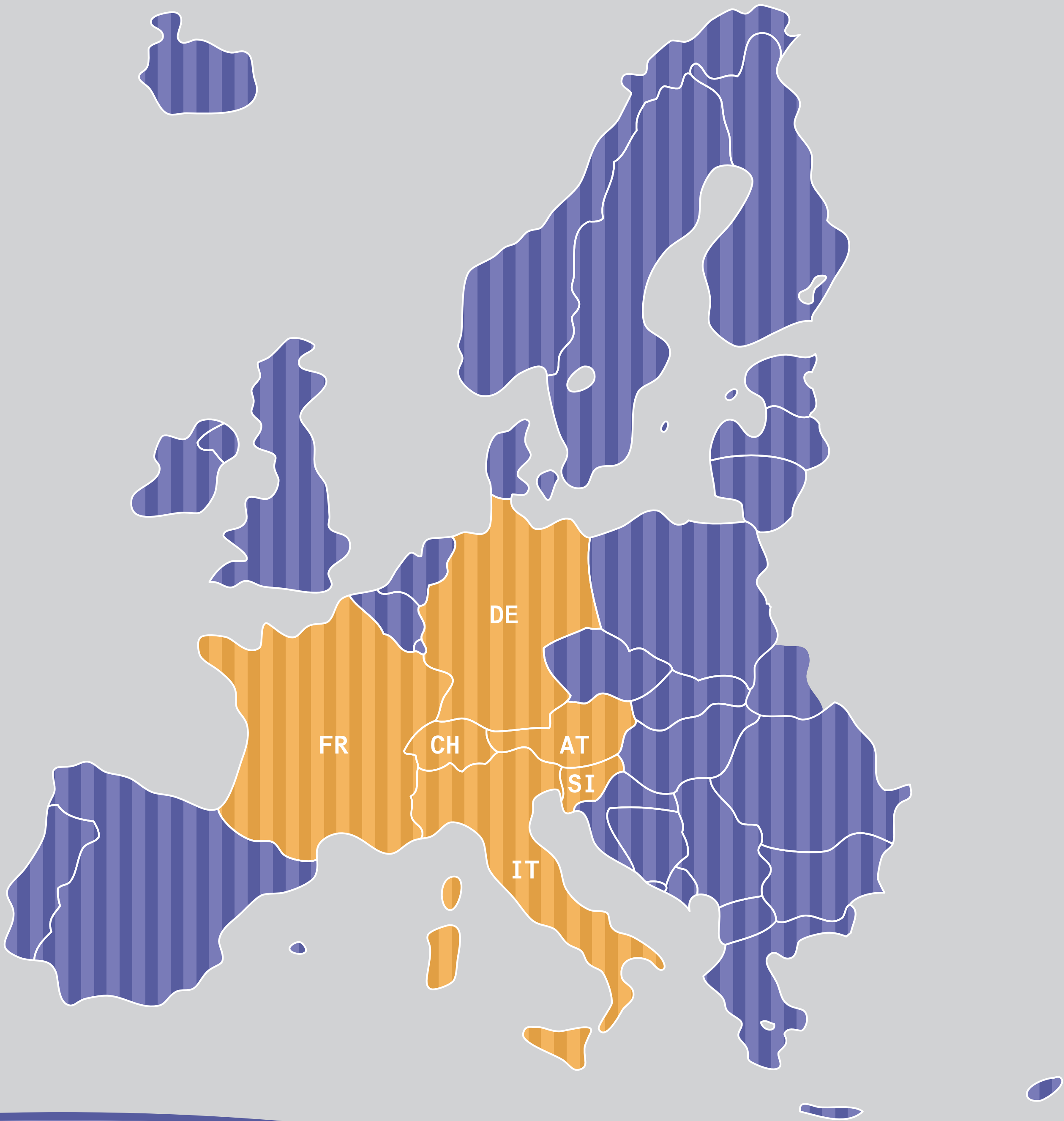
Regional Investment Plan Continental Central South

Final



European Network of
Transmission System Operators
for Electricity

entsoe

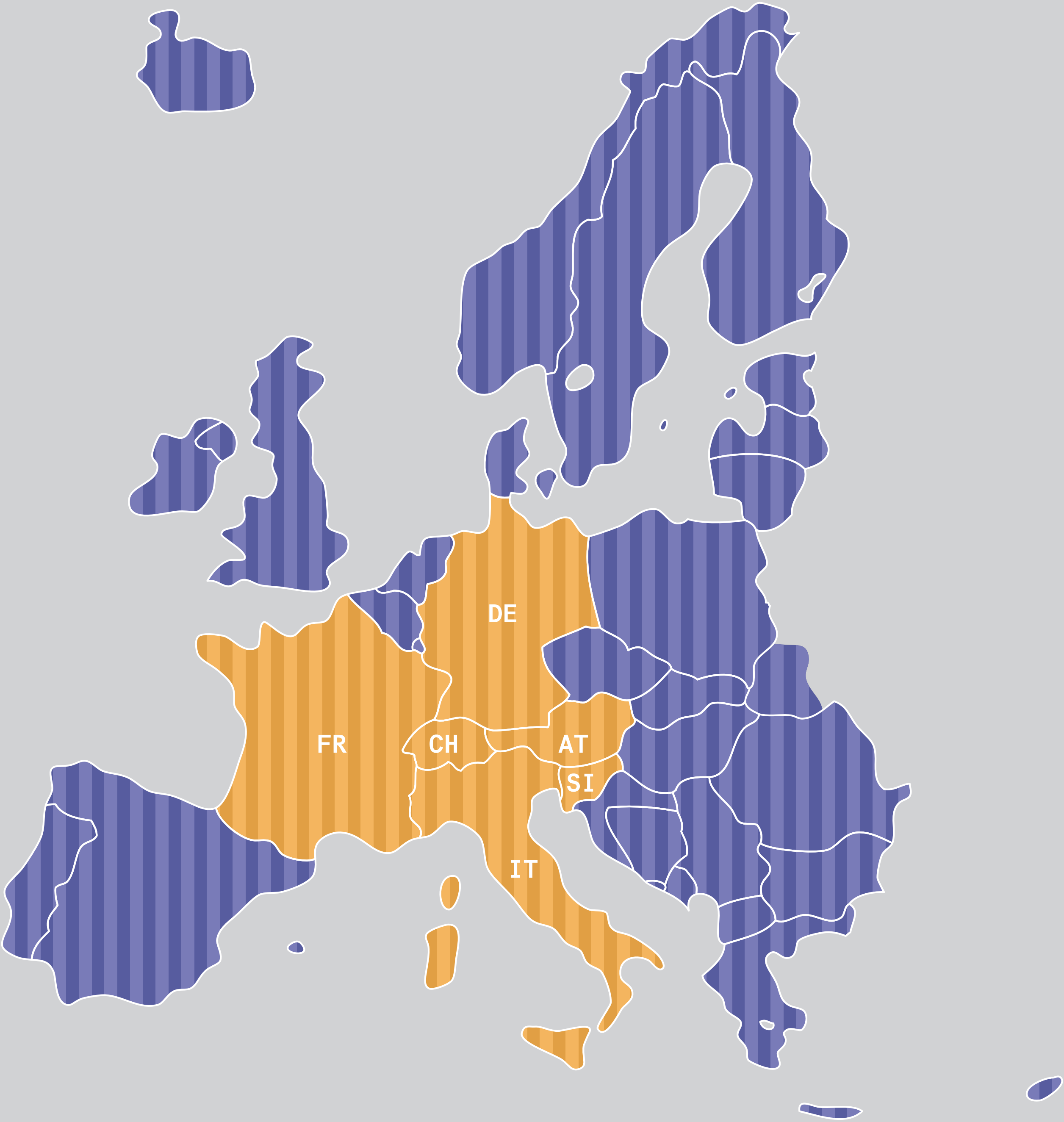
Regional Investment Plan Continental Central South

Final

5 July 2012

Content

1 Executive Summary



The development of the transmission infrastructure is crucial for reaching the European energy policy objectives of competitiveness, sustainability and security of supply (SoS). In addition, the European Commission's action to boost the necessary investments is urgently needed. More efforts are necessary in order to modernize and expand Europe's energy infrastructure and to interconnect electricity networks across borders in order to meet these objectives.

The Regional Investment Plan 2012 on hand (hereinafter only "RIP 2012") aims to describe the investment needs and projects in the Continental Central South (CCS) Region formed by Germany, France, Switzerland, Austria, Slovenia and Italy.

The RIP 2012 focuses on necessary investments in the transmission infrastructure within the next ten years (2012 – 2021). It contains both cross-border and internal projects of European, regional and national significance, constituting the basis to reach European targets, with particular regard to security of supply (SoS), development of the European internal energy market (IEM) and integration of renewable energy sources (RES).

Two main scenarios have been analyzed in the RIP 2012. The first scenario with a top-down approach is referred to as the "EU 2020", and represents a context in which European 20-20-20 objectives are met (20 % of RES in the final energy consumption, 20 % reduction of greenhouse gas (GHG), and 20 % increase in energy efficiency). The second scenario with bottom-up approach is known as the "Scenario Best Estimate", or "Scenario B", and represents the best estimation of the TSOs, according to their expertise and the information provided by stakeholders, regardless of whether or not European objectives are globally met. In the Continental Central South region the EU 2020 scenario considers 10 % less load than in current trends with regards to energy efficiency measures, but the development of RES is different in the countries. During the study, as a consequence of the Fukushima accident, it has been decided that there will be a shutdown of approximately 10 GW of nuclear power generation in Germany by 2020. In light of this, a sensitivity analysis taking this nuclear power shutdown into account has been performed additionally and the results are available in a dedicated paragraph.

A set of studies have been performed for the presented scenarios: market studies focused on economic efficiency, adequacy studies on generation adequacy and network studies on congestion detection and transmission adequacy. In the network analysis some cases have been selected with the expectation that they would represent some of the most challenging conditions for the system such as the peak and low demand situations with high and low RES generation. Different simulation tools were used for each type of analysis but with similar input data and similar methodology, so that similar outputs have confirmed the robustness of both the results and tools.

The market studies showed that the CCS region will be generally exporting to the rest of Europe, with about 45 TWh energy surplus considering the strong development of RES and the demand reduction simulated in the EU 2020 scenario. In Scenario B the exports were considerably reduced to around 2 TWh, and the Nuclear Phase Out sensitivity analysis revealed the CCS region as a net importing region with approximately 42 TWh of net imports.

In the CCS RIP 2012, 41 projects are depicted, 9 of which are interconnection projects within CCS countries. The proposed investments in the plan on hand are to be completed in the mid-term (2012 – 2016) and in the long-term (2017 – 2021) and an amount of 50,8 billion € are respectively estimated.

The projects have been assessed by means of a set of indicators in order to evaluate their contribution to the integration of the EU electricity market, RES integration, security of supply (SoS), reduction of losses, resilience and flexibility.

The implementation of the projects of this plan will result in an increase of interconnection capacity between CCS's countries by around 14.000 MW. Other benefits relate to the improvement of SoS and integration of the EU electricity market which results in variable generation cost savings. In the EU 2020 scenario more than 600 M€/y can be saved and CO_2-output can be decreased by around 9 Mt/y directly related to the 9 interconnections. Further benefits are due to internal reinforcements, shall in terms of integration of new RES generation capacities (more than 100 GW) and reduction of CO_2-emissions and losses

The driver of more than 60 % of the projects is the RES integration, while 43 % of the projects improve the security of supply, particularly in some urban areas. Projects of regional significance represent roughly 25000 km of new or refurbished network routes, out of which 32 % are expected in the mid-term. 10200 km of new 400 kV AC are overhead lines (OHL). Approximately 95 % of DC links are new infrastructures. Additionally, the planned refurbishment of around 4500 km of existing AC lines in order to minimize grid extension and avoid construction of new routes demonstrates a concerted effort with regards to making the best use of existing assets.

The main drivers of the transmission network development in the CCS over the coming years can be summarized briefly in 5 specific issues:

- **Massive RES connection:** The connection of RES (mainly wind and photovoltaic) to the network, the efficient balancing of the system and the increased on-shore transmission capacity from North and Western region to the South are three main investment needs. For the latter, both offshore interconnections and optimized usage of available hydroelectric facilities will also trigger new investment requirements;

- **Integration of storage power plants, mainly hydro in the Alps region, facilitates efficient use of RES:** The increase of variable renewable generation leads to high and fluctuating utilization of the transmission networks and to this scope, a more flexible transmission grid is needed. In particular the grid's architecture must be adapted and expanded in order to allow transmission over long distances and across national borders, from generation to consumption and storage sites. A considerable rise in new pump storage power plants which facilitate the efficient integration of RES is planned, particularly in the Alps region.
- **Important North-South flows:** these investment needs are dictated by an insufficient cross-border capacity which causes structural market congestion between price zones;
- **Nuclear Phase Out in Germany** will affect the structure of electricity flows mainly between Germany, Switzerland and North-eastern France but in general across the entire CCS region. The generation and load balance in Germany will become more stressed compared to previous years and it is expected that Germany could depend on imports especially in cases of high demand conditions and low RES generation;
- **The power supply of some European cities and regions:** ensuring security of supply becomes a driver of some investments in the CCS Region.

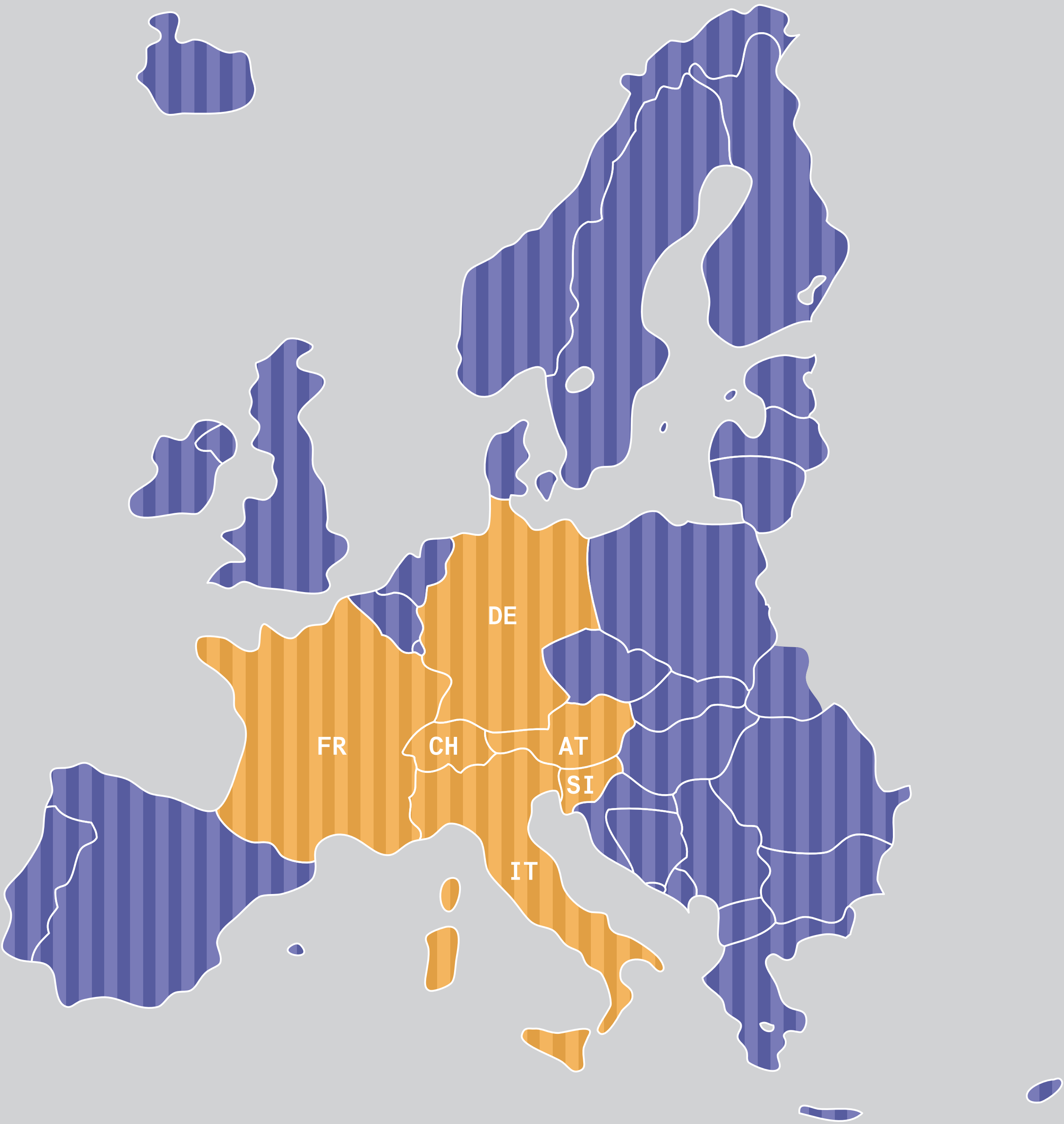
In the mid-term horizon, the development of the transmission grid in the CCS region must face new challenges due to the Nuclear Phase Out in Germany and the ongoing development of many new generation plants, especially from RES, often located far from the main consumption centres and/or the transmission backbones.

Renewable energy, presently sharply increasing in Germany and Italy (at the borders of the CCS region), comes mainly from wind farms installed onshore (in the North and North-East of Germany and in the South of Italy), offshore (in the North and Baltic Sea) and photovoltaic plants (in the North and in the South of CCS). This configuration, in some situations, tends to create a huge amount of the energy flows from the North of Germany to the South which add to the existing congestions. Additionally, it is worth mentioning that the Alps area is enhancing its energy storage facilities by installing new pump storage power plants facilitating the efficient use of RES. Therefore, reinforcements of the transmission grid, along the North-South axis, from Germany to Italy, are strongly recommended in order to improve the integration of different sources of production and increase the cross border transmission capacity.

In the longer-term a further increase of the cross border capacity to and through the Alps area will be needed to improve security of supply and reliability of the system and to avoid barriers to commercial exchanges taking into account the evolution of the generation in Europe. In particular the security of supply in the French Riviera is at risk, owing to the cancellation of the "Public Utility declaration" of a 400 kV grid project in 2006. A mid-term project (3*225-kV underground cables) and a sustained effort in saving electricity will improve the supply of the area for a couple of years but securing the supply in the long run will require additional grid development. For the above mentioned needs, the roles of interconnections becomes essential and in fact, new ones are being considered between France and Switzerland in the area of the Genève lake and between Germany, Switzerland and Austria. Other internal 400 kV projects and new interconnection projects are planned across the northern border of Italy, in particular with France, Switzerland, Austria and Slovenia, in order to comply with the promotion of the internal electricity market by reducing existing and future constraints and by creating an added value for the market. New pumping storage power plants in the Alps area will also foster the long-term possibility of storing a large amount of power from North Europe and North Africa, with generation mainly based on RES, namely wind and solar sources.

The technical feasibility and economic viability of the new Mediterranean subsea corridors needed for the interconnection of the Region with northern Africa (Tunisia and Algeria) and South-East Europe will represent important pillars in the development of the Trans Mediterranean highways. The proposal mentioned above has strong political support, particularly from the EU, for the development of new interconnections in the Mediterranean basin. As a matter of fact, the Mediterranean interconnections, the corridor South-North, have been included in the European priority project since the year 2003.

2 Introduction



2.1 Expectations of the 3rd Legislative Package

The 3rd Legislative Package for the Internal Electricity[1)] Market (hereinafter the 3rd Package), which entered in to force 3 March 2011, imposed a number of requirements on the European Electricity Industry in terms of regional cooperation to promote the development of the Electricity Infrastructure both within and between Member States, and looking at Cross-border Exchanges of Electricity between the Member States.

The key requirement of the 3rd Package which forms the legislative driver for the "2012 Ten Year Network Development Plan" suite of documents is Article 8.3 (b) of The Regulation, whereby "The ENTSO for Electricity shall adopt: (b) a non-binding Community-wide network development plan, … including a European generation adequacy outlook, every two years".

The specific requirements are elaborated on under Articles 8.4, 8.10 and 12.1 of The Regulation, covering the scope and content required in the publication. This includes; time frames for assessing overall generation adequacy, the relationship between National Development Plans and the Community-wide Network Development Plans, identification of investment needs and the requirement to publish Regional Investment Plans every two years.

An explanation of how the Ten Year Network Development Plan (TYNDP) package meets these requirements is contained in Section 2.3.

2.2 ENTSO-E

ENTSO-E was established on a voluntary basis on the 19th of December 2008 and became fully operational on the 1st of July 2009, in anticipation of the entry in to force of the 3rd Package on the 3rd March 2011.

Today, 41 TSOs from 34 European countries are members of ENTSO-E. The working structure of the association consists of Working and Regional Groups, coordinated by three Committees (System Development, System Operations and Markets), supervised by a management Board and the Assembly of ENTSO-E, and supported by the Secretariat, the Legal and

1) The 3rd Legislative Package for the Internal Market in Electricity refers to Directive 2009/72/EC, Regulation (EC) 713/2009 and Regulation (EC) 714/2009

Regulatory Group, and Expert Groups. A list of countries and TSO members can be found at the end of this document.

The main purposes of ENTSO-E are:

- to pursue the co-operation of the European TSOs both on the Pan-European and regional level; and
- to have an active and important role in the European rule setting process in compliance with EU legislation.

2.3 Documents in the TYNDP Package

The objectives of the TYNDP package are to ensure transparency regarding the electricity transmission network and to support decision-making processes at regional and European level. The report is the most comprehensive and up-to-date European-wide reference for the transmission network. It points to significant investments in the European power grid in order to help achieve European energy policy goals.

The Ten-Year Network Development Plan 2012, the Regional Investment Plans 2012 and the Scenario Outlook and Adequacy Forecast 2012 combine to meet the above aims and fulfil the requirements of Articles 8.3 (b), 8.4, 8.10 and 12.1 of The Regulation, as detailed in Section 2.1.

The focus of each document in the package is outlined below:

1. **Ten-Year Network Development Plan 2012:**

   The TYNDP focuses specifically on the projects of Pan-European significance detailed within each Regional Investment Plan, covering those which make significant contributions to enabling Renewable Energy Supply connections, facilitating cross-border flows and meeting security of supply in large areas of demand. Further information on the content, methodology and selection criteria can be found in the TYNDP document itself.

2. **Regional Investment Plans: 2012 (Comprising 6 individual, regional documents)**

   The Regional Investment Plans overlap between the National Development Plans which TSOs are bound to publish to their regulatory authority (under Article 22 of Directive 2009/72/EC) and the TYNDP document which is outlined above. Each Regional Investment Plan provides a regional approach to the specific drivers for grid development and the projects which are being planned to meet these European and regional needs.

3. **Scenario Outlook and Adequacy Forecast 2012:**

   The Scenario Outlook & Adequacy Forecast (SO & AF) assesses the future system adequacy at a mid- to long-term time horizon. It provides an overview of generation adequacy analyses for all of ENTSO-E, its regions as well as for individual countries, including an assessment of the role of the transmission capacities and security of supply on a regional basis.

More information about the history and evolution of the Ten-Year Network Development Plan can be found in the TYNDP 2012 document.

2.4 Regional Groups

As described in Section 2.2, co-operation of the European TSOs both on the Pan-European and regional level in order to undertake effective planning is the main requirement of the 3rd package, and therefore one of ENTSO-E's key purposes. To achieve this ENTSO-E is split into 6 regional groups for grid planning and system development tasks. The Member States belonging to each group are shown in Figure 1.

ENTSO-E considers the regional approach to be the most appropriate framework for grid development in Europe, and contains numerous instances of overlapping to ensure overall consistency of the Regional Investment Plans.

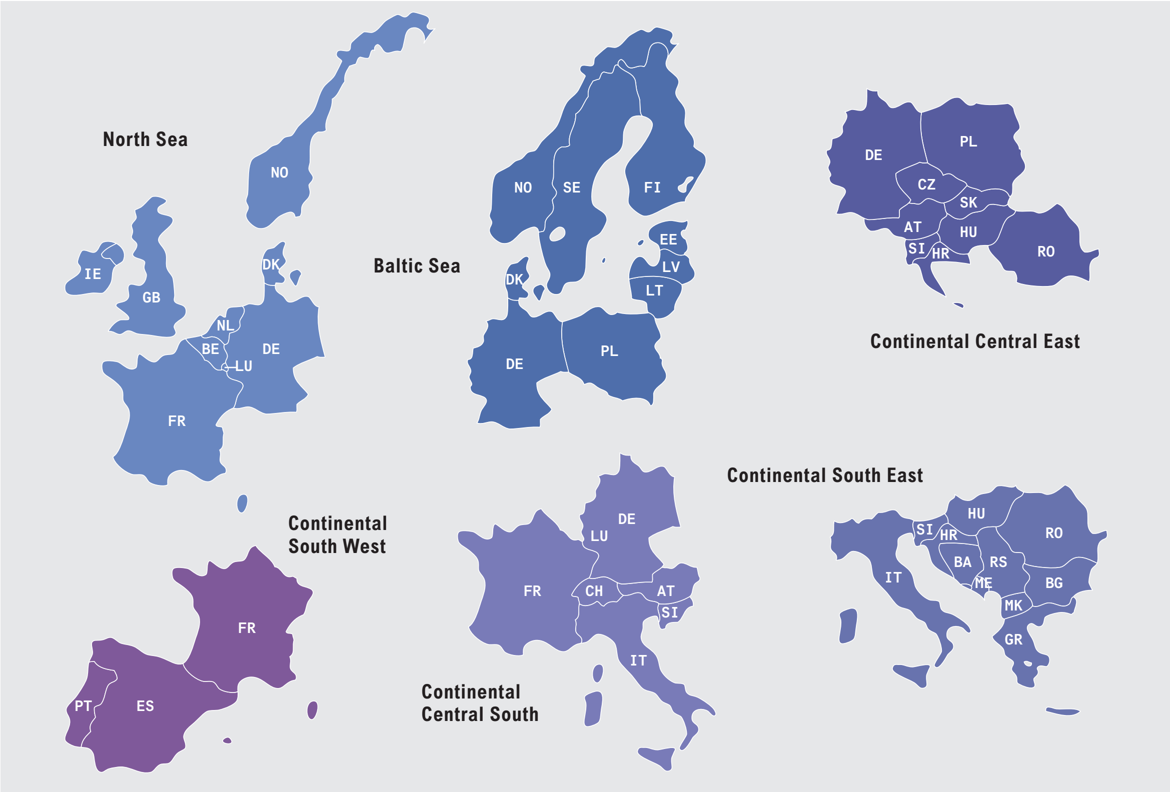


Figure 1:
ENTSO-E regions (System Development Committee)

2.5 How to Read the Document

The present document is focused on the Continental Central South (CCS) Region which embraces France, Germany, Switzerland, Austria, Slovenia and Italy.

Chapter 3 identifies and explains the main changes which have occurred in the investments including the pilot TYNDP 2010 submission.

Chapter 4 describes the specific methods and tools used in the regional market and network studies.

Chapter 5 describes the scenarios considered while developing the Regional Investment Plan, looking at the common scenarios at ENTSOE level contributing to the TYNDP 2012 – 2022 but also highlighting any specific regional scenario.

Chapter 6 forecasts the evolution of power flows and transmission capacity across the Region for the ten year period of this plan, looking at the main drivers for system evolution and the consequences these will have.

Chapter 7 focuses on the Projects of European significance and projects of regional interest identified to meet the investment needs presented in Chapter 6, split up into medium-term (2012 to 2016 inclusive) and long-term (2017 to 2021 inclusive) projects.

Chapter 8 then looks at the overall adequacy of the transmission network after the proposed investments in the proposed scenarios, and identifies any remaining challenges.

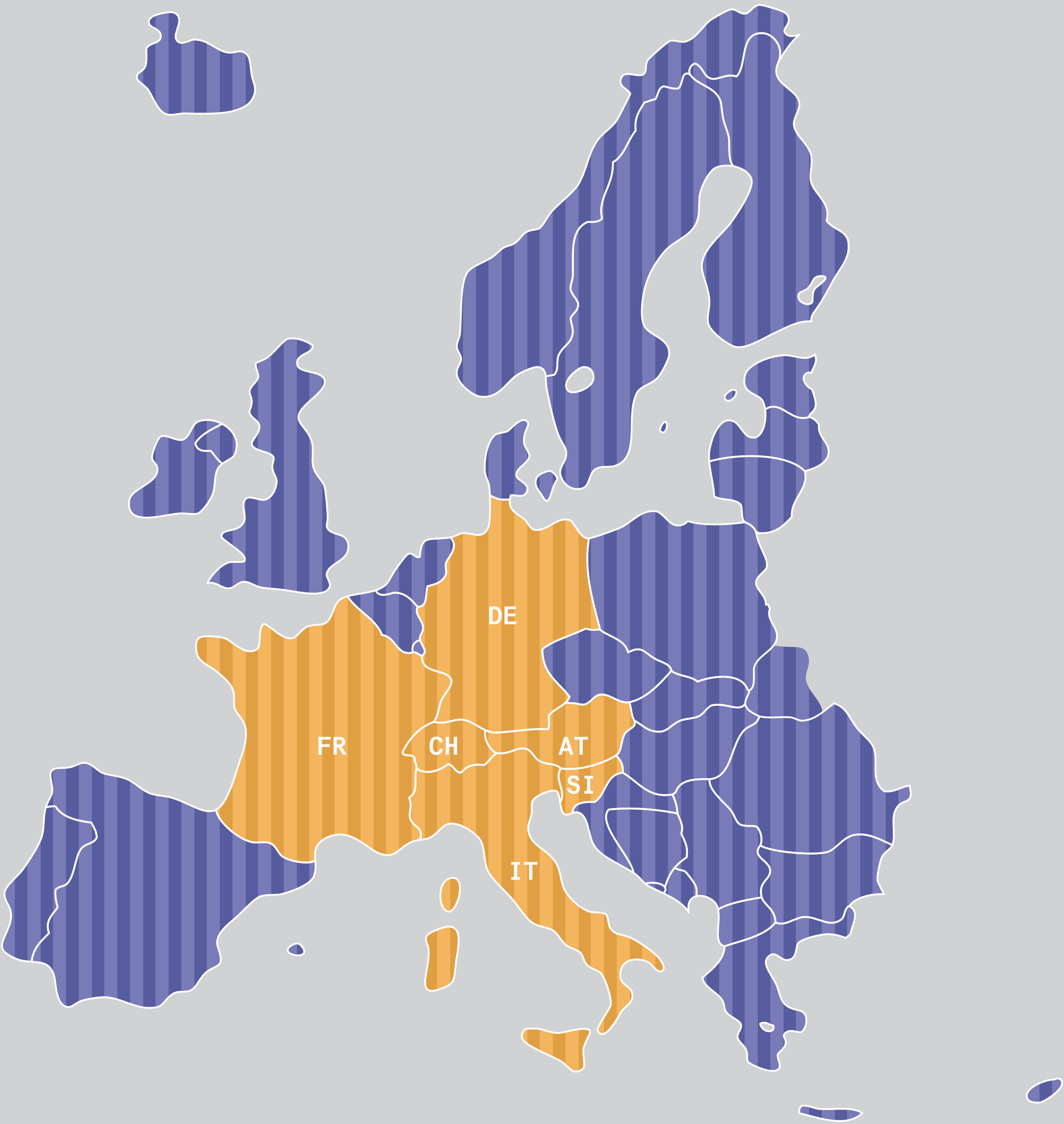
Chapter 9 underlines the process of environmental assessment utilized in the course of constructing the Regional Investment Plan and presents key statistics.

Chapter 10 revisits the resilience principles highlighted in the TYNDP 2012 – 2022 and justifies the planned investments. It also highlights and describes the adverse scenarios which may occur in the region and which may require special attention and possible future investment.

The **Summary and Conclusions** section presents aggregate figures and statistics for the entire Regional Investment Plan.

Finally, **Appendix 1** provides a detailed insight into the interconnection projects in CCS countries and a synthetic view of all the projects in the CCS region.

3 Assessment of the TYNDP 2010



The present chapter presents an overview of the main changes in the project consistency, commissioning date and status compared to information presented in the pilot TYNDP 2010. More detailed monitoring data on the interconnection projects are available in the Appendix.

When comparing the pilot TYNDP which was published in June 2010 to the present TYNDP 2012 a few changes have been introduced to the list of regional projects, taking into consideration the post-2010 developments with regards to both project implementation and network needs.

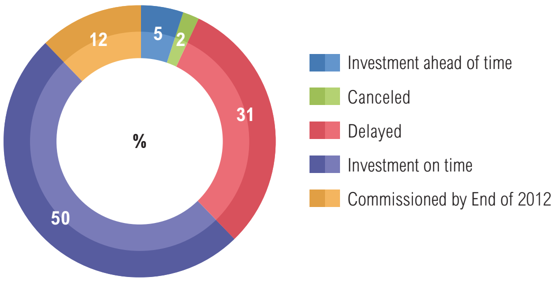


Figure 2:
Monitoring of CCS Projects of TYNDP 2010 (%)

While some of the projects contained in the previous TYNDP 2010 were already commissioned, some more recent projects have been added to TYNDP 2012, as new needs arise or alternative solutions appear more preferable. In contrast, other cases may have been affected due to the fact that the project implementation date has changed.

Delays on projects are caused, in most cases, by difficulties relating to the authorization and permitting processes, generally due to consultation results or environmental issues which sometimes means that a project must be revised in order to introduce some changes regarding its definition, or even, in more extreme cases, to look for an alternative solution (new project).

For this issue the required grid may not be in time and it can lead to a higher cost for the system, to be not able to insure the production of the installed RES, to reduce the risk of the security of supply in some areas or to improve the integration of the electricity market.

The following figures summarize the current project status on the CCS region and ENTSO-E in terms of TYNDP 2012 compared with the pilot TYNDP 2010:

Concerning TYNDP 2012 projects on the CCS region, of a total number of 41 projects, most of them – 76 % – were contained in the previous TYNDP 2010. However, some of them have been reshuffled, 24 % are new projects, while 23 % have experienced some delay in their commissioning date and more or less 1 % have been cancelled.

3.1 Completed Projects

From the set of TYNDP 2010 projects, in the CCS region many projects have already been commissioned. Among these, the following are highlighted:

- The reinforcements of the existing 400 kV axis between France and Italy "Cornier – Montagny – Albertville – La Praz – Villarodin – Venaus – Piossasco" and installation of the new PST 220/220 kV in Camporosso (IT) substation on 220 kV interconnection line Camporosso – Broc Carros;
- The installation of the new PST 400/400 kV in Divača (SI) substation on 400 kV interconnection line Divača (SI) – Redipuglia (IT) between Italy and Slovenia in order to optimize the transmission capacity between the two countries;
- The installation of the 2nd circuit on the Austrian part of the 380 kV line Wien SO (AT) – Szombathely (HU) (63 km);
- The new 400 kV double circuit overhead line 22 km Chignolo Po (IT) - Maleo (IT), in the North of Italy, essential for the increase of the transmission capacity in the North-West border;
- The first section of the 380 kV Salzburgline (St. Peter (AT) – Tauern (AT)) between the grid node St. Peter (AT) and the new substation Salzburg (AT) with a length of 46 km was erected is presently being put into service with 220 kV;
- The new 400 kV single circuit overhead line 12 km Ittiri (IT) – Codrongianos (IT) in Sardinia island;
- The 400 kV single circuit line 40 km Casellina (IT) – Tavarnuzze (IT) - Santa Barbara (IT) in the central part of Italy;
- In the South of Italy the new 400/150 kV substations for RES integration were commissioned, namely Deliceto, Bisaccia, Troia and Maida.

In addition, a number of important 400 kV investments are currently under construction. Among these, the following are highlighted:

- The reinforcement of the existing 400 kV axis between France and Italy "Cornier – Montagny – Albertville – La Praz – Villarodin – Venaus - Piossasco" (almost completed)
- The 400-kV "Cotentin-Maine" OHL in western France (total length 163 km)
- The new France-Spain 65-km 2*1000 MW HVDC (VSC) interconnection in Eastern Pyrenees via underground cable
- The 400 kV double circuit line, partially with submarine AC cables, Sorgente – Rizziconi with a total length of 80 km;

- The 400 kV single circuit OHL line Foggia – Benevento with a total length of 80 km;
- The 400 kV double circuits OHL line Trino – Lachiarella with a total length of 80 km;
- The 400 kV double circuits Dolo – Camin with a total length of 15 km;
- The new PST 400/220 kV in Lavorgo (CH) substation on 400 kV interconnection line Lavorgo (CH) – Musignano (IT) between Switzerland and Italy in order to optimize the transmission capacity between the two countries.

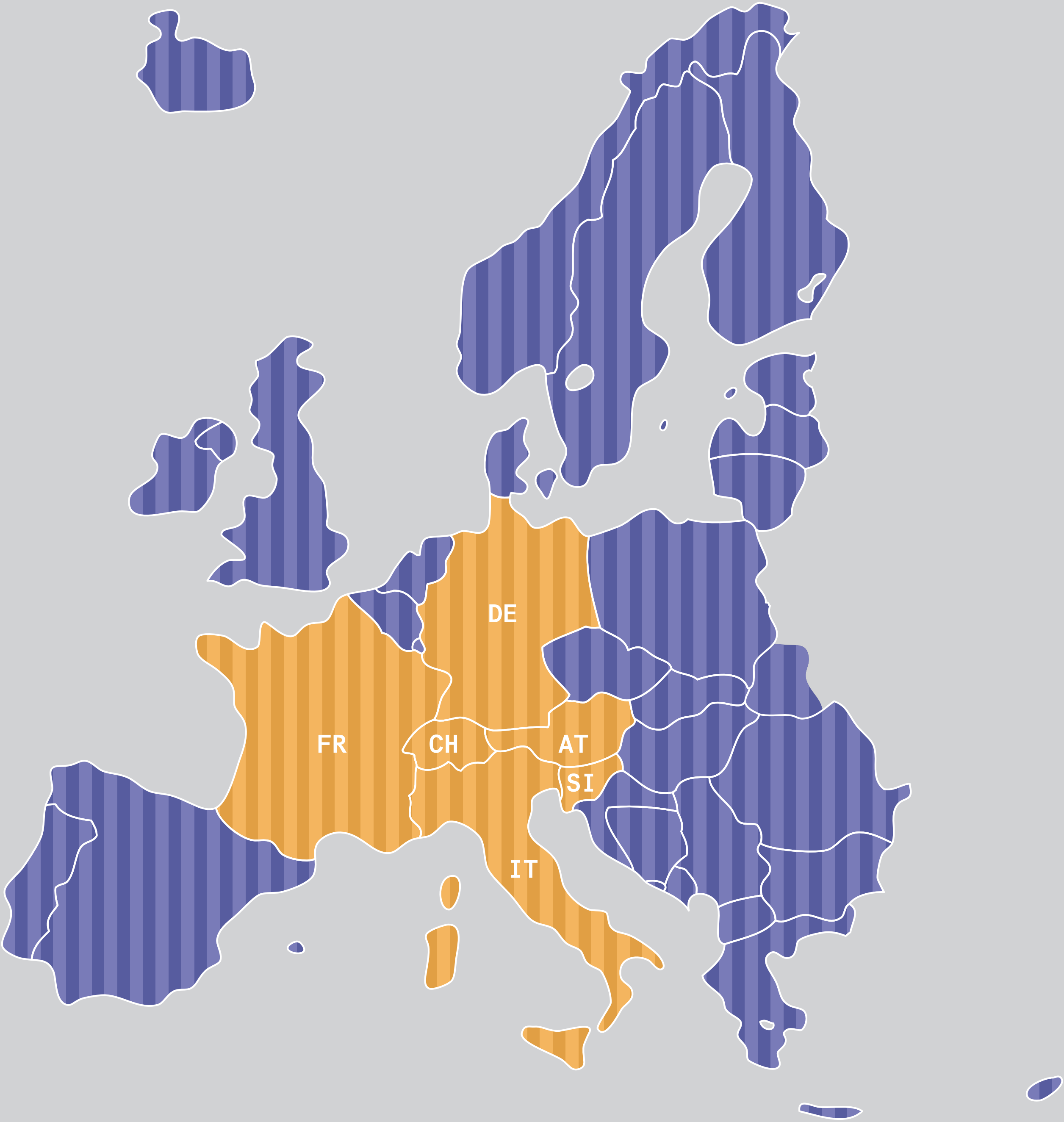
New projects represent something like 20 % of total projects. From the set of these new projects included in the TYNDP 2012, the following can be mentioned:

- Reinforcement of the existing HVDC "Sardinia – Corse – Mainland" connection, partially with overhead line;
- New 400 kV backbone "Aliano – Montercorvino" to reinforce the corridor from South to Central South of Italy due to RES integration and to avoid market congestion;
- New HVDC connections from the North to the South of Germany (project n. 43);
- New HVDC subsea cable between the South-East and South-West of France.

3.2 Delays in Commissioning Date

The percentage of projects which experience delays in commissioning date is 23 % and the main motivations are largely due to permitting issues, for example alterations in the legal framework, local public resistance, delays in permitting process, and so on. Mostly delays do not change the classification of the projects from mid-term to long-term.

4 Specific RG Methodology and Assumptions



4.1 TYNDP 2012 Methodology

Common main scenarios build the base of the analysis for the TYNDP and the Regional plans. These scenarios are described in Chapter 5. In addition, during the process of preparing the TYNDP and the Regional plans, a Pan European Market Database (PEMD) has been developed containing scenario supply and demand data as well as other common data such as interconnection exchange capacities. Moreover, fuel prices based on the World Energy Outlook 2010 published by the IEA have been used (New Policies Scenario, year 2020).

This common data is the basis for Regional analysis, both market model analysis and network analysis.

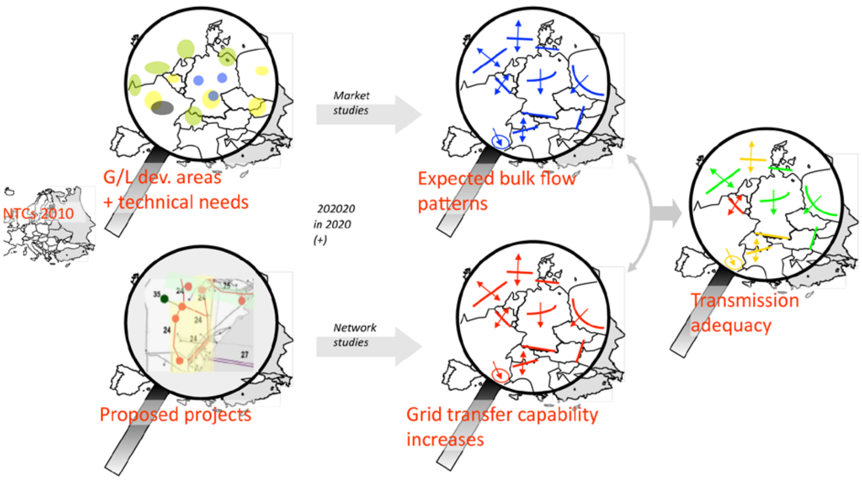


Figure 3:
Overview of the General Methodology

Market study results have also been used to define the benefits of the planned investments. Common guidelines have been defined for project assessments.

The main focus on market studies is the evaluation of the energy flows across the borders based on a pure economic optimization. While the congestions are evaluated by network study. Market studies have been performed at the regional level taking advantage of the existing competence and tools.

A common grid model is used to assess the future grid transfer capability with the planned investments and the resilience in stressed grid situations.

A more detailed description of the common method can be found in the TYNDP 2012.

4.2 Market Studies Methodology

4.2.1 Purpose of Market Studies & System Modelling

The development of cross-border interconnection capacities, the expansion of the CCS generation systems, and the load evolution during the next ten years were based on a set of pre-determined assumptions which are presented in Chapter 5.

The purpose of the market studies is to investigate the impact of the new interconnection projects, by comparing two different grid situations in terms of economic efficiency: the ability of the system to schedule plants accordingly to their intrinsic merit-order[1], the overall resulting variable generation costs as well as the overall amount of CO_2 emission, and volumes of spilled energy. An economic optimization is conducted for every hour of the year, taking into account several constraints such as flexibility and availability of thermal units, wind and solar profiles, load profile and uncertainties, and transmission capacity between countries.

Each country is modelled as one single node (all generation and load data is aggregated to this single node), considering that there is no internal constraint within the country, and limited border transmission capacity between countries.

The rationale behind system modelling is to use very detailed information within CCS, and a decreasing level of detail when deviating from the studied area. This is done fundamentally in 3 steps:

1. Modelling of CCS Countries

The CCS region is modelled with a detailed regional market database which was exchanged in the framework of the Regional Group. This data refers mainly to:

- Load (hourly profile, sensitivity to temperature, etc.);
- Generation:
  - thermal units, with their characteristics: installed capacity, efficiency, flexibility, must-run obligations …
  - hydraulic system: run-of-river, storage, pumping capacity, ...
  - other renewable generation (wind, solar, biomass, …)
  - other generation (CHP, waste …)

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[1] The variable generation costs of a given unit, and consequently the merit-order, being a consequence of mainly fuel cost and CO_2 cost

– Exchanges with non-ENTSO-E countries (Italy <-> Tunisia) (on an hourly step).

Besides these, a synchronous wind profile provided by EWIS[1)] (hourly load factor based on the historical data of the year 2006) has been used in order to stabilize the behavior of the wind generation within many countries.

2. Modelling of neighbouring countries

CCS being part of the whole ENTSO-E interconnected system and having interaction with the rest of Europe, the 1st neighbours of CCS (Great-Britain, Belgium, the Netherlands, Spain, Sweden, Poland, Denmark, Norway, Czech Republic, Hungary, Croatia, Luxembourg) are modelled (Slovakia excepted, which has no direct electrical link with countries of CCS). The description of these countries is based on the Pan-European Market Database, which contains the same kind of data (load, generation, exchanges with non-ENTSO-E countries) but with less detailed information than the ones exchanged for CCS countries.

3. Modelling of exchanges with the rest of ENTSO-E

Finally, in order to take into account the interaction of the whole modeled system (18 countries) with the rest of ENTSO-E, limit exchanges conditions have been fixed, on an hourly step, based on a Pan-European simulation performed by the Regional Group Continental Central East.

1) EWIS: European Wind Integration Study

The map below synthesizes how countries and exchanges are modeled:

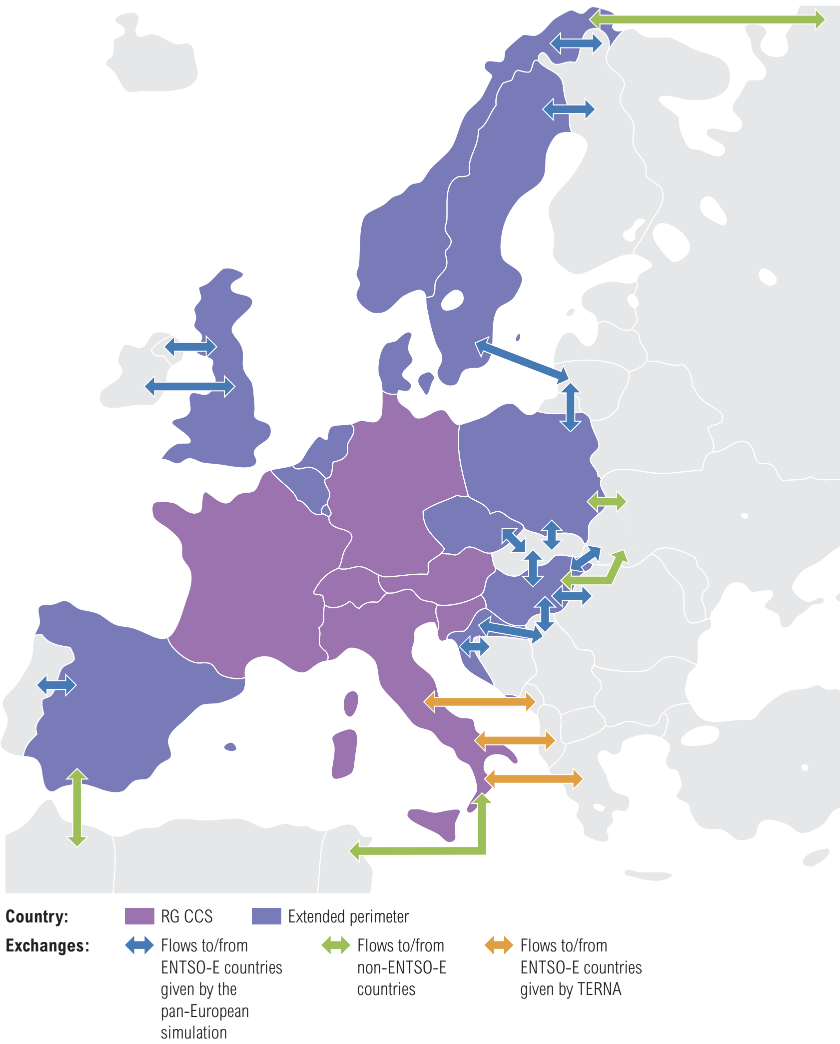


Figure 4:
Countries and exchanges

The electrical behaviour of the whole interconnected system is simulated for the full 8760 hours of the horizon year. Results are available from the hourly to the annual step.

4.2.2 Valuation of Reinforcements

The benefits assessed in the market studies process are those provided by long-term cross-border reinforcements, which increase the transmission capacity between two countries. To evaluate them, the two grid situations (with or without all of the long-term reinforcements) are compared – thus, the comparison gives the benefits provided by all long-term CCS projects taken together.

Furthermore, for Scenario EU 2020 (described in Chapter 5), the benefits due to each cross-border project are analyzed by comparing the situation with planned grid for 2020 everywhere and the situation when considering that "grid capacities as expected in 2015 on the analyzed border and grid capacities as expected in 2020 everywhere else". This method gives the benefits due to one project, as if it were the last to be commissioned – and thus it can be considered, in most cases, as the minimal benefits provided by the project.

Benefit analysis refers mainly to:

- Generation dispatch,
- Social welfare (in terms of variable generation costs),
- CO_2 emissions,
- RES integration (how much energy spillage is avoided),
- Energy exchanged on the interconnections and % of congestion.

Besides these, additional specific analysis of the commercial exchanges duration curves between countries is carried out, in order to help in assessing the bulk power flows (BPF) indicators.

In addition, adequacy studies are conducted in order to assess the evolution of the Security of Supply (SoS) in each country. The indicators provided concerning the SoS are:

- Loss Of Load Expectation or LOLE (hours)
- Loss Of Load Probability or LOLP (%)
- Expected Energy Not Supplied or EENS (GWh)

4.2.3 Market Study Models used

The basis for the performed market and adequacy studies is provided by 2 simulation tools: ANTARES and PROMED, which were developed by RTE and TERNA.

Among other specificities, briefly, ANTARES is a sequential Monte-Carlo multi-area adequacy and market simulator, which simulates hundreds of situations that are the outcome of random events (low outdoor temperatures, planned or unplanned outages, levels of wind and hydro-reservoirs …) whose possible combinations form a set of scenarios so large that their comprehensive examination is out of the question. In contrast, PROMED performs a deterministic coordinated hydrothermal hourly scheduling of the generation units, in which pumping and reserves are modelled in more detail.

4.3 Network Studies Methodology

The aim of this paragraph is to provide an operative methodology for the evaluation of grid reinforcements' benefits in respect to their impact on grid transfer capability (GTC). The identification of exchange limits among the countries' GTC is normally obtained starting from stressed network situations suitable for highlighting the reinforcement outcomes.

4.3.1 Market Studies as an Input to the Network Studies

An accurate selection of the cases to be studied is of paramount importance for an adequate valorisation of projects' effects on forecast network. A selection of credible cases to be studied should start from realistic network configurations (load/generation balance, presence and production of renewable generation plants) agreed from TSOs considering among the others factors: projects under investigation, TSOs' historical knowledge of grid critical conditions, amount of renewable generation production (High Res or Low Res cases) and interaction with other projects.

The market studies results (with planned grid for 2020, extended perimeter) have been used as a reference to prepare the forecast scenarios, in particular the load/generation balance for the country included in the network model, and the import/export data with fictitious border representation. As soon as the power exchanges among the countries involved in the market studies rise, mainly due to economic cost minimization, it is possible to impose on the network model only country generation/load balance, while the power exchanges are determined from the solution of load-flow calculation.

The simulations have been carried out in several conditions of load and generation, adjusting the power injection/consumption in each node of the grid, with regards to the winter and summer. Among the more extreme conditions two cases were selected for the high level of exchange within the RG, in order to assess the capacity of the interconnections to transmit the power flow without violations:

- Hour n. 7458, 7th November 2020 at 17.00: Low RES case;
- Hour n. 8332, 14th December 2020 at 3.00: High RES case.

These two cases refer to winter season. The Low RES case being referred to is Saturday 7th November 2020 at 17.00, while the High RES case being referred to is Monday 14th December 2020 at 3.00.

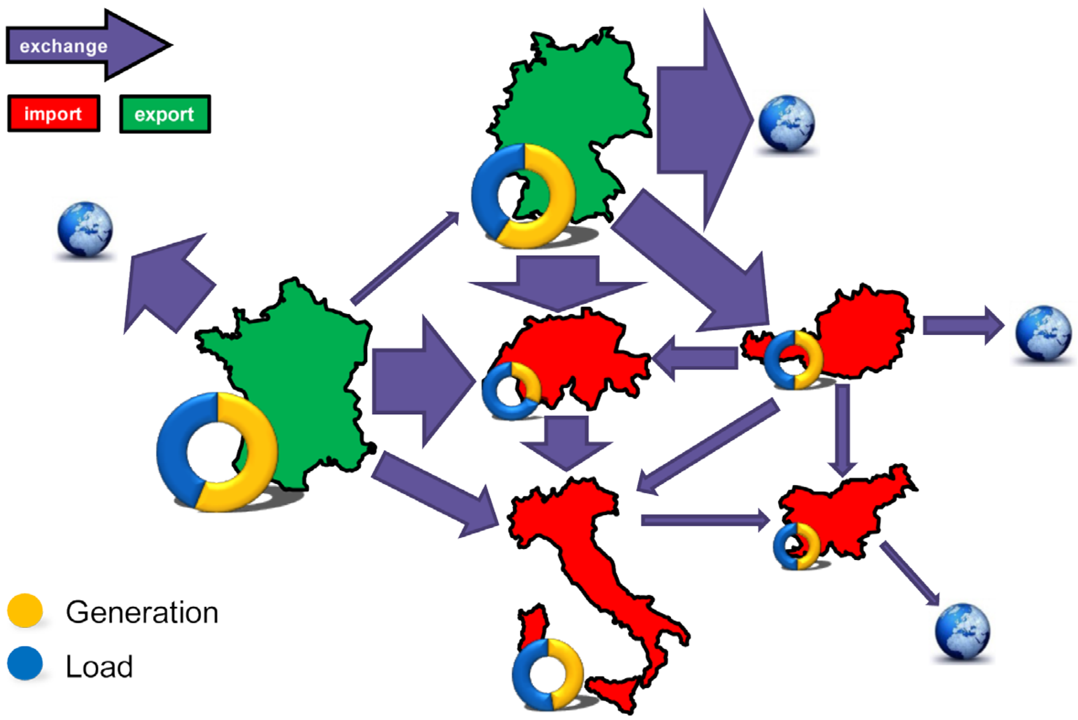


Figure 5:
High RES case

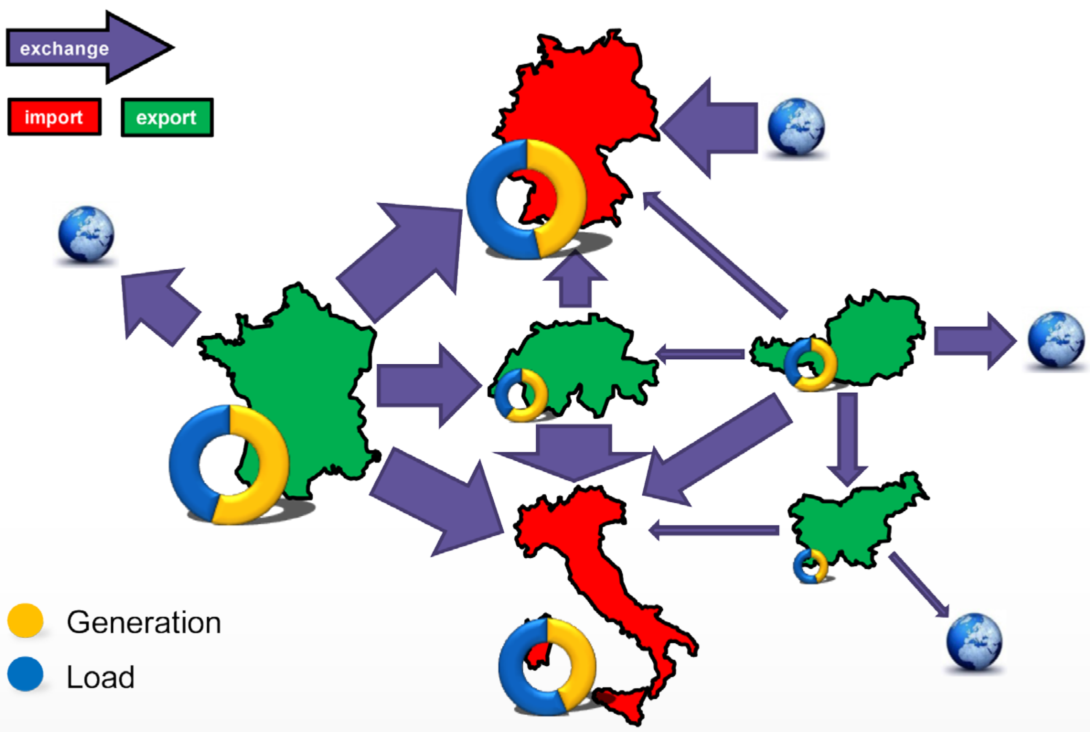


Figure 6:
Low RES case

Starting from the selected forecast scenario, GTC is evaluated with a static analysis in safe network conditions. For both cases the project's assessment indicators evaluation method will consider a starting condition with all projects in service, with the steps comprising:

- Static analysis in safe network conditions with verification of violation of lines rating, at least for interconnection lines and those near the borders
- Static analysis in safe network conditions putting out of service each project and verification of lines overload at least for interconnection lines and those near the borders, or indicated from TSOs; threshold acceptable: no more than 100 % for lines and 100 % for transformers in N-1 condition.

4.3.2 Evaluation of Reinforcements

During this analysis different reinforcements are considered (among France and Italy, Austria and Italy, Switzerland and Italy, Austria and Germany, Italy and Slovenia). This is in order to improve network security and to increase the ability of the electric system to support the production of actual and future RES plants, thus minimizing curtailments and avoiding network overloads.

4.3.3 Model used for CCS

4.3.3.1 Modelling of CCS countries and neighbouring countries

the CCS network model adopted for this analysis is a 2020 scenario Winter Peak.

- Network consistency:
  - nodes: 7873
  - lines: 8108
  - transformers: 2452
  - generators: 3155

More elaborate and detailed data was exchanged in the framework of the Regional Group. This data refers mainly to:

- Load
- Generation:
  - thermal units, with their characteristics: installed capacity
  - hydraulic system: run-of-river, storage, pumping capacity ...

    - other renewable generation (wind, solar, biomass ...)
    - other generation (CHP, waste ...)
- Exchanges with other countries

4.3.3.2 Updating of generation and load data

In order to develop the network models according to the selected cases of market results, the reference model on Winter Peak 2020 has been modified; the model has been fine tuned using ANTARES data: 'Import/Export' exchange balance, Load and Wind generation, as below:

- Load extracted from ANTARES (for each selected hour) has been redistributed proportionally on all positive loads, in relation to load data available with the following priorities:
    - Load data provided by TSOs;
    - Load data present on network.

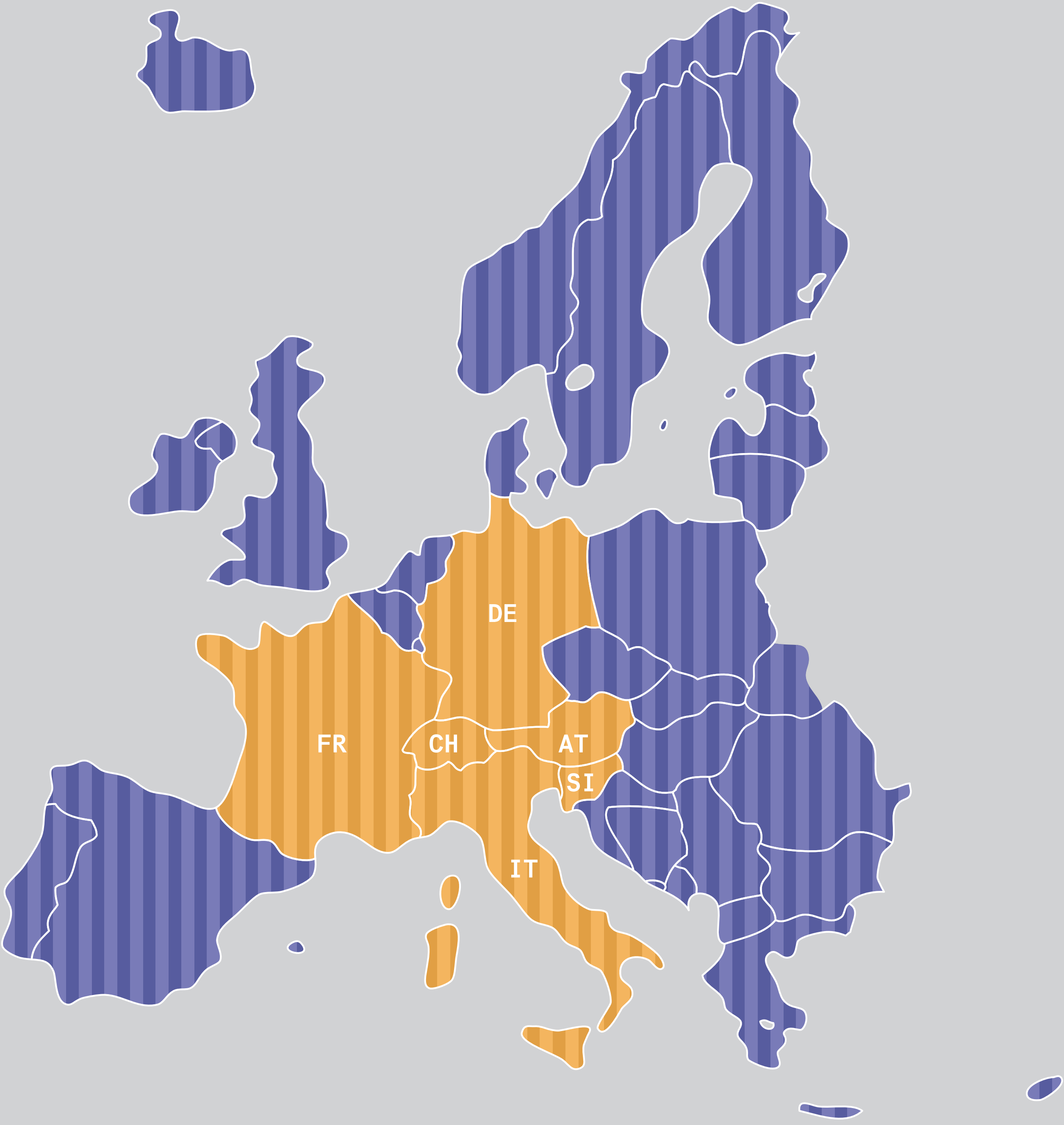
- Wind generation extracted from ANTARES (for each selected hour) has been redispatched with a homothetic distribution based on the available generation with the following priorities:
    - Wind generation data provided by TSOs;
    - Load data (negative value) present on network.

Such redistribution exclusively where the type of generation is identifiable (inside network database or marked by TSOs).

- Net wind generation has been redistributed as below:
  Net wind generation = "Import/Export" Balance + (Load (+) – Load (-))
  – Wind generation.

This generation has been redispatched in a homothetic way to the existent generation, taking into account the same priority of wind generation and endeavouring to not exceed the maximum power generable by each generator.

5 Scenarios



In this chapter scenarios used in the Regional Investment Plan and market simulation results are described. The chapter starts with a description of the two scenarios which are used within all ENTSO-E Regional Groups. Besides this, scenario specifics for the Regional Group CCS are addressed. Finally, market simulation results and conclusions are presented.

5.1 Description of the Scenarios

Two different scenarios have been simulated for the entire CCS Region, both for the year 2020. They represent different possibilities of the main variables involved in the behavior of systems and thus, of markets.

- The first scenario has been referred to as the "EU 2020", and represents a context in which all objectives of the European 20-20-20 objectives are met (20 % of Renewable Energy Source (RES) in the final energy consumption, 20 % reduction of Green House Gas (GHG), and 20% increase in energy efficiency).
  - Efficiency measures adopted result in low annual demands in all countries.
  - Prices of main fuels, gas and coal, are taken from the reference scenario of the International Energy Agency in its World Energy Outlook. CO_2 price is higher, and CCGT units are generally cheaper than coal plants, except for coal with its "must-run" conditions.
  - The installation of RES power can be considered optimistic, according to the National Renewable Energies Action Plans (NREAP) sent to the European Commission.
- A second scenario has referred to as **"Scenario Best Estimate",** or **"Scenario B",** and represents the best estimate condition of the TSOs, regardless of whether or not European objectives are globally met.
  - Higher demand growth rates result in significantly higher demands all over the Region perimeter simulated.
  - The price of CO_2 emissions used is the central forecast of the IEA, and is cheaper than in "EU 2020". It results in lower variable generation costs for most coal plants in Europe (regional groups may use different data from the standard values for specific units).
  - The installation of power from RES is the central forecast of the TSOs, and is generally (but not always) lower than the national targets.

– Additionally, a sensitivity analysis has been built upon “Scenario B”: “Nuclear Phase Out” (NPO), in which part of the nuclear units in Germany (10.6 GW) will be shut down (the total phase out is expected in 2022).

For both scenarios and the NPO sensitivity analysis, similar data with standard format has been shared between TSOs through the Pan-European Market Database (PEMD), in order to allow for a Pan-European simplified modelling. Some additional information is shared among TSOs of one RG when more detail is needed for the simulated region (must-run constraints of specific units, ramp rates, min time on\off, hourly Transfer Capacities between neighbour systems, etc).

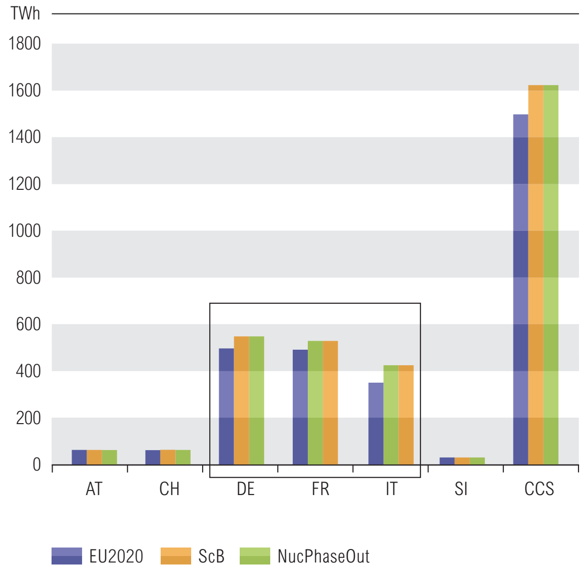
5.2 Specificities of CCS

5.2.1 CCS Market Scenarios

This paragraph describes the two scenarios and the sensitivity analyzed in CCS RG, according to the hypotheses and assumption described in Chapter 4.

Different interconnection capacity, with and without the planned long-term reinforcements into the study perimeter, was considered. The results described below refer to the simulation performed with the 2020 planned grid, while the effect of the long-term reinforcements will be analyzed in Chapter 4.3.

The demand simulated in the CCS area (see Figure) is approximately 1.660 TWh in “B Scenario” and around 1.500 TWh in the “EU 2020” Scenario, due to the load efficiency measure considered in the last one, located mainly in Germany, France and Italy.



	AT	CH	DE	FR	IT	SI	CCS
EU2020	74	69	491	488	366	15	1503
ScB	77	69	566	519	412	16	1660
NucPhaseOut	77	69	566	519	412	16	1660

Figure 7:
CCS Demand in the three scenarios

Demand is covered by the use of CCS generation internal resources and the exchanges between the Regional area and the rest of the simulated perimeter (see Chapter 4).

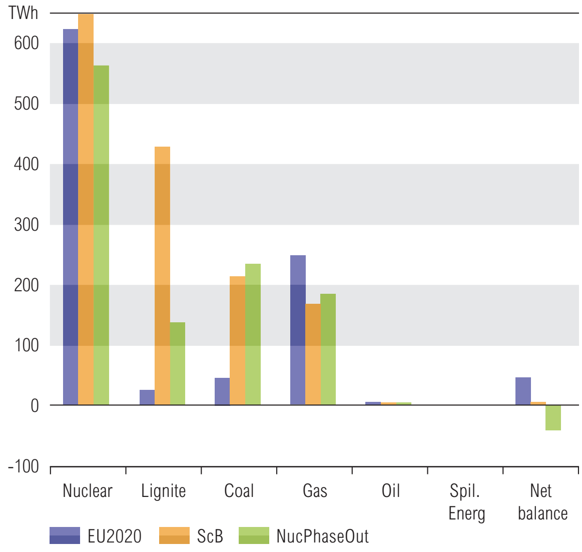
The biggest share of the generation mix in CCS (see Figure 8) is supplied by the nuclear source in all scenarios, with an obvious reduction in the Nuclear Phase Out sensitivity (approximately 13 % less than "B Scenario"). The Nuclear source is, in this context, partially compensated by an increase of Coal (around 10 % more than "B Scenario"), and Gas (around 11 % more than "B Scenario"), and partially by an increase of import from the rest of the simulated perimeter.

On the contrary, in the EU 2020 Scenario the generation from fossil fuel is strongly limited, due to the low demand, the high share of RES and the high CO_2 price increase (see Chapter 4). The Coal and Lignite generation decrease, with regard to the "B Scenario" is approximately 80 %, while the gas generation increases by around 50 %.

The grid capacities, which include the long-term network reinforcements, are as expected in 2020, that is, they are sufficient to avoid most dumped energy (spillage energy in Figure 8).

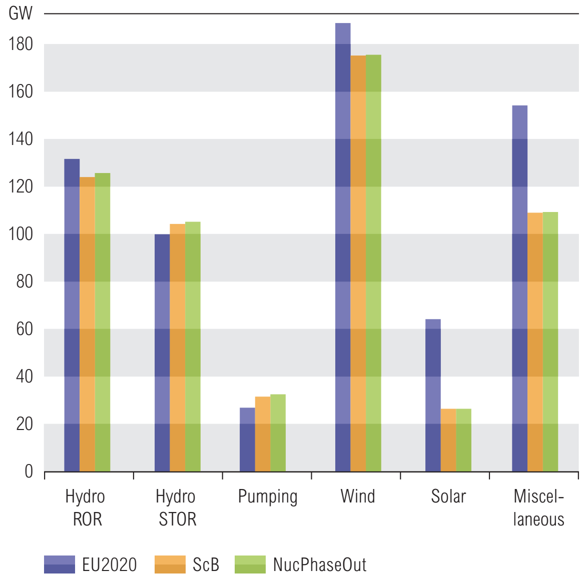
Concerning the renewable generation, which is reported in Figure 9 with the remaining non-dispatchable generation, the EU 2020 scenario is characterized by the increase of solar plant production by around 130 % compared to the "B Scenario", and by a lower increase of wind generation by approximately 10 % compared with "B Scenario".

Miscellaneous in Figure 9 are referring to energy generated by biomass, waste, CHP, and so on.



	Nuc	Lig	Coal	Gas	Oil	SE	N b
EU2020	619	24	45	245	1	0	44
ScB	644	131	214	164	1	0	2
NucPhaseOut	559	133	234	182	1	0	-42

Figure 8:
Thermal Contribution and Net Balance of CCS Area



	ROR	STOR	Pump	Wind	Solar	Misc.
EU2020	132	100	28	189	65	155
ScB	124	104	32	175	28	109
NucPhaseOut	125	105	33	175	28	109

Figure 9:
Other Generation in CCS Area

5.3 Market Results and Conclusions

5.3.1 Market Results and Conclusions

This chapter describes the main results of the market analysis concerning the effects of the long-term reinforcements, in all cases analyzed ("EU 2020", "B Scenario" and NPO sensitivity), according to the assumptions and methodologies described in Chapter 4.3.

The long-term cross-border reinforcements will lead to an increase of exchange capacities between 2015 and 2020, as shown on the following map:

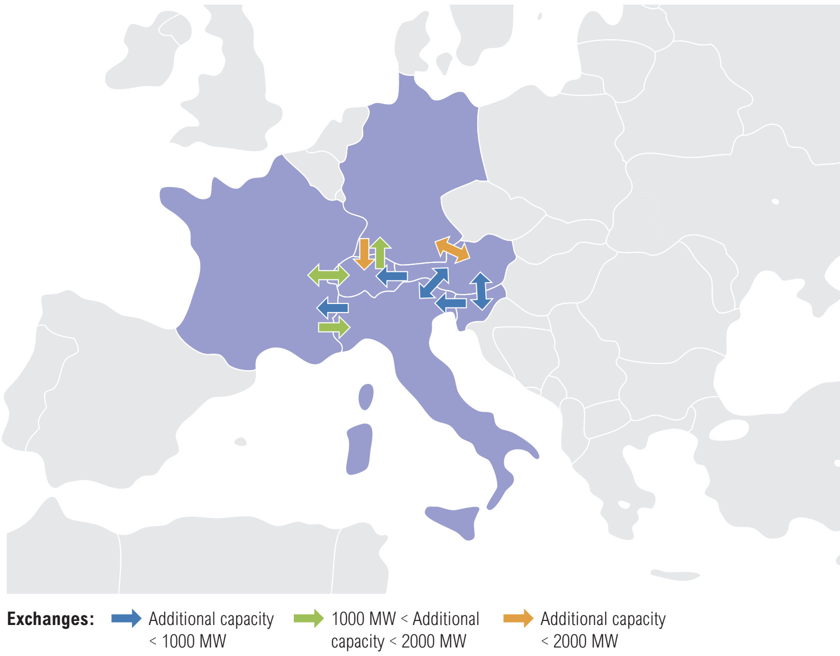


Figure 10:
Additional Interconnection Capacity between 2015 and 2020

The following figures will summarize the market study results, mainly in terms of:

- generation breakdown and balance;
- CO_2 emissions;
- generation costs savings.

In order to assess the CCS reinforcement benefits, the following figures present the differences between the simulations performed with all long-term reinforcement (grid configuration "expected in 2020") and the simulations performed without long-term reinforcement (grid configuration "expected in 2015"), inside the RG perimeter.

Figure 11 shows the difference of the generation breakdown and balance, between the two configurations mentioned above, for each of the three cases.

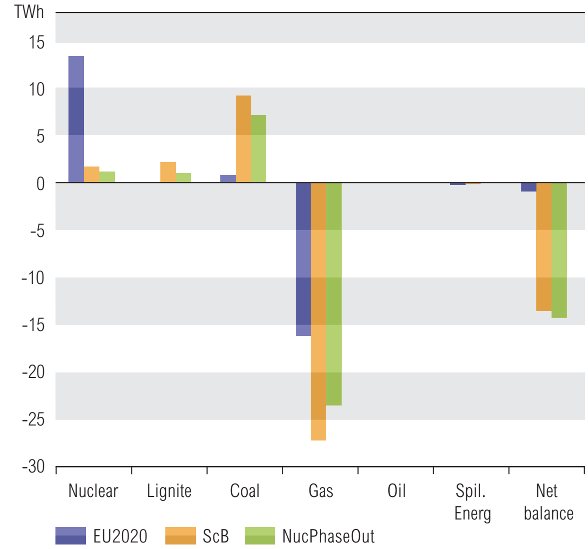
In the EU 2020 scenario the improvement of the cross-border transmission capacities allow for an increase of the nuclear generation by approximately 14 TWh, and to a lesser extent the coal generation by around 1 TWh. Concerning gas generation, old gas units (more expensive) are partially replaced by new gas units within CCS, whilst the resulting gas generation decreases by 16 TWh.

In the same scenario it is interesting to point out that without the planned long-term reinforcements, around 0.8 TWh in absolute value of dumped energy (spillage energy in Figure 11) is expected in scenario EU 2020, mainly in Germany. The variation of the dumped energy due to long-term reinforcements is a reduction by around 0.5 TWh (60 %).

In Scenario B and the Nuclear Phase Out sensitivity analysis, a similar impact from the increase of transmission capacities is expected:

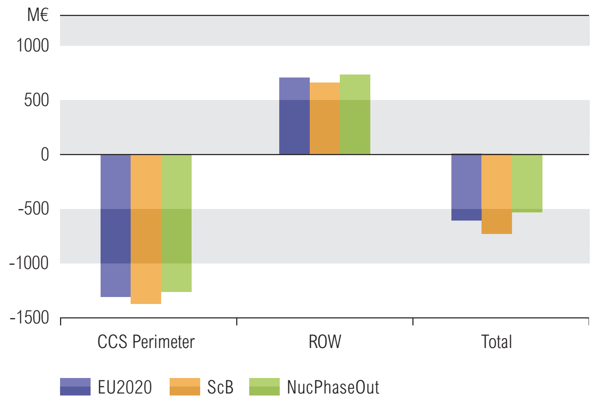
- Nuclear generation increases by around 2 TWh in B Scenario, and 1 TWh in the Nuclear Phase Out sensitivity analysis;
- Coal generation increases by around 9 TWh in B Scenario and by 7 TWh in the Nuclear Phase Out sensitivity analysis;
- Gas generation decreases by around 27 TWh in B Scenario and by 24 TWh in the Nuclear Phase Out sensitivity analysis.

The improvement of the transmission capacities between the CCS countries makes it possible to increase the import from the neighbouring countries by approximately 14 TWh in both B Scenario and the Nuclear Phase Out sensitivity analysis (mainly coal from Poland, Netherlands and Great Britain), while the increase of import in the EU 2020 scenario is not significant by approximately 1 TWh.



	Nuc	Lig	Coal	Gas	Oil	SE	N b
	14	0	1	-16	0	-0,5	-1
	2	2	9	-27	0	-0,1	-14
	1	1	7	-24	0	0,0	-14

Figure 11:
Delta Generation Breakdown and Balance in CCS (Grid Capacities as Expected in 2020 – Grid Capacities as Expected in 2015) – TWh



	CCS Perimeter	ROW	Total
	-1319	704	-615
	-1373	642	-731
	-1275	731	-544

Figure 12:
Variable Generation Cost Savings (Grid Capacities as Expected in 2020 – Grid Capacities as Expected in 2015) – M€

Figure 12 details the variable generation cost variation due to the increase of transmission capacity among the CCS countries in the three cases.

The higher variable generation cost decreases in Scenario B due to the planned network improvements (around 730 M€ in all simulated countries).

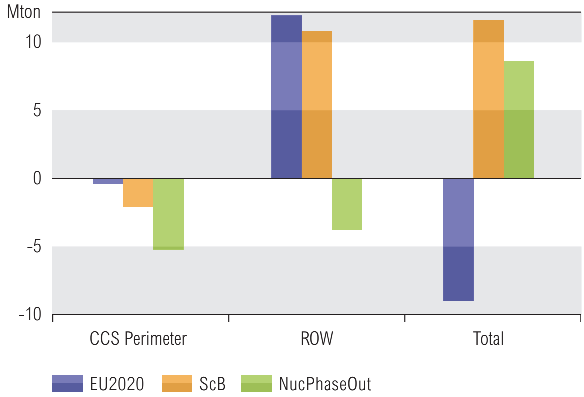
In the EU 2020 scenario, despite the high CO_2 price, generation cost savings decrease with regard to B Scenario, which is mainly due to smaller variations of the generation mix per country (inside and outside the CCS perimeter).

The phase out of the nuclear generation in Germany and Switzerland, replaced partially by more expensive generation, reduces the difference of the generation cost evaluated with and without the long-term planned network reinforcements: Approximately 71 M€ less than in the EU 2020 Scenario and around 180 M€ less than in B Scenario.

The following figure details the variation of CO_2 emission due to the network improvements.

The interconnection network improvements allow for a reduction in the CO_2 emission by around 9 Mton in the EU 2020 Scenario (gas generation replacing nuclear generation), while in the other two scenarios the increase of grid capacities causes an increase in CO_2 emission by around 12 Mton in B Scenario and 9 Mton in the Nuclear phase out scenario (coal generation replacing gas generation). In addition to the benefits associated with the interconnection projects, there are also other benefits in terms of reduction of CO_2 emission, which are due to internal reinforcements.

Considering the Nuclear Phase Out sensitivity, it is likely that part of the decommissioned nuclear generation in Germany will be replaced by thermal units or RES generation, in Germany but also in other countries. Therefore, savings and CO_2 emissions calculated here do not take into account the potential effect of this replacement, since the amount and the localization of those additional means of generation are not yet clearly identified.



	CCS Perimeter	ROW	Total
EU2020	0	12	-9
ScB	-2	11	12
NucPhaseOut	-5	-4	9

Figure 13:
Delta Co2 Emissions (Grid Capacities as Expected in 2020 – Grid Capacities as Expected in 2015) – Mton

In addition project analyses were performed, in order to evaluate the effect of the main network reinforcements groups. The results will be summarized in the following chapters.

5.3.2 Adequacy Indicators

The following section contains a synthesis of the main adequacy results described in SO & AF (4.2).

Considering Scenario B with the grid situation 2015, the benchmarks are fully respected in all countries of the interconnected system:

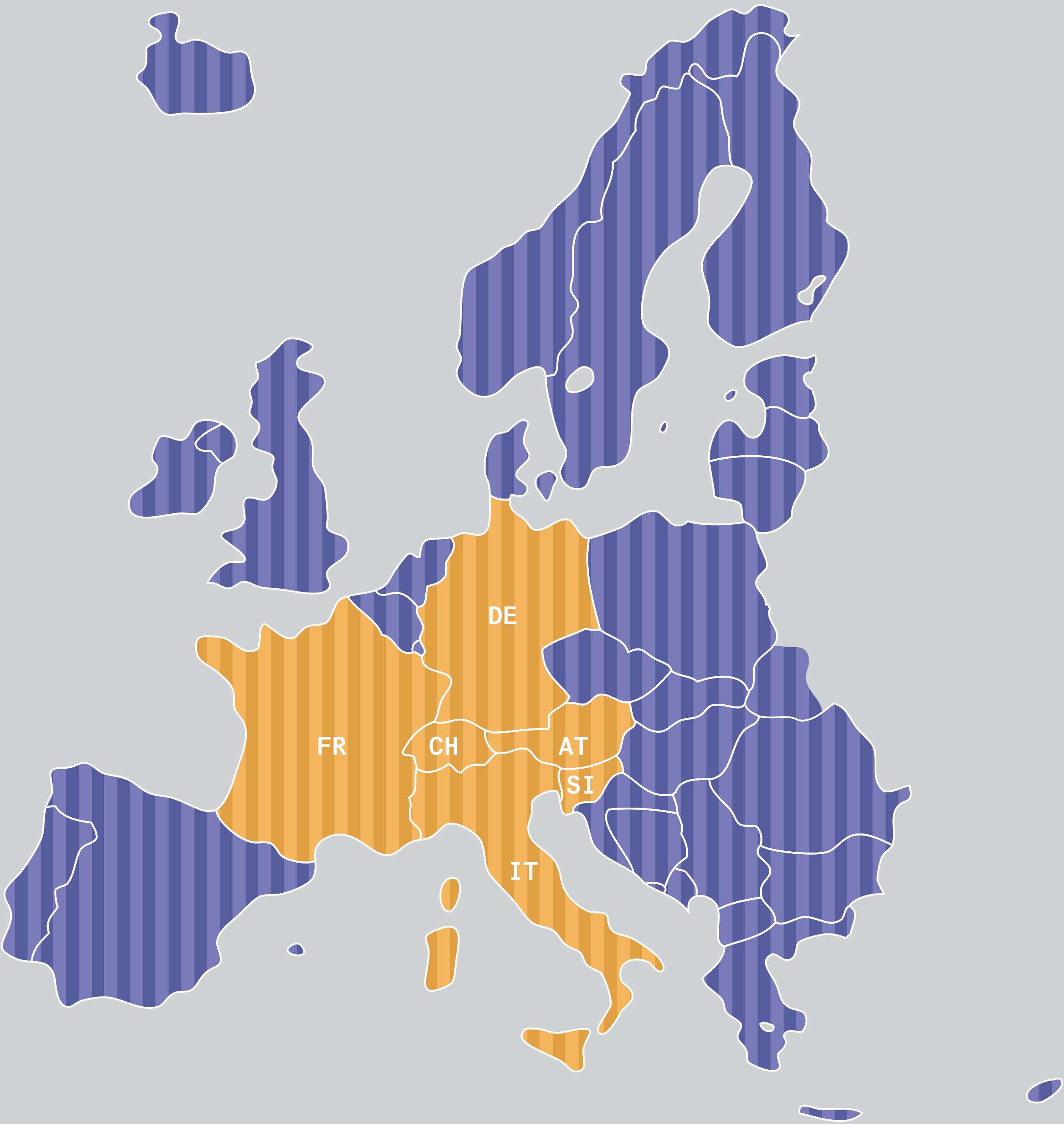
- No energy not supplied in Austria, Germany, Italy, Switzerland and Slovenia;
- Low energy not supplied in France (LOLE = 0.4 hours and EENS = 0.5 GWh). The French national criteria is respected (LOLE<3 hours).

Due to the planned long-term reinforcements, the energy not supplied in France is reduced by 50 %, from low values to very low values (LOLE = 0.2 hours and EENS = 0.2 GWh).

The benchmark is still respected with the Nuclear Phase Out, but it has a significant effect on the French adequacy system: LOLE = 0.4 hours and EENS = 0.7 GWh with grid capacities as expected in 2020. The energy not supplied remains close to zero in other countries.

More details of the adequacy analyses are reported in 4.2.4.2 of the SO & AF report.

6 Investment Needs



6.1 Drivers Of Evolution In The Countries In The Existing Grid

Recent developments in the electricity sector, such as the implementation of market mechanisms and the integration of renewable generation on a large scale, have significantly changed system operation conditions in Europe. This is especially true in its central area, where transmission networks are highly meshed in the central Western parts, while in the Eastern/South Eastern parts the grids are meshed but structurally lacking in terms of strong interconnections.

The integration of wind farms with power systems influences the operation of the latter in many ways, especially if done on a large scale. The results of study show that currently the main concerns, as seen from the perspective of the interconnected power systems on the continent are unscheduled transit flows. Specifically, the intermittent nature of wind farms (and to some extent also photovoltaic units) significantly increases the uncertainties regarding the prediction of the continent wide generation pattern and as a consequence also of load flows in the highly meshed systems.

The investment needs mentioned above are the drivers necessary for coping with future challenges.

One main driver for the development of the Austrian transmission grid is the increasing amount and volatility of grid loadings due to changes in generation and load patterns. In particular the steeply rising variable wind power in North Europe (mainly Germany) and in the eastern part of Austria as well as the close interaction with the existing and planned pump storage plants which are located in the Alps region, require the reinforcement of both interconnection and internal transmission lines. To ensure security of supply in Austria and in order to handle the increasing grid load in the long run, it is essential to close the 380kV-Ring in Austria.

In the scenarios considered, the French power system should expect a development of RES generation and especially wind. This new generation should be located mainly in northern France and along the Channel, including offshore.

New conventional generation is also expected, in specific regions, often located in already exporting areas far from load centres. Conversely, some decommissioning of old generation, generally located close to the load areas, is also expected.

Larger and more volatile power exchange with neighbouring countries are also expected, as well as some North to South loop flows due to increased generation in the North Sea countries.

Figure 14:
Illustration of Net Transfer Capacities in CCS Region (Winter 2010/11)

Last, even if France remains an exporting country in all the scenarios, due to the high sensitivity of load to temperature, short periods of imports are expected during cold spells. In such situations, the supply could even be at risk in specific regions with no or low generation and poor connection to the main grid, like Brittany or the PACA region.

The development of off-shore wind farms in the North of **Germany** induces needs for undersea connections to these wind farms as well as reinforcements of the grid capacity from North to South.

Besides the adaption of the German grid to the installation of Renewable Energy Sources, the grid must face in mid-term the change of flow due to the replacement of a number of conventional generation plants. These power plants will reach their end of life and will be decommissioned or in some cases replaced by new units.

With the recent decision of a Nuclear Phase Out by 2022, the structural changes in classical generation leading to different power balance situations in a given system or region obviously also result in changes in the generation pattern, driving further adaptations of the transmission grid.

In **Italy,** due to the development of generation facilities in the past ten years, concentrated in the North and South part of Italy, the current congestion in the North market zone is expected to increase, while new congestions will appear in the South part of the grid.

One of the critically important sections is located between the Piemonte and Lombardia Regions; large power exchanges flows are expected in the West-East direction, which will jeopardize transits toward the Milan area. More generally speaking, in the medium-term, an increase in the transits between market zones North and Central North is forecast, and the congestion between the Emilia Romagna and Toscana/Marche regions will cause market splitting at a higher frequency than today.

Another area often congested is represented by the North-East area of Italy, where the transit from Slovenia and the production of Monfalcone and Torviscosa power plants can only be managed with automatic tripping devices.

In fact, high flow from market zone South to Central South is expected; different congestions are expected on the Adriatic backbone 380 kV "Foggia – Larino – Villanova", where in addition to existing transits caused by Foggia and Brindisi limited poles production, the import from Montenegro through a new HVDC cable connected to Villanova station will increase power transits (by around 1.000 MW).

With regards to the Sicily Island, considering the forecast development of RES plants, the internal network and the existing interconnection with the mainland must be reinforced. In addition the long-term future interconnections with North Africa must also be taken into account.

Nevertheless, the connection of a large number of RES power plants to HV networks (typically, large wind farms) must be properly managed from a technical point of view. Furthermore, a certain amount of attention must also be devoted to the consequences of a large presence of distributed generation units (mainly PV) connected to the distribution networks on the dynamic behaviour of the transmission system.

Electricity transits in **Slovenia** represent more than one third of the total electricity transmission in the country. This indicator places Slovenia at the very top of the European table. Due to the position of the areas with large surpluses and significant electricity shortages, particularly neighbouring Italy, Slovenian transmission networks remain strongly exposed to the high power flows. Investment in neighbouring countries including installation of renewable sources in the North area will further affect the Slovenian transmission system. Wind penetration will have a major impact on power flows which will in turn increase transit in Slovenia.

To ensure the safe and reliable operation of the Slovenian power system and to achieve the goal of increasing capacity and reliability of electricity transmission between central-southern, central-eastern and South-eastern Europe, the Slovenian transmission system requires considerable reinforcements. New investments are also necessary in order to accommodate new RES and conventional generation expected in the related countries, together with removal of congestion at the North-South and East-West axes in order to strengthen security of supply. In addition to the high level of safe and reliable operation, 400 kV double OHL Beričevo – Krško, is under construction. This will be followed by the new interconnection lines with Hungary/Croatia (double OHL 400 kV Cirkovce – Heviz (HU)/Zerjavinec (HR) and with Italy (double OHL 400 kV Okroglo – Udine and project HVDC Italy–Slovenia – investment is in pre-feasibility study). The remaining network restrictions will be removed by upgrading internal 220 kV network to 400 kV level between Cirkovce and Divača.

The transmission grid in **Switzerland** has reached its limits in large regions because of large transits and due to the dramatic generation variations within Switzerland.

The main goals of the planned grid investments are the removal of structural congestion, the connection of the new pump storage power plants with a total capacity of around 4.500 MW and the adequate exchange capacity (Import/Export/Transit) of the resulting power flows.

Furthermore, on the Swiss-Italian and Swiss-French border, several 380 kV line projects aiming to increase the current power exchange and to evacuate the future generation capacity from Switzerland are under consideration.

6.2 Drivers of Evolution Between the Countries

In the Regional Group Continental South, 5 main needs clusters can be briefly summarized:

- **Massive RES connection:** the connection of RES (mainly wind and PV) to the network, the efficient balancing of the system and the increased on-shore transmission capacity from the North and Western region to the South are three main investment needs. For the latter, both offshore interconnections and optimized usage of available hydroelectric facilities will also trigger new investment requirements;
- **Integration of storage plants, mainly hydro in the Alps region, facilitates an efficient use of RES:** the increasing penetration of variable renewable generation leads to high and fluctuating utilization of the transmission networks and to this scope, a more flexible transmission grid is needed. In particular the grid's architecture must be adapted and expanded to allow transmission over long distances, and across national borders, from generation to consumption and storage sites. A considerable number of new pump storage power plants, facilitating the efficient integration of RES, are planned particularly in the Alps region.
- **Important North-South flows:** these investment needs are dictated by an insufficient cross-border capacity which causes structural market congestion between price zones;
- **Nuclear Phase Out in Germany** will affect the structure electricity flows mainly between Germany, Switzerland and north-eastern France but in general the entire CCS region. The generation and load balance in Germany will become more stressed compared to previous years and it is expected that Germany could depend on imports especially in cases of high demand conditions and low RES generation;
- **The power supply of some European cities and regions:** ensuring security of supply becomes a driver for a number of investments in the CCS Region, as this could interact with other investments needs in the area. Otherwise the cross-border capacity will be limited.

The following pictures depict the main investment needs in the CCS region in the mid- and long-term.

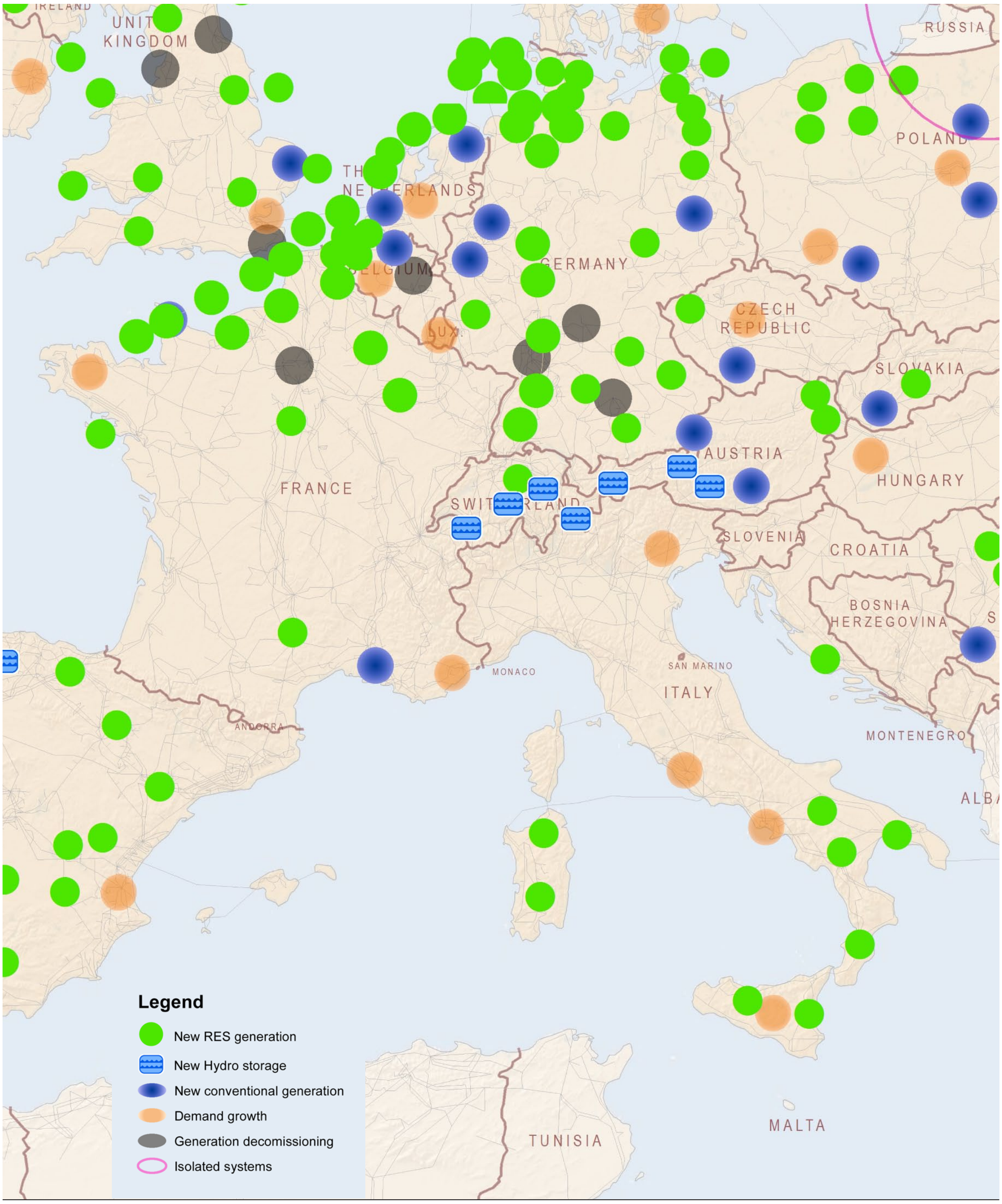


Figure 15:
Grid Development Drivers of CCS System

In the mid-term horizon, the development of the transmission grid in the CCS region must face new challenges due to the ongoing development of large numbers of new generation plants, especially RESs, often located far from main consumption centres and/or the HV transmission backbones. In addition, the supply is at risk in the French Riviera, an electric peninsula with no generation and connected to only one 400-kV line, following the cancellation in 2006 of the "Déclaration d'Utilité Publique" of the 400-kV Boutre-Broc Carros project planned to strengthen the connection to the main grid. Renewable energy, presently sharply increasing in Germany and Italy (at the extremes of the CCS Region), comes mainly from wind farms installed onshore (in the North and North-East of Germany and in the South of Italy) and offshore (in North and Baltic Sea). This configuration tends to create in some situations a huge number of vertical energy flows from the North of Germany to the South. Additionally, it is worth mentioning that the Alps area is enhancing its energy storage facilities by installing new pumping storage power plants; therefore, the reinforcements of the transmission grid, along the North-South axis, from Germany to Italy, is strongly recommended in order to improve the integration of different sources of production and to increase the cross border capacity.

In the longer-term new changes will be faced requiring effective coordination among TSOs.

A further increase of the cross border capacity to and through the Alps area will be needed in order to improve security and reliability of the system and to avoid barriers on commercial exchanges taking in account the evolution of the generation parks in Europe. A strong central-European North-South transmission corridor will also allow for better integration of the intermittent sources by combining the wind farm generation in the North area with the pump storages in the Alps, thus helping to achieve a real central-European power balance. New pump storage power plants in the Alps area will support the aim of the 20/20/20 initiative but will also foster the long-term possibility of storing a large amount of power from North-Europe and North Africa, with generation mainly based on RES, namely wind and solar sources. In addition, new interconnections are being considered between France and Switzerland in the area of the Geneva Lake and between Germany, Switzerland and Austria in order to accommodate RES production. Other internal 400 kV projects and new interconnection projects are planned in order to comply with the promotion of the IEM by reducing these current/future constraints and by creating an added value for the market (e.g. Italian northern borders, SI – HU and reinforcements between Italy and South-East Europe). Large investments are needed in order to adapt the transmission grid to favour the attainment of the new European binding targets (EU 202020), in particular taking into account the global collaboration for the integration of the common European market and the possible synergies of the European infrastructural corridors. The technical feasibility and economic viability of the new Mediterranean subsea corridors needed for the interconnection of the Region with northern Africa and South-East Europe are presently under discussion; however, it has already become evident that they will represent important pillars in the development of the Trans Mediterranean super grid. The main expected advantages related to the commissioning of the Trans Mediterranean submarine corridors, to be quantified by means of dedicated studies, are also related to the promotion of competitive electricity markets in Maghreb, the support of new low cost conventional generation, and the incentive in the installation of RES (wind and solar) power plants in the Mediterranean Basin. The points highlighted above show that there is strong political support, particularly from the EU, for the development of new interconnections in the Mediterranean basin. As a matter of fact, the Mediterranean interconnections, corridor South-North, have been included in the European priority project since the year 2003.

6.3 Boundaries and Bulk Power Flows in 2020

In order to identify the main constraints on the European network, each regional group has defined boundaries which represent the location of congestion which could be due to an increase of capacity exchanges, generation evacuation or growth of consumption. On the map below, there is a representation of the CCS Region drivers for system evolution associated with the boundaries' locations. When the boundary is closed, it represents a zone where the congestion is principally due to consumption or generation evacuation.

The main flows are expected on the corridor North -> South, in particular from the North-and North-East of Germany to Italy, through the Alps Region. New investments aim to increase the interconnection capacity in all the countries of the CCS Region to cope with the expected bulk power flows.

In the long-term, the planned reinforcements will be necessary for the constitution of the entire Mediterranean energy hub through the utilization of the Italian transmission grid and for a better integration of North African countries.

6.3.1 Generation Connection

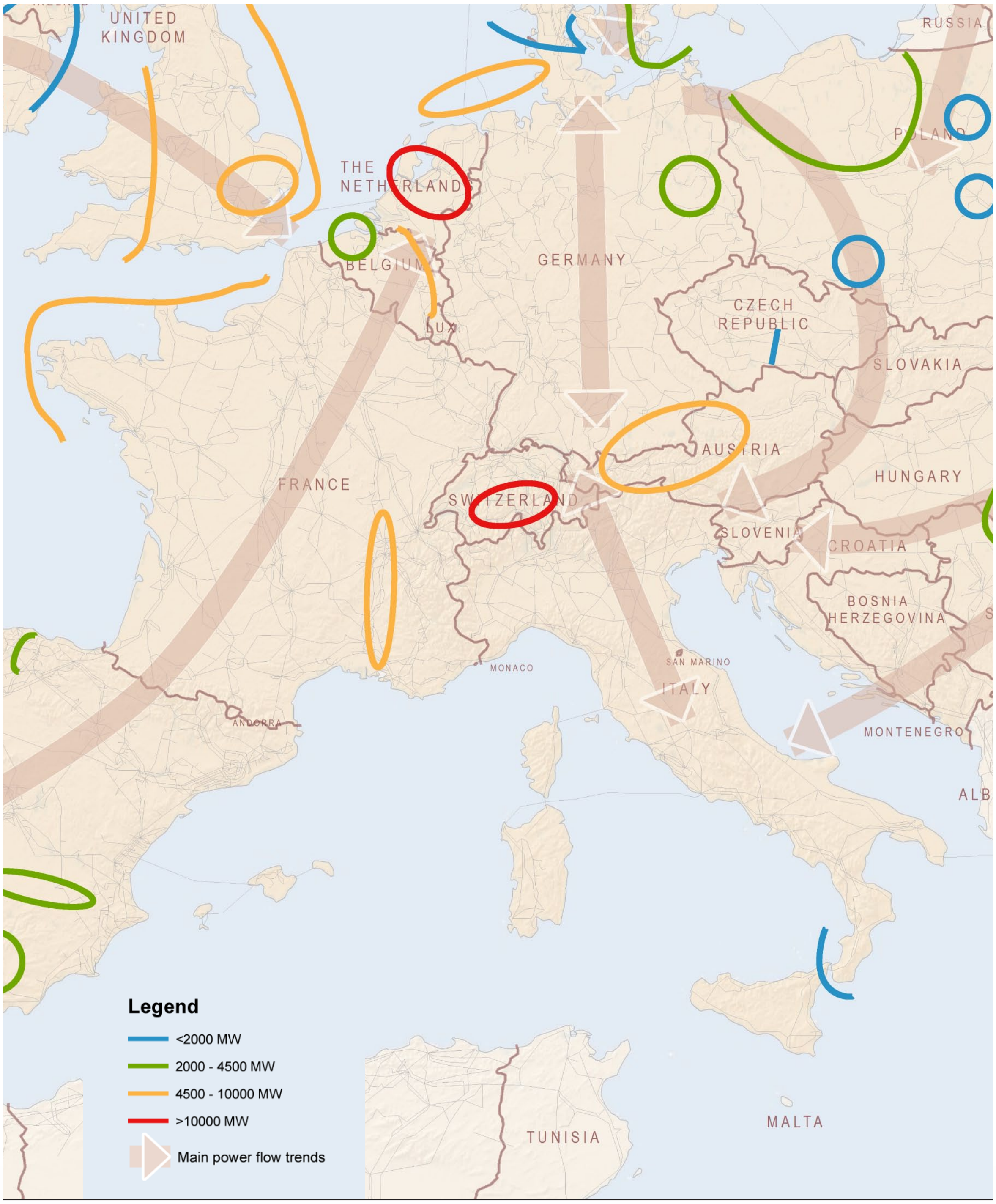


Figure 16:

Bulk Power Flows Related to Generation Connection in CCS Region

6.3.2 Market Integration

Figure 17:

Bulk Power Flows Related to Market Integration in CCS Region

6.3.3 Security of Supply of Large Areas

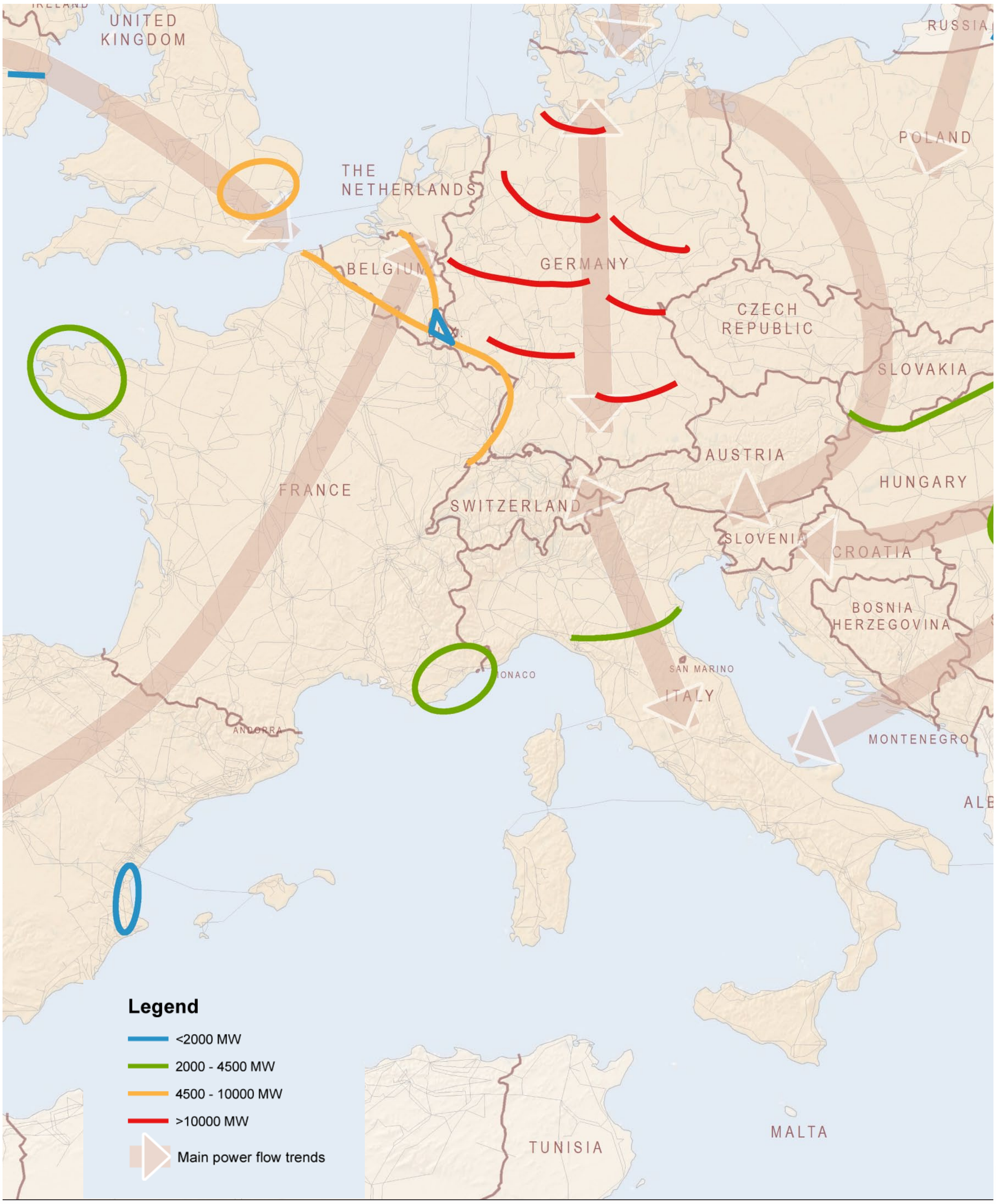


Figure 18:
Bulk Power Flows Related to Security of Supply in CCS Region

6.4 RES Integration as the Major Concern

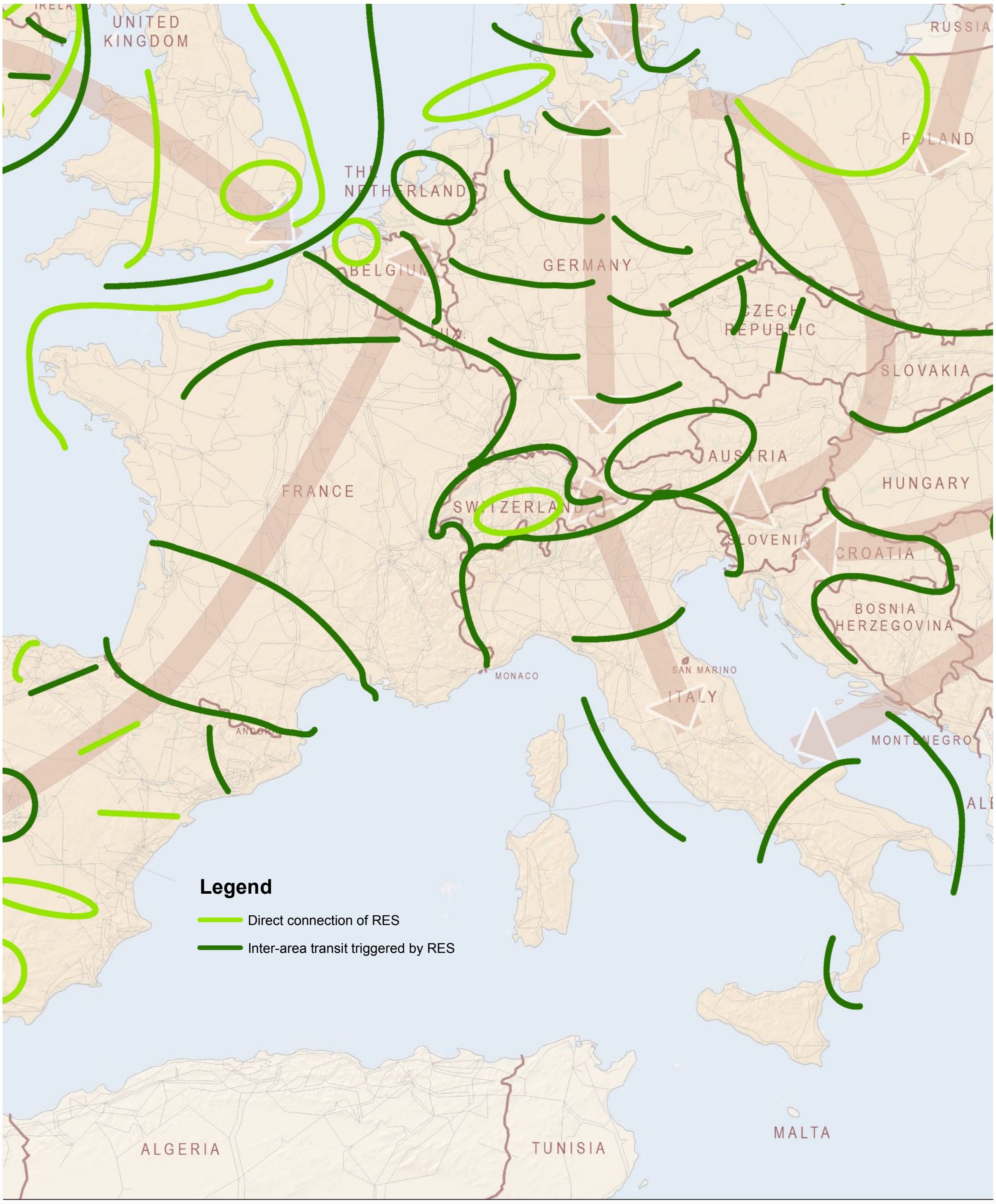
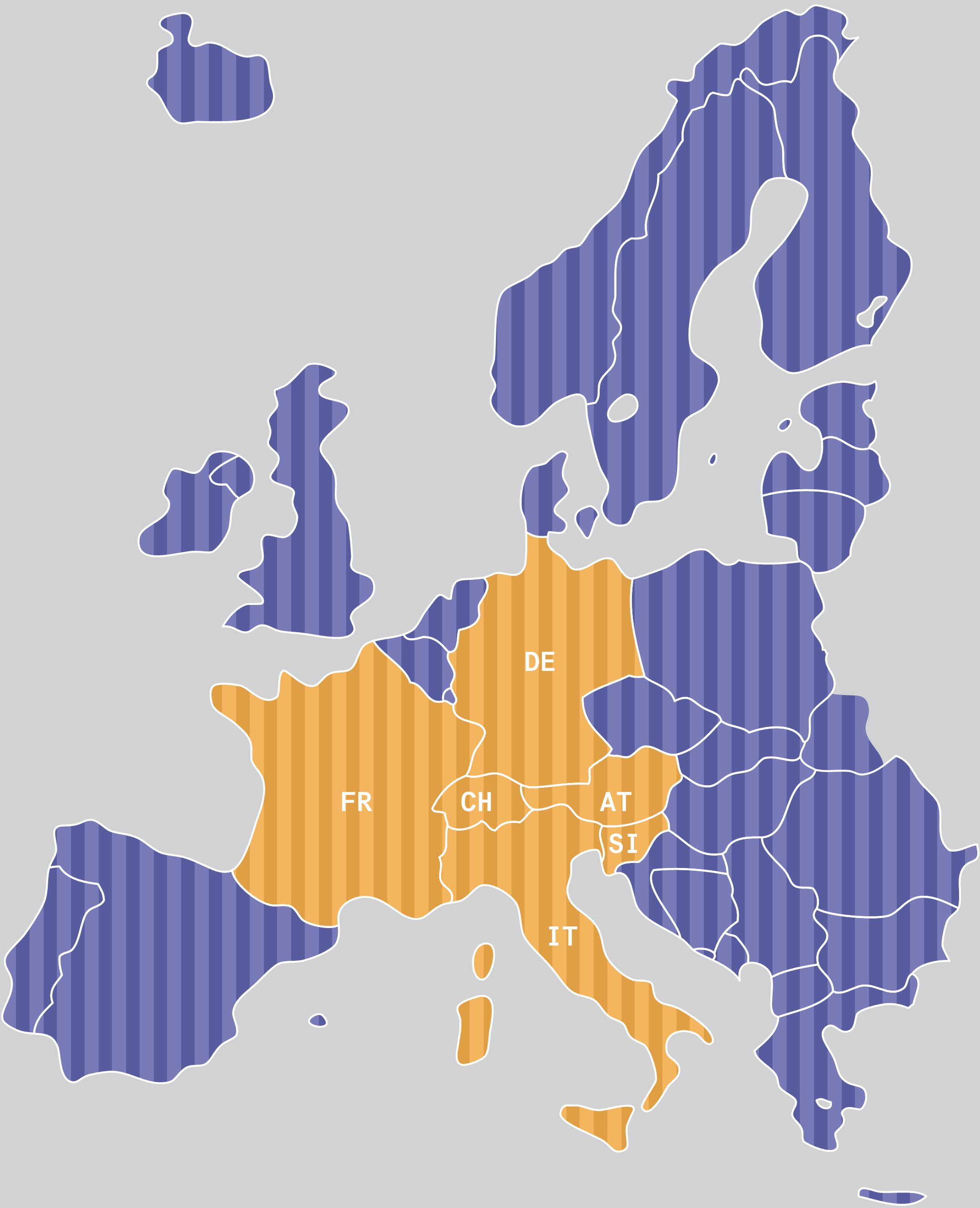


Figure 19:
Res Integration is the Major Concern for Grid Development in CCS Region

7 Investments



In order to provide a better and more transparent understanding of this complex issue, the present chapter analyzes the transmission development investments planned at European, Regional and National level by Continental Central South RG, which are likely to trigger EHV grid investment in order to restore the EHV grid's ability to fulfil the duties and services expected from these infrastructures. The aim is to give an overview of all expected investments on the whole Regional transmission grid for the next ten years, presented in two different categories of projects:

– Projects of European significance

– Projects of Regional and National interest

The investments presented will be split between mid-tem (commissioning date estimated within 2016) and long-term projects (commissioning date estimated +2017), and will be shown on qualitative maps referring to each time horizon in support of the explication.

Due to the strategic geographical position of some countries' RG members, this chapter will also highlight a number of the development projects which affect some non-ENTSO-E member promoted projects which fulfil the criteria considered in this Plan.

7.1 Projects of pan-european Significance

In order to overcome the challenges emerging from the future needs on the grid in Europe, the European TSOs evaluated in collaboration numerous grid reinforcements. The TYNDP focuses mainly on projects of European-Significance. These projects are on an Extra-High-Voltage-Level with an increasing impact on grid transfer capability on network boundaries between market areas or borders within the ENTSO-E interconnected network. Projects with more regional or national impact are evaluated and published in the ENTSO-E Regional Investment Plans or National Grid Developments Plans. The majority of these projects are in close relationship within the projects of Pan-European-Significance.

Specific details of the projects are presented in the following sub-chapters.

The following two maps show the evaluated Projects of Pan-European Significance separated for the mid-term and long-term time horizon. The mid-term time horizon covers projects commissioned by the end of 2016, whilst long-term represents those commissioned in 2017 and beyond. The level of information for mid-term projects is often higher than long-term, because they are further along in the development process.

In the maps of projects the routes or substation locations are marked with the definition of used AC or DC technology, the voltage level and a differentiation of extension or a new project given by the legend. If the route or positions of projects are not eventually defined, the project is marked with a bubble spreading over the area of expected commissioning. Every project is labelled with the TYNDP investment number, which is identical to that reported in the Table of projects.

7.2 Overview of Grid Developments mid-term (incl. 2016)

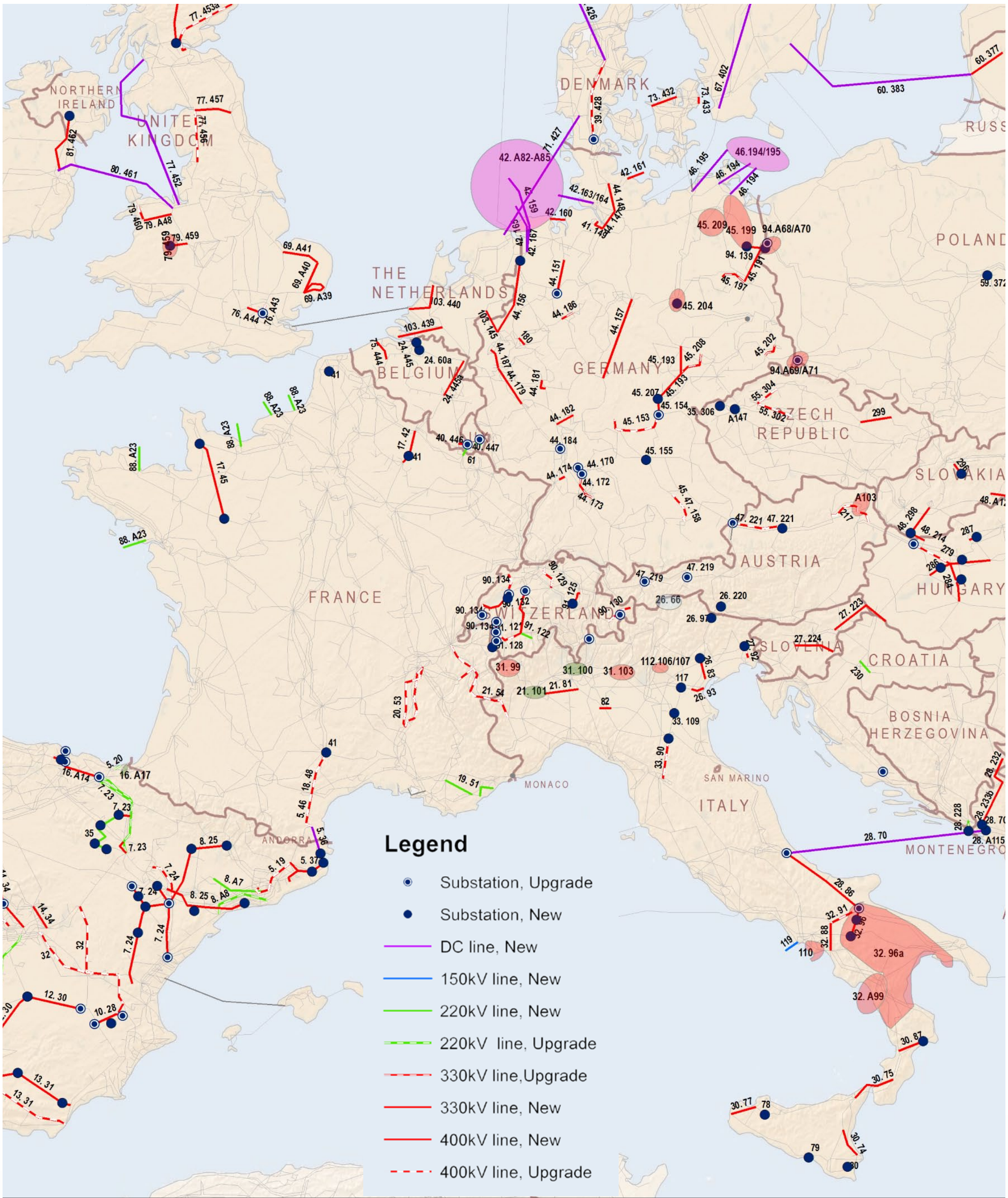


Figure 20:

Projects of Pan-European Significance Around the CCS Region – Mid-Term (Until 2016)

7.2.1 Mid-term (incl. 2016)

The mid-term investments around the CCS Region are focused on the main challenge of finding and investigating solutions to adapt the network to constraints and to increase the grid transmission capacity crossing neighbouring countries and across internal congested areas. Indeed, the overall aim is to increase power exchange capability due to the new renewable generation development in the North of Germany and in southern Italy.

In this context it is important to summarize the list of investments:

Project 5 includes the new France-Spain HVDC underground cross-border line in eastern Pyrenees and associated adaptation of the internal grids in the area.

Projects 19 involves 3*225 kV underground cables that will improve the security of supply of the Provence-Alps-Cote d'Azure Region (PACA region)

Projects 20 involves both reconductoring of some existing 400-kV OHL in the north of the Rhone valley and, in the long run, an HVDC link between South-Eastern and South-Western France. It is needed for integrating generation in the Rhone Valley and Fos area as well as for increasing the overall capability of the grid to accommodate international power exchanges in the area.

Project 21 is concerned with Italy – France interconnection and internal reinforcements in order to permit, in the long-term, the correct service of these interconnections; the mid-term investments are primarily concerned with the optimization of the existing assets, expected to provide an increase of FR-IT GTC, improve the security of supply of the system, and solve future congestion of the 380 kV in the North-West/North-East Italian area also due to further increase of generation in Piemonte – Lombardia.

Project 26 considers the Austrian – Italian interconnection and internal reinforcements. For the 220 kV tie-line Lienz (AT) – Soverzene (IT) the installation of a 220/220-kV-phaseshifting transformer (PST) in the existing substation Lienz is foreseen. It will be mainly used to achieve a secure and optimized operation of the 220 kV-tieline, particularly at peak times. The expected benefits are improvement of security of supply for the region (no more special circuit switching), a reduction of congestion management costs and an optimized operation of the tie line AT – IT. Moreover, an upgrade of the 110/132-kV-line Steinach – Prati di Vizze is foreseen for the mid-term period. The total transmission capacity of new links on this border is expected to increase significantly. As a result of this, within the mid-term two main new 400 kV lines in Italy, namely "Volpago – North Venezia" and "Dolo – Camin" are planned in order to support this transmission capacity. The other mid-term investments items are necessary in order to improve security of supply and to assist with the integration of future hydro generation.

Project 27 contains considerable reinforcements to ensure safe and reliable operation of the Slovenian power system and to achieve the goal of increasing capacity and reliability of electricity transmission between central-southern, central-eastern and South-eastern Europe. In order to strengthen security of supply whilst also increasing resilience and flexibility of the transmission network, new investments are necessary to accommodate RES integration and conventional generation which are expected in the related countries. The new mid-term investments are: 400 kV double OHL Beričevo – Krško which is under construction. This is followed by the new interconnection lines with Hungary/Croatia (double OHL 400 kV Cirkovce – Heviz (HU)/Žerjavinec (HR)).

Project 28 is associated mainly with the new HVDC interconnection between Italy and Montenegro "Villanova (IT) – Lastva (ME)". The capacity of this link will be 1.000 MW and it is expected to be completed in 2015. An extension of the 400 kV network in Montenegro is planned in the mid-term in order to support this dc-link as well as to improve security of supply and assist the integration of future hydro and wind generation (for further details on investments see also Regional Investments Plan of the CSE region).

Project 30 concerns the realization of the double circuit 2.000 MW AC link between Sicily Island and the mainland (IT) in order to support RES integration by transmitting wind power from Sicily to the mainland and to reduce grid losses whilst also improving the security of supply by avoiding the risk of Sicily tripping to isolated operation. Nevertheless, the investments of this project will reduce re-dispatching costs.

The planned investments related to the low transfer capacity on the portion of grid between Riddes and Avise/Valpelline/Chatillon present in **project 31** will improve import/export power exchanges, and this project also contains investments necessary to ensure, on the whole, the local conventional generation integration and security of supply of urban areas. Terna and Swissgrid are studying reinforcements on the CH-IT border with the aim of increasing the existing border transmission capacity by up to over 1.000 MW also involving investments which had been considered interesting in the past.

Project 32 is related to all investments in southern Italy which are necessary to improve and guarantee the integration of large numbers of RES plants which are forecast in this area, and to reduce congestion whilst favoring more efficient production for the energy demand coverage.

Project 41 (partly long-term) refers to Germany and in particular to the investments necessary to connect new conventional generation in North and eastern Germany, to maintain security of supply, and to support market development.

Projects 44 and **45** (partly long-term) are related to the German West and East Corridor. Due to the strong increase in RES generation, meeting the goals of the European and especially German energy policy new connections between areas with high installed capacities of RES and areas with high consumption and storage capabilities is necessary. For this reason the development of new North-South and Northeast-Southwest electricity transmission capacity in Germany is necessary. For the mid-term time horizon the necessary grid development in Germany is covered by common projects relating to the Western and eastern corridor. The German West corridor starts in the North-West of Germany, an area with high surplus of RES production (planed and existing) and connections with Scandinavia (planed and existing). It continues to the Rhine-Ruhr area (high consumption and a vast amount of a conventional power generation). The German East corridor begins in the North-East of Germany, an area with high RES generation (planed and existing), conventional generation and connections with Scandinavia (planed and existing). Both corridors end in the South of Germany, an area with high consumptions and connections to Austria and Switzerland (transit to Italy and pump storage in the Alps).

Projects 42 and **46** (partially long-term) consider the connections of approximately 10 GW offshore wind farms in the North- and Baltic Sea to the German grid by subsea cables.

Project 47 considers investments related to the interconnection between Austria and Germany and also internal reinforcements necessary to increase the transmission capacity in North-South direction, contributing to the internal energy market. Furthermore, project 47 allows for the integration of new pump storage power plants with the Austrian and EU energy markets and their valuable interaction with the variable generation of RES. In the mid-term period the upgrade of the OHL St. Peter (AT) – Ernsthofen (AT), is a vital first step to reaching the aforementioned aims.

Project 90 pertains to Switzerland and has a strategic role in central Europe as it helps to overcome existing bottleneck limitations, both from France, Germany and Austria, and to increase the transmission capacity in the South-West of Germany. **Project 91** is also necessary for the development of Switzerland's transmission grid and considers benefits for the power of existing and future generation as well as pump storage in the Alps region.

Investments in **project 112** aim to improve the security of supply in the Triveneto area, characterized by high load penetration with the realization of new substations.

7.3 Overview of Grid Development for the Longer Run (2017+)

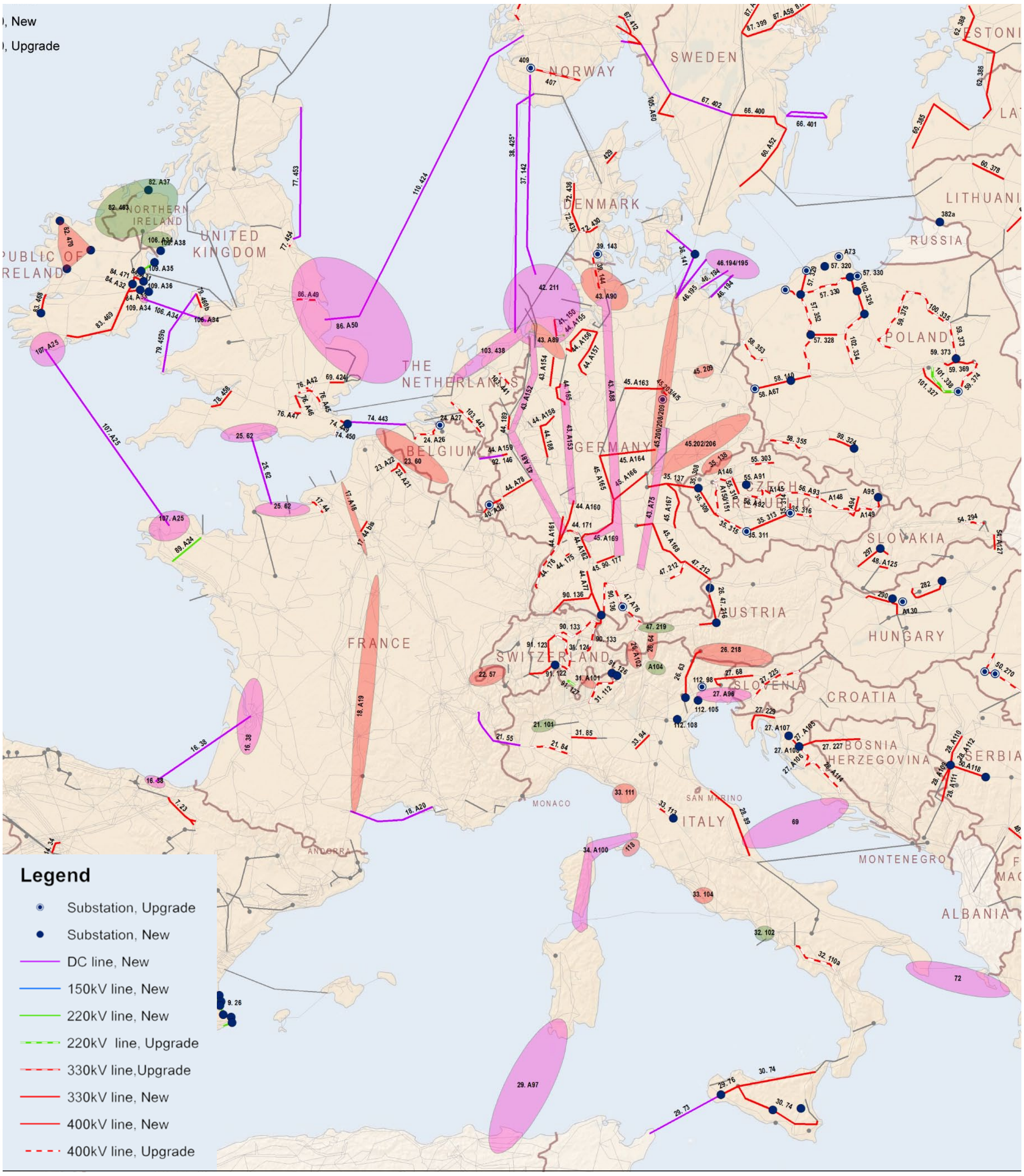


Figure 21:
Projects of Pan-European Significance Around the CCS Region – Long-Term (as of 2017)

7.3.1 Long-term (2017+)

On the long-term horizon, the CCS investments are briefly described as follows.

Project 16 is the long term development of the France-Spain interconnection, involving a HVDC subsea cable in the Biscay Gulf.

Project 17 involves several long term investments[1)] in northern France, aiming at transporting the power from new generation sources (along the Channel and in northern France and further North abroad) to the main load areas: Paris area but also more broadly from Brittany to Reims.

Project 18 mainly consists of long term investments in the Massif Central area triggered by the development of local RES generation but also influenced by transit flows between neighbouring countries. It also includes the Midi-Provence investment (also part of **project 20**), that is necessary for transporting the power generated in South-Eastern France (and especially new generation in Fos area) as well as balancing the flows between South-Eastern and South-Western France and thus providing mutual support[2)] to these regions, depending on the generation pattern, in the context of larger and more volatile cross-border power flows.

Long-term investments contained in **project 21** are the new "Savoie – Piémont" between FR – IT via underground cable and converter stations at both ends (two poles, each of them with 600 MW capacity). The cables will be laid in the security gallery of the Frejus motorway tunnel and possibly also along the existing motorways' right-of-way and the Italian internal reinforcement of existing "Casanova - Vignole" 220 kV OHL in order to reduce congestion on 220 kV local grid, which is also caused by the further increase of generation in Piemonte.

The long-term investments in **projects 22, 23** and **25** are respectively related to the need for an increase in the cross-border capacity of France with Switzerland and Italy, the need to increase the cross border capacity on BE-FR border and the need for increasing interconnection capacity between GB and the European Continent.

Project 26 contains investments necessary to increase cross border capacity between Italy and Austria complying integrated energy market, with a reconstruction of the existing 220 kV-interconnection line as 380 kV-line on an optimized route in order to minimize the environmental impact. On the Austria side, it contains investments related to enhancing the North-to-South transmission capacities, integration of hydro capacities with the Austrian and EU energy markets and the increase of (n-1) security and transport

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1) It also includes the mid-term investment Cotentin-Maine, needed for integrating new generation in Cotentin area.

2) In addition, a new 400-kV substation, Roquerousse, connected to existing lines West of Marseille, currently under investigation, could also improve the security of supply of the area.

capacities in the southern grid area. On the Italian side investments are necessary to overcome the congestion in operation (also on HV grid) and to ensure the supply to large urban centers under N and N-1 conditions.

The long-term investments related to **project 27** will remove the remaining network restrictions by upgrading internal 220 kV network to 400 kV voltage level between Cirkovce and Divača. In addition, long-term investments mainly consist of the need to strengthen the connection between Slovenia and Italy whilst also increasing existing power exchange capability. Assuming there are no delays, the new double OHL 400 kV will be built between Slovenia and Italy (Okroglo (SI) Udine(IT)) to increase power exchange capacity. With regards to strengthening IT-SL border connection, a new HVDC interconnection is in the pre-feasibility study phase.

Project 28 contains the long-term Italian reinforcement necessary for achieving 1000 MW NTC increase on border Italy-Eastern EU and investments which contribute to meshing the network surrounding the HVDC link IT-ME and to increasing the reliability of the EHV system in the Continental South East region (for further details on investments see also RIP CSE). In contrast, **project 32** and **33** are related to Sicilian Island transmission development and these investments will support RES integration, increase the NTC and will reduce the re-dispatching costs in Sicily taking into account future interconnections with North Africa. Nevertheless, in order to overcome the expected congestion on the central-east HV network of Sicily affected by the flows of consistent production from renewable plants, a 380 kV ring grid will be realized, through the construction of 3 new 380 kV lines: "Chiaramonte Gulfi – Ciminna", "Sorgente – Ciminna" and "Paternò – Priolo".

At present the constrained border between Switzerland and Italy, **project 31** will consider new long-term reinforcements with the target to increase the existing GTC on the border. The new reinforcements shall be joined to Italian and Swiss internal reinforcement by evaluating the feasibility of the optimization of existing network infrastructures. In particular the network area 400 – 220 kV between Milano and Brescia will be reinforced, whilst also considering the possibility of using existing infrastructures.

Project 32 concerns investment in southern Italy in order to increase the transmission capacity between the South and Center of Italy and to overcome the congestion in operation and ensure the supply to large urban centers such as Naples under N and N-1 conditions.

Project 33 is concerned with the central Italy area and also collects investments necessary to overcome the congestion in operation and to ensure the supply to large urban centers under N and N-1 conditions.

Project 34 pertains to investments due to the requirement of strengthening the connection of Elba Island to the mainland and increasing SoS on the island of Sardinia whilst also overcoming the regional market splitting caused by the limited transmission capacity of the current link.

Project 43 refers to Germany. For the long-term time horizon the foreseen RES generation (especially wind) in northern Germany, the increasing geographical imbalance between generation and consumption, as well as the long distances separating generation and consumption regions would require additional grid extension inside Germany. The needs for transportation over long distances, as well as the need to improve the grid stability regarding dynamic and static voltage play in favor of HVDC technology. For this reason, the German TSOs are considering several DC connections, allowing the North – South and Northeast – Southwest power flow and enhancing the grid stability. These projects are being considered in order to enable future evolutions of the generation and consumption patterns.

Project 47 aims to strengthen the interconnection between Austria and Germany. In particular the upgrade to 400 kV of the existing OHL "Vöhringen/Leupolz (DE) – Westtirol (AT)" and a new 400 kV double circuit OHL "Isar (DE) – St. Peter (AT)" are planned at that border. In combination with the 380 kV Salzburgline St. Peter (AT) – Tauern (AT), and other internal projects within both countries, the interaction of the steeply increasing volatile renewable energy production in North-Europe (mainly Germany) and wind power in the eastern area of Austria with the green batteries in the Alps (pump storage power plants) is facilitated. Another great benefit - namely a strong European North-South-axis – is realized. Peter (AT)".

Project 88 contains several long-term investments in France for the connection of offshore wind farms by subsea cables. **Project 89** is needed for increasing the security of supply of Brittany and consists of a double circuit underground cable with 2 phase shifters and the T-connection of existing HV substations between Calan and Plaine-Haute.

Switzerland's long-term development is contained in **projects 90** and **project 91.** In **project 90** the investments mentioned mainly concern the improved connections between the existing and future generation in the Alps, the urban area and the northern neighbors, attained by building new 400 kV OHL sections and by the voltage upgrading of existing 225 kV lines into 400 kV lines. In **project 91,** Swiss long-term investments which will evacuate power from existing and future generation and pump storages foreseen in the Alps region are defined.

Project 107 consists of a new HVDC subsea interconnection between France and Ireland, currently under consideration.

Project 112 contains investments for improving the security of supply in the Triveneto area.

7.4 3rd Parties Interconnection Lines

In order to deliver the most comprehensive and up-to-date outlook of the electricity grid by 2020 and beyond, ENTSO-E, based on the stakeholders' feedback to the 2010 TYDNP, elaborated and made available in February 2011 a set of guidelines for the inclusion of the third party projects. This was detailed in the 2012 release of the TYNDP:

https://www.entsoe.eu/system-development/tyndp.

As result, ENTSO-E received the submission of the Italy-Albania project in HVDC subsea cable: The project is market driven with the need to increase the cross border capacity between the South East Europe area and Italy, thus allowing the transfer of energy from RES sources (wind from Valona area) but also conventional generation

The project failed to demonstrate evidence of a transmission license or an exemption for such license granted by the relevant national regulatory authorities and EC, as required by the ENTSO-E guidelines. The non-discrimination principle (especially with regard to similar projects which may not have been included for this reason), makes it inappropriate for this project to be incorporated into the table of projects of the TYNDP 2012 package.

In the CCS region, at the present stage, the following merchant lines are in operation:

- 150 kV cable "Tirano (IT) – Campocologno (CH)" in operation since 2008;
- 380 kV cable "Cagno (IT) – Mendrisio (CH)", in operation since 2009;
- 132 kV overhead line "Tarvisio (IT) – Arnoldstein (AT)" in construction phase and expected to be in operation within the year 2012.

7.5 Projects under Study

As the Communitarian target constitutes a huge integrated European energy market, reaching an adequate interconnection level along Regions is something which is being studied. Different investments are being investigated in order to find those which are the most relevant in this sense.

Italy, due to her geographic position which gives her the natural feature of energy hub into Mediterranean basin, is facing different investigations on new possible interconnections. At present, the interconnections under study involve the Balkans area and the North Africa border.

In particular, on the Balkans front, the evaluation of a new interconnection Italy – Croatia using HVDC technologies is still in progress. This investment could represent an important energy corridor allowing direct access to the South East Europe electricity markets, and presenting the opportunity to increase the development and imports from renewable sources. Nevertheless, plans are also being considered regarding whether to double the Italy – Greece existing HVDC submarine connection, in order to guarantee long-term best use of existing transmission assets, which would in turn increase the reliability of the Greek system.

On the North African front, a possible HVDC interconnection between Italy and Libya is under study, with the aim of increasing the opening of a new energy frontier with the countries of North Africa. In addition, a feasibility study for a new interconnection of a transmission capacity among 600 and 1.000 MW between Italy and Algeria is ongoing. Other interconnection projects between North Africa and Italy are still under investigation and under study.

On the northern Italy border feasibility studies are ongoing in order to identify new projects which could increase the grid transmission capacity (GTC) with neighbouring countries:

- Italy – France: new HVDC onshore interconnection associated with additional new network reinforcements in the Italian territory (Liguria and Toscana regions) which permits full utilization, ensuring additional transmission capacity as well as securing support to the PACA region (TEN-E 255\09 study);
- Italy – Switzerland: possible upgrading or optimization of the existing 220 kV interconnection tie-lines and some Italian internal reinforcements (Val D'Aosta, Piemonte and Lombardia regions) also able to increase the transmission capacity up to 1.000 – 1.400 MW, by using an old project still under consideration;
- Italy – Austria: new interconnection with a number of internal reinforcements, with particular interest in the area of Milano, able to increase the transmission capacity by up to 800 – 1.000 MW;
- Italy – Slovenia: new HVDC offshore interconnection with a number of internal reinforcements able to increase the transmission capacity by up to 1.000 MW.

7.6 Regional and National Projects of Importance

This section describes the major projects of regional and national relevance which must be taken into account for the correct evaluation of the reference scenario.

With regards to Italy, it would be appropriate to mention a new interconnection between Italy and Albania, financed by a private investor, which will connect the final stations at 380 kV level "Brindisi (IT) – Babica (AL)". This connection will be realized with a HVDC submarine cable and at present it has passed through authorization processes both in Italy and Albania.

Another development investment of Regional interest is the connection of Malta Island with the Italian transmission system. This project is, at this stage, going through the authorization process and consists of a new submarine cable from Sicily island to Malta at 220 kV level with a length of 120 km. If completed this would guarantee the integration of the Maltese electricity system with the European network thus making more adequate and stable the Maltese electricity system compared to the needs which may arise at mid- and long-term. However, it would also present a number of other opportunities, particularly with regards to the export of new production from Sicily by means of future renewable sources.

The electrical network of the Sorrento's peninsula and Italian minor islands such as Capri, Ischia, Procida and Elba is characterized by great risk of unsupplied energy and low levels of service quality. For these reasons, an upgrade of the existing local 60 kV network in Sorrento peninsula to 150 kV is expected. This involves the completion of the ring at 150 kV, using submarine cables which will connect Capri, Ischia and Procida islands whilst also doubling the link between the island of Elba and the Italian mainland.

In order to improve the quality of service of the 150 kV grid which powers the main cities of Sicily such as Palermo, Catania, Agrigento and Noto and in view of the expected increase of electrical load in urban areas, a series of actions on 220 and 150 kV network are planned. These will provide, among other things, the realization of new 220\150 kV substations and related reinforcements of existing assets.

In addition to the above critical congestion on the 150 kV transmission grid in southern Italy, in particular on regions of Puglia, Calabria and Campania due to the high penetration of generation from renewable sources (especially wind and solar), special installations of energy storage plants have been studied in cooperation with distributors.

In the Italian Alps region, in order to reduce and avoid constrains in operation due to the large hydroelectric production, a new 220 kV line has been planned between the Castelbello and Naturno substations.

Regarding Switzerland, one can say that several new 220 kV lines and substations are planned in order to improve the security of supply in the urban regions.

In the eastern part of Austria, an increase of around 2000 MW of the installed wind power capacities is planned. With the existing grid infrastructure this huge increase cannot be integrated. To enable the connection and efficient integration of the planned wind capacities it is necessary to reinforce the transmission grid in the Weinviertel region and to install the 3rd and 4th system to the existing 380-kV-OHL Dürnrohr – Sarasdorf. Moreover, the installation of the 3rd and 4th system is an essential means by which to improve the security of supply for Vienna and allows more flexibility in grid operation.

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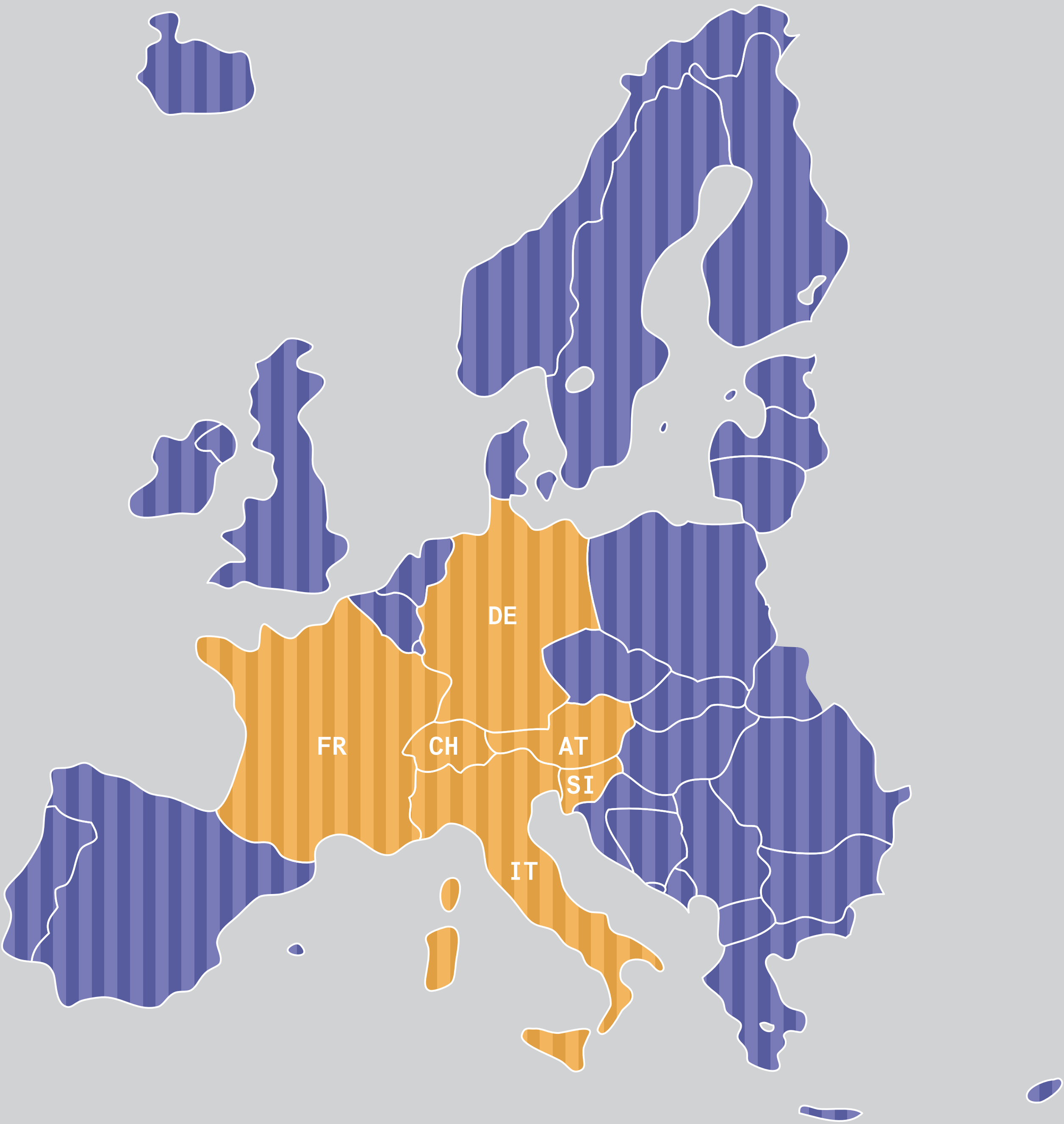
8 Transmission Adequacy



Transmission Adequacy shows how adequate the transmission system is in the future in the analyzed scenarios, considering that the presented projects are already commissioned. It answers the question: "is the problem fully solved after the projects are built?"

Three categories have been considered in the transmission adequacy showing that needs are solved in every situation, in almost every situation or that the need is not completely solved:

- light purple: unlikely that with all projects in the plans, in the span of scenarios considered in the plans, further measure is reported related to the boundary;
- purple: possibly, with all projects in the plans, in the span of scenarios considered in the plans, certain rare developments could trigger further measures on the boundary although sufficient transmission capability is provided for the vast majority of the situations ;
- dark purple: most likely that in the span of scenarios considered in the plans, additional measures are needed on top of all projects in the plans to cope with congestion on the boundary.

The assessment aims to show what will happen with all development infrastructures realized and in operation (i.e. in the frame of the scenarios presented above and with all the projects commissioned on the expected date). Forward the analysis, most of the planned projects should solve congestion in most cases in most parts of the CCS region for In particular:

- the interconnections capacities between France, Italy, Slovenia and Switzerland (boundaries 21, 22, 27 and 31), as well as the interconnection between Germany, Austria and Switzerland (90) should be considerably increased by planned projects such as rewiring of existing lines and building of new overhead lines as well as an underground DC connection between France and Italy;
- the interconnection between Mediterranean islands and the mainland (projects 30 and 34) should be considerably increased by planned projects, but that the planning of further reinforcements in the future cannot be ruled out;
- the planned reinforcement of the export capacity of the Rhône Valley in France (20) should address the needs of the area for a number of years.

Since the German government has decided by law to accelerate the Nuclear Phase Out by 2022 and has set a more ambitious target for RES, there is a high probability that additional investments will be needed in the German western and eastern corridors (boundaries 78 and 79). There is the possibility that new investment needs and therefore grid developments will appear in the next version of the TYNDP.

Need for additional projects in the CCS region on top of those in the plan has been identified only in two specific cases: i/ the France-Spain interconnection, where significant residual congestion is expected, despite the planned projects on both Eastern and Western parts of the border and ii/ the PACA area, and especially the eastern part, where the mid-term project may not be sufficient in the long run, depending on the pace of load growth.

Last, residual congestion is still present in some rare situations whilst the need for further investigation remains in some areas:

– Market simulations have shown additional request at the borders between France and Germany (boundary 23) and along the Italian South-North corridor (boundaries 31, and 36): initial investigations are in progress to assess the need for additional projects;

– Some additional projects on top of those presented in the plan may be needed in order to accommodate the North-to-South flows in norther Framce (boundary 17) due to cross-border exchanges added to generation in North and North-Western France flowing to the load of Paris area and more broadly from Brittany to Champagne;

– Depending on the generation installation as well as cross-border exchanges, the grid development in the Massif Central area is still under investigation (boundary 18);

– The security of supply in Brittany could be at risk in tense situations as it relies on energy efficiency measures in order to limit peak load growth, evolution of the generation in the area and grid development;

– Due to the age structure of existing 220-kV-lines in the concerned area and depending on the further development of RES and pump storages as well as other generation, further investments in Austria could be necessary.

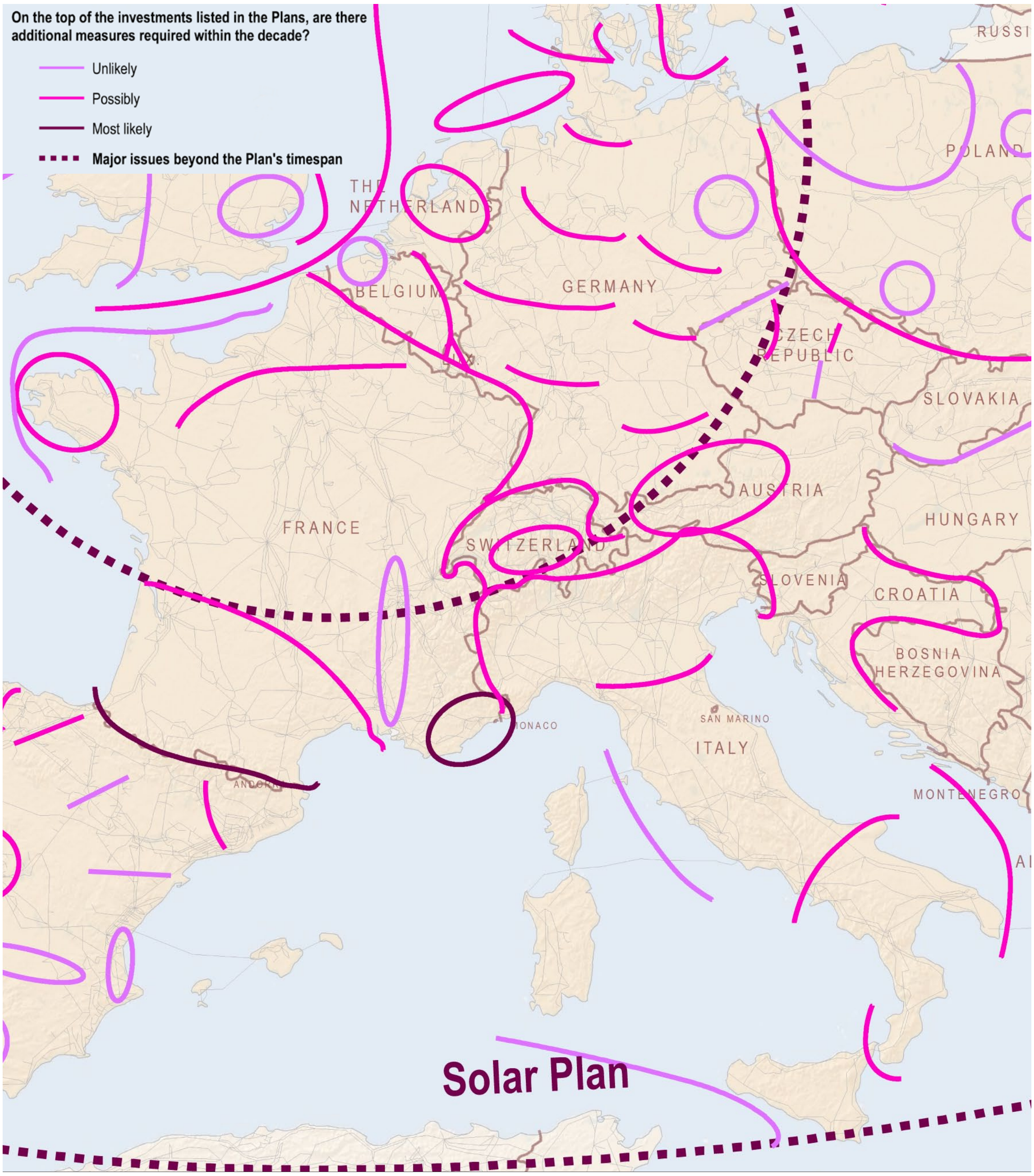
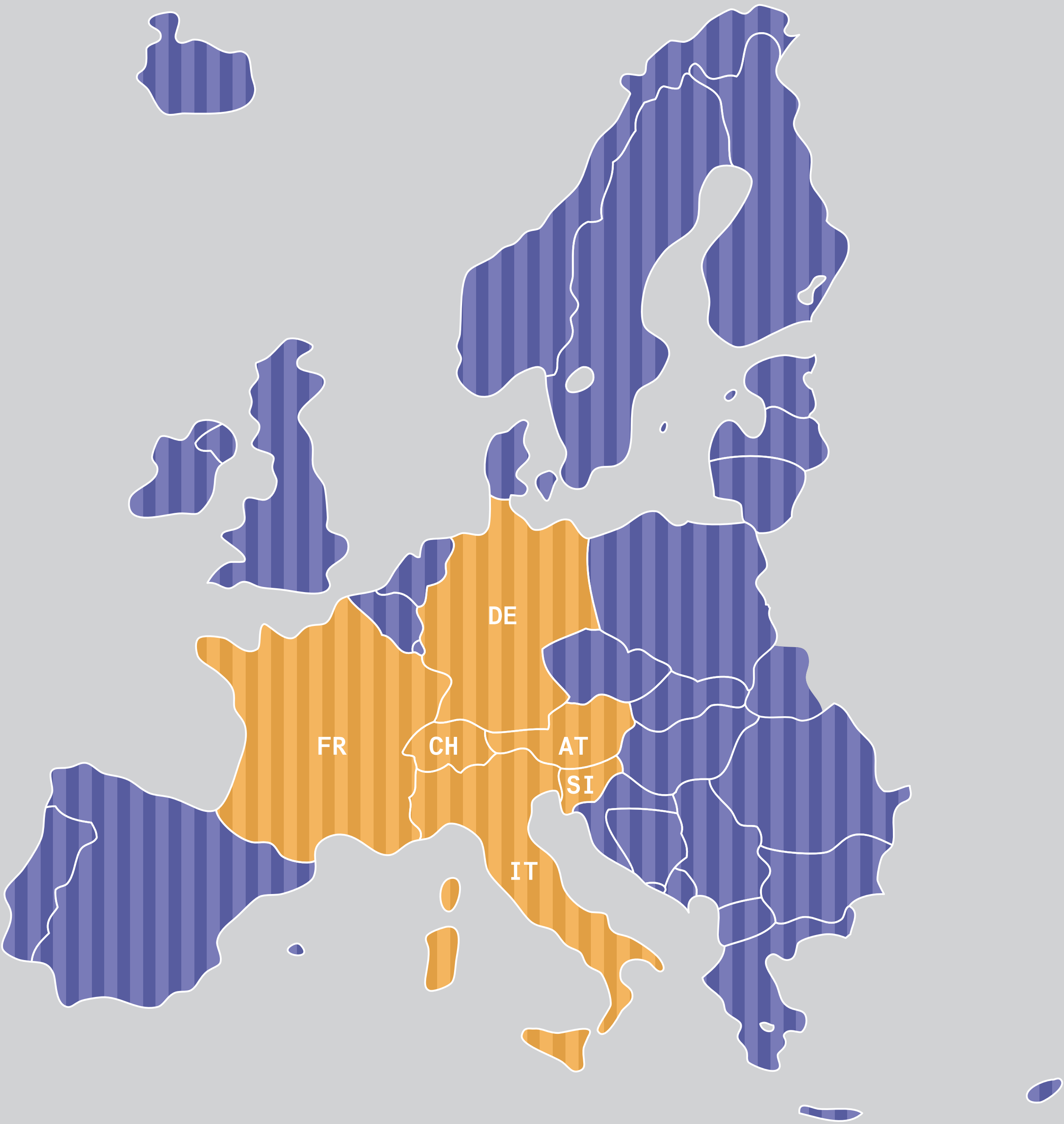


Figure 22:
Transmission Adequacy Map

9 Environmental Assessment



The growing environmental awareness and widespread local opposition to the construction of new infrastructures has led, in recent years, to the TSOs developing an approach of great concern for the environment and the needs of the territory.

The social and environmental aspects must be taken into account at an early stage in order to improve the sustainability of the solutions identified. In fact the path chosen is that of cooperation with local institutions in order to consider the environmental requirements from the earliest stages of planning and to take these into account in increasing detail until the implementation phase.

Once defined, investment needs are taken into account. In addition, wherever possible, alternative hypotheses are also considered relating to project favoring solutions which allow the use of existing infrastructure corridors with an optimization of the network for an efficient use of electricity and for the containment of interference with the environment and cultural heritage by promoting the creation of energy corridors.

9.1 Overview

In recent years, TSOs have made the best in order to encourage the building consensus and acceptance of new infrastructures, adopting new measures which are able to reduce or limit the environmental impact, for example:

1. installing new facilities in some grid substations which will improve the distribution of the power flows among the different parallel paths in order to fit better with the capacities of the lines maximizing the use of existing transmission infrastructures, for example PST;
2. taking great advantage of existing assets when possible, namely changing the conductors of a line to high temperature ones or adding a second circuit on an existing line, the towers of which have been originally designed for that purpose;
3. using more environmentally friendly technology (special pylons, etc ...);
4. replacing existing assets with new ones with higher transmission capacity, namely building 400 kV double circuits in place of existing 220 kV ones which will be dismantled;
5. optimization of the route of the new and existing lines;
6. adoption of techniques for reducing electromagnetic field (e.g. split phases, raising pylon, etc.);

7. planning naturalistic projects and visual mitigation projects of interferences on the landscape produced by electricity lines or substations on monumental structures of landscape and cultural interest;
8. restoring priority habitat in protected natural areas, and implementing measures for the protection of biodiversity;
9. carrying out works for the removal of obsolete lines, thereby easing the existing electricity grid and providing solutions which have a lower impact on landscape and environment.

Of course, all of these solutions are neither always possible to implement, nor appropriate to provide the suitable transmission capacity increase. Therefore, TSOs conduct case by case analyses comparing expected future needs and actual possibilities, whilst also taking into account the existing network characteristics and the environment.

The environmental assessment goes through the definition of indicators both quantifiable and objective; in the following paragraph some macro environmental indicators, acknowledged by all TSOs, are provided and calculated on the basis of impact of the RIP, whilst others could be defined by taking in account the design of the project (specific route, technology adopted and so on …).

9.2 Environmental Indicator

9.2.1 Impact of the Regional Investment Plan in Terms of km of new Lines [1)]

The projects described in the RIP represent around 25000 km of new or refurbished network routes, of which around 8000 km are expected in the mid-term (within 2016).

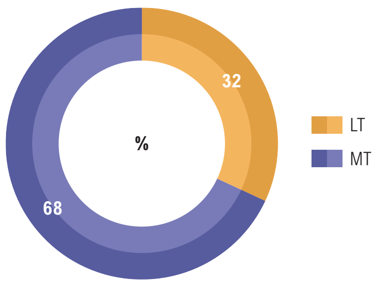


Figure 23:
Percentage of km of new/upgraded asset expected in mid-term and long-term

1) The figures displayed in this paragraph might be considered as not absolute as the length of the new lines has not been provided for each line/cable, in some cases decisions have not yet been made regarding the kind of technology (AC/DC) or the length and so on.

The graph below shows the length of the proposed investments

Generally the projects which consist of upgrading AC and DC existing infrastructures will have less environmental impact than the new ones since those investments are mainly going to be built in existing corridors; in addition, more than 70% of the DC projects are subsea or land cables. Moreover, in reference to the value of dismantled transmission lines, it must be noted that this takes into account only the 400 and 220 kV and not the lower voltage level (in the latter case the dismantled value would be much higher).

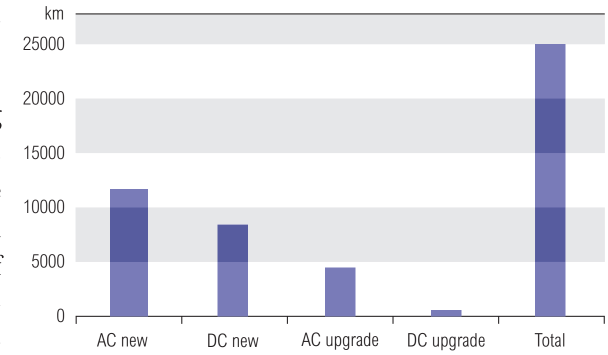


Figure 24:
Statistics of new line in the perimeter of RG Continental Central South

9.2.2 CO_2 Savings

The indicator related to the CO_2 saving, shown in Figure 26, is presented as a change for 2015 compared with the 2020 grid situation, taking into account the three scenarios investigated, namely Scenario B, EU 2020 and Nuclear Phase Out sensitivity.

In the EU 2020 scenario, the CO_2 emission overall change, due to the CCS interconnection network reinforcements is around 9 Mton/y less, split into 5 Mton/y less in the CCS area and 4 Mton/y less in the CCS area (expensive coal units being replaced by cheaper gas units). In Scenario B and in the Nuclear Phase Out sensitivity, the increase of interconnection transmission capacity into the CCS area causes a global increase of CO_2 emission, 12 and 9 Mton/y respectively due to the consequent increase of coal generation, especially in the CCS area. This is in place of mainly gas generation (more expensive). Nevertheless if we also take into account the internal reinforcements in the CCS region, we have a big reduction of the CO_2 emission due to a decrease of losses and integration of RES.

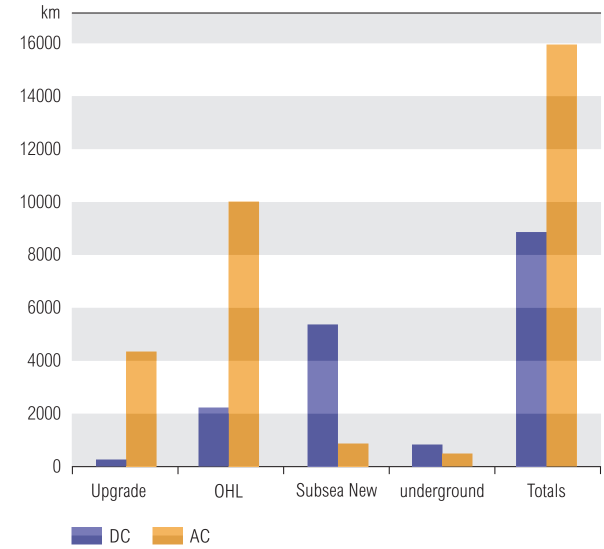


Figure 25:
Projects length [km] for technology (AC or DC)

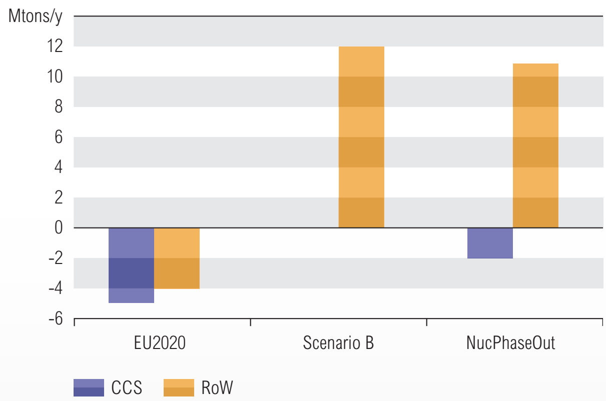


Figure 26:
Statistics of CO_2 emission impact due to long-term cross-border reinforcement

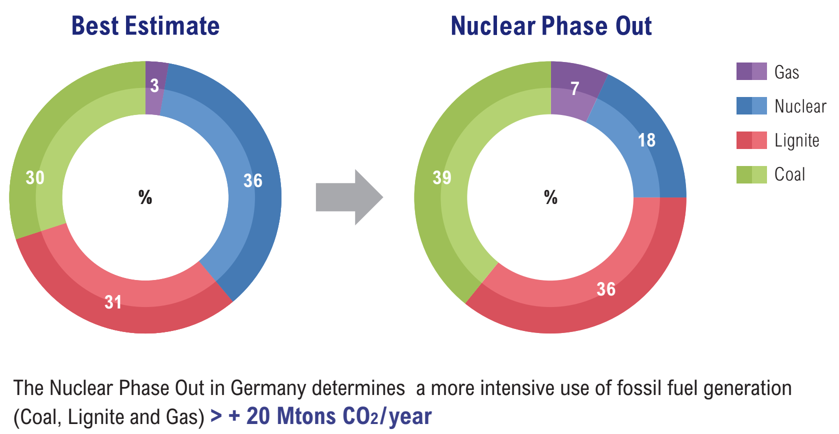


Figure 27:
impact of the Nuclear Phase Out in Germany on CO_2 emission

Impact of the Nuclear Phase Out in Germany

In the Nuclear Phase Out sensitivity, moreover, the CO_2 emission increases with respect to Scenario B by approximately 70 %. This is due to a more intensive use of fossil fuel generation to replace nuclear fuel:

9.2.3 Load, RES Growth versus km of new Lines (MT & LT)

The diagram below depicts and compares the load growth, the RES increase and the total length of the investment package (grid expansion in terms of length of new lines) taking in account the mid- and long-term in the different scenarios analyzed.

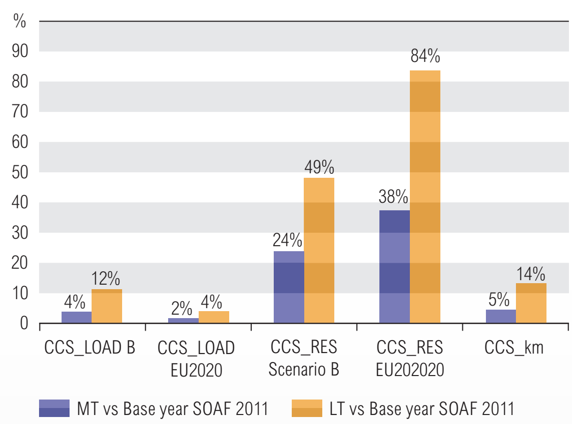
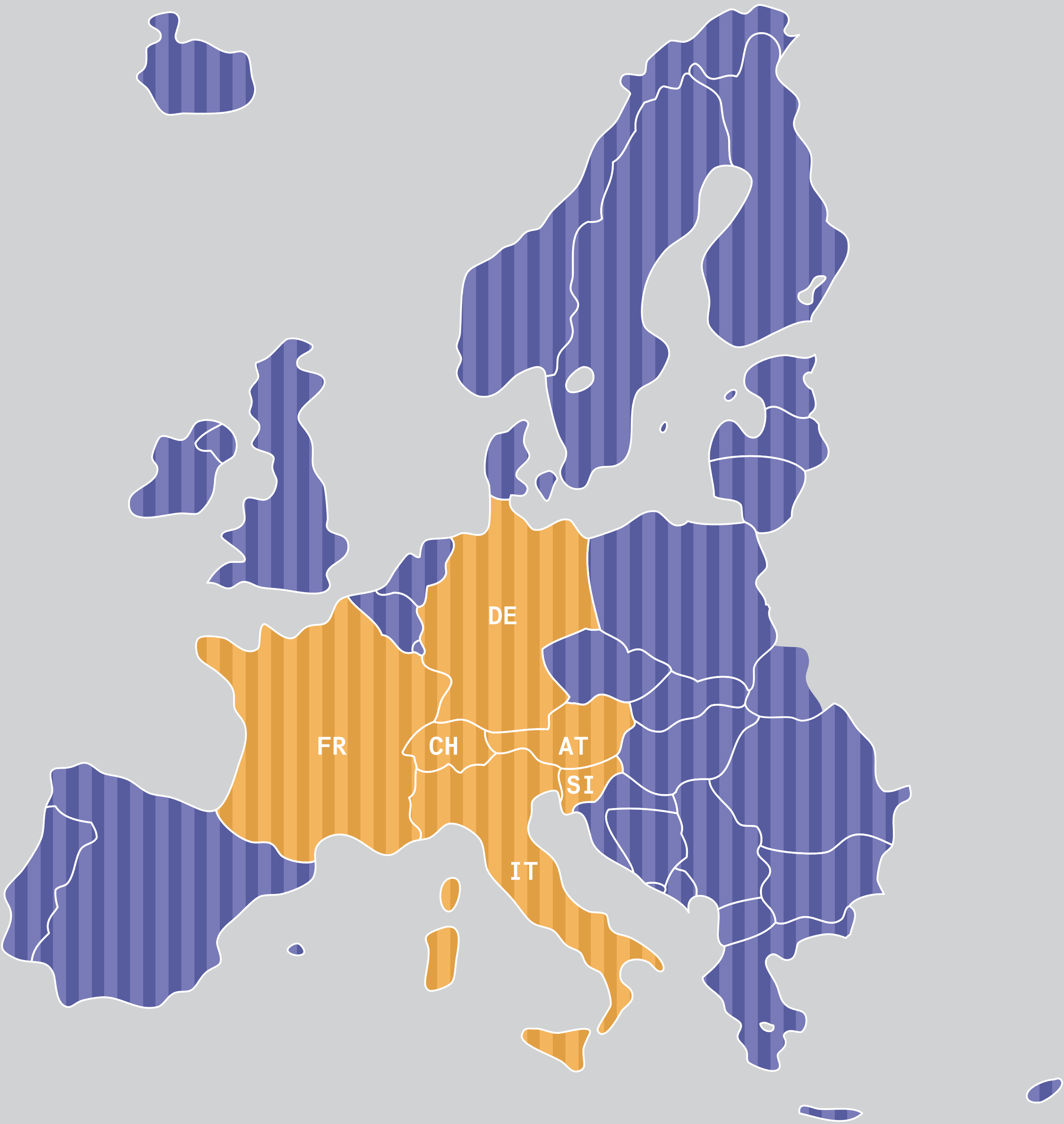


Figure 28:
Increasing in Load, RES and grid expansion [%]

10 Assessment of Resilience



High voltage grid investments are expensive infrastructure projects, with a long lifetime (more than 40 years). These set the precedent for coming projects and require years in order to be completed. Both in order to avoid stranded costs and to meet grid users' expectations on time with appropriate solutions, TSOs assess the resilience of their investment projects. This assessment is mainly performed in the following major directions:

- Ability of the system to face uncertain future conditions and deliver the expected quality: this is why TSOs use scenarios;
- Ability of the system to cope with severe, adverse conditions (climatic conditions as well as severe contingencies);
- Economic viability: investments should prove useful and profitable in as many scenarios as possible, bringing more benefits to the European population than they cost;
- Flexibility: advantage should be taken of the existing grid, using traditional and unconventional control systems to adapt the grid and minimize the new routes;
- Ability to integrate new technologies: as long lasting expensive infrastructure components, investments should take advantage of technological evolution so as to optimize their performance and ensure they do not become obsolete in the course of their expected lifetime;
- Compatibility with longer run challenges looking ahead to 2050: present projects must be appropriate steps to meet future challenges and must fit with wider and longer-term perspectives.

Methodologies and criteria developed by TSOs focus on risk assessment and mitigation. They assess the resilience of the system for whatever situation it may realistically have to face: high/low demand growth, different generation dispatch and exchange patterns, adverse climatic conditions, severe contingencies, and so on.

Several scenarios considered

The planning process begins with the definition of scenarios, depicting uncertainties on future developments on both the generation and demand sides, as well as a number of alternative grid operational conditions and development states which must be considered to ensure the secure and efficient operation of the transmission grid in the future. In the present document, Scenario B and scenario EU 2020 have been considered. In addition, these scenarios are regularly updated in the course of the planning process and adapted in case of sudden change (e.g. Nuclear Phase Out in Germany).

High variety of plausible situations

In order to assess the behavior of the planned grid against a large number of possible conditions, a number of cases are built taking into account forecast future demand, mix of generating units and cross-border power exchange patterns. As previously stated in Chapter 4.2 representative planning cases based on market studies results have been provided to TSOs in order for them to conduct the relevant grid studies. Not only the most frequent, but also the most extreme cases, as shown in Chapter 4.3 are investigated.

In addition, extreme conditions (e.g. ice, storms) are considered when designing the assets (towers, substations) and also when deciding the structure of the transmission grid.

Economic viability

Economic analyses are regularly updated against different scenarios throughout the planning phase in order to assess the economic soundness of the planned grid investment. Thus the risk of stranded cost should be minimized.

Flexibility, smart grids

Transmission grids are equipped with special protection schemes which ensure the safe operation of the grid in adverse conditions. In addition, control systems can change the network topology and transmit signals to grid users (generators, consumers), making congestion management possible in stressed situations. In addition, TSOs make higher use of systems for monitoring the temperature on the lines, allowing better use of the existing assets by having a more accurate assessment of grid thermal capacities, and being able to better assess the location of faults in cables, and so on. All of these issues require an investment in IT systems, which will enable the transmission network to be smarter than today.

Phase Shifter Transformers (PST) have been used for many years in order to control the power flows, to manage congestion and to increase the transmission capacity. PSTs do not increase the capacities of lines. However, in cases with overloads of some connections and free capacities on parallel ones, the overall grid capacity can be increased by optimizing flows by PST. Many of these devices already exist in the CCS region, for example in Rondissone, Camporosso and La Praz substations at the France-Italy border in order to increase the grid capacities during unbalanced situations on the entirety of the Italian border, or in Divaca (SI) substation, on the Italy-Slovenia border. Other PSTs are planned as in Lavorgo (CH) substation on interconnection tie-line Lavorgo (CH) – Musignano (IT) or in Lienz (AT), at the Austria-Italia border.

In addition, HVDC systems become more frequent, not only for subsea links, connections of offshore generation, or non-synchronous systems, but they are also inserted within the synchronous AC grid. Flows on these facilities are fully controllable and the margins left by the market could be used in operation for congestion mitigation. A lot of cross-border HVDC projects are foreseen at the Italian borders (with France, Balkans, North Africa); in addition an HVDC subsea cable is planned between the French Provence and the Languedoc region in order to cope with flows either East-West (from the generating areas of the Rhône Valley and Fos area towards South-Western France and the Iberian Peninsula) or West-East from Languedoc and the Iberian peninsula to the PACA region.

Finally, grid development strategies are developed in a modular scheme (step by step implementation), which presents opportunities to adapt or even cancel the projects according to external conditions or economic framework evolution.

New technologies

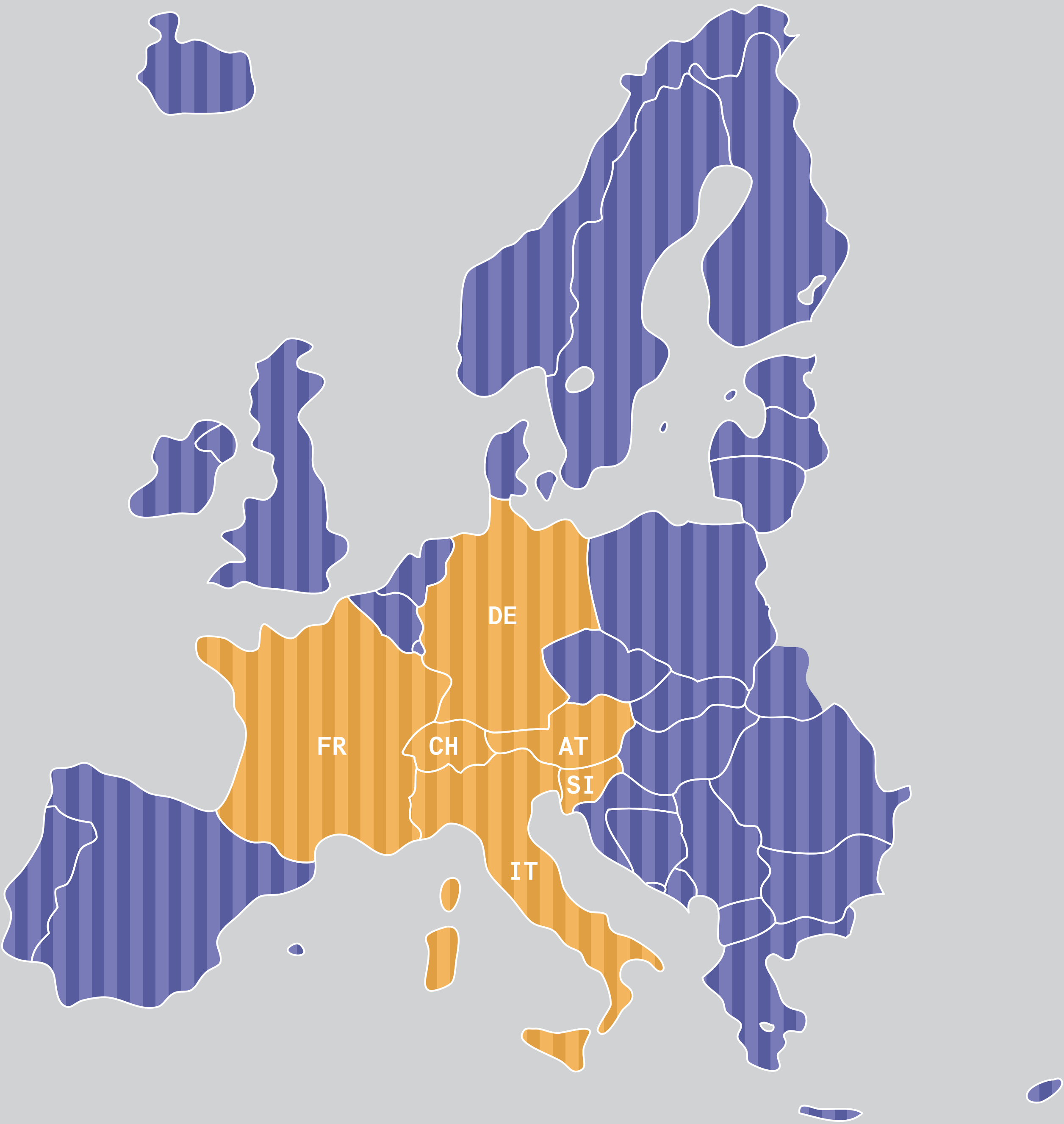
TSOs use new technologies where appropriate namely VSC (Voltage Source Converter) for some HVDC projects (e.g. France-Italy interconnection, or previously mentioned internal projects such as "Midi-Provence") or FLM (Flexible Line Management) for the maximum utilisation of the existing assets through online monitoring of their operating temperature (overhead lines, cables or transformers).

Long-term issues

As the lifetime of grid assets is around 40 years or more, TSOs develop long-term visions and plan grid development as the first steps towards a long-term future. Projects which are launched now should not jeopardize the expected grid development in the longer run. An example of such a long-term issue is the increasing flows to and from northern Africa.

Reciprocally, long-term grid development is considered vital among existing and planned assets. Overall consistency with long-term issues will be assessed in the e-Highways study for 2050 time horizon.

11 Summary and Conclusion



11.1 Main Statistics

The Continental Central South Region comprises six countries, namely France, Switzerland, Austria, Germany, Slovenia and Italy.

This Regional Investment Plan has been founded on the most complete ever region wide market and grid analysis coordinated at ENTSOE level. A similar market study in this region was presented in TYNDP 2010 as a best practice exercise, although it was not based on European databases, procedures or methodologies. On the other hand, bilateral analyses on interconnection developments and transmission capacity assessment have been performed for years, although without a European approach.

A number of scenarios were developed for assessment in the analysis. The EU2020 scenario represents the countries NREAP targets while Scenario B represents the TSOs' outlook. Both scenarios envisage predominance in 2020 of nuclear plants, gas-fired plants and wind generation plants in the region's generation portfolio. The analysis also took into account the Nuclear Phase Out strategy, which emerged during the course of the studies, through the consideration of a sensitivity analysis on Scenario B.

Market Studies performed showed that the CCS region will be generally an exporting region, around 45 TWh, to the rest of Europe considering the strong development of RES and the demand reduction simulated in the EU 2020 scenario. This export value, as pointed out in Chapter 5, will be considerably reduced by around 2 TWh, considering B Scenario. Conversely, in the Nuclear Phase Out sensitivity the CCS region will be a net importing system, approximately 42 TWh.

One of the main uses of the market studies in the CCS region was to assess the impact of the newly planned interconnection projects in the system. Interconnections within the region allow higher exchanges of energy, and provide an important social economic welfare to the system from 544 M€ in Nuclear Phase Out sensitivity, to 615 M€ in EU 2020 and 731 M€ in Scenario B. In addition, proposed interconnections reduce by around 9 Mtons CO_2/y, on the all simulated perimeter, in Scenario EU 2020. If we also take into account the internal reinforcements, the reduction of CO_2 emission is around 100 Mtons/y.

The Nuclear Phase Out implies higher imports of Germany, which are smoothly dispatched between many countries. This has a significant impact in the CCS region, reducing the benefits of interconnection projects in our region.

The generation adequacy indicators, which inform about risk of security of supply due to insufficient available generation, are generally low or very low in all scenarios, and do not exceed the different national limits.

This regional investment plan presents 41 projects necessary to meet the medium- and long-term needs of the region and to fulfil the criteria of projects of European significance. However, National Development Plans include many more investments of local importance.

The total investment costs of this Regional Investment Plan in the CCS region amount to around 52 € billion. This expenditure is balanced in the mid- and long-term. The mid-term horizon includes many projects in the North part which are planned mainly to integrate and evacuate the RES, whilst long-term projects include a lot of new interconnections.

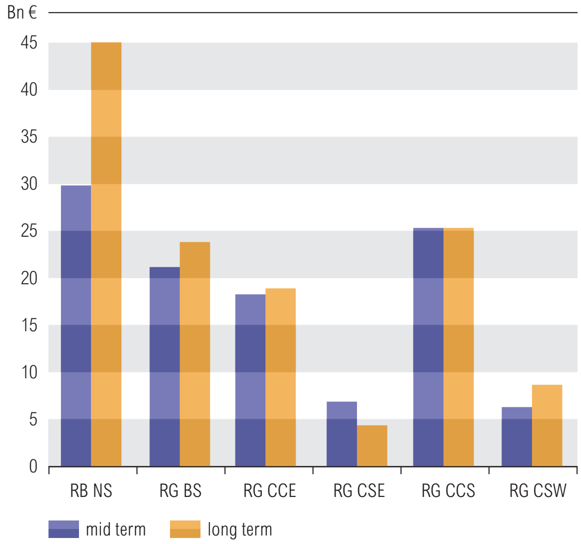


Figure 29:
Costs of RGS Projects

Renewable power plants in the North and in the South of CCS were initiated several years ago to take advantage of the huge potential of wind and solar energy. Today a massive renewable integration is planned in the North, in the Alps Region and in the South part of CCS. With this in mind, it is evident that plans for 2020 are quite ambitious: it is estimated that RES integration will increase by over 100 GW.

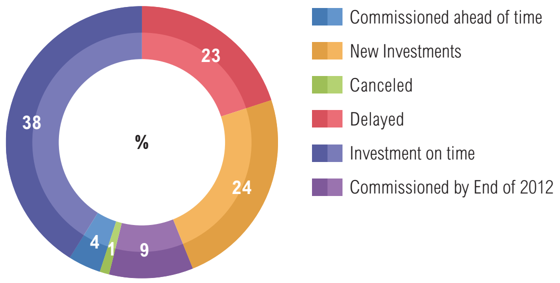


Figure 30:
Comparison of CCS REGIONAL Projects in the Pilot TYNDP 2010 and current TYNDP 2012

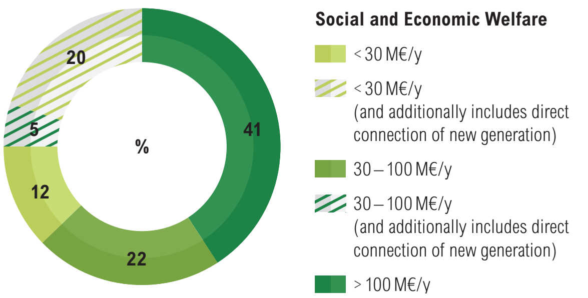
The monitoring of pilot TYNDP 2010 is possible with the information in Chapter 3. Around 24 % of the projects are new in this plan due to better definition of the projects or due to new long-term needs. With regards to the TYNDP 2012 when compared to the previous TYNDP 2010, 38 % of the projects already included in TYNDP 2010 maintain the expected commissioning date although some of them have been reshuffled. 9 % will be commissioned by the end of 2012, 23 % have some delay and around 1 % have been cancelled.

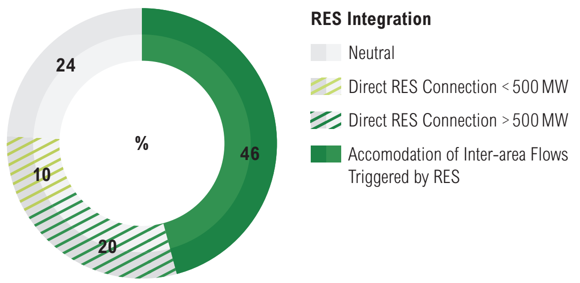
The investment plan proposed sums around 25000 km, 64 % of them in AC technology. It includes 9 new cross border lines within the region, 15 interconnections with the rest of Europe and non EU countries, and 15 internal projects. The plan shows a big effort to make the best of existing assets in order to minimize grid extension and avoid creating new routes as 18 % of the AC projects are upgrades, uprates or change of conductor, including high temperature conductors. Moreover, FACTS and Phase Shifter Transformers are considered to control active power flows in some parts of the network. In addition, new but efficient technologies are considered in the project definition such as the High Voltage Direct Current, both LCC and VSC technologies.

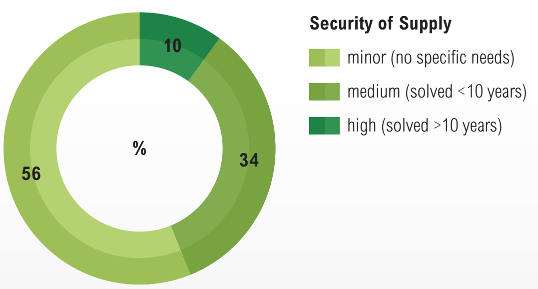
In total 61 % of the new DC projects are subsea cables. Regarding AC, 87 % of the new projects are overhead lines.

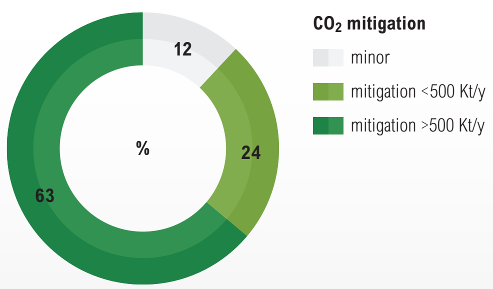
The projects have been assessed with a set of indicators which evaluate their contribution to the social economic welfare, renewable integration, and security of supply, variation of losses, CO_2 emissions, and fulfilment of network codes, resilience and flexibility. The assessment has 3 steps according to a high benefit, medium or low / no benefit and are represented with dark, medium and light green colours respectively.

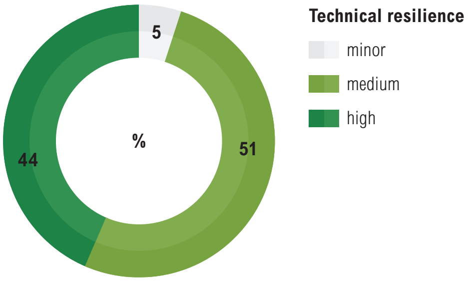
Proposed projects contribute highly to the European policy and the 3 × 20 objectives. More than 70 % of the projects contribute to integrating RES. Projects of EU significance integrate new Renewable Energy Sources in the region. It is worth mentioning that not all of the National Master Plans are included in RIP, and therefore not all Renewable National plans are attached to projects of EU significance. Security of supply is enhanced with projects of EU significance. However in general, local investments of national relevance are required in addition to the projects included in this plan in order to secure supply. On the other hand, more than 60 % of the projects contribute importantly to increasing the social economic welfare as they allow for the production of more sustainable and cheaper power plants, which means variable generation costs savings (and CO_2 savings) and therefore, it contributes to the Internal Electricity Market. Regarding energy efficiency, the effect of projects of European relevance in the system losses is not always positive: indeed, renewable energy sources are sometimes located far away from load, creating important power flows with long transits, which can result in higher losses. Finally, all of the proposed projects highly fulfil the network codes and help to gain resilience and flexibility.

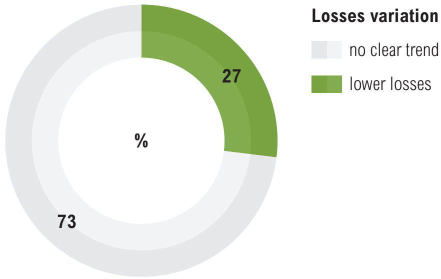


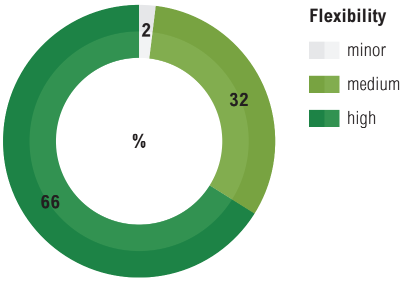


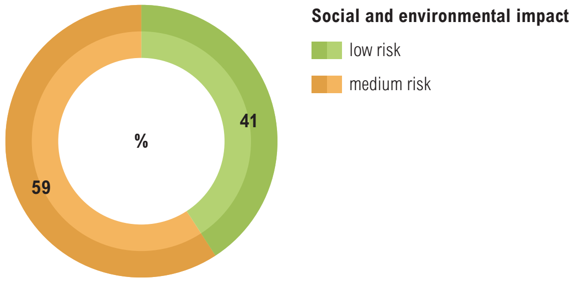








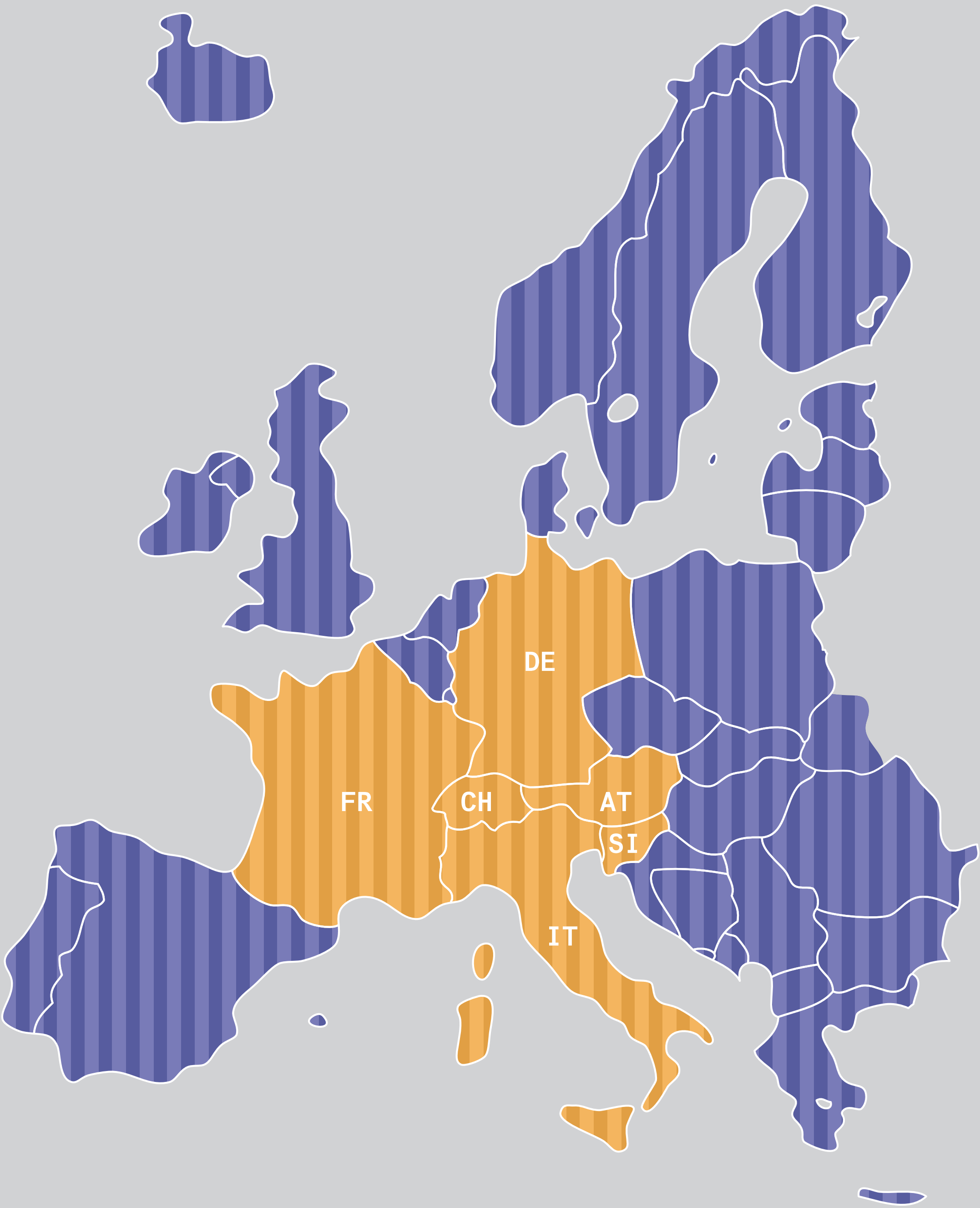




41 % of the proposed projects have a high probability of being commissioned at the planned date, while 59 % are realistic but have some uncertainty. According to prefeasibility analyses, many of the projects are considered to affect heavily the environment or social opposition.

The analysis undertaken shows that completion of the identified projects will provide sufficient grid adequacy to meet the needs presented by the 2020 scenarios, except for the area of Provence-Alps-Cote-d'Azur (PACA) region, whose security of supply may be at risk after the cancelation of the "Public Utility declaration" of a 400 kV OHL in 2006. For this project, a mid-term project (3*225-kV underground cables) will improve the supply for a couple of years but an additional project is needed in the longer run. It should be noted however that these long-term scenarios are likely to change over the course of the coming years and in some cases further investments will be required. For instance, this Regional Investment Plan considers that there is no need to reinforce the interconnection between Italy and North Africa by 2022. However, depending on the progress of ambitious plans to install large amounts of RES in North Africa, this may be reconsidered. Updates regarding future situations can be considered in future plans and TYNDP is updated every 2 years.

12 Appendix



12.1 CCS Interconnection Projects of European Significance

Appendix 1 aims to provide a detailed summary of the ongoing interconnection development projects and their related internal reinforcements which are needed to increase the transmission capacity between CCS countries. Moreover, these investments, most of them contained in the TYNDP 2012 document, have also been described inside the respective National Development Plans of each TSO.

For each project, expected benefits assessed are given, taking into account the fixed range of values as follows:

Grid transfer capacity increase:	+ … MW
Socio-economic welfare:	
RES integration:	
Improved security of supply:	
Losses variation:	
CO_2 emissions mitigation:	
Technical resilience:	
Flexibility:	
Social and environmental impact:	
Project costs:	

Table 4.1:
Principles of multi-criteria assessment of projects of pan-European significance

Total project expenditure:

	Higher than 1000 M€
	Between 300 M€ and 1000 M€
	Lower than 300 M€

Social and environmental impact

	the probability of carrying out a project at the planned commissioning date is considered as high (no protected or dense urban area is affected, there are no known former infrastructure conflicts in the area, the visual impact is perceived as low).
	the probability of carrying out a project at the planned commissioning date is considered as realistic but exposed to uncertainty (protected or urban area may be affected in a limited way, visual impact is perceived as moderate).
	the probability of carrying out a project at the planned commissioning date is considered as low (visual impact is perceived as high, protected or urban area may be affected, there have been former conflicts in the area).

Grid Transfer Capability (GTC) reflects the ability of the grid to transport electricity across a boundary, that is, from one area (price zone, area within a country or a TSO) to another. It depends on the considered state of consumption, generation and exchange, as well as the topology and availability of the grid. The Grid Transfer Capability is oriented, which means that across a boundary, there may be two different values. It is measured in MW.

Security of supply

the project will not improve security of supply, that is, for supplying electricity for normal contingencies, during the ten years following its commissioning.
the project improves the security of supply under normal contingencies as defined in Chapter 2 during the ten years following its commissioning.
the project additionally improves the security of supply under rare contingencies as defined in Chapter 2 during the ten years following its commissioning.

Social and economic welfare

the project has an annual benefit < € 30 million.
the project has an annual benefit < € 30 million and includes direct connection of new generation.
the project has an annual benefit between € 30 and € 100 million.
the project has an annual benefit between € 30 and € 100 million and includes direct connection of new generation.
the project has an annual benefit > or = to € 100 million.

RES Integration

the project has a neutral effect on the capability of integrating RES.
the project allows direct connection of less than 500 MW RES production.
the project allows direct connection of more than 500 MW RES production.
This project allows an increase of capacity between an area with excess of RES generation to share this with other areas[1)] (in order to facilitate at least 500 MW of RES penetration).

Variation in losses (energy efficiency)

the project contributes to increase the volume of losses on the grid.
the project may help to decrease losses in some situations and to increase them in others.
the project contributes to decreasing the volume of losses on the grid.

Variation in CO_2 emissions

	the project has no positive effect on CO_2 emissions.
	the total number of projects reduces CO_2 emissions by < 500 kt/year.
	the total number of projects reduces CO_2 emissions by > 500 kt/year.

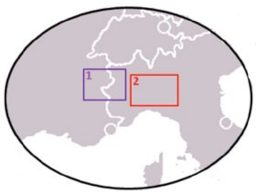
Technical resilience/system safety margin

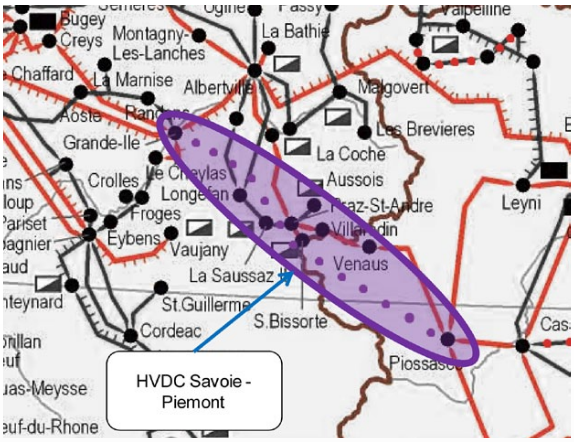
	the score of KPI’s is 0.
	the score of KPI’s is < or = 3+.
	the score of KPI’s is > 3 +.

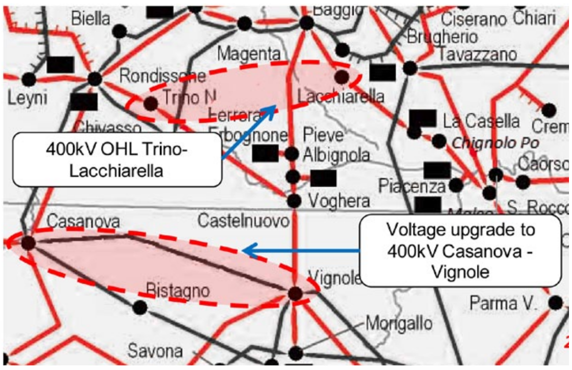
Robustness/flexibility

	White: the score of KPI’s is 0.
	Green: the score of KPI’s is < or = 5+.
	Dark green: the score of KPI’s is > 5+.

Project 21 Italy – France







Overview:

This Project comprises a mid-term investment, using the existing grid and a long-term one with a new HVDC cross-border link. The objective is to increase the NTC between France and Italy. Necessary investments of internal grids in both countries have been included. On Italian side, congestions are located in the regions of Piedmont and Lombardy, characterized by high load density. Furthermore, the increase of installed generation power in these regions will worsen the situation. On French side, the Albertville node is very critical for this interconnection. A part of the mid-term project is so to make stronger the links between Albertville and Grande Ile and between Albertville and Cornier. No additional internal reinforcement is needed in France for the long term step.

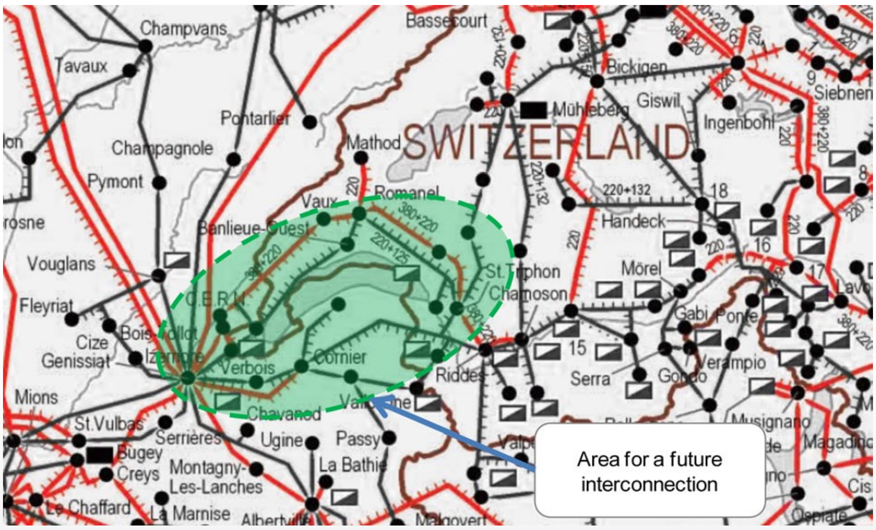
Expected benefits:

The benefits expected by this project are mainly related to the increase of cross-border capacity between France and Italy, improving the security of supply on Savoy region; helping conventional generation integration; reducing congestions on 220 kV local grid due also to further increase of generation in Piedmont and Lombardy regions and developing the Italian-French interconnection.

Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
1800 from FR to IT, (600 in the MT)									

Geographical data	Technical data	Status	Commission-ing expected
Cornier (FR) – Piossasco (IT)	Replacement of conductors on Albertville (FR) – Montagny (FR) – Cornier (FR) and Albertville (FR) – La Coche (FR) – La Praz (FR) – Villarodin (FR) – Venaus (IT) - Piossasco (IT) single circuit 400 kV OHLs. Change of conductors and operation at 400kV of an existing single circuit OHL Grande Ile (FR) – Albertville (FR), and works in Albertville (FR) 400kV substation. (Total length of lines : 257 km)	Under construction	2012 – 2013
Grand'Ile (FR) – Piossasco(IT)	"Savoie – Piémont" Project 190 km HVDC (VSC) interconnection via underground cable, converter stations at both ends (two poles, each of them with 600 MW capacity).	under construction in Italian side, design & permitting on French side	2017/18
Trino (IT) – Lacchiarella (IT)	New 95 km 400kV double circuit AC OHL. Voltage upgrade of the existing Magenta 220/132 kV substation up to 400 kV.	Under construction	2013
Casanova (IT) – Vignole (IT)	Voltage upgrade of the existing 100 km 220 kV AC OHL to 400 kV and new 400/220/150 kV substation in Asti area.	Design & permitting	long-term
Torino (IT)	Total length: 63 km.	permitting	long-term

Project 22 France – Switzerland



Overview:

The southern part of the French – Swiss interconnection mainly consists of 220 kV lines. This section of the grid is the critical part of the interconnection. In order to increase the cross-border capacity between France and Switzerland, the project consists of replacing existing 220 kV double lines with 400 kV lines, on the northern or/and the southern part of Lake Geneva.

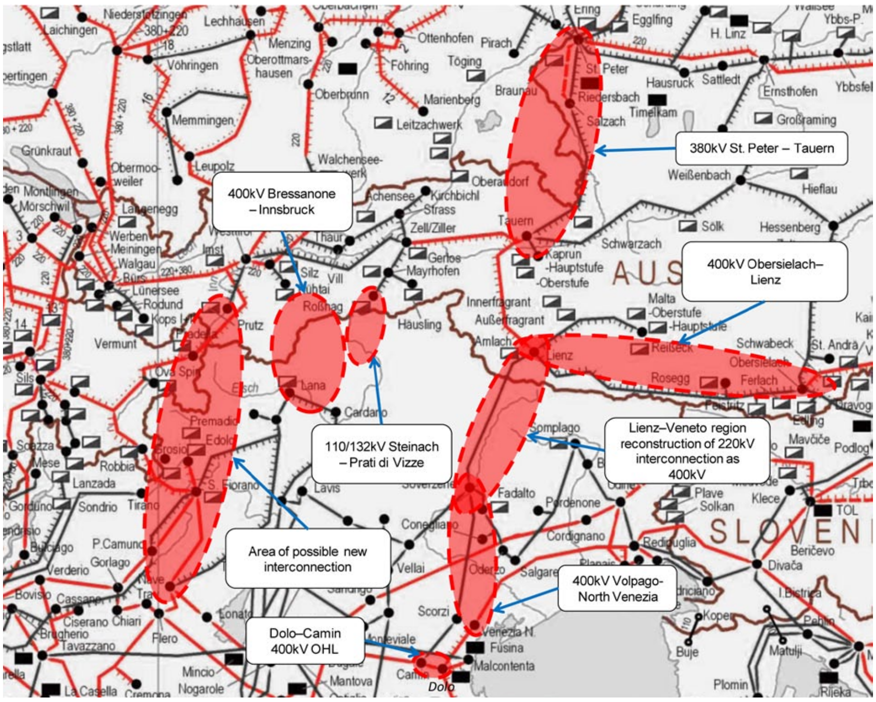
Expected benefits:

The benefits expected from this project are mainly related to the increase of cross-border capacity between France and Switzerland. It also helps the integration of new pumped storage plants in the Alps in Switzerland, facilitating the efficient use of RES.

Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
< 1000 from FR to CH and < 1500 from CH to FR									

Geographical data	Technical data	Status	Commissioning expected
North and/or South Leman	Reinforcement of the interconnection in the area of Geneva's lake; several options (routes, technologies) are being investigated, taking best advantage of exisiting assets (two double-circuit 220 kV OHL)	Under consideration	long-term
Châtelard (CH) – Vallorcine (CH)	A PST will be installed on the Châtelard – Vallorcine 220 kV line to optimize the load on the Pressy-Vallorcine 220 kV line	In pre-feasibility study phase	2017

Project 26 Italy – Austria



Overview:

One 220 kV single circuit OHL currently constitutes the interconnection between Austria and Italy. Due to the high load on this line special switching and congestion management is necessary to keep this interconnector in operation. One main aim of the project is therefore to increase the NTC between Austria and Italy by means of constructing new interconnection lines respectively, whilst upgrading existing ones and also reinforcing the relevant national transmission lines as a precondition for achieving the necessary transmission capacities.

To optimize the operation of the existing 220 kV cross-border line and in particular to improve the operational security, the installation of a 220/220 kV PST in Lienz is foreseen in 2012. For the mid- and long-term period an upgrade of the 110/132 kV OHL Steinach – Prati di Vizze and the construction of a new 380 kV cross-border OHL Lienz – Veneto is planned. Beyond this, further interconnection lines are currently under consideration.

To integrate the interconnection lines effectively with the transmission grid, the 380 kV Salzburg line (St. Peter – Tauern) and the 380-kV-reinforcement between Lienz and Obersielach in Austria are essential. Moreover, the therewith established 380-kV-Ring is the planned backbone of the Austrian transmission system constituting the basis for the future security of supply in Austria.

In Italy, planned works on the Italian North-East network are necessary in order to overcome congestion in operation (also on HV grid) and to ensure the supply to large urban centers under N and N-1 conditions. At present, this portion of grid represents a critical section on the national HV system, which is characterized by few links and a low level of grid meshing. Furthermore, the 132 kV grid strongly needs new connection points with the 400 kV network. Important steps must also be taken with regards to the network of Triveneto area, for example the areas of Venice and Padua. This is also in light of new generation power plants in the area. A new interconnection is under feasibility study.

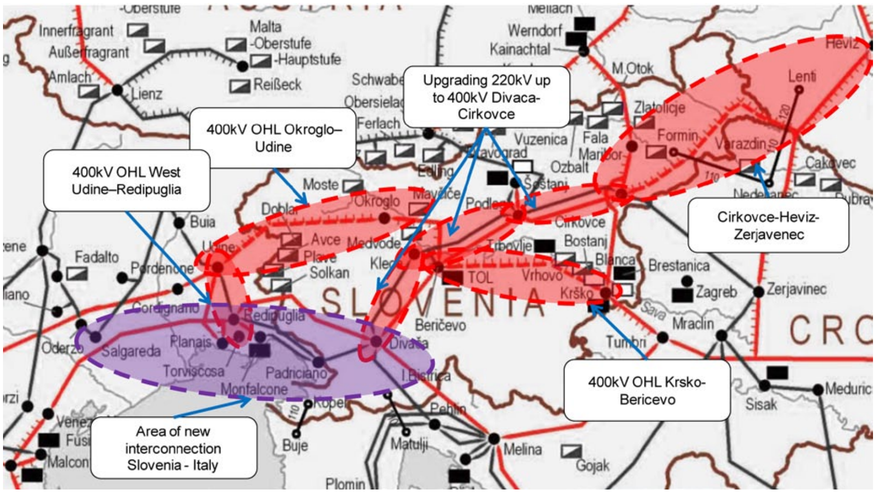
Expected benefits:

Increasing cross-border capacity between Italy and Austria complies with the aims towards the integration of the EU internal energy market (IEM), improving the security of supply and reducing annual grid losses. This will also help to overcome the constraints in Venice and Padua area due to generation plant development in the North East of Italy and will support RES integration. The establishment of a powerful connection to the pump storages in the Austrian Alps helps to facilitate efficient RES integration in Italy and Austria.

Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
750									

Geographical data	Technical data	Status	Commission-ing expected
Lienz (AT) – Veneto (IT)	range of 100 – 150 km.	Planned	long-term
Lienz (AT)	Erection of a new 220/220kV- PST in the substation Lienz (AT).	Under construction	2012
Bressanone (IT) – Innsbruck (AT)	New double circuit 400 kV interconnection through the pilot tunnel of the planned Brenner Base Tunnel. Total line length: 65 km.	Under consideration	>2022
Prati di Vizze (IT) – Steinach (AT)	Upgrade of the existing 44km single circuit 110/132 kV OHL, currently operated at medium voltage and installation of a 110 kV/132 kV PST.	Design & permitting	mid-term
St. Peter (AT) – Tauern (AT)	Completion of the 380 kV-line St. Peter – Tauern. With an upgrade of the existing 380kV-line St. Peter – Salzburg from 220 kV operation to 380kV operation and the erection of a new internal double circuit 380 kV-line connecting the substations Salzburg and Tauern (replacement of existing 220 kV lines). Moreover the erection of the new substations Wagenham and Pongau is planned. Line length: 115 km.	Design & permitting	2017/2019
Volpago (IT) – Venezia Nord (IT)	New OH 400 kV line of 31 km.	Design & permitting	2015
Dolo (IT) – Camin (IT)	New 15km double circuit 400 kV line.	Under construction	2014
Obersielach (AT) – Lienz (AT)	New 380 kV-line to close the Austrian 380 kV-Ring in the southern grid area. Line length: 190 km.	Under consideration	long-term
Polpet (IT)	Voltage upgrade of Polpet 150 kV/medium voltage substation up to 220 kV, complying with 400 kV standards.	Design & permitting	2015
New Interconnection between Italy and Austria	New possible interconnection line between Italy and Austria.	Consideration	long-term

Project 27 Italy – Slovenia



Overview:

This project establishes new 400kV corridors in order to increase the safe transfer of power from Hungary and Bosnia towards Croatia, Slovenia and Italy. It aims to increase the transmission capacity between Slovenia and Italy, aiming to IEM, it becomes necessary for both Italy and Slovenia to work on their own grids. Particularly on the Slovenian side the actions will aim to improve SoS, to reduce system operating costs, and to increase the transmission capacity of those near Croatia; on the Italian side the North East area is at present a critical section of national high voltage network, and is characterized by few links and a low level of grid meshing. The Redipuglia node is one of the most critical of the North-eastern grid. In fact, power flows from the interconnection Italy-Slovenia and from the production poles of Monfalcone and Torviscosa pass through Redipuglia node. To ensure safe and reliable operation of the Slovenian power system with the goal being to increase capacity and reliability of electricity transmission between central-southern, central-eastern and South-eastern Europe, the Slovenian transmission system requires considerable reinforcements. In order to strengthen security of supply, increase resilience and flexibility of the transmission network, new investments are necessary in order to accommodate RES integration and conventional generation which are expected in the related countries. This investment will also remove congestion on North-South and East-West axes.

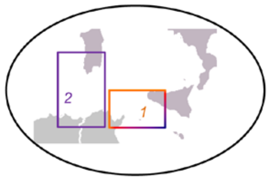
Expected benefits:

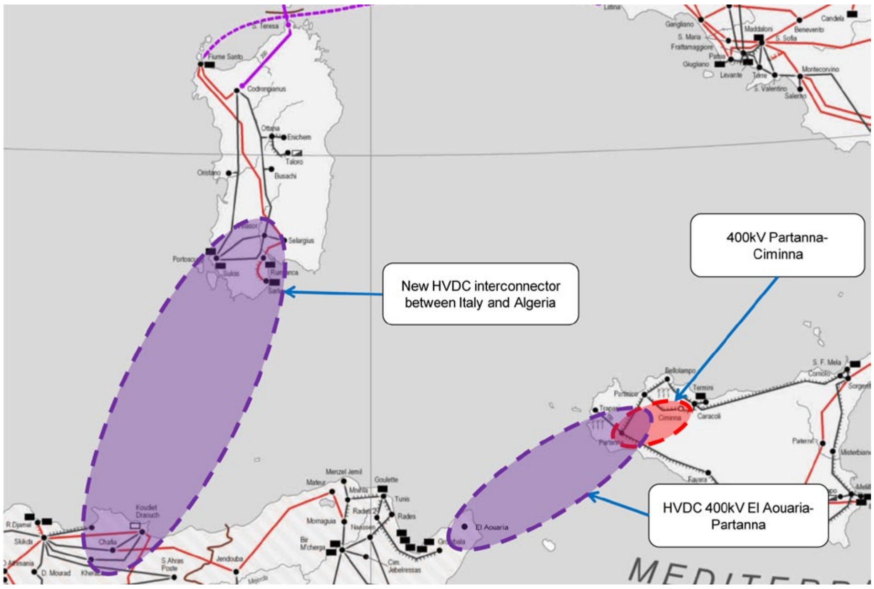
This project aims to increase transfer capacity of the West Balkans area to Italy through Slovenia and Hungary and Slovenia, Italy, Croatia and BIH new interconnections. Additional benefits are related to the realization of all project investments in order to concur and thus to achieve diversity security of supply and market integration. In addition, clustered investments are needed to guarantee the operation of the Slovenian grid and to enable full use of Regional Market improving market integration. This cluster will also allow for the safe integration of more than 1500 MW of RES in Croatia and Bosnia and over 500 MW of RES in Slovenia.

Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
>1800									

Geographical data	Technical data	Status	Commissioning expected
Okroglo (SI) – Udine (IT)	New 120 km double-circuit 400 kV OHL.	Planned	long-term
Lienz (AT)	Erection of a new 220/220 kV – PST in the substation Lienz (AT).	Under construction	2012
Udine Ovest (IT)–Redipuglia (IT)	New double circuit 400kV OHL, with construction of a new substation called Udine South on the way. The line will replace the path of the existing 220 kV line between Udine NE and Redipuglia.	Design & permitting	2015
HVDC interconnection between Slovenia and Italy	New interconnection between Slovenia and Italy.	Under consideration	long-term
Zerjavenec (HR)	SI)-Žerjavenec (HR).	permitting	2016
Krsko (SI) – Bericevo (SI)	New 80 km 400kV double circuit OHL.	Under construction	2015
Divaca (SI) – Cirkovce (SI)	Voltage upgrade of 220 kV lines up to 400 kV. Line length: 193 km.	Planned	Long-term
Lika (HR)	New 400/110 kV substation.	Planned	2017
Brinje (HR)	New 400/220 kV substation.	Planned	2020
Lika (HR) – Brinje (HR)	New 400 kV overhead line replacing aging 220 kV overhead line.	Planned	2020
Lika(HR) – Velebit (HR)	New 400 kV overhead line replacing aging 220 kV overhead line.	Planned	2020
Plomin (HR) – Melina (HR)	New 90km double circuit OHL, with two connecting substations and transformer 400/220 kV, 400 MVA.	Design & permitting	>2016
Banja Luka (BA) – Lika (HR)	OPS network study.	consideration	2020

Project 29 Italy – North Africa





Overview:

With a view to the development of renewable power generation in Africa, especially from photovoltaic sources, the creation of interconnections between Europe and the African continent becomes necessary. An interconnection is forecast between Sicily and Tunisia, which will allow for the participation of the Maghreb area in the European Energy Market. This investment is partially financed by private investors.

Another new interconnection between Europe and North Africa which is necessary to permit the increase of power exchange capability with the North African frontier is in the feasibility study phase: a new HVDC submarine link between Algeria and Sardinia Island.

Expected benefits:

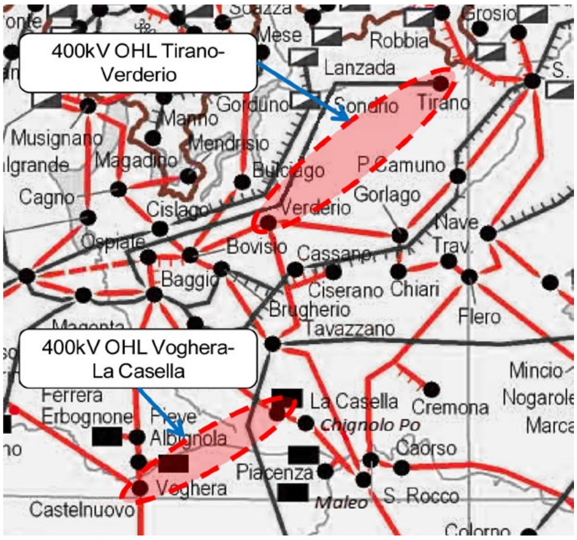
The project is expected to increase transmission capacity, to improve the security of supply in Sicily and to allow integration of different continental markets. It will also support RES integration and will reduce the re-dispatching costs.

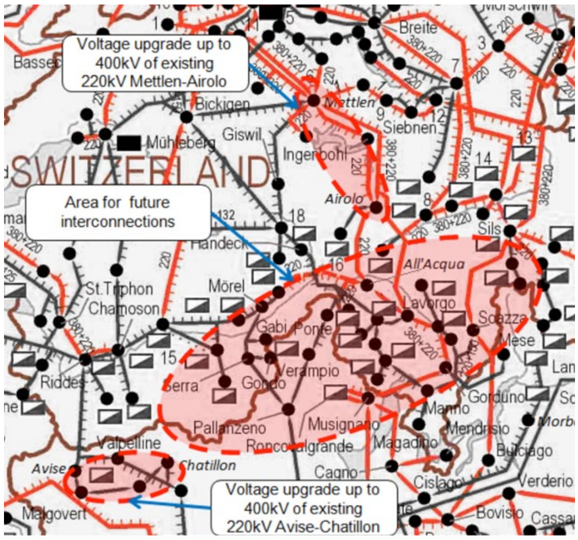
Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
1000									

Geographical data	Technical data	Status	Commissioning expected
El Aouaria (TU) – Partanna (IT)	New 350 km 1000 MW HVDC line between Tunisia and Italy via Sicily with 400 kV DC subsea cable and converter stations at both ends.	Design & permitting	long-term
Partanna (IT) – Ciminna (IT)	New 65km single circuit 400 kV AC OHL.	Planned	long-term
Italy and Algeria	Algeria and Italy	Under consideration	long-term

Project 31

Italy – Switzerland





Overview:

In the North part of Italy one will find the greatest concentration of industrial loads. In particular, the Lombardy region has the most elevated energy consumption of Italy, and together with the Piedmont and Veneto regions they are characterized by energy import from neighboring countries. At present the constrained border between Switzerland and Italy is considering new reinforcements with the target to increase the existing transmission capacity on the border. The new reinforcements shall be joined with Italian and Swiss internal reinforcement by evaluating the feasibility of the optimization of existing network infrastructures. In particular, the network area 400 – 220 kV between Milano and Brescia will be reinforced whilst also considering the possibility of using existing infrastructures and the area near Milan which displays criticalities on the 220 kV grid management due to high load density in this area.Terna and Swissgrid have been studying reinforcements on the CH-IT border with the aim of increasing the existing border transmission capacity by up to over 1.000 MW also involving investments which had been considered interesting in the past.

Expected benefits:

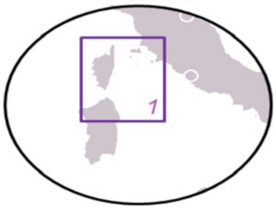
The planned investments related to the low transfer capacity on the portion of grid between Riddes and Avise/Valpelline/Chatillon will improve import/export power exchanges, and this project also contains investments necessary to ensure, on the whole, the local conventional generation integration and security of supply of urban areas. It is expected to decrease congestion, due to further increases of generation in Piedmont and Lombardy regions and increases in energy exchange with Switzerland and France, thus allowing for the installation of new generation plants, especially renewable sources. Nevertheless, it will overcome the constraints in operation and ensure the supply in N and N-1 condition in large urban centers.

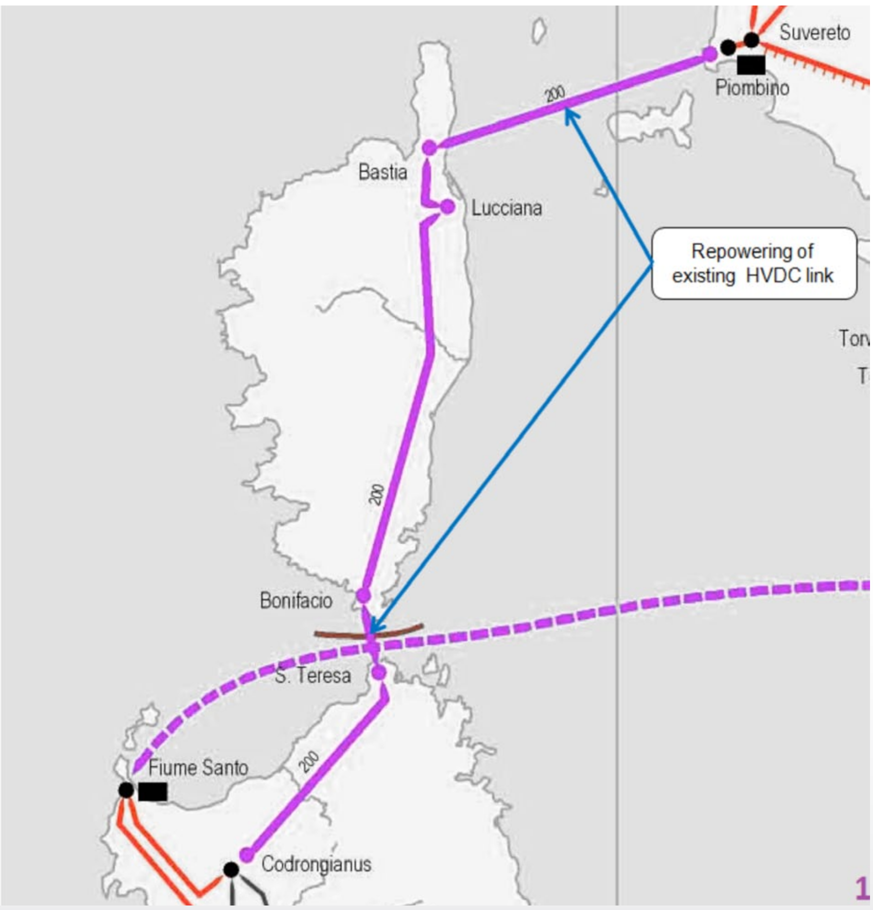
Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
>1000									

Geographical data	Technical data	Status	Commission-ing expected
Pavia (IT) – Piacenza (IT)	45 km double circuit 400 kV AC OHL.	Planned	long-term
Tirano (IT) – Verderio (IT)	140 km single circuit 400 kV AC OHL	Planned	long-term
Avise (IT) – Chatillon (IT)	Upgrade 40 km single circuit 220 kV OHL up to 400 kV.	Design & permitting	2014
Mettlen (CH) – Airolo (CH)	Upgrade 90 km single circuit 220 kV OHL up to 400 kV.	Under consideration	2020
Milano (IT)	Restructuring of the 220 kV urban network, new 220 kV cables (33 km), reinforcements of exist-ing assets (35 km).	Design & permitting	mid-term
Mese (IT)	Upgrade of the existing 220/132 kV substation up to 400 kV.	Design & permitting	2014
Brescia (IT)	New 400/132 kV substation, while r estructuring the 132 kV network.	Planned	mid-term

Project 34

Italy – France
(Corse Island)





Overview:

At present, Sardinia island is linked to the mainland by two different HVDC links with a grid transfer capacity of 1,300 MW. In order to increase the SoS and RES integration in the Sardinia and Corse islands and to overcome the regional market splitting caused by limited transmission capacity, it is planned to repower the existing HVDC 220 kV known as SA.CO.I.

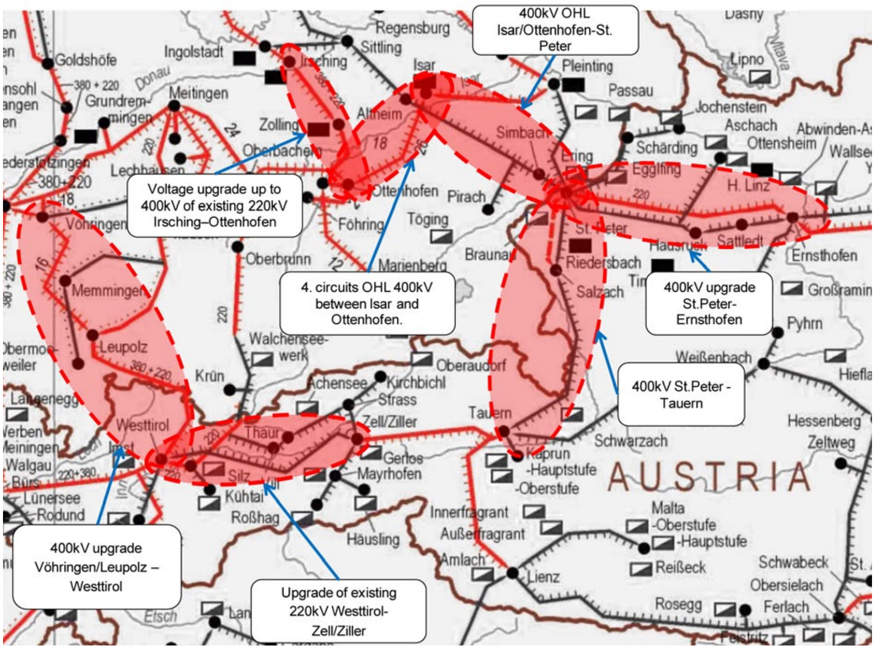
Expected benefits:

The expected benefits from this Project are estimated to involve the increase of GTC between Sardinia island, Corse island and the Italian peninsula, enabling full use of Regional market, improving the security of supply and achieving the diversity of supply (RES integration).

Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
500									

Geographical data	Technical data	Status	Commissioning expected
Codrongianos (IT) – Suvereto (IT)	Repowering of existing HVDC interconnection between Sardinia, Corse and mainland Italy via 220 kV DC subsea cable (358 km). The first connection is in operation since 1970. Total capacity of the bipolar link: 500 MW.	Design & permitting	long-term

Project 47 Germany – Austria



Overview:

On the one hand this project considers a clustering of the investments related to the interconnection between Austria and Germany by the upgrade of the existing OHL "Vöhringen/Leupolz (DE) – Westtirol (AT)" to 400 kV and a new 400 kV OHL "Isar/Ottenhofen (DE) – St. Peter (AT)". Moreover, the project includes other investments which aim to enhance the North-to-South axis transmission capacities, the integration of the existing and new hydro capacities into the Austrian and EU energy markets and an increase of N-1 security and transport capacities from the North to South-West Austrian grid, due to the increase of RES in Germany.

The aim of the Austrian investments St. Peter (AT) – Tauern (AT), Ernsthofen (AT) – St. Peter (AT) and Obersielach (AT) – Lienz (AT) is the completion of the Austrian 380 kV-Ring structure in order to enhance the overall security of supply of the Austrian electricity system, as well as to facilitate the integration of new pump storage plants and RES. The investment Westtirol – Zell/Ziller will improve the East-West transmission capacity whilst also improving the N 1 security. The project Dürnrohr – Sarasdorf considering the installation of the 3rd and 4th circuit on the existing line is the basis for the integration of the planned wind energy in the eastern parts of Austria and strengthens the Austrian 380 kV-Ring in the area around Vienna.

Expected benefits:

This project strengthens the interconnection capacity between Austria and Germany and therefore facilitates market integration. It connects areas with high RES capacities (in northern Europe (particularly Germany) and eastern parts of Austria) to the Alps region in Austria with great capacities of existing and planned pump storage power plants. In the spirit of the European climate goals, the project therewith facilitates a flexible, market oriented interaction of these pump storage plants with the fluctuating wind production and is therefore vital to efficiently integrate RES generation with the energy system. With the ongoing Nuclear Phase Out, it becomes increasingly important for the security of supply of southern Germany (Bavaria).

Furthermore, the investments within Austria will enhance the security of supply as they will be part of the 380 kV-ring structure which aims to secure security of supply on a long-term basis. In addition, the further integration of RES in Austria such as wind and pump storage plants will be secured in the long-term.

Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
>2000									

Geographical data	Technical data	Status	Commission-ing expected
Westtirol (AT)	Upgrade of an existing OHL to 400 kV, extension of existing and erecting of new 400-kV-substations including 400/110-kV-transformers.	Planned	long-term
Irsching (DE) – Ottenhofen (DE)	Upgrade of 230 kV AC circuits to 400 kV AC, including new 400 kV switchgear Zolling. Length 76 km.	Planned	mid-term
Isar/Ottenhofen (DE) – St. Peter (AT)	New 400 kV AC double circuit OHL including new 400 kV switchgears Altheim, Simbach and St. Peter and one new 400/230 kV transformer in substation Altheim and fouth circuit on line Isar – Ottenhofen. Line length: 90 km.	Design & permitting	2017
St. Peter (AT) – Tauern (AT)	Completion of the 380 kV-line St. Peter – Tauern. With an upgrade of the existing 380 kV-line St. Peter – Salzburg from 220 kV operation to 380 kV operation and the erection of a new internal double circuit 380 kV-line connecting the substations Salzburg and Tauern (replacement of existing 220 kV lines). Moreover the erection of the new substations Wagenham and Pongau is planned. Line length: 115 km.	Design & permitting	2017/2019
Westtirol (AT) – Zell-Ziller (AT)	Upgrade of the existing 220 kV-line Westtirol - Zell-Ziller and erection of additional 220/380 kV-Transformers. Line length: 105 km	Partly under construction	2013 – 2020
St. Peter (AT) – Ernsthofen (AT)	Upgrade from 220 kV operation to 380 kV and erection of a 380 kV-Substation in Ernsthofen and St. Peter.	Under construction	2013
Vöhringen / Leupolz (DE) Westtirol (AT)	Upgrade of an existing OHL to 380 kV, extension of existing and errection of new 380-kV-substations including 380/110-kV-transformers. Transmissions routs Vöhringen – Westtirol and Pkt. Woringen – Memmingen. Length: 114 km.	planned	long-term

Project 90 Germany/Austria – Switzerland

Overview:

Due to increased North-South transits as a result of the high wind energy of the on- and offshore power plants in North Germany and the planned new pump storage power plants in Switzerland, the need for increased transmission capacity between Germany/Austria and Switzerland increases. Important grid projects inside Switzerland will be needed to achieve the adequate integration of the Swiss pump storage plants and the RES in northern Europe. The transmission corridor from the area of Oberschwaben/Lake Constance (known in Germany as "Bodensee") to Vorarlberg and further to the western and southern part of Switzerland is also affected by this new condition.

Moreover, the programmed grid extension in Germany from 220 kV to 380 kV requires a coordinated and future-oriented planning of interconnection lines in the grid area affected by conversions.

Expected benefits:

This project strengthens the interconnection capacity between Switzerland and Germany/Austria and therefore facilitates market integration. It connects areas with high RES capacities (in northern Europe) to the Alps region in Switzerland with great capacities of existing and planned pump storage power plants. In the spirit of the European climate goals, the project therewith facilitates a flexible, market oriented interaction of these pump storage plants with the fluctuating wind production and is therefore vital to efficiently integrate RES generation with the energy system

Grid Transfer Capability increase [MW]	Socio-Economic Welfare	RES integration	Improved Security of Supply	Losses variation	CO_2 emissions variation	Technical Resilience	Flexibility	Social & environmental impact	Project Cost
4000									

Geographical data	Technical data	Status	Commissioning expected
Bickigen (CH)	Addition of a second 400/220 kV transformer in an existing substation.	Design & permitting	2012
Mühleberg (CH)	Construction of a new 400/220 kV substation.	Design & permitting	2015
Bassecourt (CH) – Romanel (CH)	Construction of different new 400 kV line sections and voltage upgrade of existing 225 kV lines into 400 kV lines. Total length: 140 km.	Design & permitting	2015
Area of Bodensee (DE, AT, CH)	Upgrade of the existing 220 kV-line Westtirol - Zell-Ziller and erection of additional 220/380 kV-Transformers. Line length: 105 km.	Planned	long-term
Beznau (CH) – Mettlen (CH)	Upgrade of the existing 65km double circuit 220 kV OHL to 400 kV.	Design & permitting	2015
La Punt (CH) – Pradella/ Ova Spin (CH)	Installation of the second circuit on existing towers of a double-circuit 400 kV OHL (50 km).	Planned	2017
Bonaduz (CH) – Mettlen (CH)	Upgrade of the existing 180 km double circuit 220 kV OHL into 400 kV.	Under consideration	2020
Goldshöfe (DE) – Bünzwangen (DE)	A new 380 kV OHL. Length: 45 km.	Under consideration	2020
Area of Bodensee (DE, AT, CH)	Construction of new lines, extension of existing ones and erection of 400/220/110kV-substation. Transmission routs: Herbertingen – Tiengen, Herbertingen – Pkt. Rommelsbach, Herbertingen – Area of Lake Constance in CH, Pkt. Wullenstetten – Pkt. Niederwangen	planned	long-term

12.2 Table of Projects of Pan-European Significance

The following table summarizes some brief synthetic information regarding the projects mentioned in the main body of the document. It gives a synthetic description of each project with some factual information as well as the expected impacts of the projects and commissioning information.

Project & investment Items

A project in the TYNDP package 2012 can cluster several investment items. Every row of the table in Appendix 1 regarding the TYNDP or Regional Investment Plan report corresponds to one investment item. The basic rule for the clustering is that an investment item belongs to a project if this item is required to develop the grid transfer capability increase associated with the project. A project can be limited to one investment item only. An investment item can contribute to two projects; in this case it is depicted only once in the table of projects, in one of the projects (and only referred to in the other project: no technical description, status, etc. are repeated).

Labeling

Projects of Pan-European significance are numbered from 1 to 112. Investment items' labels have the following structure: project_index.investment_index. They are displayed on the projects maps in Chapter 7 and in the table of projects below.

Investment items which were present in the TYNDP 2010 have the same index in the TYNDP 2012 package. Indices of investments items which were not present in the TYNDP 2010 start with "Axxx".

Examples:

TSOs support energy efficiency, considering the following criteria to qualify the efficiency of energy:

- 79.459 designates an investment item already present in TYNDP 2010 (under the label 459) and contributing to project 79;
- 42.A86 designates a new investment item, not present in TYNDP 2010, contributing to project 42.

Projects develop grid transfer capability across the boundaries as displayed on the following map (see Fig. A). The numbers attached to every boundary on the following map correspond to the projects' indices relieving the constraints across that boundary:

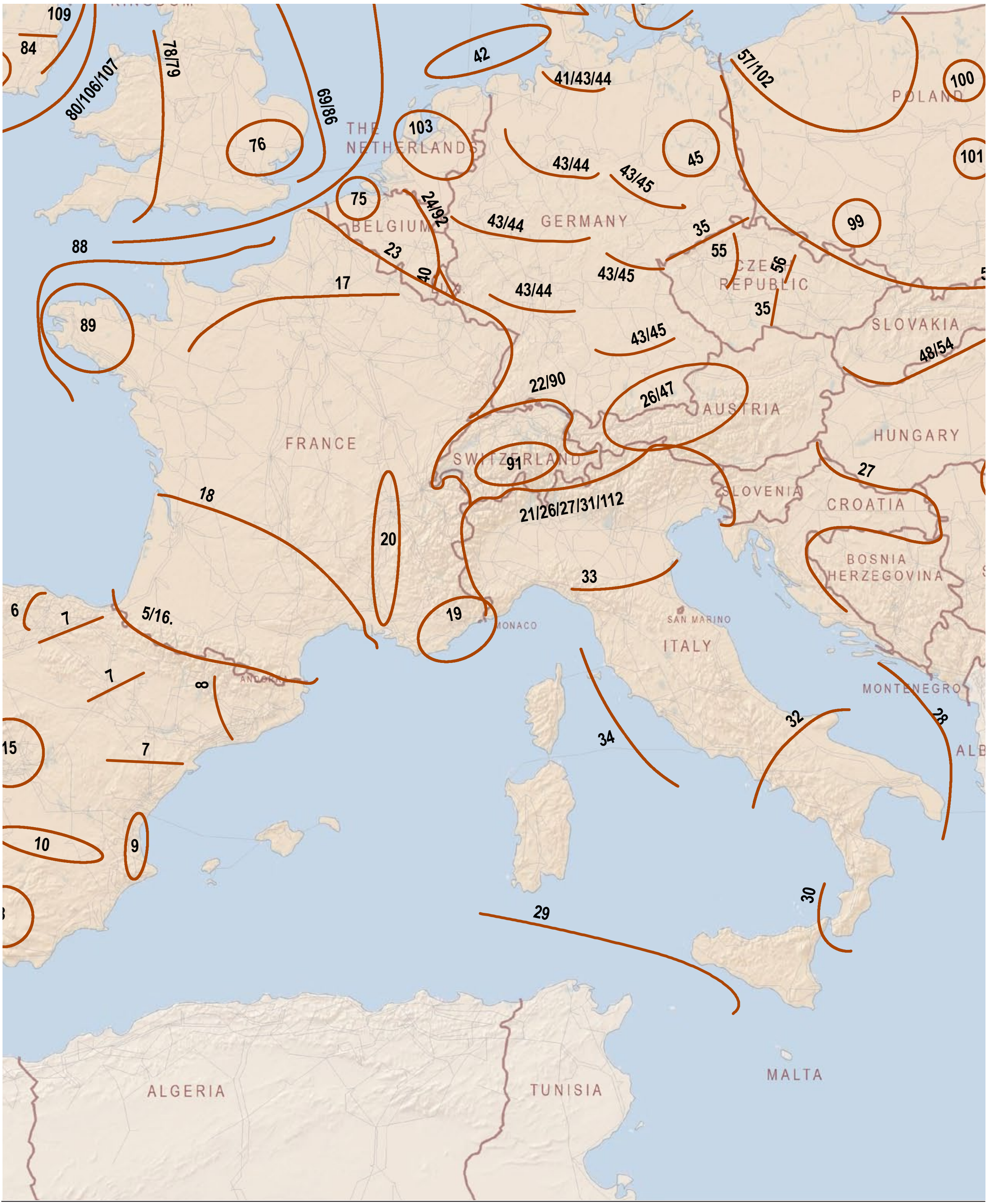


Figure 12.2:

Projects-Boundaries Correspondence

For each project, the following information is displayed:

Column 1	**Project number**	
Column 2	**Investment number**	shows the label under which the investment item is referred to in the TYNDP 2012 package, especially the projects maps shown in Chapter 7.
Column 3+4	**Substation 1 & Substation 2**	show both ends of the investment item. The code of the country concerned is given between brackets.
Column 5	**Brief technical description**	gives a summary of the technical features (e.g. new line/upgrading of existing circuit, underground cable/OHL, double circuit/single circuit, voltage, route length ...).
Column 6	**Grid transfer capability increase**	shows in MW the order of magnitude or a range for the additional grid transfer capability brought by the project.
Column 7	**Social and economic welfare**	can show 5 different displays distinguishing 1. the SEW gained via better accommodation of inter-area transits and 2. the SEW gained if the project supplies access to the grid for new generation: < 30 M€/yr < 30 M€/yr and additionally gives direct grid access for new generation ≥ 30 M€/yr and ≤ 100 M€/yr ≥ 30 M€/yr and ≤ 100 M€/yr and additionally gives direct grid access for new generation > 100 M€/yr
Column 8	**RES integration**	can show 4 different displays distinguishing the direct connection of RES (< or > 500 MW) and the accommodation of inter-area flows triggered by large amount of RES (> 500 MW): Neutral Direct access to the grid for less than 500 MW of new RES (medium, connection) Direct access to the grid for more than 500 MW of new RES (high, connection) Increasing the capacity between an area with excess of RES generation to share this with other areas[1] (in order to facilitate at least 500 MW of RES penetration)
Column 9	**Improved security of supply**	shows 3 levels of concern, and specifies the area at risk as the case may be: Minor (no specific need) Medium (supply risk solved for less than 10 years after commissioning) High (supply risk solved for more than 10 years after commissioning)
Column 10	**Losses variation**	Higher losses No clear trend Lower losses

[1] Direct access can be also achieved incidentally.

Column 11	**CO_2 emissions mitigation**	Neutral Medium (savings < 500 kt CO_2/yr) High (savings > 500 kt CO_2/yr)
Column 12	**Technical resilience**	Minor Medium High
Column 13	**Flexibility**	Minor Medium High
Column 14	**Social and environmental impact**	Low risk Medium risk High risk
Column 15	**Project costs**	> 1,000 M€ ≥ 300 and ≤ 1,000 M€ < 300 M€
Column 16	**Present status**	describes the progress of the project, with respect to the main typical phases of grid projects: – under consideration, – planned, – design & permitting, – under construction and – commissioned.
Column 17	**Expected commissioning date**	gives the year by which the investment should be commissioned.[1]
Column 18	**Evolution compared to the TYNDP 2010 situation**	explains the reasons for any adaptation of the technical consistency, evolution of the commissioning date and status of the investment.
Column 19	**Investment comment**	displays any additional information that could be of interest for every investment.
Column 20	**Project comment**	displays any additional information that could be of interest for every project.

More information on the methodology on how to calculate the indicators corresponding to the columns 6 – 15 can be found in appendix 3 of the TYNDP report.

1) This date highly depends of the duration of the permitting process, which TSOs do not master. The date given here is the most likely one, according to present status and to TSO's experience in conducting projects. The date proposed for reinforcements at a very early stage, the consistency of which is still uncertain, is likely to be further refined by the next TYNDP.

Project identification					Project assessment														
Project number	Investment number	Substation 1	Substation 2	Brief technical description	Grid transfer capacity increase	Socio-economic welfare	RES integration	Improved security of supply	Losses variation	CO_2 mitigation	Technical resilience	Flexibility	Social and environmental impact	Project costs	Present status	Expected date of commissioning	Evolution compared to the TYNDP 2010 situation	Investment comment	Project comment
5	5.19	Vic (ES)	Pierola (ES)	Upgrading (uprating) the existing 75 km single circuit Vic – Pierola 400 kV line in order to increase its capacity from 1,360 MVA to 1,710 MVA.	1,200 – 1,400 MW in both directions			Perpignan, Gerona							under construction	2012	Delays due to authorization process.		Mid term interconnection project between France and Spain ("2.8 GW"). It includes cross border lines and internal lines required to assure NTC.
	5.20	Arkale (ES)	Hernani (ES)	Upgrading the existing single circuit Arkale – Hernani n° 2 220 kV OHL in order to increase its capacity up to 640 MVA.											design & permitting	2014	Delays due to authorization process.		
	5.36	Sta.Llogaia (ES)	Baixas (FR)	New HVDC (VSC) bipolar interconnection in the eastern part of the border, via 320 kV DC underground cable using existing infrastructures corridors and converters in both ending points.											partly under construction, design & permitting	2014	Progresses as planned.		
	5.37	Santa Llogaia (ES)	Bescanó (ES)	New double circuit Sta. Llogaia – Ramis – Bescano – Vic / Senmenat 400 kV OHL (single circuit in some sections) New 400 kV substations in Bescano, Ramis and Sta.Llogaia, with 400/220 kV transformers in Ramis and Bescano.											under construction	2011 – 2013	Bescano-Vic / Senmenat 400 kV commissioned. Difficulties in the authorization process of the section Bescano – Sta Llogaia 400 kV		
	5.46	Baixas (FR)	Gaudière (FR)	Reconductoring of existing 70 km double circuit 400 kV OHL to increase its capacity.											design & permitting	end 2013	Progresses as planned.		
16	16.38	Gatica (ES)	Aquitaine (FR)	New HVDC interconnection in the western part of the border via DC subsea cable in the Biscay Gulf.	FR – ES 1,200 MW ES – FR 2,000 MW			Biarritz, Basque country							under consideration	approx. 2020	New investment in TYNDP, defined since last release, aiming 4 GW capacity between France and Spain.		Long-term interconnection project between France and Spain ("4 GW"). It includes cross border lines and internal lines required to assure NTC.
	16.A14	Amorebieta (ES) Garraf (ES) Adrall (ES) Orcoyen (ES)	Gueñes (ES) Secuita (ES) La Pobla (ES) Elgea (ES)	Uprates required in Basque country and Catalonia in order to use fully the benefit of the long-term ES – FR interconnection.											under consideration	2016	New investment in TYNDP meant to solve congestion in this area.		
	16.A17	Arkale (ES)		New PST on Arkale – Argia 220 kV interconnection line.											design & permitting	2016	New investment enabling to take full advantage of the transfer capacity.		
17	17.42	Lonny (FR)	Vesle (FR)	Reconstruction of the existing 70 km single circuit 400 kV OHL as double circuit OHL.	9,000 MW			Reims, Paris area							design & permitting	2016	Progresses as planned.		Project needed to cope with larger and more volatile power flows from Normandy to Champagne, triggered especially by the development of new generation sources (along the Channel coasts, from Picardie to Champagne and further north abroad) that would naturally flow to large consumption areas: Paris area, but also more broadly from Britanny to Reims.
	17.44	Havre (FR)	Rougemontier (FR)	Reconductoring of existing 54 km double circuit 400 kV OHL to increase its capacity.											under construction	2018	As the pace of generation installation is lower than expected, the investment has been postponed.	This investment is needed for integrating new generation in Le Havre area. As the pace of generation installation is lower than assumed earlier, the investment has been postponed from 2015 to 2018	
	17.A18	tbd (FR)	tbd (FR)	New network reinforcement between Haute Normandie and the south of Paris area. Length about 160 km.											under consideration	long term	New investment in TYNDP, defined since last release.	Either existing assets uprate or new HVDC, actual needs still being evaluated, depending on uncertainties on generation location.	
	17.45	Taute (FR)	Oudon (FR)	"Cotentin – Maine" Project: New 163 km double circuit 400 kV OHL connected to existing network via two new substations in Cotentin and Maine regions.											under construction	2013	Delays due to authorization process.		
	17.A144	Cergy (FR)	Terrier (FR)	MORP project: New single circuit 400 kV line between existing 400 kV substations.											planned	2018	New investment in TYNDP, defined since last release, triggered by larger and more volatile power flows between generation developing north of Paris and Paris area.		
18	18.48	Gaudière (FR)	Rueyres (FR)	Reconductoring with ACCS limiting section (10 km) of existing single circuit 400 kV OHL.	>1,000 MW			Provence area							under construction	end 2012	Progresses as planned.		Larger and more volatile north – south power flows in southwestern France, triggered by the development of local RES generation but also influenced by transits flows with neighboring countries.
	18.A19	tbd (FR)	tbd (FR)	Restructuration of whole EHV grid in Massif Central area.											under consideration	long term	New investment in TYNDP, defined since last release, triggered by larger and more volatile power flows in Southwest France.		
	18.20.A20	(Provence) (FR)	(Midi) (FR)	New subsea HVDC link between Marseille area and Languedoc.											design & permitting	2018	New investment in TYNDP, defined since last release, triggered by larger and more volatile power flows in Southwest France.		

Table of projects - Regional Group Continental Central South

Project identification					Project assessment														
Project number	Investment number	Substation 1	Substation 2	Brief technical description	Grid transfer capacity increase	Socio-economic welfare	RES integration	Improved security of supply	Losses variation	CO_2 mitigation	Technical resilience	Flexibility	Social and environmental impact	Project costs	Present status	Expected date of commissioning	Evolution compared to the TYNDP 2010 situation	Investment comment	Project comment
19	19.51	Boutre (FR)	La Bocca (FR)	PACA "Filet de sécurité" project: 3 new AC 220 kV underground cables – Boutre – Trans (65 km), – Biançon – Fréjus (26 km) and – Biançon – La Bocca (17 km). Installation of reactive power compensation devices in 220 kV Boutre and Trans substations.	500 MW			French riviera							design & permitting	2015	Progresses as planned.		Security of supply of the French Riviera.
20	20.53	Coulange (FR)	Le Chaffard (FR)	Reconductoring (with ACCS / ACCR) of two existing double circuit 400 kV OHL (Coulange – Pivoz-Cordier – Le Chaffard and Coulange – Beaumont-Monteux – Le Chaffard). Total length of both lines: 275 km	2,400 MW			Southeast France							under construction	2016	Progresses as planned.	Construction over 4 years because the works are only possible during limited periods every years on this strategic corridor.	The project aims at ensuring the reliable grid operation to cope with new generation development along the Rhone Valley and more volatile power flows between the Alps and southwestern France.
	20. 18, A20																	The investment contributes both to project 18 and project 20. For the technical description see project 18.	
21	21.54	Cornier (FR)	Piossasco (IT)	Replacement of conductors (by ACCS) on Albertville (FR) – Montagny (FR) – Cornier (FR) and Albertville (FR) – La Coche (FR) – La Praz (FR) – Villarodin (FR) – Venaus (IT) – Piossasco (IT) single circuit 400 kV OHLs. In addition, change of conductors and operation at 400 kV of an existing single circuit OHL between Grande Ile and Albertville currently operated at lower voltage, and associated works in Albertville 400 kV substation. Total length of lines: 257 km	FR – IT 1,800 MW (600 MW in the MT)										under construction	2012 – 2013	Mainly progresses as planned although the works on existing lines take slightly longer than initially thought.		Planned France – Italy interconnection development
	21.55	Grande Ile (FR)	Piossasco (IT)	"Savoie – Piémont" Project: New 190 km HVDC (VSC) interconnection FR – IT via underground cable and converter stations at both ends (two poles, each of them with 600 MW capacity). The cables will be laid in the security gallery of the Frejus motorway tunnel and possibly also along the existing motorways' right-of-way.											design & permitting	2017 – 2018	Progresses as planned.		
	21.81	Trino (IT)	Lacchiarella (IT)	A new 380 kV double circuit OHL between the existing 380 kV substations of Trino and Lacchiarella in Northwest Italy area. Total line length: 95 km Voltage upgrade of the existing Magenta 220 / 132 kV substation up to 380 kV.											under construction	2013	Authorization process ended, construction phase on going.		
	21.84	Casanova (IT)	Vignole (IT)	Voltage upgrade of the existing 100 km Casanova – Vignole 220 kV OHL to 400 kV and new 400/220/150 kV substation in Asti area.											design & permitting	long term	Delays due to authorization process.		
	21.101	Turin (IT)		Restructuring of the 220 kV network in the urban area of Turin. Some new 220 kV cables, some new 220 / 132 kV substations and some reinforcements of existing assets are planned. Total length: 63 km											design & permitting	long term	Progresses as planned.		
22	22.57	under consideration (FR)	under consideration (CH)	Reinforcement of the interconnection in the area of Geneva's lake.	FR – CH 1,000 MW CH – FR <1,500 MW										under consideration	long term	Progresses as planned. Several technical options (route, technologies) have been designed and are being investigated.	The very uncertain environment, regarding commissioning and decommissioning of generation in particular makes the assessment complex.	France – Switzerland interconnection development under consideration.
23	23.60	under consideration (FR)	under consideration (BE)	To be determined.	1,800 – 3,000 MW			Lille, Ruien area							under consideration	2018 – 2020	Project entered a feasibility study phase.		France-Belgium interconnection development: internal French grid reinforcements, that are prerequisite to maintain the present NTC and further interconnection development under consideration. This project enhances security of supply in Belgium and allows intra and inter countries RES integration.
	23.A21	Avelin (FR)	Mastaing (FR)	Operation at 400 kV of existing line currently operated at 220 kV.											design & permitting	2017	New investment in the TYNDP.	Upgrade of all grid assets in northern France at the same standard	
	23.A22	Avelin (FR)	Gavrelle (FR)	Substitution of a new double circuit 400 kV OHL to an existing 400 kV single circuit OHL											design & permitting	2017	New investment in the TYNDP.		
25	25.62	under consideration (FR)	under consideration (GB)	IFA2: New subsea HVDC link between the UK and France. Capacity is still to be determined. (Possibly 1000 MW).	1,000 MW										under consideration	2020	Further investigations during the feasibility phase have led to reassess the expected commissioning date for "IFA2".		France – UK interconnection development under consideration.

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Project number	Investment number	Substation 1	Substation 2	Brief technical description	Grid transfer capacity increase	Socio-economic welfare	RES integration	Improved security of supply	Losses variation	CO_2 mitigation	Technical resilience	Flexibility	Social and environmental impact	Project costs	Present status	Expected date of commissioning	Evolution compared to the TYNDP 2010 situation	Investment comment	Project comment
26	26.63	Lienz (AT)	Veneto region (IT)	The project foresees the reconstruction of the existing 220 kV interconnection line as 380 kV line on an optimized route to minimize the environmental impact. Total length should be in the range of 100 – 150 km.	750 MW										planned	long term	Progresses as planned.		Reinforcement of the interconnection between Italy and Austria. Also the support the interaction between the RES in mainly Italy with the pump storage in the Austrian Alps.
	26.47.220	Lienz (AT)		Erection of a new 220/220 kV PST in the substation Lienz (AT).											under construction	2012	Project is in erection and expected to be commissioned 2012 according to the schedule.	The investment contributes also to project 47.	
	26.47.216																	The investment contributes both to project 26 and project 47. For the technical description see project 47.	
	26.64	Bressanone (IT)	new substation near Innsbruck (AT)	New double circuit 400 kV interconnection through the pilot tunnel of the planned Brenner Base Tunnel. Total line length: 65 km.											under consideration	>2022	Progresses as planned.		
	26.66	Prati di Vizze (IT)	Steinach (AT)	Upgrade of the existing 44 km Prati di Vizze (IT) – Steinach (AT) single circuit 110/132 kV OHL, currently operated at medium voltage and installing a 110/132 kV PST.											design & permitting	mid term	Investment delayed with 2 years due to the permitting process.		
	26.83	Volpago (IT)	North Venezia (IT)	Realization of a new 380 kV line between the existing substation of North Venezia and the future 380 kV substation of Volpago, connected in and out to the 380 kV "Sandrigo – Cordignano". Total line length: 31 km											design & permitting	2015	Delays due to authorization process.		
	26.93	Dolo (IT)	Camin (IT)	New 15 km double circuit 400 kV OHL between existing Dolo and Camin 400 kV substations, to be built in parallel with the existing line.											under construction	2014	Authorization process ended, construction phase ongoing.		
	26.97	Polpet (IT)		Voltage upgrade of the existing Polpet 150 kV / medium voltage substation up to 220 kV, complying with 400 kV standards. The substation will be connected by two shorts links to the existing Soverzene – Lienz 220 kV line.											design & permitting	2015	Authorization process started, project phase ongoing.		
	26.47.218	Obersielach (AT)	Lienz (AT)	New 190 km 380 kV OHL connecting the substations Lienz (AT) and Obersielach (AT) to close the Austrian 380 kV ring in the southern grid area. Line length: 190 km											under consideration	long term	Progresses as planned.	The investment contributes also to project 47.	
	26.A102	new interconnection between Italy and Austria		New possible interconnection line between Italy and Austria.											under consideration	long term	This investment replaces investment n° 65 mentioned on TYNDP 2010. The previous investment evolved so much that it is substituted by a new project. Feasibility studies ongoing including internal reinforcements.		
27	27.68	Okroglo (SI)	Udine (IT)	New 120 km double circuit 400 kV OHL with installation of a PST in Okroglo. The thermal rating will be 1,870 MVA per circuit.	>1,800 MW										planned	long term	Progresses as planned.		This project increases the capacity between Slovenia – Italy and Slovenia – Hungary. Project will remove congestion and strengthen connection on north-south and east-west axis.
	27.92	West Udine (IT)	Redipuglia (IT)	New 40 km double circuit 400 kV OHL between the existing substations of West Udine and Redipuglia, providing in and out connection to the future 400 kV substation of South Udine.											design & permitting	2015	The investment is delayed due to longer than expected authorization procedures.		
	27.A96	new interconnection between Italy and Slovenia		New interconnection between Italy and Slovenia.											under consideration	long term	Feasibility studies ongoing including the internal reinforcements.	Need for strengthening the connection between Slovenia and Italy and increasing of power exchange capability.	
	27.223	Cirkovce (SI)	Heviz (HU) Zerjavenec (HR)	The existing substation of Cirkovce (SI) will be connected to one circuit of the existing Heviz (HU) – Zerjavenec (HR) double circuit 400 kV OHL by erecting a new 80 km double circuit 400 kV OHL in Slovenia. The project will result in two new cross-border circuits: Heviz (HU) – Cirkovce (SI) and Cirkovce (SI) – Žerjavenec (HR).											design & permitting	2016	Presently in the authorization process. This investment was delayed due to permitting process.		

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Project number	Investment number	Substation 1	Substation 2	Brief technical description	Grid transfer capacity increase	Socio-economic welfare	RES integration	Improved security of supply	Losses variation	CO_2 mitigation	Technical resilience	Flexibility	Social and environ-mental impact	Project costs	Present status	Expected date of commissioning	Evolution compared to the TYNDP 2010 situation	Investment comment	Project comment
Project identification					Project assessment														
	27.224	Krsko (SI)	Bericevo (SI)	New 400 kV double circuit OHL. This project will strengthen connection between East and Central part of Slovenia and connect an internal loop. Line length: 80 km	>1,800 MW										under construction	2015	Authorization process ended, construction phase is on going. This investment was delayed due to permitting process.		This project increases the capacity between Slovenia – Italy and Slovenia – Hungary. Project will remove congestion and strenghten connection on north-south and east-west axis.
	27.225	Divaca (SI)	Cirkovce (SI)	Upgrading 220 kV lines to 400 kV in corridor Divaca – Klece – Bericevo – Podlog – Cirkovce. Line length: 193 km											planned	long term	Progresses as planned.		
	27.A105	Lika(HR)	Brinje (HR)	New 55 km single circuit 400 kV OHL replacing aging 220 kV overhead line.											planned	2020	Strengthening of the 400 kV corridor across the Adriatic coast in Croatia in LT period and removal of regional congestion at north-south axis , also to accommodate power transfers from Croatia and Bosnia & Herzegovina to Italy through new IT – ME DC link (Investment 70).		
	27.A106	Lika (HR)	Velebit (HR)	New 60 km single circuit 400 kV OHL replacing aging 220 kV overhead line.											planned	2020			
	27.A107	Lika (HR)		New 400/110 kV substation, 2 × 300 MVA.											planned	2017			
	27.A108	Brinje (HR)		New 400/220 kV substation, 1 × 400 MVA.											planned	2020			
	27.229	Plomin (HR)	Melina (HR)	New 90 km double circuit OHL, with two connecting substations and transformer 400/220 kV, 400 MVA.											design & permitting	>2016	Project moved to long term, due to postponed commissioning date of thermal power plant Plomin.		
	27.227	Banja Luka (BA)	Lika (HR)	New 400 kV interconnection line between BA and HR.											under consideration	2020	End points of OHL and commissioning date defined after bilateral HR – BA agreement.		
28	28.70	Villanova (IT)	Lastva (ME)	New 1,000 MW HVDC interconnection line between Italy and Montenegro via 375 km 500 kV DC subsea cable and converter stations at both ending points.	1,000 MW										under construction	2015	Authorization process ended, construction phase ongoing. The substations on the ME side has been changed.		It contributes significantly to the increase of GTC between the West Balkans and IT such contributing to market integration; complements the ME – IT cable.
	28.86	Foggia (IT)	Villanova (IT)	New 178 km double circuit 400 kV OHL between existing Foggia and Villanova 400 kV substations, also connected in and out to the Larino and Gissi substations. A PST will be installed on the new 400 kV line.											design & permitting	2015	Progresses as planned.		
	28.89	Fano (IT)	Teramo (IT)	New 200 km single circuit 400 kV OHL between the existing 400 kV substations of Fano and Teramo, providing the connection in and out to the future substation to be built in Macerata area.											design & permitting	long term	The investment is delayed due to longer than expected authorization procedures.		
	28.232	Visegrad (BA)	Pljevlja (ME)	New 70 km single circuit 400 kV OHL between Visegrad and Pljevlja.											planned	2015	Feasibility study for 400 kV interconnections RS – ME – BA proposed under Infrastructure Projects Facility for western Balkans.		
	28.233a	Lastva (ME)		A new substation will be connected to the existing line 400 kV Podgorica 2 (ME) – Trebinje(BA), with two transformers 2 × 300 MVA 400/110 kV, and convertor station for the DC cable Lastva (Tivat) – Villanova (see 70).											design & permitting	2015	Feasibility study covering the aspects of route planning, substation location, environmental and social issues and equipment selection is due to end in second half of 2011.		
	28.233b	Lastva (ME)	Pljevlja (ME)	New 160 km double circuit 400 kV OHL existing substation Pljevlja and new substation Tivat.											design & permitting	2016	Feasibility study covering the aspects of route planning, substation location, environmental and social issues and equipment selection is due to end in second half of 2011.		
	28.A109	Bajina Basta (RS)	Visegrad (BA)	New 400 kV interconnection OHL between RS and BA, and reconstruction of existing two OHL 220 kV between BA and Serbia.											planned	>2016	New investment in TYNDP.	New 400 kV overhead line between RS and BA. It will eliminate constraints in the region for electric energy transits and exchange.	
	28.A110	Bajina Basta (RS)	TPP Obrenovac (RS)	New double circuit 400 kV OHL between new substation Bajina Basta (see infra), and substation Obrenovac.											design & permitting	>2016	New investment in TYNDP.	Obrenovac is the “strongest” 400 kV node in Serbia, thus providing significant upgrade for evacuation and energy transfer from north to south, and further down in Montenegro, through the new line between Bajina Basta and Pljevlja (ME).	
	28.A111	Bajina Basta (RS)	Pljevlja (ME)	New 86 km single circuit 400 kV OHL connecting existing substation Pljevlja (ME) and substation Bajina Basta (RS).											planned	>2016	New investment in TYNDP.		
	28.A112	Bajina Basta (RS)		New 400/110 kV substation in Bajina Basta, upgrading an existing 220/110 kV substation.											planned	>2016	New investment in TYNDP.		

					Project assessment														
Project number	**Investment number**	**Substation 1**	**Substation 2**	**Brief technical description**	**Grid transfer capacity increase**	**Socio-economic welfare**	**RES integration**	**Improved security of supply**	**Losses variation**	**CO_2 mitigation**	**Technical resilience**	**Flexibility**	**Social and environmental impact**	**Project costs**	**Present status**	**Expected date of commissioning**	**Evolution compared to the TYNDP 2010 situation**	**Investment comment**	**Project comment**
	28.A113	Bistrica (RS)		New 220/110 kV substation.	1,000 MW										design & permitting	2015	New investment in TYNDP.	After a topology change in the area, the investment will eliminate firm connection in "Vardiste" (secure and stable operation in Serbian network and systems of Bosnia & Herzegovina and Montenegro), to eliminate constraints in the region for electric energy transits and exchange.	It contributes significantly to the increase of GTC between the West Balkans and IT such contributing to market integration; complements the ME – IT cable.
	28.A114	Konjsko(HR)	Velebit (HR)	New 100 km single circuit 400 kV OHL replacing ageing 220 kV overhead line.											planned	2020	Strengthening of the 400 kV corridor across the Adriatic coast in Croatia in LT period and removal of regional congestion at north-south axis, also to accommodate power transfers from Croatia and Bosnia & Herzegovina to Italy through new IT – ME DC link (Investment 70).		
	28.231	Konjsko (HR)		Installation of a 150 MVAr reactive power device.											design & permitting	2014	Investment postponed 1 year due to permitting process.		
	28.A115	Plat (HR)		New 220/110 kV substation.											under construction	2013	New investment in TYNDP, contributing to mesh the network surrounding HVDC link IT – ME and to increase the reliability of the EHV system.		
	28.228	Trebinhe (BA)	Plat (HR)	Re-establishment of two previously existing 220 kV single circuit interconnection Trebinje (BA) – Plat (HR). Total length: 10 km											planned	2014	Progresses as planned.		
29	29.73	El Aouaria (TU)	Partanna (IT)	New 350 km 1000 MW HVDC line between Tunisia and Italy via Sicily with 400 kV DC subsea cable and converters stations at both ends.	1,500 MW										design & permitting	long term	The investment is delayed due to longer than expected authorization procedures.	This project will be realized in 2 steps. In the previous TYNDP just the first part of the investment was mentioned (500 MW).	Interconnection between Italy and North Africa. Other interconnection projects between North Africa and Italy are still under investigation and under study.
	29.76	Partanna (IT)	Ciminna (IT)	New 65 km single circuit 400 kV OHL in Sicily between existing Partanna and Ciminna substations.											planned	long term	Progresses as planned.		
	29.A97	unknown (IT)	unknown (AL)	New interconnection between Italy and Algeria – new DC submarine cable.											under consideration	long term	New investment in TYNDP.	Need for a new interconnection between Algeria and Italy and increasing of power exchange capability with North Africa frontier. Feasibility study ongoing.	
30	30.74	Chiaramonte Gulfi (IT)	Sorgente (IT)	Realization of 380 kV ring grid, trough the construction of 3 new 380 kV lines: Chiaramonte Gulfi – Ciminna, Sorgente – Ciminna and Paternò – Priolo. It will be realized a new 380/150 kV substation in Caltanissetta area and the voltage upgrade of the existing Ciminna substation up to 380 kV. Total line length: 365 km New 380/150 kV substation in Sorgente area will be temporaly connected in and out to the existing 400 kV line Paterno – Sorgente and to the local 220 kV and 150 kV network.	1,000 MW			Palermo, Catania, Agrigento and Messina area							planned	2016 / long term	Feasibility studies carried out have led to adapt the schedule.		Sicilian 400 kV transmission ring.
	30.75	Sorgente (IT)	Rizziconi (IT)	New 90 km double circuit 400 kV line, partly via subsea cable and partly via OHL. This line is part of a larger project that foresees the creation of the future 400 kV ring grid of Sicily.											under construction	2014	Delays on construction phase.		
	30.77	Partinico (IT)	Fulgatore (IT)	New 45 km single circuit 400 kV OHL between Partinico and Fulgatore in western Sicily.											planned	2016	Feasibility studies carried out have led to adapt the schedule.		
	30.87	Feroleto (IT)	Maida (IT)	New 400 kV OHL across Calabria between the existing substation of Feroleto and the future substation of Maida, while restructuring the existing grid in North Calabria.											design & permitting	mid term	Delays due to authorization process.		
	30.A98	Mineo (IT)		New 380/150 kV substation in Mineo area connected in and out to the existing 400 kV line Chiaramonte Gulfi – Paterno and to the local HV network.											planned	long term	New investment in TYNDP.	Need to overcome the expected congestions on the central-east HV network of Sicily affected by the flows of consistent production from renewable plants.	

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31	31.85	Pavia area (IT)	Piacenza area (IT)	New 45 km double circuit 400 kV OHL between 2 substations in the Pavia area and Piacenza.	>1,000 MW										planned	long term	Initial design partially changed, with new reinforcements and rearrangements activities on the neighboring areas resulting from further studies.		Increase interconnection capability between IT and CH.
	31.95	Mese (IT)		Voltage upgrade of the existing 220/132 kV Mese substation up to 400 kV.											design & permitting	2014	Delays due to authorization process.		
	31.99	Avise (IT)	Chatillon (IT)	Voltage upgrade of the existing 40 km Avise – Villeneuve – Chatillon single circuit 220 kV OHL up to 400 kV.											design & permitting	2014	Delays due to authorization process.		
	31.100	Milan (IT)		Restructuring of the 220 kV network in the urban area of Milan. Some new 220 kV cables (33 km), a new 220 kV substation (Musocco) and some reinforcements of existing assets (35 km) are planned.											design & permitting	mid term	The cables in the Milan area are in operation, the appropriate substations are under construction and the reinforcements are under design and permitting.		
	31.103	Brescia (IT)		New 400/132 kV substation in southeast area of Brescia, connected in and out to the existing Flero – Nave 400 kV OHL, while restructuring the 132 kV network.											planned	mid term	Progresses as planned.		
	31.112	Tirano (IT)	Verderio(IT)	New 140 km single circuit 400 kV OHL between Tirano and Verderio substations connecting also the new 400 kV substation Grosio / Piateda.											planned	long term	Progresses as planned.		
	31.124	Mettlen (CH)	Airolo (CH)	Upgrade of existing 225 kV OHL into 400 kV. Line length: 90 km											under consideration	2020	Progresses as planned.		
	31.A101	new inter-connections between Italy and Switzerland		Up to 4 interconnection projects are under discussion, one or two probably will be implemented.											under consideration	long term	This investment replaces investment n° 120 mentioned on TYNDP 2010. The previous investment evolved so much that it is substituted by a new project. Feasibility studies ongoing including the internal reinforcements.		
32	32.88	Montecorvino (IT)	Benevento (IT)	New 70 km double circuit 400 kV OHL between the existing 400 kV substations of Montecorvino and Benevento II, providing in and out connection to the future substation to be build in Avellino North area, which will be also connected to the existing Matera – S. Sofia 400 kV line.	1,900 MW			Naple urban area, Sorrento Penninsul, minor Campania islands and Tirrenic South coast Italy							design & permitting	mid term	The Avelino substation is under construction, the line is in delay due to authorization process.		Reinforcement between south and central-south of Italy to accommodate increasing market flows.
	32.91	Foggia (IT)	Benevento II (IT)	Upgrade of the existing 85 km Foggia – Benevento II 400 kV OHL and installation of a PST on this line.											under construction	2013 – 2014	Authorization process ended, construction phase ongoing.		
	32.96	Deliceto (IT)	Bisaccia (IT)	New 30 km single circuit 400 kV OHL between the future substations of Deliceto and Bisaccia, in the Candela area.											design & permitting	mid term	The 2 substations are in operation from 2011. The connecting line is still in design and permitting. This delay is due to authorization process.		
	32.96a	several new 380 kV substations in Central/South of Italy for RES (IT)		It will be realized few new 380/150 kV substations. The new substations will be connected to the wind power plants in order to avoid the congestions on the 150 kV network and to dispatch the renewable energy produced.											under construction	mid term	The realization of the substations is delayed. These investments are highly sensitive to the construction of the wind / solar plants that are meant to connect.		
	32.102	Naples (IT)		Restructuring of the 220 kV network in the urban area of Naples. Some new 220 kV cables and some reinforcements of existing assets are planned. Total length: 36 km											design & permitting	long term	Progresses as planned.		
	32.110a	Aliano (IT)	Montecorvino (IT)	New connection OHL 400 kV between north Basilicata and Campania region.											planned	long term	Progresses as planned.		
	32.A99	restructuring of North Calabria (IT)		New 400 kV OHL between the existing substations of Laino and Altomonte in Calabria and a new 380/150 kV substation in Aliano connected in and out to the existing 400 kV line Matera – Laino and to the local HV network. Related to this project will be acted a great restructuring of the local HV network, downgrading the existing 220 kV lines to 150 kV level and the demolition of great part of existing 150 kV lines inside the Pollino Park.											partly under construction, design & permitting	2012 / mid term	New investment in TYNDP (initial design partially changed, evolution including new reinforcements and rearrangements activities on the neighbouring areas resulting from further studies).		

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33	33.90	Calenzano (IT)	Colunga (IT)	Voltage upgrade of the existing 80 km Calenzano – Colunga 220 kV OHL to 400 kV, providing in and out connection to the existing 220/150 kV substation of S. Benedetto del Querceto (which already complies with 400 kV standards).	500 MW			central part of Italy							design & permitting	mid term	Delays due to authorization process.		Reinforcement between northern and central part of Italy to accommodate increasing market flows.
	33.94	Mantova area (IT)	Modena area (IT)	New 35 km 400 kV OHL between the 2 substations in Modena and Mantova area.											planned	long term	During the preliminary consultation process the substations have became uncertain.		
	33.104	Rome (IT)		Restructuring of the network in the Rome area. The work consists of – a new 380/150 kV substation in southwest area of Rome, connected in and out to the existing 380 kV line Rome West – Rome South, – a voltage upgrade of the existing Flaminia substation up to 380 kV to be connected in and out to the foreseen 380 kV lineRome West – Rome North and – a restructuring of the 150 kV network.											design & permitting	2013 / long term	Progresses as planned.		
	33.109	North Bologna (IT)		New 400/132 kV substation in North Bologna area connected in and out to the existing Sermide – Martignone 400 kV line.											design & permitting	mid term	Delays due to authorization process.		
	33.111	Lucca (IT)		New 380/132 kV substation in Lucca area connected in and out to the existing 380 kV line La Spezia – Acciaiolo.											planned	long term	Progresses as planned.		
	33.113	Monte S. Savino (IT)		New 400/220/132 kV substation in Monte S. Savino area connected to the existing S. Barbara 400 kV substation by upgrading an existing 220 kV line.											design & permitting	2015 / long term	Delays due to authorization process.		
34	34.A100	Codrongianos (IT)	Suvereto (IT)	Repowering of existing HVDC interconnection between Sardinia, Corse and mainland Italy via 220 kV DC subsea cable (358 km). The first connection is in operation since 1970. Total capacity of the bipolar link: 500 MW	500 MW										planned	long term	New investment in TYNDP.		Reinforcement between Sardinia, Corse and mainland Italy.

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35	35.137	Vitkov (CZ)	Mechlenreuth (DE)	New 400 kV single circuit tie-line between new (CZ) substation and existing (DE) substation. Length: 70 km	500 MW										under consideration	long term	Progresses as planned.		This project is required to enable power flows between west and east, enhance the transfer capability between CZ and DE and supports the future generation evacuation.
	35.138	tbd (CZ)	tbd (DE) – southeastern part of 50Hertz Transmission control area (Röhrsdorf)	Possible increase of interconnection capacity between CEPS and 50Hertz Transmission is under consideration: – Either a new 400 kV tie-line (OHL on new route) or – a reinforcement of the existing 400 kV tie-line Hradec (CEPS) – Röhrsdorf (50Hertz Transmission).											under consideration	long term	Progresses as planned.		
	35.306	Vitkov (CZ)		New 400/110 kV substation equipped with transformers 2 × 350 MVA.											planned	2017/2018	It is closely dependent on construction of line investment n° 308.		
	35.307	Vernerov (CZ)		New 400/110 kV substation equipped with transformers 2 × 350 MVA.											planned	2013/2016	Commissioning date has been divided into two phases: – 1st phase – temporary connection of wind plant 180 MW – 2nd phase – finalization of substation construction including connection to the distribution grid (consumption)		
	35.308	Vernerov (CZ)	Vitkov (CZ)	New 400 kV double circuit OHL, 1,385 MVA.											planned	long term	Permitting procedure complications are foreseen (line crosses protected area).		
	35.309	Vitkov (CZ)	Prestice (CZ)	New 400 kV double circuit OHL, 1,385 MVA.											under consideration	long term	Permitting procedure complications are foreseen (line crosses protected area).		
	35.311	Kocin (CZ)		Upgrade of the existing substation 400/110 kV; upgrade transformers 2 × 350 MVA.											design & permitting	long term	Schedule harmonization with market participants.		
	35.312	Mirovka (CZ)		Upgrade of the existing substation 400/110 kV with two transformers 2 × 350 MVA.											planned	long term	Schedule harmonization decided with market participants.		
	35.313	Kocin (CZ)	Mirovka (CZ)	Connection of 2 existing 400 kV substations with double circuit OHL having 120.5 km length and a capacity of 2 × 1,385 MVA.											planned	long term	Schedule harmonization decided with market participants.		
	35.314	Mirovka (CZ)	V413 (CZ)	New double circuit OHL with a capacity of 2 × 1,385 MVA and 26.5 km length.											planned	long term	Schedule harmonization decided with market participants.		
	35.315	Kocin (CZ)	Prestice (CZ)	Adding second circuit to existing single circuit line OHL upgrade in length of 115.8 km. Target capacity: 2 × 1,385 MVA											planned	long term	Schedule harmonization decided with market participants.		
	35.316	Mirovka (CZ)	Cebin (CZ)	Adding second circuit to existing single circuit line (88.5 km, 2 × 1,385 MVA).											under consideration	long term	Schedule harmonization decided with market participants.		
	35.317	Hradec (CZ)	Reporyje (CZ)	Upgrade of existing 400 kV single circuit OHL with length of 116.9 km. Target capacity: 1,385 MVA											commissioned	commissioned	Commissioned.		
36	36.141	Ishøj / Bjæverskov (DK)	Bentwisch / Güstrow (DE)	The Kriegers Flak Combined Grid Solution is the new offshore multiterminal connection between Denmark and Germany used for both grid connection of offshore wind farms Kriegers Flak and interconnection. Technical features still have to be determined.	600 MW										planned	long term	Permission for Danish wind farm KF 3 is in pending. Connection to Sweden is withdrawn at present, but can come on a later stage.		The Kriegers Flak Combined Grid Solution is the new offshore multiterminal connection between Denmark and Germany used for both grid connection of offshore wind farms Kriegers Flak and interconnection.

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37	37.142	Tonstad (NO)	Wilster (DE)	Nord.Link / NorGer: a new HVDC connection between southern Norway and northern Germany. Estimated subsea cable length: 520 – 600 km Capacity: 1,000 MW	up to 1,400 MW										design & permitting	2018/2021	Revised capacity and progress postponed, due to more demanding system operations and time needed to obtain necessary government permits for reinforcing the national grid.		The purpose is: Market integration with the continent and facilitating RES integration in southern and western Norway. Will also improve security of supply in southern Norway.
	37.408	Kristiansand, Feda (NO)		Reactive compensation due to HVDC links NorNed and Skagerak 4. Reactive power devices in 400 kV substations.											design & permitting	2012/2014	Feda is in the planning and permitting stage. Kristiansand is under construction(commissioned expected as planned 2012)		
	37.406	(southern part of Norway) (NO)		Voltage uprating of existing 300 kV line Sauda / Saurdal – Lyse – Tonstad – Feda – 1 & 2, Feda – Kristiansand; Sauda-Samnanger in long term. Voltage upgrading of existing single circuit 400 kV OHL Tonstad – Solhom – Arendal. Reactive power devices in 400 kV substations.											design & permitting	2016 (2013 – 2018)	Revised progress. Due to more demanding system operations and time needed to obtain necessary government permits for reinforcing the national grid. The investment now embed former TYNDP 2010's investments 407 and 409 and the technical description has been updated accordingly.		
39	39.428	Kassø (DK)	Tjele (DK)	Rebuilding of a 400 kV OHL of 173 km from a single circuit to a double circuit . This increases the transfer capacity with approx. 1,000 MW.	1,000 – 1,550 MW										design & permitting	2012/2014	Progresses as planned.		Step 3 in the Danish-German agreement to upgrade the Jutland – DE transfer capacity.
	39.144	Audorf (DE)	Kassö (DK)	Step 3 in the Danish-German agreement to upgrade the Jutland – DE transfer capacity. It consists of partially an upgrade of existing 400 kV line and partially a new 400 kV route in Denmark. In Germany new 400 kV line mainly in the trace of a existing 220 kV line. The total length of this OHL is 114 km.											under consideration	2017	Progresses as planned.		
40	40.446	Bascharage (LU)	Aubange (BE)	As a first step(2016) a PST could be placed in the existing 225 kV line between LU and BE. In a second stage, two solutions are currently investigated (4 TSOs – Elia, Amprion, CREOS, RTE are involved). Solutions 1 would be a new interconnection between CREOS grid in LU and ELIA grid in BE via a 16 km double circuit 225 kV underground cable with a capacity of 1,000 MVA. Solution 2 would be the interconnection between CREOS grid in LU and ELIA grid in BE via a new 380 kV double circuit. The current study will investigate the impact of this new interconnection on other boundaries (impact of loop flow) and on internal grids . The potential reinforcements of the other boundaries and the internal grids will also be taken into account in the evaluation.	380 – 900 MW			Luxemburg area							under consideration	2016 / 2020	The comissioning date and status changed as the study to determine the best investment is still ongoing.		Increase the transfer capability between LU,DE, BE and FR.
	40.A29	Bascharage (LU)	tbd (BE, DE and / or FR)	New interconnection with neighbor(s) either 220 kV or 400 kV											under consideration	2020	New investment in TYNDP.	An ongoing network study (4 TSOs involved) investigates the robustness of the planned 220 kV connection between LU and BE and the potentially need for an upgrading to a 400 kV interconnector in the south.	Increase the transfer capability between LU,DE, BE and FR.
	40.447	Heisdorf (LU)	Berchem (LU)	New 20 km double circuit mixed (underground cable + OHL) 225 kV project with 1,000 MVA capacity including substations for infeed in lower voltage levels.											design & permitting	2012 / 2017	Progresses as planned.		
	40.A30	Bascharage (LU)	Niederstedem (DE) or tbd (DE)	Upgrading and new construction of an interconnector to DE, in conjunction with the interconnector in the south of LU. Partial upgrading of existing 220 kV lines and partial new construction of lines. With power transformer station in LU.											under consideration	2020	New investment in TYNDP.		

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41	41.149	Dollern (DE)	Stade (DE)	New 400 kV double circuit OHL Dollern – Stade including new 400 kV switchgear in Stade. Length: 14 km	>3,000 MW										design & permitting	mid term	This investment depends on the commissioning of a conventional power plant in the area. The additional reason for delay is the long permitting procedure associated with this investment.		Evacuation of the new conventional generation in the 50Hertz and TenneT area.
	41.150	Conneforde (DE)	Maade (DE)	New 400 kV double circuit (underground cable + OHL) Conneforde – Maade including new 400 kV switchgear Maade. Length: 37 km											design & permitting	long term	Progresses as planned.		
	41.A74	north of Control Area 50Hertz Transmission (DE)		Construction of new substations / lines for integration of newly build power plants in northern part of 50Hertz Transmission control area.											planned	long term	New investment in TYNDP, because of additionnal need for generation evacuation. Some of the investments are to be commissioned by the mid term and the some by long term.	Support of conventional generation integration in northeastern Germany, maintaining of security of supply and support of market development.	
42	42.152	Dörpen / West (DE)		New substation for connection of offshore wind farms.	>8,000 MW										under construction	mid term	Progresses as planned.	Commercially sensitive information about this new wind farm connection cannot be displayed in the TYNDP report.	Integration of the offshore wind parks and the onshore grid reinforcements in the northern DE.
	42.159	Cluster BorWin1 (DE)	Diele (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 205 km. Line capacity: 400 MW											under construction	mid term	The commission date of this wind farms connection should be in 2012. Energy transportation is however already enable.	Due to nondisclosure agreements it is not possible to give further information about this wind farm connection in TYNDP.	
	42.160	offshore wind park Nordergründe (DE)	Inhausen (DE)	New AC-cable connection with a total length of 35 km.											design & permitting	mid term	Progresses depend on development of the offshore wind farm.		
	42.161	offshore wind park GEOFreE (DE)	Göhl (DE)	New AC-cable connection with a total length of 32 km.											design & permitting	mid term	Progresses depend on development of the offshore wind farm.		
	42.163	Cluster HelWin1 (DE)	Büttel (DE)	New HVDC transmission systm consisting of offshore platform, cable and converters with a total length of 145 km. Line capacity: approx. 690 MW This Project includes also a new substation Büttel and connection of this new substation with the existing OHL Brünsbüttel – Wilster.											under construction	mid term	Progresses with delay.	Due to nondisclosure agreements it is not possible to give further information about this wind farm connection in TYNDP.	
	42.164	Cluster SylWin1 (DE)	Büttel (DE)	New line consisting of underground + subsea cable with a total length of 210 km. Line capacity: approx. 864 MW											under construction	mid term	Progresses as planned.	Due to nondisclosure agreements it is not possible to give further information about this wind farm connection in TYNDP.	
	42.165	Cluster DolWin1 (DE)	Dörpen / West (DE)	New line consisting of underground + subsea cable with a total length of 155 km. Line capacity: 800 MW											under construction	mid term	Progresses as planned.	Due to nondisclosure agreements it is not possible to give further information about this wind farm connection in TYNDP.	
	42.166	offshore wind park Riffgat (DE)	Emden / Borßum(DE)	New AC-cable connection with a total length of 80 km.											under construction	mid term	Progresses as planned.	Due to nondisclosure agreements it is not possible to give further information about this wind farm connection in TYNDP.	
	42.167	Cluster BorWin2 (DE)	Diele (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 205 km. Line capacity: 800 MW											under construction	mid term	Progresses as planned.	Due to nondisclosure agreements it is not possible to give further information about this wind farm connection in TYNDP.	
	42.A82	Cluster DolWin2 (DE)	Dörpen / West (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 160 km. Line capacity: 900 MW											under construction	mid term	New investment in TYNDP, for connection of new offshore wind farms.	Due to nondisclosure agreements it is not possible to give further information about this wind farm connection in TYNDP.	
	42.A83	Cluster DolWin3 (DE)	Dörpen / West (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 160 km. Line capacity: 900 MW											design & permitting	mid term	New investment in TYNDP, for connection of new offshore wind farms.		

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	42.A84	Cluster BorWin3	Dörpen / West (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 180 km. Line capacity: 900 MW	>8,000 MW										design & permitting	mid term	New investment in TYNDP for connection of new offshore wind farms.		Integration of the offshore wind parks and the onshore grid reinforcements in the northern DE.
	42.A85	Cluster HelWin2	Büttel (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 145 km. Line capacity: 690 MW											under construction	mid term	New investment in TYNDP for connection of new offshore wind farms.	Due to nondisclosure aggreements it is not possible to give further information about this wind farm connection in TYNDP	
	42.A86	Cluster BorWin4 (DE)	Emden / Ost (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 185 km. Line capacity: 900 MW											under consideration	long term	New investment in TYNDP for connection of new offshore wind farms.		
	42.A87	Cluster SylWin2 (DE)	Büttel (DE)	New HVDC transmission system consisting of offshore platform, cable and converters with a total length of 210 km. Line capacity: 800 MW											under consideration	long term	New investment in TYNDP for connection of new offshore wind farms.		
	42.211	further connections of more offshore wind farms (DE)		Further connections in the clusters BorWin, DolWin, SylWin and HelWin.											under consideration	long term	Progresses depend on development of the offshore wind farm.		
43	43.A81	Osterath (DE)	Philippsburg (DE)	New HVDC lines from Osterath to Philippsburg to integrate new wind generation especially from north / Baltis Sea towards Central-South Germany for consumption and storage.	10,000 MW			Bavaria and Baden-Württemberg area							under consideration	long term	New investment in TYNDP due to long distance RES integration, voltage stability of the grid and security of supply in the south of Germany.		Combined DC and AC new infrastructure to accommodate the new RES generation, the associated flows from north to south and also to secure the security of supply in South Germany.
	43.A152	Emden (DE)	Osterath (DE)	New HVDC lines from Endem to Osterath to integrate new wind generation especially from north / Baltis Sea towards Central Germany for consumption and storage.											under consideration	long term	New investment in TYNDP due to long distance RES integration, voltage stability of the grid and security of supply in the south of Germany.		
	43.A153	Wehrendorf (DE)	Urberach (DE)	New lines in HVDC technology from the region of Lower Saxony to North Baden-Württemberg to integrate new wind generation especially from North Sea towards Central-South Europe for consumption and storage. The investment is part of the transmission corridor Cloppenburg – North Baden-Württemberg.											under consideration	long term	New investment in TYNDP due to long distance RES integration, voltage stability of the grid and security of supply in the south of Germany.		
	43.A154	Cloppenburg (DE)	Westerkappeln (DE)	New 400 kV double circuit OHL Cloppenburg – Westerkappel (75 km). The investment is part of the transmission corridor Cloppenburg – North Baden-Württemberg.											under consideration	long term	New investment in TYNDP due to increase of RES and changes in conventional power plants in Germany and increase transits.		
	43.A88	Brunsbüttel (DE), Wilster (DE), Kaltenkirchen (DE)	Großgartach (DE), Goldshöfe (DE), Grafenrheinfeld (DE)	New DC lines to integrate new wind generation from northern Germany towards southern Germany and southern Europe for consumption and storage.											under consideration	long term	New investment in TYNDP due to long distance RES integration, voltage stability of the grid and security of supply in the south of Germany.		
	43.A75	Lauchstadt (DE)	Meitingen (DE)	New DC lines to integrate new wind generation from Baltic Sea towards Central / Ssouth Europe for consumption and storage.											under consideration	long term	New investment in TYNDP due to long distance RES integration, voltage stability of the grid and security of supply in the south of Germany. New Investment due to increase of RES and changes in conventionel power plants in Germany and increase transits.		
	43.A89	area of northern Lower Saxony (DE)		New lines for integration of on- and offshore wind generation incl. 380 kV lines Halbemond – Emden, Emden – Conneforde and Conneforde – Cloppenburg. Total length: 160 km											under consideration	long term	New investment in TYNDP due to new wind generation projects.		
	43.A90	area of Schleswig-Holstein (DE)		About 300 km new 380 kV lines and around 24 new transformers for integration of onshore wind in Schleswig-Holstein, incl. lines – Brunsbüttel – Barlt – Heide – Husum – Niebüll – border of Denmark, – Audorf – Kiel – Göhl – Siems – Lübeck – Kaltenkirchen and – Kaltenkirchen – Itzehoe – Brunsbüttel.											under consideration	long term	New investment in TYNDP due to new wind generation projects.	The German west-coast line is planned to be connected to the Danish grid in the 400 kV substation Endrup. The distance from the German / Danish border is approx. 80 km. Bilateral technical / economical investigations are ongoing. Reinforcements in the Danish 400 kV grid are foreseen in order to facilitate the increased power exchange capacity on the Danish-German border.	

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44	44.147	Dollern (DE)	Hamburg / Nord (DE)	New 400 kV double circuit OHL Dollern – Hamburg / Nord including one new 400/230 kV transformer in substation Hamburg / Nord and new 400 kV switchgear Kummerfeld. Length: 43 km	5,000 MW			Bavaria and Baden-Württemberg area							design & permitting	mid term	Delays due to authorization process.		This project helps accomodating the increasing flows coming mainly form RES in NW DE to SW DE and CH.
	44.148	Audorf (DE)	Hamburg / Nord (DE)	New 400 kV double circuit OHL Audorf – Hamburg / Nord including two new 400/230 kV transformers in substation Audorf. Length: 65 km											design & permitting	mid term	This investment was scheduled for 2015. Presently it is foreseen a delay of around 1 year due to permitting process.		
	44.151	Wehrendorf (DE)	Ganderkesee (DE)	New line (length: approx. 95 km), extension of existing and erection of substations, erection of 380/110 kV transformers.											design & permitting	mid term	Delays due to authorization process.		
	44.156	Niederrhein (DE)	Dörpen / West (DE)	New 400 kV double circuit OHL Dörpen – Niederrhein including extension of existing substations. Length: 167 km											design & permitting	mid term	Delays due to authorization process.		
	44.157	Wahle (DE)	Mecklar (DE)	New 400 kV double circuit OHL Wahle – Mecklar including two new substations. Length: 210 km											design & permitting	mid term	Delays due to authorization process.		
	44.90.170	Großgartach (DE)	Hüffenhardt (DE)	New 380 kV OHL. Length: 23 km Included with the project: – 1 new 380 kV substation – 2 transformers											under construction	2012	Progresses as planned.	This investment contributes to both project 90 and 44.	
	44.171	Hüffenhardt (DE)	Neurott (DE)	Upgrade of the line from 220 kV to 380 kV. Length: 11 km Included with the project: 1 new 380 kV substation.											planned	2020	Progresses as planned.		
	44.90.172	Mühlhausen (DE)	Großgartach (DE)	Upgrading line from 220 kV to 380 kV. Length: 45 km											design & permitting	2014	Progresses as planned.	This investment contributes to both project 90 and 44.	
	44.90.173	Hoheneck (DE)	Endersbach (DE)	Upgrading line from 220 kV to 380 kV. Length: 20 km											design & permitting	2014	Progresses as planned.	This investment contributes to both project 90 and 44.	
	44.174	Bruchsal Kändelweg (DE)	Ubstadt (DE)	A new 380 kV OHL. Length: 6 km											design & permitting	2014	Postponed from one year due to permitting procedures.		
	44.90.176	Daxlanden (DE)	Eichstetten (DE)	Upgrade of transmission capacity of existing 380 kV line. Length: 120 km											under consideration	2020	Progresses as planned.	This investment contributes to both project 90 and 44.	
	44.178	Baden-Württemberg, Süden & Nordosten (DE)"		Installation of 2 × 250 MVAr 380 kV capacitance banks.											under construction	2014	One more bank in addition. Two have already been installed. Projects realized earlier because the need for reactive power compensation became urgent.		
	44.179	Rommerskirchen (DE)	Weißenthurm (DE)	New line, extension of existing and erection of substations, erection of 380/110 kV transformers. Total line length: 100 km.											under construction, design & permitting	mid term	Some parts are commissioned but the main elements of the investment are still in design and permitting due to delays in permitting process.		
	44.181	Dauersberg (DE)	Limburg (DE)	New 380 kV double circuit OHL, extension of existing of substations. Total line length: 20 km											under construction, design & permitting	mid term	Some parts are commissioned but the main elements of the investment are still in design and permitting due to delays in permitting process.		
	44.182	Kriftel (DE)	Obererlenbach (DE)	New 400 kV double circuit OHL Kriftel – Obererlebenbach in existing OHL corridor. Length: 11 km											planned	mid term	Some parts are commissioned but the main elements of the investment are still in design and permitting due to delays in permitting process.		
	44.A80	Area of West Germany (DE)		Installation of several 300 MVAr 380 kV capacitance banks, extension of existing substations.											under consideration	long term	New investment in TYNDP, because of additional needs for RES integration (combined with SoS).		
	44.183	Wehrendorf (DE)		Installation of 300 MVAr 380 kV capacitance banks, extension of existing substations.											design & permitting	mid term	Delays due to authorization process.		
	44.184	Bürstadt (DE)		Installation of 2 × 300 MVAr 380 kV capacitance banks, extension of existing substations.											design & permitting	mid term	Delays due to authorization process.		
	44.185	area of Muensterland and Westfalia (DE)		New lines and installation of additional circuits, extension of existing and erection of several 380/110 kV substations. Total length: approx. 110 km											design & permitting	long term	Delays due to authorization process.		
	44.186	Gütersloh (DE)	Bechterdissen (DE)	New lines and installation of additional circuits, extension of existing and erection of 380/110 kV substation. Total line length: 27 km											under construction	mid term	Delays due to authorization process.		
	44.187	area of West-Rhineland (DE)		New lines and installation of additional circuits, extension of existing and erection of several 380/110 kV substations.											under construction	2013	Progresses as planned.		

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	44.188	Kruckel (DE)	Dauersberg (DE)	New lines, extension of existing and erection of several 380/110 kV substations. Total line length: 130 km	5,000 MW			Bavaria and Baden-Württemberg area							planned	long term	Progresses as planned.		This project helps accomodating the increasing flows coming mainly form RES in NW DE to SW DE and CH.
	44.A78	Pkt. Metternich (DE)	Niederstedem (DE)	Construction of new 380 kV double circuit OHLs, decommissioning of existing old 220 kV double circuit OHLs, extension of existing and erection of several 380/110 kV substations. Length: 108 km											planned	long term	New investment in TYNDP.	RES integration / Market integration especially east-west-direction.	
	44.A77	area of South Wuerttemberg (DE)		Construction of new 380 kV double circuit OHLs, decommissioning of existing double circuit OHLs, extension of existing 380 kV-substations. Length: approx. 60 km											planned	long term	New investment in TYNDP.	RES integration combined with pump storage in the alp region (market) / increasing of the NTC DE – CH / AT.	
	44.190	Saar-Pfalz-Region (DE)		New lines, extension of existing and erection of several 380/110 kV substations. Upgrade of an existing line from 220 to 380 kV											planned	long term	Delays due to authorization process.	Security of Supply (Neub. Frltg Fraulaut – Saarwellingen) combined with RES integration.	
	44.A155	Conneforde (DE)	Unterweser (DE)	Upgrade of 230 kV circuit Unterweser – Conneforde to 400 kV. Line length: 32 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.A156	Dollern (DE)	Elsfleht / West (DE)	New 400 kV line in existing OHL corridor Dollern – Elsfleht / West. Length: 100 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.A157	Dollern (DE)	Landesbergen (DE)	New 400 kV line in existing OHL corridor Dollern – Sottrum – Wechold – Landesbergen (130 km).											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.A158	Hamm / Uentrop (DE)	Kruckel (DE)	Extension of existing line to a 400 kV single circuit OHL Hamm / Uentrop – Kruckel. Length: 60 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.A159	Pkt. Blatzheim (DE)	Oberzier (DE)	New 400 kV double circuit OHL Pkt. Blatzheim – Oberzier including extension of existing substations. Length: 16 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.A160	Urberach (DE)	Daxlanden (DE)	New line and extension of existing line to 400 kV double circuit OHL Urberach – Pfungstadt – Weinheim – Daxlanden including extension of existing substations. Length: 219 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.A161	Bürstadt (DE)	Daxlanden (DE)	New line and extension of existing line to 400 kV double circuit OHL Bürstadt – Lambshein – Daxlanden including extension of existing substations. Length: 134 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.A162	Großgartach (DE)	Endersbach (DE)	Extension of existing 400 kV line Großgartach – Endersbach. Lenght: 32 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	44.175	Birkenfeld (DE)	Ötisheim (DE)	A new 380 kV OHL. Length: 11 km											planned	2020	New investment in TYNDP.		
	44.189	Niederrhein (DE)	Utfort (DE)	New 380 kV double circuit OHL Niederrhein – Utfort (24 km).											under consideration	long term	New investment in TYNDP.		
45	45.90.177				5,000 MW			Bavaria and Baden-Württemberg area										The investment contributes both to project 45 and project 90. For the technical description see project 90.	This project helps accomodating the increasing flows coming mainly form RES in NE DE to South DE and to the Alps.
	45.191	Neuenhagen (DE)	Vierraden (DE)	Project of new 380 kV double circuit OHL Neuenhagen – Vierraden – Bertikow with 125 km length as prerequisite for the planned upgrading of the existing 220 kV double circuit interconnection Krajnik (PL) – Vierraden (DE / 50Hertz Transmission).											design & permitting	2013 / 2015	Project in permitting phase, strong local resistance.		

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	45.193	Halle / Saale (DE)	Schweinfurt (DE)	New 380 kV double circuit OHL between the substations Vieselbach – Altenfeld – Redwitz with 215 km length combined with upgrade between Redwitz and Grafenrheinfeld (see project 153). The Section Lauchstedt – Vieselbach has already been commissioned. Support of RES integration in Germany, annual redispatching cost reduction, maintaining of security of supply and support of the market development. The line crosses the former border between East and West Germany and is right downstream in the main load flow direction. The project will help to avoid loop flows through neighboring grids.	5,000 MW			Bavaria and Baden-Württemberg area							design & permitting	mid term	Project partly completed, strong local public resistance. Delay due to permitting process.		This project helps accomodating the increasing flows coming mainly form RES in NE DE to South DE and to the Alps.
	45.197	Neuenhagen (DE)	Wustermark (DE)	Construction of new 380 kV double circuit OHL between the substations Wustermark – Neuenhagen with 75 km length. Support of RES and conventional generation integration, maintaining of security of supply and support of market development.											under construction	mid term	Project partly under construction and partly in permitting phase. Expected date of commissioning was adjusted due to long permitting process and strong local public resistance.		
	45.199	Western Pomerania (DE)	Uckermark North (DE)	Construction of new 380 kV double circuit OHLs in northeastern part of 50Hertz Transmission control area and decommissioning of existing old 220 kV double circuit OHLs, incl. 380 kV line Bertikow – Pasewalk (30 km). Length: 135 km Support of RES and conventional generation integration in North Germany, maintaining of security of supply and support of market development.											planned	2015	Progresses as planned.		
	45.200	Lubmin (DE)	Erfurt area (DE)	380 kV grid enhancement and structural change area Lubmin / Stralsund and area Magdeburg / Wolmirstedt, incl. 380 kV line Güstrow – Wolmirsted (195 km).											planned	long term	Progresses as planned.		
	45.202	area upper Lausitz (DE)	area Gera(DE)	Upgrading existing double circuit 380 kV OHL Bärwalde – Schmölln in the southeastern part of the control area of 50Hertz Transmission. Length: approx. 50 km Support of RES and conventional generation integration in northeastern Germany, maintaining of security of supply and support of market development.											design & permitting	2017	Progresses as planned.		
	45.204	Calbe (DE)		Construction of new 380 kV double circuit OHL between substation Calbe for double connection / loop into an existing line.											planned	mid term / long term	The evolution of this investment depends on the development of the power plant in the area. The date mentioned in the TYNDP 2010 was a typing mistake.		
	45.205	Fördertsedt	area Magdeburg (DE)	Construction of new 380 kV double circuit OHL from the substation Förderstedt with 20 km length for double connection / loop in for Förderstedt. Reinforcement of existing switchgear. Support of RES and conventional generation integration, maintaining of security of supply and support of market development.											planned	2015 / 2020	Progresses as planned.		
	45.206	area Leipzig(DE)	area Chemnitz (DE)	Construction of new double circuit 380 kV OHL in existing corridor Röhrsdorf – Remptendorf (103 km).											under consideration	2020	Progresses as planned.		
	45.207	substations in southwestern part of 50Hertz Transmission control area (DE)		Construction of new 380 kV substation in southern Magdeburg area and restructuring of existing 220 kV equipment. Total length: approx. 50 km											planned	long term	Some of the investments are to be commissioned by the mid term and the some by long term.		
	45.208	lines and substations in southwestern part of 50Hertz Transmission control area (DE)		Construction of new 380 kV double circuit OHL in existing corridor Pulgar – Vieselbach (103 km). Support of RES and conventional generation integration, maintaining of security of supply and support of market development.											planned	2015 / 2020	Progresses as planned.		

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	45.209	substations in 50Hertz Transmission control area (DE)		Extension of existing and erection of new 380 kV substations and several 380 / 110 kV substations, incl. reactive power compensation devices.	5,000 MW			Bavaria and Baden-Württemberg area							design & permitting	mid term	This investment includes several substations in the 50Hertz Transmission control area. Present status varies form design & permitting, planning to under consideration and the date of commissioning varies from short / mid to long term.		This project helps accomodating the increasing flows coming mainly form RES in NE DE to South DE and to the Alps.
	45.A163	Wolmirstedt (DE)	Wahle (DE)	New double circuit OHL 380 kV. Line length: 111 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	45.A164	Vieselbach (DE)	Mecklar (DE)	New double circuit OHL 400 kV in existing OHL corridor (129 km).											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	45.A165	Mecklar (DE)	Grafenrheinfeld (DE)	New double circuit OHL 400 kV (130 km).											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	45.A166	Altenfeld (DE)	Grafenrheinfeld (DE)	New double circuit OHL 400 kV (130 km).											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	45.A169	Grafenrheinfeld (DE)	Grossgartach (DE)	Additional 380 kV circuit on an existing line. Length: 160 km											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	45.A167	Redwitz (DE)	Schwandorf (DE)	New double circuit OHL 400 kV in existing OHL corridor Redwitz – Mechlenreuth – Etzenricht – Schwandorf (185 km).											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	45.A168	Raitersaich (DE)	Isar (DE)	New 400 kV line in existing OHL corridor Raitersaich – Ludersheim – Sittling – Isar (160 km).											under consideration	long term	New investment due to increase of RES, changes in conventional power plants in Germany and increase transits.		
	45.153	Redwitz (DE)	Grafenrheinfeld (DE)	Upgrade of 230 kV connection Redwitz – Grafenrheinfeld to 400 kV, including new 400 kV switchgear Eltmann. Line length: 97 km											design & permitting	mid term	Investment delay due to delay in the implementation or the line Halle – Schweinfurt (investment 45.193).		
	45.154	Redwitz (DE)		New 500 MVAr SVC in substation Redwitz.											planned	mid term	Progresses as planned.		
	45.155	Raitersaich (DE)		New 500 MVAr SVC in substation Raitersaich.											planned	mid term	Progresses as planned.		
	45.47.158																	The investment contributes both to project 45 and project 47. For the technical description see project 47.	
46	46.194	wind farm cluster Baltic Sea East (DE)	Lüdershagen / Lubmin (DE)*	Offshore wind farm connection project (by AC-cables on transmission voltage level or by clustering with DC connections) has to be constructed and afterwards also to be operated by the TSO (in this project: 50Hertz Transmission) according to German law.	>2,000 MW										design & permitting	2012-2020	This investment includes several connections of offshore wind farms in the eastern part of the Baltic Sea. The present expected date of commissioning varies from 2012 to 2020.		The integration of offshore wind generation in the Baltic Sea.
	46.195	wind farm cluster Baltic Sea West (DE)	Bentwisch (DE)	Offshore wind farm connection project (by AC-cables on transmission voltage level or by clustering with DC connections) has to be constructed and afterwards also to be operated by the TSO (in this project: 50Hertz Transmission) according to German law.											design & permitting	2013-2020	This investment includes several connections of offshore wind farms in the western part of the Baltic Sea. The present expected date of commissioning varies from 2013 to 2020.		

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47	47.A76	Vöhringen / Leupolz (DE)	Westtirol (AT)	Upgrade of an existing OHL to 380 kV, extension of existing and erection of new 380 kV substations including 380 / 110 kV transformers. Transmissions routs Vöhringen – Westtirol and Pkt. Woringen – Memmingen. Length: 114 km. This project will increase the current power exchange capacity between the DE, AT and CH.	>2,000 MW										planned	long term	New investment in TYNDP.		The reinforcement of the interconnection between Austria and Germany. Also the support the interaction between the RES in northern Europe(mainly DE) with the pump storage in the Austrian Alps. The project scheduling is not related only to the network needs, but even to the feasibility and to the authorization process (the possibility to anticipate specific projects could be evaluated in the future considering the three above mentioned elements).
	47.158	Irsching (DE)	Ottenhofen (DE)	Upgrade of 230 kV connection Irsching – Ottenhofen to 400 kV, including new 400 kV switchgear Zolling. Length: 76 km											planned	mid term	Progresses as planned.	The investment contributes also to project 45.	
	47.212	Isar / Ottenhofen (DE)	St. Peter (AT)	New 400 kV double circuit OHL Isar – St. Peter including new 400 kV switchgears Altheim, Simbach and St. Peter, and one new 400/230 kV transformer in substation Altheim and fourth circuit on line Isar – Ottenhofen. Line length: 90 km											design & permitting	2017	Progresses as planned.		
	47.26.216	St. Peter (AT)	Tauern (AT)	Completion of the 380 kV line St. Peter – Tauern. This contains an upgrade of the existing 380 kV line St. Peter – Salzburg from 220 kV operation to 380 kV operation and the erection of a new internal double circuit 380 kV line connecting the substations Salzburg and Tauern (replacement of existing 220 kV lines on optimized routes). Moreover the erection of the new substations Wagenham and Pongau and the integration of the substations Salzburg and Kaprun is planned. Line length: 130 km											design & permitting	2017 / 2019	Preparation for the permitting procedure is ongoing. APG is making efforts to set the 380 kV Salzburg-line 2017 into service. Depending on possible delays during the permitting procedure the commissioning is expected between 2017 and 2019	The investment contributes also to project 26.	
	47.26.218																	The investment contributes both to project 26 and project 47. For the technical description see project 47.	
	47.219	Westtirol (AT)	Zell-Ziller (AT)	Upgrade of the existing 220 kV line Westtirol – Zell-Ziller and erection of additional 220/380 kV transformers. Line length: 105 km											partly under construction	2013 – 2020	Project consists of several measures and is on schedule.		
	47.26.220																	The investment contributes both to project 26 and project 47. For the technical description see project 47.	
	47.221	St. Peter (AT)	Ernsthofen (AT)	Upgrade from 220 kV operation to 380 kV and erection of a 380 kV substation in Ernsthofen and St. Peter.											under construction	2013	The project is on schedule. Permissions are obtained. Commissioning is expected for 2013		
58	58.353	Krajnik (PL)	Baczyna (PL)	Construction of a new double circuit 400 kV OHL Krajnik – Baczyna (2 × 1,870 MVA, 91 km), single circuit temporarily working at 220 kV on Krajnik – Gorzów part. New substation 400 kV Baczyna will be connected by splitting and extending existing line Krajnik – Plewiska. Upgrading of limitations line Krajnik – Plewiska.	>1,000 MW										planned	2020	Progresses as planned.		Bridge Third interconnection between Poland and Germany.
	58.355	Mikułowa (PL)	Świebodzice (PL)	Double circuit line 220 kV Mikułowa – Świebodzice will be upgraded to 400 kV – single circuit temporarily working at 220 kV.											planned	2020	Progresses as planned.		
	58.A67	Gubin (PL)		New 400 kV substation planned near the PL – DE border. The substation will be connected to planned line Eisenhüttenstadt (DE) – Plewiska (PL) creating new lines Eisenhüttenstadt (DE) – Gubin (PL) and Gubin (PL) – Plewiska (PL).											planned	2020	New investment in TYNDP.	This new substation on the third DE – PL connection is necessary for future generation connection while ensuring interconnection capability.	
	58.140	Eisenhüttenstadt (DE)	Plewiska (PL)	New 400 kV double circuit OHL Eisenhüttenstadt (DE) – Plewiska (PL) including the construction of new substation Plewiska Bis (PL).											planned	2020	Progresses as planned.		

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88	88.A23	offshore wind farms (FR)	several French substations (FR)	Subsea cables and substations works.	3,000 MW (MT) 6,000 MW (LT)										planned	2015 – 2020	New investment in TYNDP, required to connect offshore wind farms as decided by the French government in 2010.	Project development will adapt to the pace of generation installation.	Connection of 6 GW offshore wind farms in 2 phases. First 3 GW phase in progress (tender).
89	89.A24	Calan (FR)	Plaine-Haute (FR)	New 80 km double circuit 220 kV underground cable with 2 phase shifters and T-connection of an existing HV substation. 1,150 MVARs of capacitors and SVC. New transformer 400/220 kV	500 MW			Brittany area							design & permitting	2017	New investment in TYNDP, required to secure Brittany's supply, along with DSM management plan and a new CCGT in Finistère area.		The project is needed to secure Brittany's supply.
90	90.131	Bickigen (CH)		Addition of a second 400/220 kV transformer in an existing substation.	4,000 MW										design & permitting	2012	Progresses as planned.		This project increase the transfer capability between FR, DE, AT towards pump storage in CH.
	90.132	Mühleberg (CH)		Construction of a new 400/220 kV substation.											design & permitting	2015	Delays due to authorization process.		
	90.134	Bassecourt (CH)	Romanel (CH)	Construction of different new 400 kV line sections and voltage upgrade of existing 225 kV lines into 400 kV lines. Total length: 140 km											design & permitting	2015	Delays due to authorization process.		
	90.136	area of Bodensee (DE, AT, CH)		Construction of new lines, extension of existing ones and erection of 400/220/110 kV substation. This project will increase the current power exchange capacity between the DE, AT and CH. The project is expected to increase NTC and improve the security of supply.											planned	long term	Progress as planned.		
	90.129	Beznau (CH)	Mettlen (CH)	Upgrade of the existing 65 km double circuit 220 kV OHL to 400 kV.											design & permitting	2015	Progresses as planned.		
	90.130	La Punt (CH)	Pradella / Ova Spin (CH)	Installation of the second circuit on existing towers of a double circuit 400 kV OHL (50 km).											planned	2017	Delays due to authorization process.		
	90.133	Bonaduz (CH)	Mettlen (CH)	Upgrade of the existing 180 km double circuit 220 kV OHL into 400 kV.											under consideration	2020	Progresses as planned.		
	90.44.170																	The investment contributes both to project 44 and project 90. For the technical description see project 44.	
	90.44.172																	The investment contributes both to project 44 and project 90. For the technical description see project 44.	
	90.44.173																	The investment contributes both to project 44 and project 90. For the technical description see project 44.	
	90.44.176																	The investment contributes both to project 44 and project 90. For the technical description see project 44.	
	90.45.177	Goldshöfe (DE)	Bünzwangen (DE)	A new 380 kV OHL. Length: 45 km											under consideration	2020	Progresses as planned.	The investment contributes also to project 45.	

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Project number	Investment number	Substation 1	Substation 2	Brief technical description	Grid transfer capacity increase	Socio-economic welfare	RES integration	Improved security of supply	Losses variation	CO_2 mitigation	Technical resilience	Flexibility	Social and environ-mental impact	Project costs	Present status	Expected date of commissioning	Evolution compared to the TYNDP 2010 situation	Investment comment	Project comment
91	91.121	Bickigen (CH)	Romanel (CH)	Construction of different new 400 kV OHL sections and voltage upgrade of existing 225 kV lines into 400 kV lines. Total length: 250 km	>4,000 MW										design & permitting	2015	Delays due to authorization process.		The investments help accommodating new pumping storage units which support mainly the increasing RES generation in North Sea area.
	91.122	Chippis (CH)	Lavorgo (CH)	Construction of different new 400 kV line sections and voltage upgrade of existing 225 kV lines into 400 kV. Total length: 120 km.											design & permitting	2017	Delays due to authorization process.		
	91.123	Mettlen (CH)	Ulrichen (CH)	Construction of different new 400 kV line sections and voltage upgrade of existing 225 kV lines into 400 kV lines. Total length: 90 km											planned	2019	Delays due to authorization process.		
	91.125	Schwanden (CH)	Limmern (CH)	New 400 kV double circuit (OHL and underground cable) between Schwanden and Limmern.											design & permitting	2015	Progresses as planned.		
	91.126	Golbia (CH)	Robbia (CH)	New 2 × 400 kV cable connection between Golbia and the Bernina line double circuit.											under consideration	2019	Progresses as planned.		
	91.127	Magadino (CH)	Verzasca (CH)	Upgrade of existing 150 kV line into 220 kV line.											under consideration	2020	Progresses as planned.		
	91.128	Bâtiaz (CH)	Nant de Drance (CH)	New 400 kV double circuit OHL between Bâtiaz and Châtelard. New 2 × 400 kV cable connection between Châtelard and Nant de Drance. Total length: 22 km											design & permitting	2016	Delays due to authorization process.		
92	92.146	Aachen / Düren region (DE)	Lixhe (BE)	Connection between Germany and Belgium including new 100 km HVDC underground cable and extension of existing 380 kV substations. On Belgian side, new 380 kV circuit between Lixhe and Herderen and second 380 kV OHL in / out from Herderen to Lixhe. In Belgium, addition of 2 transformers 380/150 kV in Lixhe and in Limburg part.	1,000 MW			Northern Belgium							design & permitting	2017	Project entered design and permitting phase in 2011, technical description has been completed and expected date of commissioning is 2017.	Alegro Project	First Belgium – Germany interconnection. This project enhances security of supply of both BE and DE. This HVDC link in an AC grid brings flexibility and bidirectional power control allowing integration of RES in both countries. This project aims to be a demonstration for HVDC link integration in the AC meshed grid.

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Project identification					Project assessment														
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94	94.139	Vierraden (DE)	Krajnik (PL)	Upgrade of existing 220 kV line Vierraden – Krajnik to double circuit 400 kV OHL.	>1,000 MW										design & permitting	long term	Expected date of commissioning was adjusted due to long permitting process and strong local public resistance.		PSTs: Control of the transits of power on the polish synchronous profile (increase of import capacity, increase of grid operation safety).
	94.A68	Krajnik (PL)		Upgrade 400 kV.											design & permitting	2014	New investment in the TYNDP, split out from investment 139.		
	94.A69	Mikułowa (PL)		Upgrade 400 kV.											design & permitting	2014	New investment in the TYNDP, split out from investment 139.		
	94.A70	Krajnik (PL)		New PST.											design & permitting	2014	New investment in the TYNDP, split out from investment 139.		
	94.A71	Mikułowa (PL)		New PST.											design & permitting	2014	New investment in the TYNDP, split out from investment 139.		
103	103.145	Niederrhein (DE)	Doetinchem (NL)	New 400 kV line double circuit DE-NL interconnection line. Length: 60 km	13,900 MW			NW part of Netherlands							design & permitting	>2013	Delays due to authorization process.		The project reinforces the Dutch grid to accommodate new conventional and renewable generation, to handle new flow patterns and to increase the interconnection capacity between DE and NL.
	103.438	Eemshaven (NL)	Diemen (NL)	New 175 – 200 km AC overhead line with capacity of 2 × 2,650 MVA of 380 kV.											design & permitting	2018	Delays due to authorization process.		
	103.439	Borssele (NL)	Geertruidenberg (NL)	New 100 – 130 km double circuit 380 kV OHL with 2 × 2,650 MVA capacity.											design & permitting	2016	Delays due to authorization process.		
	103.440	Maasvlakte (NL)	Beverwijk (NL)	New 380 kV double circuit mixed project (OHL + underground cable) including approximately 20 km of underground cable for 2,650 MVA. The cable sections are a pilot project. The total length of cable at 380 kV is frozen until more experience is gained.											under construction	2016	Delays due to authorization process.		
	103.441	Zwolle (NL)	Hengelo (NL)	Upgrade of the capacity of the existing 60 km double circuit 380 kV OHL to reach a capacity of 2 × 2,650 MVA.											under consideration	long term	Progresses as planned.		
	103.442	Krimpen aan de Ijssel (NL)	Maasbracht (NL)	Upgrade of the capacity of the existing 150 km double circuit 380 kV OHL to reach a capacity of 2 × 2,650 MVA.											under consideration	long term	Progresses as planned.		
107	107.A25	tbd (IE)	tbd (FR)	A new HVDC subsea connection between Ireland and France.	700 – 1,000 MW										under consideration	long term	New investment in TYNDP, conceptual, cost benefit analysis to be confirmed.		This project will establish interconnection capacity between Ireland and France.
112	112.98	Pordenone (IT)		Voltage upgrade of the existing Pordenone 220 kV substation up to 400 kV. The substation will be connected in and out to the existing Udine O. – Cordignano 400 kV line.	2,150 MW			Triveneto area							planned	long term	Progresses as planned.		This projects helps to increase the security of supply in the northeastern part of Italy.
	112.105	Treviso (IT)		New 380/132 kV substation in Treviso area, connected in and out to the existing 380 kV line Sandrigo – Cordignano.											design & permitting	mid term	Project delayed by 2 years due to longer than expected permitting procedure.		
	112.106	Schio (IT)		New 220/132 kV substation in Schio area, providing the connection in and out to the existing 220 kV line Ala – Vicenza Monte Viale.											planned	mid term	Project delayed by 2 years due to longer than expected permitting procedure.		
	112.107	Vicenza Industrial (IT)		New 380/132 kV substation in the industrial area of Vicenza, connected in and out to the existing Sandrigo – Dugale 400 kV line.											planned	long term	Progresses as planned.		
	112.108	Northwest Padova (IT)		New 220/132 kV substation in Northwest Padova area, complying with 400 kV standards, providing the connection in and out to the existing Dugale – Marghera Substation1 220 kV line.											planned	long term	Progresses as planned.		

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	40	Avelin (FR) Mastaing (FR)		Installation of a 3rd busbar in Avelin (existing 400 kV substation) andreplacement of components to increase the ability to withstand short-circuit power. Connection of Mastaing (existing 400 kV substation) to existing 400 kV circuit between Avelin (FR) and Lonny (FR).											commissioned	commissioned	Commissioned.		
	41	Fruges, Sud-Aveyron, Marne-Sud, Somme (FR)	0	New 400 kV substations connected to existing 400 kV network and equipped with transformers to 220 kV or high voltage networks.											design & permitting	mid term	Project progress according to the plan.		
	58	Ensdorf (DE)	St. Avold (FR)	Change of conductors on the German part of this single circuit 220 kV line (9 km) and installation of a phase-shifter in Ensdorf (DE) 220 kV substation.											commissioned	commissioned	Commissioned.		
	69	Candia (IT)	Konjsko (HR)	New 1,000 MW HVDC interconnection line between Italy and Croatia via 280 km 500 kV DC subsea cable and converters stations at both ending points.											under consideration	post 2022	These projects are very sensitive to the market and still under investigation.		
	71	Brindisi (IT)	Babica (AL)	500 MW single pole HVDC merchant line between Italy and Albania via 290 km 400 kV DC subsea cable and converter stations at both ends. On the Italian side, the new line will be connected to the existing substation of Brindisi South.											design & permitting	long term	Permitted as a merchant line (it develops according to the plan for the stakeholders).		
	72	Aetos(GR)	Galatina (IT)	Second 500 MW HVDC link between Greece and Italy via 316 km 400 kVDC subsea cable and converters stations at both ends.											under consideration	post 2022	These projects are very sensitive to the market and still under investigation.		
	120	Lavorgo (CH)	Morbegno (IT)	New 400 kV tie line between Italy and Switzerland.											cancelled	cancelled	It has been replaced by investment n° ITA-4 "New interconnection between CH and IT". Change in the design and complexity of the project.		
	135	220 kV nodes (CH)		Many 220 kV reinforcement around the urban areas.											planned	2015	Progress according to the plan.		
	168	Goldshöfe (DE)	Dellmensigen (DE)	Upgrade the line Goldshöfe – Dellmensigen from 220 kV to 380 kV. Line length: 114 km Included with the project : 3 × 380 kV substations, 2 transformers											under construction	2014	Investment 168 has been postponed to 2014 due to local resistance against the project in a specific area. The rest of the investment is ready.		
	168a	region South-West Bavaria (DE)		Upgrading the existing 220 kV OHL to 380 kV, length 100 km, and the extension of existing substations, erection of 380/110 kV-transformers.											cancelled	cancelled	The project was abandoned / was not seen necessary with the new set of projects in place. Note: in the previous TYNDP the status of the project was under consideration and not planned (printing mistake).		
	192	Hamburg / Krümmel (DE)	Schwerin (DE)	This 380 kV double circuit OHL project will close the missing gap in the northeastern German grid infrastructure. Only 65 km of new line must be constructed, 22 km already exist.											under construction	2012 / 2013	Commissioning delayed by complex permitting procedure. Line is partly constructed. Is expected to be commissioned in 2012 / 2013 short term.		
	198	Wuhlheide (DE)	Thyrow (DE)	Berlin South Ring: replacement of an existing old 220 kV double circuit OHL by a 380 kV double circuit OHL. Length: 50 km											cancelled	cancelled	Project was depending on the replacement of a CHP power plant based in Berlin. Due to a new general CHP concept the plant size could be adopted and the upgrade of the existing 220 kV connection to 380 kV was not necessary any longer. Project was given up with regard to the CHP plant investor.		
	222	Silz (AT)	Zell-Ziller (AT)	Upgrade of the existing 220 kV double circuit OHL Zell – Ziller – Silz. Line length: 42 km											under construction	2013 / 2014	Progress as planned.	This line, due to change in, switched from the TSO environment to the distribution area.	

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	267	Suceava (RO)	Balti (MD)	New 400 kV OHL (139 km) to increase capacity of transfer between Romania and Rebublic Moldova. The project also implies new substation 400 kV in Moldova (extension of the substation Balti with 400 kV level).											design & permitting	2020	The project is associated to the connection of the Rep. Moldova and Ukraina. Delay is associated to the procedure for the connection of UA and MD.		
	268	Constanta (RO)	Pasakoy (TR)	New DC link (subsea cable) between existing stations in RO and TR. Line length: 400 km											under consideration	>2020	The delay in the investment is caused by the lack of financial means.		
	65	Curon (IT) / Glorenza (IT)	new substation close to the border in AT	New 380/220 kV substation in AT directly located near the border. Erection of a 24 km single circuit 220 kV connection via OHL and underground cable till Graun (IT) and upgrade of the existing line Graun (IT) – Glorenza (IT).											cancelled	cancelled	It has been replaced by investment n° ITA-5 "New interconnection between AT and IT". This project which was depicted in the TYNDP 2010 suffered important changes in the design.		
	203	area Wolmirstedt (DE)	under consideration	Support of RES and conventional generation integration, maintaining of security of supply and support of market development.											under consideration	2020	Included in new investment H3 due to new wind BS generation.		
	78	Palermo area (IT)		Restructuring of the network in the Palermo area. The work consists of – a new 220/150 kV substation, complying with 400 kV standards, connected to the Ciminna substation with a new 400 kV line and in & out the existing Bellolampo – Caracoli 400 kV line, – the connection of 15 kV lines Casuzze – Monreale and Casuzze – Guadalami and – a repowering of the existing Casuzze 150 MV substation. It is foreseen also large a restructuring of the 150 kV network in the Palermo area in order to increase the security and the quality of supply. Total length: 49 km											design & permitting	2015	The project has changed in terms of composition (new refurbishments were added to the initial project). The date of commissioning was advanced due to the faster need of increasing the security of Palormo area.		
	79	Agrigento (IT)		New 220/150 kV substation, complying with 400 kV standards. The new substation will be connected in and out to the existing Partanna – Favara 400 kV line.											design & permitting	2015	The authorization process is faster than expected.		
	80	Noto (IT)		New 220/150 kV substation, complying with 400 kV standards, connected in and out to the existing Ragusa – Melilli 400 kV line.											design & permitting	2014 / 2015	The authorization process is faster than expected.		
	110	restructuring of Sorrento Peninsula network (IT)		It is planned a new 380/220/150 kV substation in East Vesuvius area (near Naples) connected in & out to the existing 380 and 220 kV lines Montecorvino – S. Sofia and Nola – S. Valentino. Related to this project, it has been programmed also some reinforcements and restructuring of the existing 220 kV and 150 kV network in the area of Sorrento Peninsula. Total net length: 58 km											design & permitting	2014	Shifted from long term to 2014 due to the authorization process which started a little bit before the scheduled time.		
	119	Capri, Ischia, Procida (IT)		New 150 kV subsea connection between the Capri, Ischia and Procida islands to the existing substations of Cuma and Torre Annunziata (mainland Italy). Total length: 95 km											design & permitting	2014	Delays due to authorization process.		
	118	Porto Ferraio (Elba Island / IT)	Cornia (Piombino / IT)	New 40 km 132 kV connection via subsea cable between the existing substation of Porto Ferraio and the future 400/132 kV substation of Cornia that will also be connected in and out to the existing Suvereto – Piombino Termica 400 kV line.											design & permitting	2012 / long term	Delays due to authorization process.		

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	180	Mengede (DE)	Kruckel (DE)	Installation of a second circuit 380 kV OHL and extension of existing substations. Line length: 16 km.											design & permitting	mid term	Project develops according ot the plan.		
	217	Dürnrohr (AT)	Sarasdorf (AT)	Installation of the 3rd and 4th circuit on the existing line Dürnrohr – Sarasdorf and restructuring in the area of the substation Bisamberg and the 220 kV Weinviertel line . Total length: 100 km											under construction	2014	The project is on schedule. Permissions are obtained. Commissioning is expected for 2014.		
	52	Feuillane (FR)	Realtor (FR)	Operation at 400 kV of existing 63 km double circuit OHL previously operated at 220 kV, creation of a new 400 kV substation and restructuring of the existing 220 kV local network.											under construction	2012	To be commissioned by end of 2012. Delays due to longer than expected authorization process.		
	61	Moulaine (FR)	Belval (LU)	Connection of SOTEL (industrial grid in LU) to RTE network by mixed (underground cable & OHL) single circuit 220 kV line. Parts of the new line use existing ones.											under construction	short term	Commissioned in 2010 for the FR part, the LU part is still pending.		
	39	Avelin (FR)	Warande (FR)	Reconductoring (with ACSS) of both circuits of existing 400 kV OHL between Avelin, Weppes and Warande. Total length: 85 km											commissioned	commissioned	Commissioned in 2010.		
	43	Mandarins (FR)		Replacement of thyristors in the AC/DC substation (IFA 2000 interconnector, DC voltage 270 kV).											commissioned	commissioned	Currently under final tests; will be commissioned in Summer 2012		
	47	Tamareau (FR)	Tavel (FR)	Reconductoring with ACCS of both circuits of existing 92 km double circuit 400 kV OHL to increase its capacity.											commissioned	commissioned	Commissioned in 2011.		
	49	Cantegrit (FR)	Mouguerre (FR)	Reconductoring (with ACSS) of existing 83 km single circuit 220 kV OHL to increase its capacity.											commissioned	commissioned	Commissioned in 2011.		
	50	Néoules (FR)	Broc-Carros (FR)	The second circuit (formerly operated at 220 kV) of a 197 km double circuit 400 kV OHL will be operated at 400 kV and 400/225 autotransformers installed in relevant substations.											commissioned	commissioned	Commissioned in 2010.		
	56	Camporosso (IT)		New 450 MVA PST in Camporosso (IT) 220 kV substation on Camporosso (IT) – Menton (FR) – Trinité-Victor (FR) OHL.											under construction	2012	Will be commissioned in 2012.		
	59	Moulaine (FR)	Aubange (BE)	Installation of a second circuit on the existing 220 kV cross-border OHL											commissioned	commissioned	Commissioned in 2010.		
	114	Ittiri (IT)	Codrongianos (IT)	New 18 km 400 kV OHL between the existing substation of Codrongianos and the future 400 kV substation of Ittiri that will be also connected in and out to the existing Fiumesanto – Selargius 400 kV line.											commissioned	commissioned	Commissioned.		
	115	Fiumesanto (IT)	Latina (IT)	Second pole of HVDC link between Sardinia and mainland Italy via 400 kV DC subsea cable (420 km). The first pole is in operation since 2009. Total capacity of the bipolar link: 1,000 MW											commissioned	commissioned	Commissioned.		
	116	Casellina (IT)	Tavarnuzze (IT)	New 37 km 400 kV OHL with rearrangement of EHV grid in the area between Casellina and S. Barbara. Voltage upgrade of the existing substations of Casellina 400/132 kV and S. Barbara 400/132 kV.											commissioned	commissioned	Commissioned.		
	117	Castegnero (IT)		New 220/132 kV substation connected in and out to the ex-isting 220 kV line Cittadella – Este and Dugale – Stazione 1, providing a restructuring of HV grid.											commissioned	commissioned	Commissioned.		
	169	Großgartach (DE)		Upgrade the substation for a higher short circuit capacity. New installation includes 10 gas insulated bays, 63 kA, 3 busbars and 2 transformers.											commissioned	commissioned	Commissioned.		

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	201	Bärwalde (DE)	Schmölln (DE)	New internal double circuit 380 kV line connecting the substations St. Peter and Salzach neu (replacement of the existing 220 kV line). Length: 46 km											design & permitting	2014	Delays due to authorization process.		
	196	wind farm Baltic 1 (DE)	Bentwisch (DE)	Connection of the offshore wind farm Baltic 1 (AC-cables on transmission voltage level).											commissioned	commissioned	Commissioned.		
	210	substations in 50Hertz Transmission control area		Construction of new 380/110 kV substations.											commissioned	commissioned	Freiberg and Stendal / West are commissioned. The remaining substations were transferred to the 44.209 investment.		
	213	Wien SO (AT)	Szombathely (HU)	Installation of the 2nd circuit on the existing interconnection from Wien SO (AT, APG) to the border (both circuits have already been installed on the Hungarian side, one is connected to Györ and the 2nd circuit to Szombathely). Line length: 63 km											commissioned	commissioned	2011 > 2010: Completed earlier. It was due to scheduling of the field work.		
	215	St. Peter (AT)	Salzach neu (AT)	New internal double circuit 380 kV line connecting the substations St. Peter and Salzach neu (replacement of the existing 220 kV line). Length: 46 km											commissioned	commissioned			
	226	Ernestinovo (HR)	Pecs (HU)	New 400 kV double circuit interconnection line between existing stations. Line length: 86 km											commissioned	commissioned	Commissioned.		
	67	Divaca (SI)		Installation of a new 400 kV PST to assist control of power flows to Italy on secure level and secure the operation of Slovenian grid enabling full utilisation of regional market.											commissioned	commissioned	This is PST in SS Divaca and it has been in operation since 2011.		
	82	Chignolo Po (IT)	Maleo (IT)	A new 380 kV double circuit OHL between the new 380 kV substations of Chignolo Po and Maleo in Lodi area. Restructuring of HV network. Total line length: 22 km											commissioned	commissioned			
	A103	Weinviertel-line New investment for the integration of RES (mainly wind power) in the northeastern part of Austria ("Weinviertel")		To allow the grid integration of the planned renewable energy generation (mainly wind power) in the northeastern part of Austria ("Weinviertel"). To cover the foreseen load growth in that region the transmission grid infrastructure has to be enforced and new substations for the connection have to be erected.											planned	2016 / 2017	New project.		
	A104	Castelbello (IT)	Naturno (IT)	New 220 kV (insulated at 400 kV level) OHL connection between existing stations of Naturno and Castelbello.											planned	long term	Overcoming the constrains in operation, due the renewable generation in the area of Trentino Alto Adige region.		

12.3 Abbreviations

AC	Alternating Current
ACER	Agency for the Cooperation of Energy Regulators
CCS	Carbon Capture and Storage
CHP	Combined Heat and Power Generation
DC	Direct Current
EIP	Energy Infrastructure Package
ELF	Extremely Low Frequency
EMF	Electromagnetic Field
ETS	Emission Trading System
ENTSO-E	European Network of Transmission System Operators for Electricity (see § A2.1)
FACTS	Flexible AC Transmission System
FLM	Flexible Line Management
GTC	Grid Transfer Capability (see § A2.6)
HTLS	High Temperature Low Sag Conductors
HV	High Voltage
HVAC	High Voltage AC
HVDC	High Voltage DC
KPI	Key Performance Indicator
IEM	Internal Energy Market
LCC	Line Commutated Converter
LOLE	Loss of Load Expectation
NGC	Net Generation Capacity
NRA	National Regulatory Authority
NREAP	National Renewable Energy Action Plan
NTC	Net Transfer Capacity
OHL	Overhead Line
PEMD	Pan European Market Database
PCI	Project of Common Interest (see EIP)
PST	Phase Shifting Transformer
RAC	Reliable Available Capacity
RC	Remaining Capacity
RES	Renewable Energy Sources
RG BS	Regional Group Baltic Sea
RG CCE	Regional Group Continental Central East
RG CCS	Regional Group Continental Central South
RG CSE	Regional Group Continental South East
RG CSW	Regional Group Continental South West
RG NS	Regional Group North Sea
SEW	Social and Economic Welfare
SO&AF	Scenario Outlook & Adequacy Forecast
TSO	Transmission System Operator
TYNDP	Ten-Year Network Development Plan
VSC	Voltage Source Converter

12.4 Imprint

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