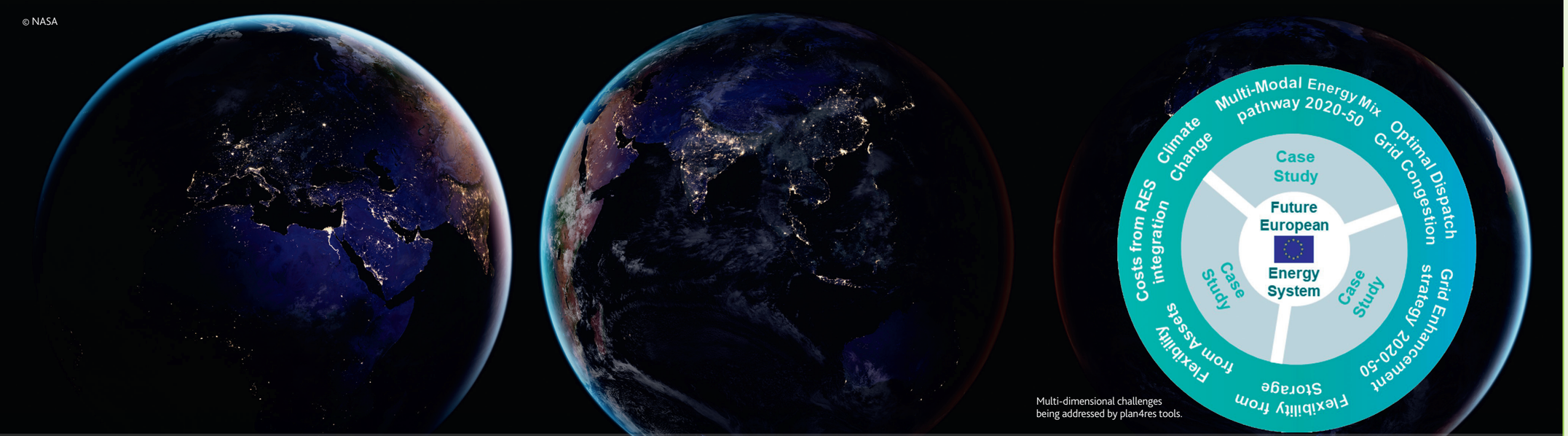

Multi-dimensional challenges being addressed by plan4res tools.

Planning for the new energy landscape

Renewable sources of energy like wind and photovoltaics produce a variable output, which poses new challenges in terms of planning and operating the European Energy System. We spoke to **Sandrine Charousset** and **Danny Pudjianto** about the plan4res project's work in developing new tools for supporting the integration of increased renewable energy within the system.

The European electrical system was designed for a world in which energy was mainly generated by traditional power plants, like those based on burning fossil fuels. However, with the EU setting ambitious objectives for reducing carbon emissions by 2030 and then 2050, many countries are now looking to decommission these plants and replace them with renewable sources of energy. "This means mainly photovoltaics (PV) and wind power, but also hydropower," says Sandrine Charousset, research director at EDF and coordinator of the plan4res project. These renewable sources are intermittent by nature and so cannot provide a guaranteed supply, which poses a challenge in terms of planning and operating the energy system, a topic at the heart of plan4res. "In plan4res we are trying to develop and implement tools that will help to plan and manage the European energy system more effectively," explains Charousset. "The objective is to have a system that can host more renewables and take advantage of the flexibilities that exist."

This research is centred around the question of how energy demand can be met while also increasing the use of renewable sources. While previously a system planner would typically use data on peak demand to identify how much capacity is needed in a system, the inclusion of more renewable sources of energy greatly increases complexity. "The number of operating conditions that need to be taken into account during planning increases exponentially," says Danny Pudjianto, a researcher at Imperial College London, one of the partners in the project consortium. The growth of the electric vehicle market and the trend for people to engage in individual demand response are also important considerations. "People may adapt their energy load according to different incentives and tariffs, like using their washing machine at a point when energy is cheaper," outlines Charousset. "There is also load curtailment, where people may choose not to consume energy at a specific time."

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Planning and operation

The tools currently available for planning and operating the energy system are not well-suited to this changing situation, an issue that the project is working to address by developing an end-to-end planning and operation tool built on a set of optimisation models. The project brings together partners with deep mathematical and technical expertise to deal with the complexity of the different problems around energy planning and operation. "A large amount of work has been done on algorithms and mathematical optimisation methods in the project. Our partners have deep expertise in optimisation methods" says Charousset. "We are developing an entirely new and innovative modelling framework, endowed with state-of-the-art algorithms, that will be open-source. It will be available at the end of the project, and it will contain many different modules, among which are ones for stochastic optimisation, decomposition algorithms and large-scale mixed-integer programming, together with many ready-to-use modules for energy optimisation problems."

This is part of the goal of developing improved planning tools in line with wider objectives around reducing carbon emissions. An integrated representation of the European energy system, including sector coupling of electricity, heating & cooling, mobility and fuels, is an important step towards the development of improved planning tools, as certain forms of renewable energy may be generated in higher quantities in certain areas. "One of the difficulties is to identify the right balance between building new generation capacity in some places, extending the capacity of the interconnections between different zones, and increasing storage capacity in other zones," says Charousset. "The solution is to find the right balance between generation, inter-connection and storage, in different regions. This is closely correlated with the existing energy mix, as well as physical factors, like prevailing wind patterns."

A set of tools have been developed in the project to help build a deeper picture in this respect. On the supply side, tools for planning energy generation have been developed, while Pudjianto and his colleagues have also been working on a transmission planning tool. "The challenge there is in the uncertainty involved in planning the pan-European transmission system. For example, there is uncertainty about how much wind energy will be generated in the North Sea," he explains. While storage capacity can be expanded relatively quickly, building a transmission network is a costly, long-term investment, so the asset in question must be used as efficiently as possible. "Suboptimal capacity means it is a stranded asset or heavily constrained, which both cost money. And ultimately the customer will pay," points out Pudjianto. "There are risks associated with making this kind of investment."

The next step, once the tools have been validated, would be to apply them in the practical sphere. The project consortium brings together both academic and commercial partners, and Charousset says EDF are keen to bring these tools to practical application. "One of our main objectives is to develop tools that we could use in our own operations," she says. A variety of different tools have been developed in the project, and they will be used in several studies, while they will also be implemented in a related H2020 project called Open Entrance. "This project is less industrially-oriented. The objective is to build a platform for sharing data results and open models," continues Charousset. "The models that have been implemented in plan4res are currently being connected to the Open Entrance platform where they can be used in some studies. This platform will be open access, so they can also be used by other people from outside the project."

High performance computing

A further dimension of the project's work involves the development of an IT platform, designed to provide access to data and high-performance computing (HPC) resources. Many of the problems around energy management and energy modelling cannot be solved on an office PC, so access to HPC resources can be highly beneficial, another topic that is being addressed in the project. "Our partners are implementing tools for dealing with workflows and parallelisation, and the use of different kinds of HPC resources," continues Charousset.

Plan4RES

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

Project Objectives

Plan4RES is a collaborative research and innovation project which aims at developing an end-to-end planning tool to successfully increase the share of renewable energy into the European Energy system without compromising on system reliability. The targeted platform will account for the Pan-European interconnected electricity system, potential synergies with other energy systems, emerging technologies and flexibility resources, providing a fully integrated modelling environment.

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Project Partners

https://www.plan4res.eu/project/consortium/

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