Workshop on methods and models for the preparation of GHG emissions projections up to 2050

Electrical generation expansion planning tool

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THE PURPOSE AND USE OF MODEL

- The model is used for expansion planning for electrical generating system on mid and long term,
- It is adjusted to be used for small and specific electric generating system like Slovenian system is,
- ELEK started to develop the model in 2005 and it was several times updated
- Model uses Windows platform,
- Written is in Python programming language and
- communicates with I/O data through Excel environment,
- Model communicates (data exchange) with other models created in IJS platform.

WHAT HAS BEEN DONE WITHIN LIFE PROJECT

- **Through LIFE project, the following upgrades of the model have been realized**
  - new hourly electric demand curves were applied based on year 2017,
  - updating of all data (technical, economic and environmental) concerning existing and new power plants, (hydroelectric, nuclear, thermal and pumped hydro storage) were done,
  - Extension of hydrological data with impact of climate change on hydrological conditions was done,
  - A new interface into the model for hourly bulky wind and photovoltaic power plants operation was applied,
  - A wholesale market electricity price analysis was done and used for price driving unit commitment,
  - Etc.
- **The model was tested,**
- **Different scenarios were calculated,**

BASIC CHARACTERISTIC OF THE MODEL

- The model is used for expansion planning for Electrical generating system, specially adopted for slovenian EPS,
- Model is based on generating unit scheduling considering the technical, economic and environmental constraints.
- The basic time step of the calculation is one hour, a whole year is based on 864 hours (12 months x 3 days x 24 hours)
- It solves the following problems on mid and long term:
  - Economic dispatch,
  - Unit commitment,
  - Generation expansion planning,
  - Generating system reliability – adequacy
- Model is probability based orientated on Monte Carlo simulation,
- It deals with the following generation technologies:
  - Hydro, wind, thermal (coal, gas, biomass,..) storage, nuclear, photovoltaic, CHP, geothermal, etc.

OUTPUT RESULTS

- A detailed electricity generation data of the unit thought the analyzed time horizon based on the probability simulation are given as the main result.
- General output of a one year simulation consists of:
  - Name of the scenario,
  - Number of Monte Carlo Simulation,
  - Power balance in MW:
    - Electric system peak demand,
    - Installed power of a defined technological generation group (hydro, wind,..)
  - Reliability indexes: LOLE in hours and ENS in MWh
  - Energy balance in GWh:
    - Electricity demand,
    - Electricity generation by each defined unit
    - Electricity from IMPORT,
    - Electricity for EXPORT,
  - Heat balance for system CHP units,
  - Use of primary fuels by particular generation unit,
  - Environmental emissions of CO_2, PM, NOx and SOx.
- All output data are excel based and ready for exchange with other models