frequency (RoCoF) relays at distribution level);
- possible increased exploitation of the existing line, 110 kV Letterkenny–Strabane;
- new cross-border distribution lines (MV);
- voltage conversion of MV lines (from 10 kV to 20 kV).

The main outcomes of the project are:

- improved distribution continuity and security standards (reduced outage time and increased frequency stability);
- increased variable access capacity on distribution networks at system level;
- reduced distribution losses and energy savings;
- increased cross-border cooperation (DSO–DSO).

Deployed assets and system architecture

The system architecture of the project is shown in Figure 2 and Figure 3.

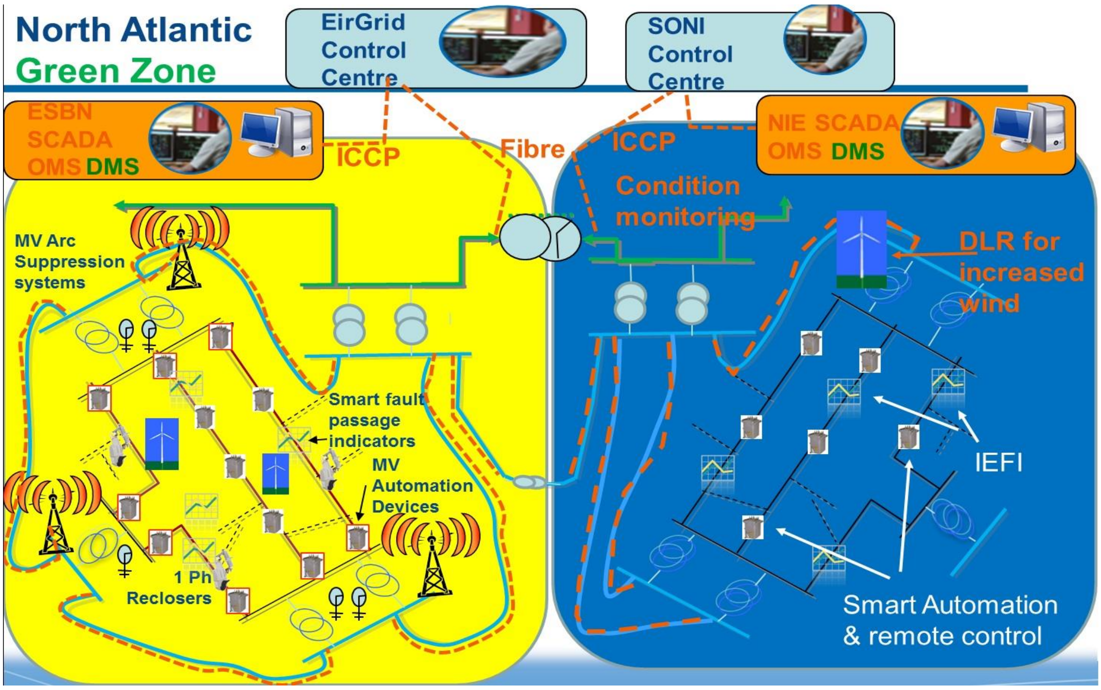

Figure 2 North Atlantic Green Zone system architecture

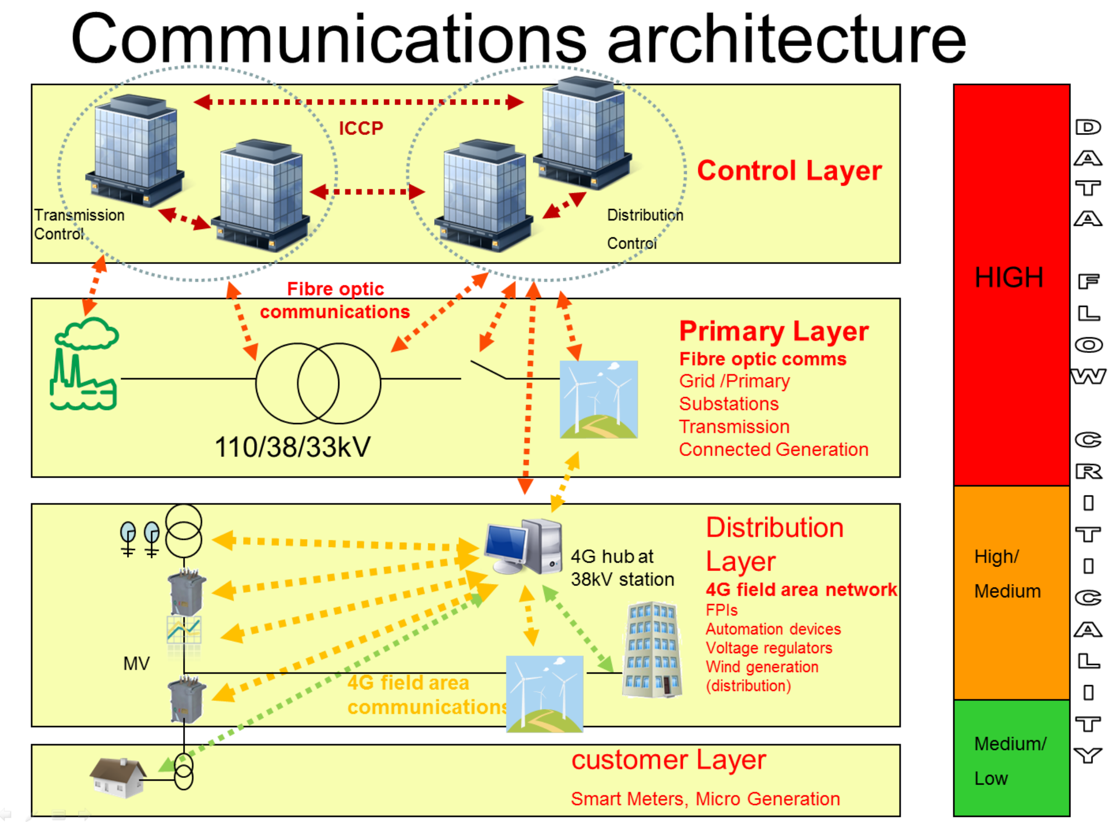

Figure 3 North Atlantic Green Zone communication architecture

Ireland

In Ireland, the project will impact 25 MV substations of 38 kV, 8 110/38 kV substations and more than 2 600 km of MV lines.

NETWORK INFRASTRUCTURE

The following measures are to be implemented within the proposed project, in order to deliver the full benefits of an integrated project.

- Convert all MV networks to 20 kV: more than 2 600 km MV network lines are intended to be converted from 10 kV to 20 kV, so as to improve electricity supply quality and reduce network technical losses. In addition, this intervention will more than double the capacity of the network to accommodate load or generation connections.

- Smart ASC system: the project envisages deployment of ASCs at 22 substations as an innovative protection scheme; it is expected to considerably reduce average customer interruptions and customer minutes lost due to faults.

- Smart complementary fault passage indicators (three per outlet): for easier fault location with near real-time notification; these are currently being integrated into a central control centre for fault analysis and operator notification.

- Automation devices: 2.5 reclosers per outlet with self-healing functionality to isolate the faulted part of the network, and 2.5 remote control switches per rural circuit to automatically enable further isolation of the faulted network.

- 1-ph trip-saver device: a single-phase recloser device to reduce trips due to transient faults on the single-phase network, and to isolate the single-phase line containing the actual fault.

- Five cross-border distribution connections: the project proposes five interconnections operated by the DSOs with consultation and agreement with the TSOs. This will more economically or effectively address the challenges of balancing renewable generation, load and reactive power on both side of the border, and thus leverage the reliability and quality of supply. In addition, the project supports reducing the overall quantity of overhead electricity networks required in the region, hence increasing public acceptance and having positive environmental impact.

- MV booster automation: automation of MV network voltage regulators already present in the network of the project area.

- Reactive power resources: the project argues for reactive power management using the optimisation engine to alter system voltage and optimally deploy reactive resources.

ICT

- Fibre on 38 kV substations.

- Wireless communications for MV down-line sensors and devices.

- Upgrade software at the distribution control centre (DCC) (supervisory control and data acquisition (SCADA), distribution management system (DMS), outage management system (OMS) — closed-circuit TV (CCTV)), as follows:

  - SCADA upgrade to enable backhaul of all MV network signals, including remote terminal unit (RTU) capacity upgrades to cater for fibre backhaul of fourth-generation (4G) down-line networks' monitoring and control signals from 38 kV substations;

  - DMS upgrade: high-speed reliable communication, full electrical models of the MV, 38 kV and 110 kV systems and full deployment of network sensors integrated with the existing DMS;

  - enabling active management of the distribution system on the top of the existing DSO outage management system;

  - Installation of CCTV at high-voltage (HV) stations for theft reduction.

The project will also implement dynamic line rating and CVR, keeping voltage levels slightly below the nominal value to reduce consumption.

Northern Ireland — United Kingdom (NI)

In NI, the project will impact 27 HV stations and 60 MV circuits.

Deployed assets include the following.

NETWORK INFRASTRUCTURE

- Smart automation and remote control: 2.5 remotely controlled reclosers or switches per circuit — through advanced control, these can automatically isolate a line fault and restore supply to all other customers on the faulted network in under 1 minute.
- Smart complementary fault passage indicators: three per circuit for easier fault location with near real-time notification.
- Five cross-border distribution connections.
- Increase operational capacity of 110 kV interconnectors: the potential use of these interconnectors for normal operation is addressed within the project (so far, they have been used only for emergency back-up), for balancing renewable generation, load and reactive power on both sides of the border.

ICT

- Fibre on 38 kV substations.
- Upgrade software at DCC: SCADA, DMS and OMS.
- Condition monitoring system: installation of battery system upgrade at all HV stations, transformer monitoring, oil monitoring and office-based back-room systems for analysis and processing.

2.1.2 Role of DSOs and TSOs

DSOs will be leading the activities in the project. The project will focus on increasing the observability and controllability of the distribution grid at MV. This would result in easier management of the transmission grid by TSOs.

In the project, the TSOs will participate in the following activities/tasks (in close collaboration with the DSOs):

- review the potential use of existing 110 kV interconnectors for normal operation (not just for emergency back-up) to balance renewable generation, load and reactive power.

The project will require cooperation between DSOs and TSOs in the following domains:

- operational framework between DSOs and TSOs for implementing voltage and reactive power control for wind integration at both DSO and TSO level, operating the new distribution interconnections and frequency control measures at DSO level;
- installation of reactive compensation resources: choice of optimal installation points to be jointly determined by DSOs and TSOs;
- development of market frameworks for demand side management for:
    - energy losses optimisation at both DSO and TSO system level;
    - enabling growing potential of renewable generation at both DSO and TSO system level;
- management of cross-border flows at distribution level;
- development of an operational framework for management of potential future energy storage applications in the distribution and transmission systems for frequency support, thus reducing the level of wind curtailment.

2.1.3 Cross-border impact and added value of joint project

The regions of the two Member States making up the project proposal are presently interconnected via a 275 kV double circuit connection and two 'power-flow controlled' 110 kV circuits. The two distribution systems are presently electrically isolated, i.e. the IE-NI 110 kV interconnectors that are part of the project zone are currently used in emergencies, while the main cross-border load flow is through the 275 kV interconnector, which is outside the project zone.

At distribution level, the project proposes five new cross-border lines operated by the DSOs, mainly driven by reliability requirements in the distribution networks. This implies that a framework for cross-border DSO–DSO operations needs to be developed which would include sharing information (DSO–DSO and DSO–TSO) for the operation of the cross-border distribution lines. However, despite the notable contribution of such investment, this element does not directly comply with the dimension of the smart grid requirement of the project.

At transmission level, the project intends to explore improved exploitation of the existing cross-border interconnections (110 kV) for normal operation in balancing renewable generation, and optimal control of both active and reactive power across the border that would lead to increased hosting capacity of renewables in the area. Presently, these are only used in emergency cases, and have a net power flow of only 20 MVA. Increasing the capacity of existing lines through more effective exploitation (thanks to improved load-flow management in the area), and thus increasing the net transfer capacity (NTC) in the area could be considered a smart grid measure.

The project proposes development of communication and control software between the two 110 kV interconnectors to allow for their full exploitation through automated coordination. This would increase the potential of the 110 kV interconnectors (not their physical capacity) through adjustment of the operational range of the existing primary stations (HV/MV).

Potential benefits arising from improved exploitation of these interconnectors include the following.

- Increase MW transfers (subject to considerable network capacity limits) to reduce curtailment of RES. Where greater levels of non-firm wind generation can be accommodated, this might also lead to lower network constraint payments (i.e. balancing costs) and lower wholesale prices for consumers;
- Provide enhanced operational security during transmission maintenance;
- Coordinated MVar dispatch to optimise voltage levels, thereby enhancing system security, and reducing losses;
- Frequency response (control);
- Use of real-time information exchange to increase interconnector capacity.

However, it must be noted a quantification of these benefits has not been carried out as yet.

Furthermore, the project proposal notes that 'further interconnections to address capacity transfer limitations between the two jurisdictions are already planned and are being submitted for funding under the TYNDP' ([5]). In fact EirGrid, SONI and NIE are jointly proposing a new high-capacity electricity interconnector between the electricity networks of Ireland and Northern Ireland under the North-South 400 kV Interconnection Development (also known as the Meath–Tyrone 400 kV Interconnection Development). Currently, there is only a single 275 kV interconnector between the two networks. Also, further interconnections between the two jurisdictions are being considered as part of the Renewable Integration Development Plan (RIDP).

Project coordinators have clarified that:

1. under no circumstances is there an overlap between these new interconnectors and this project proposal;

2. the envisaged reduction in RES curtailment (from 25 % to 6 %) will be achieved through measures addressing frequency response and reactive power management, not through the additional capacity considered under the RIDP and funded under the TYNDP.

Added value of a joint project

According to the TSOs' letter of project endorsement, in order to reduce wind curtailment from 25 % to 6 %, it is necessary to see improvements at system level across the whole project zone. In this respect, there is added value in carrying out a joint project that would ensure coordinated system improvements to the whole region. It is worth mentioning that the project area is already operated as a single electricity market.

The implementation of five new cross-border lines, which aim at significantly reducing outage times in the region, calls for cross-border cooperation between the two DSOs.

Conversely, benefits like 'reduced outage times' and 'energy savings through CVR' are mainly achieved through the implementation of new distribution automation, line voltage reconversion and ASC systems in both project regions. In principle, these installations can be carried out independently in both regions, but the proposal argues that a joint project will

(5) Ten-Year Network Development Plan by ENTSO-E (see https://www.entsoe.eu/major-projects/ten-year-network-development-plan/tyndp-2012/ online).

bring added value in terms of sharing experiences, expertise and knowledge. Examples include ESB Network trials on CVR, and self-healing networks and NIE trials on dynamic line rating.

2.1.4 Compliance with technical requirements

1) Voltage level(s) (kV) greater than 10 kV

The project will involve interventions on the MV and HV grid, particularly from 10 kV to 220 kV.

The project proposal fulfils this criterion.

2) Number of users involved (producers, consumers and prosumers) greater than 50 000

The portion of the grid impacted by the project proposal includes 187 000 users (106 000 users in Ireland and 86 000 users in NI).

The project proposal fulfils this criterion.

3) Consumption level in the project area (MWh/year) greater than 300 G Wh/year

The level of consumption in the project area was 1. The level of consumption in the project area was 1 145 GWh in 2011 (Ireland: 721 GWh/year, and NI: 424 GWh/year.)

The project proposal fulfils this criterion.

4) Percentage of energy supplied from renewable resources that are variable in nature, of at least 20 %

The capacity of renewables connected is 550 MW ([6]), while the peak demand in the consumption area considered is equal to 300 MW. This implies that, in terms of capacity, renewable resources that are variable in nature provide more than 100 % of the peak demand.

(6) In Ireland, wind power capacity is as follows: 308 MW connected, 186 MW offered, and a further 700 MW requested. In NI, wind power capacity is 269 MW connected and 185 MW offered.

Concerning energy supplied, data provided by project promoters show that in the year 2011 in the consumption area concerned, the energy supplied from renewable resources that are variable in nature equals 1 700 GWh per year, i.e. 148 % ([7]) of the consumption in the area, as quoted by the project promoters.

The project proposal fulfils this criterion.

5) Projects involving transmission and distribution operators from at least two Member States

The project involves the DSO and TSO from Northern Ireland (NIE and SONI) and the DSO and TSO from Ireland (Electricity Supply Board Networks (ESBN) and EirGrid). The two Member States are Ireland and the United Kingdom.

The project proposal fulfils this criterion.

2.1.5 Smart grid dimension

The main smart grid applications foreseen in the project are:

- ✓ communication infrastructure to integrate new sensors and actuators on the MV grid into demand side management (DSM);
- ✓ dynamic line rating;
- ✓ voltage and reactive power control of DER for DER variable access;
- ✓ anti-islanding, frequency control, monitoring of MV lines and CVR;
- ✓ automatic fault management.

Based on the information supplied to date, other key elements of the project do not appear to be directly in line with the smart grid dimension of the project.

In particular, these are:

- ✓ voltage conversion of the MV lines from 10 kV to 20 kV (only in Ireland);

(7) The energy production from renewables that are variable in nature in the project area is 907 GWh in Ireland and 792 GWh in NI (measured and calculated data).

- ✓ five new cross-border lines at distribution level.

However, in the evaluation, it is recognised that — apart from offering direct benefits — these elements of the project are also necessary to enable the smart aspects of the project.

In fact, voltage conversion:

- ✓ increases the feasibility of CVR (by flattening the voltage across the network);
- ✓ facilitates dynamic network sectionalisation (higher voltage level gives a greater security margin to the implementation of dynamic network sectionalisation).

Moreover, the new cross-border lines at distribution level will require and enable a coordinated cross-border operation of the two networks by the two DSOs. This will entail the development of new operating protocols and sharing of real-time signals between the DSOs, enabling the integration of networks at different voltages, with each portion of the network being dynamically operated with actively managed voltage and active and reactive power.

2.1.6 External developments affecting project impact

A key goal of the project proposal is to increase the grid's hosting capacity for RES. A large fraction of the expected project benefits are based on the assumption that RES installation in the project area will substantially increase.

To support this claim, project promoters report that they have received requests to connect RES that far exceed the connection requests considered in their project proposal — which only includes those approved by the respective TSO and DSO.

In calculating the KPIs, additional RES that will be integrated in the smart grid scenario are therefore equal to the level of approved requests for connection. Project promoters state that without the developments brought forward by the project, there is a far higher risk that many RES for which applications have been received by the DSOs and TSOs would see higher delays or would ultimately withdraw from the process. In other words, project promoters expect that, thanks to the project, the foreseen level of RES will actually be installed, thanks to the following.

- ✓ Reinforced networks, which offer increased and more stable capacity.

- ✓ New contractual arrangements and the facilities to enable their operation, allowing potential more economically viable connections for promoters of new RES installations.

- ✓ Decreased risk on investments in new RES installations, as the risk of curtailment will be reduced from 25 % to 6 %, increasing the expected rate of return.

- ✓ More certainty for potential wind developers, by showing a dedicated commitment to the networks in this region. There are already significant uncertainties and delays concerning wind generation connection in Ireland, due to network development requirements. This also creates barriers for wind developers trying to access necessary funding. By delivering this project, the network operators are firmly demonstrating to the industry that there is a degree of certainty for developers and investors in this region.

Additionally, it is assumed that the following developments will take place, thanks to the project implementation:

- ✓ 10 % more (compared to the business as usual (BaU) scenario) of the planned and contracted wind generation will be delivered (from 70 % to 80 %);

- ✓ 10 % power of large-scale MV customers (around 7 MW) will commit to demand response.

Finally, another key assumption in the project proposal is that the project will enable a substantial reduction of wind curtailment in the area: from 25 % to 6 %.

A detailed study of the region provided by project coordinators (the Facilitation of Renewables Studies (8)) shows that in order to achieve 40 % of overall electricity consumption from wind generation by 2020 (a binding government commitment), it is necessary to achieve up to 70 % to 80 % of instantaneous wind penetration. With this level of instantaneous wind penetration, wind curtailment is likely to reach a level of 25 %.

The study indicates which critical interventions are necessary in order to safely achieve such a level of wind penetration, while reducing the wind curtailment to 6 %.

(8) EIRGRID study on Facilitation of Renewables (see: http://www.eirgrid.com/renewables/facilitationofrenewables/ online).

Some of these interventions are addressed in the North Atlantic Green Zone project:

- ✓ voltage-reactive support from wind farms;
- ✓ reactive power resources in the distribution grid;
- ✓ improved observability of the grid, allowing monitoring of the wind generation portfolio to ensure it develops in line with expectations.

In other words, information provided shows that the North Atlantic Green Zone (NAGZ) project is necessary (even if not necessarily sufficient) to achieve a reduction of wind curtailment from 25 % to 6 %.

In both KPI analysis and CBA, the positive contribution of the NAGZ project as a critical enabler for this outcome has been recognised. However, it should be recognised that other external developments (e.g. connection requests for new renewable power sources) outside the control of project coordinators impact on the achievement of a wind curtailment limited to 6 %. In this respect, the project coordinators were requested to carry out a sensitivity analysis of wind curtailment levels. This analysis confirmed the possibility of having wind curtailment below 10 %, where the difference from the 6 % level is attributable to issues such as frequency excursions after network faults, and reactive power and voltage control. Nevertheless, information provided indicates that the NAGZ project still has a positive impact — even if, under unfavourable circumstances, the level of wind curtailment cannot be reduced below 10 %.

2.1.7 Policy criteria: evaluation of key performance indicators

Key assumptions

- ✓ In the smart grid scenario, there will be a wind curtailment reduction from 25 % to 6 %. A sensitivity analysis has also been considered, to account for instances where wind curtailment could not be reduced below 10 %, due to factors beyond the NAGZ project's control.
- ✓ 80 % of the planned and contracted wind generation required nationwide to achieve Ireland's 2020 goals (40 % of electrical energy coming from renewables) will be delivered in the smart grid scenario; this is higher than the 70 % assumed in the BaU scenario.

- ✓ Variable access capacity of wind generation at MV will allow an additional 177 MW to be connected.

Criterion 1: level of sustainability

A reduction of greenhouse gas emissions is expected through:

- ✓ reduced wind curtailment;
- ✓ electricity savings (CVR and reduced technical losses).

The hypothesis of reduction of wind curtailment from 25 % to 6 % significantly affects the calculation. The CO_2 displacement in the smart grid scenario comes mainly (96 %) from reduced wind curtailment. The remaining 4 % comes from energy savings (reduced losses and CVR savings). The proposal estimates around 550 ktonnes of displaced CO_2. The electricity consumption in the area is 1 400 GWh in the BaU scenario.

Table 1 North Atlantic Green Zone: evaluation of project performance against the first policy criterion

Level of sustainability			Estimated project impact according to information provided
KPI $^a_1$	Reduction of greenhouse gas emissions	The KPI was estimated (assumption over CO_2 energy content: 325 g/kWh). It has been assumed that wind curtailment is reduced from 25 % to 6 %. Overall, the project is expected to displace 564 000 tonnes of CO_2. The sensitivity analysis shows that if wind curtailment cannot be reduced below 10 %, the KPI amounts to 287 g/kWh (–12 %).	
KPI $^b_1$	Environmental impact of electricity grid infrastructure	The KPI is not provided. However, the project is expected to have a positive impact in terms of hosting capacity and efficiency. It is reasonable to assume that this could defer the construction of new planned transmission systems and generation plants. More information is expected at the detailed design stage of the project.	

Criterion 2: capacity of transmission and distribution grids to connect and bring electricity from and to users

Provided data show that the project has a positive impact in terms of hosting capacity of wind generation and in reducing the energy curtailment. The hypothesis that the system improvements resulting from the project will lead to a reduction of wind curtailment (from 25 % to 6 %) significantly affects the calculation.

It is assumed that thanks to the NAGZ project (including smart grid and traditional investments), around 200 MW of additional wind generation will be connected, and an increase of around 800 GWh/y of wind energy will be injected.

Table 2 North Atlantic Green Zone: evaluation of project performance against the second policy criterion

Capacity of transmission and distribution grids to connect and bring electricity from and to users			**Estimated project impact according to information provided**
KPI $^{a}_{2}$	Installed capacity of distributed energy resources in distribution networks	The KPI was estimated (0.575). 491 MW of existing and 70 % of 337 MW wind generation to be connected in the BaU scenario. The smart grid scenario involves a connection of 491 MW and 80 % × (the planned 337 MW + additional 177 MW variable access wind). It has been assumed that wind curtailment is reduced from 25 % to 6 %. If wind curtailment cannot be reduced below 10 %, the KPI amounts to 0.505 **(–12 %).**	
KPI $^{b}_{2}$	Allowable maximum injection of power without congestion risks in transmission networks	A detailed assessment has not been carried out. However a positive impact is expected through: • replacement of existing conductors with high-temperature low-sag (HTLS) conductors; • increased cross-border capability; • dynamic line rating; • reactive power/voltage management.	
KPI $^{c}_{2}$	Energy not withdrawn from renewable sources due to congestion or security risks	The KPI was estimated, showing a significant increase of wind energy that could be safely injected in the system. It has been assumed that wind curtailment is reduced from 25 % to 6 %. If wind curtailment cannot be reduced below 10 %, the KPI is reduced by 21 %, but still remains positive.	

Criterion 3: network connectivity and access to all categories of network users

The project proposal refers to project contribution to increase the amount of dispatchable power through DSM. The calculation is carried out under the hypothesis that 10 % of the contracted power will be committed to DSM.

The project will support demand response uptake through:

- development of a commercial framework via collaboration among project promoters, the regulator and all stakeholders;

- technical facilitation through the increased monitoring and communications infrastructure, which are required for the provision of any service to be included in advanced network planning and operational policies;

- variable wind access and other more flexible contract types, incentivising commercial parties to engage in demand response contracts (or storage activities).

The project also aims to deliver more operational flexibility and the possibility of better balancing reactive power in the region, through reactive power and voltage management of wind generation, installation of reactive power resources on distribution networks, and integrated control of these resources through DMS, communications and monitoring systems. The detailed design and operation of reactive power management and flexibility will be realised in the delivery of this project, and at that stage the precise magnitude of these resources and their impact in terms of flexibility will be clear.

Finally, another project contribution is the implementation of widespread monitoring and control capabilities. This would make available detailed data to be used for new methods of calculating charges and tariffs. Of course, the actual definition of calculation methods is beyond the scope of the project coordinators.

Table 3 North Atlantic Green Zone: evaluation of project performance against the third policy criterion

Network connectivity and access to all categories of network users			Estimated project impact according to information provided
KPI ${}^{a}_{3}$	Methods adopted to calculate charges and tariffs, as well as their structure, for generators, consumers and those that do both	New advanced monitoring and control capabilities can make available detailed grid information, which is expected to allow: • a wider range of connection solutions for generators — by offering a range of variable capacity options; • determining of loss factors more accurately — both those on the time-of-use basis, and average loss factors for demand and generation customers at different voltage levels; • an ancillary service market for reactive power, thus contributing to improved system stability.	
KPI ${}^{b}_{3}$	Operational flexibility for dynamic balancing of electricity in the network	Flexibility comes from increased DSM. **Two scenarios are considered:** • 10 % capacity of large-load customers in the project area of Ireland committed to DSM — 6.73 MW; • 20 % capacity of all large-load customers in the project area committed to DSM — 13.4 MW. According to the project proposal, the potential for demand response is strong in the area, based on historical programme subscriptions and expressions of interest by commercial parties. By implementing new monitoring and communication capabilities, the project is expected to facilitate a coordinated response between DERs and DSOs. In the project, coordinators will also explore the possibility of combining storage and biodiesel generation to increase wind generation access to the network.	

Criterion 4: security and quality of supply

The project delivers a significant improvement of the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI), both of which are currently very poor in the project area. According to an ESBN study, more than 80 % of earth faults seen on MV networks (in Ireland) are transient and can be effectively managed by using reclosers.

Significant improvements in terms of security and quality of supply will also be achieved through the 20 kV MV line conversion. However, it should be noted that this measure does not appear to directly fall in line with the smart grid dimension of the project.

The project proposal reports that improvements to voltage quality performance cannot be reliably measured, as data from the BaU scenario are not known. The number of customer complaints is used as proxy.

The project also delivers an increase in reliably available capacity, through both smart grid and traditional investments:

- DSM: 10 % of power committed from large commercial loads;
- increased available capacity of wind generation.

Table 4 North Atlantic Green Zone: evaluation of project performance against the fourth policy criterion

	Security and quality of supply		Estimated project impact according to information provided
KPI $^{a}_{4}$	Ratio of reliably available generation capacity and peak demand	The KPI was estimated. Benefits are expected as a result of peak shaving measures like: • 20 kV conversion leading to peak loss reduction; • dynamic sectionalisation leading to peak loss reduction of 371.2 kW; • CVR leading to peak reduction. The KPI was calculated only for the Irish part of the zone, under the assumption that similar factors apply to Northern Ireland.	
KPI $^{b}_{4}$	Share of electricity generated from renewable sources	The KPI was estimated (0.62). It has been assumed that wind curtailment is reduced from 25 % to 6 %. If wind curtailment cannot be reduced below 10 %, the KPI amounts to 0.542 **(–12.5 %).**	

	Security and quality of supply		Estimated project impact according to information provided
KPI $^c_4$	Stability of the electricity system	The KPI was estimated. Time restrictions prohibited a detailed study. However, an indication of the increased stability of the system is the degree to which curtailment of variable renewable generation (due to frequency and voltage stability criteria) will be reduced. It has been assumed that wind curtailment is reduced from 25 % to 6 %. If wind curtailment cannot be reduced below 10 %, the KPI is reduced by 21 %.	
KPI $^d_4$	Duration and frequency of interruptions per customer, including climate-related disruptions	The KPI was estimated. Significant improvement is expected, due to the current poor disruption indexes in the region. SAIDI improvement is foreseen at around 30 %, and SAIFI improvement at around 50 %.	
KPI $^e_4$	Voltage quality performance	The KPI was estimated. Voltage complaints were used as proxy. Significant improvement (+30 %) is expected, mainly due to a 20 kV MV line conversion of the Irish part of the project zone. Furthermore, the monitoring and communication resources of the project would further account for easier identification of critical points in the network, particularly with the intention to deploy targeted domestic smart meters as voltage sensors.	

Criterion 5: efficiency and service quality in electricity supply and grid

The project delivers a reduction of peak consumption which in turn leads to a reduced level of energy network losses. This is achieved through the following means.

- CVR, assuming 0.8 % average load reduction per 1 % voltage reduction; 2.4 % peak demand reduction with 3 % voltage reduction. It is worth stressing that 'energy efficiency' does not explicitly appear in the KPI formulation. However the energy saving potential of CVR has been considered in the evaluation of this policy criterion.

- Voltage increase to 20 kV.

- Dynamic sectionalisation.

The project is also expected to incentivise the uptake of demand response and will create market opportunities for storage. It is, however, noted that these positive outcomes are highly dependent on the development of the right regulatory frameworks and on the actual uptake of such services in the market.

Table 5 North Atlantic Green Zone: evaluation of project performance against the fifth policy criterion

Efficiency and service quality in electricity supply and grid			Estimated project impact according to information provided
KPI $^a_5$	Level of losses in transmission and in distribution networks	Significant reduction of energy losses through dynamic sectionalisation and 20 kV conversion. The KPI was estimated for the Irish part only.	
KPI $^b_5$	Ratio between minimum and maximum electricity demand within a defined time period	The KPI was estimated only for the Irish ESBN/EirGrid part of the zone, under the assumption that similar factors will apply to the full region.	
KPI $^c_5$	Demand side participation in electricity markets and in energy efficiency measures	A demand response participation of 10 % is assumed. Energy efficiency will be achieved through CVR.	
KPI $^d_5$	Percentage utilisation (i.e. average loading) of electricity network components	Project coordinators estimated an increase of 30 %. Initiatives (both smart grid and traditional) that will increase the utilisation of assets are: • doubling the capacity of more than 2 600 km (approximately 25 % of the MV network); • offering variable capacity connections to generators — enabling dynamic line rating management of voltage set points; • offering more (up to 177 MW) variable generation capacity on existing distribution transformers than would be the case in the BaU scenario; • more accurate and real-time monitoring of network components (lines, transformers, etc.).	

	Efficiency and service quality in electricity supply and grid		Estimated project impact according to information provided
KPI $^{e}_{5}$	Availability of network components (related to planned and unplanned maintenance) and its impact on network performances	Implementation of a condition-based maintenance system is expected to provide the following benefits: • reduced faults and improved reliability due to proactive management of risks; • reduced maintenance costs due to optimised maintenance programmes based on individual unit information; • the move from interval-based maintenance to risk-based maintenance has reduced the maintenance requirement by over 30 %, according to experience of project coordinators. • The KPI was estimated (improvement of around 5 %). Not enough data available to back up the estimation.	
KPI $^{f}_{5}$	Actual availability of network capacity with respect to its standard value	An improvement of 20 % was estimated. No details provided.	

Criterion 6: contribution to cross-border electricity markets by load-flow control to alleviate loop flows and increase interconnection capacity

The design of the two transmission systems (with a single main interconnection) and the coordinated approach to system operation mean that loop flows are not significant in the project region compared to the ones in continental Europe. Congestion rents across interconnections are not present.

Some impact might be expected from better exploitation of the 110 kV lines connecting the two regions, which are currently used in emergency situations only. The project will carry out studies to assess the potential for better exploitation of the interconnection capacity through development of communication and control software between the two 110 kV interconnectors, to allow for their full exploitation through automated coordination.

Thanks to the new cross-border connections at distribution level provided by the project, another expected impact is the availability of new network development options to grid planners, for the purposes of reinforcing connections to any regions bordering with the island.

Better exploitation of the existing interconnection lines through smart grid monitoring and control infrastructure conform with the smart grid dimension of the project.

Table 6 North Atlantic Green Zone: evaluation of project performance against the sixth policy criterion

Contribution to cross-border electricity markets			Estimated project impact according to information provided
KPI $^a_6$	Ratio between interconnection capacity of a Member State and its electricity demand	Improvements based on better exploitation of the 110 kV interconnectors. A study will be carried out to assess potential for improvement.	
KPI $^b_6$	Exploitation of interconnection capacity	The project will study how to better exploit the 110 kV lines connecting the two regions.	
KPI $^c_6$	Congestion rents across interconnections	There are no congestion rents in the area, as both sides of the border are part of a single market. However, the project may contribute towards managing future potential congestions at the interconnections, due to the increase in renewable generation.	

2.1.8 Project economic performance

The project proposal includes an economic CBA, which details the costs and benefits included.

The main monetary benefits and costs resulting from the potential project deployment are listed below.

MAIN MONETARY BENEFITS

- ✓ **Reduced compensation costs for wind generation curtailment (52 %)**

This estimation assumes that the plans of installing 5 GW of wind will be respected. In this scenario, TSOs' studies foresee 25 % of curtailment for BaU and 6 % in the smart grid scenario.

- ✓ **Electricity savings**

These are achieved through voltage reduction with CVR.

- ✓ **Reduced outage times**

This is achieved through:

- the ASC system;
- distribution automation (fault passage indicators, reclosers and remote operable switches) to isolate the faulty phase line;
- coordinated use of the ASC and the fault passage indicators for accurate fault location detection.

- ✓ **Reduced technical losses**

This is achieved through peak reduction by implementing:

- optimal sectionalisation;
- (and mainly) 20 kV conversion.

MAIN COSTS (CAPEX)

- Fibre optic;
- 20 kV conversion;
- ASCs.

SENSITIVITY ANALYSIS

The sensitivity analysis has been carried out on the following variables.

- ✓ **Load growth:** in the reference scenario, a load growth of 0 % has been assumed. The net present value (NPV) also remains positive under a growth level of –2 % and 2 %.
- ✓ **Level of wind curtailment compensations:** in the smart grid scenario, it is estimated that the reduction of wind curtailment leads to a reduction of wholesale generation costs. The NPV also remains positive only if 20 % of the expected cost reduction actually materialises.

- ✓ **Reduced outage times:** the project implements a number of measures (distribution automation, ASC and reclosers) to improve continuity of supply. The benefit amounts to 16 % of the total benefit. An underperformance of foreseen measures of 40 % reduces the total NPV to 7 %.

- ✓ **Cost of energy:** an increase of the cost of energy would substantially increase the NPV (higher benefits from energy savings).

- ✓ **Discount rate:** applying a discount rate of 12 %, the NPV is reduced by 77 %.

- ✓ **Load reduction:** in the project, it is assumed that a load reduction of 0.8 % is achieved through a voltage reduction of 1 % by means of CVR. A 60 % reduction of the estimated load reduction would reduce the total NPV by about 20 %.

The sensitivity analysis indicates a positive NPV to reasonable variations of the aforementioned variables. The NPV is particularly sensitive to the discount rate (an increase from 4 % to 10 % of its value leads to project NPV reduction by 64 %) and, to a lesser extent, to the level of wind curtailment compensations.

The costs to make the expected reduced curtailment in this region effective are borne exclusively by the NAGZ project, and these include telecommunications, monitoring, control and analytical resources. Such measures should account for network flexibility and integration of voltage/reactive power control into the system.

Project coordinators do not foresee additional costs related to possible external developments that might arise concurrently to achieve the reduction of wind curtailment, which is the key element of the project. However, project coordinators consider an additional 10 % in the contingency budget reasonable. Also, the Irish TSO EirGrid indicated that an additional EUR 200 000 may be required for the development of their systems in line with new operational frameworks.

NON-MONETARY BENEFITS

The project envisages deployment of optic fibre at the backbone level of the distribution grid, which is considered to also have positive effects on connectivity in the area, if used for commercial purposes.

2.1.9 Summary of evaluation

The objectives of this project are to enable flexible operation of networks so as to facilitate greater wind generation, improve quality of supply and reduce losses. The North Atlantic Green Zone is a project with clear objectives and a well-defined set of necessary inputs to achieve them. Project promoters have carried out a comprehensive assessment of the requirements and of what needs to be installed. KPI analysis and CBA have been performed in a structured way. In general, the provided information is detailed and adequately explained.

The competent regulatory authorities, the Commission for Energy Regulation (CER) and the Utility Regulator for Northern Ireland (UR), have informally expressed positive opinions concerning the project.

Based on the information provided by the promoters, their assessment indicates that the project meets the criteria set out by the trans-European energy infrastructure regulation and the project questionnaire for smart grids project.

CER and UR acknowledge that once smart network operation is feasible in the region, benefits will be seen in carbon reduction, reduced wind curtailment and national cost of compensation, and improved supply quality, thus improving the industrial and economic prospects as well as system security for the region.

As detailed below, the project fulfils the technical criteria and shows positive impact against the policy and the economic criteria set out by the assessment framework. Nevertheless, there are traditional elements which do not directly fit into the smart grid dimension of the project. Despite the acknowledged effort of the NAGZ promoters in the project KPIs' evaluation, missing information at this stage of the project did not allow for firm appraisal of some KPIs (coded in yellow and red in Tables 1 through 6 above).

Eligibility requirements

Based on the information provided by the project promoters, the project proposal is in line with the technical requirements as set out in the trans-European energy infrastructure regulation.

TSOs and DSOs from both Member States are actively participating in the project. The project is expected to foster increased coordinated operation between DSOs and TSOs, and new cross-border cooperation DSO–DSO.

The project is expected to provide positive cross-border impact through reduced wind curtailment in the region and reduced outages thanks to new cross-border interconnection lines jointly operated by the two DSOs.

KPI analysis

The KPI analysis has been carried out in a clear and structured way, as explained above. However, assumption-based and missing information for some of the KPIs at this stage of the project hindered their firm evaluation (as depicted in yellow and red cells in Tables 1 through 6 above).

The project provides significant benefits to the region in terms of wind integration, improved continuity of supply and energy savings, outage management and increased cross-border cooperation, particularly at DSO level. Positive impacts in terms of security of supply and of efficiency are also attributable to the fact that the region (rural) has poor indexes of continuity of supply and a high level of losses.

One key assumption is that the project will enable a reduction of wind curtailment in the project area from 25 % to 6 %. Information provided shows that the NAGZ project is necessary (even if not sufficient) to achieve the reduction of wind curtailment from 25 % to 6 %. In the KPI analysis and in the CBA, we have recognised the positive contribution of the NAGZ project as a critical enabler of this outcome.

Since external developments outside the control of project coordinators might be needed to achieve a wind curtailment of only 6 %, project coordinators have integrated the evaluation with a sensitivity analysis with respect to the wind curtailment potential. Considering a reduction of wind curtailment of 10 %, the project delivers a good impact in all related KPIs and as well as in the CBA.

When it comes to operational flexibility, the project may improve the operational flexibility in the region by enabling a higher level of participation of demand response by large industrial customers. The installation of new communication and control capabilities should make wind resources capable of contributing to reactive power control. However, uncertainties related to participation in demand response programmes and to the actual implementation of the right regulatory frameworks persist, and these are beyond the control of project promoters. This suggests caution is advised in the evaluation of the project proposal.

An area where the project has more limited impact is cross-border electricity markets (criterion 6). In fact, the area is already managed as a single market and no congestions are present. Loop flows and congestion rents are not an issue in the region.

Based on the information provided, Table 7 reports the results of the overall evaluation and the synthesis of the project impact against the six criteria. As mentioned before, incomplete information for some KPIs (that was unavailable at that stage of the project) did not allow for their firm evaluation. Notwithstanding this, green was chosen, provided that additional information and a more positive evaluation be made available for the KPIs with project initiation.

Table 7 North Atlantic Green Zone: evaluation of project performance against the six policy criteria

Criteria	Evaluation	Synthesis
1) Sustainability	Significant impact in terms of CO_2 displacement. Key hypothesis is that the project will enable a reduction of wind curtailment from 25 % to 6 %. Information provided shows that the NAGZ project contributes towards reaching the overall target of wind curtailment reduction from 25 % to 6 %. The project is a necessary but not sufficient condition to reach this target. Reduced, but still positive impact (–12 %) on CO_2 displacement is observed, even under the scenario of wind curtailment reduction not dropping below 10 % due to external factors beyond the control of the project promoters. In terms of environmental impact, the project might reduce the need for new overhead lines, due to: • smart operations and monitoring, allowing more effective use of the full capacity of existing networks; • variable access for wind generation and dynamic line ratings, reducing the new build of electricity networks required for wind to be connected in the region; • installation of new cross-border distribution network lines, with shorter line routes offered as potential reinforcement options.	
2) Capacity	Significant impact in terms of hosting capacity of wind generation, particularly at distribution level. The key hypothesis is that the project will enable a reduction of wind curtailment from 25 % to 6 %, and will thus increase the magnitude of wind capacity delivered from both distribution and transmission grids. Information provided shows that the NAGZ project contributes towards reaching the overall target of wind curtailment reduction from 25 % to 6 %. The project is a necessary but not sufficient condition to reach this target.	

Criteria	Evaluation	Synthesis
3) Network connectivity and access	In this area, the project affects the reduction of peak load thanks to demand response participation of industrial customers. The participation of large industrial customers to demand response programmes is assumed to be 10 % of their power load. The assumption is based on the positive enrolment trends for demand response in the region. The project is expected to create an incentivised framework for demand response through: • development of a commercial framework through collaboration between the project promoters, the regulator and all involved stakeholders; • enhanced monitoring and communication infrastructure; • variable wind access and other more flexible contract types which incentivise and improve the business case for any commercial parties to engage demand response. The project will also enable a detailed monitoring of the grid area and adoption of fibre communication network which will further facilitate the implementation of demand response schemes down to domestic customer level.	
4) Security and quality of supply	The impact of the project on security of supply comes from increased available wind capacity and uptake of demand response and future storage applications. The impact of the project on continuity of supply comes from the implementation of the ASC, of fault passage indicators (FPIs), voltage conversion and dynamic sectionalisation. The impact is significant, particularly on the SAIDI and SAIFI.	
5) Grid use efficiency	CVR and voltage conversion lead to energy savings and reduced energy losses. The proposal stresses that voltage conversion, although not directly a smart grid application, allows full exploitation of the potential of CVR. Energy savings have been considered in the evaluation, even if the KPI formulation does not directly take them into account. The proposal also stresses that positive impacts in this area can result from the uptake of demand response and storage. The project is expected to incentivise large load MV customers to participate in DSM and invest in storage, due to the enhanced monitoring and control infrastructure deployed within the NAGZ project. Nevertheless, incorporating demand response and storage into network management to increase variable access capacity through active balancing will rely not only on monitoring and communications, but on new market and regulatory frameworks that would meet the network operational needs.	

Criteria	Evaluation	Synthesis
6) Cross-border electricity markets	The area is already managed as a single market and no congestions are present. Loop flows and congestion rents are not an issue in the region. The main contribution of the project is in the new cross-border lines at distribution level. Although not directly in line with the smart grid dimension of the project, they will bring a reduction of outage times in both regions and will foster cross-border management by both DSOs. Also, a study for better exploitation of the existing 110 kV interconnectors will be launched through development of communication and control software between the two existing 110 kV interconnectors, to allow for their full exploitation through automated coordination. Overall, the main impact of the project in this criterion appears to be the enabling of new planning options (use of distribution cross-border lines) for reinforcements in the area.	

Economic assessment

Provided data show that the NPV of the project is positive for society. The project is expected to provide additional (non-monetised) impacts: improved availability of broadband communication in the region due to fibre extension adopted within the project, reduced risk exposure for field utility personnel thanks to distribution automation and higher quality and continuity of electricity supply in the region. A summary of the outcome of the economic assessment is reported in Table 8.

The sensitivity analysis shows that the positive result is robust in terms of several key variables, including to the amount of reduced wind curtailment, whose avoided cost is the main contributor to the positive NPV.

We note that the project is a key critical enabler to reduce wind curtailment from 25 % to 6 %. The greatest share of monetary benefits is related to this.

The technological and delivery costs, related to both smart grid and traditional investments in the project, to effect reduced curtailment in this region are borne exclusively by the NAGZ project, including telecommunications, monitoring, control and analytical resources; this allows network flexibility and integration of voltage control /reactive power into the system.

Project coordinators do not foresee additional costs related to possible external developments that might arise concurrently to achieve this result. However, project coordinators consider an additional 10 % in the contingency budget reasonable. Also, the Irish TSO EirGrid indicated that an additional EUR 200 000 not included in the current evaluations may be required for the development of their systems in line with new operational frameworks.

Moreover, the proposal indicates that a significant share of the benefits (around 25 %) can be associated with 'traditional' installations that are part of the project. Based on provided information, it has been recognised that these 'traditional' investments are necessary to enable the implementation of the smart grid applications foreseen in the project. Therefore the associated benefits have been included in the final NPV.

Finally, according to information provided, the CBA for the project proponents is negative, as the costs they would incur is greater than their share of the benefits. The project coordinators therefore stress that external funding is necessary for this project.

Table 8 North Atlantic Green Zone: summary of the economic assessment

Criteria	Evaluation	Synthesis
Economic viability	Provided data show that the economic assessment is positive. However, refinements to the estimation of costs and benefits are required in the detailed design phase of the project.	
Sensitivity analysis	Provided data show that the NPV is positive, despite changes of certain key variables (e.g. compensation for wind curtailment, and load growth and energy savings).	
Commercial/ financial viability	The project proposal indicates that the project lacks commercial viability.	

2.2 GREEN-ME (Italy and France)

2.2.1 General overview

Where

The area covered by the project includes two French and five Italian regions, for a total consumption in the area of 222 TWh/year, of which 138 TWh/year are generated within the area itself.

Who

The project is proposed by a consortium of 2 TSOs, Réseau de Transport d'Électricité (RTE) and Terna, and 2 DSOs, Électricité Réseau Distribution France (ERDF) and Ente Nazionale per l'energia ELettrica (ENEL), from both France and Italy.

When

The project duration is five years.

Why

The project is motivated by the on-going substantial increase of RES generation in the project region. The RES unpredictability determines also situations of over-generation which have a cross-border impact, particularly on the exploitation of NTC.

The main objective of the project is to increase monitoring, controllability and predictability of distribution generation for more efficient integration of renewables, thereby maintaining the reliability and security of the network, and in particular avoiding curtailments of NTC between the two involved countries in cases of over-generation from RES combined with low load conditions.

What

Activities to be performed under the project are divided into two phases.

In Phase 1, 34 new primary substations in the area (25 in France and 9 in Italy) will be upgraded to enable smart grid functionalities.

In the second phase, 55 more HV substations located in northern Italy, and possibly up to 86 primary substations (66 in Italy and 20 in France), will be equipped over the whole area. Moreover, storage facilities will be deployed in the Italian area on about 20 % to 25 % of the primary substations considered.

The proposed activities will result in:

- HV substations' automation systems (including central systems development and data exchange);
- HV/MV substations' control, automation and monitoring systems (including central systems development and data exchange);
- advanced control system, communicating with the renewable generators (RES integration);
- advanced aggregated forecasting of PV generation, connected to the distribution grid (RES aggregation);
- use of storage in primary substations, in order to obtain a more predictable load profile at the DSO–TSO interface;
- evolution of the existing procedures for modulation or limitation of power generation and loads.

The outcome of the project will be:

- increased integration of DER;
- ancillary services provision through DER;
- management, collection and coordination by the TSOs of ancillary services and forecast information provided by DSOs and RES directly connected to the HV;
- integration of the ancillary services and forecast information provided by the DSO with the TSO control infrastructure;
- increased predictability of RES generation facilitating the management of the cross-border NTC.

System architecture and deployed assets

The project will affect more than 120 primary substations (HV/MV) and more than 60 HV substations. The system architecture is reported in Figure 4.

Deployed assets include:

- new actuators and new sensors (fault detectors, voltage and current sensors);

- real-time monitoring of underground cables;
- smart grid equipment (SCADA) in primary substations;
- storage units in primary substations. There is no preferred storage technology to be implemented within the project. ENEL at this moment is testing four different technologies and all of them are taken into consideration for the project.

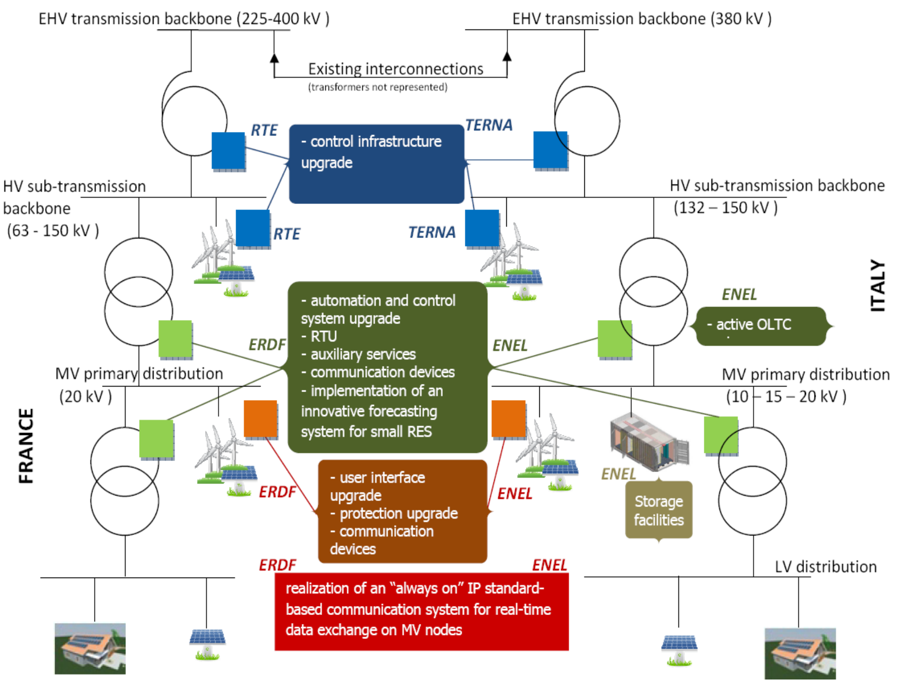

Figure 4 GREEN-ME system architecture

2.2.2 Role of DSOs and TSOs

DSOs will be leading the activities in the project. The project will focus on increasing the monitoring and controllability of the distribution grid at MV. This would result in easier management of the transmission grid by TSOs. In particular, it is expected to have a more predictable load profile at the DSO–TSO interface that delivers better network security margins.

In addition, thanks to the evolution of SCADA, operative centres of DSOs could carry out real-time monitoring of the distributed generation connected to the MV and LV grid, and provide relevant information to the TSOs.

The TSOs will participate in the following activities/tasks:

- upgrading of control and automation systems in HV substations;

- management, collection and coordination of ancillary services and forecast information provided by DSOs and RES directly connected to the HV power system;
- integration of the ancillary services and forecast information provided by the DSOs with the TSO control infrastructure (SCADA and energy management system (EMS)) for the grid control and the planning of the reserve margins;
- implementation of TLC infrastructure for the communication between systems (HV substations and primary substations).

In addition, RTE will also carry out:

- dynamic line rating design and installation with dedicated predictive algorithms to give additional margins in operation;
- new algorithms for operation of phase-shifting transformers.

The project will require cooperation between DSOs and TSOs in the following domains:

- information collected by DSOs using smart grid facilities to be sent to TSOs relating to:
    - real-time data and forecasts for active power generation for each source and HV/MV transformer;
    - mid- and long-term load forecast (demand and distributed generation) based on PV forecast and historical data for other sources.

2.2.3 Cross-border impact and added value of joint project

The project provides for increased cooperation between TSOs and DSOs from both Italy and France. The activities to be carried out under the project will entail better management of the energy distribution and transmission in the whole area, possibly alleviating the risk of curtailment, if any, of cross-border NTC due to RES/DER over-generation in the area (mainly PV in Italy). As detailed in the KPI section, the project proposal estimates an increase of up to 0.4 % of the interconnector exploitation rate for the energy import of Italy.

Provided data demonstrate how the primary substations involved in the project are already close to their limit of maximum hosting capacity, and that reserve power flows problems are already significant in the target area. These issues are expected to spread over a larger area with the significant increase in wind and PV installed capacity foreseen up to 2020.

2.2.4 Compliance with the technical requirements

1) Voltage level(s) (kV) greater than 10 kV

The project will involve interventions on the MV grid, particularly from 10 kV to 20 kV, as well as on the HV grid.

The project proposal fulfils this criterion.

2) Number of users involved (producers, consumers and prosumers) greater than 50 000

According to the project proposal, the portion of the grid impacted by the project includes 2 280 00 users.

The project proposal fulfils this criterion.

3) Consumption level in the project area (MWh/year) greater than 300 GWh/year

Current consumption level in the areas interested by the project is estimated at 10 968 GWh/year ([9])

The project proposal fulfils this criterion.

4) Percentage of energy supplied from renewable resources that are variable in nature of at least 20 %

The capacity of renewables connected is 2 198 MW; according to the project proposal, this implies a percentage of renewable resources that are variable in nature in the region of around 25 % to 32 % in terms of capacity.

(9) A total of 3 176 GWh/year in 2012 for French regions involved in the project and 7 793 GWh/year in 2012 for Italian regions involved in the project, as communicated by project promoters.

Estimations based on data provided by project promoters show that, in the consumption area concerned, energy supplied from renewable resources that are variable in nature equals 2 673 ([10]) GWh per year, representing 24 % of the consumption in the area.

The project proposal fulfils this criterion.

5) Projects involving transmission and distribution operators from at least two Member States

The project involves two TSOs (Terna and RTE) and two DSOs (ENEL and ERDF) from two Member States.

The project proposal fulfils this criterion.

2.2.5 Smart Grid dimension

The project contributes to several smart grid areas:

- ✓ information flows between EHV, HV and MV substations, leading to more coordinated management of the grid and of DERs by TSOs and DSOs;
- ✓ advanced control system for MV DERs (communication link between DER and control centre, control of active and reactive power as well as DER generation forecasting);
- ✓ automation and control of MV network (new protection and control systems, installation of new switches, fault detectors and voltage/current sensors);
- ✓ use of storage in primary substations for more predictable load and generation profile at the TSO–DSO interface.

2.2.6 External developments affecting project impact

The project proposal provides an estimation of the MW of connected distributed generation (DG) (wind and PV) in 2020 in the project areas. The project proposal assumes that connected DG capacity will increase from 2 200 MW in 2010 to 18 800 MW in 2020. In considering the

(10) A total of 975 GWh/year for French regions involved in the project, considering PV and wind resources, and 1 698 GWh/year for Italian regions involved in the project, considering PV, wind and small hydro, as communicated by project promoters.

amount of PV capacity alone, the eight primary substations already face relevant reverse power flows from the distribution to the transmission level.

Also, a new interconnection line (outside of the scope of the project) between Italy and France is foreseen for about 2 000 MW. The project is independent of new interconnections; however, expected benefits for NTC related to the existing lines could be extended to the new interconnections.

2.2.7 Policy criteria – Evaluation of key performance indicators

Criterion 1: level of sustainability

The project is expected to contribute significantly to the reduction of greenhouse gas emissions (particularly CO_2) through:

- ✓ increased hosting capacity of MV grid to connect more RES;
- ✓ avoided curtailment of RES.

It is expected that the optimisation of the integration of RES (economically and technically) will reduce the use of energy generated from fossil fuels during peaks of consumption, especially in the Provenza-Alpi-Costa Azzurra (PACA) region of France and in Italy. The expected resulting saved CO_2 emissions are 332 000 tonnes/year in Italy and 36 450 tonnes/year in France at the end of project.

A qualitative environmental impact assessment has been provided. It will be further refined during the first phase of the project. It is expected that, as a result of the project, the increased flexibility of the grid will reduce the need for new infrastructures (e.g. new lines).

In particular, it will:

- ✓ reduce the need for new construction projects on the networks for a number of equivalent customers (consumer or generator), by reducing the number of distribution and transport network constraints;
- ✓ reduce environmental impacts (such as visual, acoustic and electromagnetic impacts) resulting from a reduced number of construction projects by optimised operation using existing assets.

Table 9 GREEN-ME: evaluation of project performance against the first policy criterion

		Level of sustainability	Estimated project impact according to provided information
KPI [a]1	**Reduction of greenhouse gas emissions**	The expected saved CO_2 emissions are of 332 000 tonnes/year in Italy and 36 450 tonnes/year in France at the end of project. The key hypothesis is that the project will increase the hosting capacity for PV by 25 % in the project region (see KPI 2b). Calculations are based on results from relevant pilot projects.	
KPI [b]1	**Environmental impact of electricity grid infrastructure**	It is expected that, as a result of the project, the increased flexibility of the grid will reduce the need for new infrastructures. A qualitative evaluation has been provided. It will be further refined during the first phase of the project.	

Criterion 2: capacity of transmission and distribution grids to connect and bring electricity from and to users

Increased hosting capacity for DER integration is one the main goals of the project. The proposal includes an estimation of a 25 % increase of hosting capacity for DER. The estimation is based on previous pilot project results and studies undertaken by the project promoters.

For example, it is estimated that on the Italian side of the project, the hosting capacity would increase by around 500 MW, from 1 922 MW in the BaU scenario to 2 400 MW in the smart grid scenario.

Table 10 GREEN-ME: evaluation of project performance against the second policy criterion

	Capacity of transmission and distribution grids		Estimated project impact according to provided information
KPI $^{a}_{2}$	**Installed capacity of distributed energy resources in distribution networks**	The KPI was calculated. The estimation is based on calculations performed in previous smart grid projects, and simulation analysis (hosting capacity increase of 25 %).	
KPI $^{b}_{2}$	**Allowable maximum injection of power without congestion risks in transmission networks**	The project will enable increased controllability of DERs (e.g. PV plants) at MV/LV level. This is expected to improve security conditions and reduce congestion risks due to reverse power flow of RES generation from MV to HV. A quantitative evaluation of the impact has not been carried out since this would require detailed simulation analysis. Considering the extended project region, this was not feasible in the limited time available for project submission. However, more detailed analysis is expected at a later stage of project submission.	
KPI $^{c}_{2}$	**Energy not withdrawn from renewable sources due to congestion or security risks**	Around 80 % of RES generation in the project area is not directly controllable. The project will enable extension of the amount of RES generation that can be controlled. This can have a positive impact in terms of the possibility to modulate or limit power generation in case of emergency, according to TSO–DSO procedures. However, a reliable estimation of the KPI was not carried out as there are no historical data on RES energy curtailment in the region. Project coordinators are still expected to track this indicator during the project, though.	

Criterion 3: network connectivity and access to all categories of network users

The project intends to provide increase operational flexibility through:

- ✓ installation of storage in primary substations;

- ✓ controllability of DERs (participation of DERs in voltage regulation and congestion management).

Potential benefits in terms of demand response have not been taken into account. The proposal reports that to achieve these benefits, significant changes in the regulatory framework are needed. The project is expected to provide input for the discussion on the update of the regulatory frameworks, in order to support the integration of flexible resources in the grid.

Table 11 GREEN-ME: evaluation of project performance against the third policy criterion

Network connectivity and access to all categories of network users			Estimated project impact according to provided information
KPI $^{a}_{3}$	**Methods adopted to calculate charges and tariffs, as well as their structure, for generators, consumers and those that do both**	The project is expected to provide input to the following regulatory areas: • remuneration of storage systems according to the reduction of balancing costs in the electricity system; • more accurate allocation of network charges related to RES integration (thanks to better observability of the system). It is expected that, based on project results, coordinators will produce a detailed set of inputs and recommendations for new regulatory methods. Of course, the definition of these methods is outside the role of the project promoters.	
KPI $^{b}_{3}$	**Operational flexibility for dynamic balancing of electricity in the network**	KPI was estimated (**10 %**). The KPI is calculated as the percentage of increased storage and DG that can be modified v the total storage and DG connected to the distribution network.	

Criterion 4: security and quality of supply

The project will optimise voltage and reactive power, thus enhancing the controllability of the voltage plan and enabling automatic corrective measures. It can be inferred that the project will have a positive impact in terms of voltage quality performance, but a quantitative estimation has not been carried out at this stage.

Furthermore, the proposal estimates that the project will lead to improvements in SAIDI and SAIFI amounting to 10 % in the French project area and 25 % in Italian project area. The estimation is based on extrapolation from previous pilot projects, but needs to be verified when the project is in place. The impact of the project in terms of voltage performance and contribution of supply needs to be monitored throughout implementation where more detailed data will be available.

The project is also expected to significantly increase the share of electricity generated from RES by increasing the DER hosting capacity (see criterion 2).

Finally, the project is anticipated to improve the controllability of DER production and limit causes of possible system instabilities, typically in terms of voltage and frequencies. A quantitative evaluation of the impact has not been carried out at this stage since it would require detailed simulation analysis. An elaborated investigation in this respect is expected in the detailed design phase of the project.

Table 12 GREEN-ME: evaluation of project performance against the fourth policy criterion

	Security and quality of supply		Estimated project impact according to provided information
KPI $^{a}_{4}$	**Ratio of reliably available generation capacity and peak demand**	No information given.	
KPI $^{b}_{4}$	**Share of electricity generated from renewable sources**	By increasing the DER hosting capacity (see criterion 2), the project will significantly increase the share of electricity generated from RES.	

		Security and quality of supply	Estimated project impact according to provided information
KPI $^{c}_{4}$	Stability of the electricity system	The project is expected to improve the controllability of DER production and limit causes of possible system instabilities, typically in terms of voltage and frequencies. A quantitative evaluation of the impact has not been carried out since it would require detailed simulation analysis. It is expected that project coordinators will assess this impact in the detailed design phase, using appropriate dynamic simulation tools.	
KPI $^{d}_{4}$	Duration and frequency of interruptions per customer, including climate-related disruptions	The KPI was estimated (**10 % for the French region and 25 % for the Italian region**). The estimation is based on previous smart grid projects. Although this assumption sounds reasonable, it was not possible to assess the reliability of such an extrapolation to the whole area. However, it is also noted that SAIDI is not the primary objective of the project; SAIDI improvement will be possible as long as it does not conflict with other objectives, such as hosting capacity.	
KPI $^{e}_{4}$	Voltage quality performance	The project is expected to optimise voltage and reactive power, thus enhancing the controllability of the voltage plan and enabling automatic corrective measures. So indirectly, it can be inferred that the project will have a positive impact in terms of voltage quality performance. An estimation of the KPIs was not carried out, as estimations based on previous pilot projects are not available yet. Project promoters are expected to make sure to monitor the KPIs throughout the project.	

Criterion 5: efficiency and service quality in electricity supply and grid

In this criterion, the project provides two main contributions:

- use of storage in primary substations to smooth peaks and level the demand curve (more predictable energy profiled at the DSO/TSO interface in presence of RES);

- provision of communication and control infrastructure to enable MV connected DERs to participate in voltage regulation and demand response (provided that the right regulatory framework is in place).

Also, the project is expected to reduce the number of faults by 10 % with an innovative diagnosis tool for real-time monitoring of underground cables. The estimation needs to be verified throughout the project when more detailed data could be gathered.

Table 13 GREEN-ME: evaluation of project performance against the fifth policy criterion

Efficiency and service quality in electricity supply and grid			Estimated project impact according to information provided
KPI $^{a}_{5}$	Level of losses in transmission and in distribution networks	A reconfiguration of the network would not necessarily lead to reduced network losses. In fact, this KPI can be at odds with other KPIs like increased hosting DER capacity. The project will monitor power losses to ensure they do not exceed the values expected in other pilot projects.	(red)
KPI $^{b}_{5}$	Ratio between minimum and maximum electricity demand within a defined time period	Storage in primary substations will be used to store energy during periods of low demand and release the stored energy during periods of high demand. This is expected to smooth peaks and level the demand curve so that the exchange energy profiles between primary substations and the national grid are more predictable, especially in presence of variable RES. The estimated KPI shows a positive impact.	(green)
KPI $^{c}_{5}$	Demand side participation in electricity markets and in energy efficiency measures	The project will install additional functionalities to enable DERs to participate in voltage regulation and demand response. We note that the actual participation of MV DERs depends also on regulatory changes, which are beyond the control of project promoters, however.	(green)

	Efficiency and service quality in electricity supply and grid		Estimated project impact according to information provided
KPI $^{d}_{5}$	Percentage utilisation (i.e. average loading) of electricity network components	Improved observability and controllability of RES is expected to use existing MV transformers for the connection of additional RES, avoiding network expansions for RES integration. It is expected that during the project, coordinators will monitor the percentage utilisation of the assets.	
KPI $^{e}_{5}$	Availability of network components (related to planned and unplanned maintenance) and its impact on network performances	An estimation of 10 % reduction of faults through real-time monitoring of underground cables. No additional details provided.	
KPI $^{f}_{5}$	Actual availability of network capacity with respect to its standard value	No information provided.	

Criterion 6: contribution to cross-border electricity markets by load-flow control to alleviate loop flows and increase interconnection capacity

By increasing the predictability of RES availability, the project is expected to reduce the risk of NTC reduction, rather than increasing it. In particular, the project is expected to reduce risks of NTC curtailment in presence of over-generation of renewable resources that are variable in nature in Italy. The avoided reduction is estimated at around 0,5 TWh/year (the total import at the border is 83 TWh/year).

Potentially, better use of NTC (thanks to better controllability of RES resources) might alleviate price differentials between the Italian Northern Market Zone and France. However, a quantitative estimation would require detailed studies, which have not been performed at this stage.

Table 14 GREEN-ME: evaluation of project performance against the sixth policy criterion

Cross-border electricity markets			Estimated project impact according to information provided
KPI $^a_6$	**Ratio between interconnection capacity of a Member State and its electricity demand**	Information provided shows that the project impact on this KPI is negligible, in the sense that the project is not expected to increase the NTC, but rather to avoid its reduction in certain conditions (see KPI_b^6).	
KPI $^b_6$	**Exploitation of interconnection capacity**	The project proposers mentioned a study carried out by Terna indicating that there will be over-generation from renewable resources that are variable in nature in Italy, and therefore that the foreseen smart grid project might have positive impacts, resulting in better NTC exploitation of about 0.4 %.	
KPI $^c_6$	**Congestion rents across interconnections**	Better use of NTC could contribute in principle to alleviating price differentials between the Italian Northern Market Zone and France. However a quantitative estimation would require detailed studies which have not been performed at this stage.	

2.2.8 Project economic performance

The project proposal includes an economic CBA, which details the costs and benefits included. The proposal does not include details on the calculation approaches followed for the estimation of costs and benefits. Therefore, a check of provided figures has not been carried out at this stage.

The main monetary benefits and costs resulting from the potential project deployment are listed below.

MAIN MONETARY BENEFITS

- ✓ **Avoided distribution network reinforcements:** investments to enable the same hosting capacity in the BaU scenario.

- ✓ **Improved operational flexibility:** exploitation of interconnection capacity and optimisation of distribution network operations and storage benefits.
- ✓ **Reduced outages.**

MAIN COSTS

- HV substations automation systems.
- HV/MV substation control, automation and monitoring systems.
- Control and communication of RES.
- Storage.
- MV/LV substation automation and monitoring systems.
- TLC infrastructure.

SENSITIVITY ANALYSIS

In the sensitivity analysis, the following variable changes have been considered:

- ✓ costs increase of 20 %;
- ✓ increased hosting capacity of 20 % instead of 25 %;
- ✓ no interconnection optimisation;
- ✓ discount rate of 5.5 %.

Under all assumed conditions, the NPV remains positive.

NON-MONETARY BENEFITS

The proposal also reports a list of potential additional benefits that the project might bring.

More details would be required to fairly assess these impacts:

- ✓ quality and continuity of supply;
- ✓ black-out risk reduction;

- ✓ opportunity cost related to land that is saved with respect to construction of new aerial lines;
- ✓ reduced environmental impact of electricity grid thanks to fewer overhead lines;
- ✓ network user/consumer inclusion;
- ✓ enabling new services and application and market entry to third parties;
- ✓ dissemination of results.
- ✓ safety (reduced number of manual operations).

2.2.9 Summary of evaluation

The project proposal GREEN-ME is well articulated in its main aspects and is in line with the technical requirements. The KPI analysis and the CBA are well structured. Additional information and clarifications are expected when the project moves to the detailed design phase. It is also expected that project coordinators will monitor the project impact by assessing the KPIs throughout the project.

The project is expected to impact the project area positively in terms of integration of variable DG (mainly PV) at MV level thanks to improved predictability of DG, and automation and control of medium voltage grid. Increased controllability of RES is also expected to reduce the risk of curtailment of the NTC between France and Italy in presence of RES over-generation.

Given the documentation provided (no audit was performed), the Italian regulator, AEEG (Autorità per l'Energia Elettrica e il Gas) and the French regulator CRE (Commission de Régulation de l'Énergie) have communicated a positive technical evaluation of the GREEN-ME project. The project fulfils the technical requirements and shows positive impacts against the policy (KPI) and economic (CBA) criteria. Both regulators recommend pursuing the project but also recommend revising in more detail the business case and the economic assumptions included in the CBA.

As detailed below, the project fulfils the technical criteria and shows a positive impact against the policy and economic criteria.

Eligibility requirements

The project proposal is in line with the technical requirements.

TSOs and DSOs from both Member States are actively participating in the project and the project is expected to foster increased coordinated operation between the DSOs and TSOs.

The project is expected to provide positive cross-border impact. In particular, the increased controllability and observability of PV DG is expected to limit NTC reduction due to PV over-generation.

KPI analysis

The KPI evaluation has been carried out in a clear and structured way. Still, assumption-based and missing information for some of the KPIs at this stage of the project did not allow for their firm evaluation (as depicted in yellow and red in Tables 9 through 14 above).

The main contribution of the project is in terms of:

- ✓ additional integration of PV generation, with consequent displacement of fossil-based generation from the energy mix;
- ✓ increased grid flexibility thanks to the use of distributed generators and storage in the provisions of ancillary services;
- ✓ increased security and quality of supply thanks to new self-healing capabilities (automatic fault location and grid reconfiguration) and diagnostic tools;
- ✓ limited reduction of NTC in case of PV over-generation.

Table 15 reports a summary of the evaluation of the KPI analysis.

Table 15 GREEN-ME: evaluation of project performance against the six policy criteria

Criteria	Evaluation	Synthesis
1) Sustainability	Significant impact in terms of CO_2 displacement. The key hypothesis is that the hosting capacity for PV will increase by 25 %. In terms of environmental impact, the project might reduce the need for new overhead lines. A preliminary qualitative environmental evaluation has been carried out, which needs to be refined at a later stage of project design.	
2) Capacity	Significant impact in terms of increased hosting capacity of RES generation, particularly at distribution level. The key hypothesis is that the hosting capacity for PV will increase by 25 % (based on previous pilot projects).	
3) Network connectivity and access	Significant impact in terms of operational flexibility thanks to the use of DG for ancillary services. PV connected to the grid will be linked with the system operator through a new communication link (the inverter interface will be modified as required). It is assumed that 10 % of these connected PV plants in the area will be able to provide ancillary services. The storage installed in primary substations will also add additional flexibility, to level the energy profiles in presence of increasing levels of unpredictable RES generation.	
4) Security and quality of supply	Significant impact in terms of a higher share of RES energy injected in the system thanks to higher hosting capacity. The project will optimise voltage and reactive power, thus enhancing the controllability of the voltage plan and enabling automatic corrective measures. This should improve the voltage quality performance, and to a certain extent, prevent stability issues, but this should be verified once the project is in place. The impact of the project (in terms of SAIDI: improvement 10 % in France, 25 % in Italy) comes from the implementation of an automatic fault location system on the MV network. The estimation needs to be monitored and verified throughout the project.	

Criteria	Evaluation	Synthesis
5) Grid use efficiency	In this area, two main project impacts are foreseen: • use of storage in primary substations to smooth peaks and level the demand curve (more predictable energy profiles at the DSO/TSO interface in presence of RES); • provision of the communication and control infrastructure to enable MV connected DERs to participate in voltage regulation and demand response (provided that the right regulatory framework is in place). The project is expected to provide positive impacts in terms of network availability (e.g. reduction of faults and availability of network capacity) but additional verification needs to be carried out once the project is in place.	
6) Cross-border electricity markets	The main impact of the project lies in avoiding the NTC reduction that is required, for security reasons, in case of RES over-generation in the area. The avoided reduction is estimated at around 0.5 TWh/year (total import at the border is 83 TWh/year).	

Economic assessment

In societal terms, benefits largely exceed the costs.

Main monetary benefits include:

- ✓ avoided network reinforcement;
- ✓ improved operational flexibility;
- ✓ avoided costs of outages.

The investments costs are shared among DSOs and TSOs. According to data presented, the project lacks commercial viability: the benefits accruing to the system operators do not cover the costs. Table 16 reports a summary of the evaluation of the provided CBA.

Table 16 GREEN-ME: summary of economic assessment

Criteria	Evaluation	Synthesis
Economic viability	Data provided show that the economic assessment is positive. However, refinements to the estimation of costs and benefits are required in the detailed design phase of the project.	
Sensitivity analysis	Data provided show that the NPV is positive despite changes of certain key variables (e.g. hosting capacity, PV penetration, percentage of flexible DG).	
Commercial viability	The project proposal reports that the project lacks commercial viability.	

2.3 SUPERIOR (Spain and Portugal)

2.3.1 General overview

Where

The project proposal involves the areas of northern Portugal and north-west Spain, including a total of 10 administrative districts/regions across the two countries. The area covered by the project is characterised by a total consumption of around 16.5 TWh/year, about half of which are generated by RES.

Who

The project promoters are four DSOs from Portugal (EDP Distribuição) and Spain (Gas Natural Fenosa, Iberdrola, HC Energia). At present, the Spanish and Portuguese TSOs are not part of the project consortium. However, project promoters report that the TSOs have already expressed their interest in the project, and their participation is under negotiation with the other project partners at the time of writing.

When

The first stage of the project duration is three years.

Why

The project promoters estimate that about 43.6 % of yearly generation in the area is from renewable resources that are variable in nature

The main goal of the project is to increase the integration of RES in the electricity grid, by implementing systems and equipment improving the efficiency and flexibility of the network management, in particular w.r.t. losses, voltage control and reactive power compensation.

What

The project aims at improving the observability and controllability of the distribution network (from SCADA and communication systems to substation controllers), so that the distribution grid can behave as a technical virtual power plant (TVPP) from the transmission operators' point of view.

The main elements of the project are:

- new dispatching features in SCADA and communication systems plus advanced DMS functions;

- new HV lines;
- voltage and reactive power compensation in substations;
- automation and control of MV/LV network — dynamic network reconfiguration;
- MV network automation (FPIs, alarms and remote switches).

The main expected outcomes of the project are:

- RES integration increase;
- outage time improvement;
- losses reduction;
- CO_2 emissions reductions;
- assets lifetime increase;
- operation and maintenance costs decrease;
- DSO investments deferral;
- clients' compensation reduction.

Deployed assets and system architecture

The system architecture of the project is shown in Figure 5.

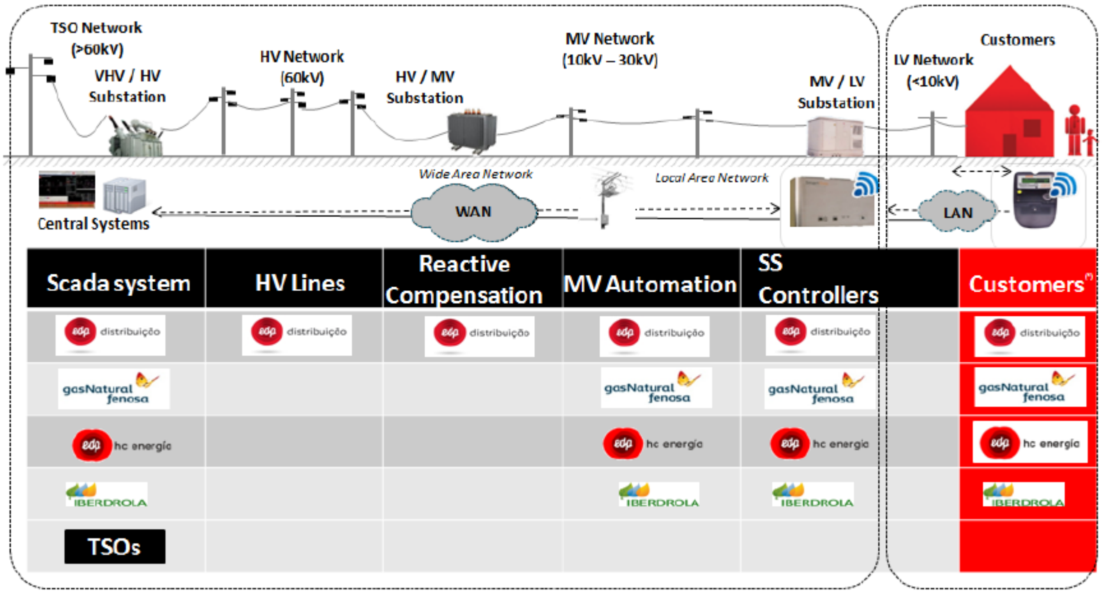

Figure 5 SUPERIOR system architecture

Deployed assets include:

- new HV lines (non-crossborder) for RES integration and load balance;
- upgrade of SCADA and communications systems;
- upgrade of more than 10 HV/MV substations with new HV lines, switch gear and reactive compensation equipment;
- automation equipment in more than 1 300 secondary substations;
- deployment of RTUs for MV network supervision;
- FPIs;
- network remote control switching equipment in MV/LV secondary substations.

2.3.2 Role of DSOs and TSOs

DSOs are in charge of the implementation of the project and would bear all the investment costs.

At this stage, there is no official TSO participation in the project. Based on information received so far, the TSOs will play an advisory role rather than an actively participate in the project.

However, project promoters note that TSO participation is being defined and that both TSOs have already expressed their willingness to be actively involved in the project.

At present, the TSOs' contribution would be to:

- assure project compliance among different system participant entities, particularly in terms of highlighting the TSO perspective;
- help further develop the technological components of the project;
- help with high-level systems' functionalities;
- help define the most relevant services (ancillary, balancing, etc.) to be provided between participants.

2.3.3 Cross-border impact and added value of a joint project

The project aims to support closer cooperation among the DSOs in the areas involved. It should be noted that this is in line with the current arrangement of the Portuguese and Spanish electricity markets, which are already integrated into the Iberian electricity market (MIBEL).

The project promoters argue that the value of a joint project is the establishment of a TVPP in both cross-border project regions. This will allow better coordination between the two TSOs and better exploitation of the cross-border interconnector in the project region. In fact, under such an approach, the DSOs would have more active role in control and management of the RES connected at distribution level, thereby enabling provision of ancillary services at a higher network level (TSO). This could give more added value to each Member State's network. However, at present, it appears that the cross-border value would be fully realised with active participation of TSOs, which could benefit from the increased observability and controllability of the distribution grid in managing the cross-border interconnection. Information provided to date in the project proposal does not spell out the cross-border value of the project at TSO level.

2.3.4 Compliance with the technical requirements

1) Voltage level(s) (kV) greater than 10 kV

The project will involve interventions on the MV and HV grid, particularly from 10 kV to 60 kV. Primary DSO HV/MV substations are affected.

The project proposal fulfils this criterion.

2) Number of users involved (producers, consumers and prosumers) greater than 50 000

According to the project proposal, the portion of the grid impacted by the project includes 2 408 000 users.

The project proposal fulfils this criterion.

3) Consumption level in the project area (MWh/year) greater than 300 GWh/year

According to the project proposal, the consumption level in the project area is 16 430 GWh/year.

The project proposal fulfils this criterion.

4) Percentage of energy supplied from renewable resources that are variable in nature of at least 20 %

Data provided in the project proposal refer to non-dispatchable energy rather than capacity.

According to the project proposal, the percentage of energy supplied by renewable resources that are variable in nature is estimated at about 43.6 % of the annual energy consumed.

The project proposal fulfils this criterion.

5) Projects involving transmission and distribution operators from at least two Member States

The project involves the DSOs from both participating Member States. The participation of TSOs is under negotiation. It is necessary that the role of TSOs and their tasks in the project are clearly defined.

The project proposal does not currently fulfil this criterion.

2.3.5 Smart grid dimension

The main smart grid applications foreseen in the project are:

- ✓ MV automation and substation controllers;
- ✓ dynamic network reconfiguration;
- ✓ voltage control for DER integration;
- ✓ reactive power control;
- ✓ predictive asset maintenance and network self-healing;
- ✓ demand response management.

2.3.6 External developments affecting project impact

According to the project proposal, the main external developments which are expected to affect the project impact are the demand growth rate and RES penetration in the region. No additional information is provided.

2.3.7 Policy criteria — evaluation of key performance indicators

The KPI analysis can definitely be improved and integrated with support information. At this stage, most of the KPIs have not yet been calculated.

Criterion 1: level of sustainability

Table 17 SUPERIOR: evaluation of project performance against the first policy criterion

Level of sustainability			Estimated project impact according to information provided
KPI $^{a}_{1}$	Reduction of greenhouse gas emissions	The KPI was calculated (14 ktonnes/year of CO_2 and a total reduction over 15 years of between 210 ktonnes and 330 ktonnes). The CO_2 emission of coal was used instead of an average value based on the energy mix of the region.	

Level of sustainability			Estimated project impact according to information provided
KPI $^{b}_{1}$	Environmental impact of electricity grid infrastructure	The project proposal indicates that project implementation is expected to reduce environmental impact due to land loss and new constructions. However, additional information is required to support this.	

Criterion 2: Capacity of transmission and distribution grids to connect and bring electricity from and to users

It is assumed that thanks to the project, the energy produced by RES will increase by 2 157 GWh/year from 9 099 GWh/year in the BaU scenario to 11 256 GWh/year in the project scenario.

Table 18 SUPERIOR: evaluation of project performance against the second policy criterion

Capacity of transmission and distribution grids			Estimated project impact according to information provided
KPI $^{a}_{2}$	Installed capacity of distributed energy resources in distribution networks	The KPI was calculated (10 %). More details would be useful.	
KPI $^{b}_{2}$	Allowable maximum injection of power without congestion risks in transmission networks	A full assessment will be made in the future (need inputs from the TSO).	
KPI $^{c}_{2}$	Energy not withdrawn from renewable sources due to congestion or security risks	No KPI was calculated. No curtailment values were given.	

Criterion 3: network connectivity and access to all categories of network users

Table 19 SUPERIOR: evaluation of project performance against the third policy criterion

Network connectivity and access to all categories of network users			Estimated project impact according to information provided
KPI $^{a}_{3}$	Methods adopted to calculate charges and tariffs, as well as their structure, for generators, consumers and those that do both	Not enough information.	
KPI $^{b}_{3}$	Operational flexibility for dynamic balancing of electricity in the network	No KPI calculated.	

Criterion 4: security and quality of supply

Table 20 SUPERIOR: evaluation of project performance against the fourth policy criterion

Security and quality of supply			Estimated project impact according to information provided
KPI $^{a}_{4}$	Ratio of reliably available generation capacity and peak demand	No KPI calculated.	
KPI $^{b}_{4}$	Share of electricity generated from renewable sources	No KPI calculated.	
KPI $^{c}_{4}$	Stability of the electricity system	No KPI calculated. The proposal mentions that it will be assessed in future.	
KPI $^{d}_{4}$	Duration and frequency of interruptions per customer, including climate-related disruptions	No KPI calculated. It is mentioned that the indicator would be improved due to the integration of more intelligent equipment and automation.	

Criterion 5: efficiency and service quality in electricity supply and grid

Table 21 SUPERIOR: evaluation of project performance against the fifth policy criterion

Efficiency and service quality in electricity supply and grid			Estimated project impact according to information provided
KPI $^{a}_{5}$	Level of losses in transmission and in distribution networks	No KPI calculated. It is mentioned that losses will be reduced. More details would be useful.	
KPI $^{b}_{5}$	Ratio between minimum and maximum electricity demand within a defined time period	No KPI calculated.	
KPI $^{c}_{5}$	Demand side participation in electricity markets and in energy efficiency measures	No KPI calculated. It is mentioned that this factor will be improved.	
KPI $^{d}_{5}$	Percentage utilisation (i.e. average loading) of electricity network components	No KPI calculated.	
KPI $^{e}_{5}$	Availability of network components (related to planned and unplanned maintenance) and its impact on network performances	No KPI calculated. More details would be useful.	
KPI $^{f}_{5}$	Actual availability of network capacity with respect to its standard value	No KPI calculated. More details would be useful.	

Criterion 6: contribution to cross-border electricity markets by load-flow control to alleviate loop flows and increase interconnection capacity

Table 22 SUPERIOR: evaluation of project performance against the sixth policy criterion

Cross-border electricity markets			Estimated project impact according to information provided
KPI $^{a}_{6}$	Ratio between interconnection capacity of a Member State and its electricity demand	The KPI should be calculated by comparing the difference between the ratio r of interconnection capacity in the current situation, i.e. taking historical data from the European Network of Transmission System Operators for Electricity (ENTSO-E), and the hypothetical ratio r after the realisation of the smart grid project. Here only r_{BaU} has been calculated, and not r_{SG}.	

		Cross-border electricity markets	Estimated project impact according to information provided
KPI $^{b}_{6}$	Exploitation of interconnection capacity	The KPI should be calculated by comparing the difference between the exploitation of interconnection capacity in the current situation, i.e. taking historical data from ENTSO-E, and the hypothetical ratio r after the realisation of the smart grid project. Here, only r_{BaU} has been calculated, and not r_{SG}.	
KPI $^{c}_{6}$	Congestion rents across interconnections	The figure is missing. The TSOs involved in the project should be able to provide the figure for the Spain–Portugal interconnection from the results of the most recent capacity auctions.	

2.3.8 Project economic performance

The CBA provided by the project proposers presents the required figures. More details about the estimation of costs and benefits would be useful.

Main costs include:

- ✓ MV automation;
- ✓ new HV lines;
- ✓ installation of reactive power compensation equipment;
- ✓ upgrade of dispatch/SCADA and communications systems.

A sensitivity analysis has been carried out of changes to the discount rate and of demand growth. In particular, in the above calculations, an electricity demand growth of 2 % per year is assumed. When considering a more conservative assumption of 0 % demand growth per year, the internal rate of return drops to 9 %.

Overall, according to provided information, the NPV of the project looks positive.

2.3.9 Evaluation summary

Based on the information provided, the SUPERIOR project proposal is in line with all the eligibility requirements except for the involvement of TSOs from both Member States. Project promoters note that TSOs have expressed their willingness to participate but have not formalised an active participation in the project.

The project is expected to positively impact the project area in terms of integration of variable DG in both regions across the border. However, the proposal should support the estimation of potential impacts with more detailed information, especially in the KPI analysis. The cross-border impact of the project, in particular, still needs to be clearly spelled out.

At this stage, the project does not fulfil the eligibility requirement concerning the involvement of both DSOs and TSOs from at least two Member States. Moreover, the KPI analysis and the CBA need to be integrated with additional information. Therefore, the project impact against a number of policy criteria could not be reliably assessed.

According to estimations provided, the project has a positive NPV. The proposal also reports that the project lacks commercial viability for the investing parties (the DSOs) and would thus require funding for its implementation.

Eligibility requirements

Based on the information made available in the project proposal, the project fulfils the technical requirements related to the number of users, the voltage level and the amount of renewable resources that are variable in nature in the project area.

However, based on received information, the project proposal does not fulfil the requirement of the participation of TSOs and DSOs from at least two Member States. TSOs have not committed to the project, and at this stage, their active participation is therefore not reflected in the project activities projected in the proposal. Their involvement is foreseen to be more advisory rather than actively participatory.

Moreover, the project is expected to bring positive impacts on the distribution grid of both Member States in terms of better control and integration of variable RES. This can also favour a harmonisation of approaches, goals and experiences among participating DSOs.

However, based on information so far provided, it appears that the full cross-border impact of establishing a TVPP on each project region cannot be fully realised without the involvement of TSOs.

KPI analysis

The project proposal includes the estimation of few KPIs. The main impact of the project lies in supporting increased integration of renewables at distribution level. A 10 % increase of installed capacity has been estimated, resulting from having a TVPP in the cross-border regions. In this respect, the active participation of the TSOs appears to be critical for reaping full cross-border benefits.

However, a comprehensive evaluation of the project impacts cannot be carried out as many KPIs have not been assessed. Table 23 reports the outcome of the evaluation process based on information provided.

Table 23 SUPERIOR: evaluation of project performance against the six policy criteria

Criteria	Evaluation	Synthesis
1) Sustainability	Impact in terms of CO_2 displacement is potentially significant. The key hypothesis is that the hosting capacity for RES at distribution level will increase by 10 %. However, more details are necessary to support this estimation.	
2) Capacity	More details are necessary to support this estimation.	
3) Network connectivity and access	There is need for more information to assess the project impact against this criterion.	
4) Security and quality of supply	There is need for more information to assess the project impact against this criterion.	
5) Grid use efficiency	There is need for more information to assess the project impact against this criterion.	
6) Cross-border electricity markets	There is need for more information to assess the project impact against this criterion.	

Economic assessment

The project proposal indicates that the NPV of the project is positive. DSOs share the entire investment (EUR 32 million). A detailed estimation of benefits has not been carried out.

The sensitivity analysis has been carried out with respect to the discount rate and the demand growth. The NPV is most sensitive to the discount rate. When assuming a 0 % demand growth, the internal rate of return drops to 9 %.

The project proposal establishes complementary links with pilot projects already carried out by the project promoters. These pilots indicate that additional (non-monetisable) benefits can result from the project implementation. However, at present, the project proposal does not provide sufficient evidence to include these benefits in the economic assessment.

Table 24 SUPERIOR: summary of economic assessment

Criteria	Evaluation	Synthesis
Economic viability	Data provided show that the economic assessment is positive. Details on the estimation of costs and benefits have not yet been provided.	
Sensitivity analysis	Data provided show that the NPV is positive despite changes of certain key variables (discount rate and demand growth). Are there other variables which might influence the project's economic performance? (variations in costs, different levels of hosting capacity in the SG scenario, etc.? Which benefits are the most affected?).	
Commercial viability	The project proposal reports that the project lacks commercial viability.	

2.4 Agricultural Farms and Smart Grids Integrated Renewable Resources (Poland)

2.4.1 Project overview

The project is based in a rural area of Poland. The project promoter is the EC BREC Institute for Renewable Energy in Warsaw.

The main objective of the project is to develop and demonstrate practical tools for planning and adjustment of small-scale RES on farms and its clusters as a comprehensive decision support system for farmers. The computerised, Internet-based, advisory system focused on farmers needs will also facilitate installation of various RES by enabling their effective integration and management (by a cluster of farmers) with energy consumption devices (both for agricultural production and house appliances) to provide maximal ecological effect and socioeconomic benefits.

Implemented tools will include RES calculators for farmers, RES simulation programmes for installers, visualisation of monitoring results, EMS for single farms and farm clusters in the frame of the micro-grid concept. Then, monitoring, processing and analysis of data will be conducted.

2.4.2 Compliance with the technical requirements

1) Voltage level(s) (kV) greater than 10 kV

The proposal does not explicitly specify the voltage level of the grid, and therefore whether the voltage threshold has been fulfilled cannot be ascertained. As the project scope is to integrate small-scale RES installed in rural farms, it is very likely the farms are connected only at the distribution grid, without any involvement of the transmission grid. The voltage threshold in the trans-European energy infrastructure regulation is intended to attract project proposals that fit at the interface between the distribution and transmission grids; however, this element is missing in the project proposed.

2) Number of users involved (producers, consumers and prosumers) greater than 50 000

The project will involve 10 agricultural farms. The proposal claims that the replication of the project could involve 835 000 farms, thus fulfilling the technical criterion. However, the criterion refers to the number of the consumers actually involved in the project rather than the number potentially involved when the project is scaled up, therefore the project proposal does not fulfil this eligibility criterion.

3) Consumption level in the project area (MWh/year) greater than 300 GWh/year

The project proposal refers to a consumption level in the project area of around 0.6 GWh/year. The proposal claims that the replication of the project could affect a consumption level of 50 000 GWh/year, thus fulfilling the technical criterion. However, the criterion refers to the consumption level actually present in the project rather than the potential level when the project is scaled up, therefore the project proposal does not fulfil this eligibility criterion.

4) Percentage of energy supplied from renewable resources that are variable in nature of at least 20 %

The project proposal mentions that in the project area, the percentage of energy supplied by renewable resources that are variable in nature is 50 %, thus fulfilling the criterion. However the claim is not supported by detailed information.

5) Projects involving transmission and distribution operators from at least two Member States

The project involved only DSOs, and these from Poland alone. No TSOs and no other Member State are involved. Therefore, the project proposal does not fulfil this eligibility criterion.

2.4.3 Evaluation summary

The project presents an interesting smart grid application. However, it cannot be considered for evaluation as it does not fulfil the technical requirements. Moreover, the project proposal did not include calculations of KPIs and of CBA.

3 SUMMARY

On the grounds of the detailed analysis carried out in the previous sections, the evaluation outcome for the four submitted projects is as follows.

North Atlantic Green Zone

The project fulfils all technical requirements and shows good performance against the policy and the economic criteria. Overall, **the project evaluation was concluded positively**. Nevertheless, the same includes traditional elements which do not directly fir into the smart grid dimension of the project, and thus the costs and respective benefits resulting from these investments need to be recognised and brought out in the analysis. Additional refinements to the estimations are expected at the detailed design phase of the project, particularly for those KPIs where no reliable assessment could be carried out at this stage. Project coordinators are also expected to monitor all relevant KPIs throughout the project and revise the estimations accordingly.

GREEN-ME

The project fulfils all technical requirements and shows good performance against the policy and the economic criteria. Overall, **the project evaluation was concluded positively**. Additional refinements to the estimations are expected at the detailed design phase of the project, particularly for those KPIs where no reliable assessment could be carried out at this stage. Project coordinators are also expected to monitor all relevant KPIs throughout the project and revise the estimations accordingly.

SUPERIOR

The project proposal foresees the active participation of DSOs only. The project has not been formally endorsed by the relevant TSOs. The project does not fulfil the technical requirements as set out in the trans-European energy infrastructure regulation. Based on information provided (which did not provide exhaustive information about a number of KPIs), the project has good potential for positively impacting the region. The participation of TSOs could definitely bring additional added value to the performance of the project against the policy and the economic criteria.

AGRICULTURAL FARMS AND SMART GRIDS INTEGRATED RENEWABLE RESOURCES

The project does not fulfil the technical requirements as defined in the trans-European energy infrastructure regulation. Since the project did not fulfil any of the technical requirements, a detailed evaluation of the project against the policy and the economic criteria has not been carried out.

The following tables summarise the evaluation of project proposals against the technical requirements, the policy criteria and the economic criterion respectively.

Table 25 Summary of the characteristics of the project proposals with reference to the technical requirements

Project	Technical characteristics			
	Voltage level	Number of users	Renewable resources	Consumption level in the project area
NAGZ (Ireland–UK)	10–110 kV	186 000	550 MW of connected wind (higher than region demand 300 MW)	1 400 GWh/year
GREEN-ME (France–Italy)	10-20 kV	2 280 000	25–32 % (PV capacity in the project area around 2 000 MW)	14 240 GWh/year
SUPERIOR (Spain–Portugal)	15 kV–400 kV	2 408 000	43 %	16 430 GWh/year

TECHNICAL REQUIREMENTS

Table 26 Summary of compliance of project proposals to technical requirements

Project	Technical requirements				
	Voltage level	Number of users	Renewable resources	Consumption level in the project area	TSOs-DSOS from at least two MSs
NAGZ (Ireland–UK)	√	√	√	√	√
GREEN-ME (France–Italy)	√	√	√	√	√
SUPERIOR (Spain–Portugal)	√	√	√	√	X
Agricultural Farms and Smart Grids Integrated Renewable Resources (Poland)	X	X	X	X	X

PROJECT IMPACT AGAINST POLICY CRITERIA

Table 27 reports a summary of the assessment of project proposals in the KPI analysis, as per the information provided so far.

Table 27 Summary of the assessment of project proposals in the KPI analysis

Criteria	North Atlantic Green Zone	GREEN-ME	SUPERIOR
1) Sustainability	Green	Green	Yellow
2) Capacity	Green	Green	Yellow
3) Network connectivity and access	Green / Yellow	Green	Red
4) Security and quality of supply	Green	Green / Yellow	Red
5) Grid use efficiency	Green	Green / Yellow	Red
6) Cross-border electricity markets	Yellow	Green	Red

Notes: Green = viable; yellow = looks positive/clarifications and discussions required; red = not viable or not enough information.

ECONOMIC ASSESSMENT

Table 28 reports a summary of the outcome of the economic assessments for the three project proposals, based on the information included in the proposals. As detailed in Chapter 2, some additional information is still needed for the three projects to back up the economic assessments.

Table 28 Summary of economic performance of project proposals

Project/economic CBA	Economic viability
North Atlantic Green Zone	Green
GREEN-ME	Green
SUPERIOR	Yellow

Notes: Green = viable; yellow = looks positive/clarifications and discussions required; red = not viable or not enough information.

Based on the information provided, none of the three projects appear to be commercially viable, and they would all likely require external funding to be implemented.

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Abstract

This report presents the outcome of the evaluation of smart grid project proposals which was carried out by Expert Group 4 (EG4) of the Smart Grid Task Force. The group comprises relevant stakeholders from industry (system operators, manufacturers), regulatory authorities and Member States' representatives. National regulatory authorities have been involved in the evaluation process.

The Expert Group 4 (EG4) was established in February 2012. During the preparatory year of 2012, the task of EG4 was to agree on an assessment framework for the identification of potential projects of common interest (PCI) in the field of smart grids. The assessment framework proposed by the JRC was adopted by EG4 on 4 July 2012. It takes into account the technical and general criteria for the selection of projects of common interest in the field of smart grids, as defined in the trans-European energy infrastructure regulation.

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