New generation of Intelligent Efficient District Cooling systems

Sprawozdania

Informacje na temat projektu

INDIGO

Identyfikator umowy o grant: 696098

Strona internetowa projektu

DOI
10.3030/696098

Projekt został zamknięty

Data podpisania przez KE
3 Lutego 2016

Data rozpoczęcia
1 Marca 2016

Data zakończenia
30 Września 2020

Finansowanie w ramach
SOCIETAL CHALLENGES - Secure, clean and efficient energy

Koszt całkowity
€ 2 792 766,56

Wkład UE
€ 2 229 321,25

Koordynowany przez
FUNDACION TEKNIKER
Spain

Periodic Reporting for period 3 - INDIGO (New generation of Intelligent Efficient District Cooling systems)

Okres sprawozdawczy: 2018-09-01 do 2020-09-30

Podsumowanie kontekstu i ogólnych celów projektu

In Europe, different prognosis show an increase in cooling demand of almost 60% in 2030 with respect to nowadays. District cooling (DC) can play a part in satisfying this demand in a sustainable

way since it can offer 5 to 10 times higher efficiency solutions than on-site stand-alone distributed systems. Even if DC captures only minor portion of the prospective market, this will translate into a dramatic increase in the size of this global sector. INDIGO aims to develop a more efficient, intelligent and cheaper generation of DC systems by improving system planning, control and management, anticipating the aforementioned scenario.
The following objectives were defined to achieve this target:
• Contribute to the wider use of DC systems and motivate the competitiveness of European DC market by the development of two open-source tools:
o A planning tool for DC systems with the aim of supporting their optimal design - https://zenodo.org/record/3891384
o A library with thermo-fluid dynamic models of DC System components which will provide the designers detailed information about their physical behaviour - https://zenodo.org/record/1108659
• Primary energy reduction over 45% addressed by a ground-breaking DC system management strategy. Its main characteristics is the predictive management, but it also addresses other challenges: integration of renewable energy sources, dealing with different types of cooling sources and suitable coupling between generation, storage and demand
All this, with the help of intelligent and innovative component controllers developed at all DC levels, some of them including embedded self-learning algorithms. Most developments have been validated in a real DHC installation.
The results obtained from the experimental and virtual validation activities of the different developments have made possible to verify their expected performance. Although in some cases the expected savings have not been achieved experimentally due to technical limitations of the different sites, in general the results are very promising.

Prace wykonane od początku projektu do końca okresu sprawozdawczego oraz najważniejsze dotychczasowe rezultaty

To achieve these objectives, the work performed in the different work packages provide the following results:
In WP2:
- Detailed models of typical components present in DC - District Cooling open-source library (DCOL)
- Building detailed models of the sites for laboratory validations at WP6
- Reduced models of DC components for controller's development (WP3)
- Simplified models of DC components for management strategy development (WP4)

Intelligent and innovative component controllers at all DC system levels have been developed within WP3. These controllers will allow the components to appropriately respond to the set-points established by the management strategy:
- Model predictive controller for HVAC systems at building level
- Optimization algorithm for a group of pumps
- Model predictive controller for cooling generation systems
- Controller for integration of solar thermal plants in DHC networks

In WP4 an innovative Management Strategy and control system that schedules the energy supply to properly cover the energy demanded by a DC has been developed. The approach finally adopted has implied to solve the optimization problem in two parts:
- An MPC for the Distribution and Consumption: Its inputs are the predictions of the demanded power by the consumers and it calculates the conditions that the distribution flow and temperature to cover the power demand in an optimal way (minimizing the losses and/or maximizing the distribution temperature difference while guaranteeing the desired demand).
- An MPC for the Generation and Storage systems: It calculates how the required conditions in the distribution should be obtained optimally.

Within WP5 a user-friendly and open source planning tool for evaluating the performance, benefits and potential of a DC system has been developed. Tree case studies have been carried out to test the tool demonstrating benefits of the DC system compared to building specific cooling solutions and to present the features of the tool developed.

In WP6 virtual and experimental test of the different developments from WPs 3 and 4 have been performed with promising results.
Key exploitable results (KER) of the project have been identified and a business plan for each result has been worked out (CANVAS and risks analysis). Most relevant KER description can be found in the Horizon Results Platform. Also several dissemination activities have been carried out for industrial and scientific community (more info at https://www.indigo-project.eu/)

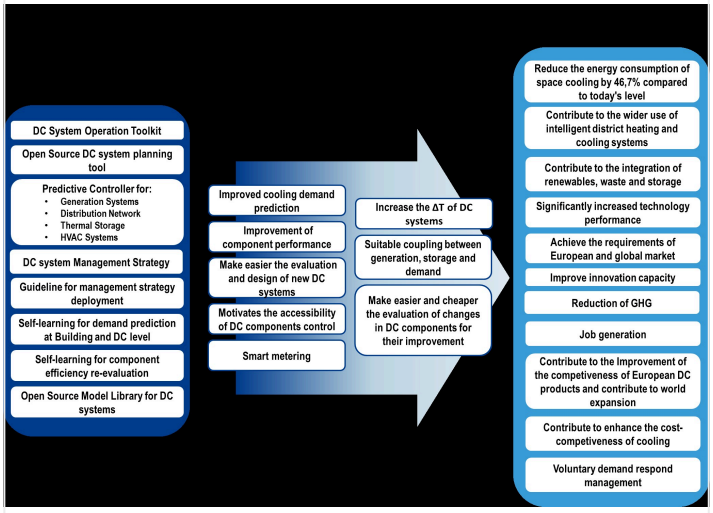
Innowacyjność oraz oczekiwany potencjalny wpływ (w tym dotychczasowe znaczenie społeczno-gospodarcze i szersze implikacje społeczne projektu)

An open-source planning tool for the evaluation/designing of existing/new DC systems have been developed. The tool binds all levels of the DC system together, incorporating a simplified version of a management algorithm.
A specific open source library with parametric thermo-fluid dynamic models of DC System components, have been worked out. It provides detailed information about physical behaviour for a better system design.
A new management strategy has been developed to schedule the energy supply in the most optimized way and satisfy the consumer demand at every moment. The overall DC efficiency is maximized, or running cost minimized, considering other factors like greenhouse gas emissions, system payback time, etc.
It integrates consumer demand prediction, energy price forecast and knowledge from fine-tuned models of DC system components.
The manager controller optimizes setpoints for lower control layer and integrates a real-time feedback controller. Predictive Controllers have been developed for Buildings and Generation systems, some of them including embedded self-learning algorithms.
INDIGO solution can reduce DC primary energy consumption compared to current systems thanks to improvements at different levels:

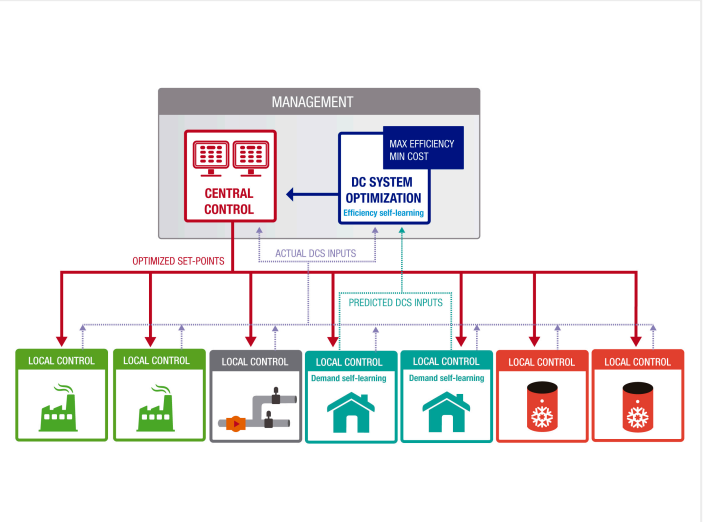
- At building level by anticipating the building needs, the consumer optimizes its cooling needs, reaching energy savings that can be as high as 62%
- At distribution level INDIGO cooling losses can be reduced up to 45% increasing at the same time the distribution temperature difference leading to further savings in the generation equipment.
- Optimal operation of the generation systems due to a suitable coupling between generation, storage and demand leads to additional energy savings that can be up to 50%

INDIGO will enhance DC systems that help the environment by increasing efficiency and reducing air pollution, greenhouse gas carbon dioxide and ozone-destroying refrigerants. By making easier the intrusion of free-cooling systems and renewable as well as waste energy, CO2 emissions will be reduced even more that in conventional DC systems.
In the same way the most relevant social benefits will be:
- Reliability and cost-effectiveness in comparison with individual building cooling systems
- Aesthetics and comfort enhancement
- Improvement of electricity supply competitiveness and grid stability
- Skilled job opportunities and contribution to Europe's Energy Security as a result from DC market development

Market penetration of intelligent DHC systems will be driven not only by the cost of energy but also by stakeholders' capacities to make informed decisions. INDIGO will work on both factors:
- Payback time for DC systems will be greatly reduced.
- Free and open tools, addressed to managers and developers of DC systems and components and to public administrators and end users, that will foster DC penetration.



INDIGO Expected impacts



INDIGO control levels (general management and local control)

INDIGO logo

Ostatnia aktualizacja: 11 Czerwca 2021

Permalink: https://cordis.europa.eu/project/id/696098/reporting/pl