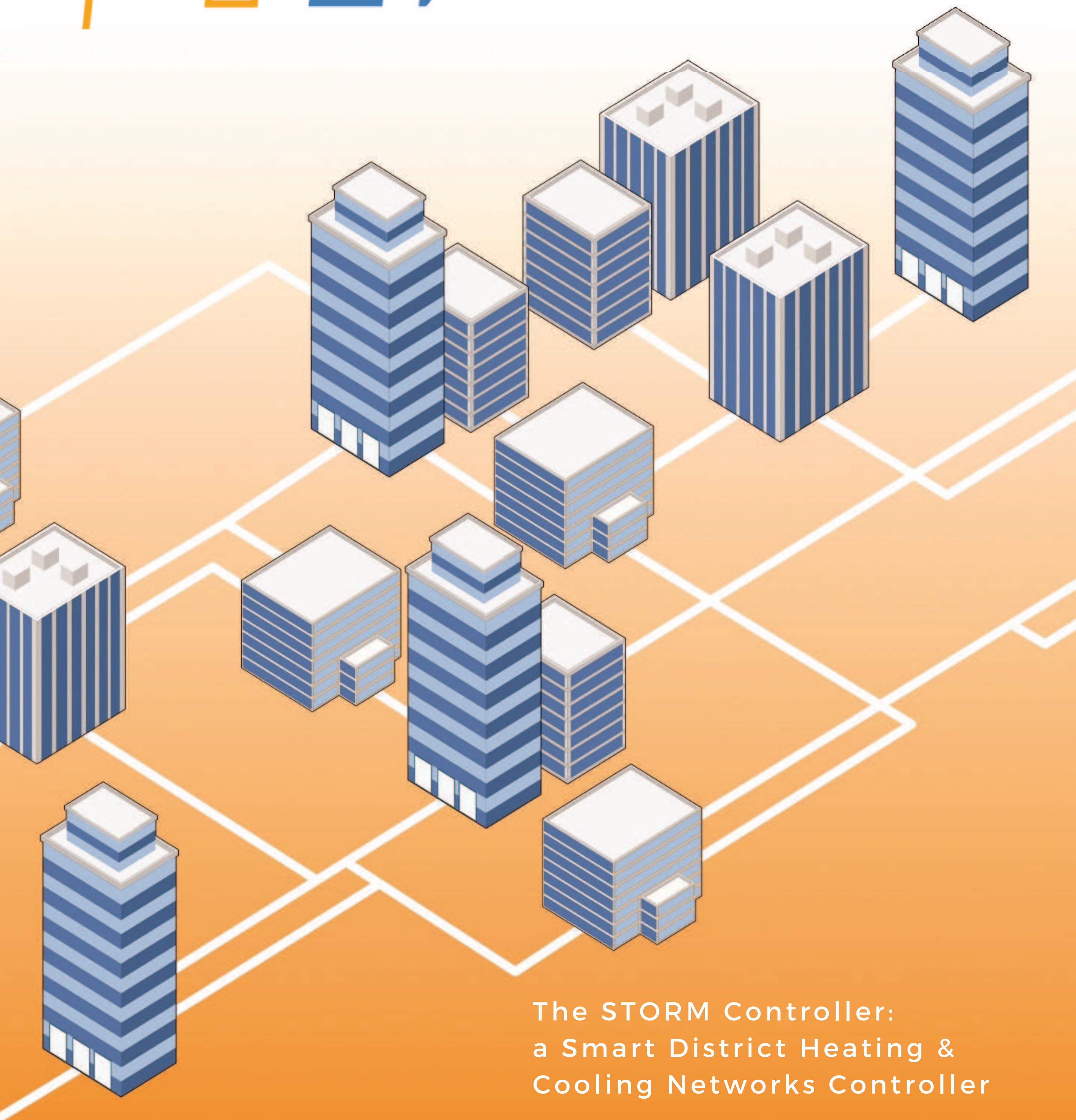
STORM
DISTRICT ENERGY CONTROLLER



The STORM Controller: a Smart District Heating & Cooling Networks Controller

Funded by the European Union's H2020 Programme Under grant agreement n°649743

Web: www.storm-dhc.eu
Mail: info@storm-dhc.eu
Twitter: @STORM_DHC

About the STORM Project

The research project, funded under the European Union's H2020 Programme, aims to boost energy efficiency at district level by developing an **innovative district heating & cooling network controller**. The project partners have developed a controller based on self-learning algorithms, which is currently experimented in the two STORM demonstration sites. The developed controller enables to **maximise the use of waste heat** and **renewable energy sources** in DHC networks and **optimise energy efficiency** in the system.

The project is coordinated by EnergyVille, a collaboration between VITO, KU Leuven and IMEC, and involves NODA Intelligent Systems, Zuyd University of Applied Science, Mijnwater BV, Växjö Energi and Euroheat & Power/DHC+ Technology Platform.

Through replication, dissemination and trainings, the project outcomes will be transferred to several stakeholders across the EU, and will thus contribute to a wider deployment of DHC networks on EU level.

> "Developing an innovative District Heating & Cooling (DHC) networks controller to increase the use of waste heat and renewable energy sources and boost energy efficiency at district level."

The STORM Project - Digitalising the DHC system

Since more than 50% of the EU's energy consumption is made up by heating and cooling, the EU's climate goals can only be met by addressing the heating and cooling sector: optimising the production and distribution system, reducing consumption, integrating more renewables and waste heat into the system, and enhancing energy efficiency.

Digitalisation is a crucial part to make this energy transition happen. Of course, there are challenges to overcome and these differ between grids. Production prices have to stay competitive, new pipes have to be placed, new buildings (i.e. new customers) must be connected, and old peak load oil or gas boilers should be phased out.

> "Is it possible to tackle all these challenges with the digitalisation of district heating systems and buildings?
> - **Yes, it is possible!**"

This is exactly what STORM can deliver!

The digitalisation of heating systems creates the needed link between production, distribution, property owners and consumers. A connected building means access to data – much **data** – which can be analysed in real time with surrounding data points such as weather forecasts, distribution constraints and operational production information. All this is processed through customised and self-learning algorithms. A connected building also guarantees access to the **thermal flexibility** of that building. This flexibility together with the online algorithm calculations can directly be applied to use buildings as a virtual **energy storage** to, e.g. reduce peak load or optimise combined heat and power generation

The STORM Controller

The STORM controller is a framework for **state-of-the-art smart heat grid technology management**. It includes modules for forecasting, planning and dispatching demand-side management actions for the benefit of the whole energy chain, spanning from energy generation and distribution to end-user consumption.

The **modular architecture** and design of the STORM controller facilitates an agile development process and continuous deployment in operational systems. This made it possible to use initial innovations and research results in industrial projects even during early stages of STORM.

The three main modules of the STORM controller are the Energy **Forecaster**, the Operational Optimisation **Planner** and the Demand-Side Management **Tracker**. Together they compile the functionality of the STORM controller.

The Forecaster answers questions relating to what will happen in the future, while, based on this forecast, the Planner is responsible for answering the question about what the controller wants to happen. The Tracker then makes sure that these things happen, while guaranteeing security of supply and continuous quality of service throughout the energy system.

“

Forecaster: "What will the energy consumption of the network be in the next 24h?"

Planner: "Given the control objectives, which optimal cluster consumption profile can be achieved, taking into account this forecast?"

Tracker: "Which individual control signals are necessary to follow the optimal consumption profile?"

”

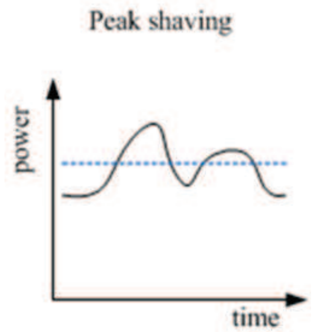
At its core the STORM controller is an advanced demand-side management system. It can be applied to help solving a number of common operational challenges in thermal grid systems, such as peak load management, demand balancing and combined heat & power optimisation.

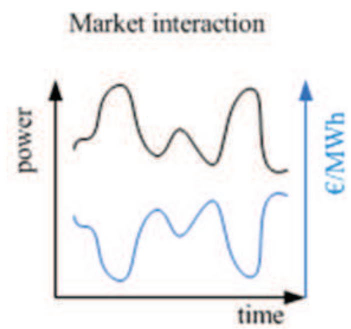
Multiple control strategies:

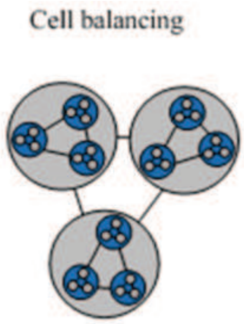
For typical networks with a small sustainable energy source and a large fossil back-up, the controller can drastically **reduce the use of fossil fuel**.

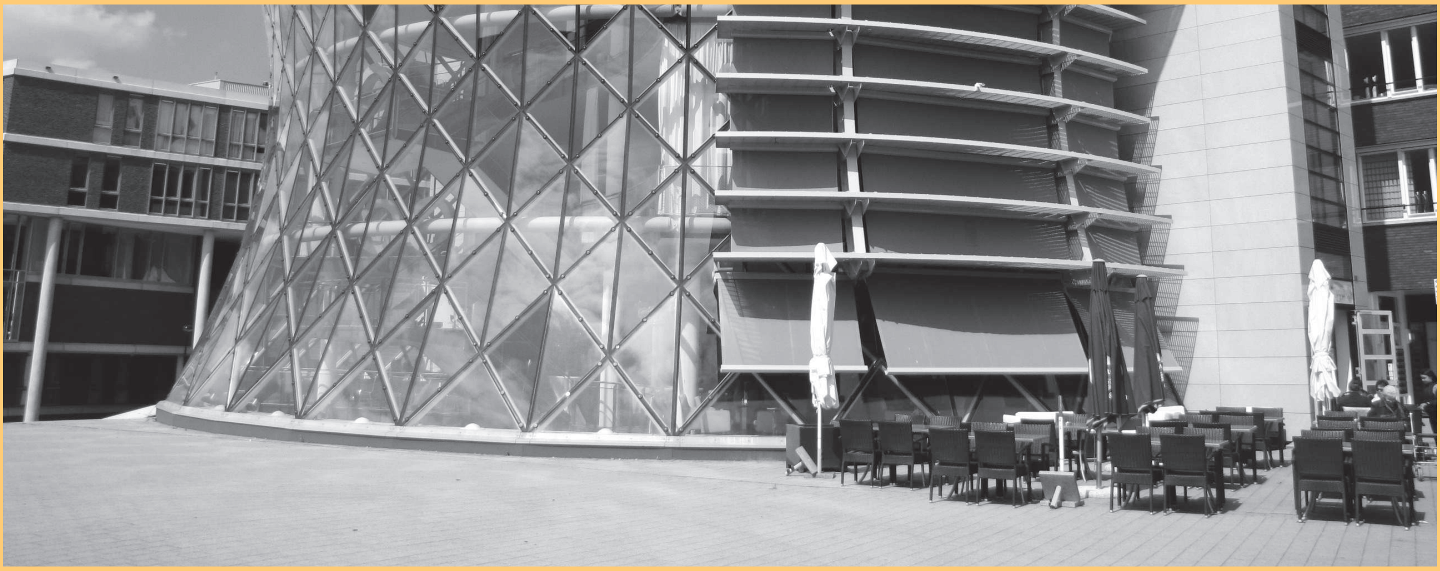
For networks coupled to the electric grid by heat pumps or CHPs, the controller intelligently employs the devices at interesting **power prices**.

For more sophisticated networks, the supply and demand of heat and cold in a cluster can be optimally balanced for increased **energy efficiency**.









The **first version** of the STORM controller was developed during 2016 and was consequently activated in the demonstration sites. This first version focused on further developing models for the Forecaster and Tracker functionality, while keeping a basic version of the Planner.

The **second version** of STORM, launched during 2017, incorporates a more advanced version of the Planner while also seeing upgrades for both the Forecaster and Tracker.

The Demonstration Sites: Spanning the DHC Generations

The controller has been implemented in the demonstration sites in Heerlen, the Netherlands, and in Rottne, Sweden, where the resulting **energetic, economic and environmental gains** are assessed.
The demonstrator in Heerlen is **a highly-innovative** district heating and cooling system using **low temperatures** and geothermal energy storage, while the demonstration in Rottne considers a **common 3rd generation** district heating set-up.

Mijnwater BV Sites in Heerlen, the Netherlands

In the Heerlen district, flooded mine galleries act as renewable energy sources and provide a total of 500,000 m^2 floor area connected to a low temperature district heating and cooling network. Since 2013, the network has been gradually transformed into an intelligent DHC network, the so-called “Mijnwater 2.0” project. The system consists of two warm wells and two cold wells connected through a pipe system, the so called backbone. Several clusters are connected to this backbone and energy is exchanged through cluster installations.

All buildings are connected to local cluster networks. The ambition is to make these clusters energy self-sufficient by energy exchange between buildings and local heat storage. Since heat is transported over shorter distances, this results in lower distribution losses. Also, energy exchange with the backbone grid that supports the clusters is minimised. This is vital because the capacity of the underground system is limited. In this way, more clusters and thus more buildings can be connected to the Mijnwater system and through improved efficiency, more customers can be linked to the same infrastructure.

However, for fully deploying this system, an automated and smart controller is necessary. This is where the STORM project comes in. Since the heating season 2016/2017, the Heerlen demo site has been connected to the STORM controller.

Växjö Energi District Heating System in Rottne, Sweden

The second largest high temperature distribution network in Växjö, Rottne makes up about 10,300 metres with a total volume of about 64 m^3. The production is based on two bio-fuel boilers (1.5 MW and 1.2 MW), complemented with a traditional oil boiler (3 MW) running on RME (rapeseed oil) for peak load usage as a backup. The bio-fuel boilers are operated on local forest residues. On average, the three boilers produce about 11.5 GWh per year.

The district heating and cooling network in Rottne, operating since 1997, produces heating for houses, industries and schools in the town of Rottne.
The purpose of the STORM project is to minimise the oil usage and optimise the operational behaviour of the bio-fuel boilers, thanks to the developed controller.

This installation is a classic set-up for temperature distribution and the general problem context is common within many district heating systems in Europe. Hence, Rottne is a good complement to the more specific situation at the Mijnwater BV site.

Before the STORM project's start, a smart heat grid technology was already installed in the network and operated by NODA. Nine of the largest consumers are equipped with a controller platform that coordinates the heat load demand in relation to the operational production situation. They represent nearly one-third of the annual energy use of the network.

This existing platform was upgraded during the project. The manageable size of this network ensures that it is possible to study full-scale benefits of the project technology in relation to production and distribution.

Would you like to learn more about digitalisation of DHC systems?

In the framework of the STORM project, you can take part in a number of **free trainings**.

Are you a professional?

Free training courses on technical and non-technical issues around **smart DHC networks** will be offered in a number of EU-countries and via webinars. The courses include topics such as planning, business models, legislative issues, permitting, consumer and social aspects, contracting, development and operation of DHC systems, ICT control frameworks for DHC networks, demand and energy balancing.
Learn from best practices and experience of our experts!

Are you a university or a teaching institution?

The STORM project develops an **educational package** on digitalisation and DHC networks to be reused by other Universities of Applied Science. It consists of a basic preparation package, a theoretical package and a practical educational package that can be used by Universities, Universities of Applied Science and Teaching Institutions. Interested universities and institutions can take part in workshops that aim at facilitating to integrate the educational package into your curriculum!

For more information and all upcoming training opportunities, please visit: www.storm-dhc.eu/project-trainings

STORM partners:

vito Energy Ville

NODA Intelligent Systems

MINE WATER, A BASIS FOR SUSTAINABLE ENERGY
WWW.MIJNWATER.COM

EUROHEAT & POWER

VEAB VÄXJÖ ENERGI

Zuyd University of Applied Sciences



Contact us!
Coordinator: Johan Desmedt, EnergyVille/VITO
Mail: info@storm-dhc.eu
Twitter: @STORM_DHC
Web: www.storm-dhc.eu

Brochure designed by:
DHC+ TECHNOLOGY PLATFORM
c/o Euroheat & Power