CapaCity Workshop

Cracow, Poland

Workshop Report

4 April 2017

Cracow, Poland

a format of

in cooperation with

Content

1 Introduction

1.1 CapaCity – Urban Competences

The program **CapaCity – Urban Competences** funded and supported by the Municipal Department 27 – European Affairs by the City of Vienna pursues a more deepened international cooperation between the City of Vienna, its organizations and other cities. Several initiatives in the Danube region already have pushed forward cooperation and intensification of social and economic exchange between countries, regions and cities (e.g. the enlargement of the European Union in 2004 & 2007; the establishment of the European Strategy for the Danube Region), nevertheless the City of Vienna now focuses on the internationalization of organizations and companies in order to generate common project ideas. Integrated urban development as holistic smart city approach is the main aspect of activities within the program CapaCity. The Municipal Department for European Affairs (MA 27) of the City of Vienna as initiator of the CapaCity program pursues to both widen the range of topics for city cooperation's and to identify core topics of common interest.

Intensified European integration is one aspect of the program, additionally the City of Vienna has been visited by various delegations and municipal experts, who are interested in urban strategies and technologies applied in Vienna. CapaCity builds up on opportunities generated by this international interest and will strive after sustaining contacts and intensifying exchange with regard to urban technologies and strategies.

The following activities are designed within the project CapaCity in order to support Viennese companies and organizations to deepen internationalization and activities in Central and Eastern Europe:

- Organization of workshops in selected cities with participation of stakeholders from Vienna. The main aim of these workshops is follow-up activities.
- Coordination and collection of statistics of delegations, experts, organisations and companies visiting Vienna with particular interest in urban solutions.
- Representation at events, relevant for smart city expert networks & cooperation ideas.
- Research on and collection of relevant challenges for future urban development with regard to important cross-border and transnational projects and attractive co-financing instruments.
- Development of project ideas, triggered by municipal expert exchange on the basis of organized workshops in CapaCity partner cities.

Diverse sectors and topics are relevant for workshops within CapaCity which are based on issues of the Smart City Vienna framework strategy: radical resource preservation, innovations/new technologies, balanced quality of living. CapaCity is open for a variety of concrete topics, e.g. urban mobility and transport planning, strategies for tourism development or urban development visions. The ruling principle of workshops is the mutual benefit for both the host city and the City of Vienna and its organizations.

The CapaCity Workshop in Cracow (PL) focused on the use of renewable energy for district heating and cooling in Cracow. Another focus of this workshop was the exchange between city stakeholders and experts from Cracow and Vienna, in order to learn and benefit from each other's perspectives and ambitions.

2 Executive Summary

Cracow is one of Poland's most important economic centres and the economic hub of the Lesser Poland (Małopolska) region. The city is also one of the co-location centres of Knowledge and Innovation Community (Sustainable Energy) of The European Institute of Innovation and Technology (EIT) hosting the office of the EIT InnoEnergy. The partners of the EIT InnoEnergy have jointly developed a strategy to tackle the weaknesses of the European innovation landscape in the field of sustainable energy in order to build a sustainable long-lasting operational framework amongst the three actors of the knowledge triangle in the energy sector.

About 70% of all residential and 50% of all commercial buildings in Cracow and in the adjacent Skawina are connected to district heating. In the 1990s, the City of Cracow made significant progress in reducing air pollution and in improving energy efficiency and environmental performance of the district heating system. However, until the end of 1997 limits were set by the Ministry of Finance on the amount of tariff increases the district heating enterprises could make which causes delays in the implementation of the modernization programs as the level of internal cash generated by most district heating enterprises was inadequate to meet their resource requirements.

Thus, the intention of the CapaCity workshop was, as part of the "WienTage (ViennaDays)", to exchange knowledge on the improvement of the energy management of the City of Cracow by optimisation of the use of heat by modernising the network (upgrading to smart grids) and to use of excess heat during summer time for district cooling. Furthermore, it was expected that based on the workshop a common project could be drafted in order to obtain funding from the European Union.

The workshop was a combination of a plenary session, which gave an introduction and general overview of several aspects of the situation followed by a workshop session.

In the first presentation (part of the plenary session) Mr. Marek Mazurek from MPEC S.A. gave an overview of the company and the overall situation and future activities of MPEC in Cracow. The second presentation (part of the plenary session) was held by Mr. Burkhard Hölzl, Heating and cooling projects, Wien Energie providing a general overview of the district heating and cooling system currently in place in Vienna as an introduction for more detailed discussions during the workshop session.

Further, mostly very detailed technical issues, on the systems with focus on district cooling in Vienna and Cracow and future developments were discussed in the workshop session. This session was attended by representatives of the City of Cracow, responsible for the operation of the city company for heating and cooling, by EDF Poland, responsible for the supply with heat in Cracow, by Wien Energie and by TINA Vienna. In order to facilitate the communication during the workshop a consecutive translation (German/Polish) was provided.

Future activities to intensify the collaboration between Vienna and Cracow in the field of district heating and cooling could be follow-up workshops or common projects with stakeholders of both cities in order to work out specific solutions for the discussed issues.

3 The study case

Cracow lies in the southern part of Poland, on the Vistula River, in a valley at the foot of the Carpathian Mountains. There are five nature reserves in Cracow with a total area of 48.6 ha. Smaller green zones constitute parts of the Kraków-Częstochowa Upland Jurassic Landscape Parks' Board. The western part of Cracow constitutes the so-called Obszar Krakowski ecological network, including the ecological corridor of the Vistula river. The southern slopes of limestone hills provide conditions for the development of thermophilous vegetation, grasslands and scrubs.

The City of Cracow is divided into 18 administrative districts, each with a degree of autonomy within its own municipal government. Prior to March 1991, the city had been divided into four quarters which still give a sense of identity to Cracow – the towns of Podgórze, Nowa Huta, and Krowodrza which were merged into the City of Cracow as it expanded, and the ancient town centre of Cracow itself.

Cracow is one of Poland's most important economic centres and the economic hub of the Lesser Poland (Małopolska) region. Since the fall of communism, the private sector has been growing permanently. In 2005, foreign direct investment in Cracow has reached about US$ 3,500,000,000. Cracow has been trying to model itself as a European version of Silicon Valley, based on the large number of local and foreign hi-tech companies.

The city is one of the co-location centres of Knowledge and Innovation Community (Sustainable Energy) of The European Institute of Innovation and Technology (EIT), too. The EIT InnoEnergy with its office in Cracow is an integrated alliance of reputable organisations from the education, research and industry sectors. It was created based on long standing links of cooperation as well as the principles of excellence. The partners have jointly developed a strategy to tackle the weaknesses of the European innovation landscape in the field of sustainable energy in order to build a sustainable long-lasting operational framework amongst the three actors of the knowledge triangle in the energy sector: industry, research and higher education, and ensure that this integration of the three is more efficient and has a higher impact on innovation (talent, technology, companies) than the three standing alone.

3.1 Challenges

The City of Cracow has about 760,000 inhabitants, of which about 100,000 are students. About 70% of all residential and 50% of all commercial buildings in Cracow and in the adjacent Skawina are connected to district heating.

In the 1990s, the City of Cracow made significant progress in reducing air pollution from many small, inefficient low-stack emission sources burning coal or coke, largely by either converting them to gas-firing or connecting them to the centralized district heating system supplied by more efficient combined heat and power plants. The city also made significant progress in improving energy efficiency and environmental performance of the district heating system. Until the end of 1997, as part of the Government’s efforts to control inflation, limits were set by the Ministry of Finance on the amount of tariff increases the district heating (DH) enterprises could make. While this control played an important role in pressuring the DH enterprises to increase efficiency, it substantially reduced their gross margins, which adversely affected their profitability and cash flow levels. This delayed the

implementation of the modernization programs as the level of internal cash generated by most DH enterprises was inadequate to meet their resource requirements. During this period, the sector's financial difficulties were exacerbated by increasing accounts receivable and bad debts of industrial enterprises.

Polish case studies had identified the following barriers to energy efficiency project development in the building sector.

- **Difficulties in Arranging Financing.** Many Polish building owners had insufficient access to project financing for up-front investment costs for energy efficiency retrofit projects that would reduce the energy bills.
- **Inadequate Information.** The building owners, the occupants and the local banks lacked information about the financing aspects of energy-saving investments, the implementation experiences of others, and the ability to use energy savings to finance some building renewal.
- **Commitment Risk.** Disbelief in the possibility of savings and fear of disruption to building occupants stalled energy management actions that might otherwise have been fundable. Basically, commercial banks and building owners perceived too much risk to enter into financing arrangements based on energy management programs from Energy Service Companies (ESCOs).
- **High Transaction Costs.** Energy efficiency projects were relatively small and carried high transaction costs, especially when using new and unfamiliar procedures such as energy performance contracting. Especially where the benefits were considered small, building owners were reluctant to incur these costs.
- **Institutional Constraints.** While Poland had considerable technical expertise relative to energy efficiency in buildings, an adequate institutional structure was not yet in place to help building owners overcome many of the barriers listed above.

Having in mind these framework conditions the general objectives of the City of Cracow in this context are:

- Optimisation of the use of heat by modernising the network (upgrading to smart grids)
- Use of excess heat during summer time for district cooling
- Improvement of the energy management

The district heating network of Cracow is operated by MPEC S.A. (Municipal heat power engineering company) obtaining the heat from two power plants (EDF and CEZ) having following main parameters:

- winter: flow temperature 135 °C, return temperature 65 °C
- summer: flow temperature 70 °C, return temperature 40 °C

In addition to the conventional systems MPEC together with the AGH University have designed a pilot project in order to test another approach. This pilot follows the idea that cold is not produced centrally and then transferred to the customer but heat is transported to the customer and the cooling is produced at the place of consumption using the heat from the district heating network.

Furthermore, MPEC expects that based on the workshop a common project could be drafted in order to obtain funding from the European Union.

4 Workshop Program

4 April, 2017 – Innovative Städte (Innovative Cities)

Venue: International Cultural Centre (MCK), Rynek Główny 25, 31-008 Kraków		
Time	Topic	Person
10.00	Welcome address by the host and official opening by the head of the EuroComm office in Cracow	Krzysztof Nowak
10.10	Ceremonial welcome by the Mayor and Governor of Vienna Ceremonial welcome by the Mayor of the City of Cracow	Dr. Michael Häupl Prof. Jacek Majchrowski
10.20	Official handover of the town furniture "Vienas"	
10.40	Presentation "City-Idea – urban circular economy", Introduction to the conference topics	Prof. Jerzy Hausner, University of Economics Cracow
11.00	Presentation of the City of CraCow on the subject of "Air quality"	Witold Śmiałek, Advisor of the Mayor for the area of air quality
11.10	Presentation of "Air quality and reduction of emissions "	Dr. Heinz Tizek, Department for Environmental Protection - MA 22
11.20	Discussion on the topic "Air quality and reduction of emissions"	
11.35	Coffee break	
11.55	Presentation "Public Transport: Concept for the Underground Tram in Cracow"	Vice-Mayor Tadeusz Trzmiel
12.05	Presentation from Vienna on Underground Tram: "From Planning to the Preparation of the Investment"	Nikolaus Panzera, Department Underground - Operation, Wiener Linien
12.15	Discussion on the topic "Underground Tram"	
12.30	Presentation on the topic of "Cooling and heating from the municipal district heating network"	Marek Mazurek, Board Member, Director of operations MPEC (Cracow district heating)
12.50	Presentation on the topic "district heating/cooling, district heating networks"	Burkhard Hölzl, Heating and cooling projects, Wien Energie
13.10	Discussion on the topic "district heating/cooling, district heating networks"	
13.35	Lunch	
14.15	Introduction to the workshop sessions • air quality • district cooling/heating (CapaCity project) • public transport/underground tram	

14.25	Introduction to the program **CapaCity – Urban Competences** and its ambitions Detailed presentation of the district heating and cooling system in Vienna Discussion	Rainer Mueller, TINA Vienna Burkhard Hölzl, Heating and cooling projects, Wien Energie
17.00	Presentation of results of Workshop "District Cooling/Heating" within the concluding plenary session	Marek Mazurek, Board Member, Director of operations MPEC Rainer Mueller, TINA Vienna

5 Workshop Findings

The workshop was part of the "WienTage (ViennaDays)" in Cracow and took place on 4 April 2017. It was a combination of a plenary session, which gave an introduction and general overview of several aspects of the situation of the three main topics of the event followed by workshop sessions. The topic of the dedicated CapaCity Workshop was "District Cooling and Heating".

In the first presentation (part of the plenary session) Mr. Marek Mazurek from MPEC S.A. gave an overview of the company and the overall situation and future activities of MPEC in Cracow.

MPEC is a joint stock company, in which the organisation, management and actions shall be governed by the relevant provisions of the commercial code. The 100% owner of the company is the City of Cracow. Based on the municipality of actions MPEC s.a, MPK s.a. and MPWiK s.a. were filed to the newly formed Company-Krakow Holding Communal in 1999. The Basic Act regulating the activities of the company is a Charter City heat power Company s.a, which specifies the name of the company, its registered office, business, the amount of capital and the company.

The mission of the MPEC in Cracow is to satisfy the needs of customers through reliable assurance expected by their thermal comfort and optimum temperature of domestic hot water. Acting on the heat market MPEC wants to create the image of a company to comprehensively and professionally installed that supports the clients always cares about the environment.

The second presentation (part of the plenary session) was held by Mr. Burkhard Hölzl, Heating and cooling projects, Wien Energie. He provided a general overview of the district heating and cooling system currently in place in Vienna as an introduction for more detailed discussions during the workshop session.

The presentations of Mr. Mazurek and Mr. Hölzl are available in the Annex of this report.

According to the programme details on the systems with focus on district cooling in Vienna and Cracow and future developments were discussed in the CapaCity workshop session. This session was attended by representatives of the City of Cracow, responsible for the operation of the city company for heating and cooling, by EDF Poland, responsible for the supply with heat in Cracow, by Wien Energie and by TINA Vienna. In order to facilitate the communication during the workshop a consecutive translation (German/Polish) was provided.

5.1 Points of Discussion

The discussion during the workshop session concentrated on three main issues of district cooling, i.e. network development and its specifications, project development and implementation and price policy and funding relevant for further development in Cracow. The main points of discussion are listed in the following subchapters. To a great extend the discussion was very technical and detailed on solutions already in place in Vienna. Thus, only the main issues are listed in this chapter, more details are shown in the annex (presentations) of the report.

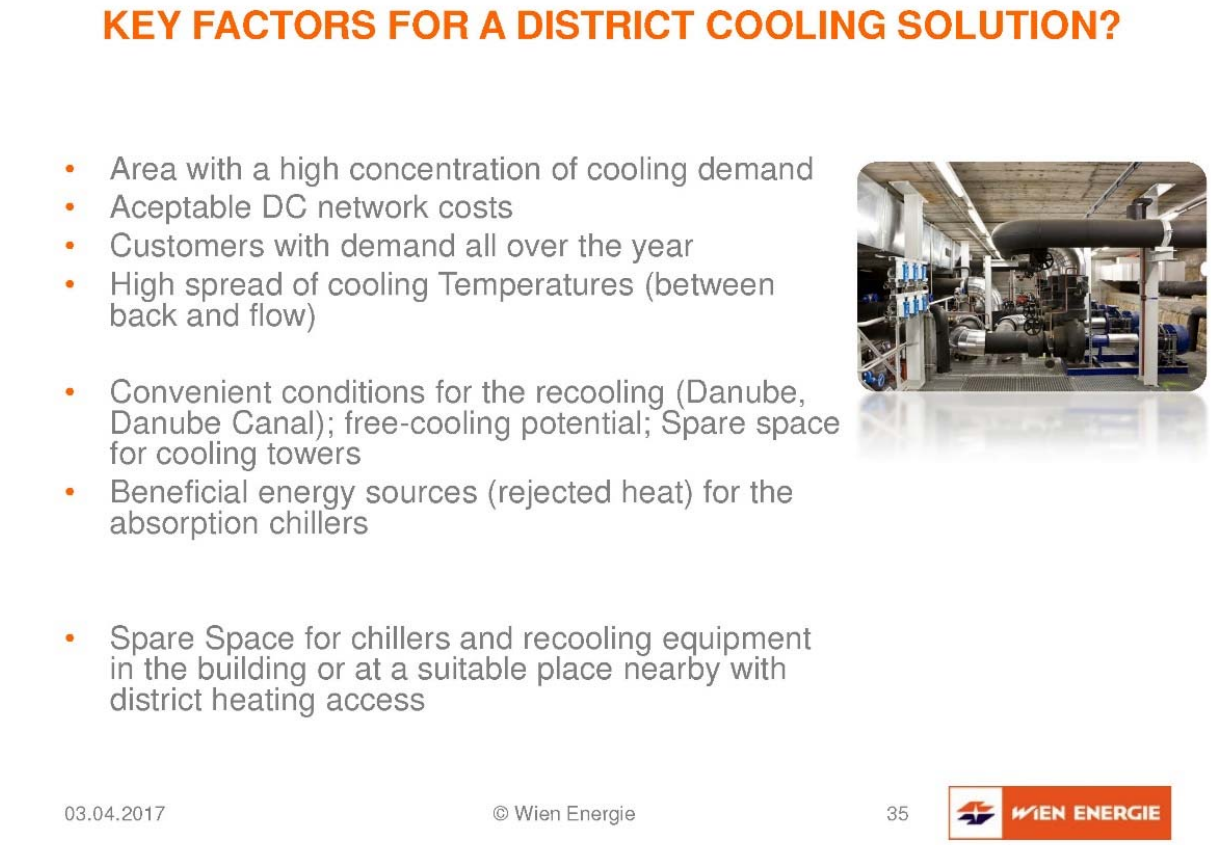
In general, the workshop is foreseen as the starting point for the implementation of new ideas in Cracow in cooperation with the City of Vienna.

5.1.1 Network Development

- Distribution of cooling energy
  - Distribution to the customers
  - Development of a "cooling market segment"
  - Generation of cold from district heating (theoretical/pilot)
  - Transformer for cooling and heating incl. network parameters
  - Temperatures of water in summer → determine factor
- Cooling using absorption chillers
  - Efficiency of chillers
    - Electric chiller: 5.5
    - Use of river water for recooling
    - Cooling tower: 4.5
    - Dry chiller: 2.5 – 3
    - Absorption chiller: 0.5 – 0.7
- Decision on the used system: centralised <-> decentralised
  - Problem of decentralised systems is the high water temperature in the summer
- In Vienna no adsorption chillers are used – not economically feasible

5.1.2 Project Development

- Development of a new project in Vienna
  - Starting from zero assuming one main customer → decision without knowing the costumer → search for one main customer
  - Adaptation of the system (e.g. temperature) for the needs of the customers
- Development of a network
  - Residential area with high "cooling density" (potential consumers)
  - Construction of a central cooling unit
  - Extension of the network
- Key factors for a district cooling solution – see below figure



- Preconditions for projects in Cracow
  - Developed district heating network in high density areas of the city
  - All main consumers are connected to the network
  - In summer there is high heat quantity → use for the increase of efficiency
  - Low flow temperature 65-70°
  - Need for cooling is low
  - No funding for cooling systems is available

5.1.3 Price Policy and Funding

- Cooling is a product
- Use of heating energy (e.g. from waste incinerator) for cooling in the summer

  → problem: the price for cooling in summer and heating in winter must be the same
- Price example for district cooling in Vienna – see below figure

DISTRICT COOLING: PRICES

Standard Price (Basis 09/2016)
Prices are calculated for each customer

- Load Price € 90.468,- per MW
- Energy Price € 35,86 per MWh
- Mixed price at 1000 Fullloadhours: 126,33 € / MWh
- Depending on the project between 0 - 50% of the invest costs are charged to the customer
- Service Limit: Cooling Substation

WIEN ENERGIE

- In Austria there are national funding schemes in place for urban development areas → up 30% of the investment cost are funded
- The calculation of any project must be done without considering any grants
- Additional the city supports the system in urban development areas with for example compulsory connections for the inhabitants
- In Poland there is no scheme for supporting/funding of district cooling
- City of Cracow is not interested → other areas of intervention are of more interest

5.2 Recommendations and Further Steps

Based on the presentations and discussions during the workshop, various challenges could be identified. In order to solve those issues, experts from Vienna and Cracow developed a list of next steps that could be implemented:

- Identification of customers for cooling in Cracow
- Method for the calculation of needs for cooling (problem: to high values based on standard measurement)
- Preparation of an overview of possible technical solutions
- Development of solutions for Cracow
- Elaboration of a business model
- Drafting and implementation of a pilot project that can be used as a reference project for new/other costumers

6 Concluding Remarks

6.1 Tangible benefits for the City of Vienna

Based on the fruitful cooperation and good relationships between EurocommPR and TINA Vienna the workshop further intensified the already existing relationships between the City of Vienna and the City of Cracow, too. Several issues and challenges were discussed and further defined, on which both cities could continue to cooperate.

In the course of the workshop the experts from Vienna always showed their openness and willingness to cooperate in all areas, which were addressed within the framework of the ViennaDays, which was acknowledged as very positive and responsive by the representatives of Cracow.

Apart from offering know-how, the experts from Vienna were also able to gain insight into different approaches and strategies, as implemented by the City of Cracow. Both cities exchanged know-how on current and future challenges and offered advice from their field of expertise. This know-how exchange will not be limited to the CapaCity workshop, but will also be continued in the future.

As Cracow's representatives showed great interest in the solutions already in place in Vienna, further cooperation on district heating and cooling and projects might be the consequence of the presentations and the workshop.

6.2 Next Steps & follow up activities

During the workshop in Cracow the discussion was targeted towards the generation of cold from district heating mainly, so there was no time for other topics. Thus, Wien Energie was approach by EDF Polska R&D after the workshop by e-mail to obtain additional information on district heating, too. The requested information, which is provided below, was on monitoring and diagnostics of the district heating pipes, i.e. monitoring of the condition of heating pipes, which diagnostics methods are used, which parameters of heating pipes are monitored and what is the maintenance politics.

The background is that EDF Polska R&D has been asked to investigate the technical possibilities of the non-destructive analysis of district heating networks in the city of Toruń. Typically, the heating pipes are made of steel, which can be pre-isolated, when underground or not isolated when above the ground. The diameter is between 150 to 1500 mm. Small diameter pipes are usually underground, whereas large pipes are above the ground. The maximum temperature of heating water, during heating season (autumn-winter), does not exceed 150oC, outside heating season its round 65-70oC.

At present EDF Polska is interested in monitoring the condition of main pipelines, that is large diameter pipes above the ground. The idea is to provide an on-line or off-line information on the material status of the cities heating lines. This could be done by a specially designed static system (neural networks, magnetic propagation, electrical measurements etc.) or by some kind of remote device, which could operate inside pipelines to scan the pipe walls and search for metal discontinuities or potential parts of pipes where a crack may occur.

Furthermore, EDF Polska was interested in the use of ground radar (minimum pipes radius analysed, precision of detection and frequency of analysis), the leakage indicator system and mobile ultrasonic systems to investigate the thickness of pipe walls.

The situation in Vienna is that there are two different heating networks in operation. A so called primary heating network with high temperatures und high pressures (up to 160°C, up to DN800) and secondary networks with lower temperatures and pressures (up to 90°C, up to DN350).

Primary heating network:

- The heating pipes are built into a collector made of concrete (precast concrete elements).
- The precast concrete elements are waterproof against groundwater.
- The precast concrete elements got a small slope (~2‰) to the next manhole.
- The steel-heating-pipes within these concrete elements are insulated with rock wool.
- In case that a concrete element is not waterproof, or the steel-heating-pipe got a leakage the water (or steam) appears in the manhole. So the maintenance staff can check out what is wrong with the concrete collector or the steel-pipe (for example with a ground radar).
- There is no other possibility to find leakages in the district heating system as there is no monitoring system for the primary heating network.
- In some particular situations there are also pipes above the ground (bridges). The insulation in these cases is made of rock wool with an aluminium cover. This aluminium cover is sealed with silicon.
- The main transport pipes (~120km of our heating network) are built in pipeline inspection passages where the staff can walk along the pipes and check them easily.
- In the past a leakage indicator system for primary pipes was installed. But not monitored only to check with electrical contacts in the manhole. As the system brought no useful information this additional leakage indicator system in the primary network was quitted.

Secondary heating networks:

- Pre-insulated plastic jacket pipe with a leakage indicator system (two wires within the insulation)
- The pipes are directly buried in the ground.
- Leakages are checked with the leakage indicator system and can be monitored.

There is no other monitoring system neither for the pipe-wall-thickness, nor for metal discontinuities. If for example the wall-thickness has to be checked mobile ultrasonic systems are used.

In the past in Vienna also a wire-indication-system was used in the primary heating network. However, due to hundreds of false alarms it was decided not use the system anymore, because if there is a leakage steam appears immediately this is easily visible for the maintenance staff. In the secondary heating network, the Nordic system is used. The system from the Austrian company called "Wundara" (www.wundara.com) is used. As

mobile ultrasonic system the one from "Olympus" is used in Vienna. For the use of the device the pipe has to be accessible but there is no need to drain it.

Summarising the mainly used systems in the heating network in Vienna are:

- Primary heating network:
  - Correlation measurement from "Esders"
  - infrared camera from "Flir"
- Secondary heating network
  - wire-indication-system from "wundara"
  - time-delay-messurement at the Nordic system (Riser Bond RD6000)
  - potential-drop-measurement from "wundara"
  - pipe-searching device (RD7000+)
  - infrared camera from "flir"

7 Annex

7.1 List of participants

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LISTA OBECNOŚCI 4.04.2017

1. Tamela Mühlmann, TINA Vienna,
2. Bartosz SARAPATA, EDF Polska S.A. R&D
3. Piotr CZUPRYŃSKI, EDF Polska S.A R&D
4. Andrzej Łazęcki GZ UMK
5. Wiesław Nowak MPEC SA w Krakowie ZEP PD
6. Mirosław Wróblewski MPEC S.A. w Krakowie
7. MAREK MAZUREK MPEC SA w KRAKOWIE
8. Emil Stańczyk AGH Kraków.
9. Krzysztof Rytel MPEC SA Kraków PZ
10. Grażyna Żebrowska EDF Polska
11. Jakub Lis EDF Polska S.A. o/1 Kraków
12. ~~Karol Stós~~ ~~EDF Polska~~
13. Ryszard Tokarski " — " — " — "
15. Burkhard Hölzl, Wien Energie
16. Rainer Müller, TINA Vienna

7.2 Presentations (ppts) of the workshop

mpec s.a. w krakowie

Ciepło, które łączy

CIEPŁO I CHŁÓD
Z
MIEJSKIEJ SIECI CIEPLNEJ W KRAKOWIE

Marek Mazurek
Członek Zarządu
Dyrektor ds. Eksploatacji
Miejskiego Przedsiębiorstwa Energetyki Cieplnej S.A. w Krakowie

mpec s.a. w krakowie

Ciepło, które łączy

Miejskie Przedsiębiorstwo Energetyki Cieplnej S.A. w Krakowie

MISJA SPÓŁKI

„Misją MPEC S.A. w Krakowie jest zaspokojenie potrzeb klientów poprzez niezawodne zapewnienie oczekiwanego przez nich komfortu cieplnego w pomieszczeniach oraz optymalnej temperatury ciepłej wody. Działając na rynku ciepłowniczym MPEC S.A. w Krakowie pragnie tworzyć wizerunek firmy kompleksowo i fachowo obsługującej klientów, zawsze dbającej o ochronę środowiska naturalnego."

2

mpec s.a. w krakowie

Ciepło, które łączy

Miejskie Przedsiębiorstwo Energetyki Cieplnej S.A. w Krakowie

ZAKRES DZIAŁANIA

- przesyłanie i dystrybucja nośnika ciepła w miejskiej sieci cieplnej,
- produkcja ciepłej wody i pary w ponad 80 kotłowniach lokalnych,
- remonty i modernizacje istniejących sieci i urządzeń ciepłowniczych,
- budowa sieci ciepłowniczych oraz przyłączanie nowych odbiorców do miejskiej sieci cieplnej,
- prowadzenie i współudział w inwestycjach na rzecz PONE i energooszczędnych,
- produkcja kompaktowych węzłów ciepłowniczych dla instalacji centralnego ogrzewania (c.o.), ciepłej wody użytkowej (c.w.u.), wentylacji i klimatyzacji.

mpec s.a. w krakowie

Ciepło, które łączy

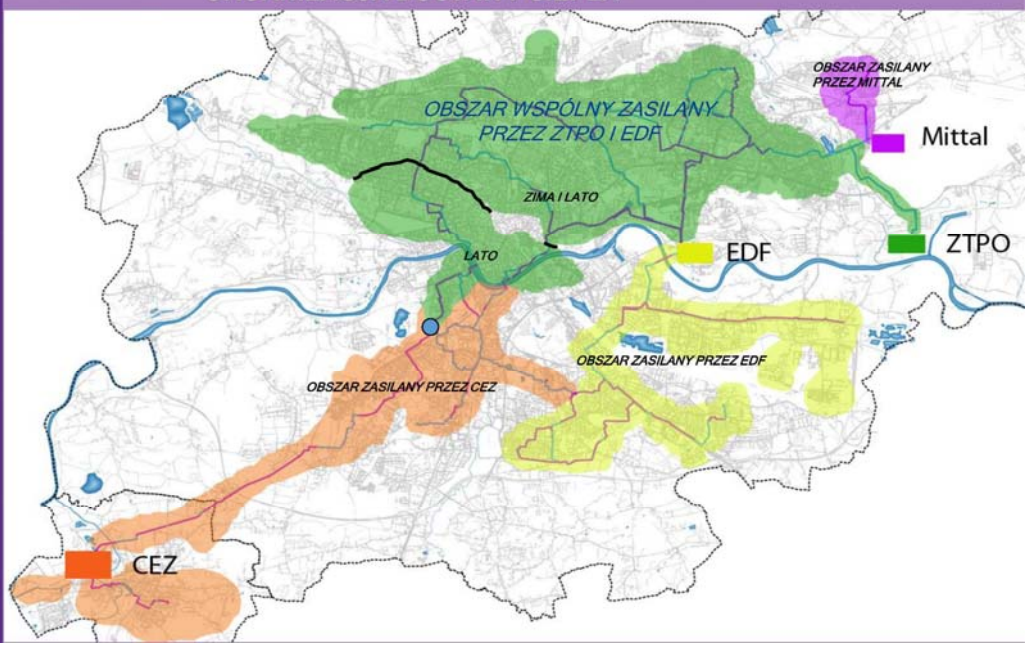
Miejskie Przedsiębiorstwo Energetyki Cieplnej S.A. w Krakowie

- 64 lata doświadczeń na rynku,
- 5,2 tys. odbiorców,
- 8,5 tys. obiektów położonych w Krakowie, Skawinie i okolicach,
- 70 % udział w rynku,
- zakup ciepła w czterech źródłach ciepła
  - EDF Polska S.A. 962,4 MW
  - CEZ Skawina S.A. 326,7 MW
  - ArcelorMittal Poland S.A. 16,8 MW
  - ZTPO (od 4 lipca 2016 r.) 35,0 MW
- roczny zakup ciepła – 10 520 TJ (rok 2016)
- roczna produkcja ciepła w 80 kotłowniach lokalnych – 128 TJ (rok 2016)
- długość sieci cieplnej (Ø 25 - Ø 1100 mm) – 846,13 km
  - w tym 506,91 km sieci preizolowanych (59,9%)
- węzły cieplne – 10 040 szt. (8451 szt. MPEC)
  - w tym 62 duże i 80 małych węzłów grupowych
  - oraz 2861 węzły niskoparametrowe

mpec s.a. w krakowie

Ciepło, które łączy

ORGANIZACJA DOSTAWY CIEPŁA

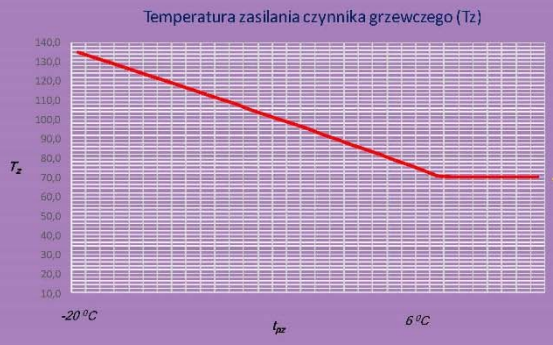


mpec s.a. w krakowie

Ciepło, które łączy

CHARAKTERYSTYKA SYSTEMU CIEPŁOWNICZEGO

System ciepłowniczy Krakowa pracuje w układzie regulacji jakościowo – ilościowej. Oznacza to, że wielkość dostawy ciepła do Odbiorców odbywa się za pomocą zmian temperatury czynnika grzewczego T_z w zależności od temperatury powietrza zewnętrznego t_{pz} (zgodnie z wykresem regulacyjnym) oraz za pomocą zmiany ilości czynnika grzewczego (przepływu) wymuszaną przez regulatory automatyki pogodowej w węzłach cieplnych.



Z uwagi na wytwarzanie ciepłej wody użytkowej temperatura czynnika grzewczego w sieci cieplnej wynosi co najmniej 70°C.

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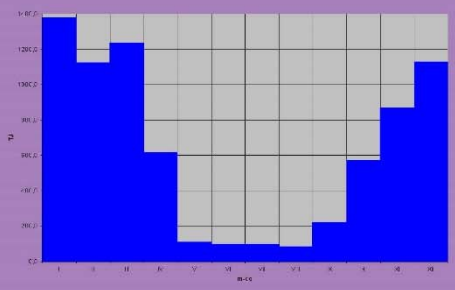
Ciepło, które łączy

CHARAKTERYSTYKA SYSTEMU CIEPŁOWNICZEGO

Stosunek zapotrzebowania na ciepło w okresie lata i zimy w krakowskim systemie wynosi jak 1 do 10. Z tego powodu badamy możliwość rozwoju „rynku letniego" z wykorzystaniem ciepła systemowego do produkcji chłodu.



Zapotrzebowanie na ciepło w systemie ciepłowniczym Krakowa w okresie roku

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Ciepło, które łączy

PRZEGLĄD TECHNOLOGII WYTWARZANIA CHŁODU

Rozwiązania tradycyjne	Rozwiązania oparte na cieple sieciowym
❑ **Agregaty sprężarkowe** ▪ Wysoka sprawność COP > 3.0 ▪ Niskie nakłady inwestycyjne (1100 PLN/kW) ▪ Praca w każdych warunkach ▪ Nie duże gabaryty w porównaniu do urządzeń sorpcyjnych ▪ Duża konsumpcja energii elektrycznej	❑ **Centralna produkcja chłodu (abs/ads)** ▪ Konieczność budowy dedykowanej sieci dystrybucyjnej ▪ Rozproszenie odbiorców znacząco podwyższa nakłady ▪ Wysoka sprawność produkcji chłodu ▪ Nie wymaga dużej przestrzeni u odbiorcy
	❑ **Agregaty absorpcyjne** ▪ Wymagana stosunkowa wysoka temperatura zasilania (95 – 120°C) ▪ Wyższa sprawność niż agregatów adsorpcyjnych COP = 0.7 – 1.2 ▪ Wysokie nakłady inwestycyjne (ok. 5000 PLN / kW) ▪ Wymagają stałej obsługi w trakcie eksploatacji
	❑ **Agregaty adsorpcyjne** ▪ **Możliwość pracy na letnich parametrach wody sieciowej (65 - 70°C)** ▪ **Stosunkowo niska sprawność COP = 0.3 – 0.8 (średnie 0,4-0,5)** ▪ **Wysokie nakłady inwestycyjne (6600 PLN / kW)** ▪ **Łatwe w eksploatacji**
	❑ **Strumienicowe urządzenia chłodnicze** ▪ Na etapie badań (COP 0,2 – 0,4)

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Ciepło, które łączy

DLACZEGO WARTO ROZWIJAĆ CHŁÓD Z CIEPŁA SIECIOWEGO?

Aspekty środowiskowe

- Zwiększenie efektywności wykorzystania energii pierwotnej
- Ograniczenie emisji CO_2
- Wyeliminowanie szkodliwych dla środowiska freonów stosowanych w agregatach sprężarkowych

Aspekty handlowe

- Istnieje rynek - systematyczny wzrost zapotrzebowania na chłód
- Urządzenia chłodnicze mają swoją żywotność w związku z czym muszą być okresowo wymieniane

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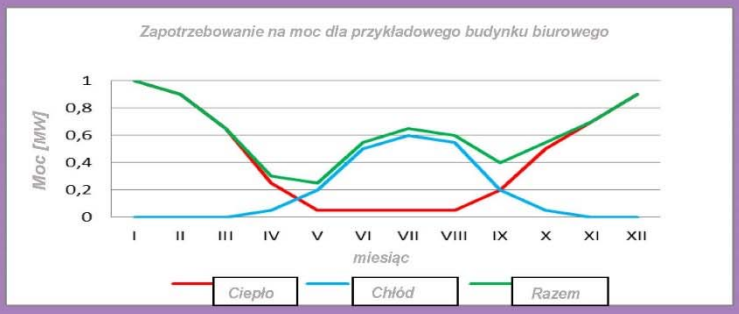
Ciepło, które łączy

DLACZEGO WARTO ROZWIJAĆ CHŁÓD Z CIEPŁA SIECIOWEGO?

Aspekty techniczne

- Zwiększenie bezpieczeństwa energetycznego, poprzez zwiększenie produkcji (w kogeneracji) energii elektrycznej w letnim szczycie obciążenia systemu energetycznego
- Poprawa efektywności wykorzystania systemów ciepłowniczych (źródeł wytwarzania jak również sieci ciepłowniczych)
- Zapotrzebowanie na moc dla celów chłodzenia mieści się w poziomie mocy na potrzeby ogrzewania.



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Ciepło, które łączy

POTENCJALNI ODBIORCY CHŁODU

- Centra handlowe
- Obiekty biurowe
- Hale sportowe
- Szpitale
- Obiekty użyteczności publicznej (centra kongresowe, hale wystawowe, urzędy, teatry, kina)
- Szkoły, budynki uczelni
- Budynki przemysłowe (hale produkcyjne)

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Ciepło, które łączy

PROJEKT PILOTAŻOWY

MPEC S.A. przy współpracy z EDF Polska Oddział nr 1 w Krakowie S.A. oraz CEZ Skawina S.A. wykonało instalację pilotażową (stanowisko badawcze), które na mocy podpisanego porozumienia zostało udostępnione AGH celem przeprowadzenia badań.

Stanowisko badawcze zostało zlokalizowane w budynku przepompowni „Zakrzówek" przy ul. Kobierzyńskiej 41 i służy do odprowadzenia nadmiaru ciepła z pomieszczenia sterowania pomp obiegowych (schładzanie szaf przetworników tyrystorowych).

Pierwsze uruchomienie 15-10-2014 r.

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Ciepło, które łączy

PROJEKT PILOTAŻOWY

Cele projektu:

- Wypracowanie referencyjnych rozwiązań
- Uzasadnienie techniczno-ekonomiczna przedsięwzięcia

Charakterystyka projektu

- Budynek stacji pomp należący do MPEC
- Agregaty adsorpcyjne firmy SorTech o mocy 8 kW
- Temperatura zasilania z m.s.c. 65-70 °C (lato)

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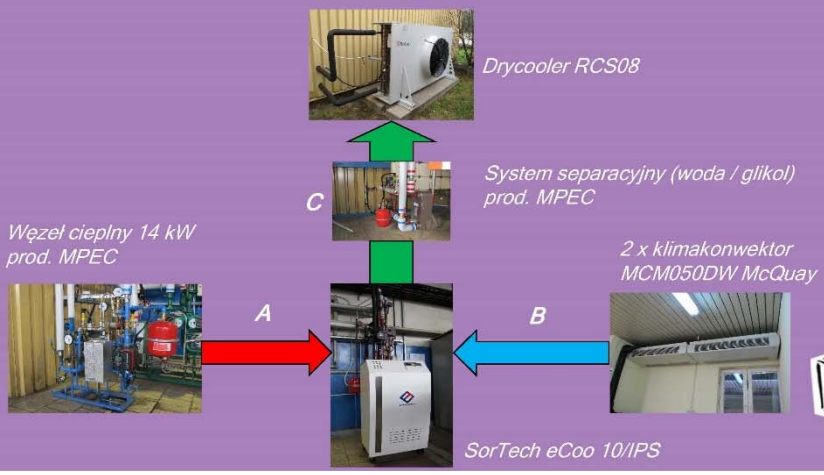
Ciepło, które łączy

PROJEKT PILOTAŻOWY

A. obieg doprowadzenia ciepła sieciowego,
B. obieg wody lodowej (obieg chłodniczy),
C. obieg odprowadzenia ciepła z instalacji.



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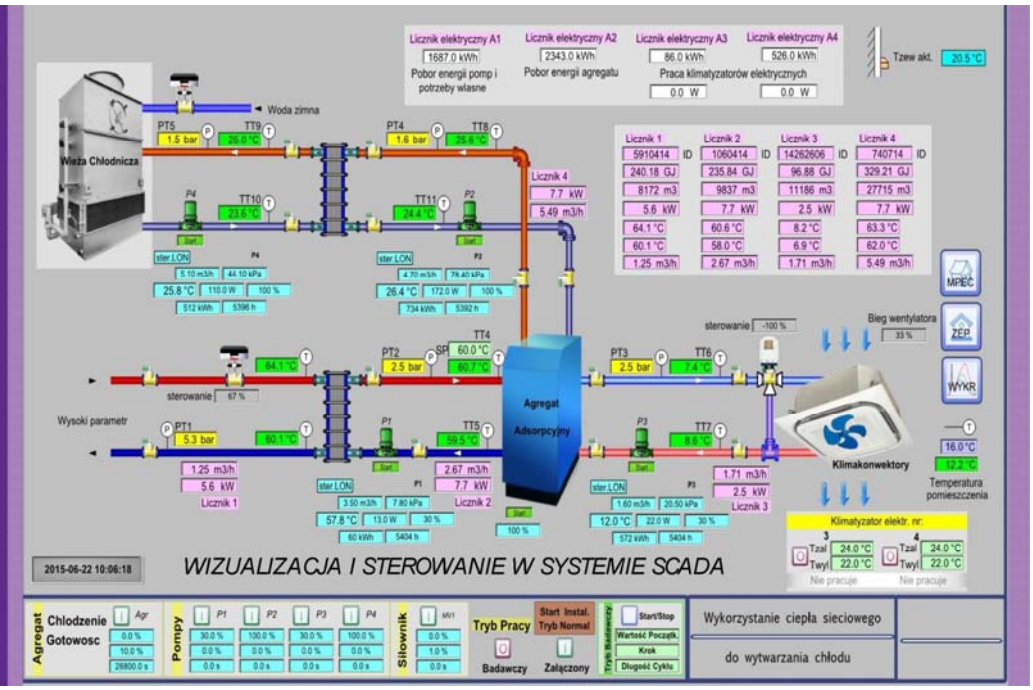
Ciepło, które łączy



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Ciepło, które łączy

PROJEKT PILOTAŻOWY – GŁÓWNE WNIOSKI

Techniczne:

- Mała efektywność energetyczna procesu objawiająca się zbyt małym schłodzeniem wody zasilającej (ok. 5 ^{0}C) – skutkiem jest zwiększony przepływ i wysoka temperatura wody powracającej do elektrociepłowni. Jest to bardzo istotne dla źródła zasilającego system ciepłowniczy i pracującego w kogeneracji.
- Osiągana sprawność procesu (COP) jest niższa od zakładanej – niezbędne są dalsze badania optymalizacyjne.
- Duże wymiary i ciężar urządzeń.

Ekonomiczne:

- Problemem są wyższe ceny urządzeń sorpcyjnych w stosunku do cen urządzeń sprężarkowych.
- Przy obecnych cenach energii cieplnej oraz energii elektrycznej technologia wytwarzania chłodu z zastosowaniem adsorpcyjnych agregatów jest droższa w stosunku do technologii sprężarkowej.

- Obecnie produkcja ciepła z wykorzystaniem procesów sorpcyjnych jest dobrym rozwiązaniem na zagospodarowanie ciepła ODPADOWEGO.

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Ciepło, które łączy

W chwili obecnej analizy ekonomiczne nie potwierdzają wprawdzie opłacalności wytwarzania chłodu z ciepła sieciowego w agregatach adsorpcyjnych. Zakładamy jednak, że w ciągu kilku najbliższych lat sytuacja ulegnie zmianie. Badane są także inne możliwości wytwarzania chłodu np. wspólnie z agregatami sprężarkowymi.

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Ciepło, które łączy

Dziękuję

Wien Energie

As Austria`s largest energy service company, Wien Energie safeguards the reliable, uninterrupted supply of energy and all of the associated services to the city of Vienna and the surrounding area around the clock.

The associated portfolio of services ranges from

- the production of energy,
- recycling waste to providing energy advice,
- helping to improve energy efficiency and energy services,
- facility management,
- telecommunications.

…is one of the largest employers in the Greater Vienna metropolitan area

03.04.2017 © Wien Energie 2 WIEN ENERGIE

DISTRICT HEATING IN VIENNA

Assignments

- Rising Heat Production Costs
- Do not miss the generation step (to be prepared for future requirements)
- Reduction of costs (maintenance and repair, operation management, etc.)

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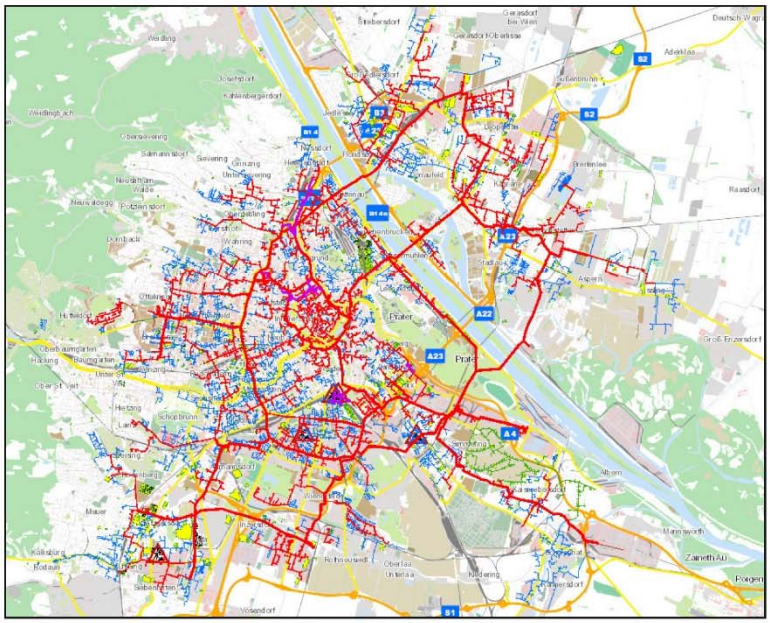
DISTRICT HEATING IN VIENNA

Assignments

- 2015 – Start of the 10-year Programm (ETA)
  Systematic optimization of substations and customer secondary systems to
  - lower the return flow temperature of the entire district heating network
  - expand capacities at housing development areas
- Modernization and Digitalization

DISTRICT HEATING IN VIENNA

Viennese District Heating System



- > 1.200 path kilometres
- > 500 areal heat exchange stations
- approx. 5.500 GWh thermal production/a
- > 370.000 housholds

DISTRICT HEATING IN VIENNA

Characteristics of the Viennese District Heating System

- Age (Foundation „Heizbetriebe Wien“ 1969)
- Thermal Production
  - Waste Incineration Plants, Cogeneration, Peak load boilers
- Network
  - Primary Network
  - Secondary Network
- An over the years grown System
  - Different technical standards
  - Requirements on customers side
- Building Standard
  - Passiv house vs. ↔ Gründerzeit building
- Temperature and Pressure level
- Customers
  - Residential buildings, industry, Officebuildings, hospitals etc.
- Operation Summer/Winter
  - District Cooling Systems
  - Part Load Operation

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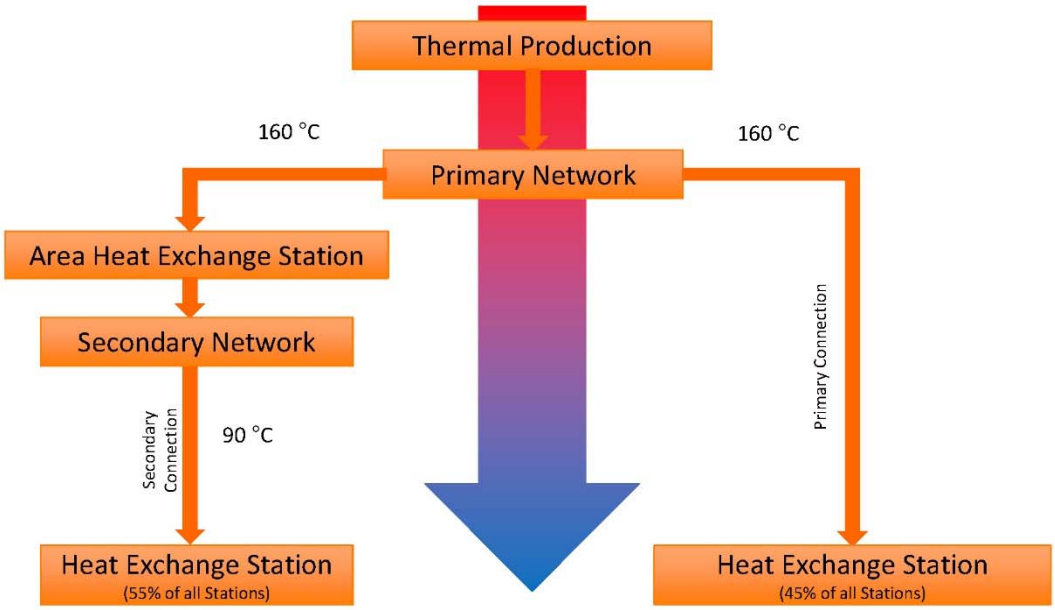
DISTRICT HEATING IN VIENNA

Viennese District Heating System



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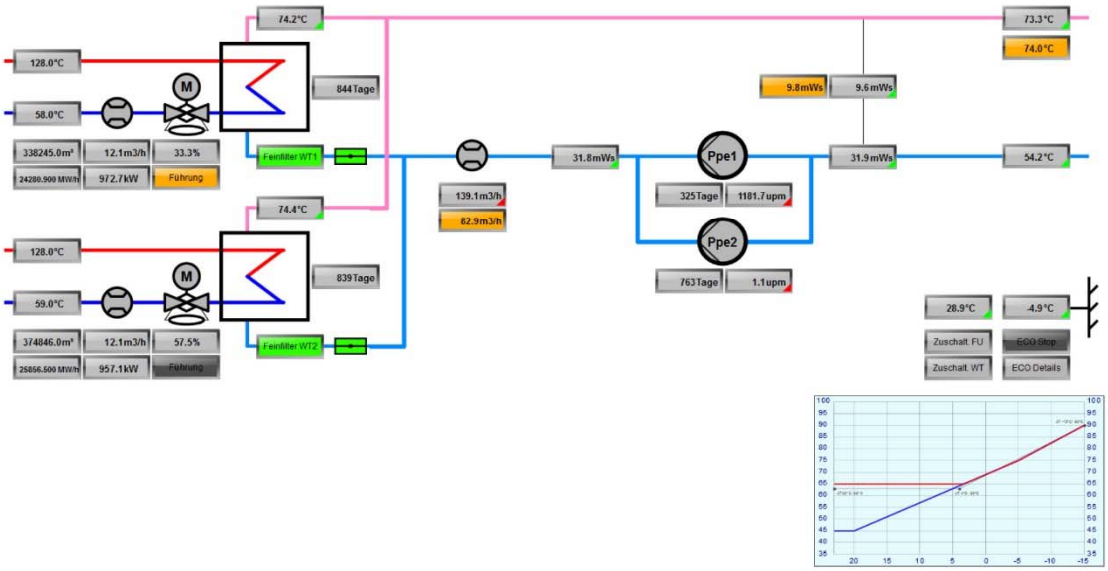
DISTRICT HEATING IN VIENNA

Optimization Strategy

- Modernization and Digitalization (user- and maintenance friendly)
  - State of the Art
  - Automatical Fault Detection
- From Consumer to Prosumer
  Integration of renewable Energysystems by Costumers and Producers
- Lowering Return Flow Temperature
  Possibility to implement Heat Pumps
- Know-How Improvement
  Conception, Planning, Construction, Commisioning and Operation of District Heating Systems
- Multipliable Actions
  Clustering of Building Types, Ages etc.

DISTRICT HEATING IN VIENNA

Digitalization, Remote Data Reading & Control



DISTRICT HEATING IN VIENNA

Improving Energy Efficiency

- Optimization (on technical and administrativ base)
- expand capacities
    - Load transfer
    - Concentration primary network
- Raising the grade of operation
    - Optimization of System Settings
    - Low Return Flow Temperature
- Following Examples of Actions can lead into Improving Energy Efficience:
    - Hydraulic measures – Lowering Massflow at same comfort
    - Smart Meter – customer awareness and involvment
    - Integration of renewable Energysources

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DISTRICT HEATING IN VIENNA

Results

- Higher amount of renewable Energysources
    - EU-Klimaziele
    - http://www.geotiefwien.at/eportal3/
- Modernization of the hole system
- Digitalization – increasing possibilites to control the system, higher data ammount and quality, better availability
- „self-supporter-Trend“

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DISTRICT COOLING IN VIENNA

Motivation of Wien Energie

- Cooling is an energy product which fits perfectly to the portfolio of Wien Energie
- Cooling in the context of District Cooling offers unique selling propositions
- Extension of the value chain und expansion of our services
- Enters the opportiunity to sell other products (Cross selling)
- Missing fragment to an full-service energy supplier
- Optimal use of exsiting infrastructure (fault-clearing service, measurement, accounting, etc.)

Additional benefit for Wien Energie in case of a district heating connection at the project site:

- Use of existing waste heat during the summer with absorption chillers
- Subsidies for the use of absorptions chillers

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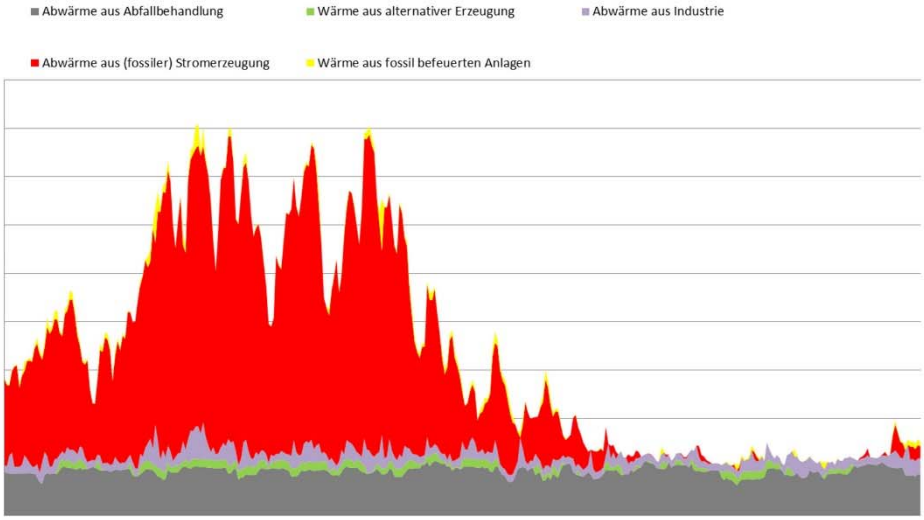
DISTRICT COOLING IN VIENNA

Heating sources for district heating

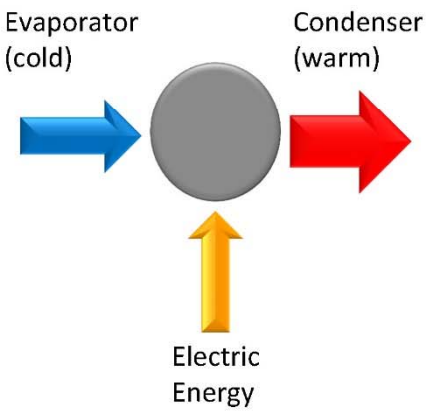


- The absorptions chillers are economicly operating if they are powered by the use of pure rejected heat.
- There is no „must“ für absorption chillers for cooling

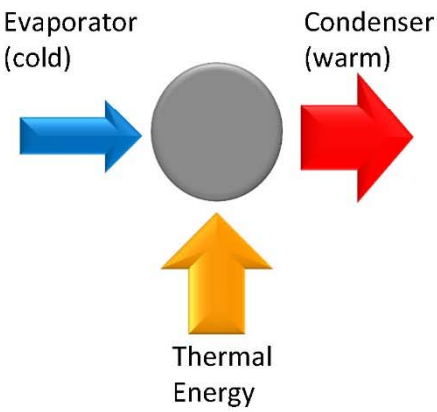
DISTRICT COOLING IN VIENNA

Types of Refrigerating Machines

Conventional compression Chiller



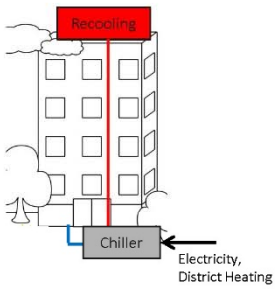
Absorption Chiller



DISTRICT COOLING IN VIENNA

Two main priciples of cooling

Cooling plant at the customer site



District cooling

Strategy

- Wien Energie takes investments – depending on agreements and manages the operation of the cooling plant.
- Customers are charged for the load supply and for the delivered energy.

  - Individual conception
  - maximum efficiency
  - Optimiezed controling concept (with remote control)
  - High security of supply

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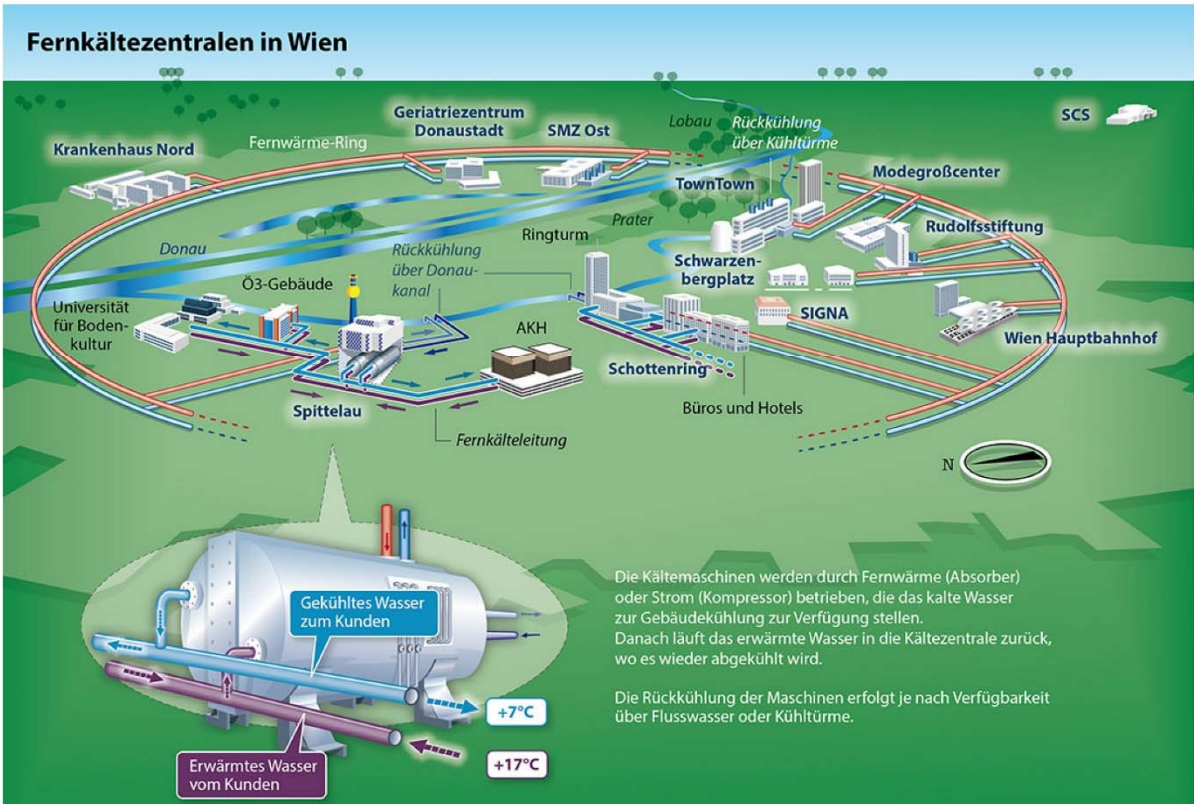
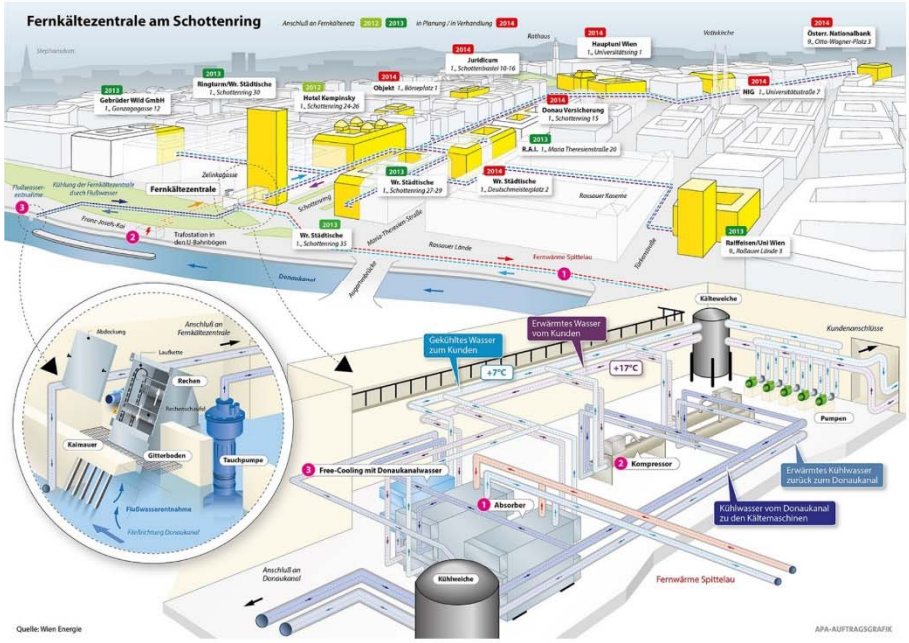
DISTRICT COOLING IN VIENNA



DISTRICT COOLING IN VIENNA

District cooling project Schottenring



New underground garage including a cooling plant

15 MW cooling capacity with absorption- and compression chiller;

recooling with river-water out of „Danube Canal "

In operation since April 2013.

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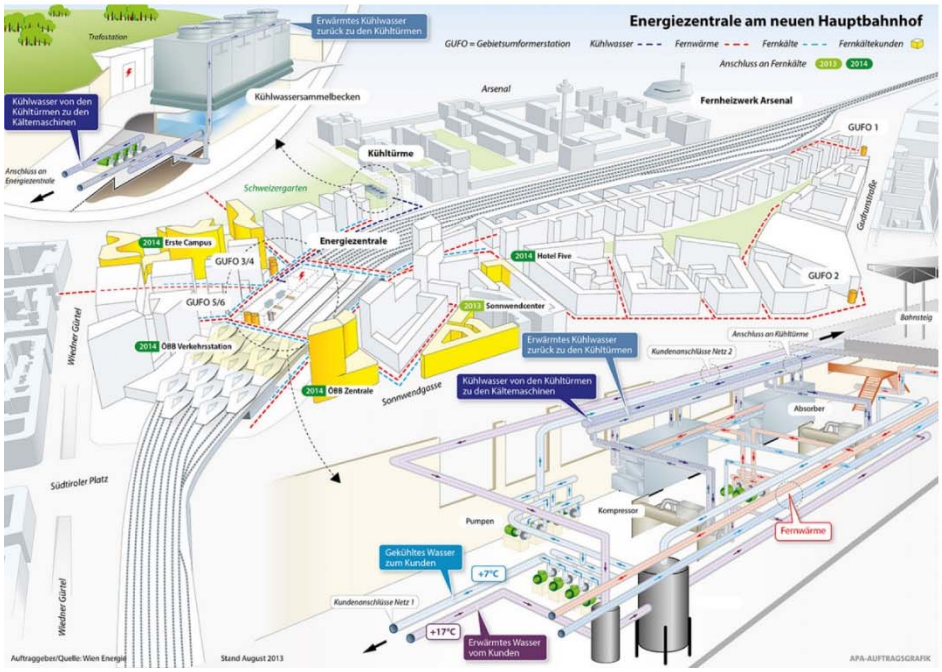
DISTRICT COOLING IN VIENNA

Central Railway Station



- Cooling Capacity: 20 MW
- Open cooling towers in the Schweizer-garten
- 9/2014

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DISTRICT COOLING IN VIENNA

Cooling Towers in the „Schweizergarten“

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DISTRICT COOLING IN VIENNA

Project Hospital „Rudolfstiftung“

- Complex with an hospital built in 1970es and a new server farm (2014)
- Project for renewing the existing and combining with the new cooling plant
- Total 7,8 MW installed cooling capacity with absorption and electrical chillers
- Heat pumps use the rejected heat from the server room
- First stage of construction under operation since December 2012

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DISTRICT COOLING IN VIENNA

Project fashion wohlesale store

- Installed cooling capacity: 2,67 MW, absorption chiller 1.700 kW, centrifugal chiller 1.000kW
- Energy storage with groundwater: groundwater is used for recooling in the summer time (chiller) and as an energy source in wintertime (heatpump)
- Low- and High-Temperature cooling, Low- and High-Temperature Heating (Heat-pumps and district heating)
- In operation since July 2013

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DISTRICT COOLING IN VIENNA

Austria Campus (Business)

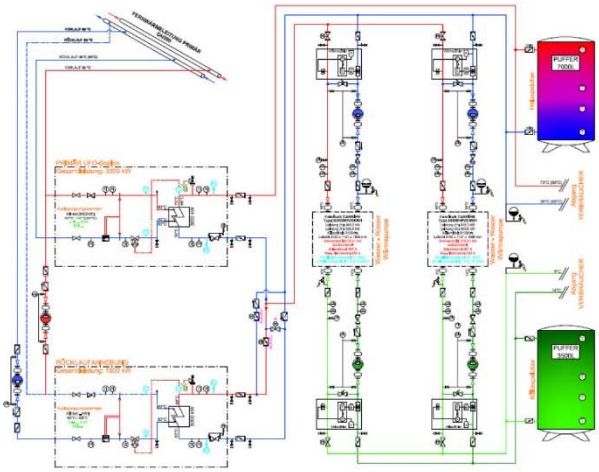
- Cooling Capacity: 11 MW electrical chillers
- Heating Capacity: 8 MW disctrict heating combined with heat pumps
- Geothermal activated basement (used as a storage for heating an cooling)
- Open cooling towers and hybrid cooling Towners
- Under Construction 08/2016 - 12/2017
- Planned start of operation in 02/2018

Pictures © SIGNA

DISTRICT COOLING IN VIENNA

Decentral Cooling – Recooling with District Heating Network

- Status: conceptual design
- Cooling demand: 1.200kW
- Heating demand: 3.000kW
- Due to the utilization recooling units should be avoided
- District heating network available (DN500)
- Decentral Cooling Plant; Recooling with district heating network (return-return connection); combination with district heating supply and preheating with waste heat from the chillers.



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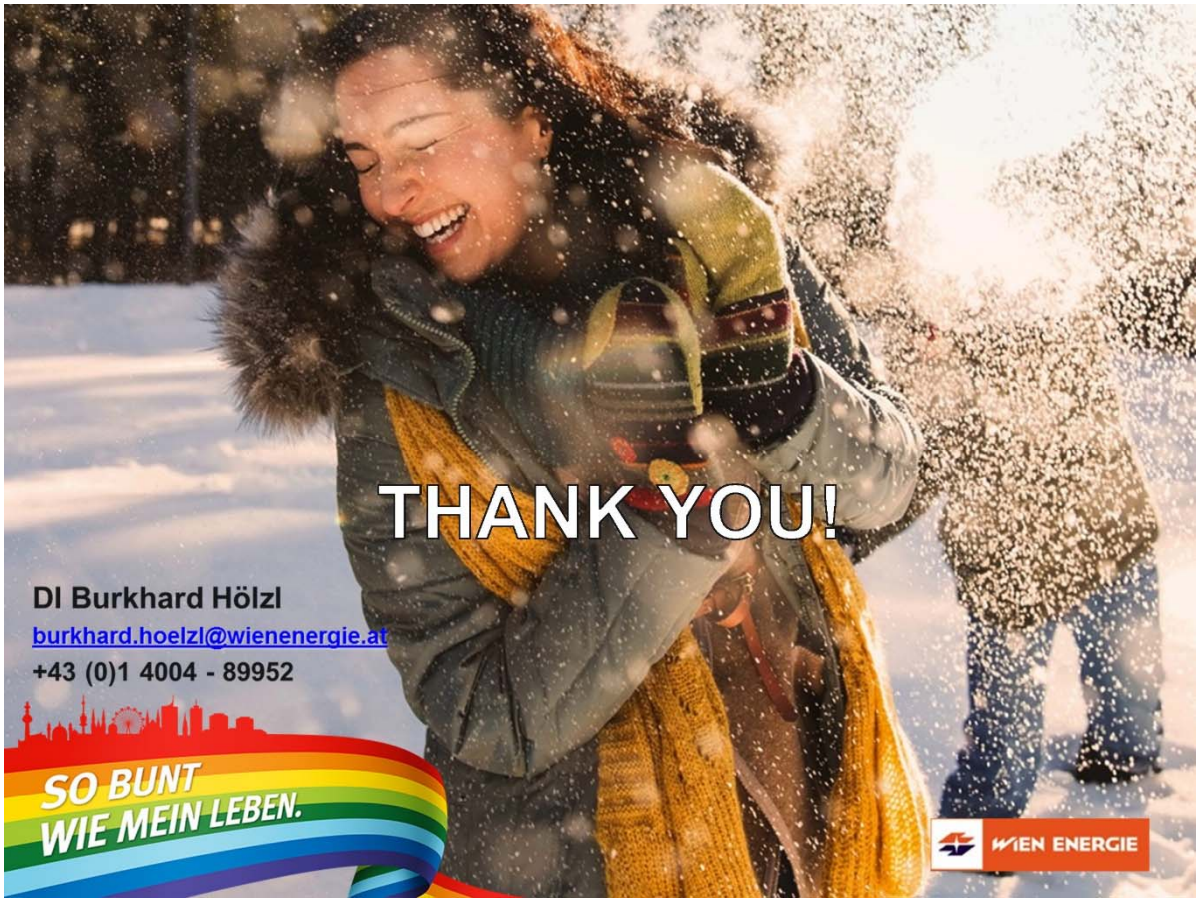
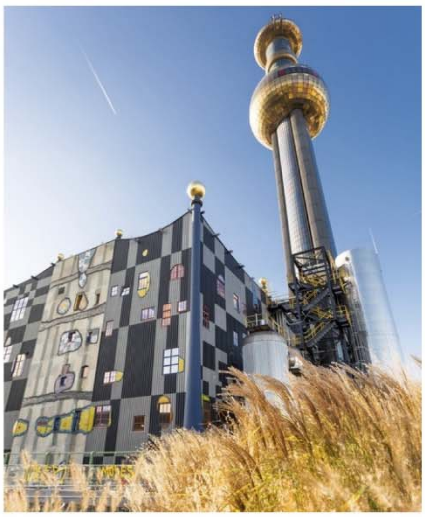


FERNWÄRME IN WIEN

Agenda



- Initial Situation
- Assignments and Target Settings
- Viennese District Heating System
  - Characteristics
  - System Structure
- Optimization Strategy
  - Digitalization, Remote Data Reading and Control
- Improving Energy Efficiency
- Results

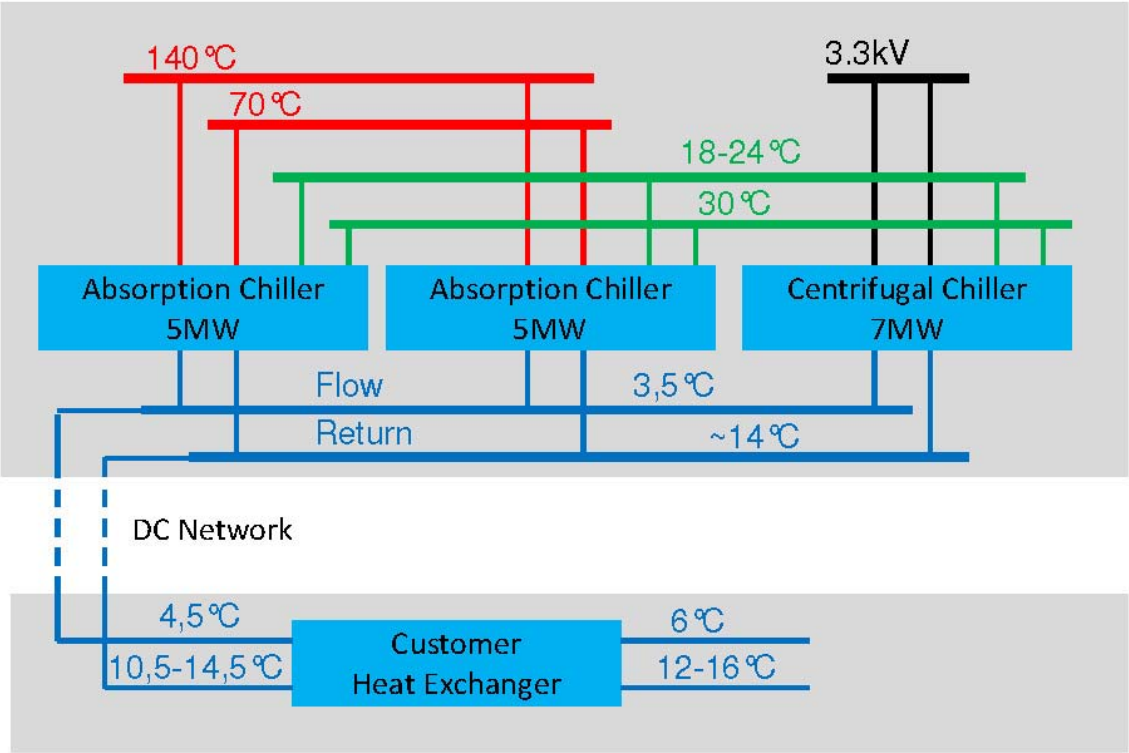
SPITTELAU COOLING

Cooling Plant

- Cooling plant at the Waste Incineration Spittelau
- First expansion 17MW cooling capacity
- After overall completion ~40 MW

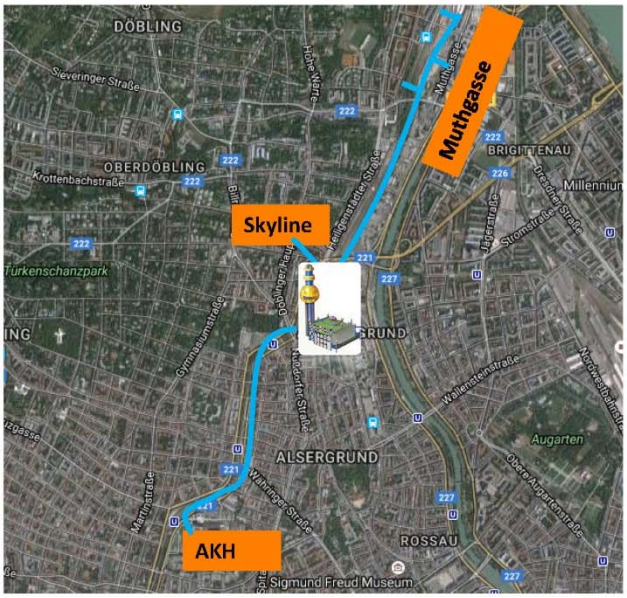
- Our customers: General Hospital Vienna(AKH), Skyline (Office blocks), Science Park of the Univ. of Natural Resources and Life Sciences(BOKU), …

SPITTELAU COOLING



SPITTELAU COOLING

Cooling Network



Muthgasse

- Plastic Jacket Pipe DN 400
- Total Cooling Capacity: 15 MW

Skyline

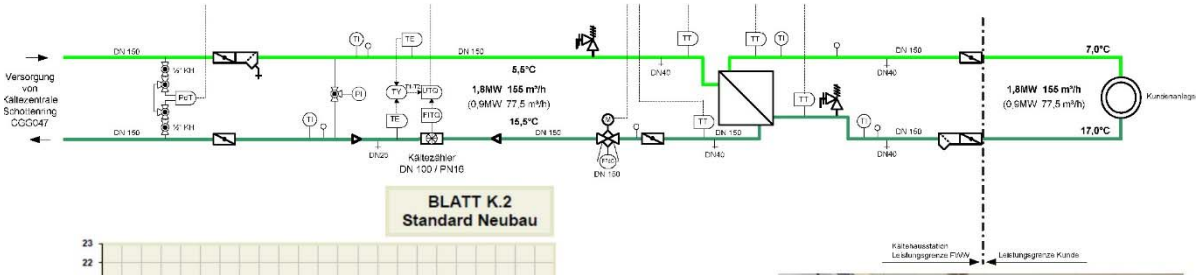
- Plastic Jacket Pipe DN 150
- Cooling Demand: 1,3 MW

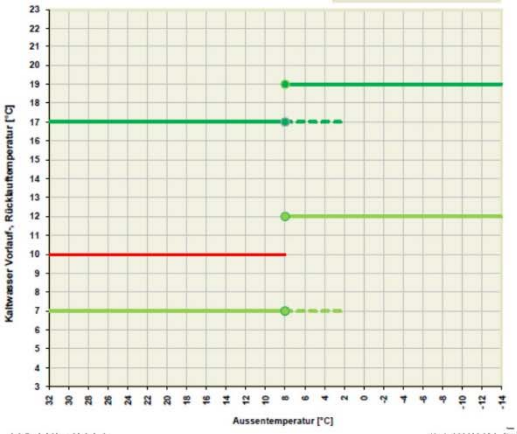
AKH

- DN400 adapted existing pipeline (switched between summer and winter)
- Total Cooling Capacity: 12 MW

SPITTELAU COOLING

District cooling Substation at the customers site





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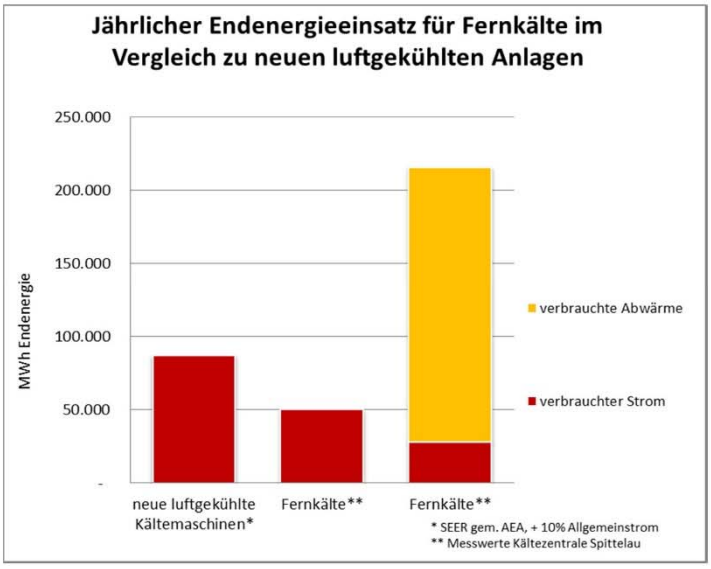
DISTRICT COOLING: PRICES

Standard Price (Basis 09/2016)
Prices are calculated for each customer

- Load Price € 90.468,- per MW
- Energy Price € 35,86 per MWh
- Mixed price at 1000 Fullloadhours: 126,33 € / MWh
- Depending on the project between 0 - 50% of the invest costs are charged to the customer
- Service Limit: Cooling Substation

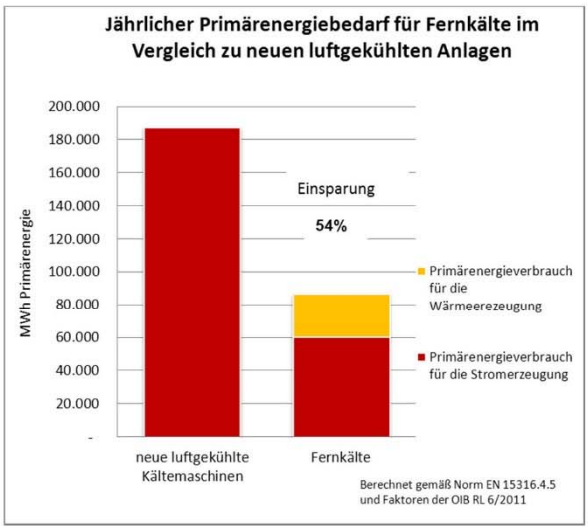
WIEN ENERGIE

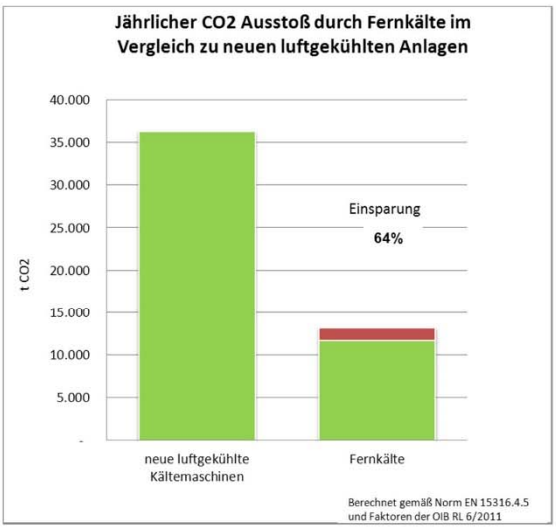
COMPARING FINAL ENERGY DEMAND



- District cooling saves electricity – also when compression only driven
- District cooling in Vienna uses more final energy due to absorption chillers (they are less efficient) but saves most electricity - when otherwise wasted heat is used like in Vienna it is environmental friendly
- Conclusion - Final energy use is not suitabel to compare different energy input

COMPARING PRIMARY ENERGY DEMAND





- Lower primary energy use effects lower CO2 Emissions

KEY FACTORS FOR A DISTRICT COOLING SOLUTION?

- Area with a high concentration of cooling demand
- Aceptable DC network costs
- Customers with demand all over the year
- High spread of cooling Temperatures (between back and flow)

- Convenient conditions for the recooling (Danube, Danube Canal); free-cooling potential; Spare space for cooling towers
- Beneficial energy sources (rejected heat) for the absorption chillers

- Spare Space for chillers and recooling equipment in the building or at a suitable place nearby with district heating access

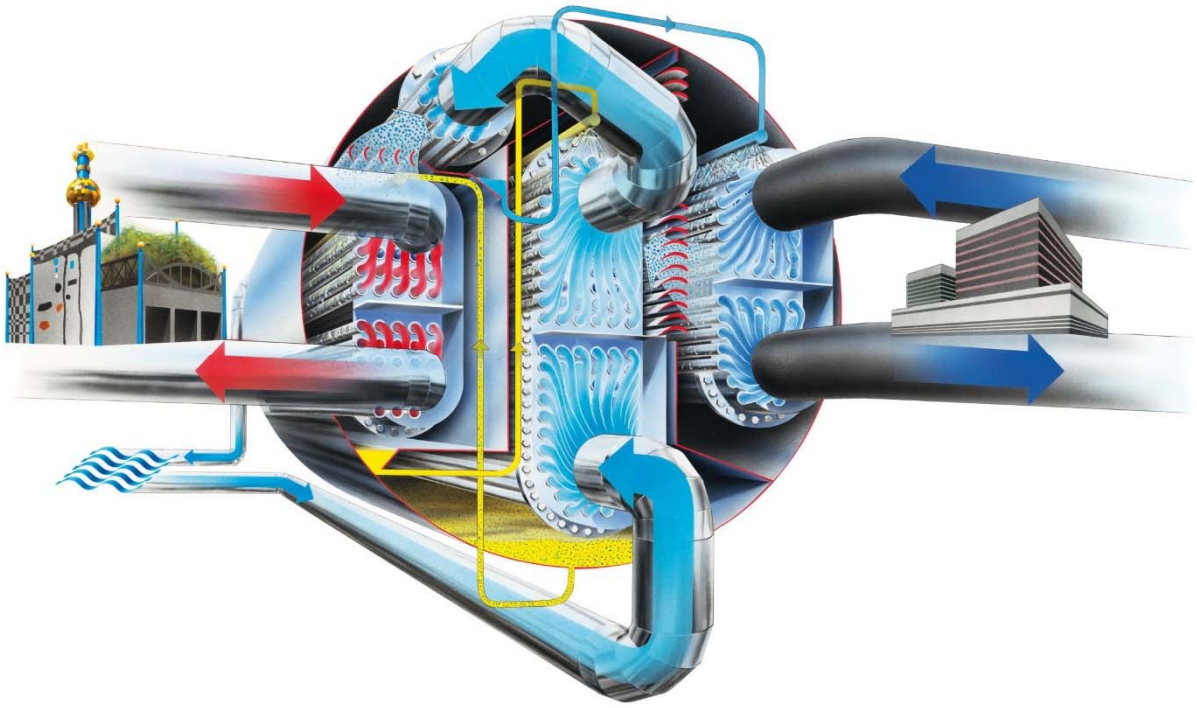
CONCLUSION

- District Cooling/Cooling from cooling plants is an economic business model
- Absorptions chillers powered by rejected heat is a perfect add-on

- Customers are very interested in DC
- In the complex circumstances of the cooling business (cooling demand, technical posibilities, DC network costs, etc.) a high rate of project realistions is attained.

- High planning effort
- Headlining time > 1year
- Cooling projects require high investments

- Specialization within the organisation is necessary to match the challanges of the cooling project business

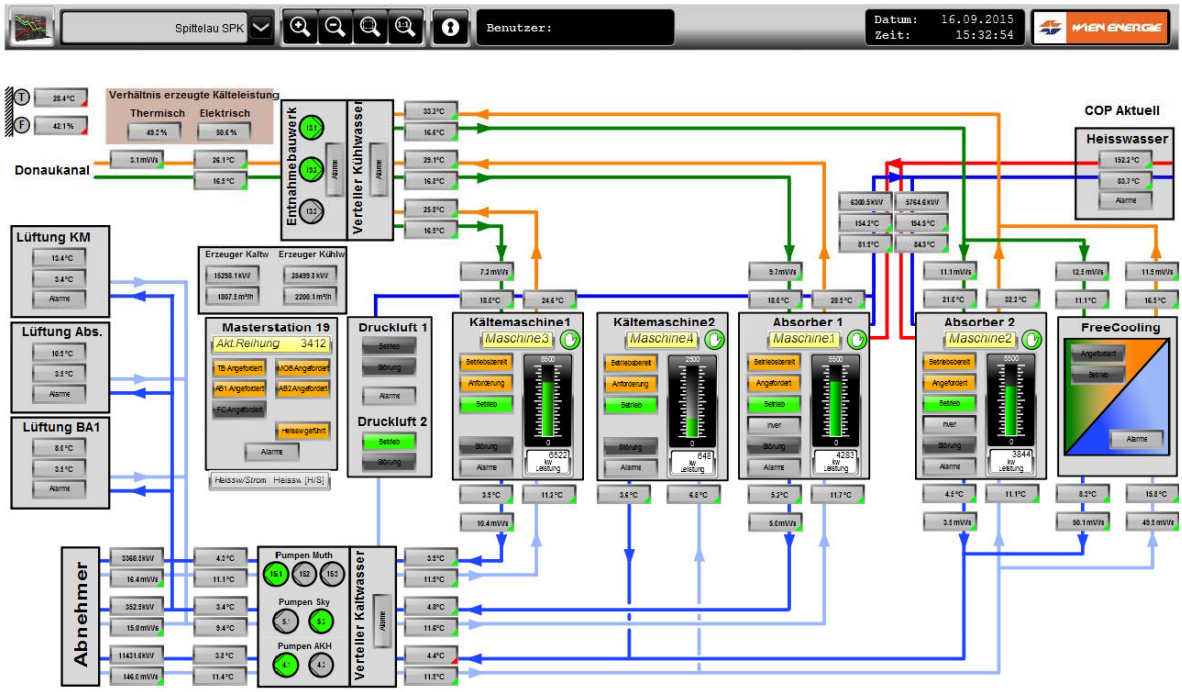


COOLING PLANT SPITTELAU – ENERGY REVIEW 2014

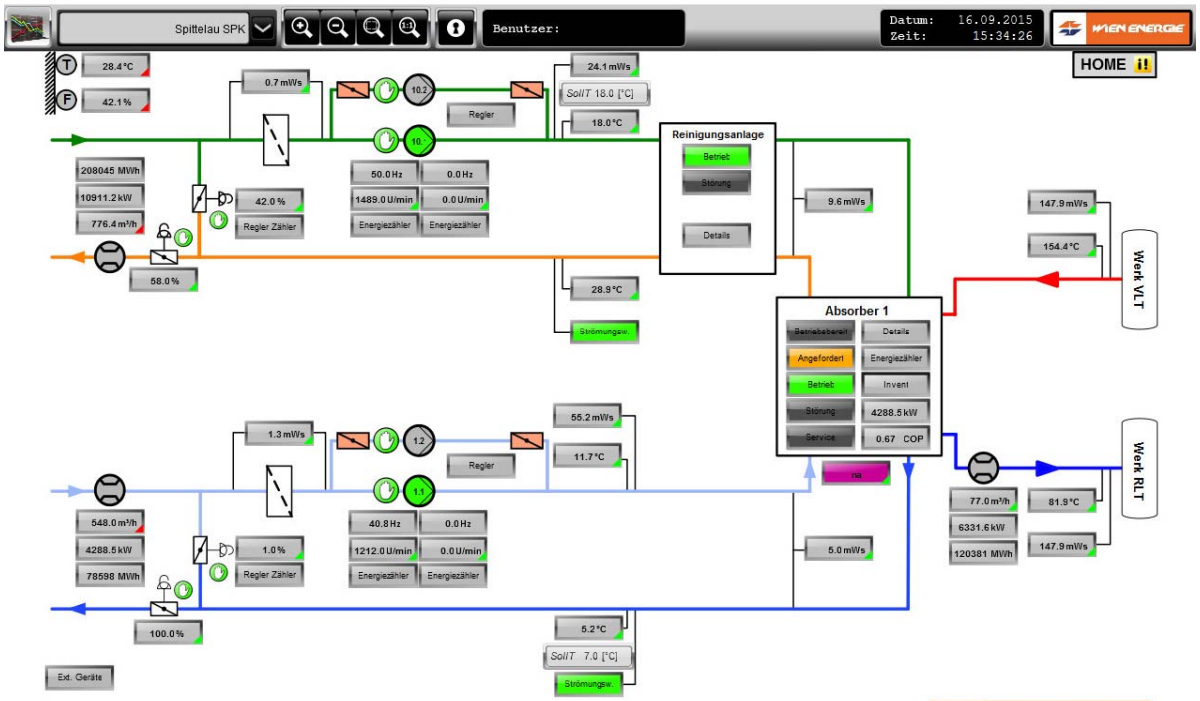
Cooling Plant Spittelau - Energy View Plant			Share Section	Total share
Energy from chillers		55.441,21	100,00%	100,00%
Energy loss air conditioning plant	-	663,23	-1,20%	-1,20%
Other losses (Pumps, transmission,...)	-	507,16	-0,91%	-0,91%
Cooling Output Plant		54.270,82	97,89%	97,89%
Cooling Plant Spittelau - Charged Energy separated Networks				
AKH		41.932,420	83,68%	75,63%
Muthgasse		7.412,591	14,79%	13,37%
Skyline		763,262	1,52%	1,38%
Charged cooling Energy		50.108,273	100,00%	90,38%
AKH+Muthg+Skyline Leitung				
Cooling Input Network (=Cooling Output Plant)		54.270,82	100,00%	97,89%
Heat Input Network	-	2.136,63	-3,94%	-3,85%
Heat Input Pumps	-	2.025,91	-3,73%	-3,65%
Cooling Output Network (=charged cooling Energy)		50.108,27	92,33%	90,38%

SEER	
all over the year EER:	
Centrifugal Chiller (without Pumps	6,41
Centrifugal Chiller (with Pumps)	5,43
Aircooled Screw	2,34
Absorption Chiller	0,67

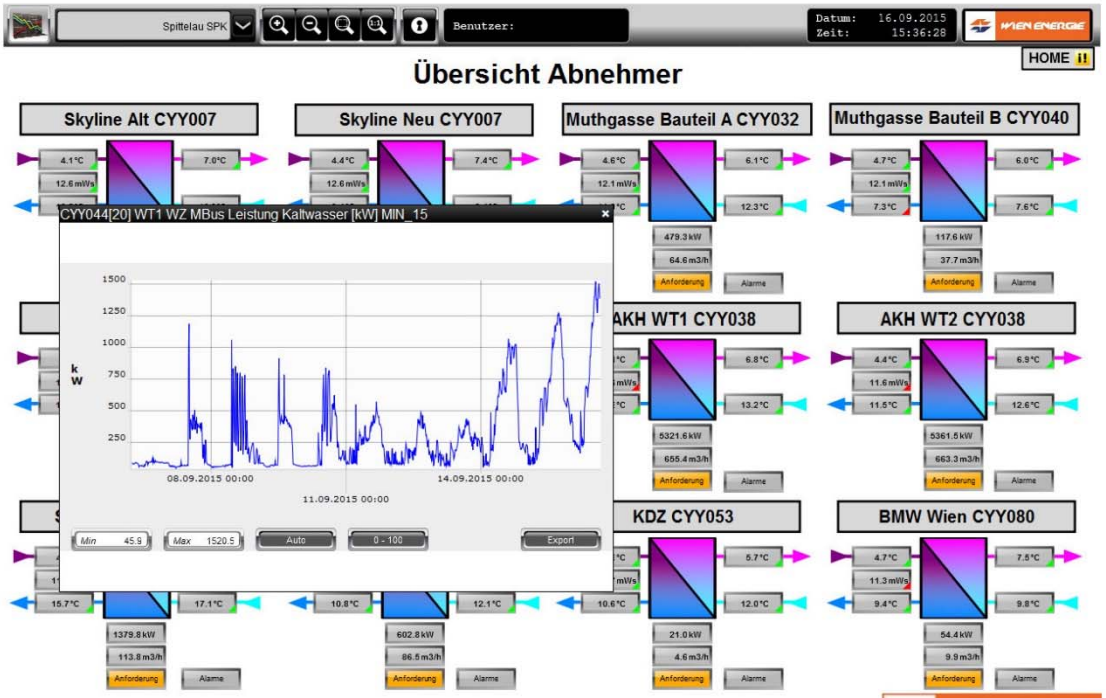
CONTROL OF THE DISTRICT COOLING PLANTS



CONTROL OF THE DISTRICT COOLING PLANTS



CONTROL OF THE DISTRICT COOLING PLANTS



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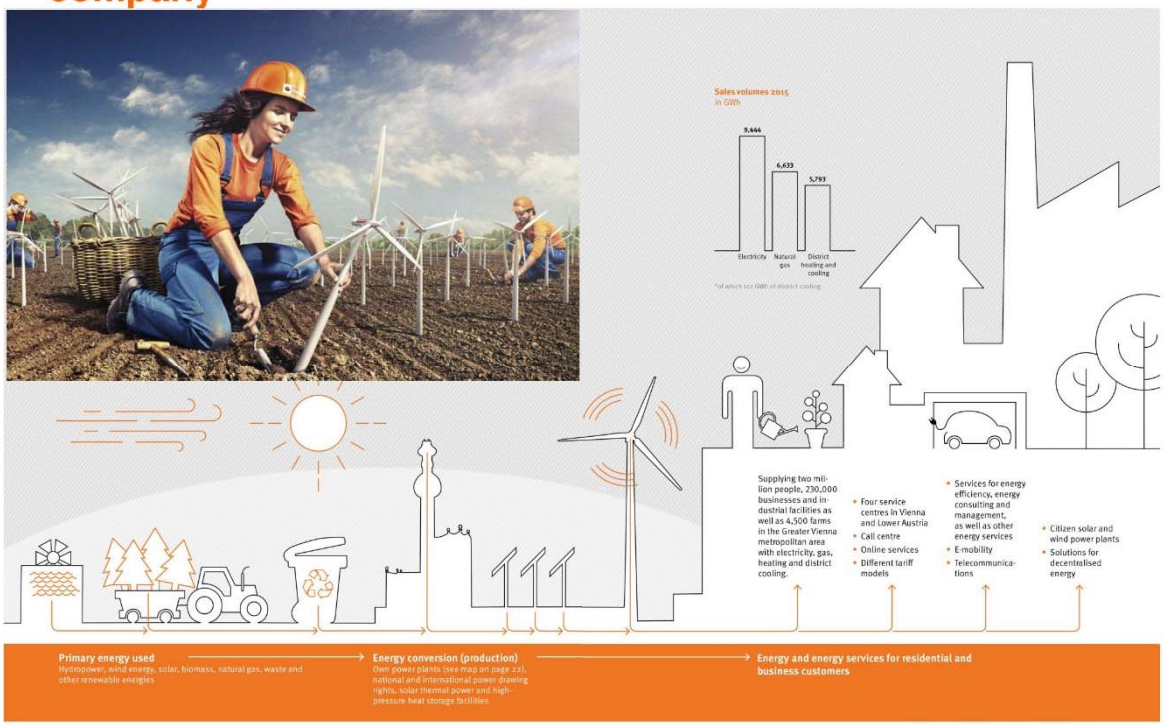
company



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strategy

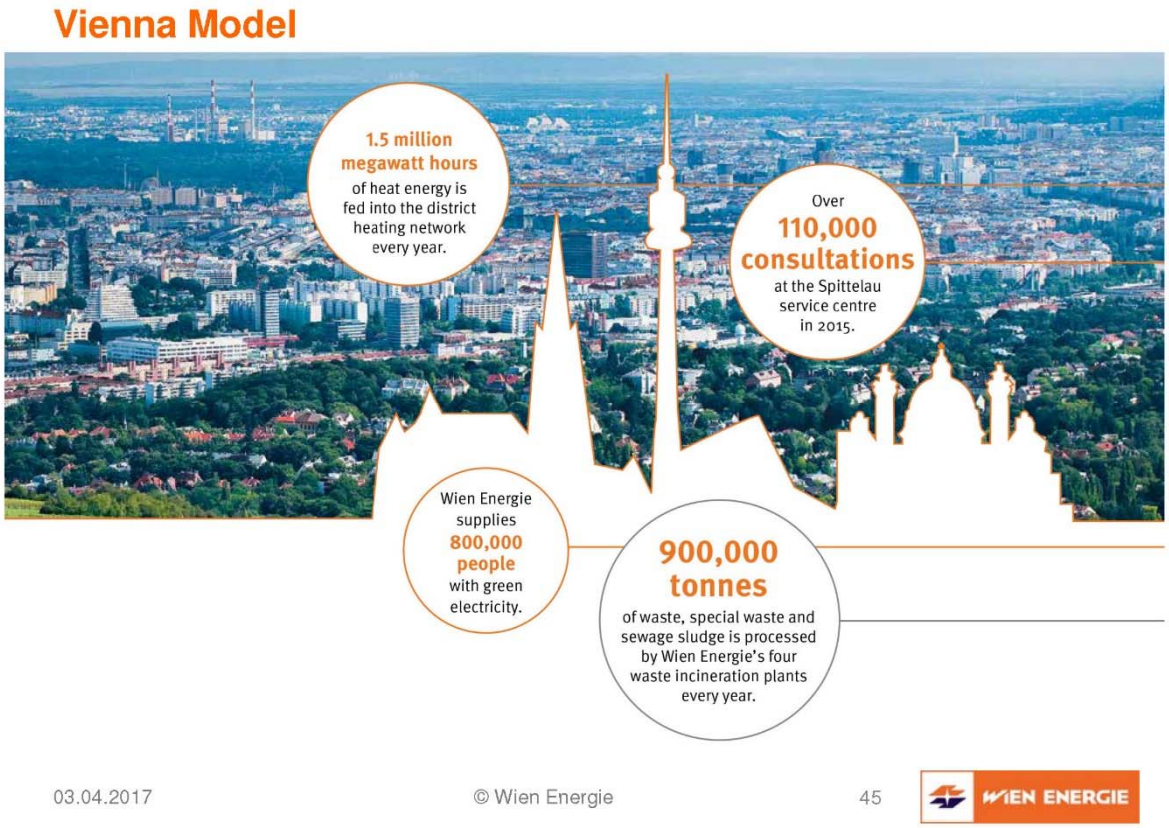
A clear course

A clear strategy is the driving force behind Wien Energie's commercial direction. The Company's primary objectives are derived from three strategic cornerstones.

Customer proximity	Sustainability for society	Safeguarding shareholder value
Objectives to be achieved by 2030		
Major increase in turnover from services	Increasing the proportion of heat produced from renewable energies to around 40 percent	Profitable result from the sale of gas and electricity, taking into account market shares
Growing market share in the area of indoor heating and hot water (district heating and decentralised technologies)	Boosting the proportion of electricity generated from renewable sources to over 35 percent	Achieving a sustainable improvement in earnings of EUR 86 million

Wien Energie-Serviceworld

- Wien Energie-World Spittelau and 2 additional service centers
- Telephone customer support
- Written customer service
  - electricity, gas, district heating, district cooling
  - energy services
- We offer
  - sales and service
  - advice
  - innovations
  - information and events



7.3 Photo documentary of the workshop


DNI WIEDNIA
WIEN TAGE
w Krakowie / in Krakau
3-5.04.2017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