R-ACES
Energy Cooperation Platform

Assessment on the Nyborg Eco-Region

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Technical References

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[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

[2] R = Document, report
DEC = Websites, patent fillings, video, etc.
DEM = Demonstrator, pilot, prototype
OTHER = other

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Project Summary

The R-ACES project is an initiative promoted by 7 partners from 6 European countries, with the vision to support high-potential industry parks and clusters to become fully fledged ecoregions that reduce emissions by at least 10%. R-ACES means a step-change in the contribution of European Industry to the climate targets of the EU. The industry sector after all represents 25% of all energy demand – and 50% of the total cooling and heating demand on the continent; yet only 16% comes from renewables. By focusing on collective measures and clustering, the efficiency of industry can be drastically increased.

The focus of R-ACES therefore is to turn high-potential, high-impact industrial clusters into ecoregions that achieve at least a 10% reduction in emissions. They do so by exchanging surplus energy, making extensive use of renewables, and tying everything together with smart energy management systems. An ecoregion is a geographic area where energy and information exchanges occur between various companies and actors to reduce waste and energy consumption. Ecoregion can be centred on an (eco-)industrial park or (eco-) business park, linked to its surroundings by a 4th/5th generation district heating/cooling network.

R-ACES is the capping stone, condensing the knowledge and experience gathered throughout EU and national projects into a set of three focused tools, namely a self-assessment tool, a legal decision support tool, and a smart energy management platform for clusters. The tools are embedded in support actions built around peer-to-peer learning, more formal coursework and webinars, and serious games. Together they enable a cluster to really become an eco-region and set up meaningful energy collaboration. The entire package of tools and support is aimed at the high-potential clusters identified in the European Thermal Roadmap. It will be validated in three eco-regions, actively deployed in another seven regions, and disseminated to identified ninety regions European wide. In addition, the tools and support methodology will be made available to third parties in a sustainable way after the end of this project.

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Partners

Institute for Sustainable Process Technology https://ispt.eu/

Condugo https://www.condugo.com/

Spinergy http://www.spinergy.it/

energy CLUSTER DENMARK https://www.energycluster.dk/

LE2C LOMBARDY ENERGY CLEANTECH CLUSTER http://www.energycluster.it/en

pom antwerpen https://www.pomantwerpen.be/

ESCI European Science Communication Institute https://www.esci.eu

EUROHEAT & POWER https://www.euroheat.org/

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Executive Summary

The R-ACES project intends to pave the road for effective energy exchange in industrial clusters and business parks in Europe. As a Coordination and Support Action (CSA), the project was designed with the objective of disseminating the project results at a wide extent. This is the reason why a significant number of high priorities regions are targeted in order to reach a critical mass.

In this context, the present report is the '***Assessment of the Nyborg ecoregion***' of the R-ACES project, which describes the setup in the area of Nyborg involving various stakeholders such as industries, DH companies, and offcause the municipality.

Disclaimer

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1 Introduction

1.1 Objective of the Work Package 3

The objective of work package 3 (WP3) is to set up the three ecoregions in Belgium, Italy and Denmark. More specifically, it consists of coordinating the efforts leading to the creation and development of the ecoregions and establishing at the same time a comprehensive validation methodology concerning the application of the solutions co-designed in WP2, in the realistic environments provided by the consortium.

As the impact of R-ACES application in industrial sites must be evaluated in the context of:

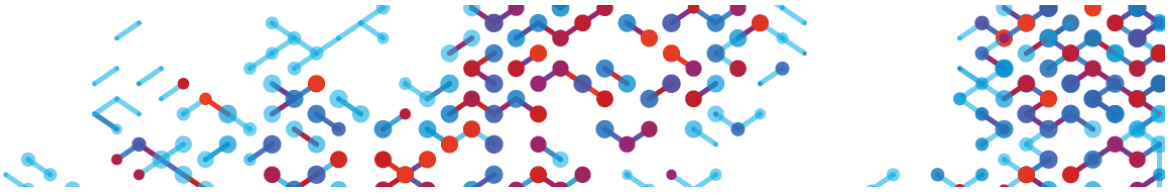
- Improving the management of energy saving;
- Making profits from the waste heat produced by energy intense industrial production processes;
- Improving at the same time environmental performances.

In the scope of WP 3 "Waste heat-based energy cooperation and transfer pilots", we aim to define a series of validation criteria concerning the application of the three tools developed in WP2.
The three tools are:

- **Assessment tool:** an assessment framework that covers multiple themes. Provides best practices, check lists to users & means to scan energy reduction potentials.
- **Legal decision support tool:** investigates how to build a practical and simple-to-use decision-support tool for management to decide on the required legal framework for energy cooperation;
- **Energy management platform** (EMP):an ICT-tool that makes energy flows transparent; allows energy consumption and production to be allocated to specific installation, stakeholders and notes; and identifies anomalies and opportunities.

1.2 Objective of this deliverable

The objective of d.3.7 is to present the Nyborg eco-region and the work that has been finalized in the project including the validation processes of the developed tools.



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2 General description of the Eco-Region

2.1 Background information on the ecoregion

In the Nyborg ecoregion, the Nyborg district heating network has been working on expanding the grid and expand the use of industrial surplus heat for different energy purposes.

Nyborg Municipality is situated on Fyn in the middle of Denmark, and is the western landing of the Great Belt Bridge. The municipality has 32000 inhabitants and a number of larger production companies situated near the rather deep industrial harbour as well as service- and production companies in the nearby industrial quarter. The industrial production companies include an incineration plant for hazardous waste, a plastic producing company (mainly electric power), an oil refining company (crude tar and naphthalene for industrial purposes), food processing companies and others.

The municipality was already a model community in Denmark in terms of use of industrial surplus heat for district heating in the main town Nyborg, as 96% of the town Nyborg is heated by industrial surplus heat. Nevertheless, additional surplus heat from the industry is available although part of the surplus heat is currently used for electricity production depending on the market price.

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The city council is focused on ways to expand circular economy initiatives based on the various industrial plants in Nyborg, including the formulation of a Climate Action Plan to reach the political goals of 70% reduction of greenhouse gasses by 2030 and 100% reduction in 2040. In this context, a positive dialogue has been conducted with the local industries towards further development and use of surplus heat.

In addition to the local commitment to explore more ways to expand circular economy initiatives and expansion of district heating based on surplus heating, the municipality cooperates with the other municipalities on the island of Fyn (approximately 500,000 inhabitants). A common green vision "Fyn 2030" for the ten municipalities is to have 100% fossil-free energy use in the district heating sector by 2030. Against this background the municipality of Nyborg joined R_ACES in order to further develop the energy co-operation between public sector, private companies and private houses.

2.2 Needs of the ecoregion

During the R-ACEs project the eco-region has been looking at new opportunities such as the possibility to:

- extend the DH network based on surplus industrial heat to nearby villages which at present are heated by natural gas.
  By extending the District Heating to nearby villages which are at present heated by natural gas, the eco-region will reduce the energy consumption and CO2-emissions since the entire extension can be supplied by industrial surplus heat, thus substituting natural gas.
- use industrial surplus heat as energy source in another production company.
  At present, industrial waste heat is used almost exclusively for heating purposes – in both private housing and in companies. By investigating the potential for using industrial waste heat for industrial processes, the eco-region addresses new potentials, since energy for production exceeds energy demand for heating by orders of magnitude in most production companies.
- identify the opportunities of using surplus industrial heat for district cooling for industrial sites, business parks and other buildings with the need of comfort cooling.
  In the future, energy demands for cooling will increase along with the anticipated climate changes in Denmark. The ambition is to develop a Local District Cooling based on industrial surplus heat, and thus substitute other energy demands for cooling. The model holds the further advantage, that cooling demands will be larger in summer, where demands for heating are low and consequently a larger share of industrial waste heat is in excess (but partly used for electricity production, though).
- Investigate the possibility of Carbon Capture and Usage (CCU) from the main industrial plant, whereby the entire heating in the DH network will become carbon neutral.
  The major share (around 80%) of industrial waste heat comes from one industrial plant, Fortum Waste Solutions Ltd., where hazardous waste is destroyed at high temperature (1200 Degr. Celcius). The hazardous waste is of fossil origin, thus leading to substantial CO2-emissions. The municipality of Nyborg has calculated that 38% of all greenhouse gasses in Nyborg Municipality comes from Fortum Waste Solutions Ltd. The implementation of Carbon Capture and Usage at Fortum thus becomes an indispensable part of the municipality's climate action plan recently approved by the city council.

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2.3 Summary of the R-ACES activities in chronological order

Activities in the Eco-region:

- 07.06.2021 R_ACES Assembly meeting
- 07.08.2021 Project meeting with NFS – Nyborg Facility and Service (DH-company)
- 12.10.2021 European Week of Regions and Cities. Presentation of eco-region Nyborg as an example of eco-region in function.
- 04.11.2021 Presentation at CSR-Forum Denmark with the aim to present a circular eco-region model to national stakeholders of circular economy.
- 22.02.2022 Project management meeting between Energy Cluster Denmark and Nyborg Municipality. General status meeting.
- 28.03.2022 Meeting between Energy Cluster Denmark and Nyborg Municipality with the purpose to comment on and validate the self-assessment tool and Legal tool produced by the project.
- 25.04.2022 Meeting with Fortum Waste Solutions Ltd. on strategic partnership on industrial waste heat and Carbon Capture and Usage.
- 07.06.2022 City Council Seminar on Climate Action Plan – including dialogue with ceo Jens Peter Rasmussen, Fortum Waste Sol. Ltd. The aim was to present the possibility of Carbon Capture to the city council
- 25.08.2022 R_ACES meeting on validation of tools.
- 01.12.2022 R_ACES General Assembly meeting. Presentation of status and future plans
- June 2021 – Dec. 2022 Elaboration of Nyborg Municipality Climate Action Plan with integration of strategic partnership with Fortum Waste Solutions and other companies identified in the R-ACEs project.
- June 2022 – Dec. 2022 Development of business case on use of surplus industrial heat for a neighbouring company's production, thus replacing natural gas with surplus heat.
- Sep. – dec. 2022 Elaboration of new Heat Plan 2022 with extension of Local District Heating to nearby villages with natural gas heating.

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- 13.12.2022 Approval of Nyborg Climate Action Plan and approval of Local Energy Plan in the City Council.

2.4 Stakeholders participating (and type of stakeholders)

The industrial site managers and other stakeholders in the Nyborg region are interested in further cooperation and has earlier shown interest in the creation of an Industrial Symbiosis in Nyborg. The Nyborg region is dense in private companies. Within a 2 km radius more than 450 companies and institutions are located. Not all of these companies are directly relevant for energy cooperation, although almost all of them are connected to the DH network.

The main stakeholders identified in the Ecoregion Nyborg are:

- The municipality of Nyborg
- The DH company of Nyborg (NFS, 0,8 PJ/y) (representing private houses with heat demand)
- Fortum Waste Solutions Ltd. A major incineration plant for hazardous waste
- A number of major production industries
- 4 large food industries some with own greenhouse areas for vegetable production
- A whiskey distillery
- Metal and plastic production companies
- A business park with service-, crafts- and logistics companies

2.5 Results

(1) Expanding Local District Heating

A new Heat Plan has been developed which will expand the DH network to the nearby town of Oerbaek and Refsvindinge in the south, to Ullerslev in the north-west and four minor settlements in the vicinity of these DH networks. The extended DH network will be supplied by surplus heat from the existing industrial sources and supplemented by a minor heat supply from a local industry in Ullerslev. The extended DH network substitutes for the majority of houses heating with natural gas, thus replacing a fossil energy source with surplus heat. The aim is to replace all natural gas heating with surplus heat or electrical heat pumps, since electricity is expected to be carbon neutral in Denmark by 2030.

The Heat Plan was approved by the city council in dec. 2022, and the further planning and implementation of the plan will follow in the years to come. Fully implemented, the Heat Plan 2022 will increase the DH network from 62% of all private houses in Nyborg Municipality to 75% of all houses. This is regardless of the fact, that a fair share of houses are situated in towns and villages scattered in the geography of the municipality.

The total energy demand of the extension of the Local District Heating is equivalent to 24.500 MWh/year.

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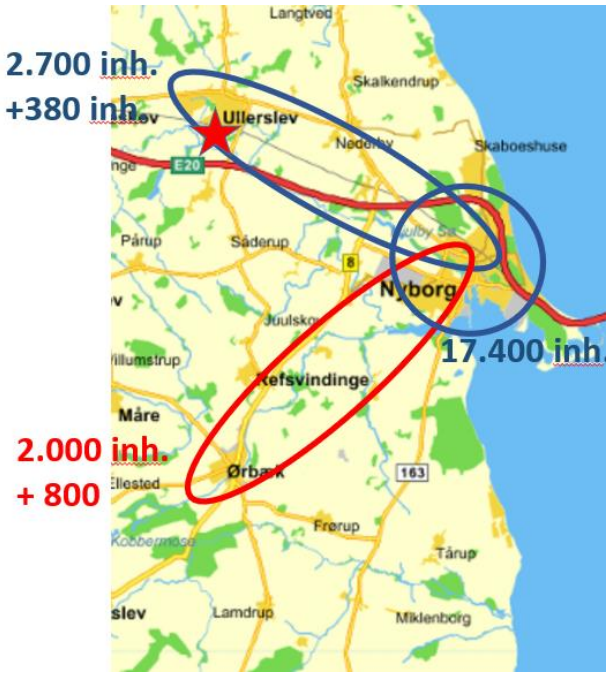

Extending Local District Heating to new areas in the municipality. The extension to Ullerslev in the northwest is ongoing, and the extension to Ørbæk in south west is included in the new Heat Plan 2022.

(2) Surplus heat for production purposes

A potential use of surplus heat for production purposes was identified and presented to the potential user, a food processing company using low temperature (< 100 degrees C) heat in their treatment of vegetables.

The surplus heat will substitute natural gas as energy source and lead to c. 60% reduction of energy costs. The CO2-emissions in the municipality will be reduced as well due to the fact that the surplus heat related emissions take place already.

To our knowledge, by far the most industrial surplus heat is being used for heating purposes in private houses, and a smaller amount for heating in companies. The use of surplus heat for production purposes is a novel opportunity with interesting perspectives, since energy consumption for production purposes are substantial. The realization of such potentials will depend on distance between the companies and a fair match in temperature requirements from the producer to the buyer as identified in this case.

The technical detailing of the project is being elaborated. The name of the company is claused by the company until a final investment decision has been taken.

The project will substitute a total consumption of 4.000 MWh/year of natural gas with surplus industrial heat. The project is calculated to reduce the energy costs of the receiving company by two thirds and will reduce the CO2-emissions by 820 tons CO2/year.

(3) District cooling

A novel opportunity for district cooling based on surplus heat has been identified and will be explored in the first quarter of 2023. Energy for cooling purposes is growing, and especially in office buildings, companies, institutions and hospitals the need for cooling is

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often necessary. But also cooling for industrial purposes might be relevant in the specific case.

The opportunity arose due to the construction of a new public health care centre in the vicinity of major industries, including Fortum Waste Solutions Ltd., which is the main supplier of surplus industrial heat.

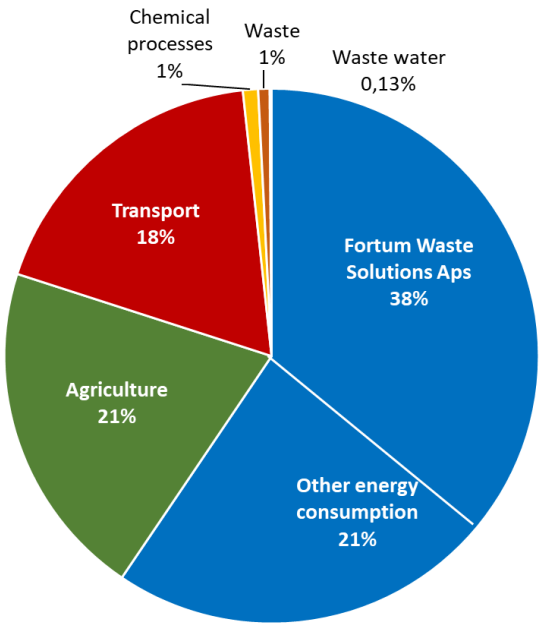
The realization of the district cooling network will depend on a critical demand for cooling from industries and offices in the vicinity of the surplus heat sources. An initial screening for cooling demands has been agreed to be followed by a technical assessment of the potential. The local District Heating company NFS Ltd. is identified as the business developer for the project, which is regarded as a new business opportunity by the company.

A total of 20 potential users of District Cooling has been identified, and a screening for potential cooling demands is to take place in Q1 of 2023.

(4) Carbon Capture

Fortum Waste Solutions Aps. is the major supplier of surplus industrial heat from the high temperature incineration of hazardous waste. The vast majority of hazardous waste are of fossil origin, thus leading to CO2-emissions when incinerated. From the point of view of use of surplus heat this is not of relevance, but following the municipality's newly adopted Climate Action Plan, the municipality is focussing also on reducing CO2-emissions.

The emissions from Fortum Waste Solutions constitutes 38% of all greenhouse gases from Nyborg Municipality. Therefore, a solution to the CO2-emissions is indispensable for the fulfilment of the climate goals.



Greenhouse gas emissions from the district of Nyborg Municipality distributed on main sectors. The total emission is 450.000 tons CO2-equivalents per year, (Data from Nyborg Municipality Climate Action Plan, 2022).

This has led to a new strategic dialogue between the municipality and Fortum Waste Solutions. The conclusion will be a partnership agreement on climate mitigation, which

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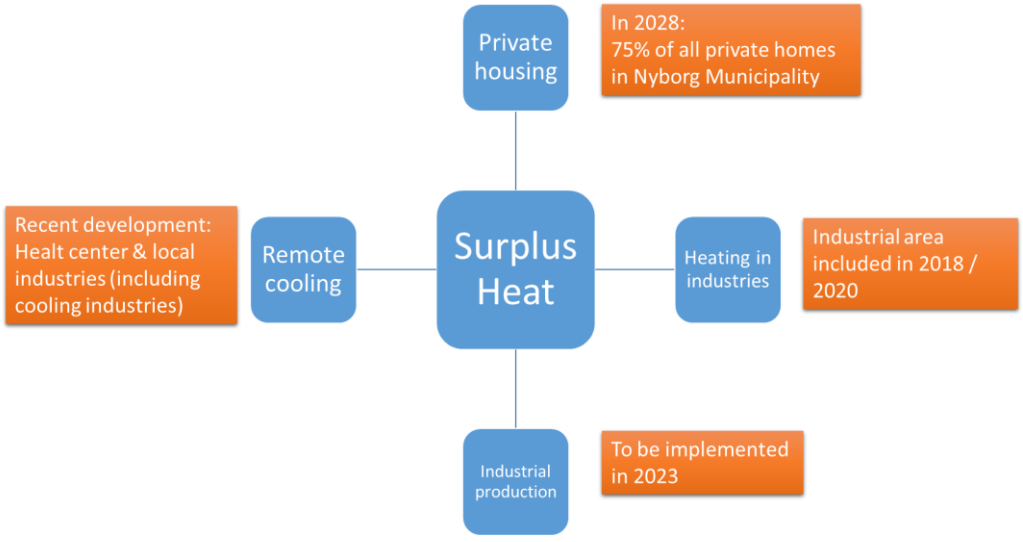
includes the obligation for Fortum to establish Carbon Capture at the facility, capturing 150.000 tons CO2 emitted each year.

A "CO2-Cluster" has been established to include all of Fyn (10 municipalities) by initiative from the Danish Government. Within the framework of the CO2-cluster, Fortum Waste Solutions is co-operating with the largest DH Company of Fyn – "Fjernvarme Fyn" –to developing large scale Carbon Capture at both Fjernvarme Fyn and at Fortum.

2.6 Possible cooperation project started / identified

A next generation strategy for developing the eco-region
The co-operation between the municipality, the local District Heating Company and the industries of the municipality has been developed over many years. For many years, the strategy has been to exploit surplus industrial heat for district heating, as in most cases in Denmark and elsewhere indeed.

The recent work in the R_ACES project and the development of the municipal Climate Action Plan has led to a new understanding and new ambitions for the partnership – extending the exploitation of surplus heat to more areas and new purposes, including district heating to both houses and companies (for heating), the exploitation of surplus heat for industrial use (production), and – in the future – exploitation of surplus heat for district cooling.



On top of this, the strategy of extending the district heating to new areas is supplemented with the ambition of establishing CO2 capture on the major CO2-source in the municipality. The strategy moves from heat exploitation to carbon reduction, from shared business (on surplus heat) to shared vision, and from co-operation to an eco-region with the ambition to reach climate neutrality by 2040.

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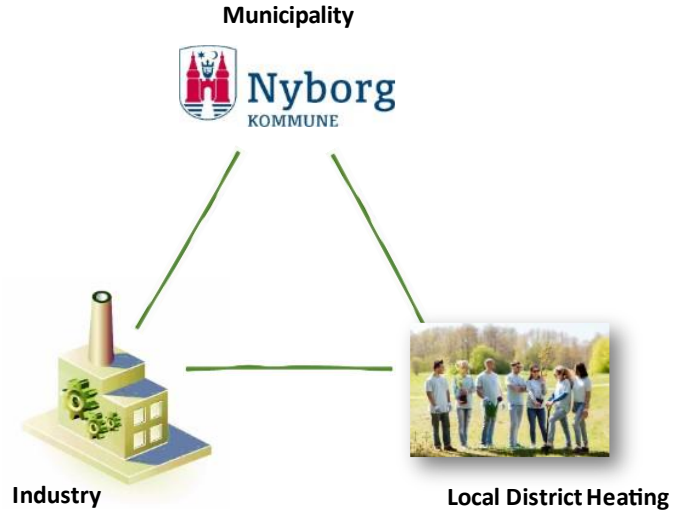
A partner agreement with Fortum Waste Solutions Ltd. is to be signed in Jan – Feb. 2023.

- From **heat exploitation** to **carbon reduction**
- From **shared business** to **shared vision**
- From **co-operation** to **eco-region**



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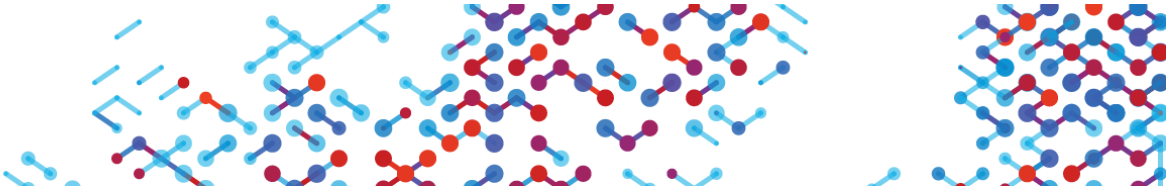
3 Added value of R-ACES

Nyborg has not participated in the active use of the developed tools due to the fact, that an informal "eco-region" was already in place with intensive use of surplus industrial heat. The role of Nyborg Eco region has therefore been to take part in the validation process of all the tools on the basis of the experiences gathered in Nyborg, hence being an active part in the development and validation process.

Additional to the participation in the development process of the tools, Nyborg eco-region has gained added value from the inspiration shared by developing eco-regions, including the need to communicate and institutionalize the idea of an eco-region. As a result of this, the eco-region concept is integrated in the Climate Action Plan developed by the municipality, including the ambition to expand the local district heating on the basis of surplus heat, using surplus heat for industrial production purposes, and – recently – efforts to develop district *cooling* in parts of Nyborg based on new technology using surplus heat for cooling.

Nevertheless, the dialogue with the partners and the systematic approach to developing energy cooperations has been an inspiration for Nyborg Municipality as well.



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4 Assessment of the short-term and long-term impact of the developed energy cooperation projects

The KPIs required by the project served as a guideline with respect to the targets to be achieved in the ecoregion. Hence the work has been carried put baring in mind the KPIs of R-ACES.

Below is a summary of the **KPIs of the Nyborg ecoregion**. The table for the Nyborg Ecoregion is based on estimations.

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4.1 Impact in relation to the KPIs

Nyborg Municipality estimates following KPIs

KPI 1	Energy savings triggered by R-ACES in PJ/a <(1) the recovery of excess heat that is used for district heating, (2) the energy reduction of business parks in the region and joint energy services, (3) the improved efficiency of DHC networks as a result of upgrading technology and usage of renewable energy sources>	4.000 MWh/year
KPI 2	€ Investments in sustainable energy	Not estimated
KPI 3	Actors that commit to energy cooperation - High priority areas	1 new company 5.000 private houses
KPI 4	Actors that commit to energy cooperation - industrial sites	1 new company In future: Up to 20 new companies on district cooling
KPI 5	Actors that commit to energy cooperation - business parks	
KPI 6	Actors that commit to energy cooperation - DHCs	Aprox. 5000 private houses
KPI 7	Number of relevant stakeholders aware of and/ or interested in implementing joint energy	
KPI 8	Number of contracts, policies and legal frameworks, including (1) Legislation/ regulation on DHC and trade in heat, (2) Local Energy Communities and the direct exchange of heat, (3) Grid codes and tariffs, (4) Mechanisms to jointly own/invest in renewable energy sources (e.g. a wind turbine), (5) Zoning regulations and building codes (specifically the obligation to connect to DHC instead of gas)	1 partnership agreement. 1 new contract on heat Up to 20 new contracts in the future on district cooling
KPI 9	GHG reduction triggered by the R-ACES project measured in MtCO2eq	820 tons CO2 5.000 houses x average emission (not calculated)

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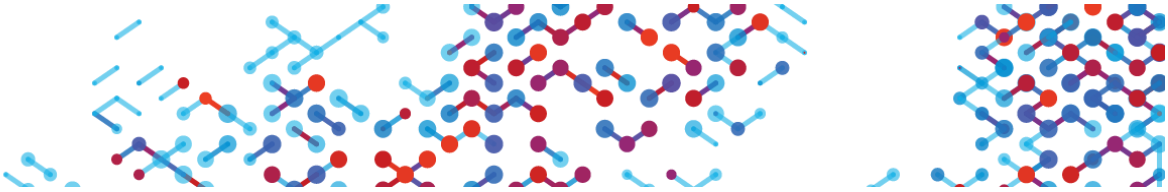
Other results include:

- The formulation of a new strategy for the eco-region, going from business co-operation to strategic partnership and from exploitation of surplus heat to a carbon neutral eco-region.
- In relation to the new strategy, a new strategy for carbon capture was developed as an integrated part of the eco-region.

4.2 Success stories

The R_ACES project has furthermore led to a strategic development of the eco-region, including a diversification of the use of surplus industrial heat, extended use for local district heating, and Carbon Capture and Usage (CCU) on the major CO2-sources in the municipality.



5 Conclusion

Nyborg Municipality has had energy co-operation with the major companies in the municipality for a long period (decades), and the municipality participates in R_ACES in order to share our experiences and assist in evaluating tools and strategies for new eco-regions to be established.
The inspiration based on the dialogue with the partners and the systematic approach to developing energy coorperations has led to a more explicit communication of the symbiosis in Nyborg towards local companies and citizens and towards national and international stakeholders.

Based on the experiences in the Nyborg eco-region, we point to the following potential major difficulties and barriers for energy co-operation :

1. Getting the overview of valuable excess heat (accessibility, temperature range)
2. To find financing for building the business case that will persuade the private company to take part in investing in the use of surplus heat. In many cases, public authorities are not allowed to invest in such cases
3. Qualified staff that can identify the potential for use of surplus heat in the companies and describe the (economic) advantage for the company
4. Adjusting the technology at the heat consumer – finding new ways to produce the same heat, or produce at a lower temperature
5. Legal framework. In some cases, taxes and regulations are a barrier for using excess heat from the production for comfort heating in offices etc.

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Our recommendations on how to solve the potential barriers are:

Ad 1) Mapping surplus heat in defined areas or in connection with developing local district heating

Ad 2) Investments may in some cases be supplied by local district heating company, or investments can be part of an EU-project (under de Minimis regulation).

Ad 3) The qualified person to identify potentials was in our experience the most important factor for several cases of surplus heat projects – also outside this project. We recommend to have dialogue with professional schools, branch organizations and universities about the relevant skills and professional background.

Ad 4) Skilled staff is necessary to describe the possibilities for the company. And financing to build the business case. A longer perspective from the companies on business cases would be a great help. Ad 5) Building better incentives for companies and their use of surplus heat. This can only be done through lobbying in ministries and in the EU parliament.

To conclude … The strategy for the eco-region in Nyborg has been embedded in the Climate Action Plan developed along with the R_ACES project and approved in the city council in December 2022. Developing the eco-region is thus an integrated part of reaching the climate goals of Nyborg.
After the R-ACES project … A completely new initiative on district cooling based on surplus heat is beeing initiated and will be further developed from 2023 and the years to come. The ambition is that excess heat from the companies can be used to supply district cooling through isolated tubes to up to 20 private and public consumers in the defined project area of the city. These include production companies, service companies, offices, supermarkets, large shops and a municipal health care center. The project will be unique in its concept and a new business opportunity for the local district heating company.

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6 References

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7 Annexes

Annex 01

R-ACES definitions

Project Glossary

Definition of Key Concepts in the R-ACES project

Business park: An area of land in which many office buildings are grouped together with a common infrastructure (Wikipedia). Business parks, like industrial sites, often have similarities in heating and cooling demand. Certain businesses may even have residual energy streams, for example data centers. As such, business parks may also organize as an ecosystem or eco business park (EBP) and become an important stakeholder within an ecoregion.

Eco Business Park: *"An eco-industrial park is a community of businesses located on a common property in which businesses seek to achieve enhanced environmental, economic and social performance through collaboration in managing environmental and resource issues. This is known as industrial symbiosis, which is a means by which companies can gain a competitive advantage through the physical exchange of materials, energy, water and by-products, thereby fostering inclusive and sustainable development."* (United Nations Industrial Development Organization)

Communicate: professional and public coverage of the project results and achievements, benefits and potential deployment. This will be realised via the adoption of a large variety of distribution channels, including already existing platforms focusing on energy cooperation in industrial sites and business parks and energy exchange/cooperation at large.

Disseminate: exploitation of the project results to relevant stakeholders in the regions. It intends to ensure a low threshold in accessibility, usage of R-ACES tools and methods. This includes access to the tools, to the use case libraries and to the training and capacity building material and related self-explanatory instruction manuals.

DHC: Abbreviation of District Heating and Cooling. A system for distributing heating/cooling generated in a centralized location through a system of insulated pipes for residential and commercial heating requirements such as space heating/cooling and water heating/cooling.

> 4th generation DHCs: *"4GDH systems provide the heat supply of low-energy buildings with low grid losses in a way in which the use of low-temperature heat sources is integrated with the operation of smart thermal grids. Smart thermal grids consist of a network of pipes connecting the buildings in a neighbourhood, town centre or whole city, so that they can be served from centralised plants as well as from a number of distributed heating and cooling producing units (or decentralised units) including individual contributions from the connected buildings. The concept of smart thermal grids can be regarded as being parallel to smart electricity grids. Both concepts focus on the integration and efficient use of potential future renewable energy sources as well as the operation of a grid structure allowing for*

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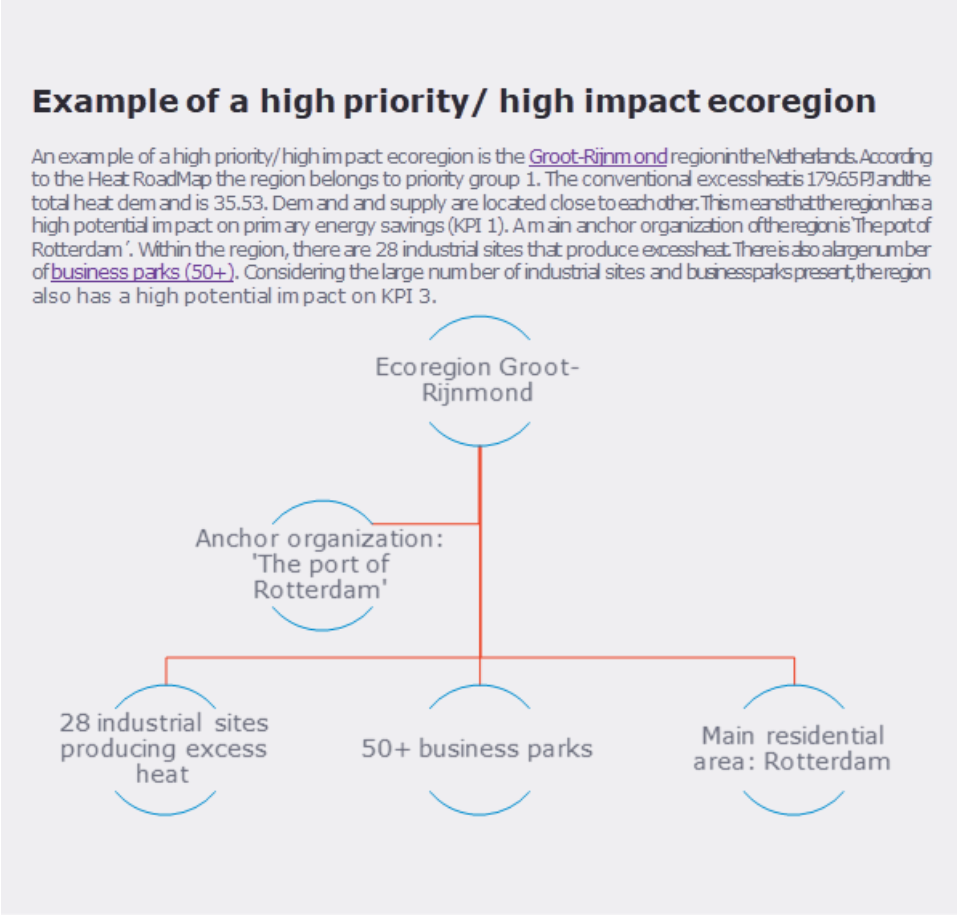
distributed generation which may involve interaction with consumers." (adapted from Lund et al, Energy 68; 2014, p1-11).

5th generation DHCs: *"5GDHC is a highly optimized, demand-driven, self-regulating, energy management system for urban areas. Its key features are: 1) ultra-low temperature grid with decentralized energy plants; 2) closed thermal energy loops ensuring hot and cold exchange within and among buildings; 3) integration of thermal and electricity grids."* (D2grids, Interreg NWE)

Ecoregion: An ecoregion within the R-ACES project is a geographic area where energy and information exchanges occur between stakeholders of various types to reduce energy consumption. Geographical size does not matter (the size of an ecoregion can be as small as a business park or as large as a city). Important is that an ecoregion relies on an anchor organization responsible for managing the area (for example park management). Another aspect is the proximity of stakeholders to ensure interconnected energy flows (continuity of supply, quality of supply, quantity). Within an ecoregion, a wide range of assets could be involved: office parks, data centers, multimodal centers, technological centers, agro-centers, science parks, brain parks, lighthouse parks, chemical parks, eco-industrial parks, and cluster/business parks. For the demand of heat, also residential areas could be taken into account. As such, the term ecoregion functions as an 'umbrella term'.



High priority region: A high priority region is an Ecoregion, as defined above, that has balanced potential match of heating/cooling supply and heating/cooling demand in both quantitative (amount of heating/cooling) and qualitative (temperature, form of heat) terms. The region should be identified by heat roadmap studies (for example, the Heat RoadMap Europe or Stratego) or other research activities. In addition, the regions should have networking possibilities. The regions can include industrial sites, business parks and residential areas.

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The table below gives an indication of the priorities. R-ACES will focus on priority group 1 +2.

Table 2.19. Excess heat ($E_{heat,o}$) and heat demand (Q_{tot}) characteristics for the definition of priority groups to identify heat synergy regions

	Characteristics			
Priority group	**Excess heat[a] [PJ/a]**	**Heat demand[b] [PJ/a]**	**Priority status**	**Comment**
1	$\Sigma E_{heat,o} > 10$	$Q_{tot} > 10$	Very high	High levels of both $E_{heat,o}$ and Q_{tot}
2	$1 < \Sigma E_{heat,o} < 10$	$Q_{tot} > 10$	High	Moderate levels of $E_{heat,o}$ and high Q_{tot}
3	$\Sigma E_{heat,o} > 10$	$1 < Q_{tot} < 10$	Moderate	High $E_{heat,o}$ and moderate levels of Q_{tot}
4	$1 < \Sigma E_{heat,o} < 10$	$1 < Q_{tot} < 10$	Low	Both $E_{heat,o}$ and Q_{tot} at moderate levels
0	$\Sigma E_{heat,o,max} < 2.5$	$Q_{tot,max} < 25$	No priority	Both $E_{heat,o}$ and Q_{tot} at low levels

[a] Maximal theoretical levels of annually available excess heat.
[b] Space heating and domestic hot water preparation in residential and service sectors.

High potential region: Within the project proposal, sometimes the term high potential ecoregion is mentioned. From now on, this term will not be used within the scope of the R-ACES project.

High impact (in R-ACES terms): Regions that have a high potential impact on the R-ACES KPIs. More specifically, regions are meant that have a high potential impact on KPI 1: Primary energy savings, and KPI 3: Number of plant sites and number of industrial parks where businesses commit to energy cooperation.

Energy cooperation: Energy cooperation activities between industries, which include physical clustering (e.g., of buildings and processes, energy exchange, collective production) and/ or service clustering (e.g., joint contracting). Both can deliver a more stable cumulative demand, economy of scale for larger installations with higher efficiencies and smaller spatial footprint and an optimized demand response. Within R-ACES, the focus is mainly on energy cooperation through the exchange of heating and cooling.

Energy Management Platform: is an ICT-tool that makes energy flows transparent; allows energy consumption and production to be allocated to specific installations, stakeholders and nodes; and identifies anomalies and opportunities. A key feature is that it is very easy to use for a wide range of stakeholders. In this way, it is possible to deploy it in a cluster and give access to the different company and cluster managers – each at their level of detail and with the information they should have access to. On the ecoregion level, there will be a dashboard that shows different energy flows.

ESCO: Abbreviation for Energy Service Company. An ESCO is a business that provides a broad range of energy solutions including designs and implementation of energy savings projects, retrofitting, energy conservation, energy infrastructure outsourcing, power generation and energy supply, and risk management.

Facilitator: someone who helps to bring about an outcome (such as learning, productivity, or communication) by providing indirect or unobtrusive assistance, guidance, or supervision. This task does not include technical expert know-how, instead facilitators are trained to facilitate interaction between multiple actors.

Industrial cluster: Within the project proposal, sometimes the term Industrial cluster is used. From now on, this term will not be used within the scope of the R-ACES project.

Industrial park: Within the project proposal, sometimes the term Industrial park is used. From now on, this term will not be used within the scope of the R-ACES project.

Industrial region: Within the project proposal, sometimes the term Industrial region is used. From now on, this term will not be used within the scope of the R-ACES project.

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Industrial site: An area zoned and planned for the purpose of industrial development. An industrial site can be thought of as a more "heavyweight" version of a business park or office park, which has offices and light industry, rather than heavy industry. They may contain oil refineries, ports, warehouses, distribution centres, factories, and companies that provide manufacturing, transportation, and storage facilities, such as chemical plants, airports, and beverage manufacturers (Wikipedia).

(R-ACES) Learning community: Local group of stakeholders that are (a) directly involved with the energy collaboration on a site; and (b) engaging in both organised and informal exchange of knowledge and best practices over the course of the project period. These groups are the first beneficiaries of instruments like serious gaming. Learning communities from different sites in this project will eventually be brought into contact with each other to further stimulate the exchange of best practices.

Learning network: *"Allow for enduring relationships built on trust to develop among companies within an industrial site. In turn these relationships encourage information sharing, creative solutions, long term planning and governance among stakeholders. Social aspects increase interactions among stakeholders and strengthen collaborations and partnerships including industrial ones"* (Scaler, 2018). To establish such learning networks, the R-ACES project will use learning communities.

(R-ACES) Legal support tool: A tool that supports practitioners by giving the legal decision support for joint contracts. A low threshold for usage is a critical requirement. The tool is self-explanatory, application oriented, using well-defined and clear terminology. The tool should be able to deal with a high diversity of local situations. For practical reasons, the name of the legal tool might change during the R-ACES process. In this case, the consortium will be informed.

LESTS framework: Abbreviation for Legal, Economic, Spatial, Technical and Social/Managerial. LESTS is a framework that is used in the project to categorize barriers and drivers in ecoregions. The different categories include: Legal, e.g. liabilities, regulatory requirements, third party contracts, service agreements, rules; Economic, e.g. cost savings, waste/ resource recovery value, funding mechanism, taxes & environmental considerations; Spatial, including geographical proximity, planning rules and environmental considerations; Technical, e.g. sharing and cascading resources, system stability, facilities; Social/Managerial, e.g. with regard to workers, consumers, local communities employment, community engagement, and capacity building.

Lock-in: Exchange of by-products will lead to long term reliance on an outside company, which will restrict flexibility of the involved companies and possibility for innovation, or possibility to relocate the site.

Longlist (for example longlist of regions): Exists of lists of items (rows), for example regions, that have been selected on the basis of loose selection criteria (columns). The long list is a first step in creating a short list. The long list should cover all potential subjects that might be of interest to the short list. Example:

Region	Region	Country	Source	# DHCS	# Industrial sites	# Business parks	Contact person	Contact details
1	Maasvlakt	Nederland	...					
2	Chemelot	Nederland	...					
3	Terneuzen	Nederland	...					

Long-term: Long-term impact of R-ACES is gained after the end of the R-ACES project (in KPI terms).

Peer2peer: A network of peers (R-ACES stakeholders) that perceive each other as equal. The peers interact with each other in order to learn from each other. The peer2peer learning context is a formal or informal setting, in small groups or online. Pear learning

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manifests aspects of self-organization. By this is meant, that there is no hierarchical structure within a peer2peer network (Wikipedia).

(R-ACES) Self-assessment tool: A tool that helps ecoregions to determine the next steps they have to take in the energy cooperation process. The tool exists of a number of questions practitioners have to answer. Based on the answers, the practitioners will get a score and some practical considerations they should take into consideration.

Serious gaming: A method for learning-through-experience that presents participants with a case study in which they have to play pre-assigned roles to each reach a pre-defined objective as quickly as possible. The interactive & competitive gaming element increases the attractiveness and the learning outcome of the case study. Serious gaming addresses cooperation elements among a large variety of practitioners and focus at creating acceptance and awareness, where the learning communities focus at sharing experiences between peers.

Shortlist (for example shortlist of regions): List of items, for example regions, that have been selected from a long list on the basis of (strict) selection criteria. Hereby, the advantages and disadvantages of each item are considered (OpenLearn). The shortlist contains items that have a high potential and likelihood to contribute to the R-ACES goal.

Short-term: Short-term impact of R-ACES is gained during the R-ACES project.

Use case: A written description of the sequence of steps performed by an ecoregion to come to fruitful energy cooperation.

Use case library: A library that contains multiple use cases.

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