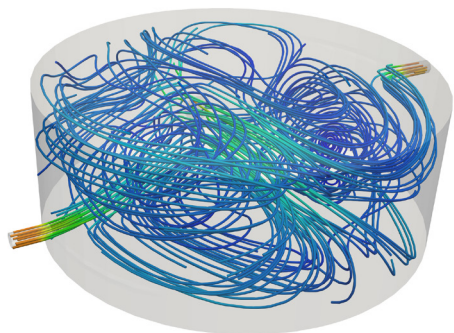


## Digester 2.0: Optimization of the anaerobic digestion process for biogas generation

### Fortissimo Experiment Facts:

- Industry Sector: **Energy**
- Country: **Spain**
- Software Used: **OpenFOAM**



### ORGANISATIONS INVOLVED

NORVENTO (End User) is a company focused on the promotion and development of energy production facilities based on renewable energies (wind, sun and biomass), as well as in the manufacture of wind turbines. Norvento has had a presence in the biogas sector since 2010 and currently owns and manages two plants in Galicia, Spain.

ENERGYLAB (Domain Expert) is a Spanish (non-profit) private technology centre specialising in energy efficiency and sustainability, including research topics related to biogas.

UNIVERSITY OF MINHO (Application Expert) with the expertise in Computational Modelling and Simulation.

CESGA (HPC Centre), Spain, is the centre for computing, high performance communications systems and advanced services addressing the needs of the Galician Scientific Community.

### THE CHALLENGE

Anaerobic Digestion is the process by which microorganisms degrade organic matter in the absence of oxygen, producing a methane-rich biogas stream that can be used for energy generation. Industrially this process takes place in large full tanks called anaerobic digesters. This experiment's main motivation was to prove that an optimal energy balance between energy consumption and production can be achieved in small-scale anaerobic digesters. The development of a computational modelling solution to simulate digesters and support the design and optimization of the energy balance was seen as a potential solution to the development of advanced digesters.

### THE SOLUTION

Before this experiment, there was no integrated model for the design of anaerobic digesters considering flow and biological aspects, able to take advantage of high-performance computing (HPC) systems.

A new open-source based solution that allows the simulation of flow (fluid dynamics) and biological aspects of an anaerobic digester was developed within the framework of the Digester 2.0 experiment. Due to the scales involved in the process (300 m<sup>3</sup> for anaerobic digester and particles around 0.01 cm<sup>3</sup>), the numerical solution of this coupled problem is very complex. Highly refined meshes are needed, which results in large computation times. Consequently, the solution requires HPC capabilities to provide results in an affordable time which model the engineering processes.

#### Fortissimo Experiment Partners:

- **Norvento** (End User)
- **EnergyLab** (Domain Expert)
- **University of Minho** (Application Expert)
- **CESGA** (HPC Provider)

#### More Information:

[www.fortissimo-project.eu](http://www.fortissimo-project.eu)  
[info@fortissimo-project.eu](mailto:info@fortissimo-project.eu)



Universidade do Minho



## BUSINESS IMPACT

Design and optimization developed tools allow Norvento to reduce volume and cost of industrial anaerobic digesters, increasing the amount and quality of the produced biogas while reducing the energy consumption (needed for mixing and heating). As a result, Norvento renewable energy power plants are able to increase their electrical and thermal production.

For Norvento, a cost reduction in investment and maintenance as a direct outcome of reduced size digesters, will improve and support a profitable and sustainable business, and favour new business lines, such as the implementation of on-site digesters for cattle raising installations.

EnergyLab obtained a valuable knowledge of fluid-dynamics, HPC and simulation models. Potentially, new services focused on energy efficiency, based on the HPC simulation tools developed, can be set up and included in the EnergyLab service portfolio.

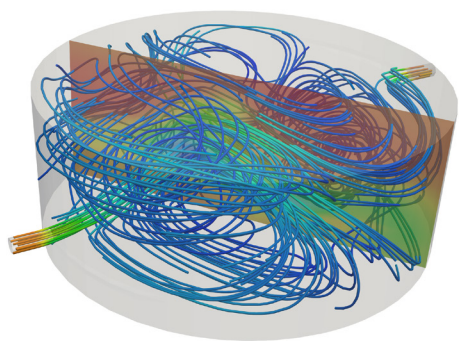
The University of Minho developed the simulation solver based on OpenFOAM and acquired valuable insights in a completely new area for them: the simulation of processes involving chemical reactions. The knowledge obtained and the developed tools may be relevant for other industrial applications such as the polymer processing area where UMinho has extensive experience.

## BENEFITS

- 5% increase of thermal and electrical production of Norvento's biogas plants.
- More efficient digesters will contribute to the reduction of greenhouse gas emissions.
- New strategic services in the EnergyLab service portfolio and growth expected by 30% in total sales. The growth in turnover of the EnergyLab non-profit centre will result in increased staff.

## THE FORTISSIMO PROJECT

Fortissimo is a collaborative project that enables European SMEs to be more competitive globally through the use of simulation services running on a High Performance Computing cloud infrastructure. The project is coordinated by the University of Edinburgh and involves more than 100 partners including Manufacturing Companies, Application Developers, Domain Experts, IT Solution Providers and HPC Cloud Service Providers from 14 countries. These partners are engaged in over 90 experiments (case studies) where business relevant simulations of industrial processes are implemented and evaluated. The project is funded by the European Commission within the 7th Framework Programme and Horizon 2020 and is part of the I4MS Initiative.



**I4MS** Fortissimo is part of I4MS ICT Innovation for Manufacturing SMEs: [www.i4ms.eu](http://www.i4ms.eu)



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