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Walk-through energy audit in district heating company ДП «Криворізька теплоцентраль» october 2015

Henrik Steffensen

State Property Fund of Ukraine & INOGATE Technical Secretariat, UA-136 CWP.07.UA

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Енергетичний аудит
ДП «Криворізька теплоцентраль»

- *Хенрік Стеффансен*
- *Олександр Овдієнко*

- Кривий Ріг 2015

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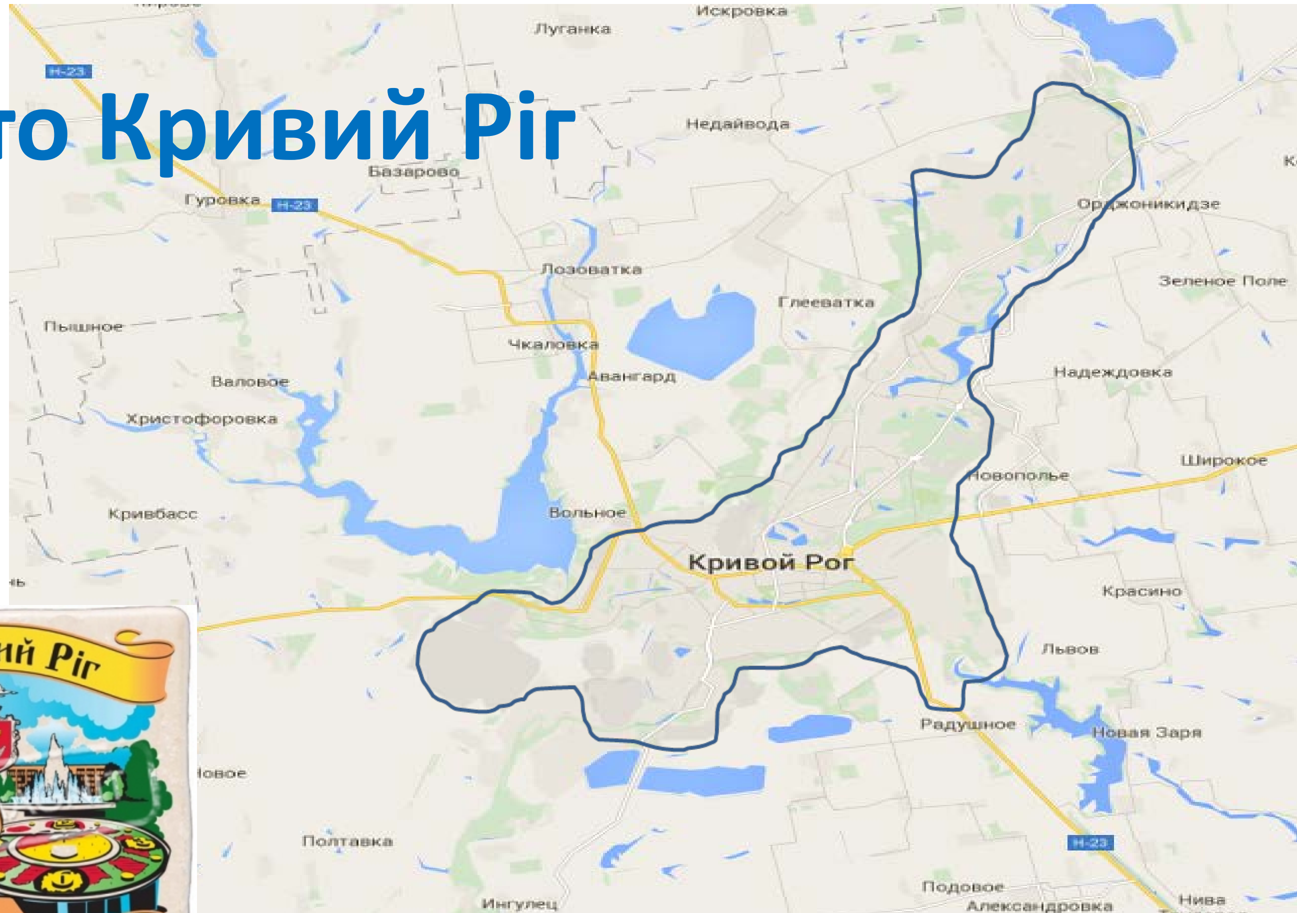
Location

Місто Кривий Ріг



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Location

The city of Kryvyi Rig is situated in the Dnipropetrivsk Region in central Ukraine.

The city territory amounts today to 430 km^2. The length is 126 km, which is said to be the longest city territory in Europe.

Historical development

The city dates back to 1775 when it was founded as a postal city of the Cossacks.

Today the city has approx. 660,000 inhabitants and is an important economic and scientific centre of Ukraine.

As of 2016, Kryvyi Rig is arguably the main steel-industry city of Eastern Europe, being the centre of the iron-ore mining and metallurgy region called “Kryvbas”.

Its oblast economy is the third-largest in Ukraine. It is also an important transport hub in central Ukraine.

The company “S.E. Kryvyi Rig District Heating Plant”

The company “Kryvyi Rig District Heating Plant (DHP)” (“Криворізька теплоцентраль”) generates heat and conducts heat transmission and distribution to households and other consumers in the districts Zovtnevyi, Saksganskiy and partially Dovgyntsivskiy and Inguletskiy of the city of Kryvyi Rig.

The customer base of the company represents more than 50% of the city’s heating consumers. S.E. Kryvyi Rig DHP is 100% state owned.

Until 2015, the name of the company was “Kryvyi Rig District Heating networks” (“Криворіжтепломережа”).

Employees approx. 1390

Energy Audit

- The company owns and operates 6 regional boiler houses with a total installed capacity of 1406 Gcal/h (Available capacity is 1,081 Gcal/h). 3 boiler houses have dual-fuel boilers (heavy fuel oil as back-up). Currently all use only natural gas.
- The boiler houses are equipped with 31 steam and water boilers of different types (10 types); mainly Soviet type KGVM and PTVM boilers. The period of commissioning of boilers and heat networks is from 1946 to 1994.
-
- Combined heat and power (CHP) production is not taking place in the 6 plants although it is possible at plant no. 1 with one (rather outdated) steam turbine.

Energy Audit

- There is no utilization of surplus heat from industry, and no other utilisation of renewable energy (RE) such as EfW (Energy from Waste) or large scale solar thermal.

- The overall value of the company's assets is in one source specified as 900 mln. UAH (2014). With the average exchange rate for 2014 (0.06 EUR/UAH), this corresponds to 54 mln. EUR. [it is not clear for the EA if that also includes the distribution networks that are still owned by the municipality.]

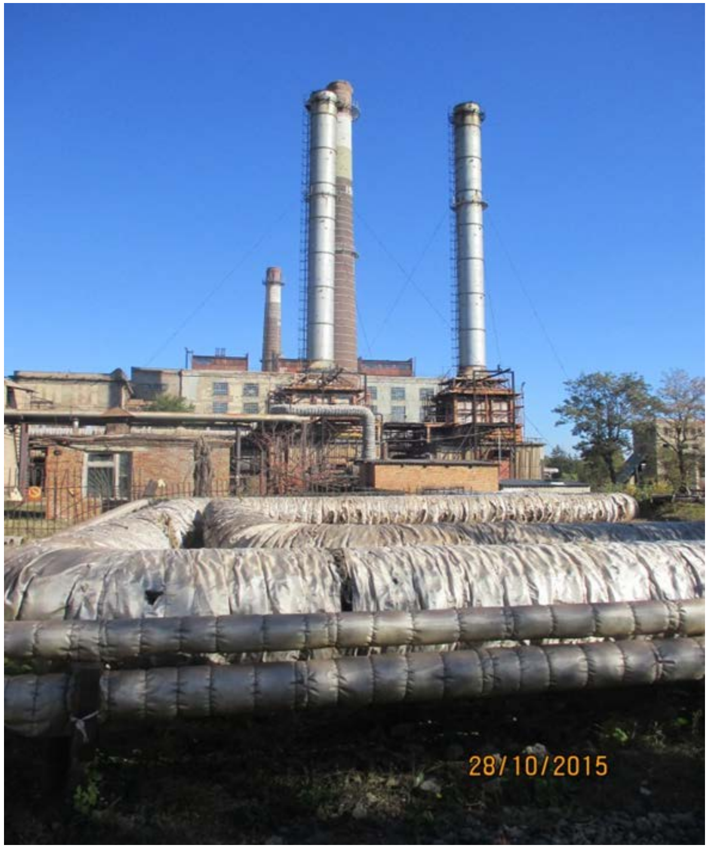
- Based on 50% average depreciation (as assessed by the company), this corresponds to app. 110 mln. EUR system replacement cost, or in specific terms (based on 1000 GCal/h) 110,000 EUR/Gcal/h (128,000 EUR/MW). In order to assess this figure further, it is necessary with additional information about what is included and what not.

Energy Audit

	Total installed capacity, Gcal/hour	Installed project capacity, Gcal/hour	Avaible capacity, Gcal/hour	Year of commissioning
Boiler House 1	509,48	341	271	1929/1946
Include peak boilers	200	200	130	
ROU	309,48	141	141	
Boiler House 2	475,81	460	290	1970/1990
Boiler House 3	200	200	185	1978
Boiler House 4	110	105	95	1979
Boiler House 5	211,26	200	158	1994
Boiler House 6	100	100	82	
Total:	1606,55	1406	1081	

Energy Audit

- Based on a walk-through inspection of boiler plant no. 1, we as Western consultants evaluate the technical condition of the plant as highly unsatisfactory (inefficient, outdated, maintenance intensive etc.).
- The newer plants in the city (which we did not visit) might be in somewhat better shape.
- Even the “newest” plant no. 5 (which we did not visit) is more than 20 years old and most likely of Soviet style, with similar characteristics.



Energy Audit

- Natural Gas used is imported Russian gas with high methane content.
- Lower heat value 8,100 – 8,400 kcal/m3
- In Ukraine, heat values for combustible gases are generally calculated acc. to GOST 22667-82. This norm allows specifying heat values either for a reference temperature of 0°C, or for a reference temperature of 20°C. (The difference is app. 7.4%.) In both cases, the reference pressure is 1,01325 mbar.
- The norm stipulates always to specify, for which temperature a heat value is valid (0°C or 20°). But practice shows that heat values are specified without specification of the temperature for which they are valid. (We consider this a potential source of error.)

Energy Audit

- In Western Europe, heat values for gas are generally specified for a "normative cubic meter (Nm^3)" (25°C, 1,013 mbar). While the pressure is the same as acc. to GOST 22667-82, the temperature differs from the two reference temperatures acc. to this norm. Heat values acc. to GOST 22667-82 must thus always be adjusted when comparing them with heat values acc. to EN 437: They must be reduced with 8.39% if the reference temperature is 0°C, and they must be reduced with 1.68% if the reference temperature is 20°C.

- Heat values for gas are determined acc. to EN 437:2003 (http://www.sarm.am/docs/437.pdf) and ISO 6976:1995.

Energy Audit

Transmission and distribution system

The overall length of DH transmission and distribution networks is 382.2 km (pipe length), and the largest dimension is DN 1000. Transmission pipelines alone represent app. 88 km, and distribution pipelines 294 km. Supposed all pipes are double pipes, this corresponds to a trench length of app. 190 km.

We have no information about percentages of aerial and ducted pipelines. We have no information either about the scope of modern pre-insulated pipe technologies.

Based on visual inspection of various aerial pipelines, we as Western consultants evaluate the technical condition of the DH network as highly unsatisfactory (inefficient, outdated, maintenance intensive etc.). All this is contributing to high heat and water losses and frequent breakdowns.

Energy Audit

Heat and water losses

- Heat losses are significant; lack of proper insulation on both buried ducted and aerial pipes. The insulation gets soaked, which increases heat losses and additionally causes external corrosion.
- Water losses are significant; leakage, pressure testing, refilling installations before heating season

Maintenance

- The main equipment is worn out by 50%.
- Company plans annually update the pipelines, but lack of funds leads to very low renewal rate .
- To replace the main pipelines need about 800 million UAH in 2014 prices. Specify km/yr. and %/yr.
- A realistic figure of the overall replacement is 4 billon UAH

Energy Audit

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Substations and metering

- No meters are installed by the company. All meters installed by the consumers. Problem?

Meters	1454	55%	537.643	Gcal 2014	69%	Metered consumption
No meters	1171	45%	238.056	Gcal 2014	31%	calculated consumption
Consumers	2625	100%	775.699	Gcal 2014	100%	

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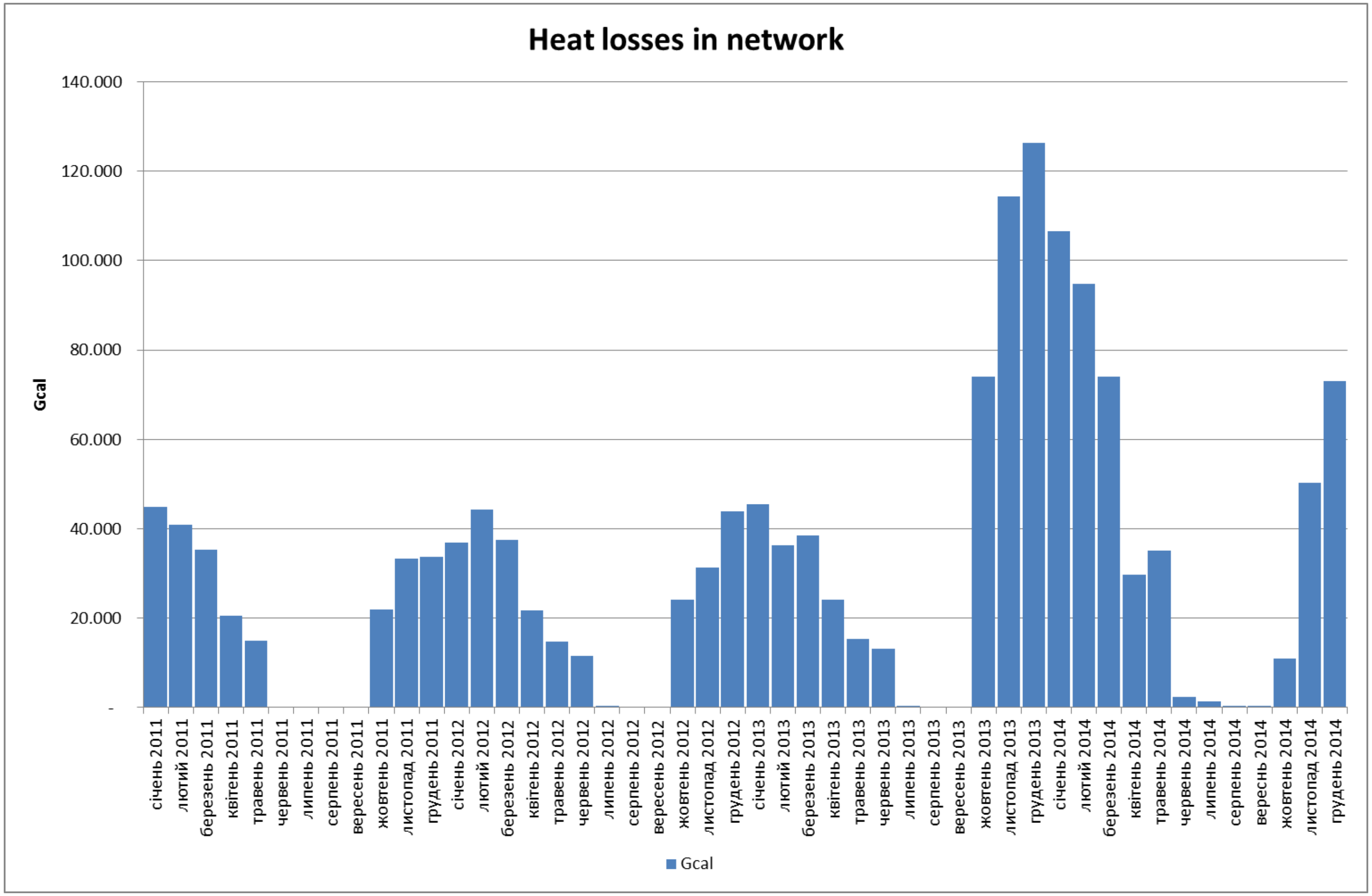
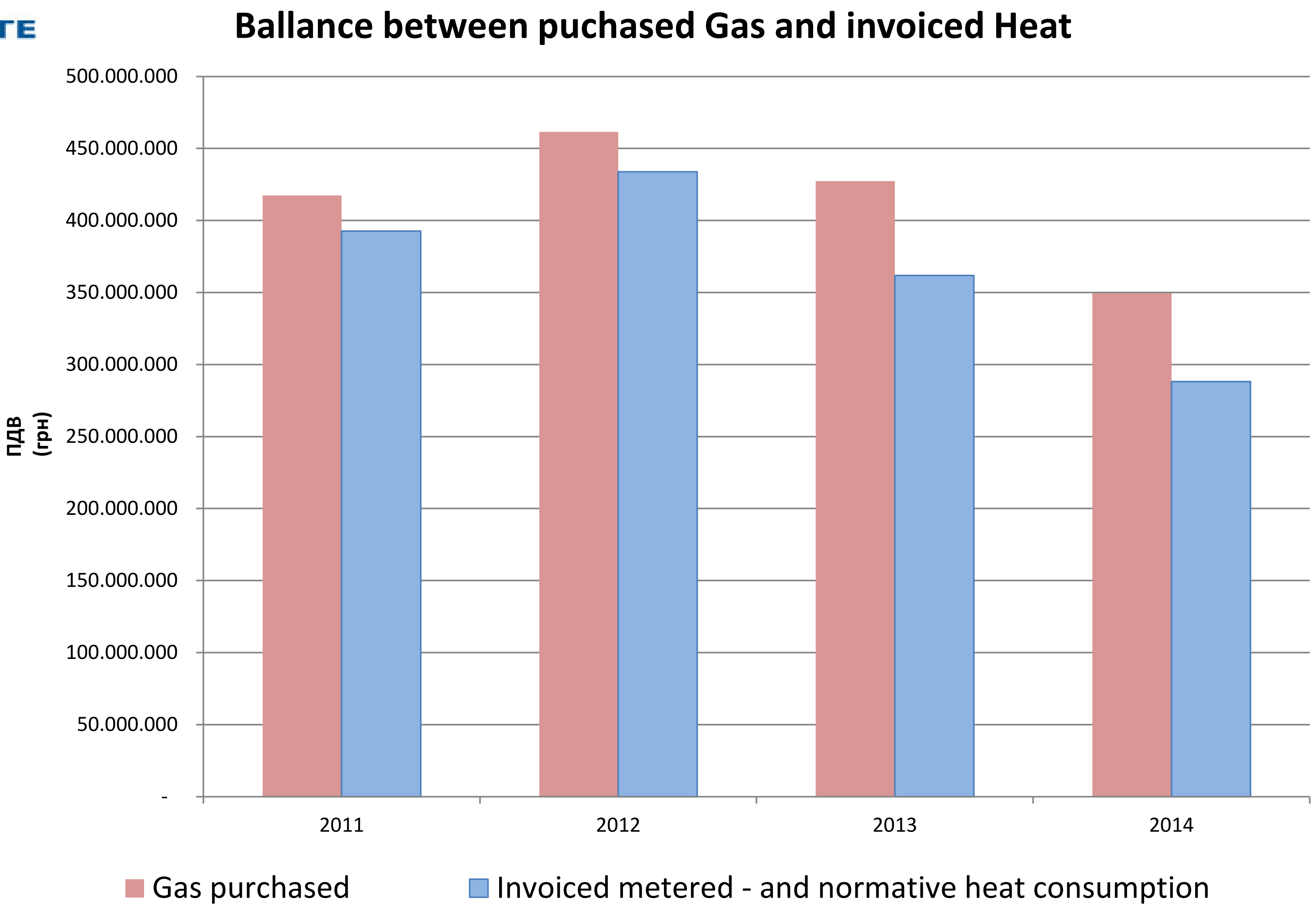
Energy Audit

	2011	2012	2013	2014
Natural gas consumption in normal m^3	226.337.000	237.592.000	232.454.000	179.692.000
Lower Heat Value (yearly average); GCal/(normal m^3)	8,095	8,052	8,123	8,142
Natural gas consumption in Gcal (LHV)	1.832.103	1.913.064	1.888.209	1.463.045
Natural gas expenses (UAH)	417.477.963	461.599.391	427.395.469	349.385.065
Heat supply into the network in Gcal	1.691.654	1.774.808	1.742.241	1.342.097
Heat plant efficiency (calculated)	92,3%	92,8%	92,3%	91,7%
Useful heat supplied and invoiced to the customers in Gcal	1.445.744	1.508.669	1.254.097	863.095
heat network efficiency (calculated)	85,5%	85,0%	72,0%	64,3%
Heat revenues (UAH)	392.620.000	433.755.000	361.819.000	288.144.000
Overall system efficiency (calculated)	78,9%	78,9%	66,4%	59,0%

Тепломережа



Energy Audit



Energy Audit

SHORT-TERM STRATEGIES

The current system efficiency (<60%, based on LHV) is unacceptably poor on the background of the current natural gas price level. We see two main strategies for short-term improvement:

Not yet approved:

- Decentralisation of heat production based on natural gas.
- Fuel conversion to coal of the current centralized boiler plants.

SHORT-TERM STRATEGIES

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Decentralisation of heat production based on natural gas

- With natural gas as the main fuel, there is no reason to preserve a centralized supply structure. The heat production can be moved much closer to the consumers, which will bring down the network heat and water losses close to zero. At the same time, more efficient (i. e. condensing) boilers should be installed. These measures together will bring the system efficiency from app. 59% close to 100%, and at the same time reduce power consumption for pumping.
- Current group substations for DHW production could be transformed to decentralized boiler plants, or boilers could be installed in building basements and on roofs.
- By doing so, the DH transmission network (and to some extent also the distribution networks) will become redundant. It is important that these networks are preserved, with respect to improvements in the medium and long term (see below).

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SHORT-TERM STRATEGIES

Fuel conversion to coal of the current centralized boiler plants

- By converting the boiler plants to coal, it would be possible to bring down the fuel costs (supposed that coal is considerably cheaper than gas, which needs to be verified). With a low price per unit of fuel energy, a low system efficiency becomes less detrimental. Of course, ecological conditions and security of fuel supply must be taken into account. In the end, it is a political decision.

- Note that the two strategies also can be combined, i. e. fuel conversion of some selected boiler plants, and in the remaining areas decentralization.

MEDIUM AND LONG TERM STRATEGIES

In the medium and long term, it is important that cheap base load heat is made available and utilized for DH supply. We see 3 main options for cheap base load heat:

- Industrial surplus heat
- Heat from waste incineration
- Large scale solar thermal

MEDIUM AND LONG TERM STRATEGIES

We believe there is a huge potential for industrial surplus heat utilisation in Kryvyi Rig. The picture below shows a group of cooling towers at the plant “ArcelorMittal Kryvyi Rig”.

Supposed that the first-mentioned short-term strategy has been selected, the DH transmission network (that had been out of operation for a certain period) must be taken into operation again in order to transport and widely distribute these kinds of heat. The decentralized boiler plants referred to will be downgraded to peak load and back-up boilers.

Conclusion

The overall system is in a poor state and the need for investment in modern technologies is significant.

To raise the overall efficiency in supply to a level like Western Europe (82%-88%)

investment of at least

10 Billion UAH must be expected.

Дякуємо за увагу

Хенрік Стеффансен
Senior Technical Expert
hst@ramboll.dk
Rambøll Energy Denmark