LOGREENER
Composing Local Green Energy Transition

Summary for modelling scenarios of local development based on renewable energy sources

Modelling Renewable Energy Scenarios for Local Energy Planning in LOGREENER

1. Introduction

The LOGREENER[1] project is dedicated to empowering local authorities in crafting and executing customized energy transition strategies. Bulit on the successful methodologies from the PRISMI and PRISMI PLUS projects, LOGREENER utilizes advanced tools like EnergyPLAN[2] to provide actionable insights for energy planning and policy development. This approach enables detailed, hourly simulations of regional, local and/or insular energy systems, effectively addressing technical, economic, and environmental challenges. By integrating localized data and optimizing energy scenario modelling, LONGREENER enhances decision- making for sustainable development emphasizing the effective use of simulation tools to support renewable energy integration, improve efficiency and achieve long-term sustainability goals.

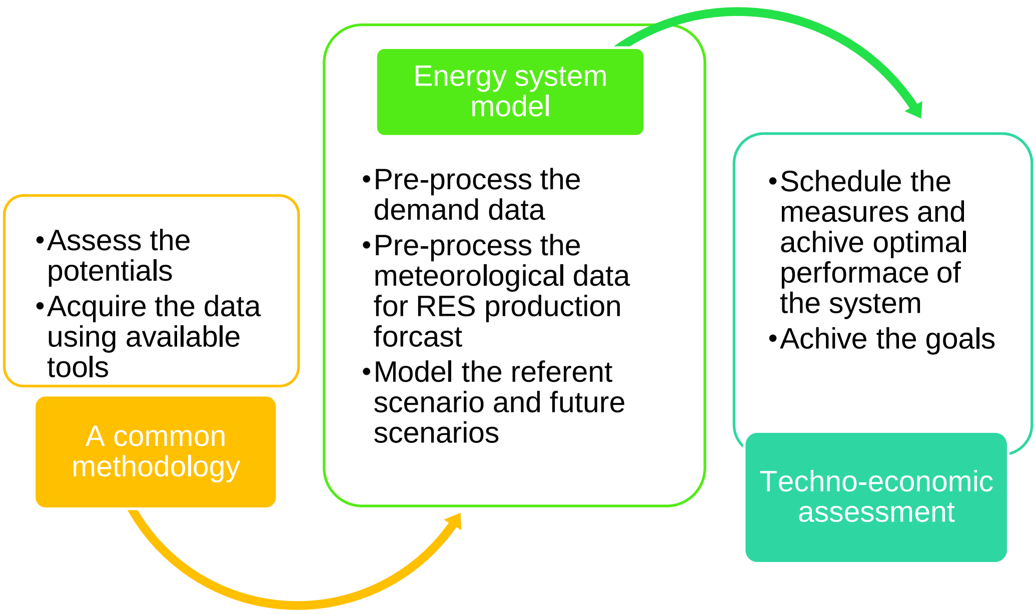


Figure 1. Methodology for modelling renewable energy scenarios for local energy transition

[1] LOGREENER is an Interreg Euro-MED project focused on local energy planning for sustainable transitions in the Mediterranean. https://logreener.interreg-euro-med.eu/

[2] EnergyPLAN is a simulation tool for energy system analysis, focusing on the integration of renewable energy and energy efficiency (access link).

2. Steps

2.1. Data Collection

A robust data collection process underpins accurate scenario modelling. This step involves gathering:

- **Energy Demand Data:** Hourly consumption data for electricity and heating, as well data for transport at the local level is critical for understanding patterns of energy usage. This data is typically obtained from smart meters, energy audits, or utility reports and provides insights into seasonal and daily demand variations, ensuring a realistic representation of energy needs. Local authorities can collaborate with electricity network operators or distribution system operators (DSOs) to access this data for electricity.
- **Renewable Energy Potential:** Geospatial and temporal data for renewable energy sources, such as solar and wind, are analysed using Geographic Information Systems (GIS) and meteorological datasets. For example, solar potential is assessed with historical solar radiation data, while wind potential relies on wind speed and direction measurements. Tools like Renewables.ninja[3] offer a simple way to access this information, enabling precise and location-specific assessments.
- **Socio-economic and Technical Constraints:** information on local infrastructure, policy frameworks, and economic parameters is essential for identifying barriers and opportunities. Examples include grid capacity for integrating renewables, available subsidies, or the economic feasibility of deploying new technologies. These constraints ensure that the modeled scenarios are feasible and adapted to local conditions.

These datasets provide the foundation for modeling scenarios tailored to the unique characteristics of each locality.

Scenario Modeling with EnergyPLAN

EnergyPLAN serves as the central tool for simulating and analysing energy scenarios. The method involves the following stages.

Scenario Definition - EnergyPLAN runs hourly simulations over an entire year to generate a detailed performance profile for each scenario.:

- LowRES (Baseline): Reflects existing energy strategies without significant changes.
- RES (Optimized): Explores feasible increases in renewable energy integration within current technical and environmental limits.
- HighRES (100% Renewable): Models complete renewable energy reliance, requiring innovative technologies and significant infrastructure investments, up to the local technical RES potential.

[3] Renewables.ninja provides geospatial and temporal renewable energy data for solar and wind resources, as well as other meteorological data necessary for calculating heating and cooling demands. (access link)

Simulation Process:

- Technical Feasibility: Identifies grid, demand response and storage requirements to balance variable renewables.
- Economic Viability: Evaluates cost implications for investment and operational phases.
- Environmental Impact: Assesses GHG reductions and land-use considerations.

Iterative Refinement:

- Adjusting inputs to test various strategies, such as maximizing renewable integration or minimizing costs.

The tool provides a comprehensive evaluation of energy system dynamics, highlighting opportunities and challenges in transitioning to renewable-based systems.

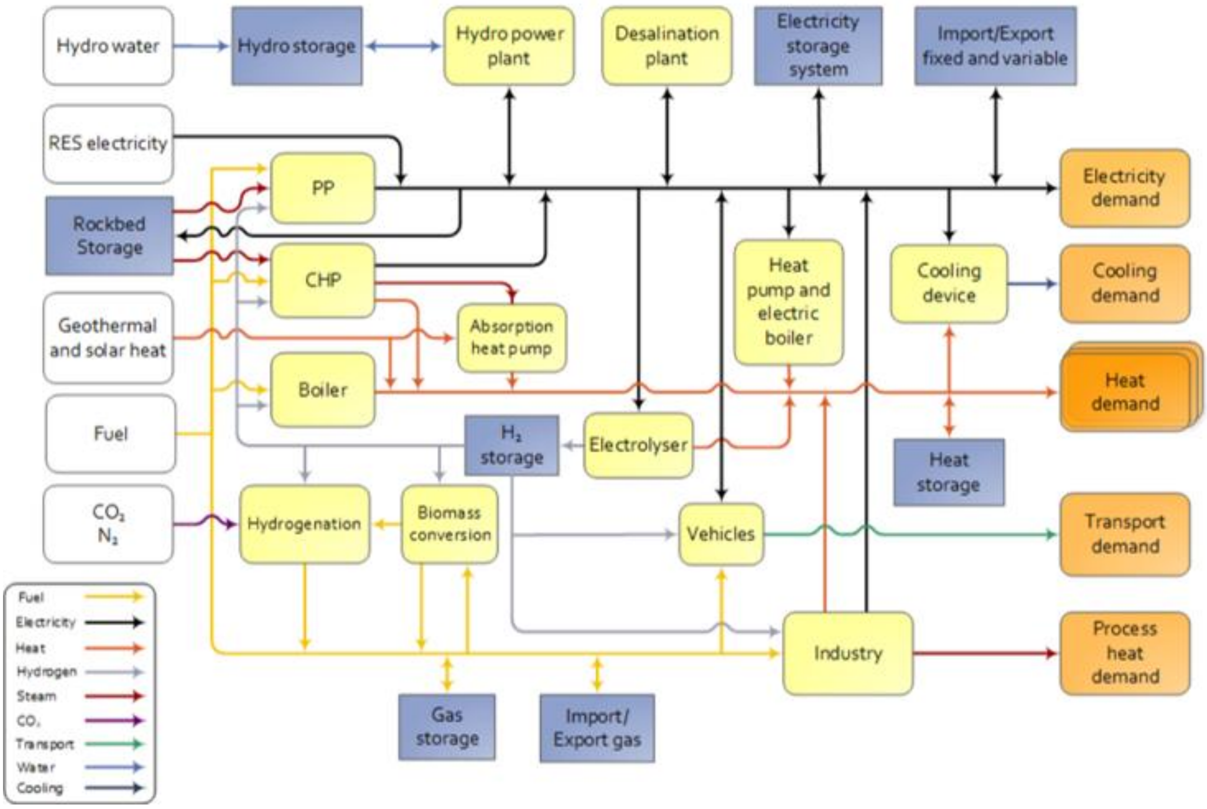


Figure 2. Overview of the EnergyPLAN model

Figure 2. provides a schematic representation of the EnergyPLAN model, a well-established simulation tool for analyzing and planning the future development of energy systems, as demonstrated in the scientific review, that brings forward hundreds of use cases for this model[4]. The model features a user-friendly interface, making it accessible for researchers and practitioners to evaluate the integration of various energy sources, storage solutions, and demands while assessing technical, economic, and environmental impacts.

[4] Review and validation of EnergyPLAN (access link)

Post-Processing and Analysis

The post-processing phase focuses on extracting meaningful insights from simulation outputs. Key steps include:

- **Analyzing Performance Metrics:** This involves assessing key indicators such as the share of renewable energy, greenhouse gas (GHG) emission reductions, job creation potential, and cost structures. These metrics help evaluate the overall performance of the scenarios.
- **Comparative Analysis:** Scenarios are benchmarked against each other to identify the relatively best strategies. This includes analyzing trade-offs between technical, economic, and environmental outcomes to guide the selection of the most effective energy transition paths.
- **Generating Visual Outputs:** Charts and graphs are created to visually present trends, comparisons, and critical outcomes, making the results more accessible and comprehensible for stakeholders. Although EnergyPLAN can produce charts internally, an MS Excel-based tool is developed for easier work of non-technical staff of the end-users.

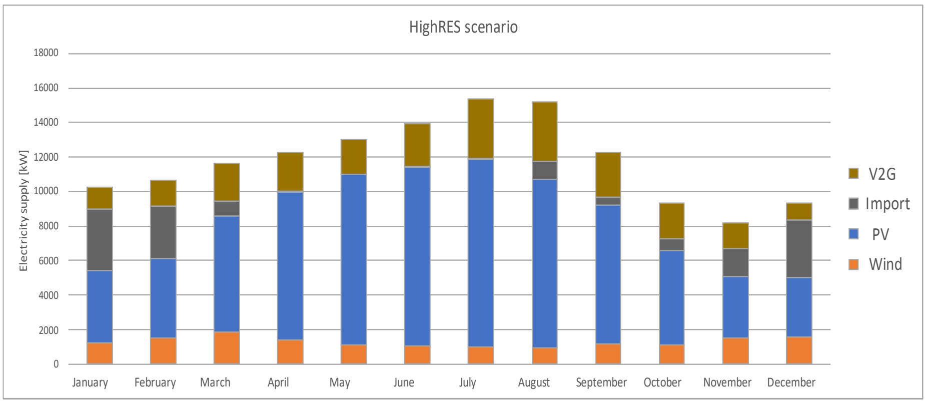
This phase enables stakeholders to make informed decisions, tailoring energy transition plans to local priorities and conditions.

3. Expected Results

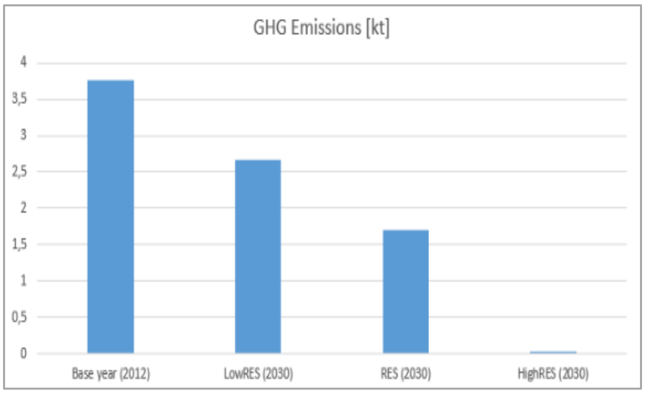
The method offers stakeholders valuable insights and practical tools to guide their energy transition efforts. It enables the development of optimized energy systems by modeling scenarios that effectively balance the integration of renewable energy with cost efficiency and system reliability. The approach provides robust quantitative evidence to support local energy policy and planning, ensuring that strategies are grounded in data and tailored to regional needs. Additionally, it highlights the significant potential for climate action, demonstrating measurable reductions in greenhouse gas (GHG) emissions achievable through renewable energy adoption. With its flexible design, the methodology can be scaled and replicated across diverse regions and contexts, making it a versatile solution for a wide range of energy planning challenges.

Figure 3 provides an overview of the types of results that can be generated using the EnergyPLAN simulation tool.

Figure 3a



Figures 3b,3c



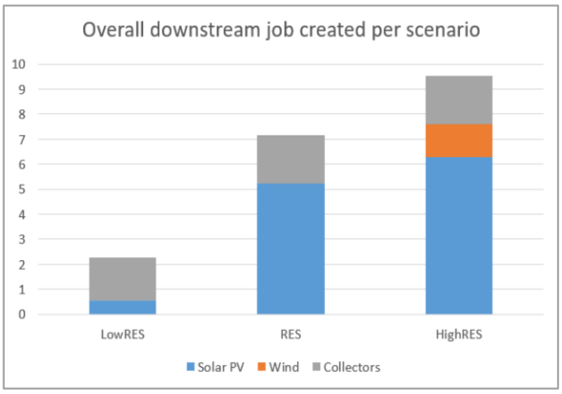
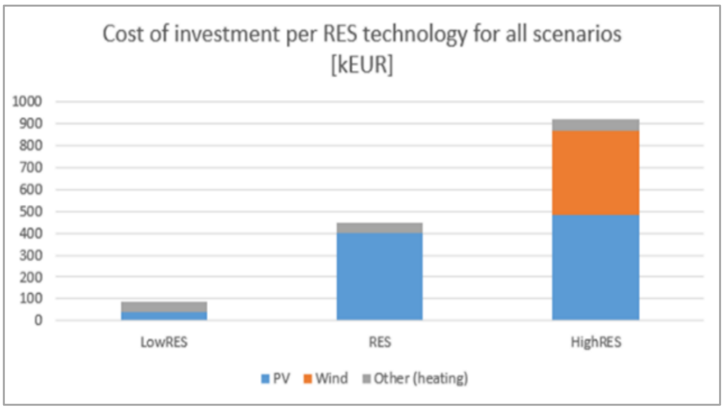


Figure 3d



Figures 3a, 3b, 3c, 3d Visualisation of EnergyPLAN Simulation results

Figure 3a illustrates the monthly share of electricity production by technology, highlighting seasonal variations and the contributions of different energy sources. Figure 3b section shows the greenhouse gas (GHG) emission reductions achieved under different scenarios. Figure 3c section presents the potential for job creation linked to renewable energy investments, while Figure 3d the cost distribution for renewable energy technologies across scenarios. These results demonstrate the tool's ability to deliver comprehensive insights to support evidence-based energy planning and decision-making.

Resources for further learning:

https://energyplan.eu/guides-training/training-exercises/

https://energyplan.eu/guides-training/tutorial-videos/