THE DUAL-USE OF NUCLEAR POWER PLANTS TROUGH THE USE OF HEAT PUMPS ON CARBON DIOXIDE

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HPS-NPP Technology

Technology of Heat Pump Systems & Nuclear Power Plants (HPS-NPP) is based on the transformation from low-grade waste heat of NPP (20 … 40°C) to the high-grade heat (80 … 100°C and more) with the help of heat pumps on carbon dioxide and transporting heat to the distance up to 100 km.

Heat Pumps Technology

- More than 90 million heat pumps with unit capacity from 1 to 100 kW for the needs of the individual heating is commissioned.
- Heat pumps with unit capacity near 30 MW is used in the district heating systems of Sweden, Norway, Finland, Switzerland, Denmark, China. The maximum total thermal capacity of heat pumps station is 360 MW.

Heat Pumps Parameters

Parameters	Freons	CO_2
Thermodynamic cycle	vapor-liquid	gas-liquid
Maximum heating water temperatures, °C	not more 80	80-100 and more
Maximum heating capacity, MW	not more 30	20-100 and more
Coefficient of performance (COP)	3-4	4-5

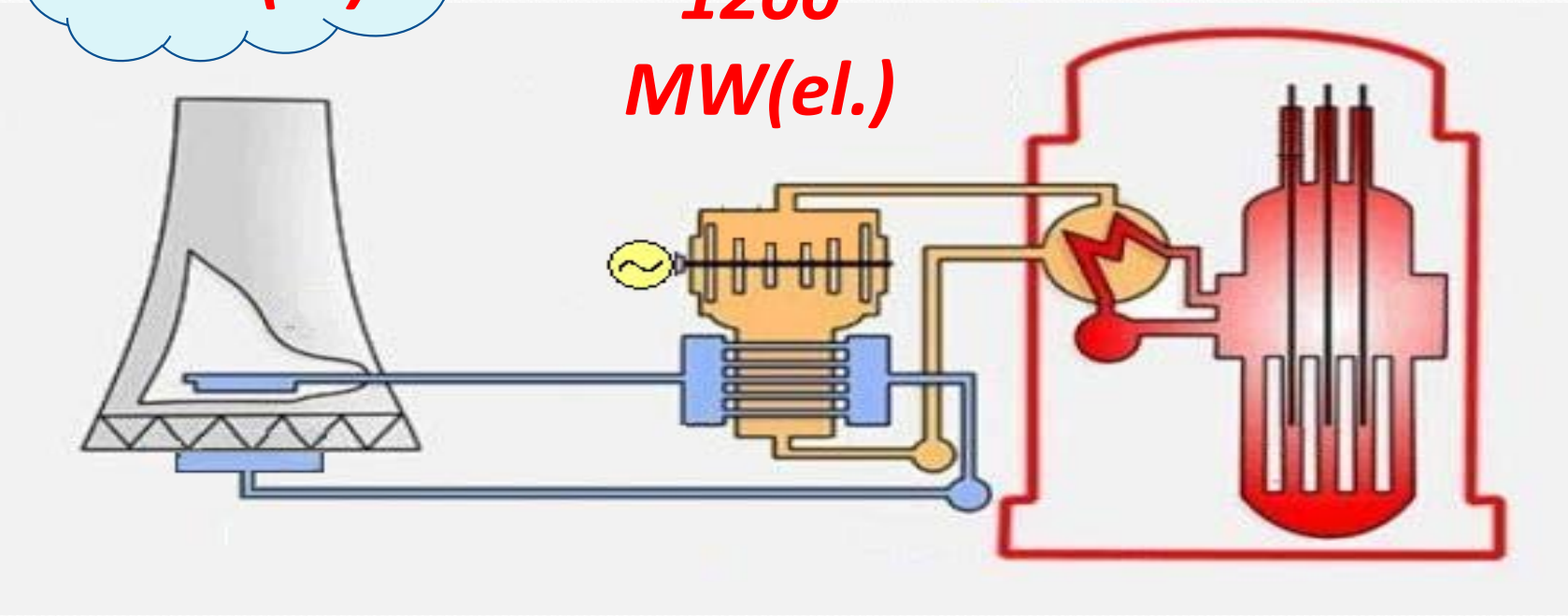
Source of waste heat of NPP on PWR-1200

5000 m3 per hour

2000 MW(h.)

3200 MW(h.)

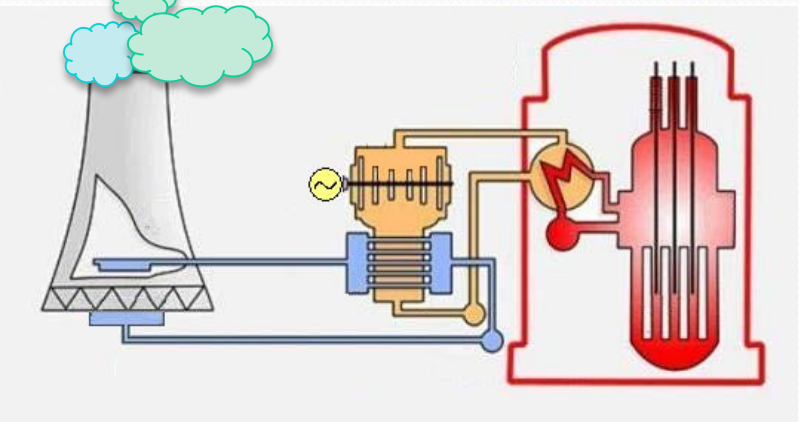
1200 MW(el.)



NPP on PWR-1200 of one-use

40 millions m3 per year

NPP



Electric Energy

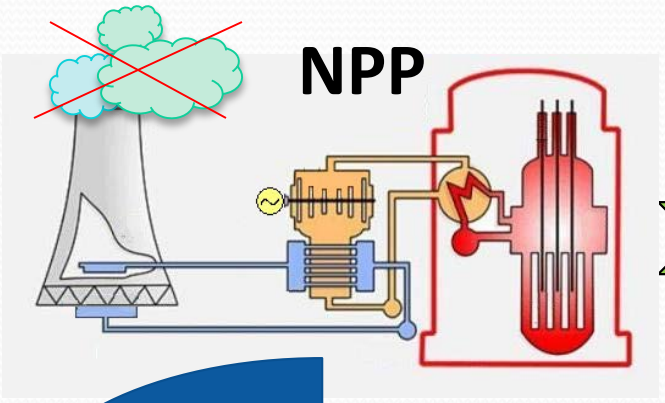
8,3 millions MW·h per year

Waste Heat

14,1 millions MW ·h per year

NPP on PWR-1200 of dual-use due to HP with electrically drive

<4 millions m3 per year

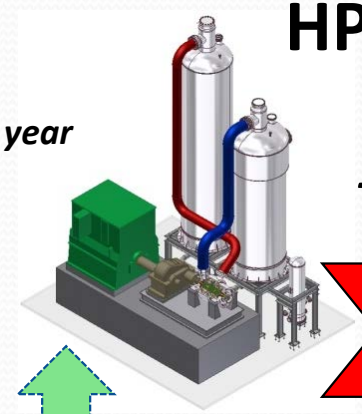


Electric Energy

8,3 millions MW·h per year

Waste Heat

12,8 millions MW ·h per year



Heat Energy

16,5 millions MW ·h per year

TM

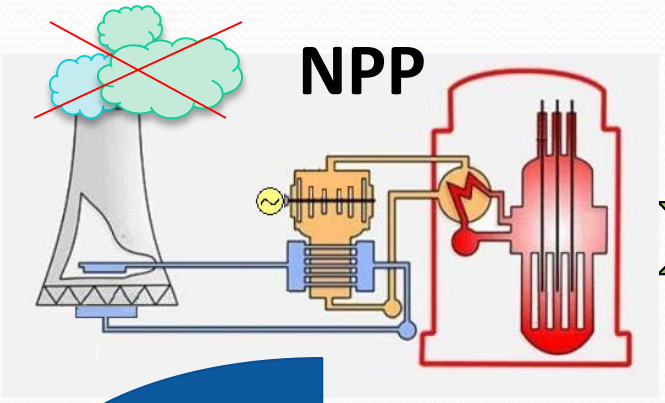
Electric Energy

4,3 millions MW·h per year

*Heat transporting up to **100 km***

NPP on PWR-1200 of dual-use due to HP with natural-gas drive

<4 millions m3 per year



Electric Power

8,3 millions MW·h per year

Waste Heat

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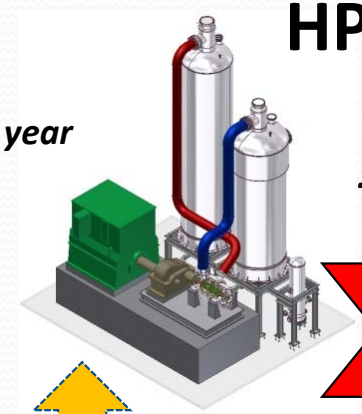


Heat Energy

16,5 millions MW ·h per year

TM

*Heat transporting up to **100 km***

Natural Gas

840 millions м3 per year

Prospective consumers of heat of HPS-NPP

- Housing facilities;

- Production and processing of agricultural products;

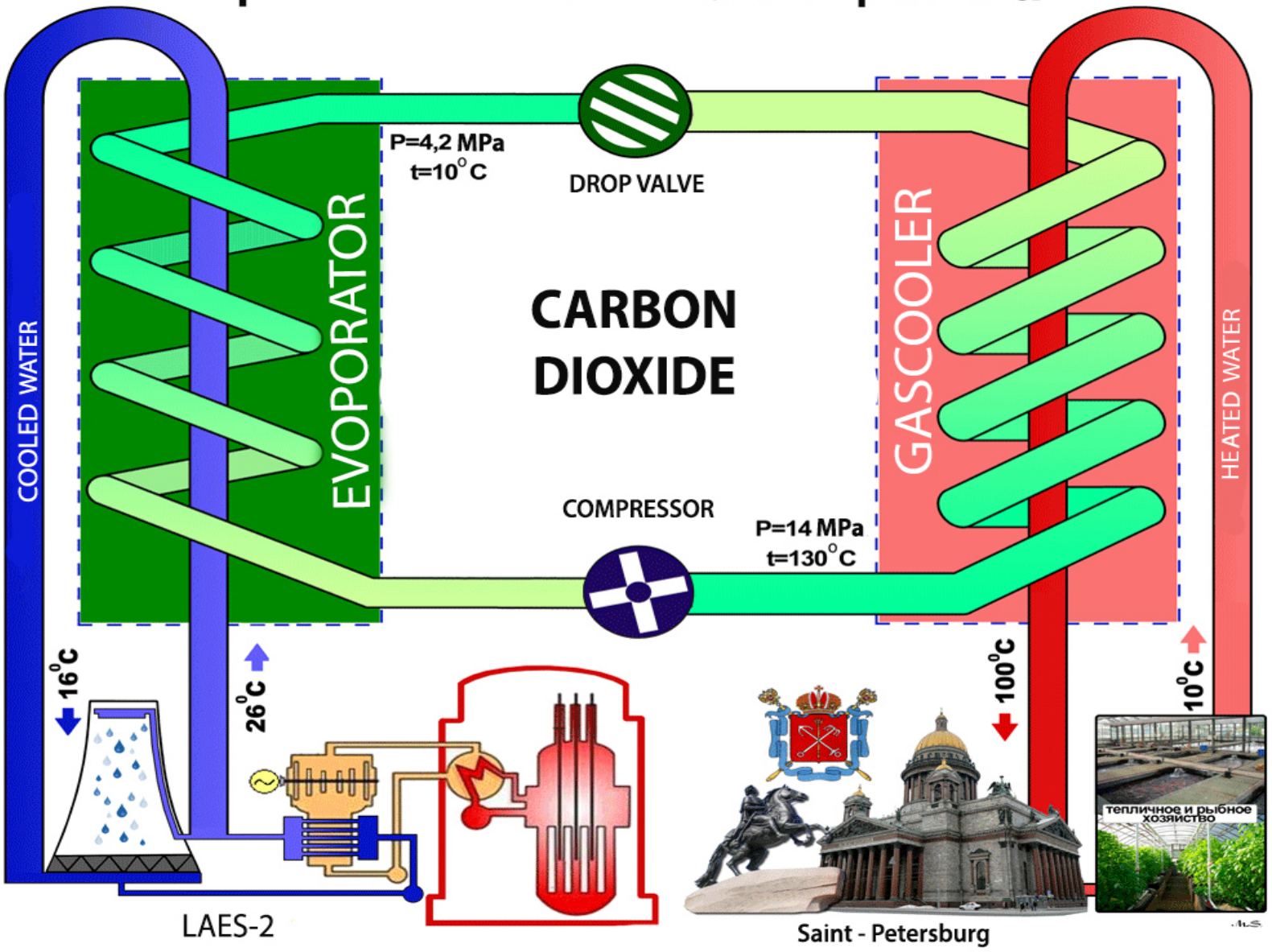
- Biotechnology, including production of biofuels, biological products and dietary supplements;

- Desalination Plants;

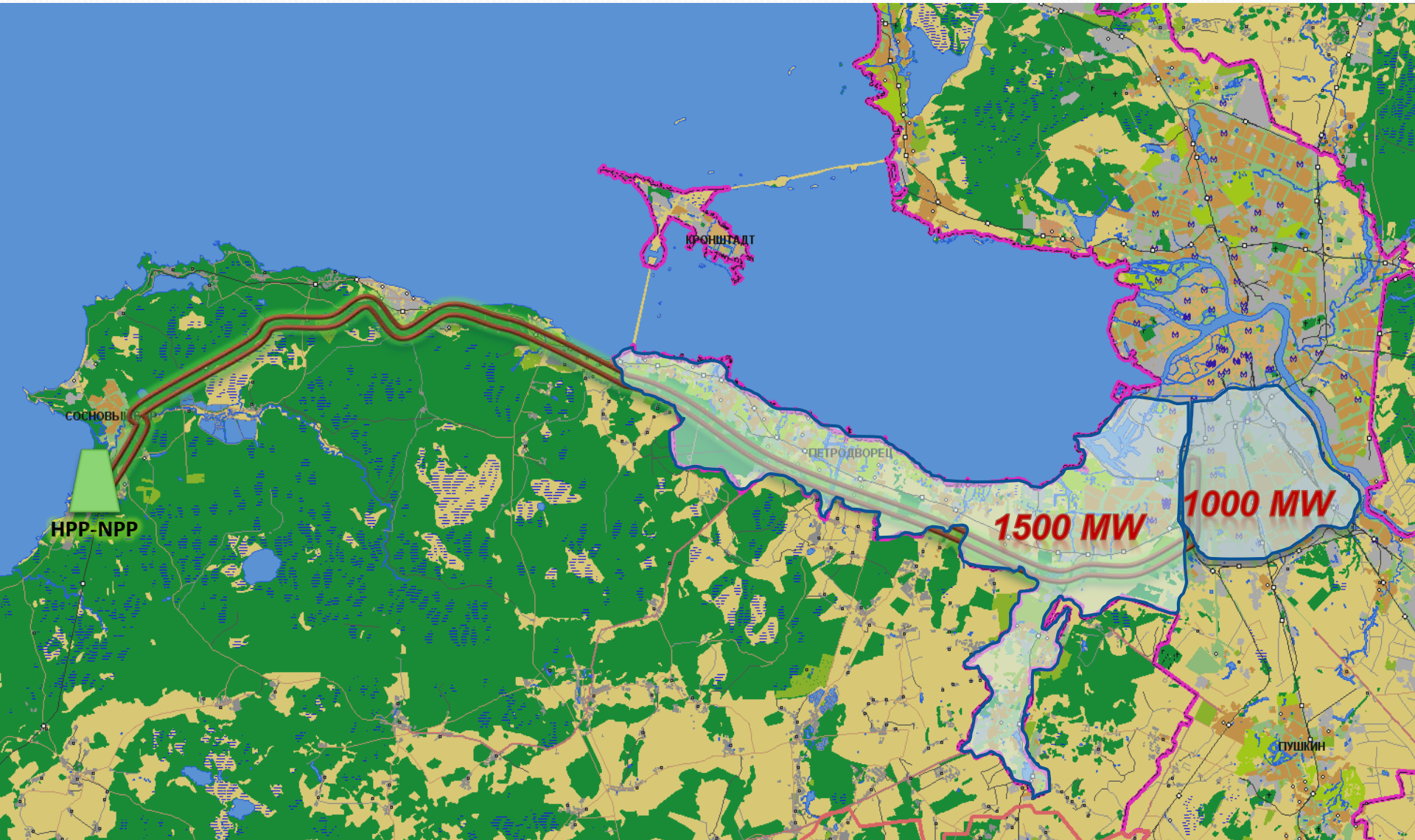
- Recycling of municipal waste and household waste;

- Production of construction materials.

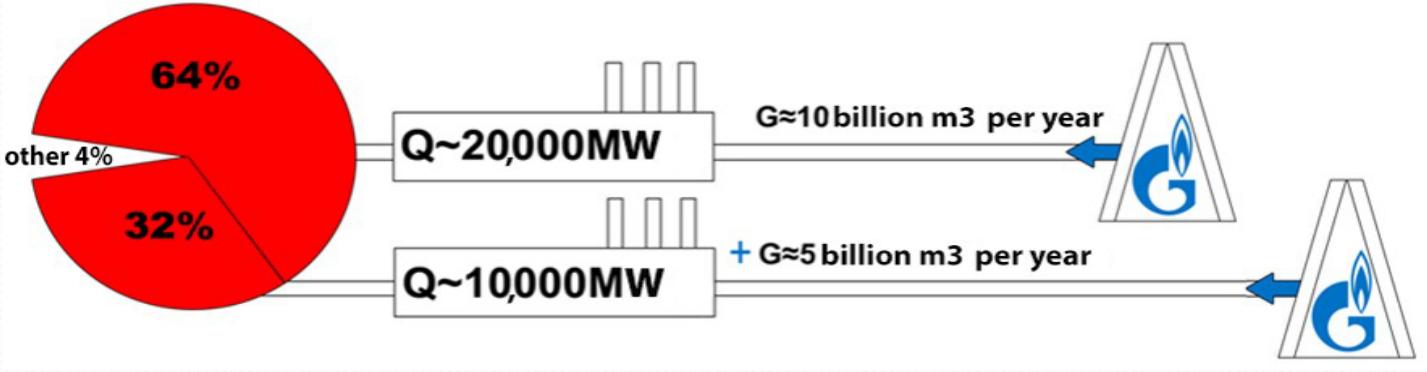
Principal scheme of HPS-NPP for example SPB & LAES-2



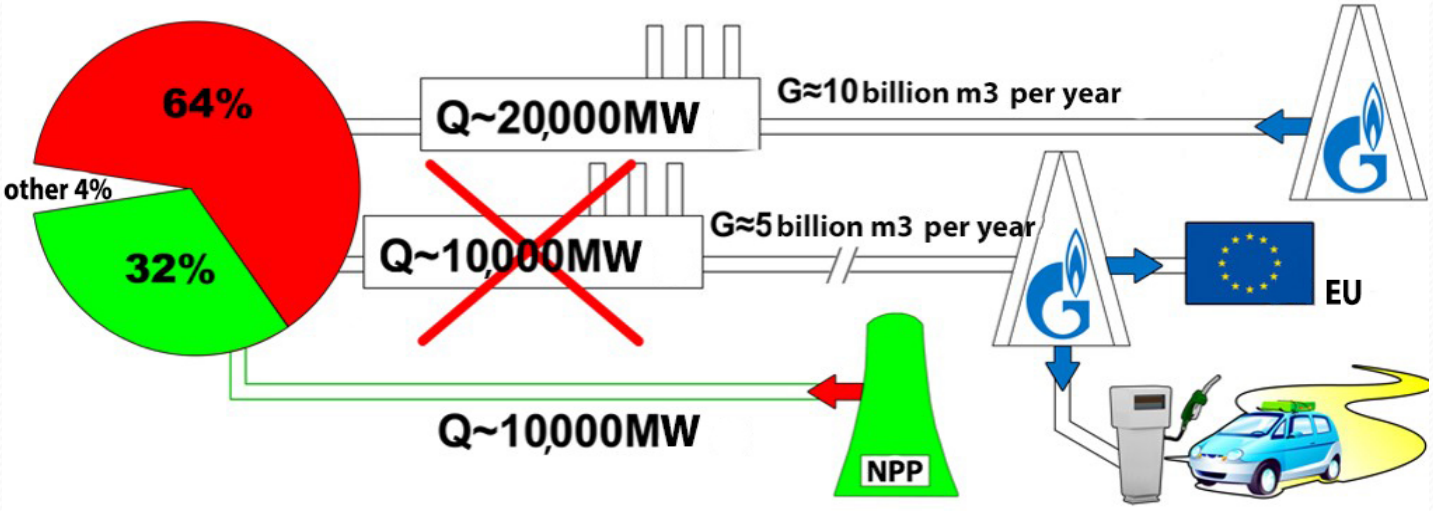
Heat transporting system from Leningradskaya NPP-2 to Saint-Petersburg (80 km)



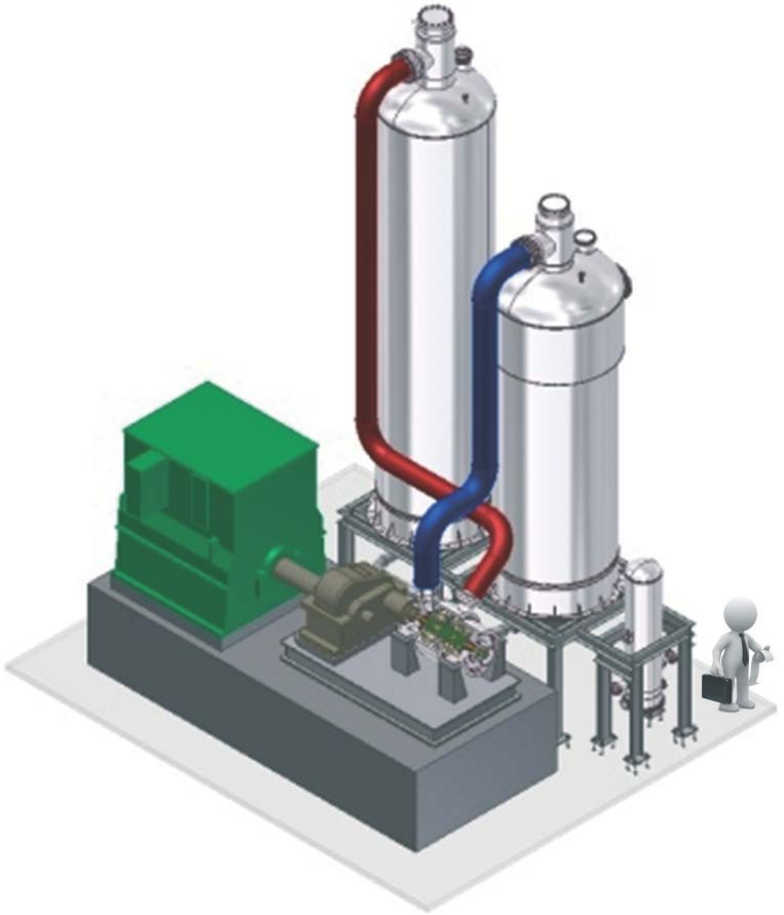
Prospective Heating Supply System of Saint-Petersburg (2025) without HPS-NPP



Prospective Heating Supply System of Saint-Petersburg (2025) with HPS-NPP



HP CO2 100 MW

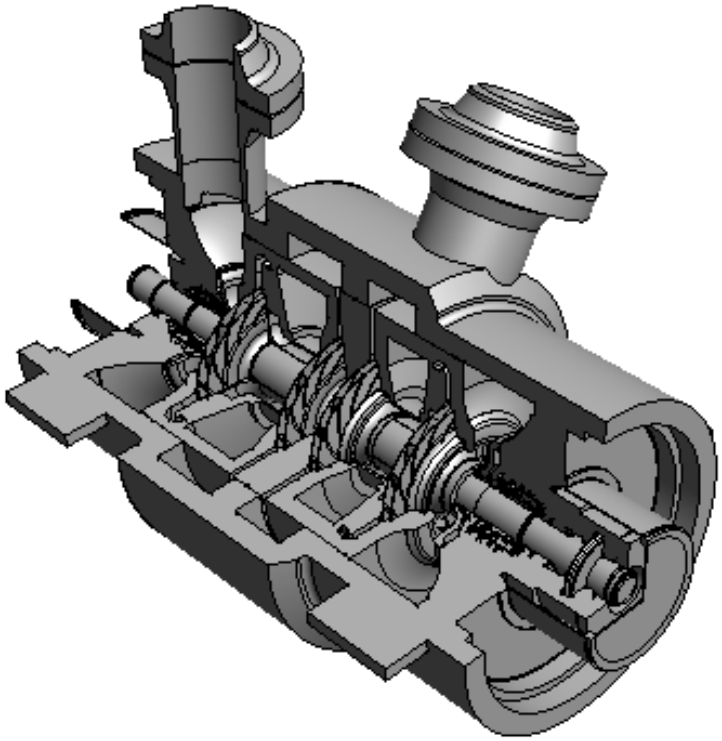


Heating Capacity	MW	100
Power Consumption	MW	25
Heating water temperatures (in/outlet)	°C	10/100
Cooling water temperatures (in/outlet)	°C	26/16
Dimensions L*W*H	meters	18.5x14x17.5
Weight	tons	270
Unit cost	$/kW	250

Centrifugal compressor of HP CO2 100 MW

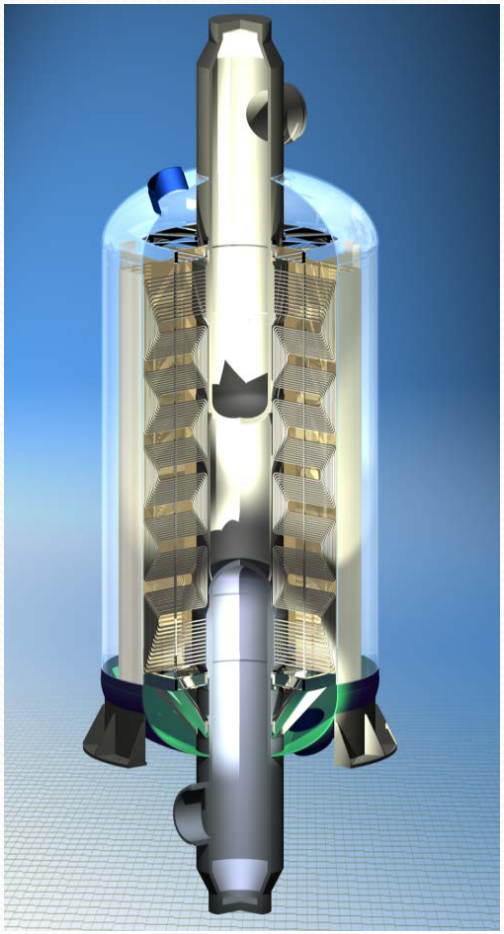
ТАКТ
ОАО КАЗАНЬКОМПРЕССОРМАШ

ЗАО НИИТУРБОКОМПРЕССОР имени В.Б.Шнеппа



Mass flow	kg/s	361
Power Consumptions	MW	25
Temperature after Compressor	°C	127
Dimensions L*W*H	meters	11 x 5x 4.5
Weight	tons	95

Heat exchangers of HP CO2 100 MW



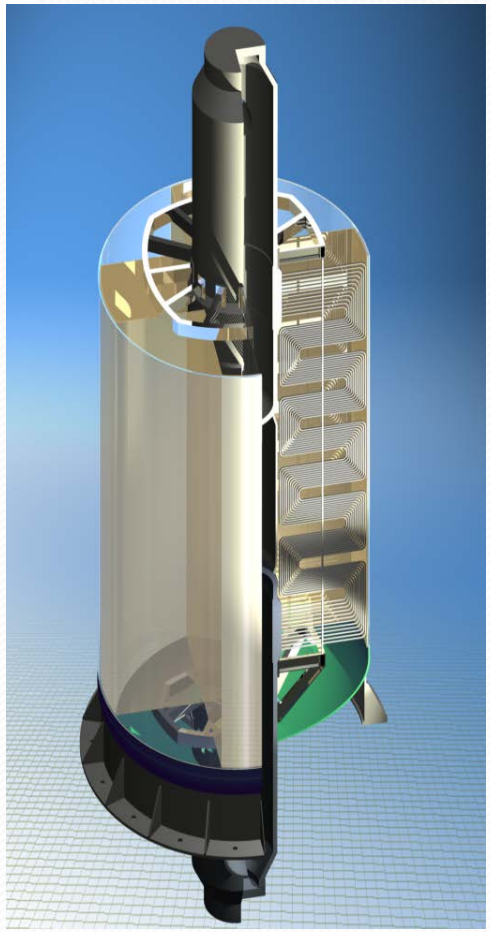
Gas cooler

Dimensions, m

13,5 x 3,3 x 3,3

Weight, tons

79



Evaporator

Dimensions, m

11,5 x 3,5 x 3,5

Weight, tons

55

Conclusion

1. Technical and technological solution of HPS-NPP is based on the Russian engineering.
2. HPS-NPP Technology can be implemented at the nuclear, organic and hydro power plants, which opens up new opportunities to optimize the energy balance in the regions of their placement.
3. The implementation of HPS-NPP Technology is a new line of non-electric use of nuclear power in the path of construction of carbon-free energy.

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