# Synergistic Approach of Multi-Energy Models for an European Optimal Energy System Management Tool

# Deliverable D3.1

# Description of model interconnections

## Summary

| Deliverable No. D7.5 | Work Package No. WP7 | Task/s No. Task | |
|---|---|---|---|
| Work Package Title | Modelling the system and the decision process | | |
| Linked Task/s Title | Description of model interconnections | | |
| Status | Final | (Draft/Draft Final/Final) | |
| Dissemination level | Public | (PU-Public, CO-Confidential) | |
| Due date deliverable | 2018-04-30 | Submission date | 2018-04-30 |
| Deliverable version | V4.0 summary | | |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773897

| Deliverable Contributors: | Name | Organisation | Date |
|---|---|---|---|
| Deliverable Leader | Daniel Beulertz | RWTH | 26/04/2018 |
| Work Package Leader | Daniel Beulertz | RWTH | 26/04/2018 |
| Contributing Author(s | Daniel Beulertz<br>Marco Franken | RWTH | 26.04.2018<br>29.03.2018 |
| | Nadia Oudjane<br>Wim van Ackooij | EDF | 04.04.2018<br>04.04.2018 |
| | Jonas Schweiger ZIB | ZIB | 06.04.2018 |
| | Ioannis Konstantelos<br>Predrag Djapic<br>Danny Pudjianto | Imperial | 05.04.2018<br>29.03.2018<br>29.03.2018 |
| Reviewer(s) | Felix Trieu | EDF | 18.04.2018 |
| | Antonio Frangioni | ICOOR | 16.04.2018 |
| | | | |
| Final review and approval | Sandrine Charousset | EDF | 30.04.2018 |

## History of Changes

| Release | Date | Reason for Change | Status |
|---|---|---|---|
| 4.0 | 30/04/2018 | Final | Published |
| | | | |
| | | | |

| | | | |
|---|---|---|---|
| | | | |

# List of Abbreviations

CEM Capacity expansion model

CHP Combined heat and power

CP Cutting plane

CTS Commercial/trade/service

CWE Central western europe

DER Distributed energy ressources

DG Distribution grid

DSR Demand side response

EUC European unit commitment

LODF Line outage distribution factor

LV Low voltage

NUTS Nomenclature des unit_es territoriales statistiques

PTDF Power transfer distribution factor

PtX Power-to-X

RES Renewable energy source

SDDP Stochastic dual dynamic programming

SSV Seasonal storage valuation

TGEM Transmission grid expansion model

UC Unit commitment

VC Voltage control

WACC Weighted average cost of capital

# DISCLAIMER / ACKNOWLEDGMENT



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773897

# TABLE OF CONTENTS

# Executive Summary

The goal of plan4res is to develop a modeling framework that allows to obtain a holistic assessment of the energy system. Having such an ambitious goal, it is required to divide the energy system in models that cover the different aspects of the energy system. This modular framework allows to make use of the most promising solving techniques and the most efficient optimization solvers, each tailored towards the needs of every single submodel. In order to guarantee a flawless workflow, it is vital to have a detailled description of the interconnections between these models. The goal of this deliverable is to give an overview of the plan4res modeling framework and describe these model interconnections.

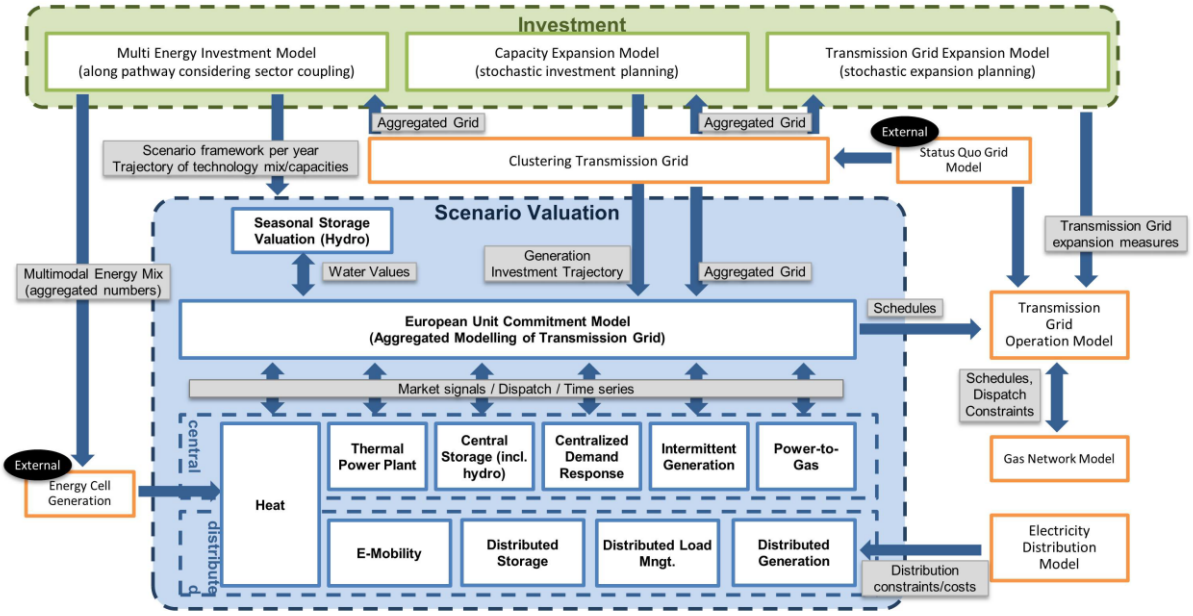


Figure 1: The plan4res model framework

Figure 1 gives an overview of the modeling framework, that is divided into

- Expansion models
- Valuation/operation models

- Supplemental models

The goal of the expansion models is to determine the optimal investment decisions for the future energy system. Since the case studies of plan4res have different key aspects, three investment models are defined that are tailored towards the needs of each case study.

The core of the scenario valuation is the European unit commitment (EUC) model, that optimizes the operation of the generation units determined by the investment models. A Lagrangian relaxation approach enables to decouple the generation units and define submodels for the different assets in the energy system. This modular approach also allows to only take the submodels into consideration, that are important for the respective case study.

Supplemental models are needed to either make input data available that are needed within the investment or valuation models (e.g. clustered version of the transmission grid, distribution reinforcement cost curves) or to do grid operation calculations (transmission grid as well as gas grid). The latter allow to also analyse the energy system regarding grid congestions, the amount of redispatch to clear these congestions and the capability of the gas grid to include gas provided by power-to-gas units.