# NEWSLETTER

Second issue-December 2017

*New generation of intelligent efficient District Cooling systems*

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## Activities

In the year 2017, INDIGO project has had a good amount of communication and dissemination activities, plus two technical meetings of the Consortium, including the visit of the External Advisory Board. Some of the highlights are:

- INDIGO Zenodo community with all of our publications: scientific papers and public deliverables.
- Publications:
  1. *Development of Future EU District Heating and Cooling Network Solutions, Sharing Experiences and Fostering Collaborations.* R2M. Proceedings 2017, 1, 974.
  2. *Models for fast modelling of district heating and cooling networks.* TEK VTT. Renewable and Sustainable Energy Reviews (2017).
  3. *Energy Efficiency Facets: Innovative District Cooling Systems.* R2M NUIG VTT. Journal: Entrepreneurship and Sustainability Issues. 2017, 4 (3), 310-318.
  4. *ICT-Technologies for Energy Efficient Buildings and Districts.* VTT TEK. Conference paper: 41st IAHS World Congress on Housing 2016.
- Organization of 2 workshops:
  1. *District Energy Systems: Opportunities and Challenges for the EU and Ireland.* 29/03/2017 NUIG, Galway. (Figure 1)
  2. *Development of future EU district heating and cooling network solutions, sharing experiences and fostering collaborations.* R2M. Conference: Sustainable Places 2017. 29/06/17 Middlesbrough, UK. (Figure 2)
- INDIGO project featured in @CORDIS_EU Twitter header. (Figure 3)

## Project facts

Project Type: Research and Innovation Action  Start Date: March 2016

Call: H2020-EE-2015-2-RIA  Budget: €2.229.321,25  Duration: 42 months

# Results - DCOL

Models for District Cooling (DC) components are either too simplistic or too complex. However, trade-off models that offer a balance between level of detail, computational demand and accuracy are rare. In addition, there is not a complete modelling library that includes the models of all the systems/components of a DC network. This results in extra work for modellers that must use models from different developers and diverse simulation environment as they have to deal with the models' compatibility.

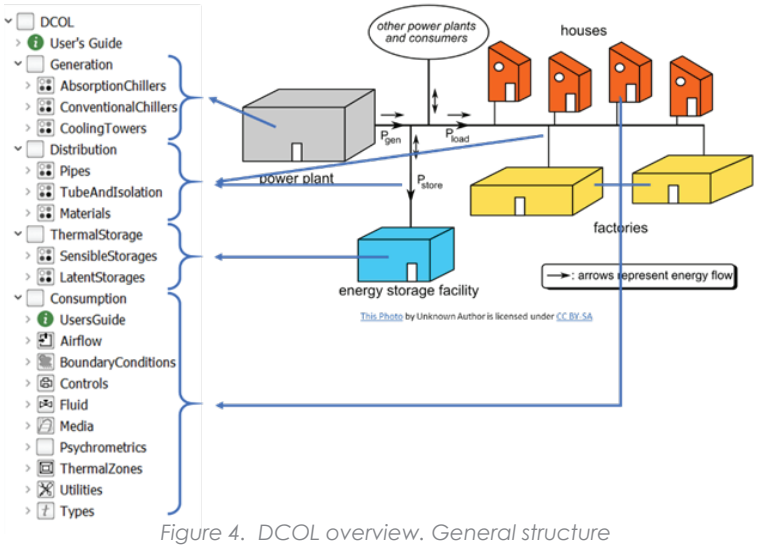


*Figure 4. DCOL overview. General structure*

DCOL addresses these problems. The library is based on Modelica, an open-source M&S language that represents a paradigm change for dynamic simulation and is rapidly becoming the de-fact standard for buildings and DC simulation. The library contains all the system/component models required to model and simulate an entire DC network typically found in the market (see Figure 4).

**Why DCOL?**

- New DC modelling library for Modelica users that contains new models or the improvements of existing models
- Suitable for further Predictive Controllers developments and DC systems simulations
- Supporting tool for new design development of components and control solutions
- Unified simulation tool with generation, distribution, storage and consumption models for modelling and designing DC networks and the corresponding control systems
- Suitable for model simplification (useful for model-based applications that require reduced models).

**To whom is DCOL meant for?**

- ESCOs and designers - This library provides the DC systems' designers (private ESCOSs and others) with insights about the physical behaviour of DC systems, thus allowing for a better overall system design.
- Component manufacturers – Using an open-source development environment allows component manufacturers to modify or extend DCOL so they will be able to verify and test their developments. This allows to assess the effect of introducing a new component at any DC network level since DCOL includes models of components for generation, distribution, storage and consumption systems.
- Control solution manufacturers – The library will assist them in two ways. On the one hand, the models are meant to be easily reduced to be used for predictive control development (reduction guidelines are part of the outcomes of INDIGO). On the other hand, DCOL allows control designers to model DC networks in order to run virtual scenario tests during the control system development phase.
- Modelica users / Energy modellers – Energy modellers, especially those working as consultants for ESCOs or for designers, have at their disposal an open-source tool that allows DC modelling & simulation in detail.

# Results - District Cooling Planning Tool

The Planning tool provides means for evaluating the performance, benefits and potential of a District Cooling (DC) system. The aim is to create an easy-to-use open-source tool that enables analysis of a cooling system in defined area with a group of buildings connected.

At this stage, the structure of the tool is designed, with input and output parameters defined. The results will be further used as input for a Life Cycle Analysis (LCA) to obtain both economic and climate impact analysis for the system.

The tool is aimed to be easily configurable by providing the user possibility to try out and compare effects of different assumptions on component specifications, costs and other input data. Feasibility of a DC system may be studied, and comparisons to building and/or space specific cooling systems can be made, presenting the benefit of DC.

In its current stage the, the report on the planning tool:

- describes the investigated systems in detail, setting the boundaries and scope for the analysis to be carried out by the tool
- introduces the methods used for energy, economic and environmental analysis
- lists and describes the input data requirements set by the system definition
- presents the subsequent program implementation.

The envisaged main input parameters for the tool are cooling load, distribution network characteristics and available resources for production. The tool will also be used to assess a reasonable size for storage solution based on the availability of resources and variation of demand during operation.

An environmental analysis component for the planning tool has also been worked out. It enables assessing the GHG emissions of the studied cooling system. It will also allow for comparing the emission impacts of planned DC systems with the reference system.

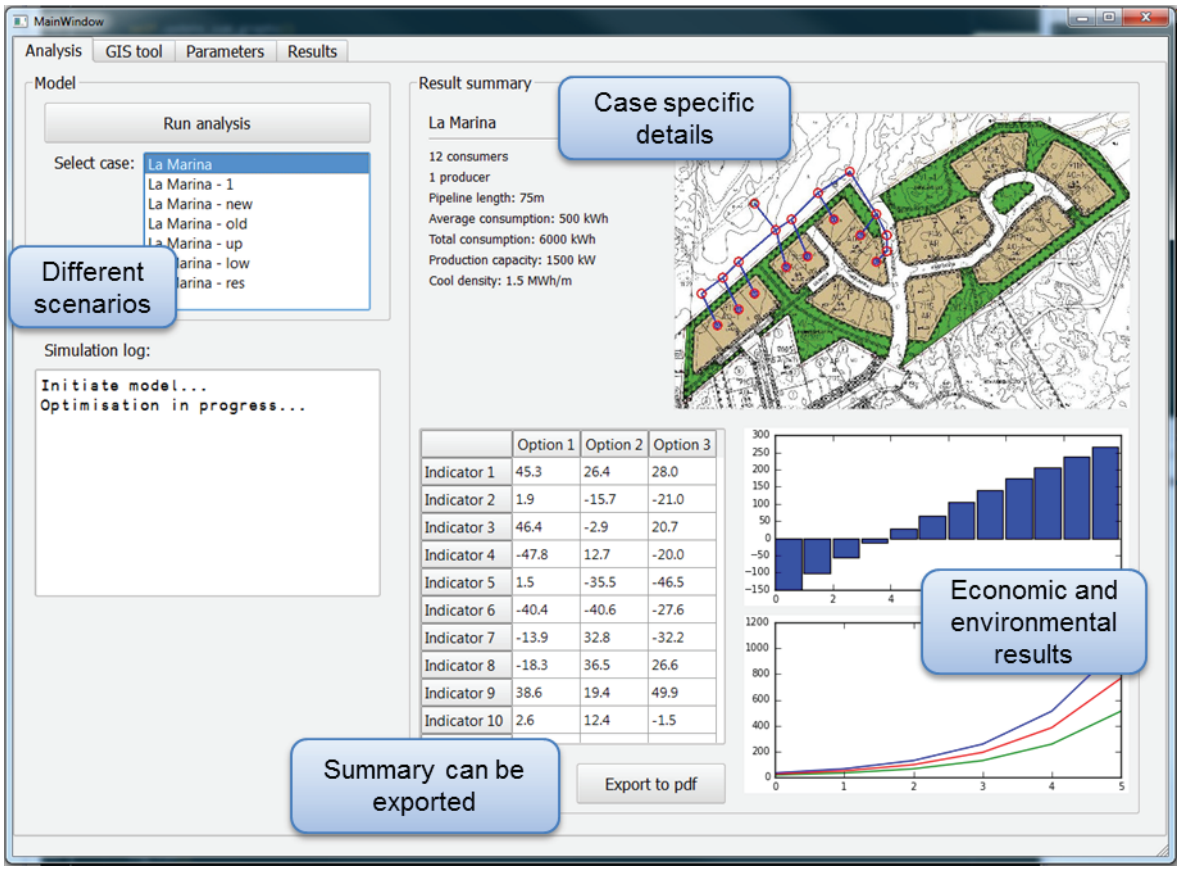


*Figure 5. Current prototype version of the tool's user interface*

# Interview to NUIG

Established in 1845, NUIG is world-renowned as an expert research-led University. NUIG is amongst the 1% top universities in the world according to QS world rankings and the Times Higher Education ranking.

In INDIGO, NUIG is represented by the IRUSE group (Informatics Research Unit for Sustainable Engineering) of the College of Engineering and Informatics. IRUSE consists of a multidisciplinary research team with expertise life-cycle management of buildings and in the modelling and simulation of energy interactions at multiple scales and system levels. The NUIG team is led by experts with extensive experience in EU and national collaborative research projects in the areas of smart grids, intelligent energy management systems, RES, and energy storage. IRUSE is committed to realising the goal of energy efficient buildings through a combination of modelling, technology development and implementation, data acquisition, management and visualisation and informatics.

www.iruse.ie, www.nuigalway.ie

**Marcus Keane**, Lecturer and PI in for NUIG in INDIGO
Consumption virtual test-bed developer in INDIGO

Marcus Keane

- Role in the Project

In INDIGO, NUIG is leading three tasks: Task 2.4: Demand-side detailed models; Task 3.3 Design of predictive controllers at generation level and Task 7.4 Scientific dissemination. Additionally, NUIG provides project-wide support to other tasks.

In Task 2.4 NUIG has developed Modelica models of the building systems for the three main demo Buildings in Basurto Hospital: Aztarain, Gurtubay and Surgical Block. The purpose of developing these models is two-fold. They will serve as data-generators for the initial development of the reduced-order models which will be included in the innovative controllers being developed by CSEM. Additionally, the models serve as a virtual test-bed to see the behaviour of CSEM developed controllers would have in the buildings.

In Task 3.3, NUIG is currently developing cutting-edge control strategies for the generation systems in a district-cooling plant (mainly chillers and cooling towers).

- Why is DC interesting for NUIG?

District energy systems and smart-grids represent the next step of specialisation for IRUSE. It is a strategic move for the group to seek ways to utilise our knowledge on building life-cycle and modelling and simulation to the benefit of district-wide systems. In this way, our research area follows a natural expansion path, our current body of knowledge is relevant and useful for the research community and we open new application areas for our research.

- Expectations from INDIGO

INDIGO will spearhead the utilisation of advanced modelling and simulation techniques together with innovative control strategies and planning tools in the district energy systems sector. NUIG clearly sees the potential for INDIGO to become a gateway for IRUSE to incorporate this research area into its portfolio. After INDIGO, NUIG will be well positioned in the research community to pursue applied research for the life-cycle optimisation of district energy systems towards solving industrial-grade issues. Finally, INDIGO will enable NUIG to publish its research in key journals and conferences, enable future spin-off research projects, provide the means to offer industry consultancy in the district energy sector and expose a large student body to the ideas and methods emerging from the project as a means to support future innovation in the energy sector.

# Interview to VTT

VTT Technical Research Centre of Finland Ltd is a state owned non-profit limited liability company established by law and operating under the ownership steering of the Finnish Ministry of Employment and the Economy.

VTT's activities are focused on three areas: Knowledge intensive products and services, Smart industry and energy systems, and Solutions for natural resources and environment. VTT is impact-driven and from its wide multi-technological knowledge base, VTT can combine different technologies, produce information, upgrade technology knowledge, and create business intelligence and value added for its stakeholders.

www.vttresearch.com

Krzysztof Klobut

**Krzysztof Klobut**, Senior Scientist
Work Package 5 Leader in INDIGO

- Role in the Project

VTT is a WP leader and a main developer of the District Cooling planning tool. We also provide scientific contribution to all other work packages.

The purpose of our WP (5) is the development of an open source planning tool for the evaluation/designing of existing and new district cooling systems. The planning tool will be based on design and performance parameters as well as on optimising the operation of a specified system. It will also enable the user to reconfigure the input to fit the characteristics of a specific system.

- Why is DC interesting for VTT?

In Finland we have a long tradition of district heating (DH) technology and we believe that district cooling (DC) has many advantages similar to DH. Furthermore, significant development of the global cooling sector is expected.
Modern buildings tend to be better insulated today and are equipped largely with appliances emitting heat indoors and thus leading to an increased need for cooling.
Our capital is already reasonably well covered by the DC network. In fact, Helsinki has even developed an innovative concept where district heating and cooling are combined into one very energy-efficient system, making use of heat pump technology.
VTT contributes to the development of computational tools supporting district heating and cooling related research. We have a sophisticated simulation platform (APROS) developed in-house, including a district heating network simulation model.

- Expectations from INDIGO

For a technology to become widely accepted it requires an evidence of success. Therefore, positive experiences in Finland, Sweden, and elsewhere, need to be supported by success stories from the countries that have the most potential for applications in the future. In the project, we have two demonstration sites in Spain for responding to this need. Our contribution to this general success of the project will be a new planning tool that will be used during and, most of all, after the project as well.



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