FlexPlan

Newsletter M24 – 17th September 2021

Letter of the Project Coordinator

The last six months of activities of the FlexPlan project have been marked by a progress on the simulation activities and by some reflections on the modelling side.

On the side of the simulations, the 6 regional cases have made good progress and the input data for running the non-expanded OPFs at 2030 (distribution network still excluded) are now ready. This should be the first step, allowing the pre-processor to analyze reinforcement needs (both grid and flexibility resources) so as to feed the new planning tool.

However, the run of these OPFs was possible only for one month of time due to memory limitations of the Amazon WEB Service (AWS) on which the simulation is run. One-year-long simulations would be necessary instead. That opened the debate on which measure could be more opportune to implement. The most obvious solutions would be either to widen the AWS memory setting, possible, yet with increasing hiring costs, or delocalizing the simulation by exploiting local servers. The former solution would however imply a very significant increase of the resources (AWS resources, unlike real servers don't manage memory swap: as soon as the memory demand overcomes the available one, the simulation crashes), whereas the latter would request a HW endowment which most regional case leaders don't dispose of. So, a modelling refection was initiated too. As the detailed analysis of storage and DSM resources prevents the simulations to adopt a rougher granularity than 1 hour, the preferred solution would be to find a way to split the yearly OPF calculation into independent monthly simulations that can be run independently. That opportunity will be explored by pre-solving the problem of the allocation of water among the year months, possibly by adopting techniques based on "water value" methodologies, well known in the Nordic Countries, where important seasonal reservoirs are managed. So, these techniques, that were already to be applied for the Nordic regional case, will be extended to all "big" reservoirs of the other regional cases. For small reservoirs, a simpler hypothesis could be applied: that those reservoirs manage every month only the water of that very month, so that the level at the end of the month is the same as the begin.

Beyond what has been mentioned so far, during the last 6 months, a significant progress has been realized on the side of the set up of the synthetic distribution networks on the basis of statistics collected on real networks.

The testing of the Benders decomposition techniques applied to the FlexPlan problem is continuing and the results seem encouraging.

Finally, the development of the planning tool is also proceeding and a Graphic User Interface layout has been also laid down and presented to the consortium TSOs for discussion. The aim of this is to create an experience that can facilitate as much as possible the adoption by the European System Operators in their future planning analyses.

Gianluigi Migliavacca (RSE)

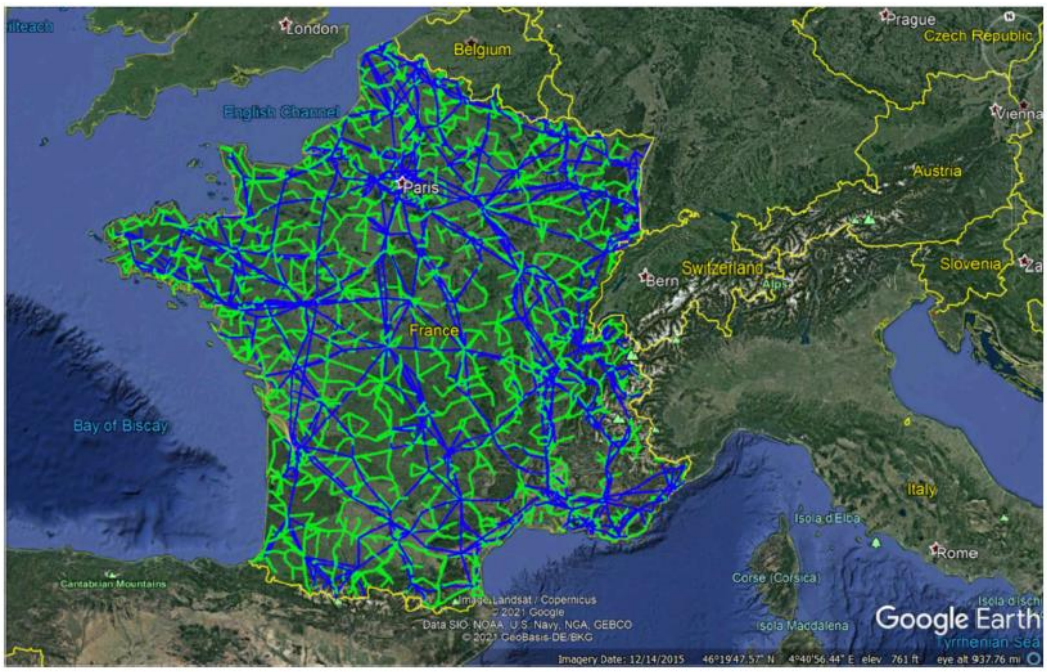
Progress in the regional cases set-up

Nuno Amaro (WP5 Leader) – R&D NESTER

The FlexPlan innovative grid planning tool is fully tested within the scope of the project by simulating network expansion plans in six ambitious regional cases. In previous editions of our newsletter we described energy scenarios to be used, up to 2050, as well as some preliminary results of pan-European market simulations. While the former constitute the basis of our simulations and provide different vision of the European Energy system in 2030, 2040 and 2050, the latter contributes to the definition and simulation of the regional cases by establishing coherent and univocal cross border flows between these. During the last six months, sound progress has been made in the setup of these six regional cases. The main activities can be summarized as follows.

Adaptation of energetic scenarios to grid nodal level. The energy scenarios created in the scope of FlexPlan start from data collected from TYNDP 2020, which reports installed capacities and load values aggregated at national level. For this reason, a methodology was created to adapt these to grid nodal level, starting from the regional level time series obtained in the scope of the pan-European simulations performed previously. This activity is currently in the last step and very soon these load and generation time series will be ready to simulate all energy scenarios considered in FlexPlan. These are complemented by the already obtained market results which provide time series data for cross border flows.

Development of grid models for transmission and distribution systems. The FlexPlan team defined and completed a very ambitious goal of having realistic regional case grid models (which add up to nearly the European grid) for both transmission and distribution systems. Transmission systems models are completed and consist of the transmission networks of countries involved in the regional cases. These models started from a data shared by ENTSO-E (grid model used in TYNDP 2018 studies), which are complemented by an extensive set of data including the full sub-transmission grid models and full geographical identification of grid nodes. This represented a comprehensive and complex data collection and validation task which now allows us to be confident on having complete and realistic transmission grid models. In the following picture, you can perceive the executed activity for the creation of the French Transmission Network model. In blue, you can see the data that was shared by ENTSO-E, already complemented with the geographical location of the different grid nodes, and in green the sub-transmission grid model, fully created by the FlexPlan team, resulting in a complete system model for the French transmission system.



Distribution systems are represented using synthetic network models. As there is no data available to cover the full extent of the distribution systems, which is the target of FlexPlan, the team resorted to a novel methodology to create synthetic networks. These are created based on statistics extracted from real distribution systems, which are representative of the different countries and geographical conditions. A detailed explanation of this modelling approach is given in the next section of this newsletter.

Collection of additional data sources. In order to simulate realistic conditions, another workflow was dedicated to the collection of data related to generation and load. On the side of generation, a full characterization of generation units is performed, including the identification of their geographical location, and technical characterization (installed capacity, fuel type, etc). Additionally, pollutant emissions data was also collected to allow performing environmental impact studies. From the load side, flexibility related data was gathered, in order to characterize and use flexibility provision from the load side as well as the identification of the geographical location of industrial loads. This data collection process is already finished for all regional cases, providing a complete characterization of load and generation, according to the requirements of the FlexPlan project.

The three activities here described can be considered as the main building blocks of the FlexPlan regional cases, allowing the grid expansion simulation toolchain to take place. In order to allow the user to quickly execute the simulation process, a dedicated methodology was also created to combine and place this datasets into a single structured input data file (using JSON format) which is then uploaded to the cloud based environment of the FlexPlan grid planning tool. At this stage, this data collection process is almost finished and the different regional cases are ready to start the simulation within the next few months. Stay tuned with us for more news.

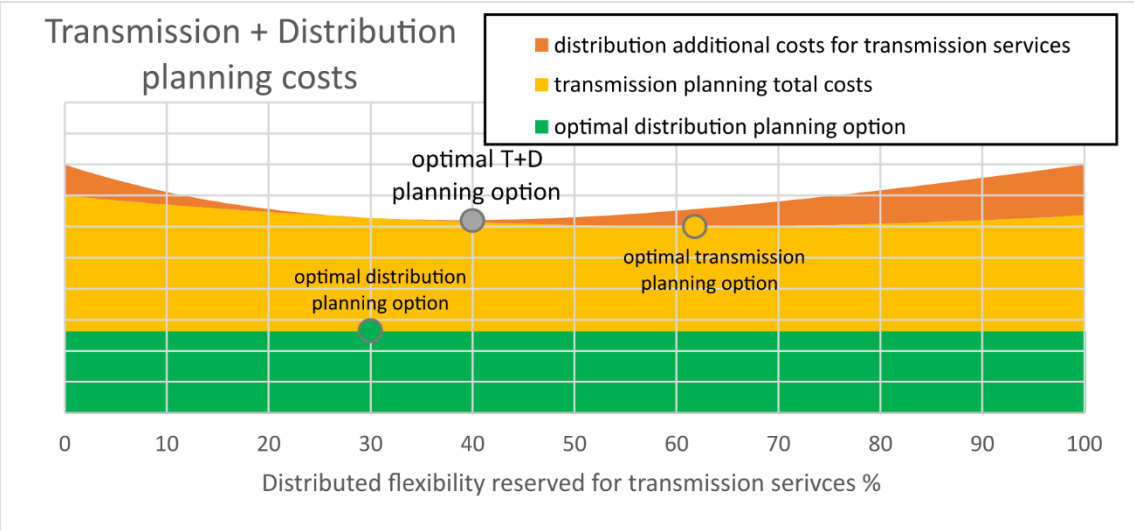
The complex procedure for setting up synthetic distribution networks

Marco Rossi - RSE

Distribution networks are increasingly important within the planning and operation of the electricity system, especially considering the volume of flexibility reserve that is connected to the lowest voltage levels which can contribute to services for both transmission and distribution networks. For this reason, a faithful representation of the distribution system over the European regions covered by the project FlexPlan is crucial for the identification of the flexibility potential in terms of grid planning (at any voltage level).

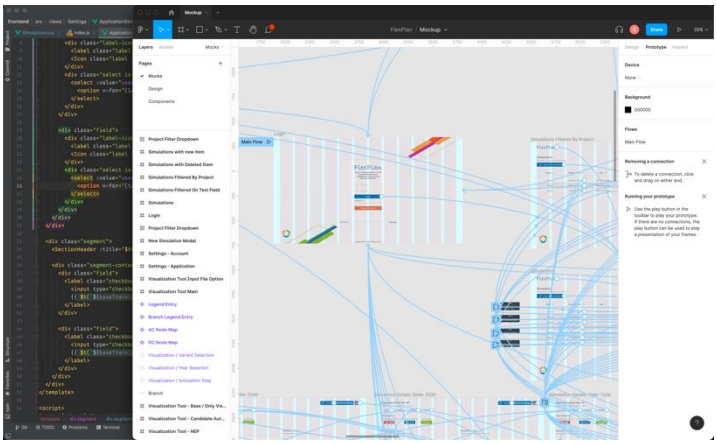
In general, a distribution system model covering the entire territory of a country is rarely available and it needs to be developed by resorting to electrical network synthesis. Literature reports many methods for the realization of synthetic grids and RSE has developed a method capable of providing a set of randomly generated networks which feature the same topological and electrical characteristics of real distribution systems (collected from public data/reports and dedicated interviews with system operators).

For each considered country, the synthetized distribution system counts hundreds of thousands of nodes and (flexible) devices that increases the complexity of the integrated transmission-distribution planning problem. The challenging dimension of the model is expected to be out of the capabilities of state-of-the-art solvers, so that the optimization of the planning measures can be obtained by adopting a decoupled (but still cooperative) transmission and distribution planning approach. FlexPlan dedicated significant resources to the development of an innovative methodology (recently published and presented at the CIRED 2021, see: https://flexplan-project.eu/wp-content/uploads/2021/09/Planning-of-distribution-networks-considering-flexibility-of-local-resources-CIRED-2021.pdf) based on the reservation of a TSO-DSO agreed distribution flexibility portion for transmission services. As in the graph shown below, an optimal compromise is calculated between a minimum cost optimal plan for distribution-only and an optimal plan maximizing the availability of resources able to provide services for the transmission system. On top of the advantages in terms of computational tractability, the decoupled planning approach brings benefits in terms of TSO-DSO coordination simplification.



Building a Graphical User Interface for the FlexPlan new planning tool: a rigorous and methodical process

Maxime Hanot (WP3 Leader), Samuel Monroe – N-SIDE



Early July marked the beginning of our work on the graphical user interface, part of the WP3. In order to build the right product for our partners, we are following a full process of UX/UI design prior to the development phase.

The process started by reviewing the requirements acquired during the customer consultations and summarizing the major features the interface should propose to the users.

From these features, we established a list of user flows to describe how the user would access and use these features on the application, and a map of the different pages and how they would be linked in the application.

The next step in the process was to start designing the wireframes of the application. Wireframes consist of a high-level and abstract representation of the future application, designed with a monochrome palette, simple black boxed elements and no typography.

Our goal at this stage was to rapidly have a raw representation of the future application, and be able to discuss among the team if we were going in the right direction with the way we designed the features.

Most importantly, we were able to prototype these wireframes by adding interactions in the design and simulate a real application flow. This prototyped wireframe helped us gather feedback from our partners and detect what we were missing and immediately adjust our design accordingly.

Last step before starting the implementation was to design a high-fidelity mockup of the user interface, taking our last iteration of the wireframes and applying design, typography and a color palette.

Again, this mockup was prototyped, iterated internally and reviewed with the partners, in particular the system operators members of the FlexPlan consortium with whom we organized several ad hoc meetings, to obtain feedback and make adjustments before reaching the implementation phase.

These processes allowed us to quickly come up with a solution in accordance with the future user needs and their inputs, and we are now tackling the implementation of the product with more ease and confidence in what we will deliver.

This implementation phase is also iterative, divided by main feature of the application, and supported by the mockup which helps us focus on the business logic rather than visual concerns.

A thick dissemination calendar for the fall season

Gianluigi Migliavacca - RSE

Dissemination is a precise duty for all Horizon2020 projects: public funded research results must be shared with all European stakeholders and constitute an experience to build upon for future industrial application.
The FlexPlan project takes very seriously this mandate and makes big efforts to bring the acquired know-how on all possible tables, yet taking into account the different expectations of the different public the project addresses to (scientific word, system operators, regulators, European stakeholders,…).

On this pathway, autumn 2021 will bring several events of interest.

FlexPlan will take an active part in the new edition of the CIRED conference (https://www.cired2021.org/), held in virtual form on 20-23 September 2021. Two important contributions will be provided:

- Presentation of the paper "*Planning of distribution networks considering flexibility of local resources: how to deal with transmission system services*". This paper outlines a new methodology, set up by FlexPlan, to perform an integrated grid planning between transmission and distribution grid by means of a TSO-DSO cooperative approach which allows to maintain a separation between the two processes and limit the amount of data to be exchanged. At the same time, this approach makes it possible to considerably reduce the computational complexity that an integrated TSO-DSO grid planning approach would entail. The FlexPlan paper will be presented by its main author, Marco Rossi (RSE), in **Session MS5.3 (22nd September – h14.30)**.

- **Participation in Round Table 20 "*The worth of flexibility in distribution planning and operation*" (22nd September – h16.30)** by Gianluigi Migliavacca (RSE), FlexPlan project coordinating person. He will carry out a presentation ("*What about the competition for flexibility between TSO and DSO? Is it possible to perform integrated planning?*") and participate in the subsequent debate.

Later in the year, FlexPlan will take part in the IEEE PES ISGT EUROPE 2021 virtual conference (18-21 October 2021), an important debate forum for smart grids, with a special session dedicated to goals and achievements of FlexPlan. Such session (Session 7A: PANEL 1) is scheduled for 18th October h16:45-18:30 CET.

Last but not least, in occasion of the semestral project meeting, a new edition of the project Advisory Board will be held in the afternoon of November 24th. The invited list includes 60 people from the most important European stakeholders, with whom we would like to debate the project results of the last year.

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