E-TREND

Extensible Tools for Renewable ENergy Decision making

DURATION
1/09/2022 – 1/12/2026

BUDGET
1 027 486€

PROJECT DESCRIPTION

The increase of renewable energy sources has been committed to by the Belgian Government in different national and international agreements, such as the Paris Agreement and the revised renewable energy directive 2018. E-TREND aims at research results that will allow better-informed decision making in the context of adaptation and mitigation. The project fits into the European efforts to enable a faster transition to a net-zero emissions EU economy by 2050.

The main goal of E-TREND is the development, validation and demonstration of fast-engineering-based solutions to leverage weather forecasts and climate data for decision making purposes by Belgian stakeholders such as grid operators, renewable energy suppliers and balancing service providers. The aim is to consider the whole chain from weather forecasts and climate projections, enhanced with statistical post-processing techniques and machine learning (ML), through renewable energy forecasting models, to end-user applications. This includes the scientific domains of meteorological forecasting, climate scenarios and modeling of wind energy, PV energy and electricity consumption. Apart from the integration of current best models and practices, our intention is to go beyond the state of the art in key areas such as the topic of uncertainty propagation in a forecasting chain and the use of probabilistic information by end users. Such information allows risk assessment by quantifying the risk of potential extreme scenarios.

In methodology, the project intends to go beyond the state of the art, with scientific developments in specifically targeted key areas such as uncertainty quantification, statistical post-processing based on machine learning, coupling of weather models and regional climate models to a Wind-Farm Atmospheric Perturbation Model, and improved nowcasting of solar irradiance for PV production modeling. The developed scientific methods, tools and techniques will be tailored for stakeholders in the energy sector to aid in their decision-making process for operations and planning. Involvement of Belgian stakeholders implies that their input will also help drive the research and development choices.

The main domain impacted by E-TREND is the science of renewable energy sources (RES) modeling. The ambition is to go beyond the state of the art, which should lead to major advancement in scientific knowledge and the development of new models, methods, and techniques. A strong impact is foreseen on the economy and the domain of policy and public services. Improved weather forecasts are valuable to wind farm operators for operational planning and maintenance, while improved renewable energy forecasts aid energy companies with portfolio management and trading in the energy market. Efficient deployment of renewable energy sources has become part of the core strategy of the Belgian Transmission System Operator (TSO) to reach net-zero greenhouse gas emissions by 2050. More reliable RES forecasting will allow the TSO to improve their risk assessment and will diminish unnecessary pre-emptive measures involving fossil-fuel burning to prevent energy shortages. Thereby, E-TREND contributes directly to mitigation. Longer-term planning by the TSO and government agencies (e.g., resource assessment) will be aided by E-TREND RES generation projections from high-resolution regional climate models over Belgium. Aiding with more efficient deployment of renewable energy sources, impacts society as whole through reduction in the use of fossil fuels, which has a positive impact on the environment, health, and general quality of life.

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Expected final research results include:

- Verification reports on various available weather models for RES forecasting purposes (probabilistic and deterministic).
- Scientific publication on new ML-based statistical post-processing methods tailored for RES forecasting.
- Recommendations and report on the effect of climate change on energy production in Belgium, making use of the newest high-resolution regional climate projections, focusing on extreme events.
- Development of a new RMI radiation nowcasting module.
- Case study on coupling of RMI ensemble weather models to a KU Leuven wind farm atmospheric perturbation model.
- Development and validation of a PV generation forecast model based on a combination of meteorological input (nowcasting and NWP models,) physics-based PV system models and ML-based algorithms.
- Scientific publication on high accuracy and fast algorithms for PV generation forecasting.
- Case study on the predictability of wind farm ramping events, and the impact of climate change on future events.
- Presentations at various international conferences on renewable energy generation forecasting.
- A scientific workshop on renewable energy forecasting, during year 3 of the E-TREND project.
- PhD's based on the work of personnel working on the E-TREND project at RMI, KU Leuven and University of Antwerp.

CONTACT INFORMATION

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