Artelia has constantly stepped up its research efforts in the area of renewable energy and now boasts innovative methods, tools and technologies covering the entire field. Energy efficiency is likewise an important topic of innovation.

Thermodynamic solar technology, which produces high-temperature heat from direct sunlight using a concentrating optical system and then electricity by thermodynamic conversion, is once again back on the agenda. Artelia is developing new methods and software for modelling the technical and economic aspects of concentrating solar plant (CSP) performance. Our research focused on the hybridisation of thermodynamic solar power plants with conventional coal-fueled ones, on linking up with seawater desalination technologies, and on adapting to low-power situations. The design and engineering contracts that Artelia has won internationally offer ideal sites for testing these innovations.

Mathieu Vrinat
Project Manager
Renewable Energy

The main focus was to **optimise the performance of hydropower plants**, in particular that of low-head ones (PENELOP2 project). 3D models of various types were linked in order to gain a better understanding of the interactions of flows in dam approach and outflow areas on the one hand, and those occurring in the generator inlet, the turbine itself and the draft tube on the other. Careful modelling of flows in the inlet of a real turbine enabled us to optimise the positions for detailed flow-measurement instruments. Artelia also worked on improving the hydro-mechanical equipment of a power plant and the methods for sizing large-scale underground structures in hydropower projects.

Complementary use of renewable energy is the subject of the ENERSTOCK3 research project. The aim is to design and test a distribution network managing several types of energy production (hydro associated with wind and solar) and energy storage (batteries and pumped storage) for applications in isolated areas such as islands.

Marine energy is the subject of ongoing research, with a particular focus on systems for harnessing current and wave energy. Artelia took out a patent in 2010 for a hydraulic funnel system supplying a vertically guided raised tank from which the water is then used to drive a turbine. The group has since continued to work on improving and validating its performance.

In the area of **low-grade geothermal energy**, Artelia worked on improving energy management for urban aquifers, in particular the interactions between several geothermal projects. 3D models combining water and heat transfer and taking into account complex existing underground facilities have been developed as the main resources for these studies.

To identify the **socio-economic aspects of renewable energy schemes**, Artelia's climate and energy team has elaborated an innovative program for performing an energy assessment on an individual structure or building as well as a methodology for evaluating the relevance of involving a regional funding body on energy efficiency and renewable energy use. New methods have also been developed for defining regional energy strategies.

Extensive work has also been carried out in the areas of **thermodynamic solar technology** (described opposite) and the **energy performance of buildings** (described elsewhere in this report).

Thibaut Ulrich
Director
Energy, Dams
& Hydraulic Works

Hydropower production has once again become a topic of interest, but it faces new challenges connected with the reliability and safety of the installations and compliance with new environmental regulations, all of which requires further research. Artelia is involved in hydropower projects whose size and complexity increase on difficult sites due to geological and seismic conditions, the extent of floods, and sediment transport. These projects require structures that are sometimes at the limit of state-of-the-art knowledge and call for innovative physical scale models, new calculation methods to assess their behaviour, particularly in the event of earthquakes, as well as intelligent use of lessons learnt on previous major construction projects.