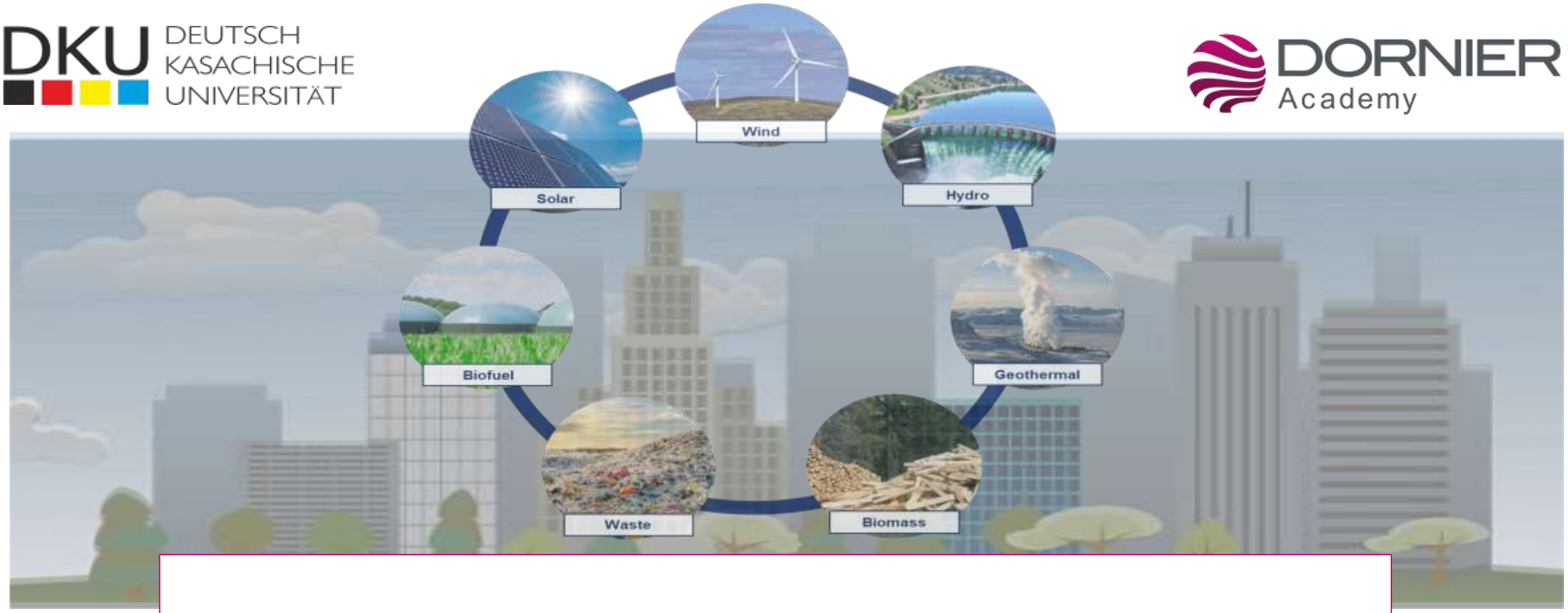


2.3 Local heating systems. Energy saving. RES. Potential. Result.

Sergei Poleschuk

Types of heat supply systems

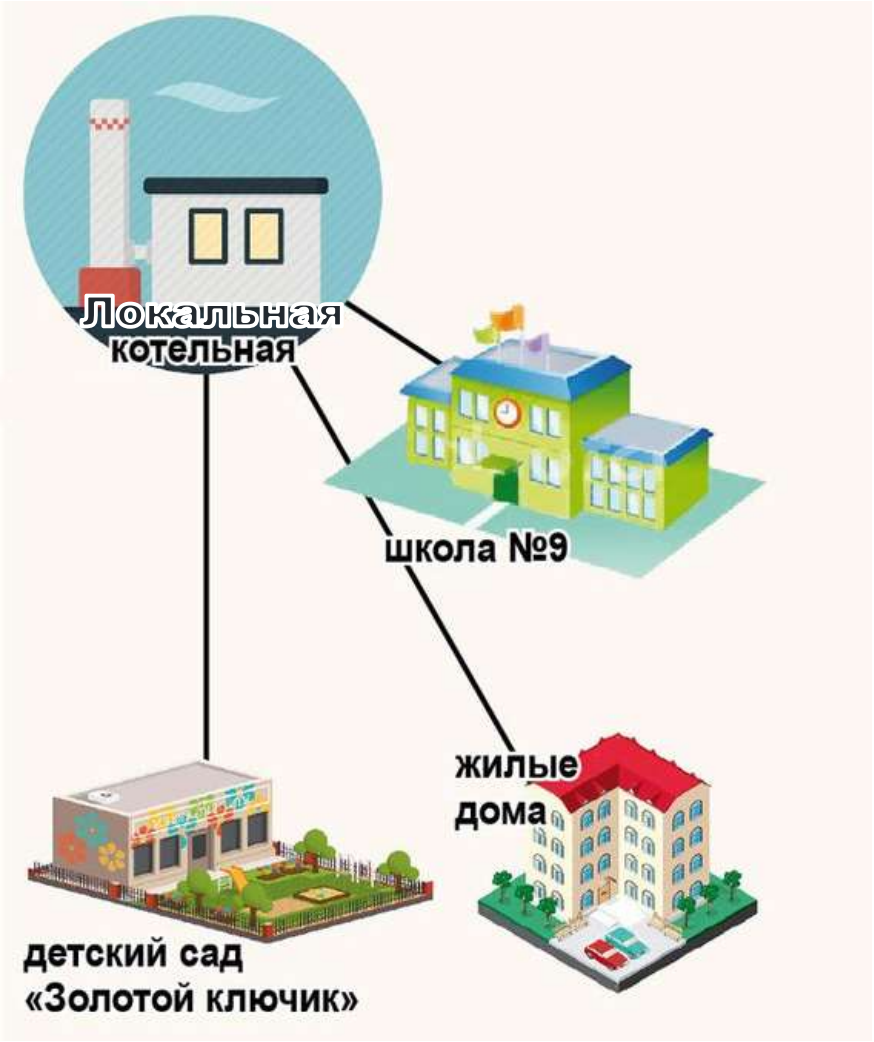
Central heat supply system - a system of heat supply from one or more heat sources with transportation of heat carrier to consumers through public heat networks

Local heat supply system - a system of heat supply to one or more consumers from one or more heat sources via heat supply networks, not being public networks

Individual heat supply system - a heat supply system, in which heat production, transportation and consumption are carried out by a single heat consumer.

Characteristics of a local heat supply system :

- the total load of consumers (public entities and households) connected to the networks does NOT exceed a certain threshold of connected consumer load (preliminarily 10 MW)
- there are pipes for heat transportation, but they are not of a district heating network nature
- the heat supply system is owned by a separate legal entity, which supplies heat to individual consumers on the basis of bilateral contracts concluded on a voluntary basis
- the tariff is final for the consumer (not divided into stages) and is unregulated;
- the tariff can be regulated for budgetary organisations and the population


Локальная
котельная
школа №9
жилые
дома
детский сад
«Золотой ключик»


Котел
Турбина
Генератор
Теплообменники
Учет
ТЭЦ
Газ
Диспетчерская
ИТП
Учет
Насосная
ЦТП
Учет
Магистральная
теплосеть

Annual heat consumption in Kazakhstan

Type of heating system	Annual system heat consumption, GWh, year
Centralised public heating systems (district heating)	42 718*
Local heat supply systems	10 680**
Decentralised (individual) independent heat supply systems	42 980*** 47 834
Heat supply systems using industrial surplus heat	No data available, probably insignificant

* based on the official statistical compilation "Fuel and Energy Balance of the Republic of Kazakhstan 2015-2019", Ministry of National Economy of the Republic of Kazakhstan, Committee on Statistics", Nur-Sultan 2020;
** is taken as equal to 25% of the consumption in public district heating systems;
*** is estimated based on the official statistical collection "On the housing stock", Ministry of National Economy of the Republic of Kazakhstan, Committee on Statistics, Nur-Sultan 2020 and the assumed specific heat consumption of buildings.

Existing problems

- physical and moral wear and tear (up to 80%);
- low efficiency (25-30%);
- use of the "wrong" fuel;
- negative environmental impact ("pipes simply "smoky");
- low level of instrumentation (in some places there is none);
- low level of automation (stoker, shovel, coal - poorly automated, especially in small HoPs);
- high failure rate due to inadequate repair and maintenance of equipment;
- lack of information on efficiency indicators (such as heat source efficiency, heat losses in the heat network, specific heat consumption, etc.)

Practical example

In 2015, work was carried out jointly with USAID to monitor solid fuel consumption by budgetary organisations in Karaganda region

Number of HoPs	–	562
Total area of heated buildings	–	1 million m2.
Fuel used	–	coal
Fuel consumption	–	159 thousand tons/year
Actual emissions	–	276 thousand tons CO2/year
Fuel costs (with delivery)	–	503 million tenge
Repair costs	–	91 million tenge
Payroll	–	407 million tenge
Emission payments	–	83 million tenge
Ash removal	–	18 million tenge
Total	–	**1 102 million tenge**

Results

- Old equipment (up to 55 years old) and high wear and tear (up to 95%).
- Extremely low efficiency of heat generating units and, as a consequence, overconsumption of fuel. The 562 autonomous boiler plants consumed more than 159 thousand tons of coal in 2013, although the normative consumption is about 40 thousand tons. Fuel overconsumption was 119,000 tonnes (75% of consumption). *For information, consumption of Shakhtinsk CHP is 102 thousand tonnes of coal/year*.
- Insufficient expenditures for repair and maintenance of equipment (on the average 8% of the total operational expenditures). It should be noted that more than a quarter of the surveyed boiler plants in 2013 did not spend funds on maintenance at all (just whitewashing and painting).
- Actual CO2 emissions into the atmosphere amounted to 276 thousand tonnes, which is 4 times higher than the normative value.

This is only an example of the Karaganda region, but what about the Kazakhstan?

Current situation

There are more than 11,000 autonomous HoPs in Kazakhstan. Half of them are heated by coal, i.e. about 5-6 thousand units.

Fuel consumption, according to the results of 2020-2021 heating season, is 2.8 mln. tons of coal and 50 thousand tons of fuel oil.

Emissions are about 5.1 mln. tonnes CO2-eq.

There is no general data on gas emissions, BUT there are HoPs.

Options for solving problems

1. **Conversion of HoPs to biomass combustion (HRSGs) - this option solves 2 problems at once:**

- The use of biomass for heat production. At the moment, almost all biomass is burned in the fields;

- reduction of coal consumption.

Example of HoP applications

Central HoP in Yavlenka village, Esil district

Installed - 2 bioboilers;

Effect over the heating season:

- **Coal consumption reduced by 2,000 tonnes**
- **Savings of 30 million tenge**
- **Reduction of emissions - 3.4 thousand tonnes CO2-eq.**

According to the NDC roadmap

The country's oilseed flax crop residue in 2020 was about 2 million tonnes. (1.3 million tonnes of coal).At the moment almost all of this straw is simply burnt, resulting in carbon dioxide emissions.

By 2030, it is expected that the area under oilseed crops may increase to 5 million ha, at which point the straw production will exceed 5 million tonnes per year (3.3 million tonnes of coal, consumption by local boilers - 2.8 million tonnes of coal/year).

How to implement?

1. Need for state support measures in the form of subsidies or compensation of costs for the purchase of installations for heat generation from RES (bioboilers)
2. Subsidies for fuel delivery

Result:

- ❑ Extensive introduction of biomass boilers;
- ❑ Opening of new equipment production plants;
- ❑ Creation of new jobs;
- ❑ Reduction of environmental impact

2. Conversion of HoPs to gas (natural gas/LPG)

Advantages

- ❑ High efficiency (over 90%)
- ❑ Eco-friendliness
- ❑ Low capital costs
- ❑ Automation
- ❑ Smooth regulation

Disadvantages

- ❑ Only price

The problem of conversion to gas:

Not all regions are gasified, the conversion to LNG is due to the high cost of the fuel itself and its delivery.

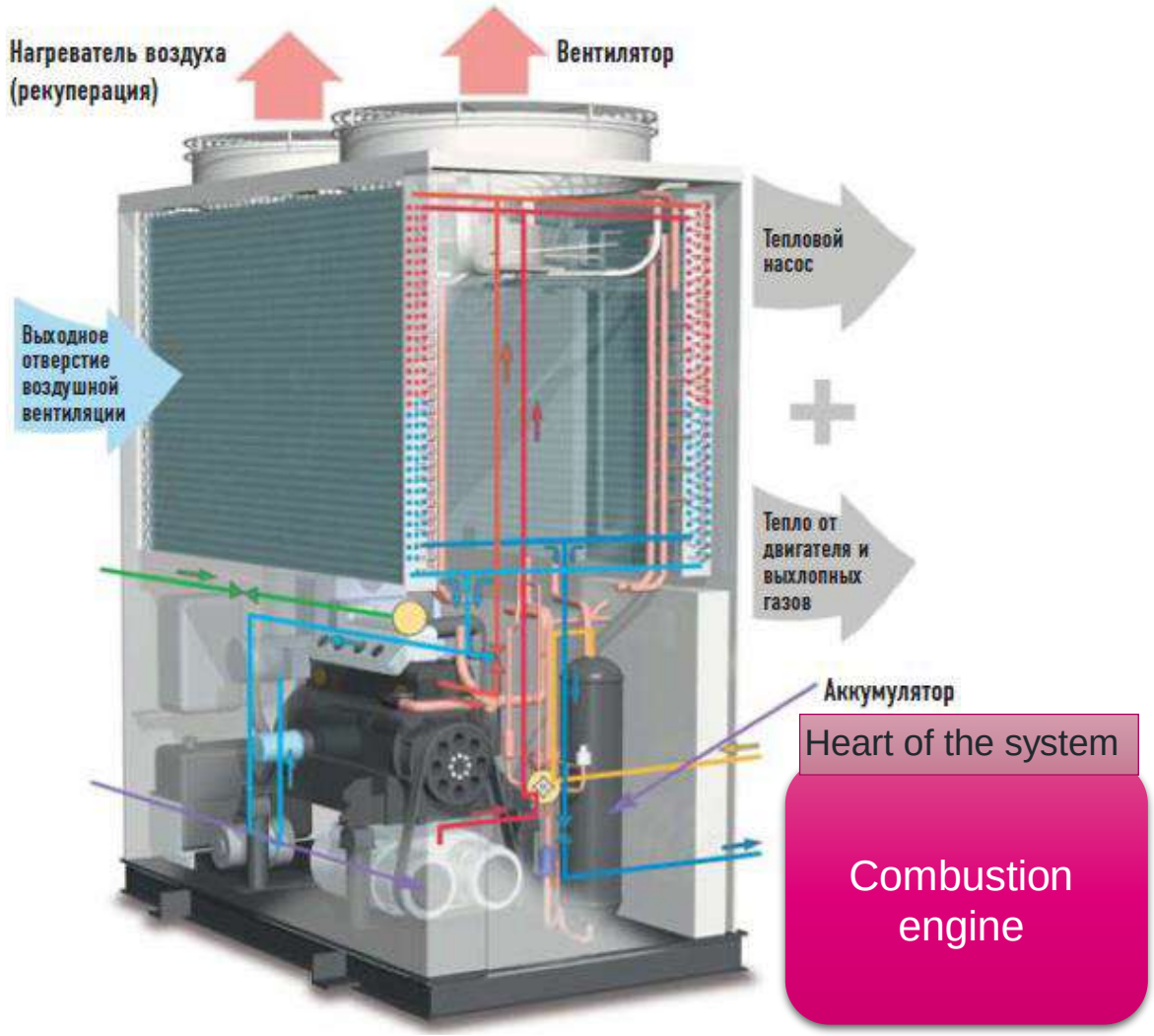
Example of an irrational (absurd) solution

In 2012, construction began on a new central HoP in Saran. Over the following years, the buildings of the administrative building, the checkpoint, the garage with a fire station, and the pumping station were built.
In 2014, the detailed design for the replacement of the process equipment was adjusted. In the following year, the main and crushing buildings, chimneys and partially assembled hot water boilers were erected.
In 2015, construction and installation work on the site was halted.
In 2017, the Karaganda region gasification project (including Saran) passed state expert review
In 2019, the gas pipeline reached Shakhtinsk (26 km from Saran).
In 2020, the project was adjusted, and despite the fact that an earlier expert review revealed that almost all structures and equipment were in disrepair and needed to be replaced, it was decided to continue the construction of the solid fuel boiler plant.
In 2021, the construction of the HoP was resumed.
In 2022 the construction of the gas pipeline to the city of Saran is in progress.
At the end of 2022-beginning of 2023 it is planned to put the HoP into operation

The cost of the HoP is 7 billion, with construction costs expected to rise by a further 10-12%.

3. Application of gas heat pumps

- ❑ 100% heating capacity down to -21 °C
- ❑ Fuel savings (up to 3 times)



It is most favourable to use heat pumps in regions that do not have access to natural gas.
The use of a heat pump will reduce LNG consumption by a factor of 3, which will also significantly reduce the cost of 1 Gcal of heat energy.

Comparison of options for converting coal-fired HoPs to cleaner fuels

	System efficiency	Required fuel quantity	Emissions, mln t	Reduction of coal/ fuel oil, mln t	Reduction of emissions, mln t	Funds required, $ million
Coal + fuel oil	40	2,8 mln.t 50 тыс. т	5,1	2,8/0,05	-	-
Natural gas	90	805 mln. м3	1,6	2,8/0,05	3,5	249
LNG heat pump	90	278,4 ths. t	0,9	2,8/0,05	4,2	2676
Biomass (Potential for use)	80	4,3 mln.t (1,8mln.t)	-	1,1/0,05	2	129
Biomass + LNG heat pump		1,8 mln.t 163,4 ths. t	0,5	2,8/0,05	4,6	1 700

Cost of emission reductions

Name of activities	Cost of reduction, $/1tCO2-eq
Conversion of HoPs to biomass combustion (HRSGs)	6,5
Conversion of HoPs to natural gas	7,1
Combination variant (Biomass + gas heat pump)	37
LNG-fired gas heat pump applications	63,7
Dissemination of electric vehicle heating technology during cold weather to save fuel and reduce GHG emissions	81,9
Increasing the share of wind and solar power plants	121,3
Installation of solar photovoltaic panels on residential roofs	124,6
Increasing the electric vehicle fleet	7190,6

Questions for discussion

1. Which heat pumps are better:
   - electrically driven
   - with a gas-powered combustion engine

   Why?

2. Which is the best place to start for local HoPs modernisation:
   - budget
   - residents
   - business

   And why?

3. Where is the best place to start for the modernisation of local heating systems:
   - with thermo modernisation of buildings
   - with thermo modernisation of HoPs.

4. How best to reduce greenhouse gas emissions:
   By modernising heating systems or by installing photovoltaic batteries (wind turbines)?

Thank you for your attention!

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