

# Flow-based capacity calculation for prospective studies

Improving the power grid physics modeling in long-term studies

## Why join Artelys

Artelys is specialized in mathematical optimization, quantitative decision-making and scientific modeling. Relying on its high level of expertise in quantitative methods, Artelys delivers efficient solutions to complex business problems. They provide services to numerous industries: Energy, Transportation, Telecommunications, Manufacturing, etc. Artelys is an international company with offices in France (Paris, Lyon, Nantes), Canada (Montréal), Belgium (Brussels), and the USA (Chicago).

Artelys offers several products and services, including software solutions (mathematical optimization software, business specific customized and custom solutions), studies, consulting, training, etc. In particular, Artelys consultants deliver prospective studies that evaluate the optimal multi-decade trajectory for the multi-energy mix at a continental level. Improvements are needed in order to model more realistically the physics of the power grid.

## Description

Most long-term grid models are zonal, i.e. only large zones -typically the size of a country- are represented. Power transfer capacity between zones is usually modeled through simple links with limited capacity between neighboring zones. This approximation is not realistic in meshed grids (e.g. only 20% of flows between France and Italy transit through the boundary lines between the countries. The remaining loops through Germany and Switzerland but also for a significant share through Belgium, the Netherlands, Austria, and Slovenia). This is due to the second Kirchhoff law that flows are higher on low impedance paths between generation and loads.

As a result, better models have been developed. Among them, the so called “Flow-Based” models are now widely used in Europe: Based on a detailed grid representation including all network elements, individual lines capacity constraints are aggregated into linear inequalities linking country-level exchanges. As a result, the joint impact of all exchanges on each line is considered and it is possible that a line between Austria and Italy limits the exchange from France to Italy because the exchanges between Austria and Italy are already very high. This set of inequalities is defining a so called “flow-based capacity domain” that represents the domain of feasible power transfers between modelled countries.

In long term studies, the flow-based domain is computed after grid expansion, i.e. after adding new lines to the network. It allows to compute with increased precision the benefits of these new lines.

The internship will focus on the design and the implementation of a Flow-Based capacity calculation methodology using PowSyBl (a set of power system modeling tools). Once the domains will have been computed, the intern will demonstrate their use in a long-term study thanks to Artelys Crystal Super Grid.

## What we are looking for

The candidate must be in his/her last year of master's degree in computer science and/or applied mathematics and/or power systems and/or operations research.

Required skills:

- Programming in Python
- Linear algebra

Valued skills:

- Power Systems (Power Flows and Power System Economics)
- Mathematical optimization
- Programming in Java
- Python numpy
- Fluent in French

## Benefits

The duration of the internship is 6 months. The internship will take place in our Paris office. The internship may lead to a long-term job offer.

## Application

Send us your cover letter and curriculum vitae via the Artelys website: [www.artelys.com/careers/](http://www.artelys.com/careers/)