# SHEDDING LIGHT ON THE FUTURE OF THE POWER SYSTEM

# ANTARES - SIMULATOR

antares simulator

Rte international

# INTRODUCTION

## Keys of the tool

1

Antares is an open-source tool that is immediately available and can be used for free.

2

Antares is a reference tool in Europe (TYNDP, ERAA, French Energy Outlook, Elia Flexibility Studies, etc.)

3

RTE international provides all the services associated with the software, namely studies, support, training and development.

# ANTARES - SIMULATOR

Antares-Simulator is an Open Source (GNU GPL 3.0) power system simulator meant to be used by anybody placing value in quantifying the adequacy or the economic performance of interconnected energy systems, at short or remote time horizons.

With an adequate modelling of the energy consumption, generation and transportation, the software performs probabilistic simulations of the system throughout many year-long scenarios made of 8760 hourly timeframes each.

Transmission system Operators, Power and Gas Producers, Regulators, Academics, Consultants, NGO and all other actors concerned by energy policy issues are welcome to use the software.

## The open-source demand

The Antares-Simulator project was launched by RTE (French Electricity Transmission System Operator) in 2007.

The massive development of intermittent renewable energies, the multiplication of local experiments related to smart-grids, the assessment of the potentialities offered by storage technologies (batteries, power-to-gas) are typical examples of strategic issues whose analysis require the assistance of a software application such as Antares-Simulator.

### Explore

Explore prospective visions of the energy sector

### Analyse

Analyse the costs and benefits of a new generation or interconnection project

### Assess

Assess the impact of a given energy policy on the generation mix

### Evaluate

Evaluate the level of security of supply of the upcoming years

## IMPROVE YOUR STUDY

Antares - Simulator is an open-source software for supply demand balance study. This open-source software was developed thanks to a wide community of Users.

It can be used for long- and short-term adequacy studies and this is considered as the most powerful probabilistic software used in reference studies. Perform Unit Commitment and Economic Dispatch on an hourly basis for a wide range of scenarios.

### Working with Antares - Simulator

It's a probabilistic tool allowing to simulate thousands of futures.

It can help to consider many climatic scenarios combining with availabilities scenarios like for example the maintenance and outage of thermal power plants or scenarios of inflows for hydro power plants.

### Antares - Simulator assess

#### Security supply

- LOLE (h)= Loss of Load Expectation
- Unsupplied energy (MWh)
- Current margin

#### Production cost

- System costs
- Marginal costs
- Cost of curtailment
- Cost of unsupplied energy
- Exchange between areas

#### CO2 emissions

- Renewable production
- Spilled energy
- Generation plan

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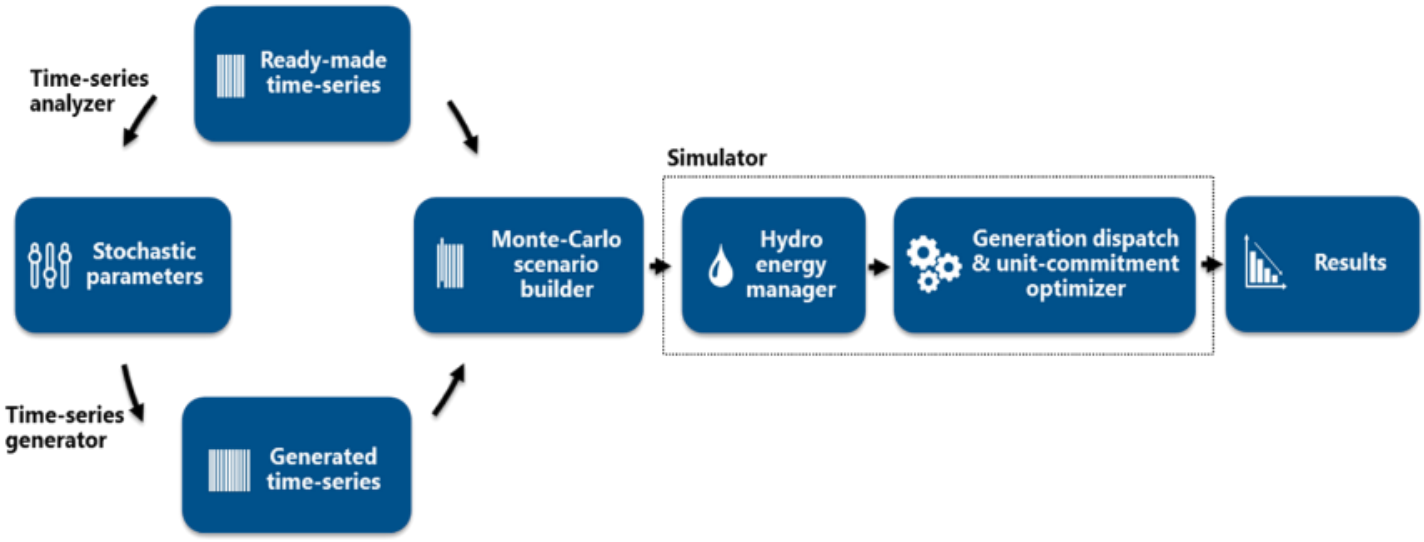
## A Monte Carlo year

The program picks one series of each kind (by random or by user choice to keep climatic consistency), to build the so-called « Monte-Carlo years ». The unit commitment is then performed on each of these Monte-Carlo Years.

### The benefits of the Monte Carlo year




When ready-made time-series are not available or are too scarce for building the required number of Monte-Carlo annual simulation scenarios, Antares provides means to generate sets of stochastic time-series to use instead. The different categories of time-series call for wholly different generation processes if this is for thermal power or for hydropower.

For each Monte-Carlo scenario, Antares optimizes the unit-commitment and dispatch so as to meet the demand at the lowest cost. Each year is seen as a succession of weekly optimization sub-problems whose objective is the minimization of the electricity supply costs. All of these problems are defined at the spatial scale of the whole interconnected system.

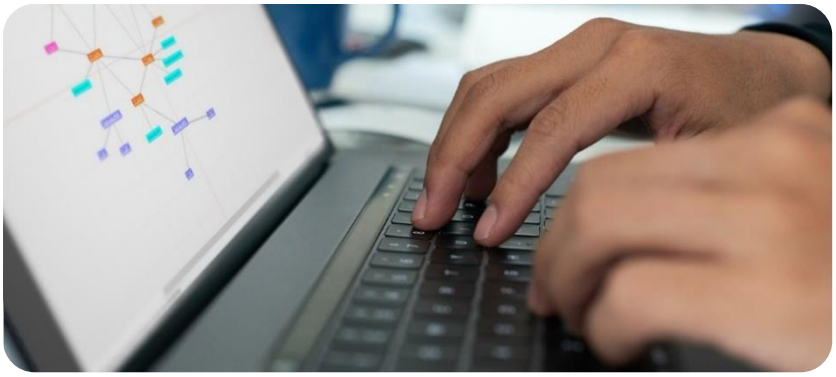
# ANTARES - SIMULATOR SUPPORT SERVICE

**Either via the standard support services, or with specific support services, RTE international can support you in your use of the software.**

## Responses to questions relating to software operations

RTE international experts will provide support for question related to the normal and expected software use.

RTEi experts will also provide support to users for the creation and the implementation of their models and the integration of this tool in their business processes.



## Support with new software versions

When a new version is released, a Notification will be sent to the customer together with a description of the new version.

In depth Analysis of your models and the support on your studies.

Based on your use of Antares – Simulator, we can support you in all questions related to the studies you're conducting.

# ANTARES - SIMULATOR TRAINING

## We offer a wide range of training courses aimed at enabling our clients to face the challenges of worldwide energy transition.

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Your job requires rigor and anticipation. The field of electricity, which is undergoing rapid change, is highly demanding.

RTE has get an international reputation for the quality of its power system, its planning capacity, and the skills of its teams.

The training can cover different topics with several session beginners or advanced audience.

**Beginner**

This training is intended for new or inexperienced users of the tool who need to reinforce their basic skills on the tool.

**Advanced**

This training session is intended for engineers, researchers and project managers working for transmission system operators, electricity and gas producers, regulators, universities or NGOs. Please note that the number of participants will be limited.

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**ADVANCED TRAINING SESSION**

**Register here**

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# JOIN OUR ANTARES USER CLUB


**The Antares User's Club aims at gathering advanced users of Antares and elaborate jointly the roadmap of the application.**

## Users club membership

The "User Club membership" offer contains:

- The participation to the User's Club meetings
- The access to expert documentation and exchanges on advanced features of Antares - Simulator
- Participate to the roadmap of Antares by defining and selecting the developments to be made by the resources of the User's Club

## During the Antares User's Club meetings, you will especially attend to:

- Technical discussion on new features of the tools
- Presentation of the roadmap of Antares - Simulator
- Definition, evaluation, and selection of new features to be developed on behalf of the user's club
- Presentation of the latest version of the tool
- Ad hoc discussion on proposed topics by the user

## BENEFIT FROM A WIDE RANGE OF EXPERTISE

**In addition to support service and software development, RTE international also has a comprehensive range of expertise on the business end and can provide its customers for:**

All types of network studies:

- Investment plans
- Development of the grid
- Market models
- Adequacy studies
- Power market analysis
- Cost benefits analysis

Over the last years, RTE international experts have in particular developed specific skills on the following topics, using Antares to run the studies

- Renewable integration
- Security analysis
- Sizing of energy storage system

## REFERENCE STUDIES WITH ANTARES

### French generation adequacy report

The French Generation Adequacy Report studies the risk of the production fleet not being able to satisfy the French electrical demand over a medium-term period of 5 years.

Since 2012, the simulations of the French generation adequacy report are performed with Antares.

### Ten years network development plan (TYNDP)

The TYNDP is a long-term plan on how the electricity transmission grid should evolve in Europe to implement the Energy Union strategy.

It is published every two years by the ENTSO-E (the European Network of Transmission System Operators).

### Volume determination of the Belgium strategic reserve

Elia is publishing every year a probabilistic analysis of Belgium's adequacy for the upcoming winter which sets out the volume of strategic reserve required to adequately meet the legal criteria in terms of security of supply.

The market simulations made in the framework of this study are carried out by Antares-Simulator.

### E-Highway 2050

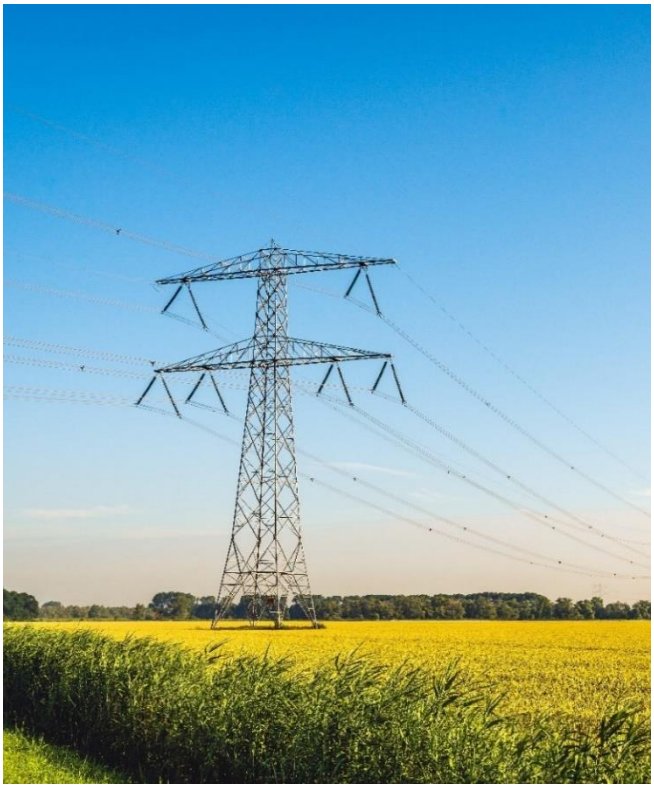
E-highway 2050 aimed at developing a grid planning methodology and to apply it over several trajectories.

Robust network development strategies have been built using extensive simulations made with Antares-Simulator over a perimeter of more than one hundred regions covering all Europe.

## ABOUT RTE INTERNATIONAL

RTE international is a consultancy and engineering company whose activities cover all areas of electricity transmission. RTE international is at the service of its clients worldwide, helping them to develop reliable and competitive power systems which rise to the challenges of the energy transition.

As a subsidiary of RTE, Europe's largest transmission system operator, RTE international offers tailored solutions to participants in the electricity sector, relating to the development, operation, and maintenance of their networks.



Since its creation in 2006, RTE international's experts have carried out more than 300 projects in over 50 countries across all continents, building on the know-how and skills developed through RTE's 70 years of successful operation. RTE international employs more than 70 members of staff and more than 100 experts each year.