This project has received funding from the European Union's Horizon2020
research and innovation programme under grant agreement N° 863819

FlexPlan

Advisory Board Meeting| 24 November 2021

FlexPlan – Goals and first results of regional cases

Nuno Amaro
R&D NESTER

Agenda

- FlexPlan Regional Cases building blocks
  - Grid models
  - Scenarios to be simulated
  - Load and generation characterization data
- Work flow for Regional Cases Simulations
- Preliminary Results

FlexPlan Regional Cases building blocks

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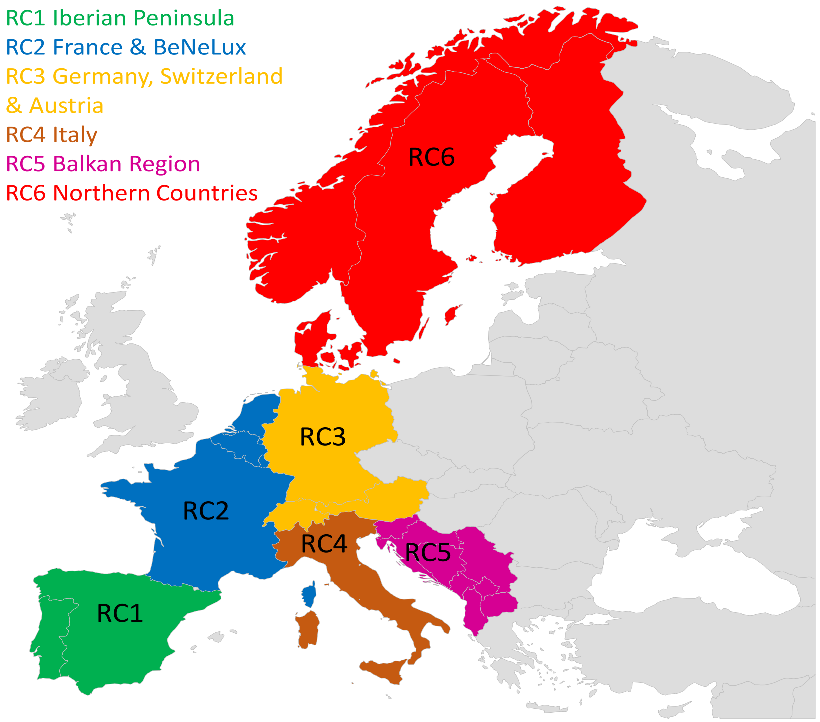
- FlexPlan innovative grid planning tool will be tested using models corresponding to six regional cases covering almost all Europe

- Outcomes of these simulations provide realistic network planning plans and allow evaluating flexibility sources in grid planning studies

- Each regional case includes
  - Full transmission and distribution network models
  - Energy scenarios for long term planning (up to 2050)
  - Full characterization of generation and flexible load



Grid Models

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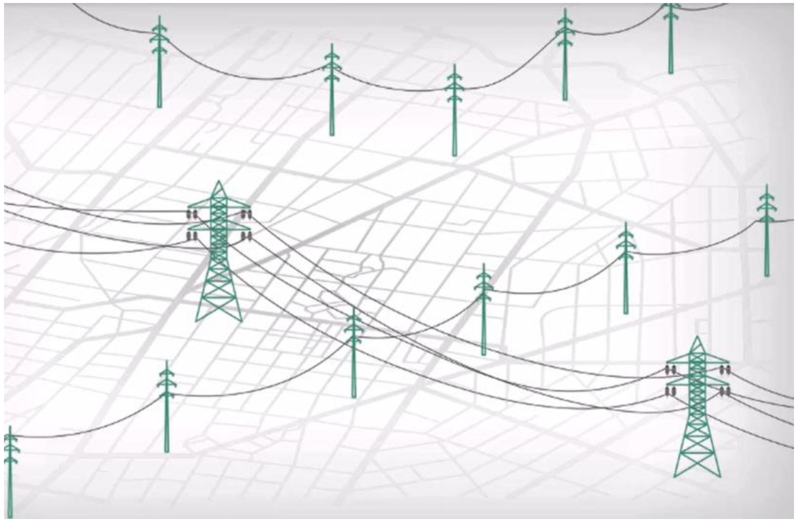
FlexPlan sets up complex and realistic grid models covering almost all Europe, including transmission and distribution systems

Transmission networks models

- Pan-European **Real** transmission network model



Distribution networks models

- Synthetic networks, based on **statistics** from **real** networks

Large-scale, realistic models

- **1-to-1 representation of grid nodes** for transmission systems and representative networks for distribution systems

Grid Models - Transmission networks

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Transmission network models are based on a real model for the pan-European transmission system

- Obtained from **ENTSO-E**, using transmission models provided by **TSOs**

In some countries, sub-transmission network (<220 kV) are missing

- Complemented with TSO level data or open sources (e.g. OpenStreetMaps)

Grid models fully validated and complemented

- **Geographical location** of all substations

Grid Models – Transmission networks

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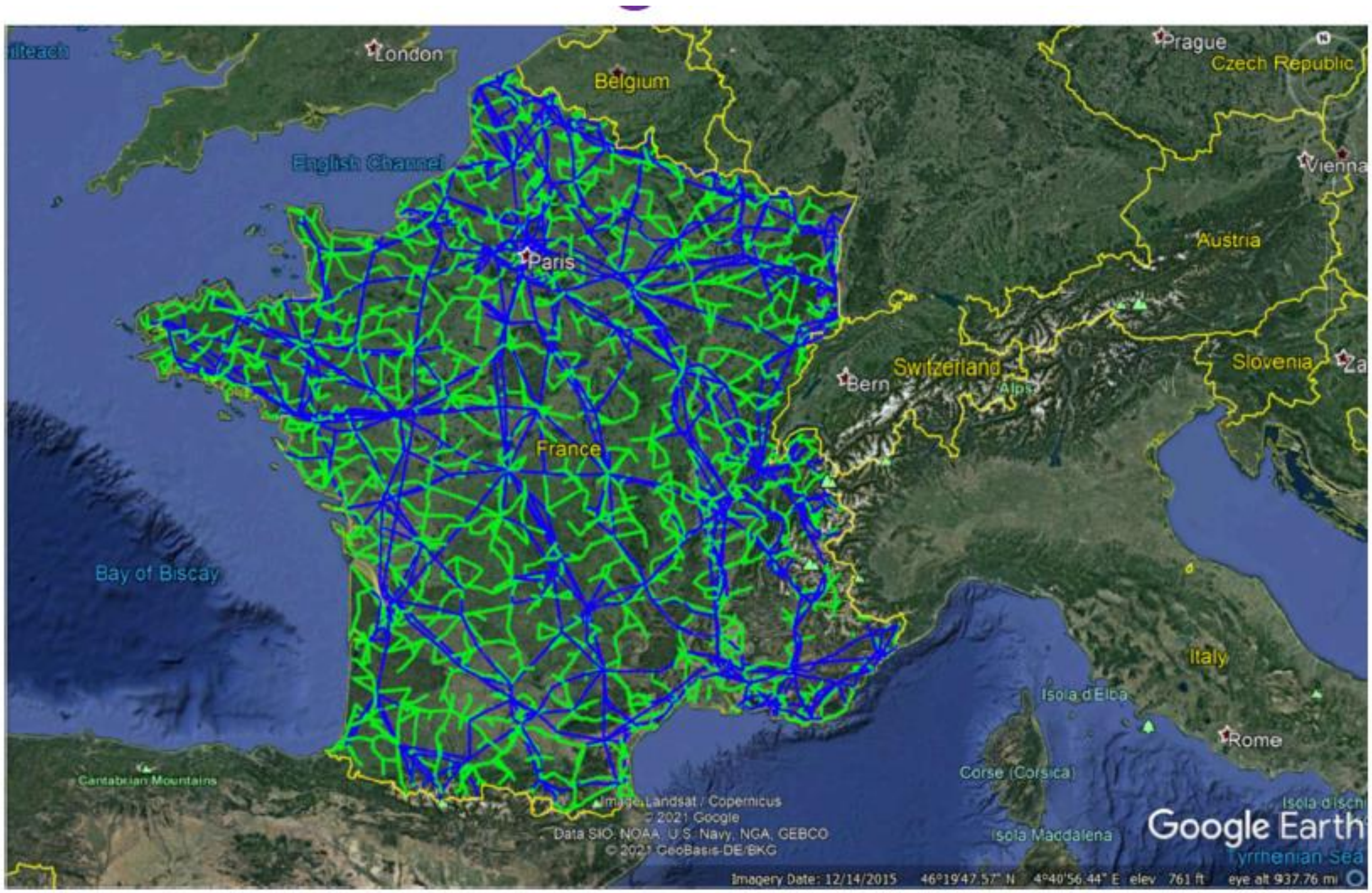
Transmission network models are based on a real model for the pan-European transmission system

- Obtained from **ENTSO-E**, using transmission models provided by **TSOs**



Transmission lines
V>=150kV

Sub-Transmission Lines
63kV - 90kv

Grid Models – Distribution networks

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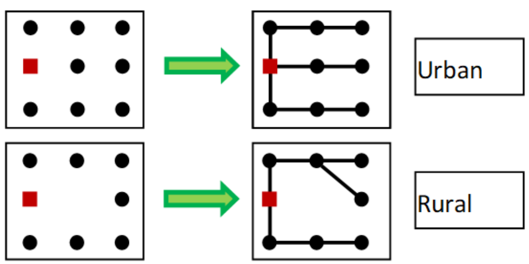
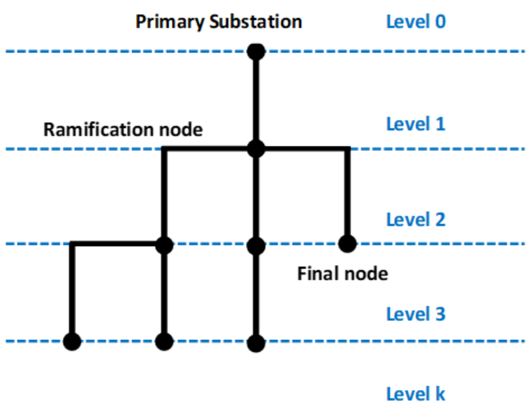
Distribution network models are based on synthetic networks created using a dedicated methodology

- Based on statistics from real networks
- Representative of the different countries / regional cases and geographic characteristics (urban/rural areas)





Scenarios to be considered

3 different scenarios to be simulated for three 3 target years (2030, 2040 and 2050)

- Each scenario considers 5 Monte Carlo variants resulting from a clustering algorithm of 40 climate years

- Scenarios based on TYNDP 2020 storylines

National Trends (NT)
is the central scenario based on draft NECPs in accordance with the governance of the energy union and climate action rules, as well as on further national policies and climate targets already stated by the EU member states. Following its fundamental principles, NT is compliant with the EU's 2030 Climate and Energy Framework (32 % renewables, 32.5 % energy efficiency) and EC 2050 Long-Term Strategy with an agreed climate target of 80–95 % CO_2 reduction compared to 1990 levels.

Global Ambition (GA)
is a scenario compliant with the 1.5° C target of the Paris Agreement also considering the EU's climate targets for 2030. It looks at a future that is led by development in centralised generation. Economies of scale lead to significant cost reductions in emerging technologies such as offshore wind, but also imports of energy from competitive sources are considered as a viable option.

Distributed Energy (DE)
is a scenario compliant with the 1.5° C target of the Paris Agreement also considering the EU's climate targets for 2030. It takes a de-centralised approach to the energy transition. A key feature of the scenario is the role of the energy consumer (prosumer), who actively participates in the energy market and helps to drive the system's decarbonisation by investing in small-scale solutions and circular approaches.

Source: ENTSO-E TYNDP2020

- Further adapted in FlexPlan to include 2050 data
  - Extrapolated from TYNDP 2020
  - Validated using "A Clean Planet for All" Energy Package from the European Commission

Scenarios to be considered

TYNDP 2020 scenarios provide **data at national level**

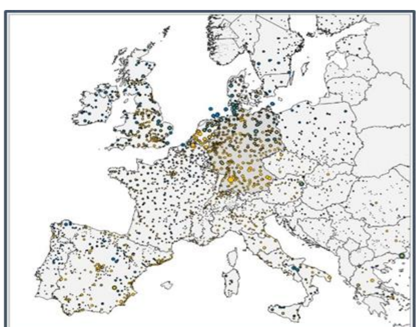
- E.g. Installed capacity per technology and national load profiles

A dedicated methodology is used to convert these into **nodal level time series data** for generation and load

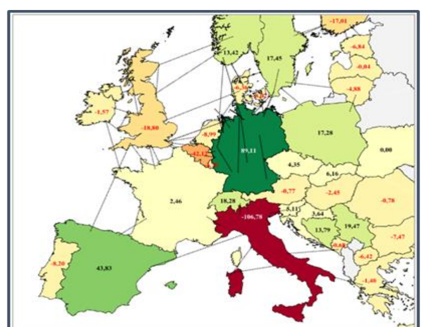
- **Regionalization**: **disaggregation of installed capacities** at regional/local level depending on a multi-criteria approach (e.g. load directly correlated with urban density) and **creation of adequate time series** for load and generation

- **Market simulation for cross border exchanges**: in order to obtain coherent Pan-EU level results and use the calculated cross-border exchanges between Regional Cases

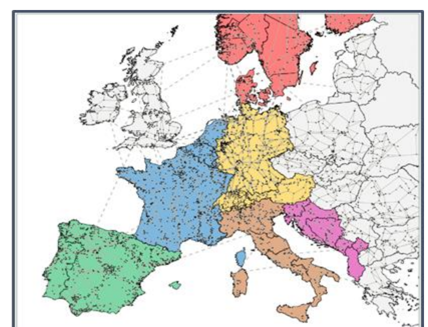
- **Nodal allocation of generation and load time series** and grid simulations, including the disaggregation of load and generation at **nodal level in distribution systems**



Regionalization of RES capacities and loads



Market Simulation for cross-border exchanges



Grid simulations for detailed Regional Cases

Load and generation characterization data

In order to realistically represent the technical conditions of the current and forecasted Pan EU power system and to fully demonstrate the capabilities of the FlexPlan tool, additional steps to the preparation of data for the Regional Cases include

Load

- **Identification of major loads** (flexibility providers), including their **location** and other characteristics allowing to **characterize** their **flexibility**

Generation

- Identification of plant specific details such as **installed capacities**, **pollutant emissions data** (for thermal power plants), **geographic location, fuel types.**

Work flow for Regional Cases Simulations

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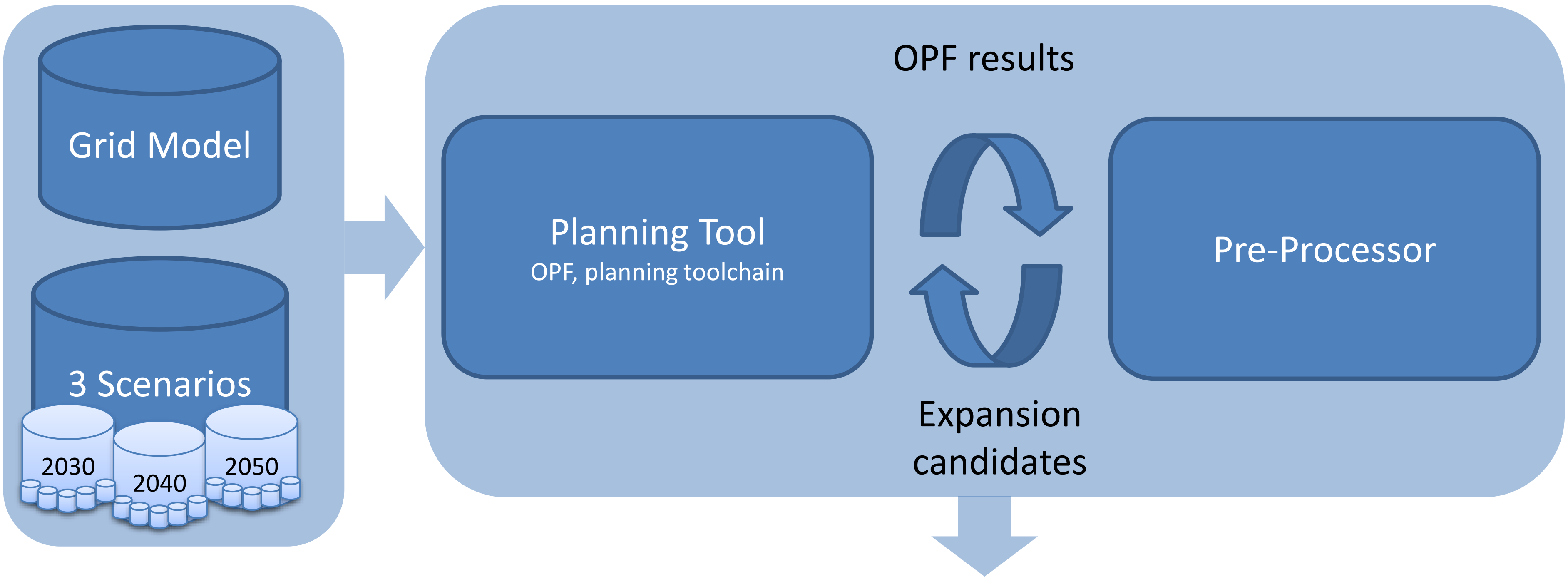

Network Planning procedures and expansion plan considering flexibility and “traditional” reinforcements

Work flow for Regional Cases Simulations

In order to keep numerical tractability, the yearly problem is decoupled into monthly periods

- Requiring less computational resources
- Allowing to run OPF in sequence (of monthly periods)
- Only the OPF are solved in monthly periods, the planning problem is still analysed at yearly level

The monthly decomposition is chosen assuming that

- Flexibility providers (DSM, Batteries) compensate provided flexibility during this period
- A dedicated modelling technique is used to capture the seasonal effects of hydro generation
  - Providing final energy contents to be available at the end of each month
  - Using average weekly inflows (calculated as a proxy from market simulations)
  - Optimal dispatch within a month is performed by the optimizer

Preliminary Results for OPF Calculations

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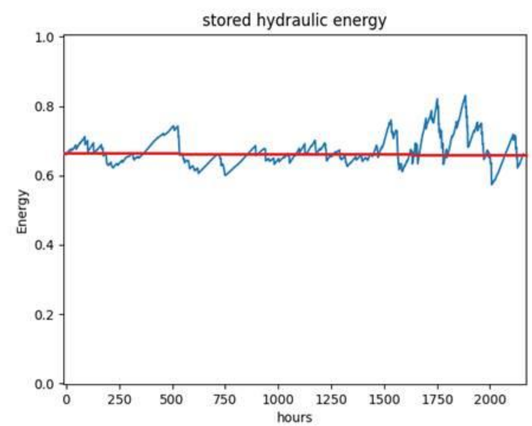
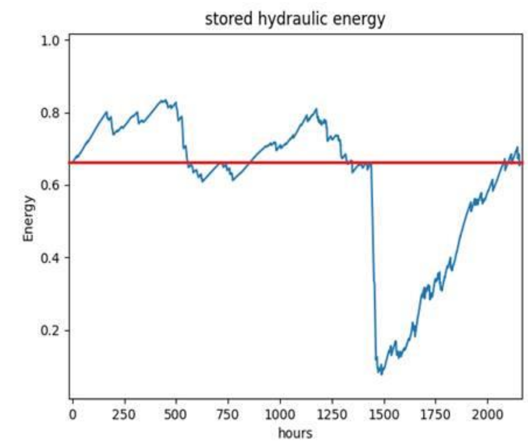
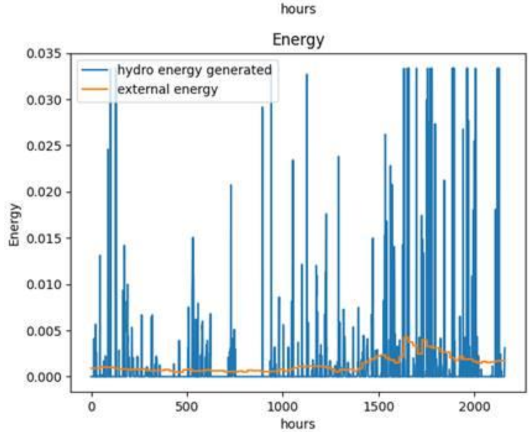
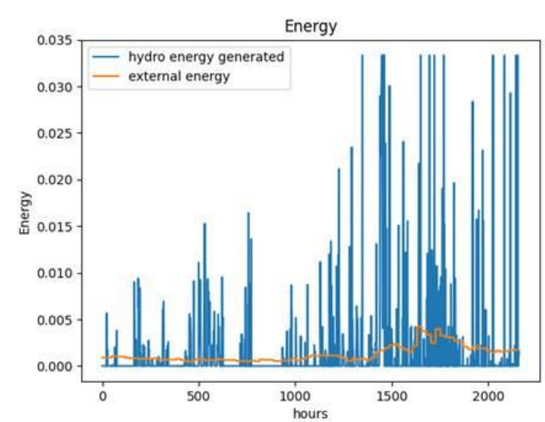
At this stage, Regional Cases are running the first sets of 2030 non-expanded OPF and there are already some preliminary results

- Importance of the monthly decomposition and comparison with other periods (weekly)
  - Weekly decomposition not chosen so as not to limit the effects of flexibility sources









Preliminary Results for OPF Calculations

OPF results allows already to identify possible grid congestions in 2030

- Using non-expanded networks – networks from 2020/2025 to run 2030 scenarios (only 1 scenario considered at this stage)
- Currently only using transmission networks
- Still preliminary – under analysis at this stage

Preliminary Results for OPF Calculations

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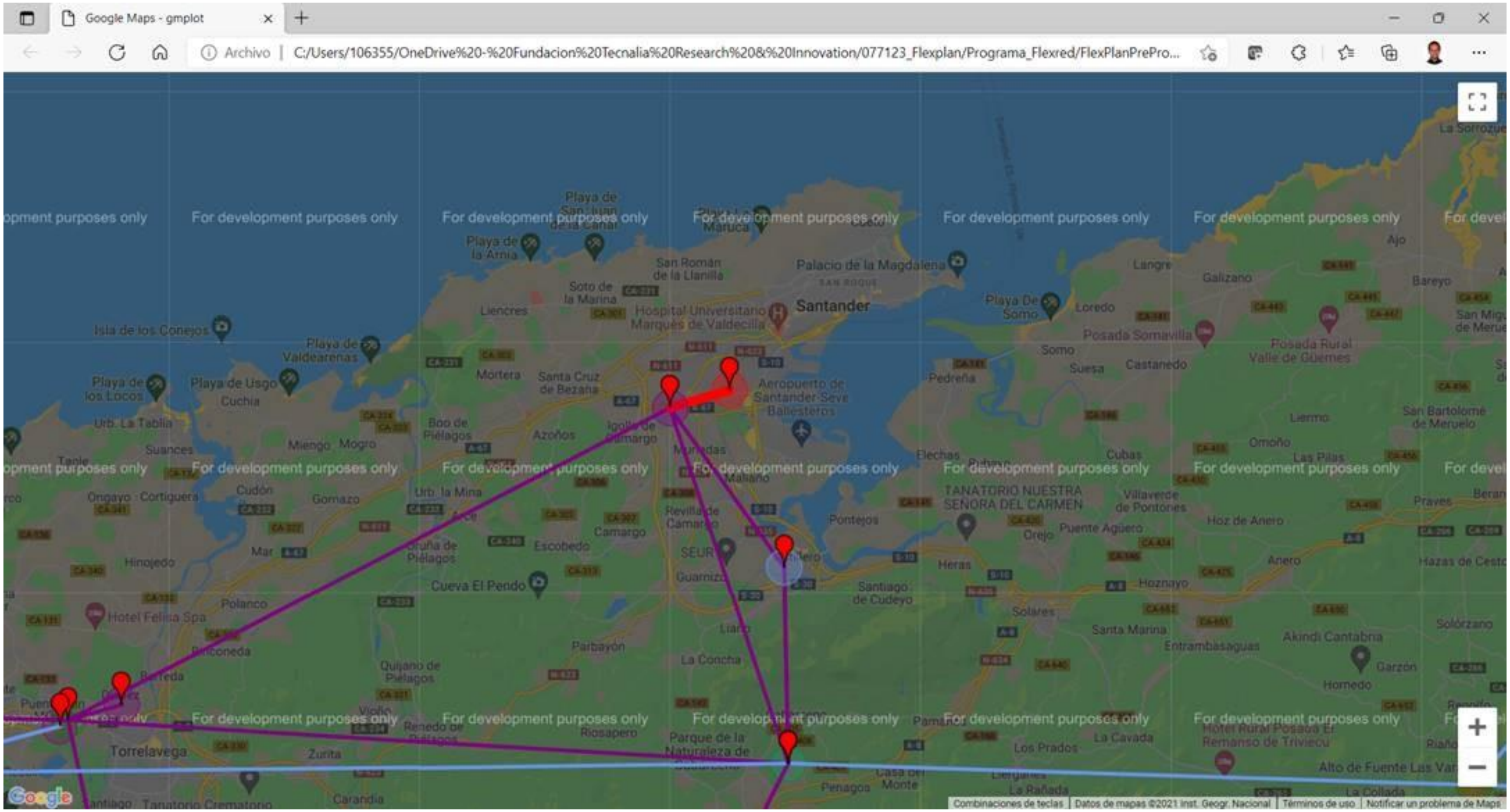
- OPF results allows already to identify possible grid congestions in 2030
  - Spain – example of identification of one congestion



Preliminary Results for OPF Calculations

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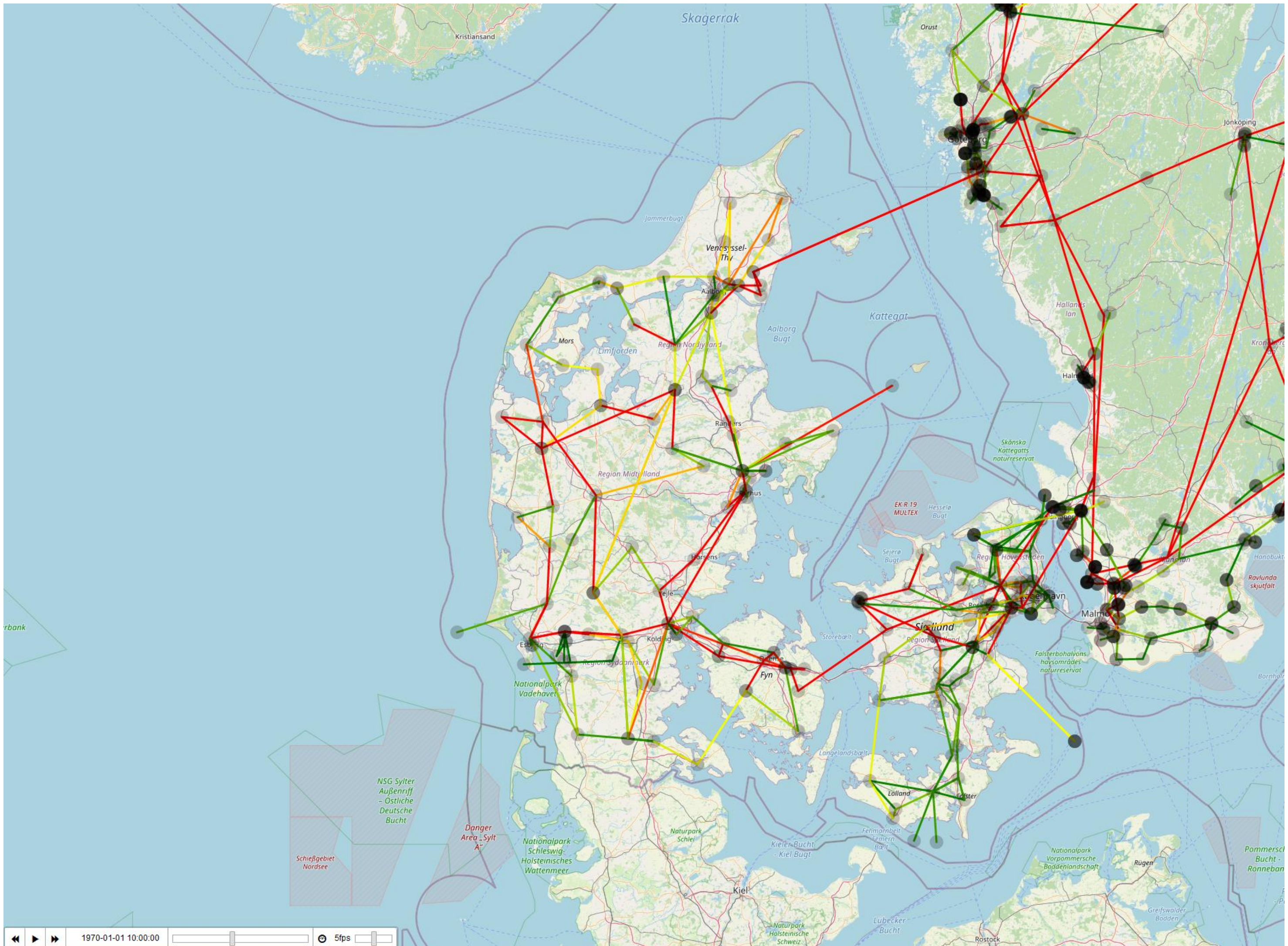
- OPF results allows already to identify possible grid congestions in 2030
  - Denmark – identification of grid congestions for 24h period



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Thank you…

Nuno Amaro

Contact Information

Affiliation: R&D NESTER

Phone: +351 210 011 302

Email: nuno.amaro@rdnester.com

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