Software implementation

Andrés Ramos

Erik Álvarez

World openTEPES Conference

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openTEPES

COMILLAS ICAI

IIT INSTITUTO DE INVESTIGACIÓN TECNOLÓGICA

Developer principle

“

Don't let reality spoil a beautiful mathematical model.

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open TEPES

openTEPES

version 4.11.14

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Open Generation, Storage, and **T**ransmission Operation and **E**xpansion **P**lanning Model with RES and **ES**S (**openTEPES**)

iiT

Read the Docs

https://opentepes.readthedocs.io/en/latest/index.html

"Simplicity and Transparency in Power Systems Planning"

The **openTEPES** model has been developed at the Instituto de Investigación Tecnológica (IIT) of the Universidad Pontificia Comillas.

It is integrated in the open energy system modelling platform helping modelling Europe's energy system.

It has been used by the **Ministry for the Ecological Transition and the Demographic Challenge (MITECO)** to analyze the electricity sector in the latest Spanish National Energy and Climate Plan (NECP) 2023-2030 in June 2023.

Reference: A. Ramos, E. Quispe, S. Lumbreras "OpenTEPES: Open-source Transmission and Generation Expansion Planning" SoftwareX 18: June 2022 10.1016/j.softx.2022.101070

OpenTEPES: Open-source Transmission and Generation Expansion Planning 10.1016/j.softx.2022.101070

https://doi.org/10.24433/CO.8709849.v1

Index

- Introduction
- Input Data
  - Acronyms
  - Dictionaries. Sets
  - Input files
  - Options
  - Parameters
  - Period
  - Scenario
  - Stage
  - Adequacy reserve margin

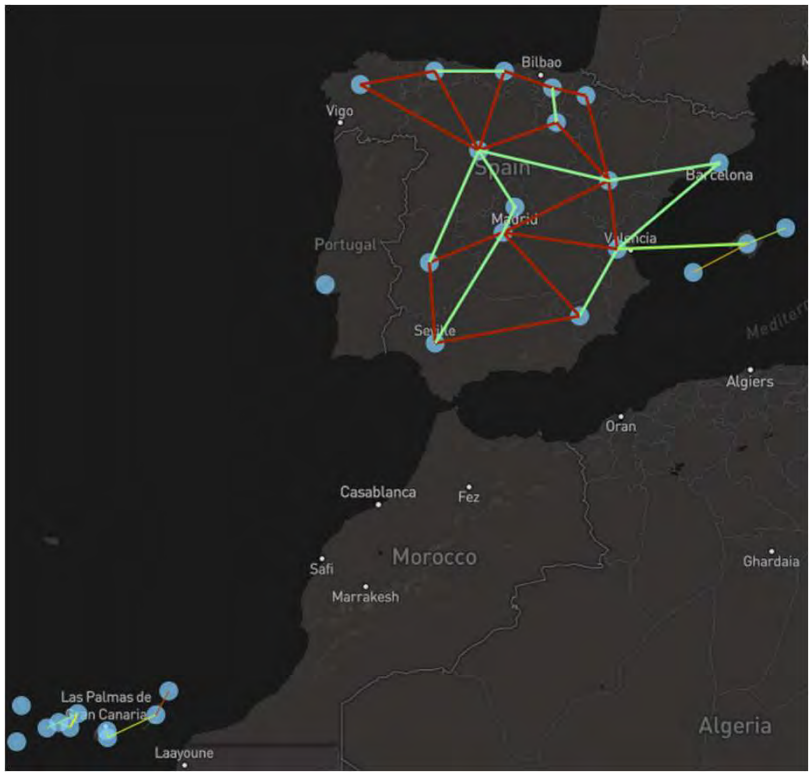
GitHub - IIT-EnergySystemModels/openTEPES: Open Generation, Storage, and Transmission Operation and Expansion Planning Model with RES and ESS (openTEPES)

Open The EU's open science policy

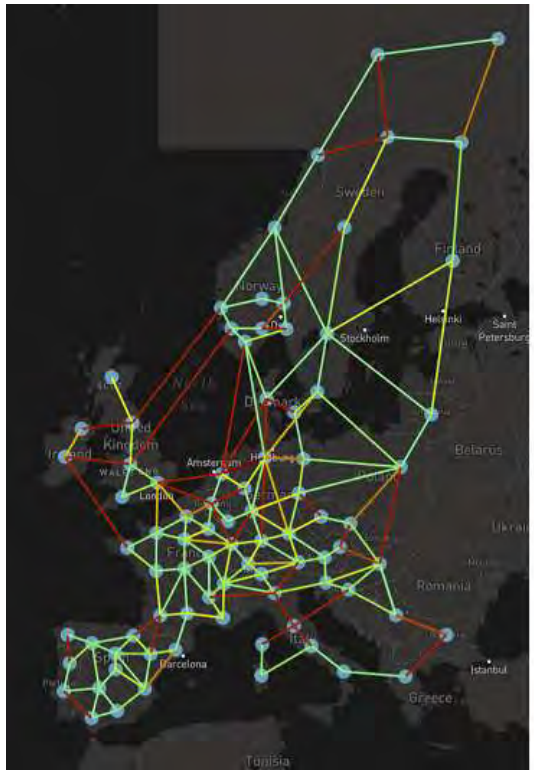
- **Open data**
  - FAIR (Findable, Accessible, Interoperable, and Re-usable data)
- **Open-source software**

- **openTEPES development goals**
  - Simplicity and transparency
  - Code written to be read by humans
  - Scalability: from small- to large-scale cases

Case studies



Spain 2030



Europe TF2030

Case SEP2030

2999548 rows, 3513436 columns, 11508142 nonzeros

Case SEPE2030

5165034 rows, 5454024 columns (1310400 binary) and 21855526 nonzeros

Case ES2030

5162243 rows, 6832942 columns, 21554828 nonzeros

Case TYNDP DE2050

22157904 rows, 26966415 columns, 73814159 nonzeros

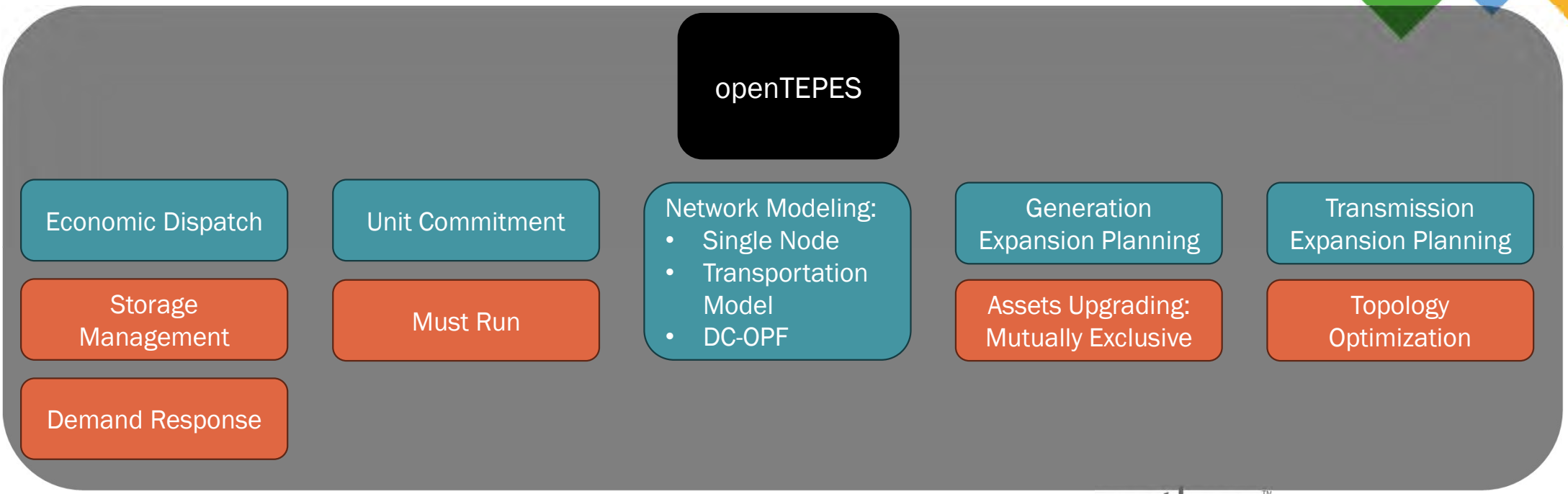
openTEPES | *Open Generation, Storage, and Transmission Operation and Expansion Planning Model with RES and ESS*

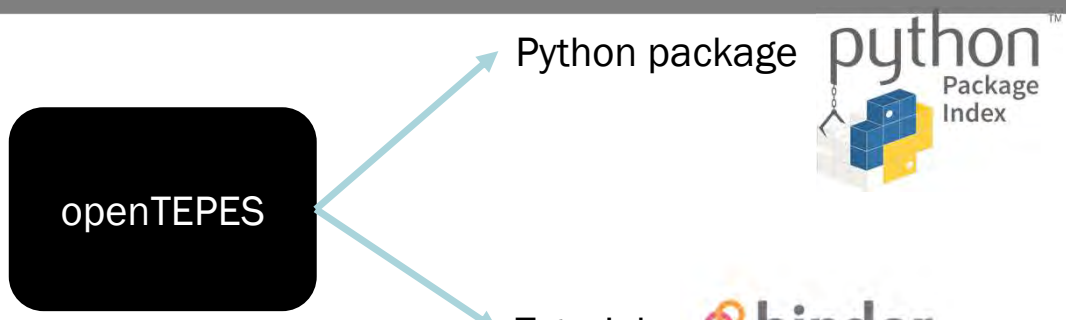
"Simplicity and Transparency in Power Systems Planning"

Open The EU's open science policy

- Numerical stability
  - Natural scaling variables and constraints around 1
  - Make 0 very small values
  - Condition number
  - Crossover
- Tight and compact formulation of some constraints with binary variables (minimum up/down time, startup/shutdown)
- Facilitate preprocessing
- Benders decomposition for very-large-scale cases

openTEPES capabilities





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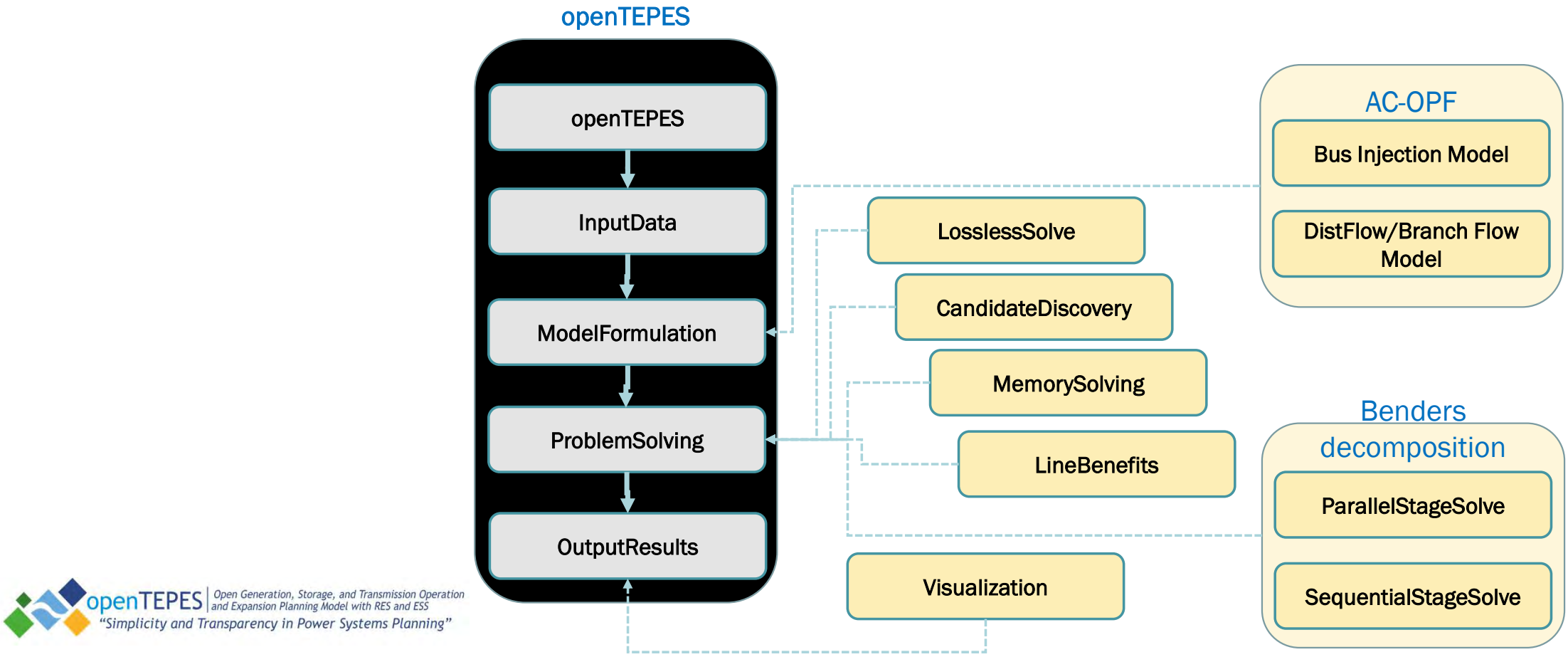
"Simplicity and Transparency in Power Systems Planning"

Plain openTEPES and advanced modules



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Thank you

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