Solar Thermal system integration in existing District Heating grid.

Experience form Salaspils Siltums project

Leo Holm
Manager Technical Sales

ARCON SUNMARK

ARCON-SUNMARK A/S IN HEADLINES

- 1974 Foundation of Arcon Solar A/S
- 1988 First large scale solar plant in combination with District heating
- 2007 Incorporation of Arcon Solar A/S in VKR Holding
- 2015 Merger of Arcon Solar A/S and Sunmark Solutions to Arcon-Sunmark A/S.

WE ARE THE WORLD'S **LEADING** SPECIALISTS

WE DELIVER **HIGH QUALITY,** AT LOW COST

Arcon-Sunmark is a Danish company with a global footprint. Design, development and our production is based in Denmark.

WE CAN **PROVE** IT

Arcon-Sunmark is behind the largest solar thermal installation for industrial process heating. In addition, we have installed more than 80% of the largest plants in Europe.

WE ARE HERE **TO STAY**

We are as solid and future-proof as can be. Arcon-Sunmark is owned by VKR Holding. In total, VKR Holding's companies employ some 14,000 people in more than 40 countries. VKR Holding owns companies which bring daylight, fresh air and a better environment into people's everyday life.

ARCON-SUNMARK - Part of the VKR Group

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ARCON-SUNMARK AND FILTER AS

Arcon-Sunmark and FILTER AS established in 2019 a sales collaboration agreement which aims to offer large-scale solar heating systems for the Baltic market and in Bulgaria, Russia and Belarus.

FILTER | POWERING YOUR INDUSTRY
ENERGY WATER SOLUTIONS

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UN GOALS NO. 7: AFFORDABLE AND CLEAN ENERGY

7.1 Modern energy
Clean and affordable energy

7.2 Renewable energy
Be part of the renewable energy transition

7.3 Efficient energy
Solar thermal shows highest energy yield per square metre

7.A Clean energy
Solar thermal production is CO_2 free

7.B Global energy
Renewable energy for everyone

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BENEFITS OF DISTRICT HEATING AND SOLAR THERMAL

STABLE HEAT PRICE, INDEPENDENT FROM FOSSIL FUELS, CO2 FREE ENERGY PRODUCTION

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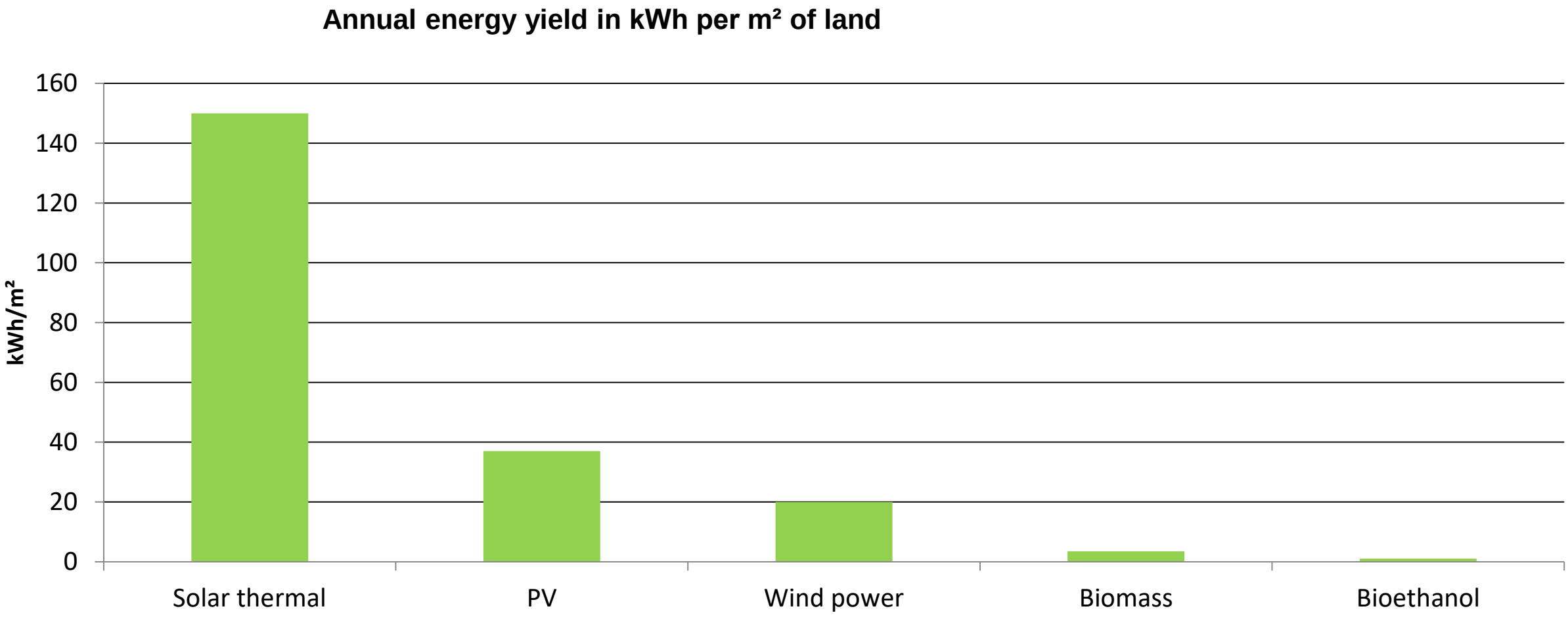
WHY SOLAR THERMAL?

IT CAN BE STORED, TRANSPORTED AND IT WORKS EVEN IF IT IS CLOUDY

WHY SOLAR THERMAL?

IT'S THE MOST LAND SAVING RENEWABLE ENERGY SOURCE



Source: Per Alex Sørensen, Planenergi: "Experience with solar thermal in Denmark", Jan. 2014

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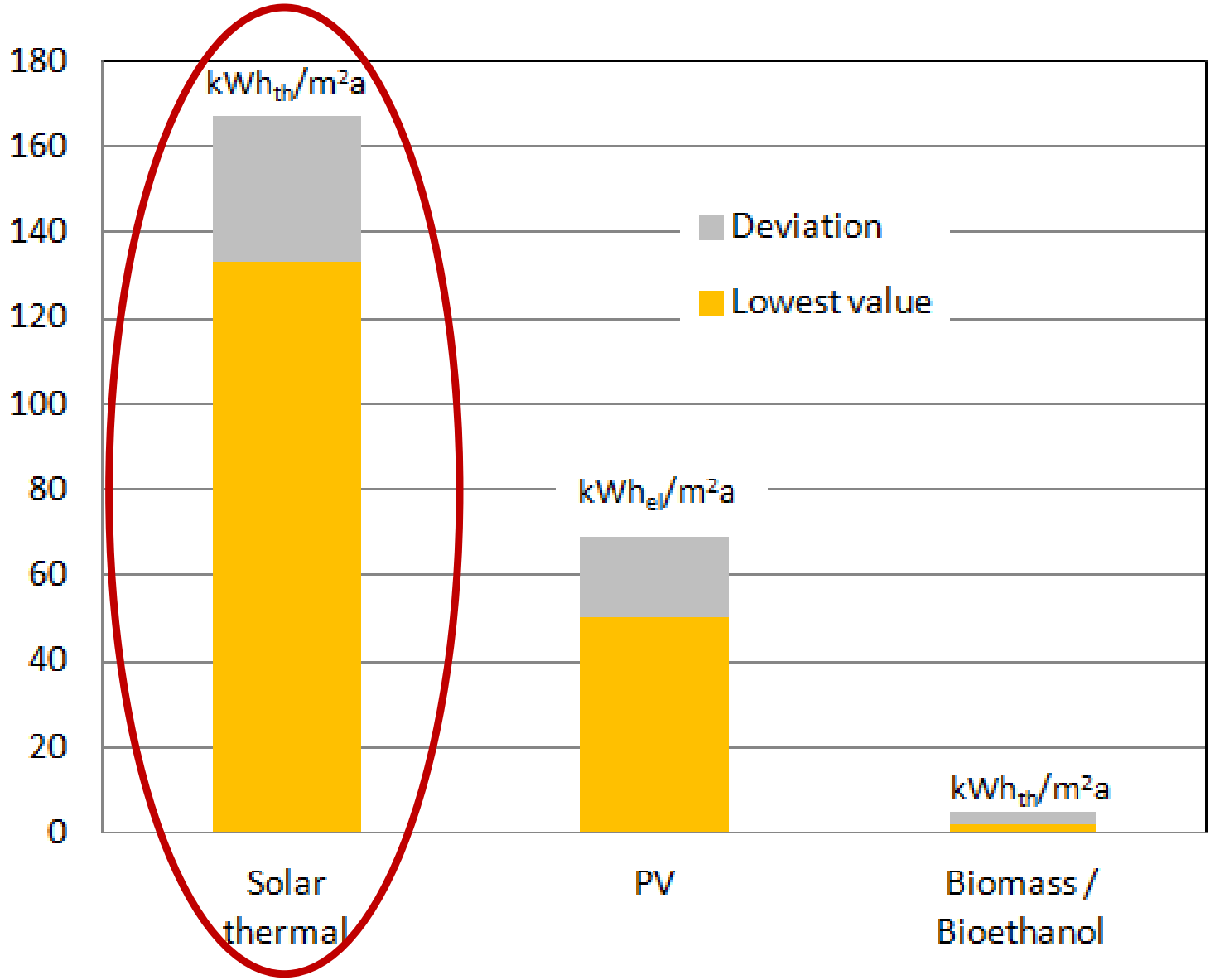
WHY SOLAR THERMAL?

SOLAR THERMAL SHOWS HIGHEST ENERGY YIELD PER SQUARE METRE



3 times as many kWh as PV

43 times as many kWh per m² as biomass

Sources: Frauenhofer ISE, PlanEnergi and Chalmers University,Submitted by Bärbel Epp, solarthermalword.org, July 31, 2017

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BENEFITS OF BIOMASS AND SOLAR

STABILE HEAT PRICE

The DH-plant can reduce it's vulnerability to increasing fuel prices

PLAN SERVICE AND MAINTENANCE

Many plants enjoy a long period of up to 4 months of total shutdown of their boiler, where service and maintenance can be performed

PROLONG THE LIFETIME OF BOILER > 25%

Shutting down the boiler in the summer, keeps it from operating at low efficiency

BECOME INDEPENDENT FROM FOSSIL FUELS

A combination of biomass and solar is the perfect way to avoid using fossil fuels

CO_2 – NEUTRAL ENERGY PRODUCTION

With biomass and solar heating, the production of district heat can become 100% green, to benefit environment and economy

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Why solar energy ?

Low operation and maintenance´s cost

- ***The operation and maintenance is app. 1 – 1,5 Euro/MWh heat produced*.**
- The electricity consumption is app 4 to 6 kwh electricity to produce 1 MWh solar.

Easy in operation and maintenance

- Easy to operate and could run 24 hours unmanned, and could be remotely controlled.
- Maintenance is very limited - cleaning filters and pump inspections

Solar heating is a perfect match to other sources of energy.

- A solar system can be installed in conjunction with any type of heating plant.
- The system is always extendable.

Why solar energy ?

CO2-neutral

- *Solar energy is a good alternative to replace fossil fuel, and reduce the companies carbon footprint.*
- *With biomass and solar the production of district heat can become 100 % green, to benefit environment and economy.*

Stable heat price

- *The District heating plant can reduce it's vulnerability to increasing fuel prices*
- *The price of fuel fluctuates, the price of harvesting the sun will always be the same low price in +25 year. Hence, the larger the part of energy covered by solar heating, the better for the customers.*

Why solar energy ?

Integration into existing system

- *Gives a better efficiency of the total plant (solar water for the city shunt instead of return water).*
- *50-60 °C from the solar thermal could be used for the city shunt or preheating of condensation heat recovery of a boiler's exhaust air.*
- *Preheat the water for the boiler, in periods where the is low solar radiation*
- *It could be 70-80 °C if the solar heat is directly connected to the flow pipe of the DH network (depending of course on the DH network supply temperature)*
- *It could be 90 °C for charging a heat storage. However – depending on the storage – it might also be possible to charge the storage at different temperature.*

Thermal solar collector

Arcon-Sunmark collectors

Data

Outer dimensions	:	2,27 x 5,97 x 0,14 m
Gross area	:	13,57 m^2
Aperture area	:	12,60 m^2
Weight, without liquid	:	250 kg
Fluid content	:	11 liter

Casing features

Welded aluminum frame and back plate
Air vents to reduce moisture accumulation

Insulation

Back side:	75 mm mineral wool
Side:	30 mm mineral wool

30 YEARS OF EXPERIENCE

WE DELIVER HIGH QUALITY AT LOW COSTS

From interest to decision

From decision to green ownership

From ownership to operator

Analyses
2 – 4 weeks

Feasibility study
2 – 4 weeks

Design & dimensioning
2 weeks

Construction of installation
10 – 24 weeks

Commissioning
2 – 4 weeks

Full scale operation
1 – 2 weeks

Service of installation
ongoing

Development with the customer

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Energy calculation

Information needed for energy calculation – Energy demand form

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1. General information

Project Name :

Costume name/company : District Heating Company

Location /City : Riga region

2. Fuel information

Information about current type of fuel:

Type of fuel	Check mark	Price per Mwh (average price last year): MWh -ton- M³ or liter	Price per MWh -ton- M³ or liter	Comment
Diesel oil				
Fuel oil				
Gas	x		26,2 EUR/MWh	
Coal				
Wooden chips				
Wooden pellets				
Straw				
Electrical power				
Other				

If only the consumed quantity of current type of fuel is known, please specify following information for the existing unit:

Type of fuel	Total quantity of fuel	Price for total quantity of fuel	Degree of efficiency
Diesel oil			
Fuel oil			
Gas	24293,50 MWh		83%
Coal			
Wooden chips			
Wooden pellets			
Straw			
Electrical power			
Other			

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3. Energy consumption

Month	Check mark	MWh (3 years average)	Temperature to/from grid		Comment
			Forward	Return	
January		3263,54	80	60	
February		2802,12	80	60	
March		2580,80	80	60	
April		1603,15	80	60	
May		702,77	60	40	
June		574,46	60	40	
July		565,71	60	40	
August		560,03	60	40	
September		602,87	60	40	
October		1735,16	80	60	
November		2400,75	80	60	
December		2772,26	80	60	
Total Energy demand		20163,60			

4. Land / location

Latitude [°N]	Riga region		*(or city name)*
Longitude [°E]			
Area / land available	M2		
Distance from solar field to boiler central	M		*(only if an area is already designated)*

5. Other

Storages tank on location	M^3	
Earthquake zone [yes/no]		

We are interested in following estimates:

1. Performance of collectors MW
2. Investment costs;
3. Maintenance costs EUR/MWh;
4. Solar heat coverage % of yearly amount;
5. Area/ land m^2 necessary for solar plant;
6. Heat storage volume m^3.

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Customer contact

Information needed for energy calculation – Energy demand form

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Total Energy demand		**20163,60**			

Production on the solar plant is highly depending on the following parameter:

- Energy demand
- Solar radiation
- Ambient temperature
- Inlet and outlet temperature

The temperature in and out the solar panels is a very important parameter that has a major influence on the solar production.

Especial the forward and return temperature is very important for the solar production, **for each 1 °C temperature changes, the efficiency of the solar panels, will change 0.5 %.**

Energy calculation

Arcon-Sunmark calculation tool

Plant data

Month	Return [°C]	Forward [°C]	Heat consumption [MWh]	Performance [MWh]	Ambient temperature [°C]	Night cooling [MWh]
January	60	80	5880	0	-3,10	0
February	60	80	4274	11	-3,57	0
March	60	80	4176	173	0,39	0
April	58	75	2550	535	7,15	0
May	57	70	1292	763	12,65	0
June	55	65	1036	862	15,51	0
July	55	65	988	1005	19,23	17
August	55	65	1008	654	17,87	0
September	57	70	1143	427	12,33	0
October	58	75	2728	118	6,92	0
November	60	80	3967	9	2,50	0
December	60	80	5210	0	-1,31	0
			34252	4556		17

Month	Heat consumption [MWh]	Performance [MWh]	Coverages
January	5880	0,098	0,00%
February	4274	10,916	0,26%
March	4176	172,528	4,13%
April	2550	535,370	20,99%
May	1292	762,852	59,04%
June	1036	861,793	83,18%
July	988	1.005,228	101,74%
August	1008	654,497	64,93%
September	1143	427,028	37,36%
October	2728	117,608	4,31%
November	3967	8,505	0,21%
December	5210	0,043	0,00%
Total	34252	4.556,465	13,30%

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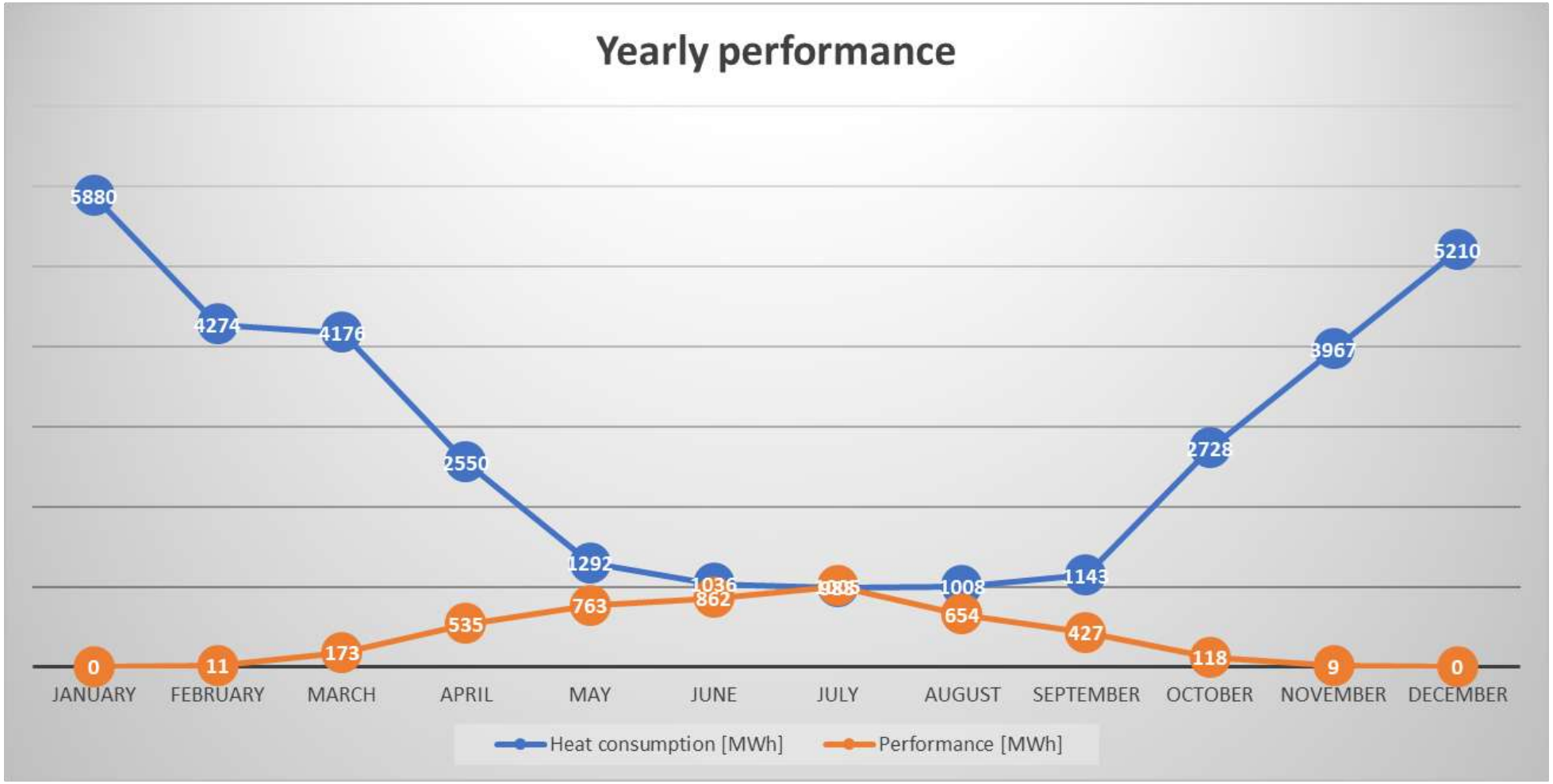
Energy calculation

Arcon-Sunmark calculation tool



Installation

Maximum possible prefabrication of the pipe network in the plant allows reduced installation costs on site and high quality / safety

Installation of the Collectors

Steel Profiles or Concete Foundations

Steel Profiles

The steel profile is manufactured from structural steel S355 with a material thickness of 4 mm and is hot dip galvanized at Arcon-Sunmark's minimum requirement of 80 µm. The solar collectors are mounted on 4 hot-dip galvanized steel profiles which are cut to a depth of 130-160 cm, depending on the characteristics of the ground. The profiles must be placed with an accuracy of +/- 5 mm in order to assure the necessary strength and stability. Steel profiles, in contrast to the traditional concrete foundations, allow unevenness of the terrain up to +/- 150 mm. Alternatively, they enable the solar collectors to adapt to the natural course of the landscape.

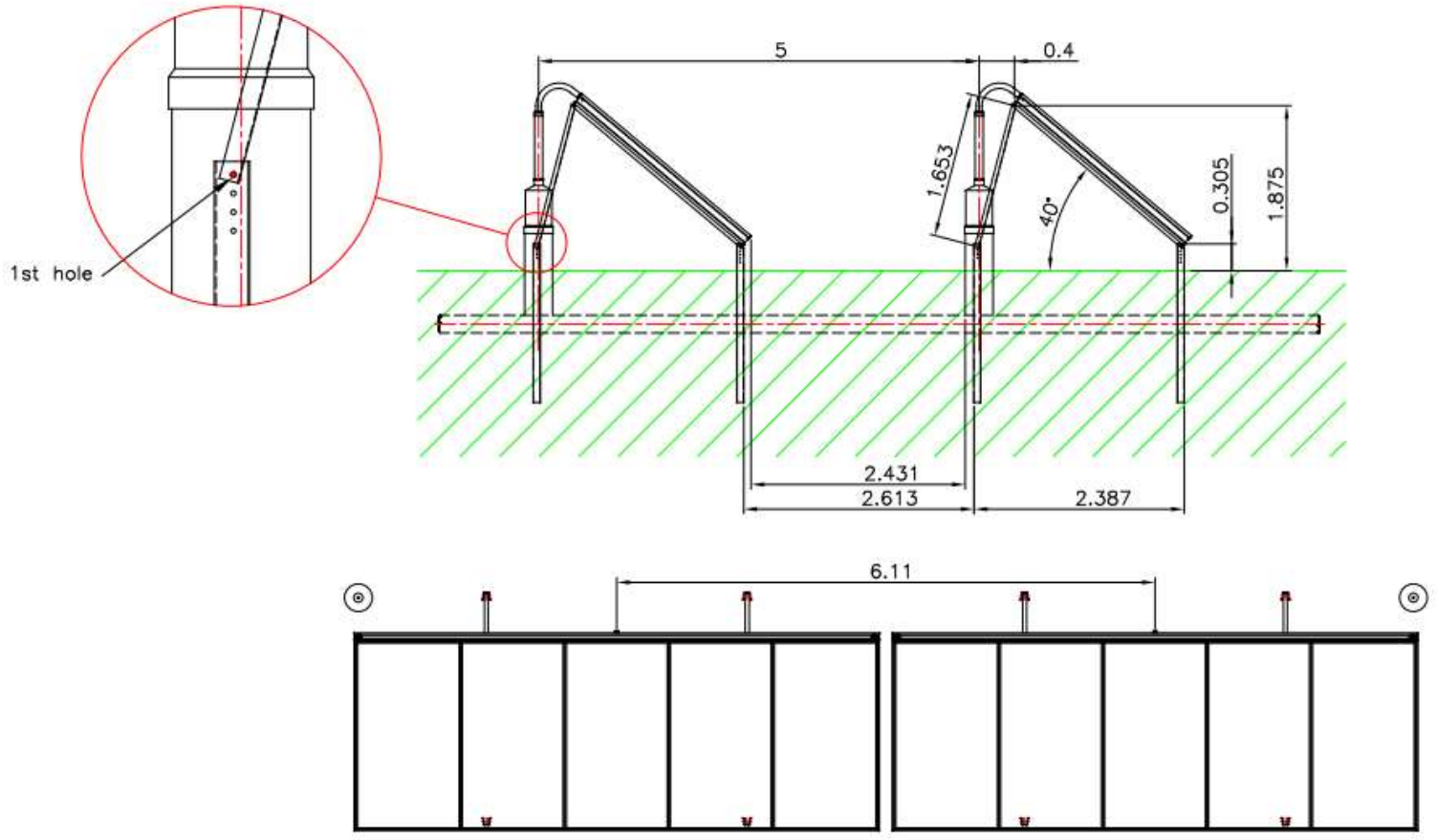
Concrete Foundations

The concrete foundation is made of reinforced concrete and has a length of 2.6 m. The concrete foundations are used on ground surfaces where the hammering in the ground is not possible or allowed. For example abandoned garbage depots

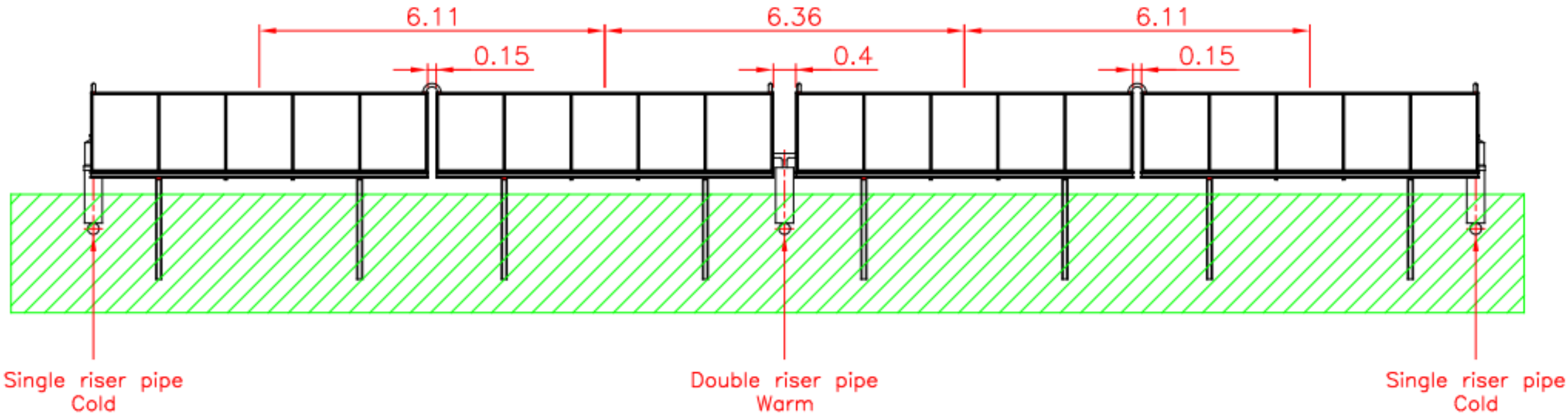
Installation of the Collectors

Efficient and proven installation of the collector field

Solar field layout



Solar field layout



FROM 1.000 – 156.700 M²

MORE THAN 1.6 MILLION SOLAR COLLECTORS INSTALLED WORLDWIDE SINCE 1988

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The world´s largest solar thermal plant Silkeborg, Denmark – 156.700 m².

Silkeborg, DK:

Solar system:	110 MW, 156.700 m² aperture area
Temperatures:	80 - 110°C
Max flow:	2.700 m³/h
Yearly yield:	80.000 MWh ➔ 20**% solar coverage of town demand**!

CHP as balancing and reserve power only

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THE FIFTH WORLD'S LARGEST SOLAR HEATING PLANT, MARSTAL (DK)

32.943 m² solar panels and
75.000 m³ thermal pit storage (2012)
10.000 m³ thermal pit storage (2002)

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Langkazi, Tibet

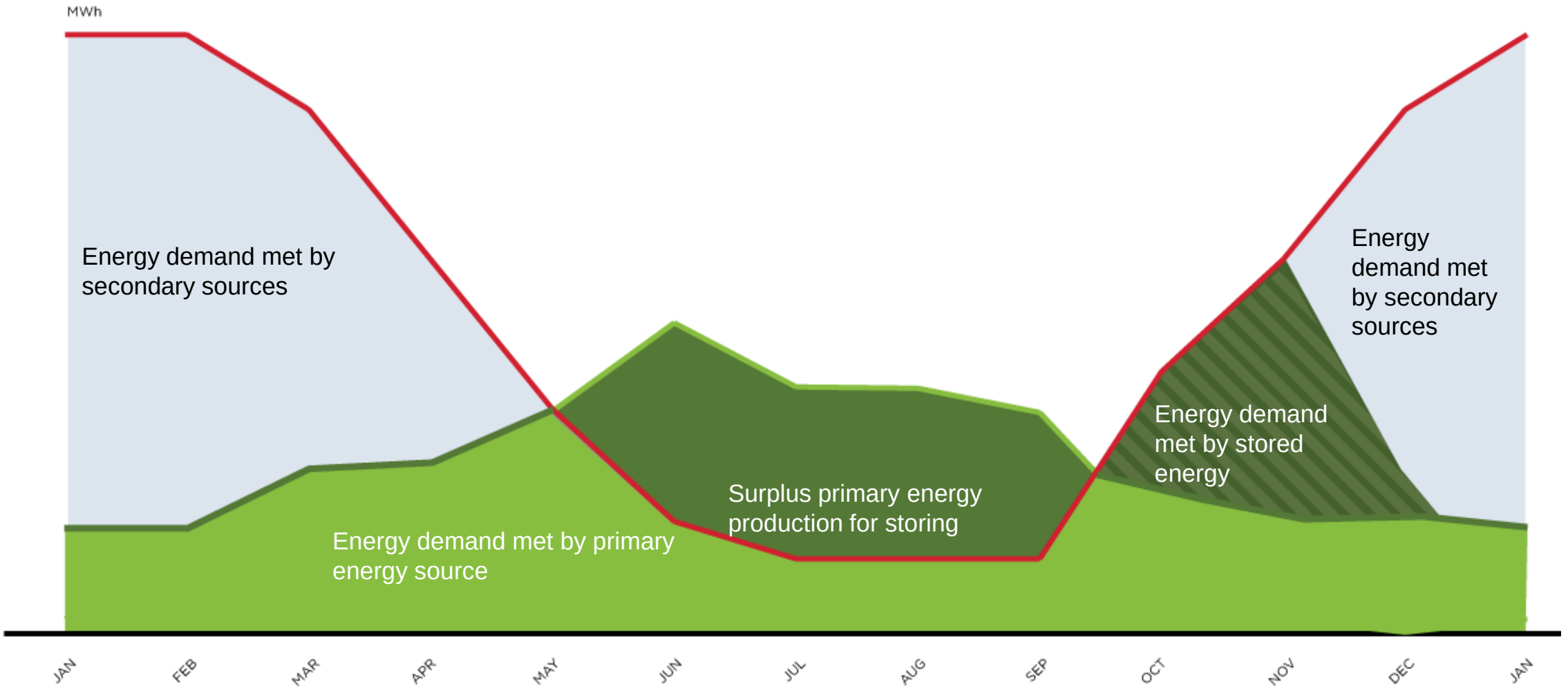
On the roof of the world *(4.700 m above sea level)*

Langkazi, Tibet

On the roof of the world *(4.700 m above sea level)*

ENERGY STORAGE

PREVENT ENERGY WASTE – USE THE ENERGY ON DEMAND



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Storage

Pressure less steel tank as short-term storage to compensate for irradiation and demand (1-4 days)

Seasonal Storage

75.000 M3 Pit Heat storage in Marstal

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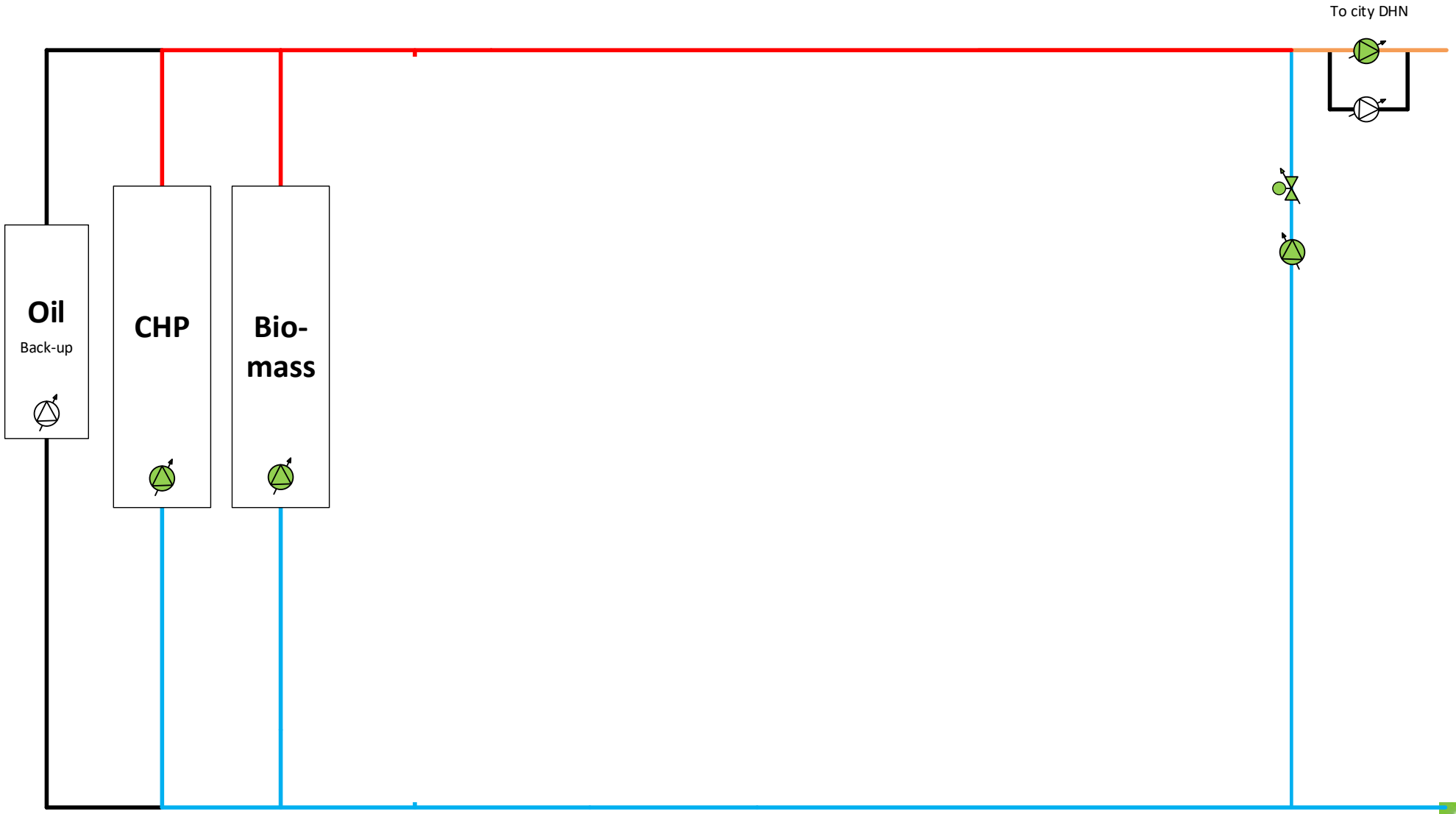
INTEGRATION

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT

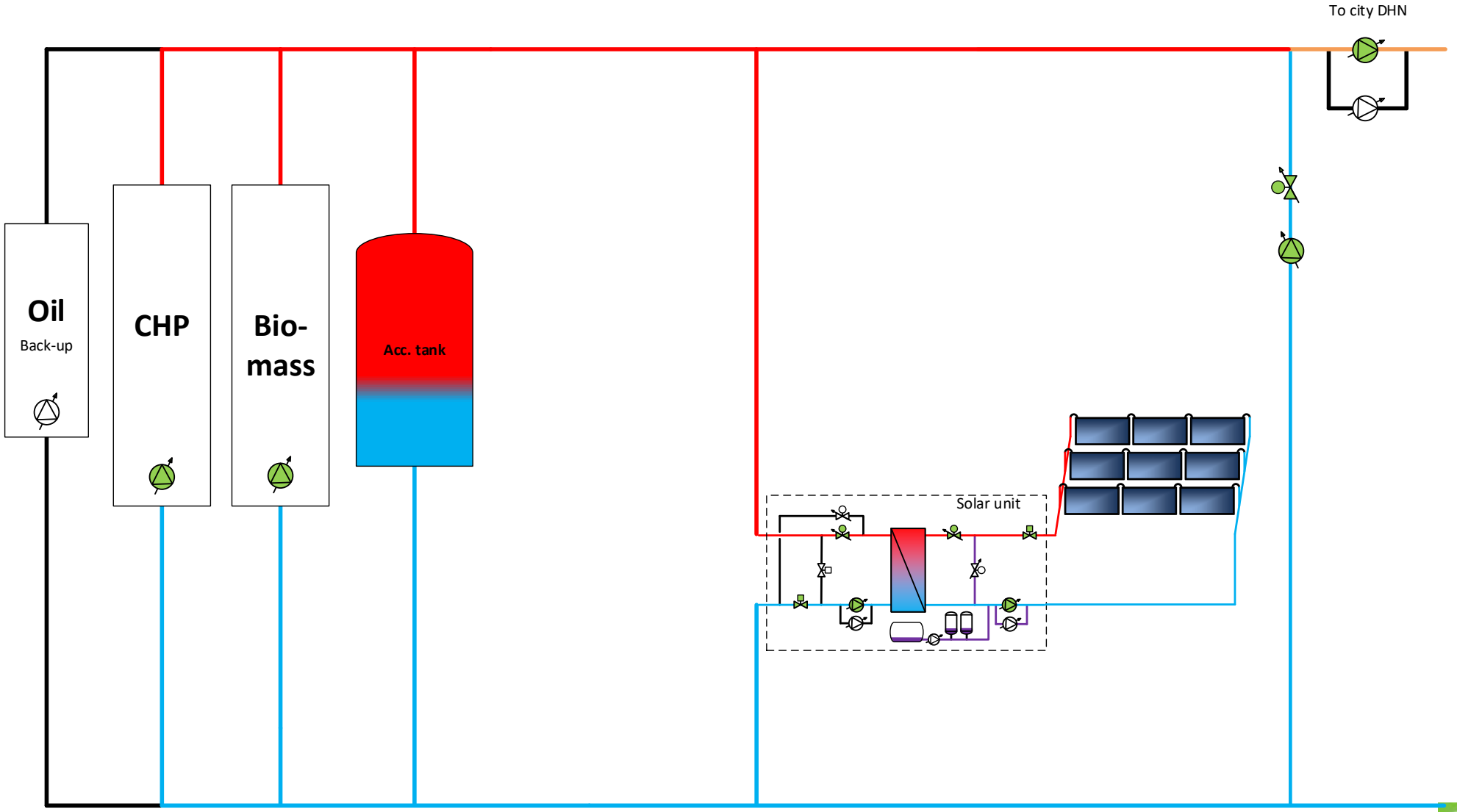
- Analysis of existing plant



INTEGRATION

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT

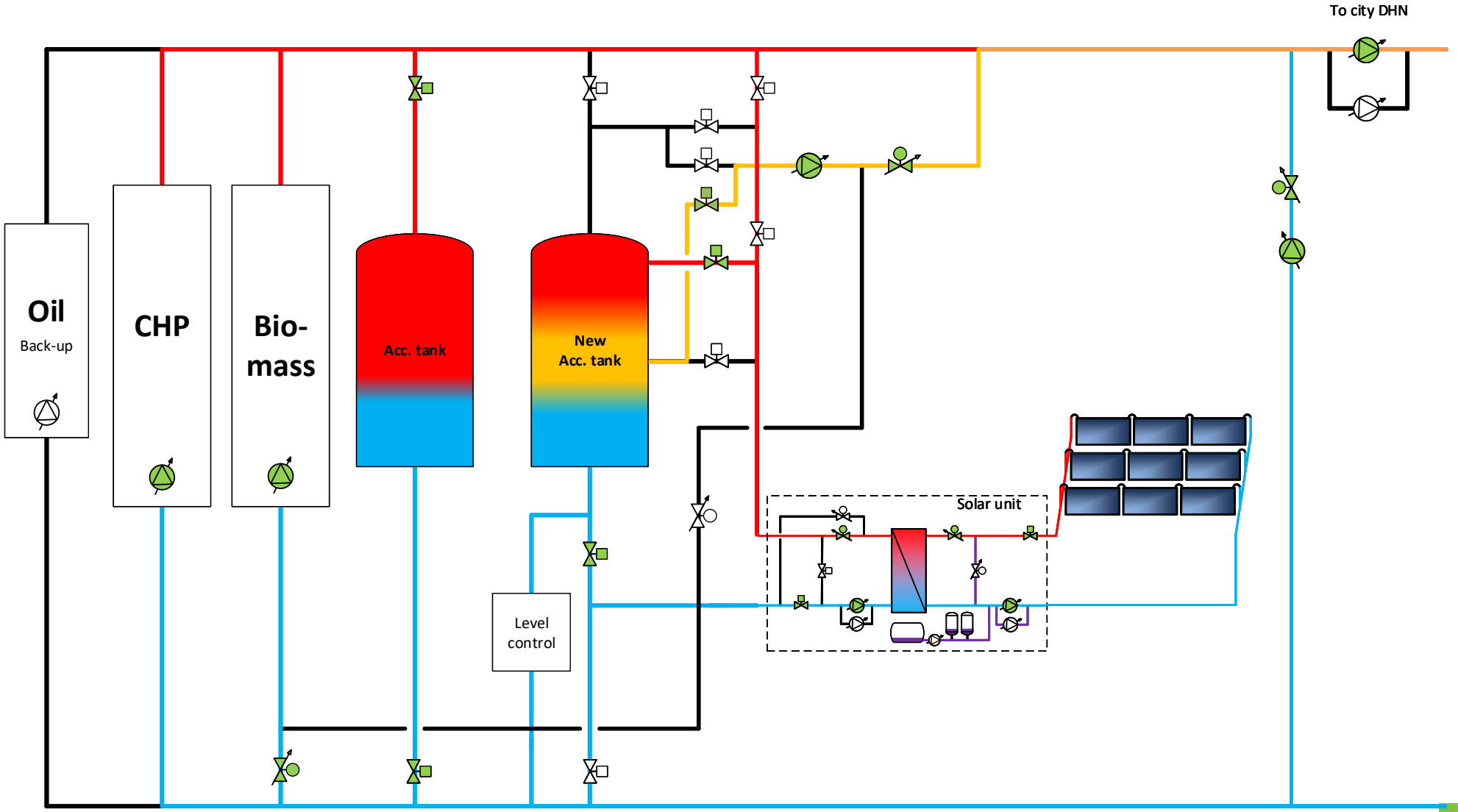
- Simple integration



INTEGRATION

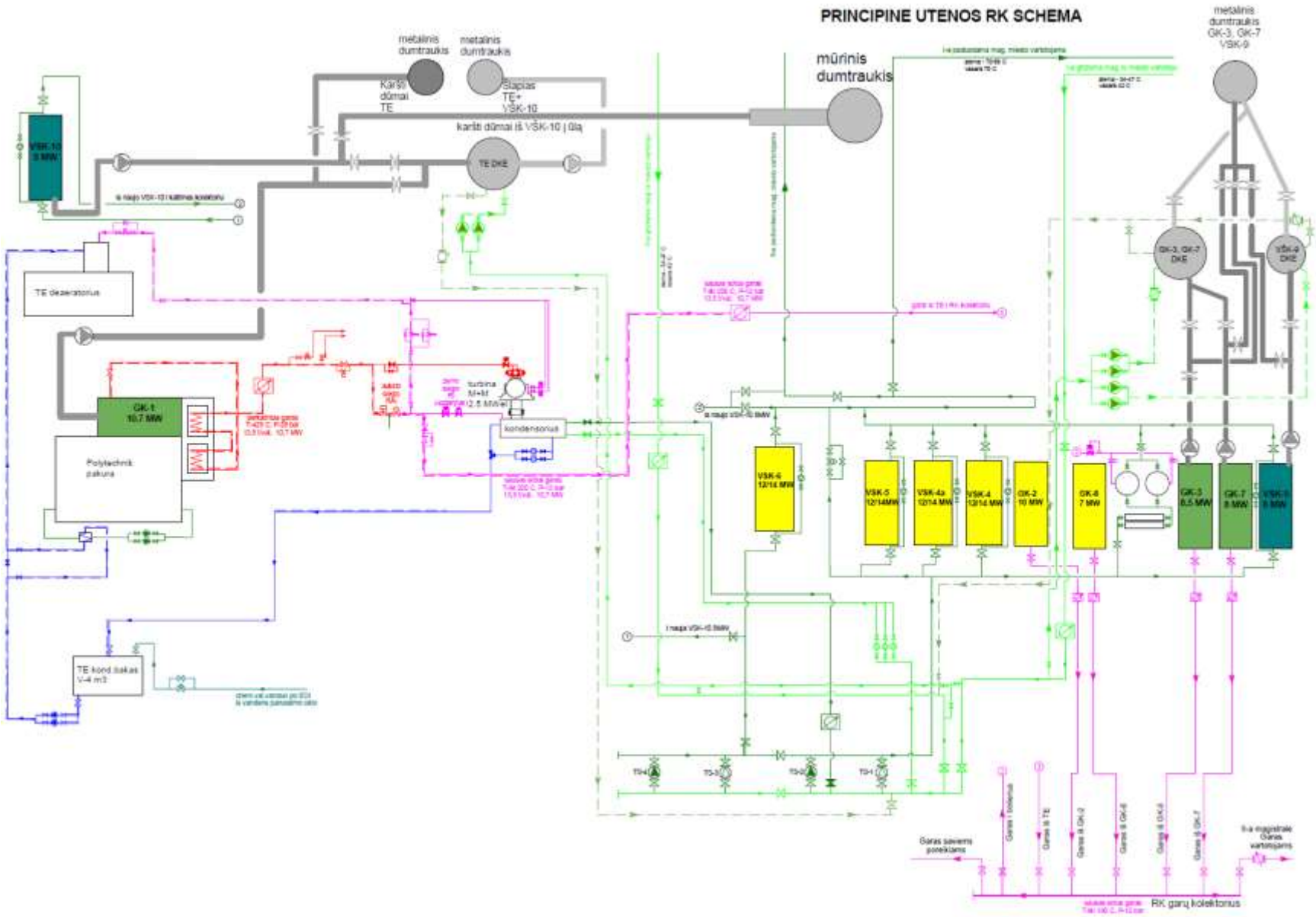
INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT

- High performance & flexibility



INTEGRATION UTENA

INTEGRATION OF A SOLAR INSTALLATION INTO DISTRICT HEATING PLANT



INTEGRATION UTENA

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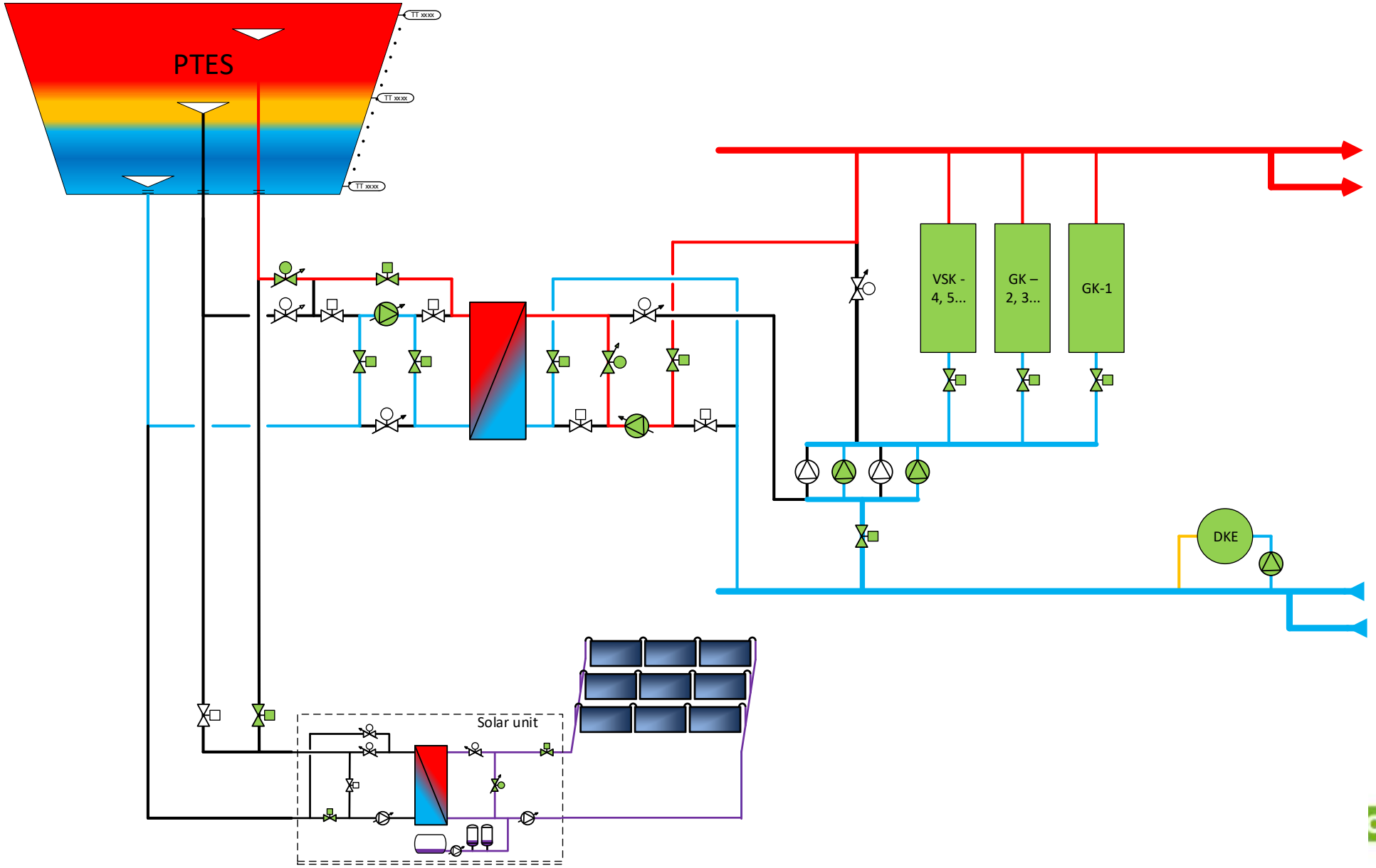


Salaspils District Heating built the first solar plant in Baltic

Salaspils Siltums

Ilze Poļikarpova

20.11.2019.

Heat production, transportation and distibution

Heat networks -20,6 km

Installed heat capacity 34,68 MW

The amount of sold heat: 60 000 MWh/year

>160 customer

Salaspils Siltums

Solar collector system **21 672** m2
Planned to produce **12 000** MWh per year
Calculated peak capacity **14,5** MW

Accumulation tank **8000** m^3

3 MW woodchip boiler
with flue gas condenser

Costs

Total

~7,26 mil EUR

40% EU funding

2,73 milj.EUR

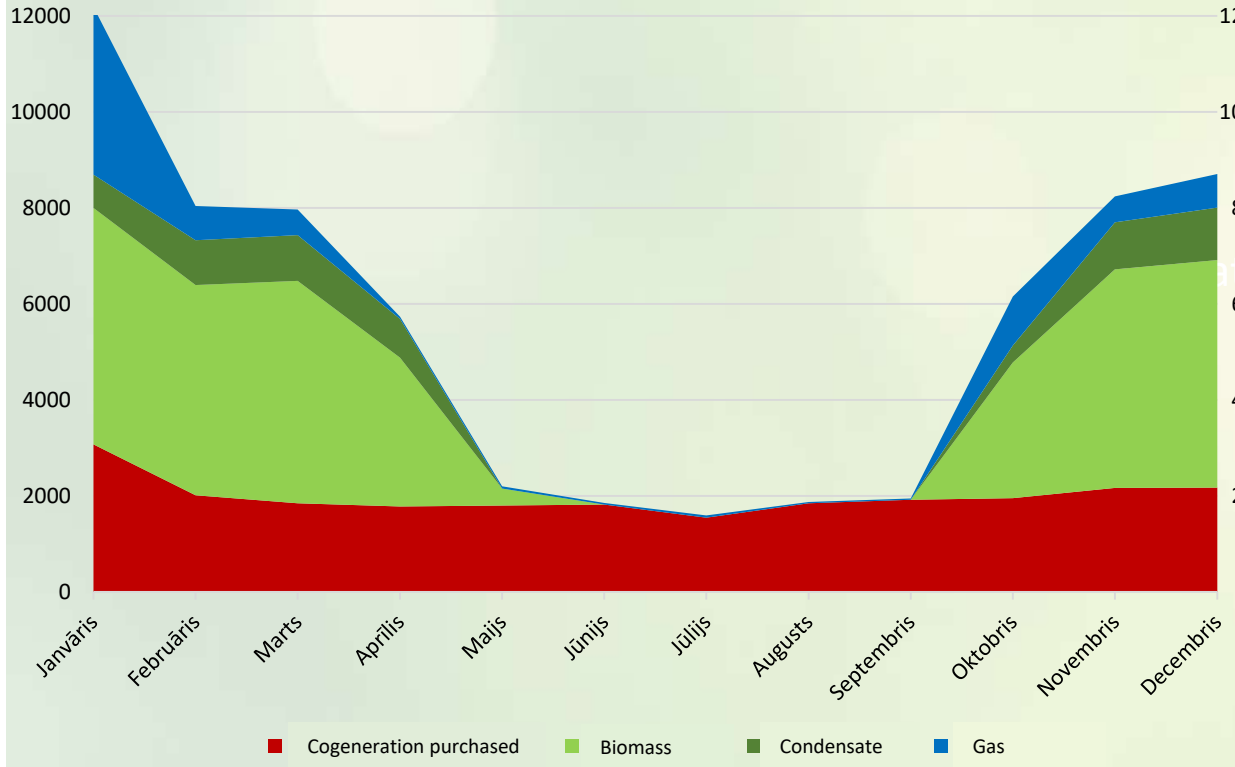
LTD «Salaspils Siltums»

1,78 milj.EUR.

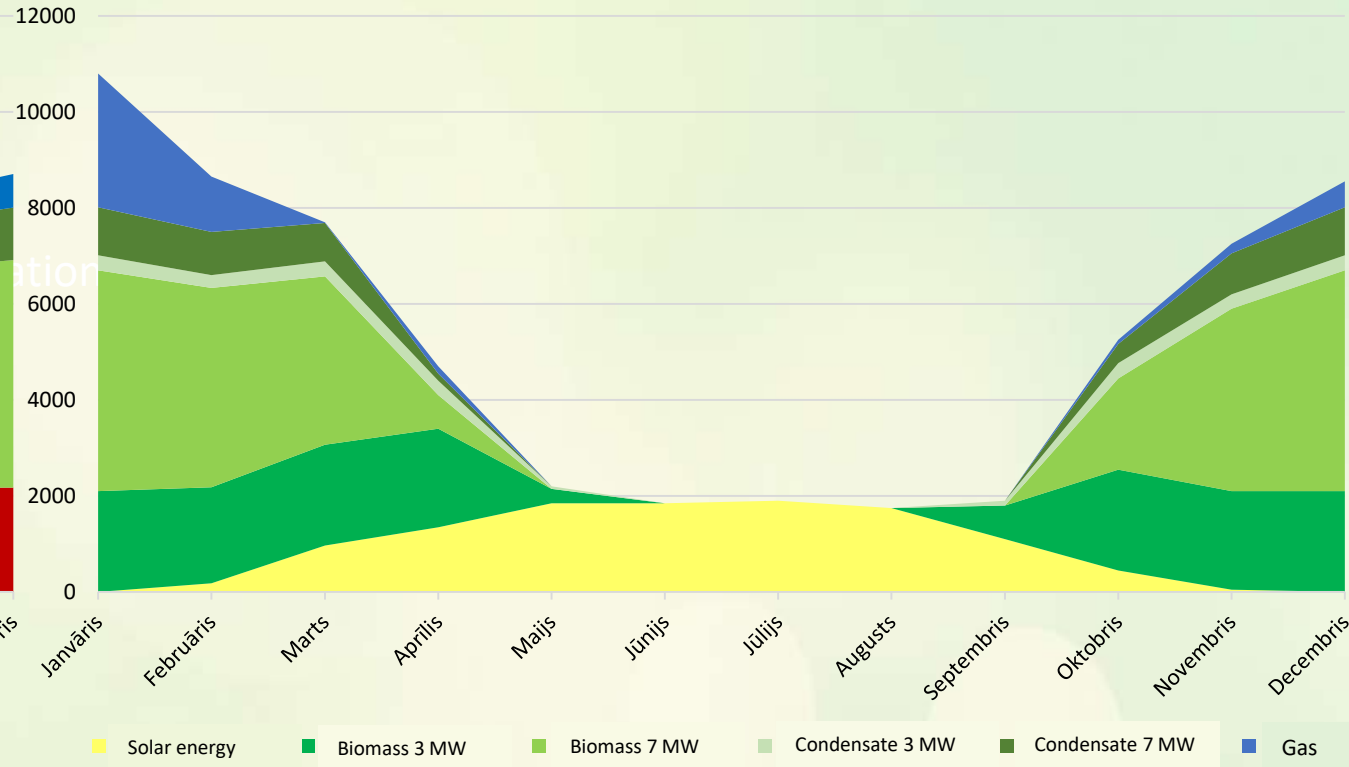
SEB Bank Loan

2,75 milj. EUR

2016

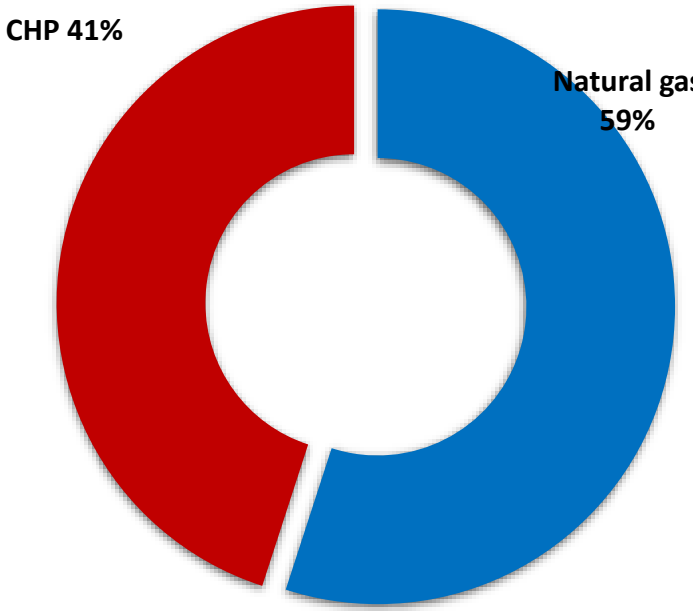


Planned



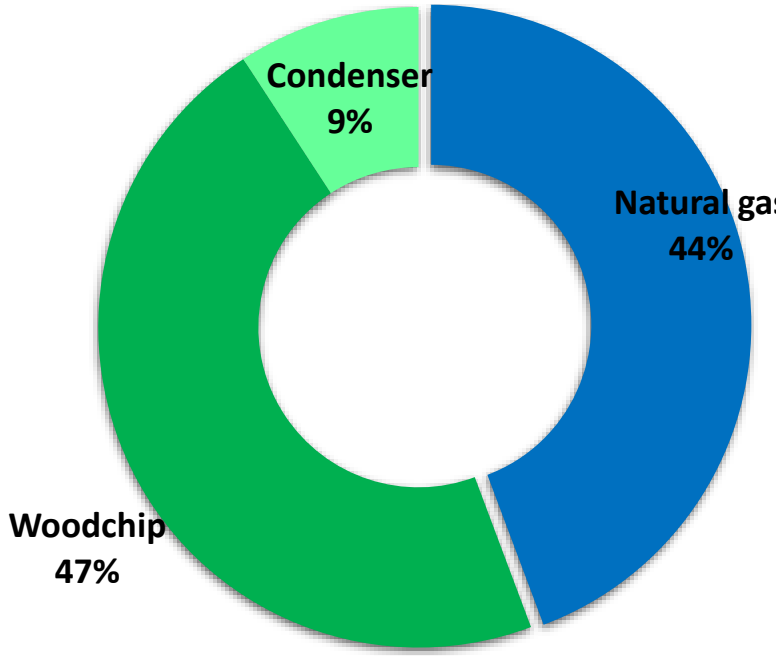
Diversification of fuels

till 2012



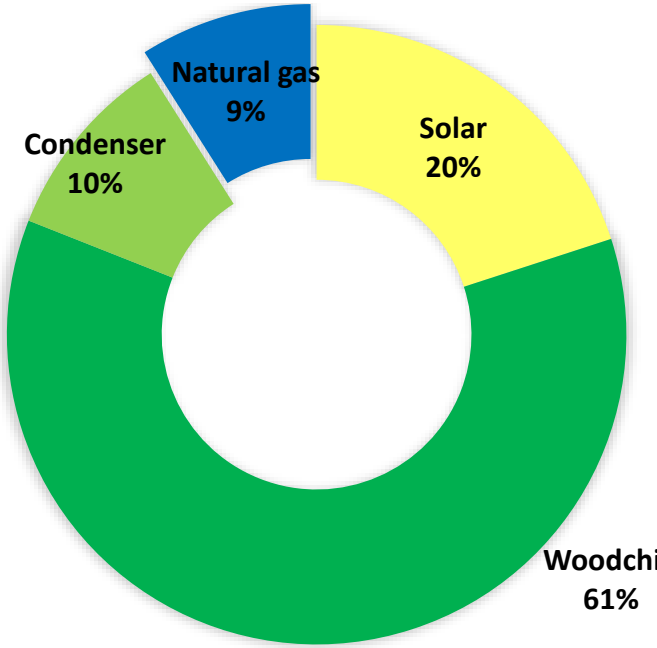
100% fossil fuel

2018



Salaspils Siltums

After project



>90% RES

REFERENCES

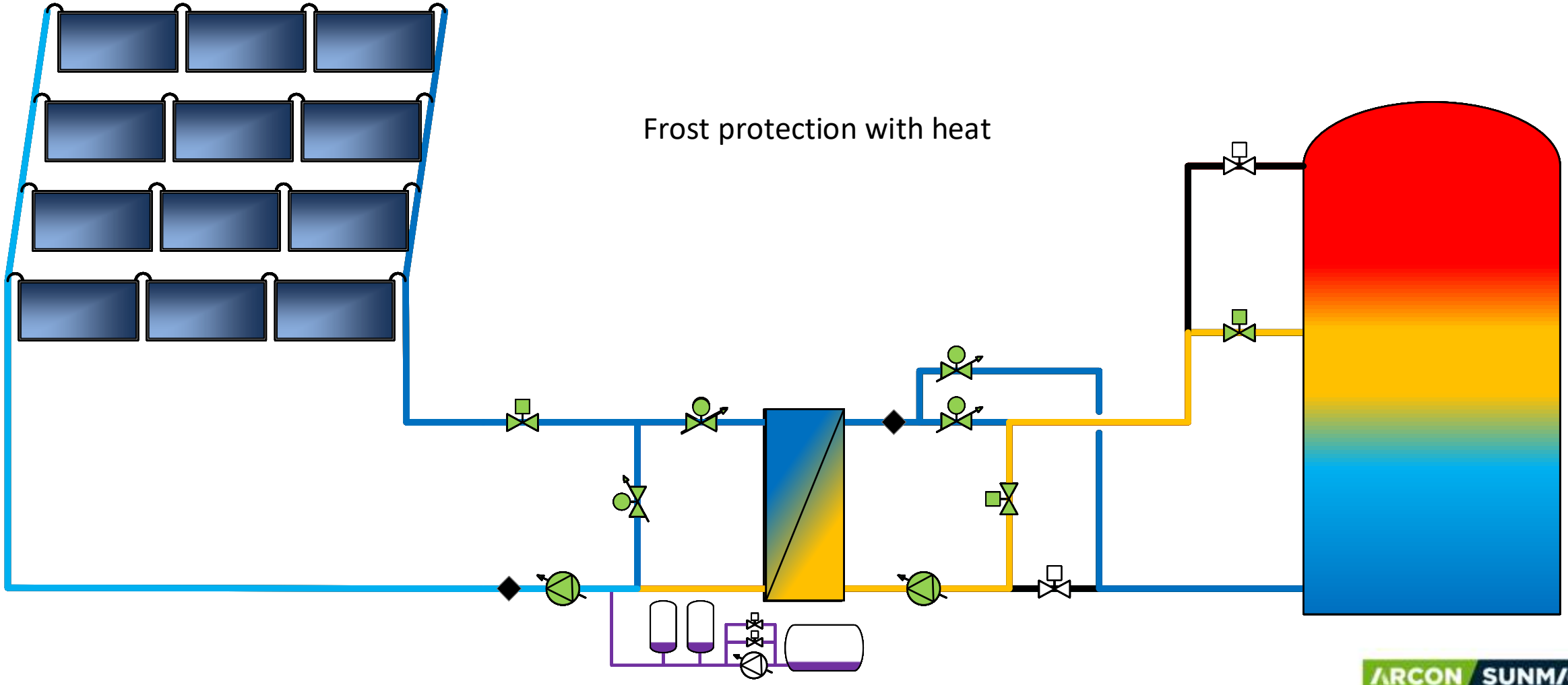
SALASPILS, LATVIA

Solar radiation 724 w/m^2 Solar production 374 w/m^2 Efficiency 52 %

REMEMBER !
There is an end to our resources.

THANK YOU
ARCON SUNMARK

CONTROL SYSTEM

SOLAR OPERATION

- Basic solar operation scenarios