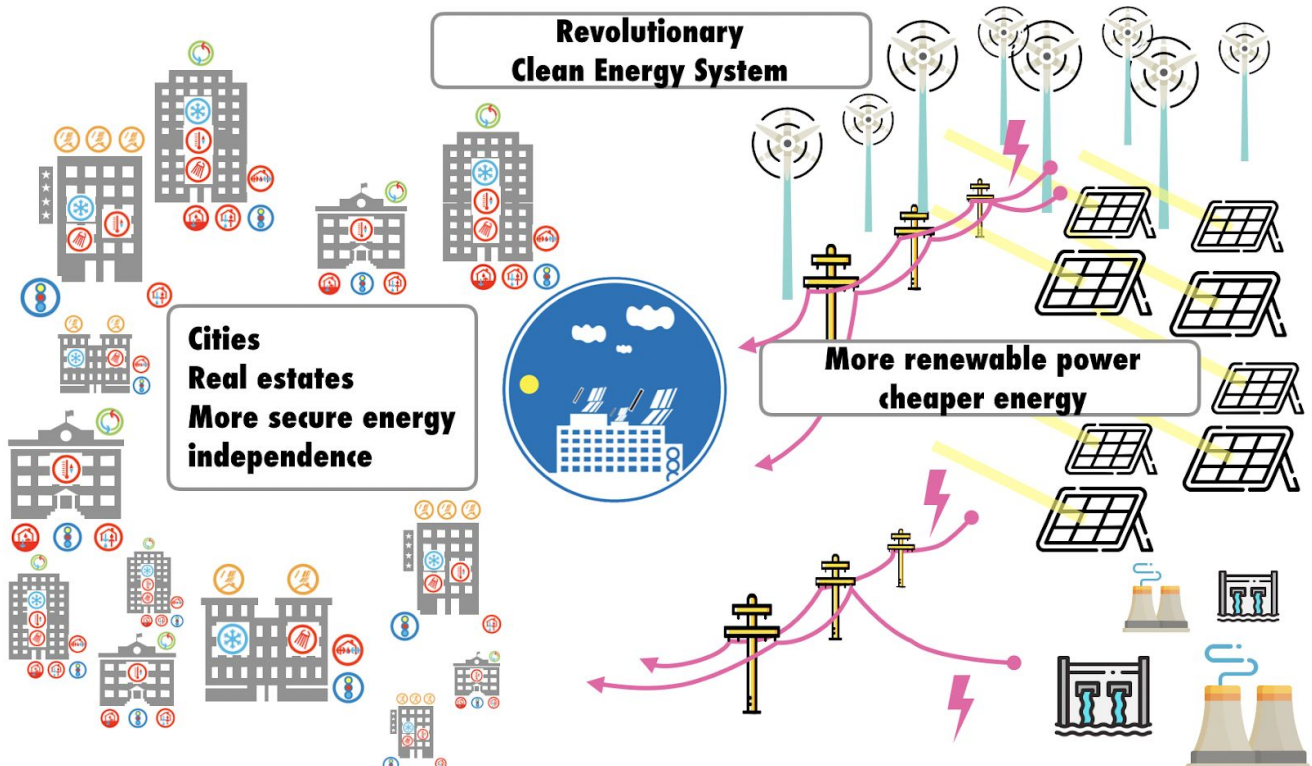
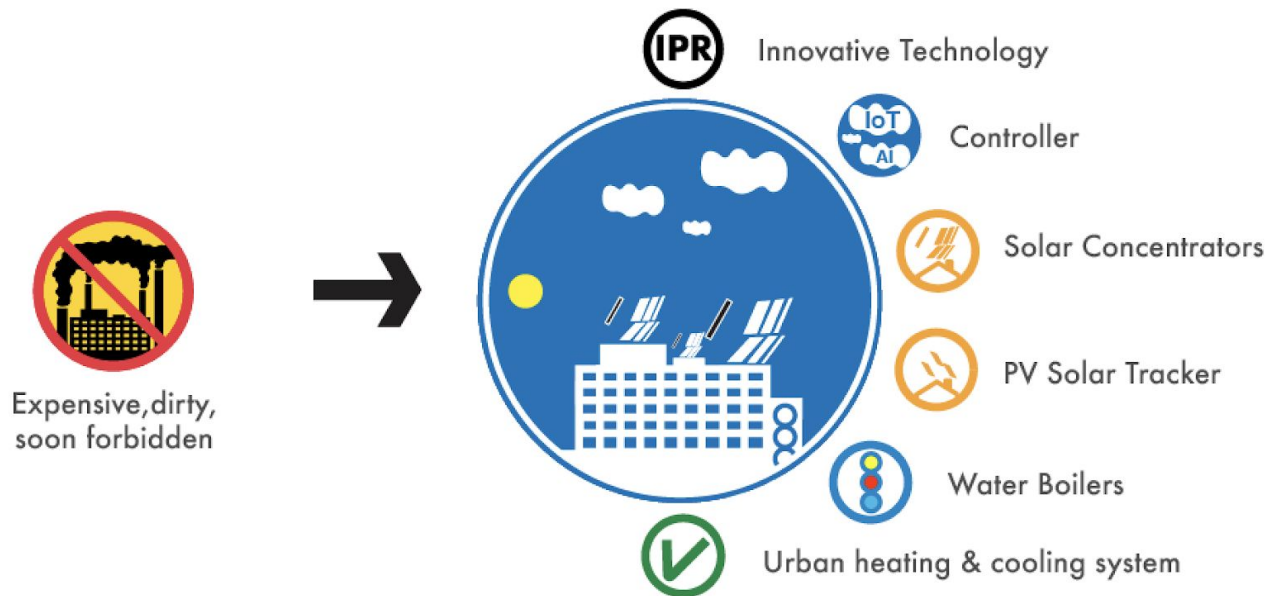




Urban building hybrid heating & cooling system

How to secure affordable clean energy when we need it the most ?



Name of the entity	Solixi Ltd, Limited company	Country
Creation date	02.11.1994, Solixi 19.09.2016 ->	Finland

Acronym: Solixi Energy System

Index

This is a public version of Solixi's [EU Horizon EIC SME2 Blended Finance](#) funding application €15M, made in accordance with the [template](#) and regulations, submitted on October 9th 2019 and updated in February 2020.

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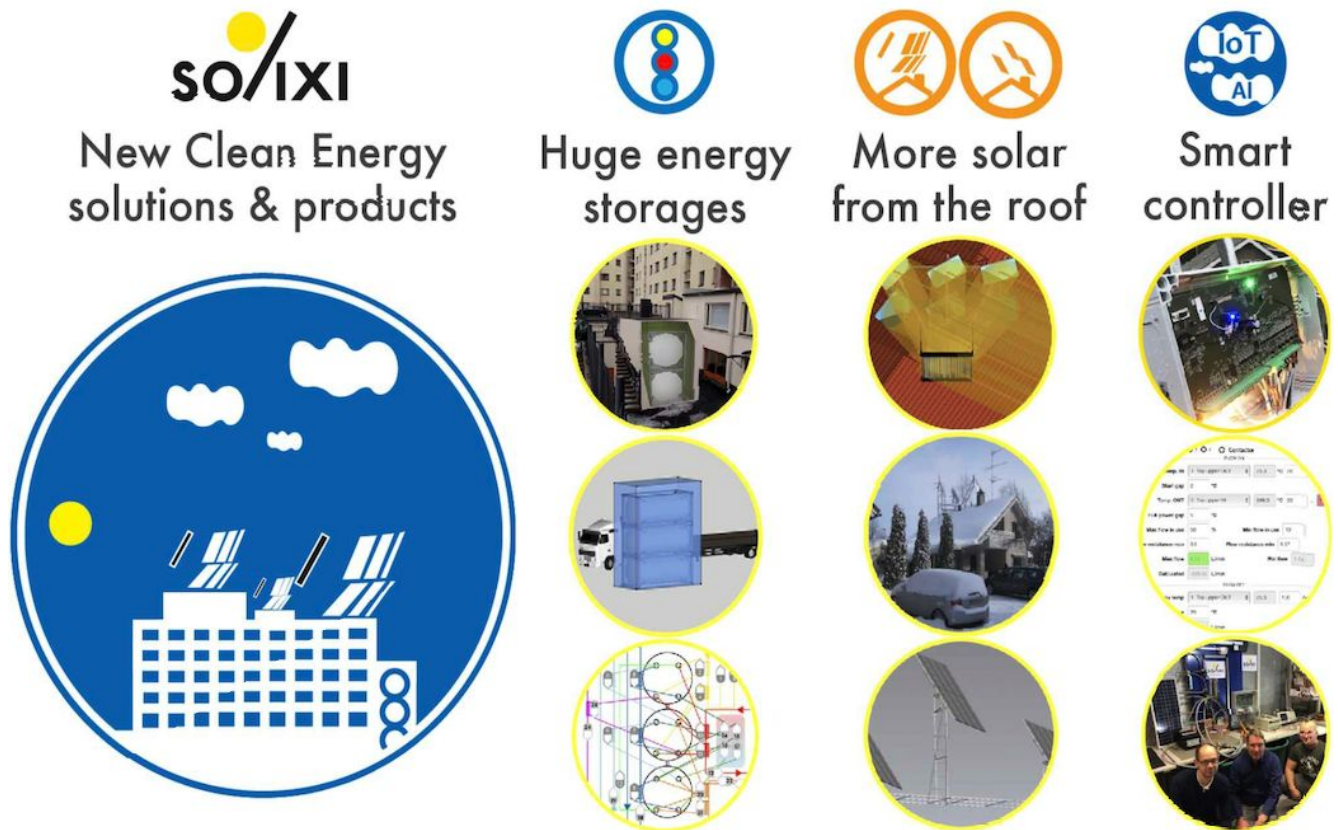
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0. Introduction, Company Description, Summary in 200 words:



Solixi consists of a number of new and unique technologies that have been developed for over a decade

Three core product lines are protected by two patent families.

Scalable **MWh-class energy storage** capacity and low cost are value propositions that no other technology can provide. **Solar Concentrators** produce hot water and orientate rooftop solar collectors and mirrors towards the sun, enabling hot temperatures all day long during all seasons. All devices can be steered by unique **AI & IoT Controller**. Improvements are usually 10 to 100 fold, with payback times of a few years.

The efficiency and profitability of devices already on the market will be lifted to a new level; heat pumps COP, heat recovery price, energy efficiency, grid stability and security.

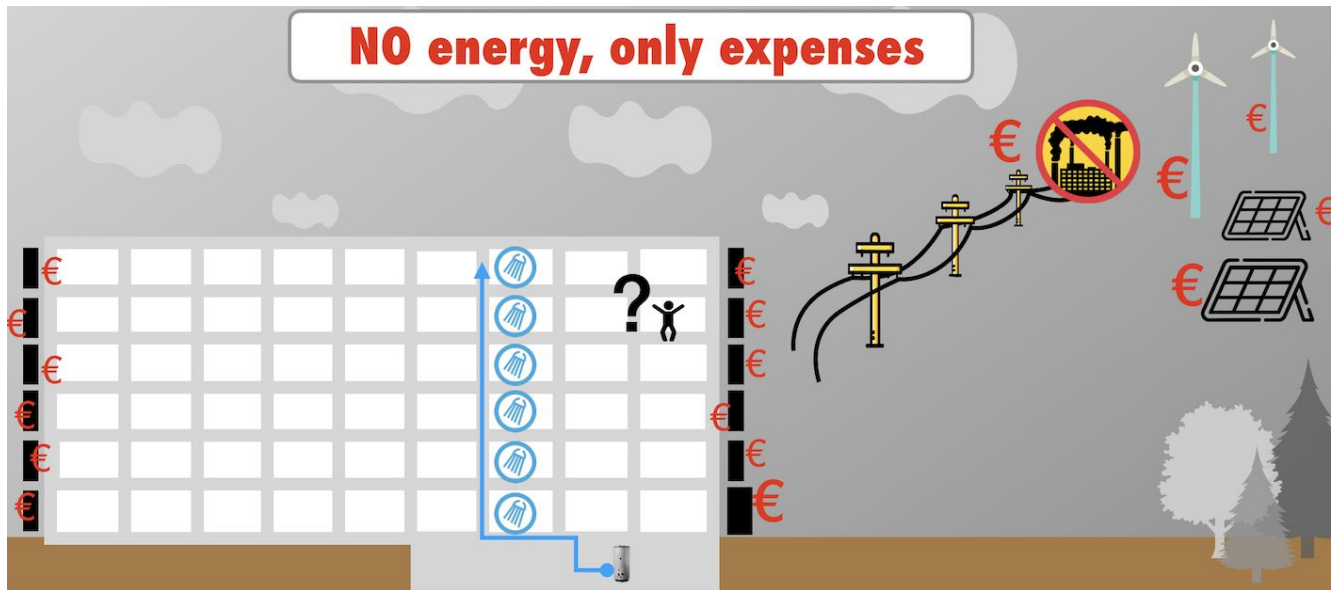
Another increase in profitability can be achieved with Solixi heat pumps and other advanced and integrated Solixi devices.

Solixi fits for any building and conditions. It solves the major challenge of modern and future energy systems; fluctuation in wind and solar power generation. Solixi is the key solution on the road to safe, affordable and clean energy.

The strategy is to license and launch new products through serial production and a large partner network.

SECTION 1 - EXCELLENCE

1.1. Idea, Challenge and Solution, Overview

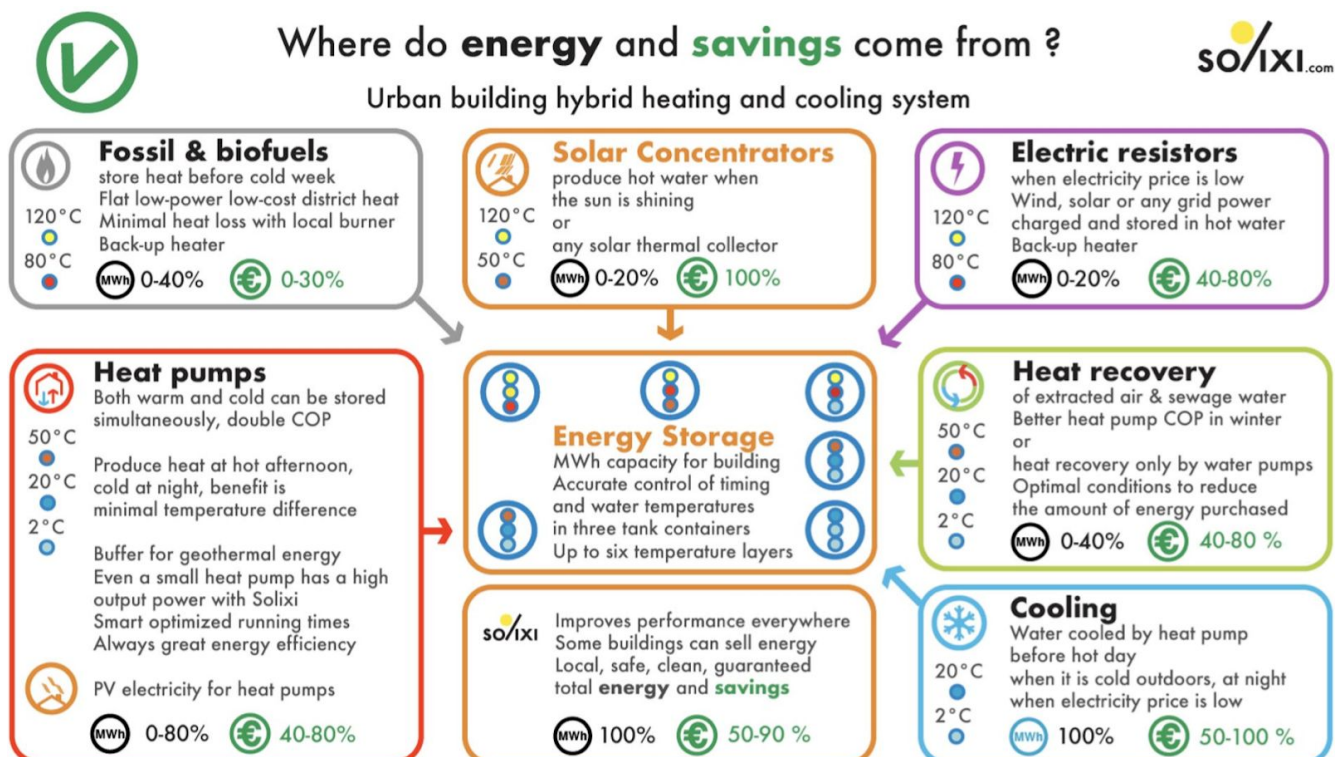


The key **challenge and problem** is (Image above); How to secure energy when the wind and solar power supply is low and consumption high? How to replace the control power that was previously obtained by burning fossil fuels and is no longer an option? How to get production to meet consumption? How to do it profitably? How to ensure the functioning of society and stop emissions in a few years?

100% clean and sustainable urban heating and cooling has not yet been accomplished.

Timing: **Climate change** is the most significant **environmental** and **economic** challenge of our time.

Solixi has everything cities and societies need, a **system level solution**:



Innovativeness: The solution is a hybrid system. In the table above, the total energy (MWh) is up to 220% and 100% is enough, so the **most suitable options for each building** can be selected (1.2.). When the system is smartly optimized (1.5., 1.20., 1.21.), **total annual savings are 50-90%**;

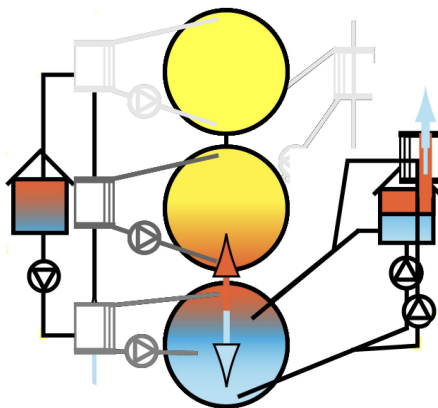
[We recommend to watch the 5:20 min video to get a quick overview of the system, click here.](#)

In the centre there is a huge water boiler, a **thermal energy storage** (1.3.). The water is heated and/or cooled by various devices like heat pumps and electric resistors that will change electricity (solar and wind) to thermal energy.

The old-school way is to heat water by **fossil fuels**, that can be at least partly replaced by **biofuels**. This is an option also in Solixi's solution, although it should be minimized. The widespread use of biofuels is not environmentally friendly. The old-school cooling method is an **air-to-air heat pump** and low energy efficiency in the middle of a hot day.

It is simple to heat water by rooftop thermal **solar collectors**. Unfortunately, the sun usually shines when the need for heating is minimal. Sun radiation is mainly heat and the efficiency is high. The energy yield and water temperatures will increase significantly by **Solixi's Solar Concentrators** (1.4.). Even weeks (months) of sunshine and thermal energy is stored in a large water tank (and soil). The rotating mirrors in the Solar Concentrator frame can be changed to PV panels, the result is **Solixi Solar Tracker** (1.6.). It enables efficient electricity generation from almost anywhere on the roof all day long.

Electric resistors (1.10.) easily heat water to hot temperatures. These are an obvious part of the system and are used when electricity price is low or even negative. Solixi has created an electric resistor that fits perfectly into the system.



Heat pump is the most efficient method to convert electricity to heat. Heat pump is not an energy source as the sun is and outcome is always both warm/hot and cold. Usually the other is waste and removed. This does not have to be the case with Solixi, both can be stored and used when needed. All water heat pumps, old and new, are compatible with Solixi; Air-to-Water, Water-to-Water and Geothermal Heat Pumps. They all benefit from Solixi because runtime and temperatures can be optimized. Solixi has designed a heat pump that fits perfectly into the system. It dramatically lowers the cost of investment and brings more flexibility and new features that further improve efficiency (1.11.).

Heat recovery (1.14.) reduces the need for external energy. Huge water volumes and accurate control of timing and temperatures make the Solixi system very simple and affordable. Solixi can design and

manufacture heat exchanger that fits perfectly into the system.

Air conditioning and cooling is vital because heat waves intensify. Solixi can store huge amounts of cold water to be used during the hottest moments of the day and secure affordable cooling.

Solixi improves the performance of all these functions. Each unit has optimum operating temperatures. All of them can be optimized at the same time, as the Solixi water boiler can have up to six temperature layers. All sectors are compatible with water boiler equipment already on the market. An old and small water boiler can be replaced with Solixi's big water boiler and continue to use equipment that has already been installed. These devices can also be replaced with better ones made to work as part of the Solixi system.

Hybrid systems are complex. Manual adjustment is not an option as conditions are constantly changing. **IoT & AI controller** (1.5.) make the Solixi solar concentrator and the large Solixi boiler to work. It orientates the mirrors and optimizes charging and discharging, dozens of water pumps and flow rates. Heat circles are automatized. **Solixi controller integrates devices to function as a system;**

1.2 Innovativeness, system and product index, TRL

The Solixi system as a whole is the most important **innovation**. Several pilots in Finland and China, prototypes and large R&D teams. Dozens of images and drawings are included in the details below.

Three core innovations

and [product lines](#). Patents see section 2.5. **Technology Readiness Level is 6-8 (depending on the model)**;

1.3. [Solixi Water Boiler](#), TRL 7-8

1.4. [Solixi Solar Concentrator](#), TRL 6-8

1.5. [Solixi Controller](#), TRL 6-8

Add-ons:

Innovations accelerate the development of other products and solutions. **Solixi has innovated a lot of improvements and useful devices**. Some of these are already tested in prototypes and **piloting already made (TRL 4-8)**. Parts may require some research and testing in various environments and buildings as part of the system, or **may also be TRL 9 products**, already installed or existing equipment provided by any dealer;

1.6. [Solixi Solar Tracker Frame](#) (The same controller and frame as in Solar Concentrator C46)

1.7. Solixi thermal collector

1.8. Solixi water pumps, temperature sensors, intelligent heat circles

1.9. [Solixi manifolds and flexible hoses](#)

1.10. Solixi Electric Resistor

1.11. Solixi Heat Pump

1.12. Air-to-water Heat pumps

1.13. Geothermal heat as seasonal storage

1.14. Solixi Heat recovery, heat removal

The use of unknown components complicates system standardization, maintenance and modeling and not all benefits may be achieved. For this reason, Solixi strives to maximize the number of its own parts by affordable **serial production** and set clear boundaries. The clear boundary is the heat exchangers between the building and the Solixi water boiler. In short, Solixi system is outdoors and heat exchangers transfer hot or cold water to the building. **To model and calculate the whole system**; sizing, economy, savings and emissions (need to burn something to create heat) Solixi has developed **a web calculator**. The result of the metering and automation is **Solixi Control**, a way to compute the system for Resilient and Smart Cities:

- 1.20. Solixi [web calculator](#)
- 1.21. [Solixi Control](#), Resilient and Smart Cities
- 1.22. **Steps planned to take Solixi system to the market**, serial production, risks

1.3. Solixi Water Boiler

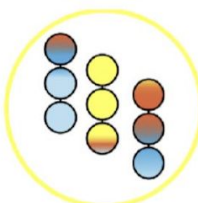


How to lift a water boiler to a new level ?



Innovation - three tank containers

Volume **150 m³**
 Price 76.500€
 Capacity **15.000 kWh / 15MWh**
 Price/capacity **5€/kWh**
 The value of stored energy **750-1500€**
 Temperature range **0-120 °C**
 Heating, Cooling, Energy efficiency,
 Grid power stabilizer
 Outdoors, insulation **30-60cm**
 Payback time **1-4 years**



Regular water boiler



Volume **0,5 m³**
 Price 2000€
 Capacity **20 kWh**
 Price/capacity **100€/kWh**
 The value of stored energy **1-2€**
 Temperature range **20-80 °C**
 Heating

Indoors, insulation **1-10cm**
 Payback time **10-30 years**



When the capacity is 15MWh and 6MWh of it can be used daily,
 annual energy transfer is 6MWh x 365 = **2,2GWh**

When there is fluctuation in energy price, outdoor temperature or consumption,
 smart energy storing can save 50% - **every second GWh is for free**

On the left Solixi's innovation in numbers. On the right is a regular indoor water boiler tank in numbers.

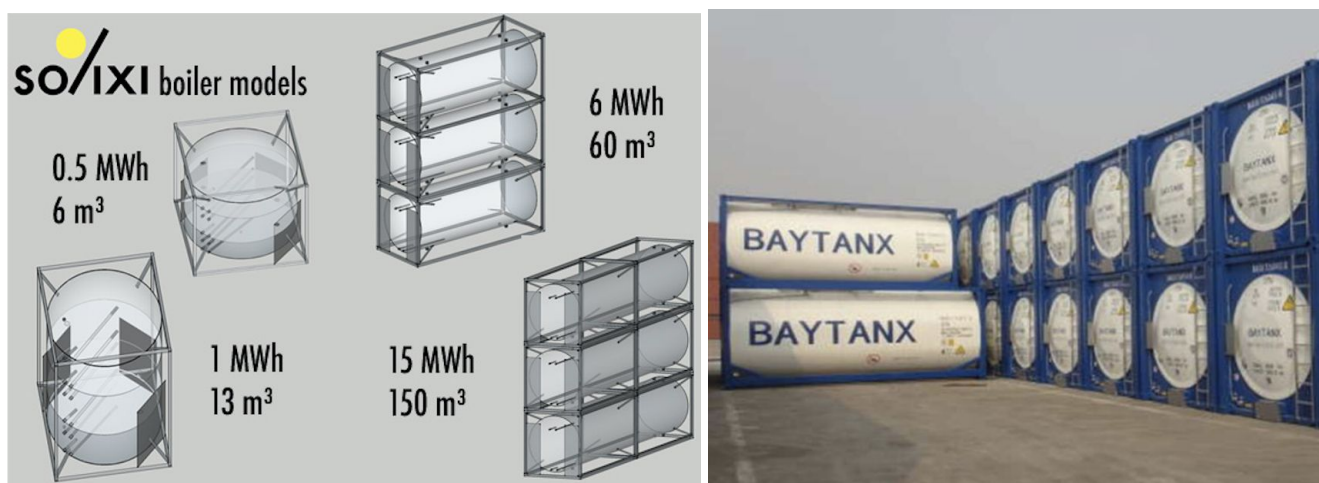
Improvements are 10 or 100 fold and even more (not 10-100%)! This is a real **game changer**;

	Solixi 15 MWh	
Price	76.500€	Including margins, tax 0%
Capacity	15.000 kWh 15 MWh	Temperature range 85°C, 150m ³ Max. water temp. 125°C
Price / capacity	5€ /kWh	
Annual cycles	150	Approx. 6 MWh daily charge / recharge. There can be 50-700 cycles per year
Annual energy transfer Heating and cooling	2.200.000 kWh 2.2 GWh	Low-cost electricity consumption is 5-20% of heat and cold production
Storage price / year	0.03€ /kWh	30€ /MWh
Storage price / 10 years	0.003€ /kWh	3€ /MWh
Maximum power	1.000-30.000 kW 1 - 30 MW	Depending on the power of the water pumps
Payback time	One year	Electricity price fluctuation and saving 0.03€ / kWh /charging cycle
Savings in 10 years	700.000€	Incl. maintenance etc. 75.000€
Space requirement with insulation Sizing	width 3m length 13m height 8,5m	Underground / a few parking spaces 150-500 residences 500-1500 occupants

Capacity and profitability can be enhanced by Solixi Controller, Solar Concentrators and other devices.
 Compare numbers with any battery or energy storage - Solixi is Super.

- Price to store energy drops to a fraction, **price €/ kWh is reduced by 80-95%**
- Volumes in cubic metres, not litres.
- Temperatures change between 0-120 °C instead of traditional 20-70 °C.
- Three compartments, store hot and cold simultaneously.
- Minimal heat losses. The uniform insulation thickness is tens of centimeters instead of centimeters. It is close to the building.
- Completely outdoors, can be underground and invisible, scalable, saves indoor space
- Quick and easy installation outdoors.
- Safe, no water or steam damage indoors.
- Transportable, standard container logistics, manufacturing, services
- Charging cycles do not affect capacity
- Lasts for decades, renovation and maintenance is normal routine ISO standard

Why tank containers? A little bigger is very difficult to transport, container logistics is the basis of all the logistics in the world. A slightly smaller diameter container would lose much of the capacity as the volume drops to a third potency. Half a million tank containers have already been manufactured. A robust and long service life and strong TRL 9. All is standardized. It is very affordable. They are easy to install, all you need is a solid foundation and an insulated hut to cover the pile of containers. Tank containers are the most expensive part of the energy system, accounting for about 30-60 % of the total Solixi investment (3.6).



[6 and 15 MWh](#) are modified tank containers, smaller [0.5 and 1MWh](#) fits into a sea container.

Risks: Solixi tanks are slightly modified. The way tank containers are used is new. There are pipes / pushes from which water flows in and out, to which manifolds and ball valves are connected. There are pipe holes for vertical flow of water to the top and bottom. Drawings have been made but full implementation has not yet been done.

Pressure vessel **regulations** vary from country to country, usually a control by (Solixi) controller is sufficient.

The water tank outdoors is harmless even in the event of a leak, insulated walls are not hot or dangerous.

Pressure control is done by an automatic compressor (TRL9) that has not been tested with the Solixi system.

The risks are in general minimal, routine work for a person skilled in the art.

Standard Tank Container can be used, in picture ISO type 1CC / 22T6 container (Baytanx):

- Tank design temperature is 120°C. Test Pressure (Hydrostatic) 10,5 bar
- 3 bar safety valve, max. temp. is 125°C (water boils at 130°C)
- Temperatures are set in Solixi controller according to local regulations, need and use.

1.4. Solixi Solar Concentrator



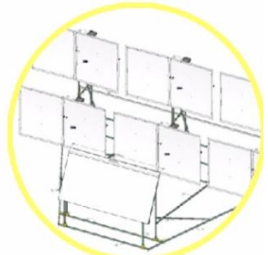
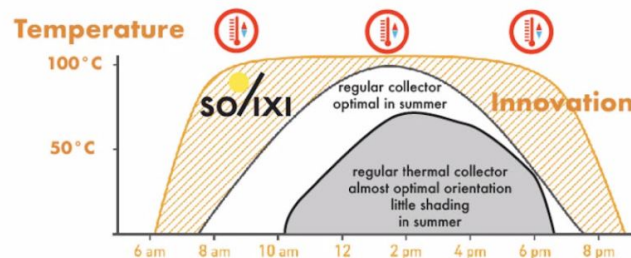
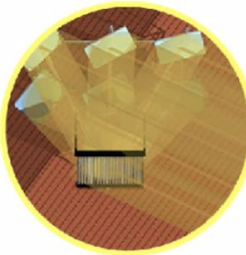
Is solar heating possible in winter ?



Only Solixi Solar Concentrator can:



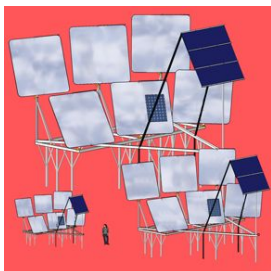
Heats always when the sun is shining.
Provide even production from sun up to sun down all year long.
Even a short glimmer of sun warms up.
Heating with **temperature adjustment and on/off**.
Orientates mirrors reflection to the collector, radiation **x10**.
Over the shadows.
Towards south independently of the shape of the roof.
Little need to clean up, does not collect snow, dust or garbage.
Light and easy assembly for all roofs in multiple sizes and models.



Traditional installation (in the diagram above, gray area), the collectors are attached to the roof lape with varying orientation. The energy yield depends on the shape of the roof, how long and when the sun shines on the collectors. Collectors are always on and produce warm (not hot) water. **Solixi will change all this;**

- Warms always when the sun is shining, hot even in the winter.
- Even production from morning to evening year round.
- Even a short glimmer of sun warms up, radiation x10.
- The only controllable solar collector, on/off, control of the produced temperature.
- Turning mirrors always follow the sun.
- Over the shadows on top of the rooftop.
- Towards south independently of the shape of the roof.
- Little need to clean up, does not collect snow, dust or garbage.
- Several sizes and models.
- Easy and fast assembly, can be dispersed into parts.

Solar Concentrator models C13, C16, C43, C46 and C96



Model; Mirror area, -plates; Power; Masts /Motors /Controllers; Price

C13; 7,5 m², 6pc.; 4 kW; 3 / 6 / 1; 2.490€

C16; 15 m², 12pc.; 8 kW; 6 / 12 / 2; 4.100€

C43; 30 m², 24pc.; 16 kW; 3 / 6 / 1; 5.350€

C46; 60 m², 48pc.; 32 kW; 6 / 12 / 2; 9.900€

C96; 135 m², 108pc.; 72 kW; 6 / 12 / 2; 17.000€

Nominal energy yield is achieved when insolation is 1000 W/m².

A sunny day.

100% power at noon 6 hours plus 4 hours 60% power am/pm. Energy yield at latitudes 30-60 (EU).

First Prototype in 2013, model C16



Model C16 early proto had 10m² mirror area in six masts. Four various mirror materials and other parts were tested. February 24th 2013 was a sunny winter day (Vantaa Helsinki, 60° latitude, very low winter sun), max power was 5kW and total 20kWh was produced. Regular collectors would have been under snow. In March 2013, without snow, 12m² of conventional collectors would have produced about 150kWh on this roof. **March 2013 C16 produced a total 723kWh, 72% of the heating energy consumption. Normal sunny day yield was 35kWh until the water boiler became too hot.** A lot of heat also on cloudy days. Daily statistics over 6 months available. In the serial production model, larger parabolic mirrors, a large boiler and an optimum collector (1.7.), and other planned improvements, further improve energy yield.

Second Prototype in 2016, model C16



CEO Jyri Jaakkola waving C16 mast. Several weaknesses were found and 3D drawings were corrected; Jouni Heikintalo, Felix Tao and Mr. Zhong & team, Guangdong, China.

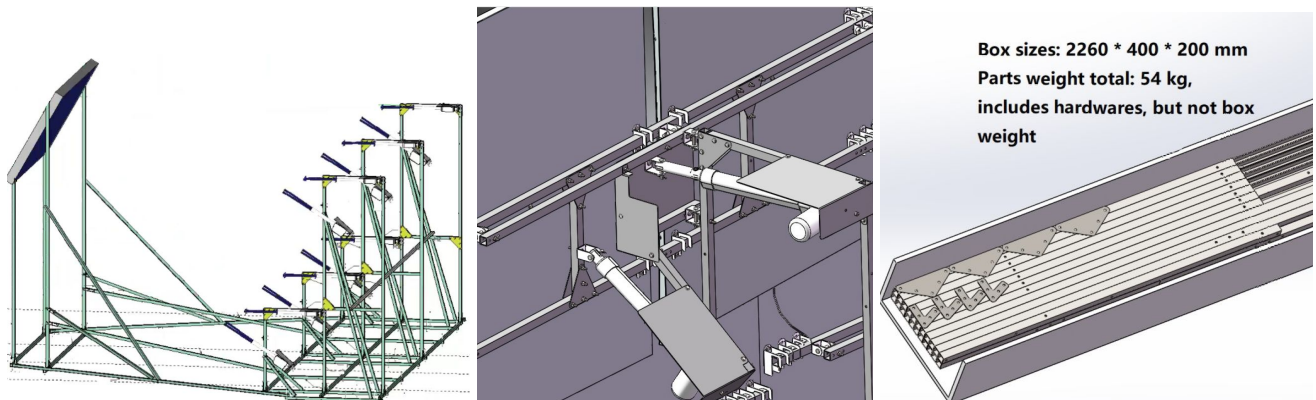
Commercial level 2018-2019, model C16



Assembling can be done on the ground or on the roof, or partially in both. Easy to disassemble and assemble in any part in minutes, bars and plates are connected with bolts. It takes about 2 to 4 days for two people to install the C16 - or a few hours if the structure is pre-assembled and lifted by crane on the roof. All models use the same components. Geometry, controller and software are the same in all models. Only the size can vary. Bars, plates, mirror supports, geometry and the entire frame are 3D modeled, all models;



Metal parts can be made anywhere in a modern metal workshop. The **best value for money** is now in China. Light, durable, weatherproof, low cost commercial Solar Concentrator ready for serial production.

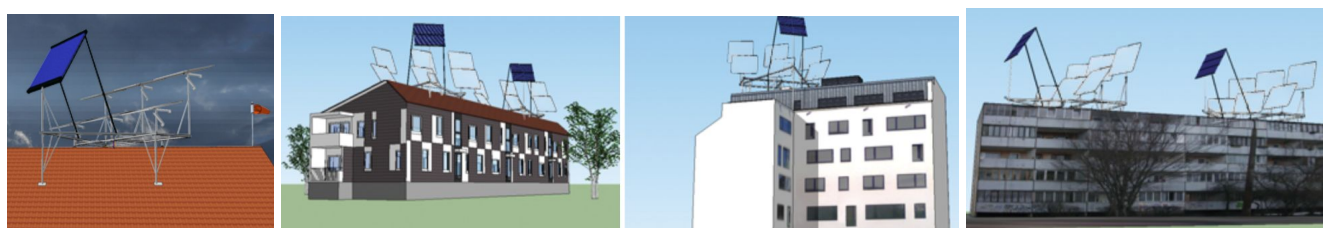


In **productization** the number of parts was minimized. Durability, installation, packaging, appearance and industrial manufacturing were all put in order. Electronics come from Finland, actuators are manufactured in Taiwan, mirror plates in Germany etc. The main components have been tested for at least one year.

Risks, fears: Usually the first impression is: it looks terrible and can't withstand a storm.



Video, [drive through Solixi City and check the views](#) by yourself. Imagine a clean city without chimneys.



Another concern is **the wind**, how does the structure withstand storms? C16 Solar Concentrators have been on the roof since 2013, no damage. During a storm, the mirrors can be turned to a favorable position. Solixi or ceiling are not stressed due to the small wind surface. Wide frame with many legs, cross brackets and attachment points is very rigid. Much more robust than a radio mast. In the middle of the ceiling, Solixi is well protected from wind-blown objects and often also from falling trees. During a hurricane, mirrors can be brought to the shelter by removing a few bolts. Wind damage can be covered by Solixi insurance (1.23).

Regulations may impose restrictions. The appearance is likely to prevent installation on the roof of the church. It is easier to get permission for suburban blocks of flats, industrial areas or the roof of the barn, where Solar Concentrators can be very big, large and effective (last image, model C96).

1.5. Solixi Controller



Image 1; Solar Concentrator Controller, **first prototype** manufactured by ElmerTech 2013.

Images 2-4; **second prototype** 2016-2019, made 10 pieces, 3 currently in operation;

The [Controller](#) makes the Solixi solar concentrator and the large Solixi boiler to work. The same hardware, single model, orientates the mirrors and optimizes charging and discharging and runs Solixi water pumps.

Microteam is the designer of the unique IoT controller. Both the software and the I/O, which includes a processor, a memory and a GSM, has been designed with lessons learned from prototypes. The system can be expanded easily by adding more wireless controllers to the Solixi Controller Network.

The controller works independently, but it's smartness comes from Solixi Cloud Service. This password protected service is used to input the controller parameters, as latitude used to calculate the sun's position, to the desired temperature layers in the boiler, which also change dynamically with weather and energy price forecasts. Solixi Control (1.21.) saves backup-copies, supplies malfunction alarms and collects statistics. Data and graphs can be accessed from for example mobile phones. It is easy to increase the power of the Solixi Boiler by installing parallel pumps and controllers. A big boiler with big capacity stores energy for a long time. It is possible to increase reliability during blackouts by installing solar PV-system with batteries. Solixi electronics works at minimal 24 Volts electricity. No electrician is needed for basic installation.

Additional water heaters, heat pumps, heat recovery and cooling devices can be connected to Solixi tanks simply with pipes. The controller can be used to start and stop these as well at the right times and optimize the efficiencies of the heat pumps. The greatest savings in a hybrid system can be achieved by [accurate control of timing and temperatures.](#)

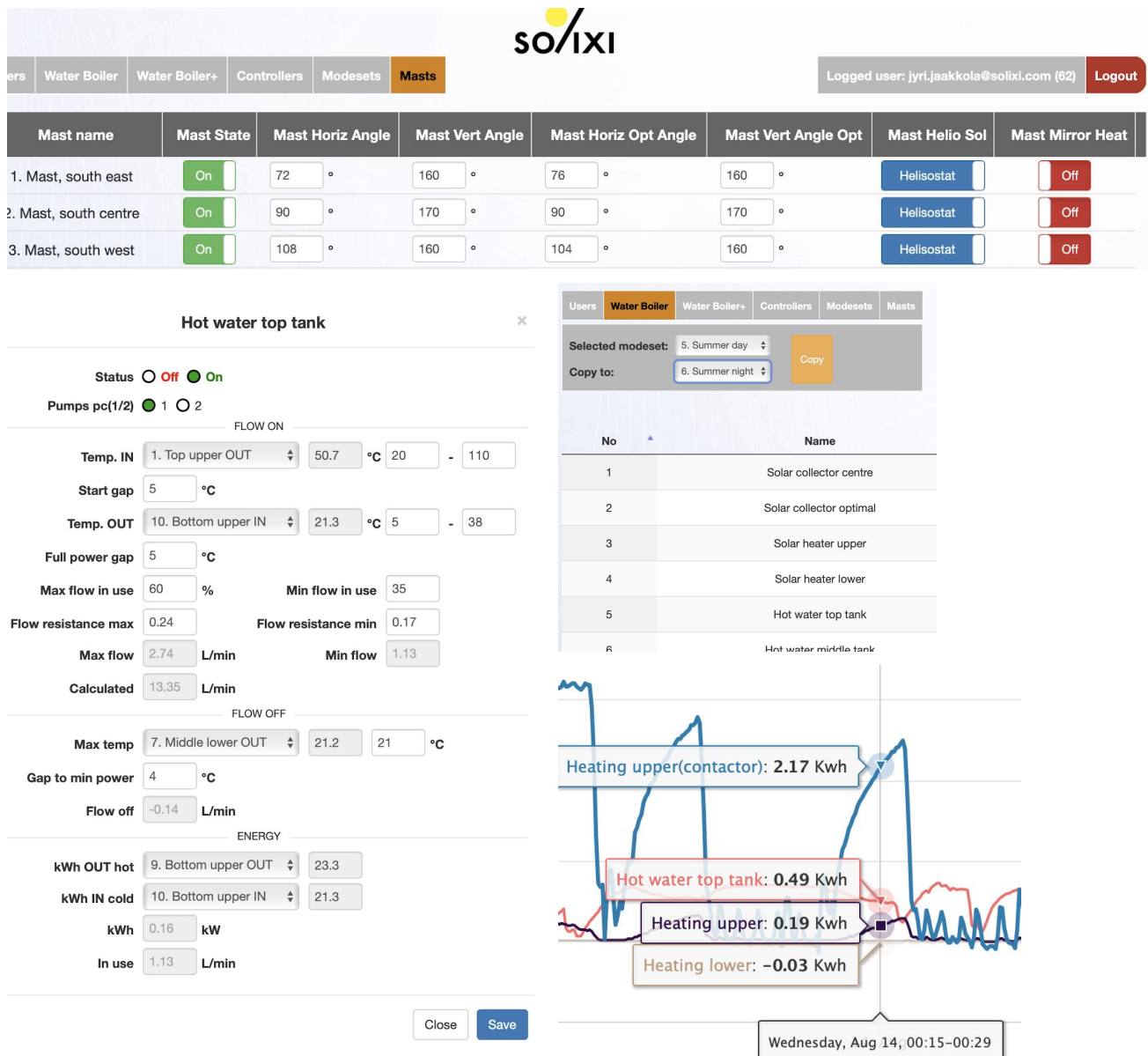


Third version is designed for serial production, **Solixi Controller 2020**;

The hardware will be manufactured by [Xortec](#) Ltd. Almost all software and functions as in previous model. The casing is weatherproof, approximately A4 size, with plug and play connectors on the bottom for cables. The price of serial production is a few hundred euros, the price level for similar controllers is a few thousand euros. Simple, data communication is secured, stand alone mode, extremely durable.

Solixi has designed three controller software

SIOA software operates on the roof and orientates solar mirrors / heliostats. The picture below shows the parameter input page on the web and cloud service;

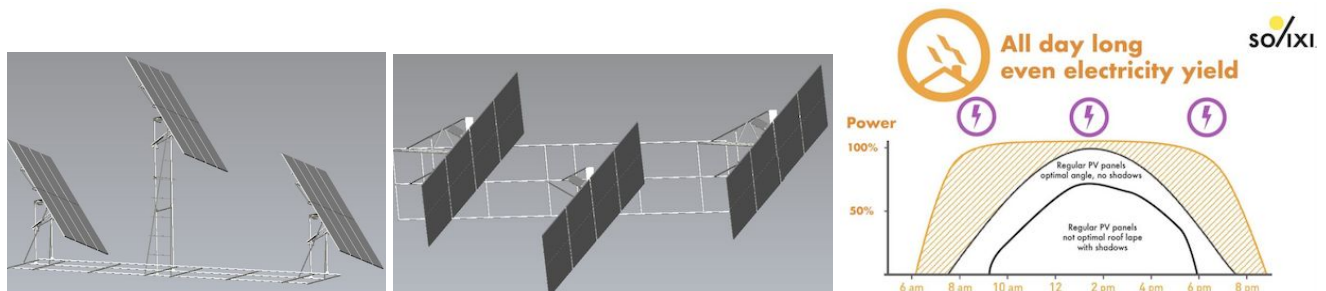


SIOB1 software is for water tank pumps. Algorithms, parameters, max/min flow rates, temperature limits and start gaps etc. settings input pages on the web and cloud service. Energy meter graphics.

SIOB2 software is modified for Solixi heat pump and cooling features (1.11.).

All software SIOA and SIOB use the same controller hardware and casing.

1.6. Solixi Solar Tracker Frame



Currently there are no large photovoltaic (PV) panels installed on **solar trackers** on the roof. Conventional solar trackers usually have only one mast. It requires massive and heavy footing and is despite it is still unstable and expensive, almost impossible on windy and sunny roofs.

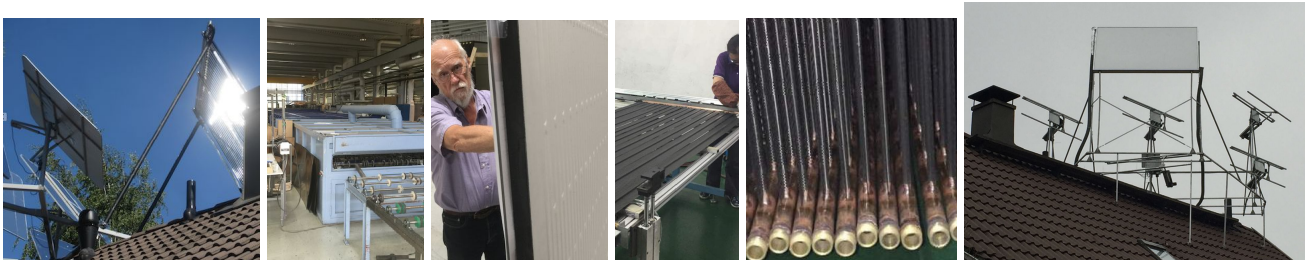
The Solixi C4PV is different. It is robust, affordable, light and intelligent; A very large flat bar foundation can

be combined with strong roof pillars and structures almost freely. No torque or vibration at any coupling point. Towards the south, regardless of the shape of the roof. The C4PV is lightweight, only a few hundred kilos plus PV panels. The bars are thin (like on TV masts), but still the structure is solid metal triangle, it does not vibrate, it does not shake the building. Under C4PV you can have just anything; ventilation, chimney, windows, swimming pool... it fits into almost any roof. C4PV is intelligent and IoT; on / off, remote control, automatic rain, dust, night and storm direction. One affordable Solixi controller can handle all three masts. In general, any standard PV panel (1 × 1.6 m or 1x2 m) can be installed on a C4PV.

The C4PV is built from the same bars, plates, actuators, controller and services and as the C46 Solar Concentrator, logistics and packings are the same, only the thermal solar collector and mirrors are omitted. C4PV is a “free extra product” but still has a huge market. 24 x 300W PV-panels = 7,2 kW, PV panel area 24 x 1,6 m² = 38 m², price € 2950, VAT 0%

Full PV electricity nominal power up to 10 hours a day on any roof (graph above, orange).

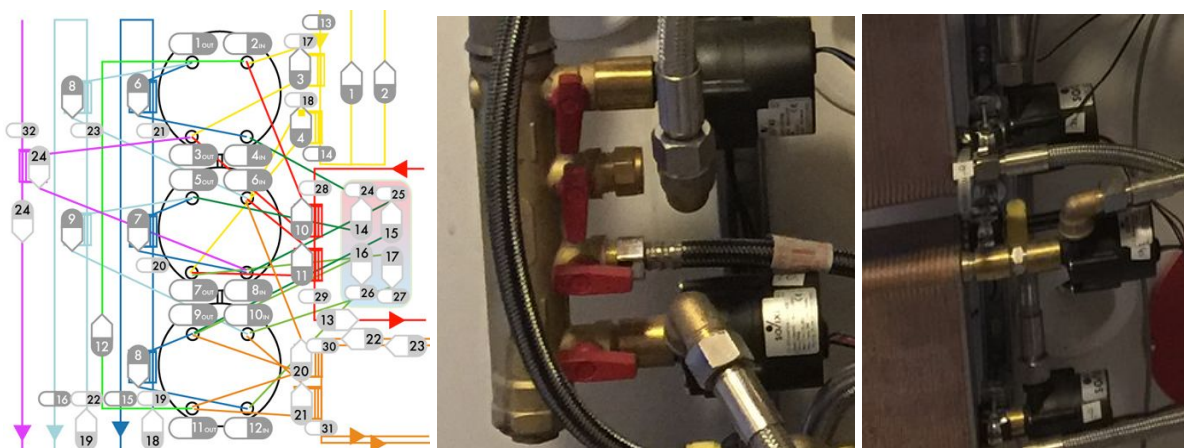
1.7. Solixi Thermal Collector



Solixi Solar Concentrators benefit from solar collectors designed for very strong solar radiation. Market collectors are “made for one sun”, are one-sided or partly transparent. Solixi takes the radiation on both sides and harvest more heat with a big non-transparent collector. High water flow rates and high quality hot water insulation and pressures of at least 6 bar are also useful. Solixi has plans and manufacturers in Finland and China a solar thermal collector that is suitable for all Solar Concentrators. Only quantities vary by model.

Collector designed for the Solar Concentrator is already installed on the latest C16 model (last image). It is one-sided. The south side is for the PV panel or can be left in silver for a better look. Black collectors stand out against the sky.

1.8. Solixi Water Pumps, temperature sensors, secured heat circles



One Solixi [controller controls](#) up to 12 automated [water pumps](#) and provides information on 16 temperature sensors. **This makes Solixi a 'water computer'.**

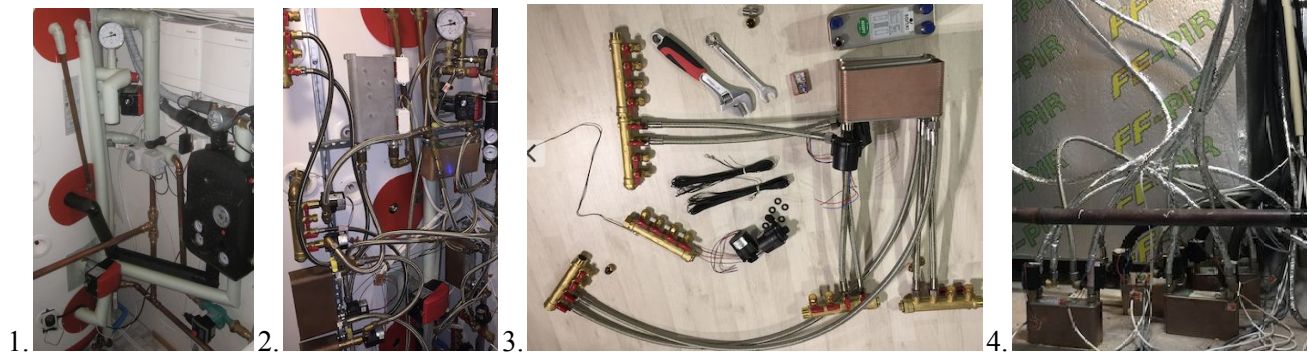
The main functions are visualized in the [video](#). The controller not only turns the pumps on / off, but also controls the flow rate when the critical temperatures change. Each water pump is also a flow meter and an

energy meter, ie the controller collects data and graphically visualizes how much energy each pump has pumped. Lots of intelligent heat circles that can be amplified by adding more controllers, pumps and temperature sensors.

A plumber and an electrician will install a standard water pump in a matter of hours, one pump costs a few hundred euros. **Anyone can install or replace a Solixi pump in minutes** (low voltage 24V, plug, threads, easy on/off valves) and **one pump costs tens of euros**. Solixi controller tests all Solixi pumps periodically.

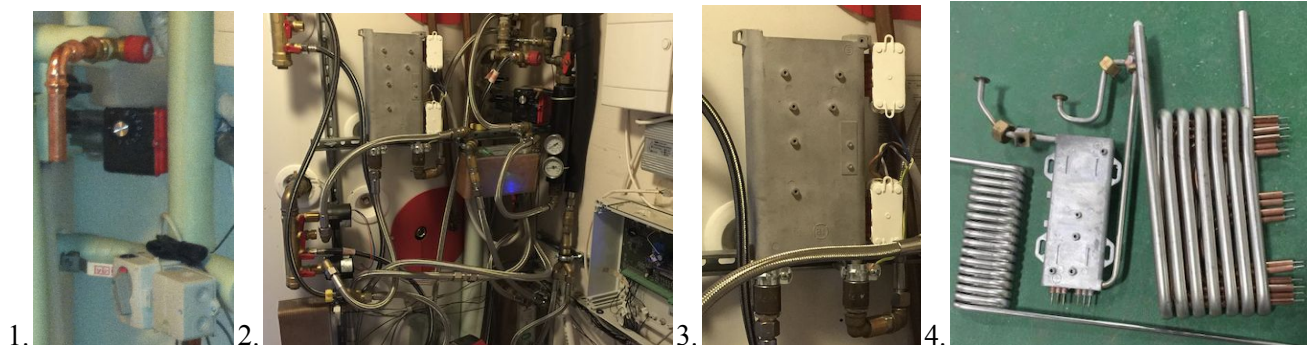
Secured heating and cooling; The heat circuits, Solixi pumps and controller, can easily be doubled. The cost is a few thousand euros, even in a large building and system.

1.9. Solixi manifolds and flexible hoses, plug & play installation



In a conventional installation, a plumber installs the pipes and pumps permanently. Typically a water tank has a few pumps and valves (1.). **Solixi** water tank has manifolds (6-12-24 pc.) with four ball valves (water flow on/off) on the side (2.). Installation does not require a plumber, it can be much more versatile and the installation can be changed in minutes. With a few affordable basic parts (3.) you can quickly assemble and get the desired combination (2., 4.). Flexible pipe hoses can be several meters in length (4.). The parts are uninsulated because they are inside the insulated hut of the water tank.

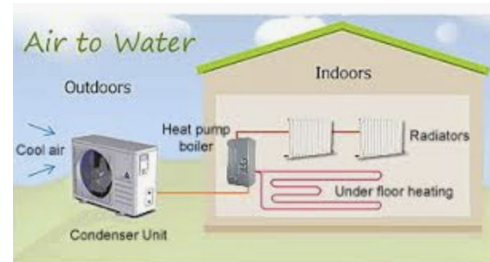
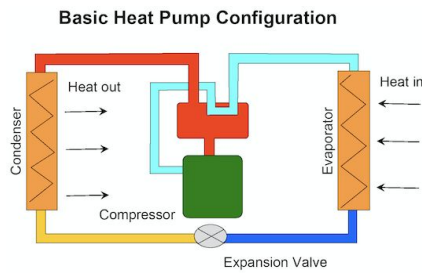
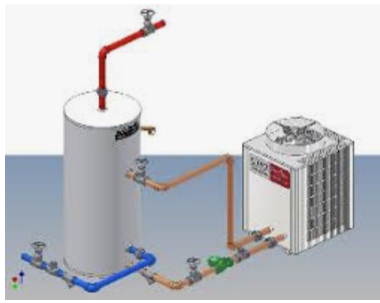
1.10. Solixi Electric Resistor



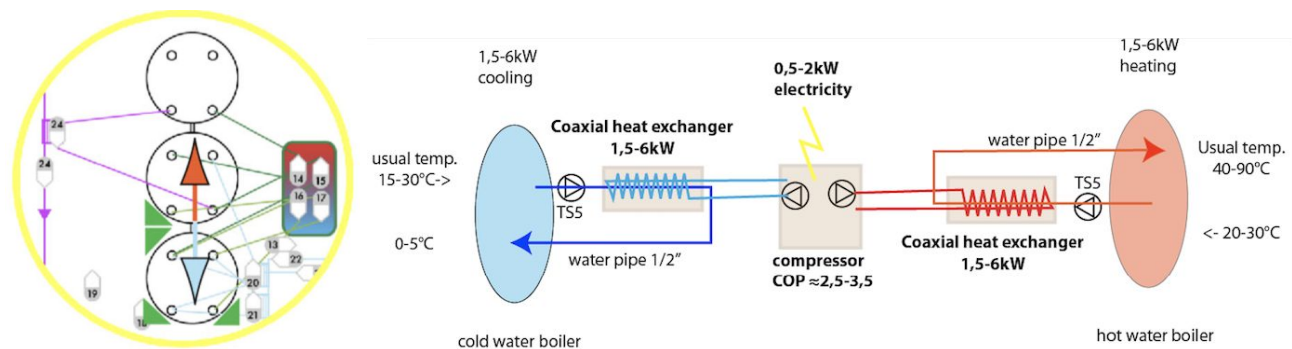
In a conventional installation, on the side of the water tank is a fixed electrical resistor with a thermostat to set max. temperature. The water is warmed up above the resistor gradually. The motor valve mixes the water to achieve the desired temperature for use (1.). Both can be adjusted remotely with specific controllers.

Solixi's solution (2.-4.) is to electrically heat the water flowing in the spiral pipe. The Solixi controller adjusts the flow rate so that the desired, usually hot (80-120°C), temperature is reached immediately. Another Solixi pump mixes the water between different volumes, or when the pump is off, only the top volume is heated. Solixi electric resistor is very cheap, robust and simple as it has no electronics. It is an ideal partner for another electric heater, the heat pump, which produces warm (40-60 ° C) water with less electricity (COP over 1). The Solixi controller intelligently controls both, one or both are ON when electricity is cheap and depending on the temperatures required for each water volume. No specific controllers nor extra expenses. Solixi has tested many resistors and found a good solution that works, **power is 2-4-6kW** (3.).

1.11. Solixi Heat Pump



An ordinary heat pump pumps cold or warm into a building. Part of the device, one heat exchanger, is outdoors. For example compressor power can be **6kW**, **price €20.000** and **COP 3**. 1 kWh to compressor creates 3 kWh heat into water. Heat pump is on when heating (or cooling) is needed, and the not wanted cold (or warm) is pumped out as a waste. The basics are simple, but installation, electronics and large heat exchangers add a lot of expenses.



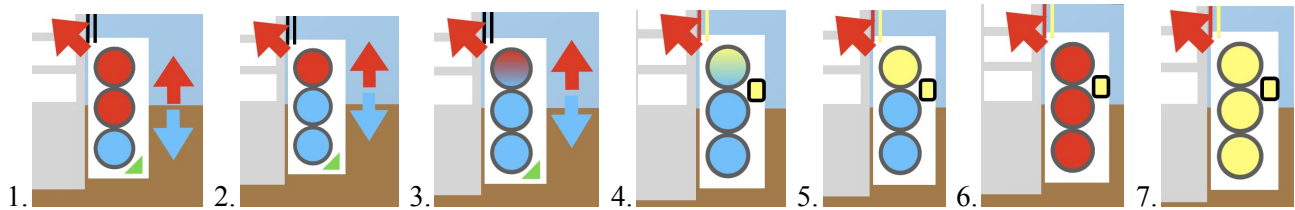
Solixi heat pump is a triangular case installed in a corner of a tank container (green, image 1). None of it is outdoors, it is completely inside insulated walls. It does not require space for installation. Weather does not affect. Runtime does not have to be dependent on consumption. Both heat and cold can be stored in large water tanks for later use. Installation is plug & play with flexible hoses. All these features are unique.

The heat pump pumps heat from the lower tank to the upper. It strengthens and moves the water stratification. The central tank can be heated or cooled. Four water circuits (4 pumps, image 1) to optimize the heat pump's energy efficiency and three tank temperatures along with other installed devices. Electronics are four Solixi pumps and SIOB controller. In four compact coaxial heat exchangers (2x evaporator and 2x condenser) water flows through the spiral pipes. For example compressor power can be **2kW**, **price €3000**, **COP 5-10**. Both warm and cold are stored and used. Power and **security** is increased by increasing the number of heat pumps (green). Solixi has plans for serial production.

Benefits; The building uses water for cooling (2-10°C) and for heating (40-60°C). The return temperature in both is about 25°C. Energy content is used and empty when all tanks are at 25°C. The heat pump between tanks can be operated in many ways with very high energy efficiency (COP) and savings;

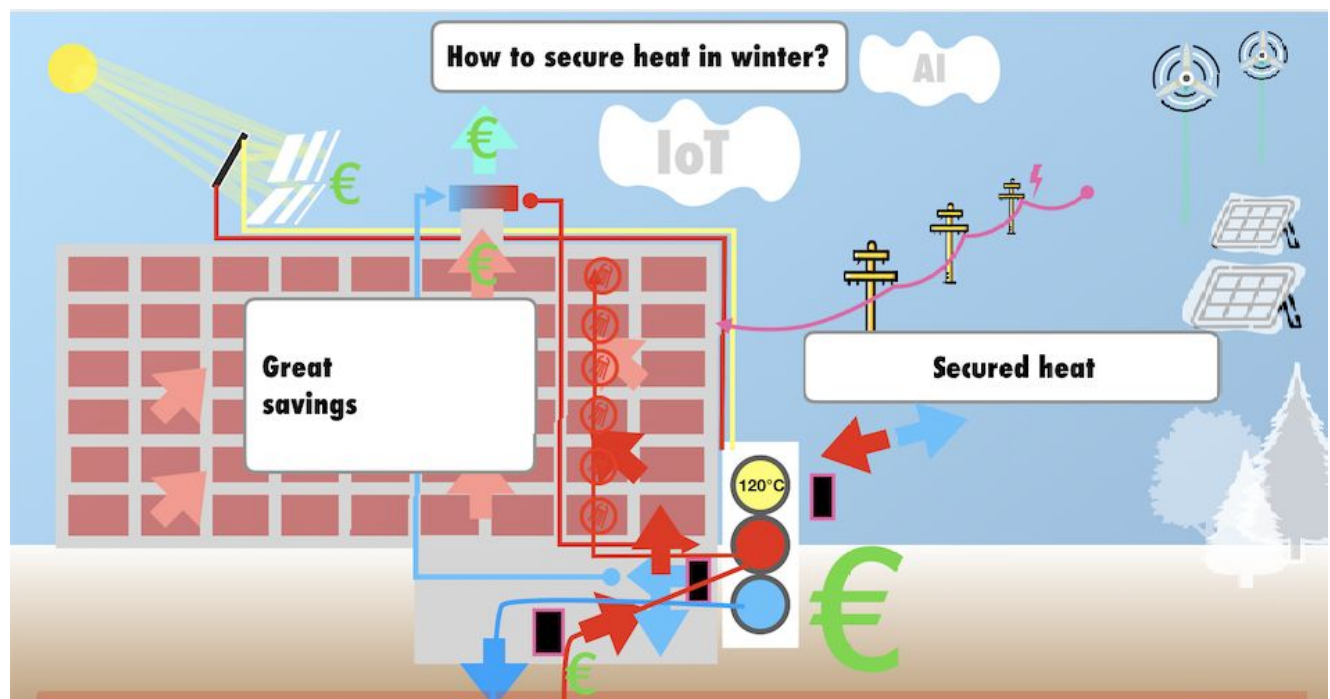
1.) The building needs just as much heating and cooling in a couple of days time period; The return from both temperatures (25 °C) is led to the central tank, the Solixi heat pump transfer cold to the lowest tank and heats up to the top tank. Temperature range is optimal for heat pump in both, in evaporator and in condenser. COP is very high 6-10. Outside temperatures and consumption peaks have no effect, high capacity balances both.

2.) Today, heating is expensive; it is cold and electricity price is high (1. below). The weather is changing, next week the heating is very cheap or free, it will be a sunny, windy and warm week. So, the Solixi heat pump transfers heat from the lower and middle tanks to the upper tank, which provides heating (1.-3.) until the end of the cold weather period.. The COP of the heat pump is good when heating water at 10-25°C to 45°C, which is suitable for heating. Heating is cheap despite the cold weather. Tomorrow all the tanks are cold (5-15°C, image 3), all of them can absorb a lot of heat;



Next week all the free heat received by Solixi Solar Concentrators and Electric Resistors, up to 120°C hot water (yellow), can be stored (images 3-7). At the same time, cold water can be used for cooling (image 5). Vertical flow / water pump mixes water in all tanks (60°C, image 6). The capacity of the water tanks is fully realized, all tanks are hot (120°C, image 7). Enough energy for days or weeks without having to buy energy.

3.) It's summer and it's been hot for several days, and the same weather continues. In the hybrid system there is low power geothermal well (and affordable, small area in urban environment). Solixi pumps heat into the soil. It has already warmed up so much that the return heat (15°C) cannot be directly used for cooling. The Solixi heat pump cools the water slightly and transfers more extra heat to the soil. It warms up faster, the heat storage in the soil to be used in the winter increases, and the building gets cooling at very low electricity usage. Up to several months.



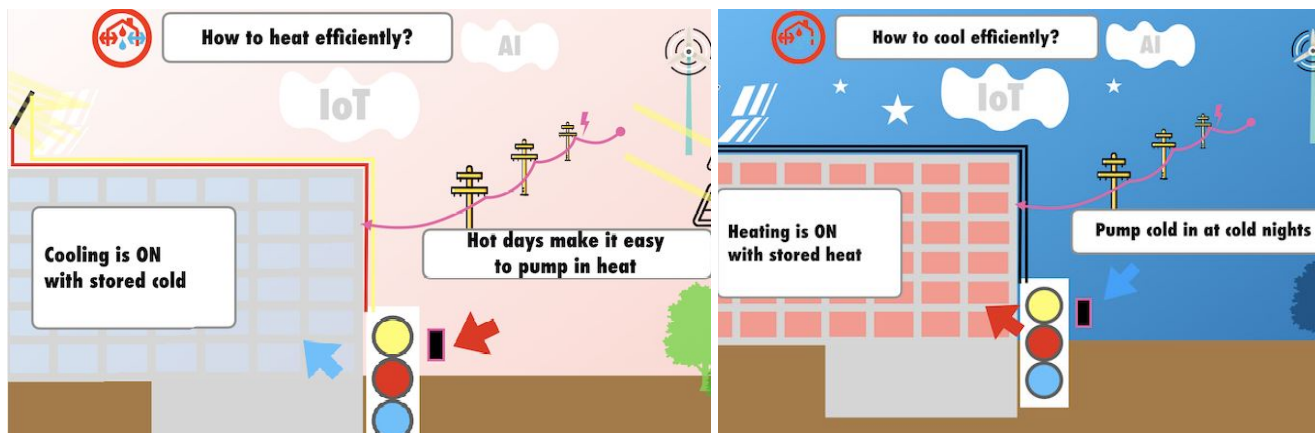
4.) It's winter and it's been cold for several days, and the same weather continues (above). The hybrid system has a geothermal well. It has already cooled so much that the return heat (15°C) cannot be directly used for heating. The Solixi heat pump heats the water slightly and transfers more extra cold to the soil. It cools up faster, the cold storage in the soil to be used in the summer increases, and the building gets heating at very low electricity usage. Up to several months.

5.) It's winter and it's been cold for several days, and the same weather continues. The hybrid system has Solixi heat recovery. The cold water produced by the heat pump is circulated through the exhaust air heat exchanger on the rooftop (1.14.) where it heats up to 15°C. In this way, cold water is also useful for heating, COP is high and heat is kept indoors.

6.) Hot and cold water can also be pumped very cheaply between adjacent houses. One building may have high heat pump capacity and a geothermal well, and another may have multiple solar concentrators, and both houses may benefit from both. Solixi system water tanks can be located hundreds of meters apart. Similarly, district heating or district cooling can be utilized.

7.) Many of these functions can be activated at the same time, depending on the need and the circumstances. Seven **unique selling points and key differentiation from competitors** are listed above (2. Impact).

1.12. Air-to-Water heat pumps



The huge capacity of Solixi water tanks and intelligent heat circles make it possible to improve the efficiency of Air-to-Water heat pumps. It easily charges heat at midday when the air is hot. It is effective to cool water on a cool night. This reverse order is possible only with Solixi; Effective heating during the day and cooling at night, both are secured at all times.

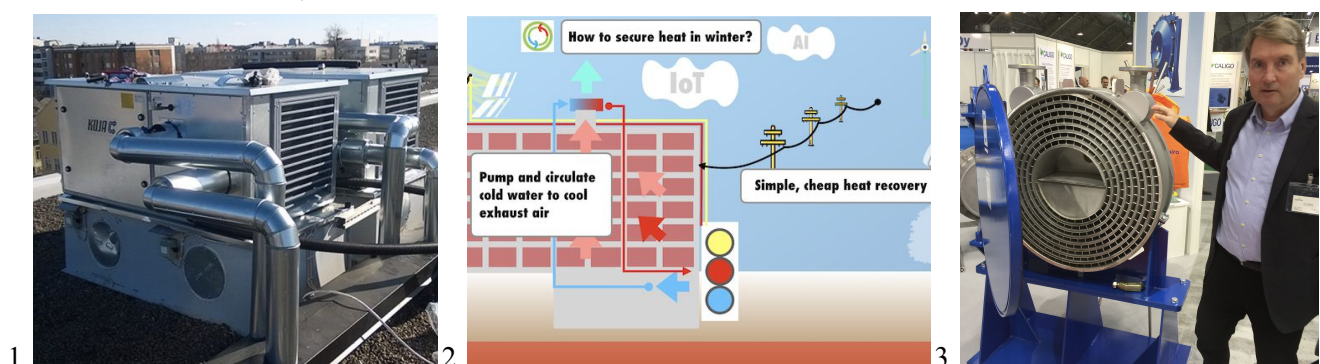
1.13. Geothermal Energy as seasonal storage

Soil is commonly used for storing seasonal energy. It is also very useful as part of the Solixi hybrid heating and cooling system. The soil beneath the city, 10 to 200 meters or more, serves as a giant energy store. **Traditionally**, a large building requires a large and expensive field of geothermal wells, which is not possible in urban areas. Soil is just like any other form of energy storage, in the long run it needs to be charged as much as it is discharged. In urban environments consumption peaks are high, soil cannot provide high power for a few hours. Heat losses are generally high, with about half of the heat charged into the soil in the summer being recovered in the winter.

Solixi solves all these challenges; Few geothermal wells are enough as Solixi is a hybrid system. Heat transfer to the soil can continue optimally at low power throughout the summer, and consequently the heat is obtained for several winter months regardless of the weather. The heat losses are lower than in the conventional case, because several adjacent heat wells are loaded throughout the summer and unloaded at the same time for optimal winter performance. All the soil under the city is heated or cooled at high power simultaneously for several months. Horizontally transmitted heat or cold is available at the adjacent building. High heating or cooling power is available any time from a hot or cold water tank. The tanks are a smart buffer between the soil and the building.

In some cases, a geothermal heat pump may be replaced by a Solixi heat pump (1.11.). Fewer geothermal wells are needed and each provide higher efficiency. All these significantly reduce investment costs.

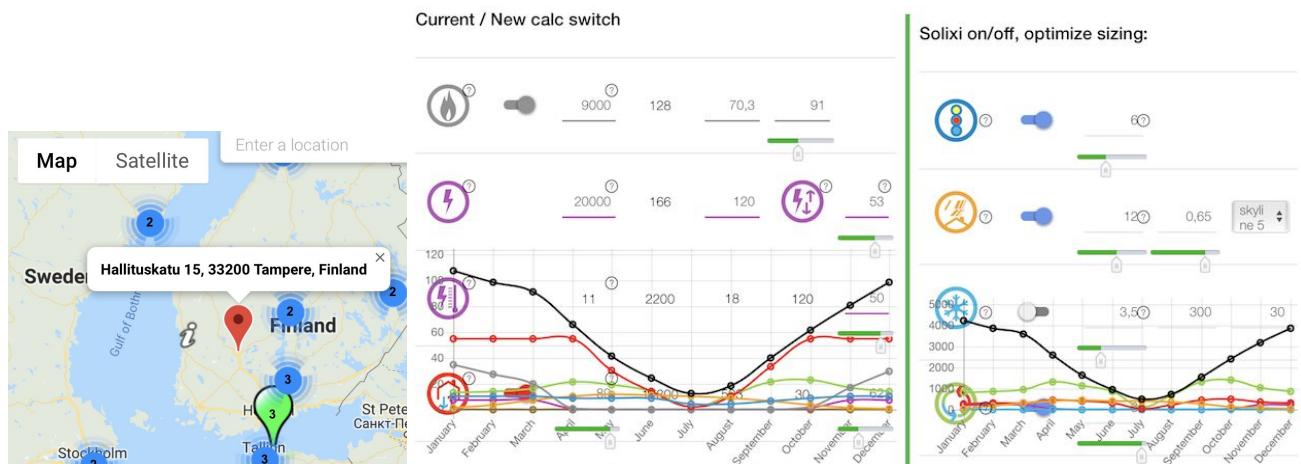
1.14. Heat recovery, heat removal



Solixi heat pump, large water tanks and heat circles are the key to cheap heat recovery and heat removal. Cold or warm water is pumped through the roof heat exchanger and exhaust air (Images 1 and 2). The sewage water

circulates through a spiral heat exchanger (Image 3). With Solixi all this very simply, thanks to the large water tanks. Heat recovery can work for a long time without heat pumps, and the Solixi heat pump can produce warm and cold water, along with other Solixi smart heating circuits when it is affordable.

1.20. Solixi web calculator



System sizing and profitability calculation. [Solixi Web Calculator](http://www.solixi.com/savings-calculator/) is a unique and revolutionary way to plan an energy renovation and model the whole system.

The first version in 2012 calculated Solar Concentrator energy yield. This updated version **calculates the whole system**. Calculating the economic size of the various components of a hybrid system is not easy. There are plenty of variables. Changing one affects the entire system. The web calculator does this. Building Information Modelling for energy has never been so easy, quick and affordable. Use the unique Solixi calculator, see how energy expenses and savings vary when you use on/off switches for devices and adjust the power, size, future estimations, prices etc. Smart algorithms will take into account other devices, the local weather, heating and cooling days and need for the map location as well as the latitude to calculate sun's orbit. Immediate response; annual & monthly MWh:s and savings /the whole system. The calculator shows the direction for an energy renovation for a particular building at a specific location. It provides the basis for an investment plan.

<http://www.solixi.com/savings-calculator/> is a great tool for Solixi resellers and licensors because it quickly calculates key information to make a purchasing decision. All you need to get started is an energy bill and an address. The calculator is calibrated according to the actual data provided by the Solixi controller. Currently, the calculator is not being used because there is not enough Solixi Controller data available yet and resources are missing to fix a few minor errors. Project team: CEO Jyri Jaakkola, Aalto University (Finland, [Reino energy project](#)) and [4tifier.com](#) (Ukraine, 3 persons) in years 2016-2018. TRL 7-8.

1.21. Solixi Control, security

Solixi software and cloud service optimizes the operation of the system, taking into account consumption, weather, energy prices and supply. This is done simply by changing the Modeset setting in the Solixi Controller software (1.5.) remotely (GSM, IoT). It can also be done automatically (stand alone mode) or manually for all Solixi systems in the area from the control room.

The operation of the electricity grid can be optimized. Solixi may use more or less electricity depending on the energy network situation. Adjustments can have a big impact when there are many Solixi systems. In the event of a power plant outage, consumption is reduced as soon as the Solixi systems are switched to discharge mode. The huge capacity of water tanks will be taken into operation at the same moment. Charging mode is activated during stormy nights when wind power overload is on and electricity prices are low.

Solixi system can also operate without active control and exchange the Modesets according to the calendar.

The program can change the settings automatically depending on the season or the daily rhythm. In this case, the weather and the price of electricity are not taken into account.

The system is proactive;

A.) If tomorrow is a sunny and warm day and the energy now in stock is sufficient till tomorrow morning, then the water tanks are in the discharge mode and energy is not purchased or produced. Heat pumps are off.

B.) If tomorrow is a cold and cloudy day and it is more affordable to make and purchase energy today than tomorrow, the water tanks are in charge mode. Electric resistors and heat pumps are on.

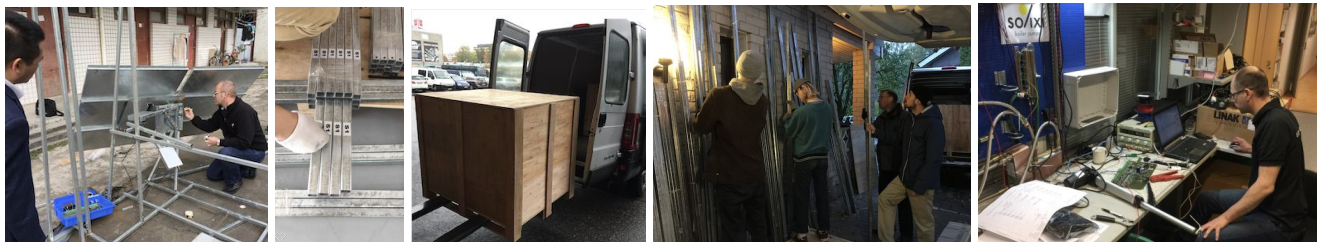
Security: Solixi allows off-grid mode for a few hours or even for days or weeks without affecting living conditions. Advantageously, the operation of the controller and the water pumps are safeguarded by a few solar panels (1.6.) and batteries. When the power is low, the pumping power is automatically limited. Heating and cooling is never completely interrupted. In the event of a crisis, heating (1.4.) or cooling (1.11.) is provided at least at some level. At all times.

No competitor has these security features. Now, virtually all systems stop heating or cooling immediately in the event of a power failure. Society is helpless in times of crisis and everyone needs immediate help right away.

Solixi buildings are resilient and safe in crisis situations.

1.22. Steps planned to take Solixi system to the market, Serial production, Risks

Technological, practical and economic feasibility - Serial production. Electronics manufacturing, parts manufacturing, product development, piloting in different areas and buildings, metering, big data AI, Solixi Control, software development, systems optimization, logistics, maintenance, service, affordable pricing and marketing all around the world **require extensive serial production.**



Small industry is no longer an option, it has already been made (pictures). The system cannot be made and commercialized without all or at least the most important components, devices, features and maintenance. Solixi has a strong supply chain from piloting and manufacturing to customer deliveries (2.4.).

Risks faced when bringing innovations to market. When volumes are high, there are significant technical and practical risks. When one part is replaced, it has or may have an effect elsewhere.

The most expensive part in Solixi system is the water boiler, tank containers. They can typically account for 10-100k €, about 30-60% of the Solixi system investment cost (3.6.). There are no significant risks in this section. Thanks to modularity, dimensioning can be increased and reduced flexibly. The container holds its value under all circumstances, its transfer and sale are inexpensive. Any Solixi water tanks suits to almost any building.

The unit prices of other parts are affordable in mass production. Solixi is plug & play, all components are easy to replace.

However, there are costs involved in redesigning potentially weak or even unsuitable parts. When there are hundreds of systems installed around the world, maintenance needs to be carefully addressed. Because of the guarantee and reliability, the job has to be done for free and quickly. Extensive experimentation and testing in different countries and buildings is expensive, especially at the beginning, when routines have not yet been developed and all staff are new. Failure can be fatal for the Solixi brand and significantly hamper marketing. The risk can be eliminated through adequate financing. It enables quick response and customer satisfaction even when problems arise. The introduction of new products, especially energy systems, requires trust in the supplier and the seller. They are ready to launch Solixi on the market more enthusiastically when Solixi can take

economic responsibility for product development and warranty.

Banks cannot take this risk and it is too big for most venture capitalists. Solixi aims to transform the entire energy system. Estimating costs is also very difficult, as they vary according to the nature, scale and magnitude of the problem. However, it can be assumed that about 10% of the initial installation parts will have to be replaced within a few years, at a cost of about a quarter of the investment. These costs are quickly reduced as experience increases.

Solixi is seeking funding for serial production, **to bring individual products and all innovations to the market**. It enables system-level revolution in the heating and cooling of buildings.

SECTION 2 - IMPACT

2.1. Broader impact, Impact assessment

Markets and customers: *Heating and cooling in buildings and industry accounts for half of the EU's energy consumption. According to 2018 figures from Eurostat, 75% of heating and cooling is still generated from fossil fuels while only 19% is generated from renewable energy.*

Today, EU imports fossil fuels worth €570 billion per year.

EU has a population of 513 million. 73% and 375 million people are living in urban areas.

Source: Eurostats EU 28 countries 2017 & [EU Heating and Cooling](#)

Solixi's **market potential** is all built environment in the **EU and worldwide**, with a focus on heating and cooling in the urban environment.

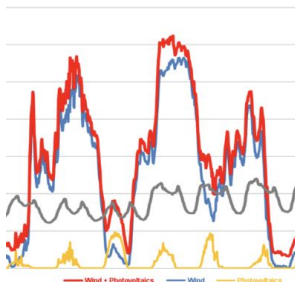
Substantial demand: We can imagine that there are **375.000 urban apartment blocks - targeted users or customers** - in the EU, each with a thousand inhabitants. These buildings can be equipped with a 15 MWh Solixi Water Boiler, Controllers, Solar Concentrators, Heat pumps, Heat Recovery and Cooling (1.2., 3.6.).

When the energy repairs are €0,25-1 million per apartment block, **€0,15M** of which is spent on Solixi and **€0,1M** installation and few air-to-water heat pumps and geothermal wells (3.6.), the investment for whole EU is €94-375 billion. IoT & AI and maintenance are included for decades. Solixi system payback time is usually 2-7 years. Savings will accrue over decades. Solixi installation does not interfere with living or factory production. Budget €0.25 million for Solixi is realistic and based on serial production and installation prices.

EU's smart energy storage capacity increases by 15 MWh x 375.000 = 5,6 Terawatt hours TWh.

The annual energy transfer to Solixi's storage and consumption, when 40% of the capacity is used daily, is 6 MWh x 365 x 375,000 = **820 TWh**.

Ultimately, the need for fossil fuels and the energy purchased online will eventually **be reduced by at least 50%, 410 TWh per year** in heating and cooling. The system has a local source of energy, storage and intelligence to improve energy efficiency; heat pump COP, heat recovery, and it benefits from weather and consumption forecasts. Further, large storage allows the purchase of only low-cost energy. It typically brings about 25-50% savings in a modern energy system where electricity generation and price fluctuates dramatically (graph on the left).



In short: The need for purchased energy is halved and the rest is bought at a lower price.

Solixi is radically increasing the share of clean energy in heating and cooling. The share of fossil fuels will be reduced and the current €570 billion in imports annually can be halved as heating and cooling become emission free.

Massive energy storages are local; Solixi balances peak load and investment needs in the grid. Solixi improves supply **security**. Solixi enables and support many other

IoT & AI Smart City solutions due to its modularity and compatibility. Affordable wind and solar power can be

further increased profitably and rapidly as the EU storage capacity will increase by 5.6 TWh or more at very low cost (1.3.). **The additional savings are hundreds of billions.**



In this scenario, 100% of urban apartment blocks are equipped with Solixi, 50-80% could be more realistic. Solixi is on the roof and/or underground, it is best suited and most profitable in older, less energy efficient buildings, where it can be impossible or is very expensive to add insulation or refurbish the interior. On the other hand, cities also have public and office

buildings that benefit from the Solixi system. Solixi products can also be used as part of a power plant, industry, in greenhouses, agriculture, district heating and cooling etc.

European/global dimension: Solixi is a system-level revolution in the transition to emission-free and prosperous societies around the world. Heating and / or cooling are vital around the world.

Unique selling point 1.: The whole system; no **competitor** has any of its core parts (1.3.,1.4.,1.5.), for sure (2.5. Patenting). Add-ons (1.6. - 1.21.) emphasize uniqueness even more. Solixi Urban Building Hybrid Heating and Cooling system is **definitely unique**.

Climate policy and legislation force Solixi into strong growth. **The impact and result of growth** is to make the climate policy a reality, to achieve significant emission reductions and savings.

Market conditions and growth-rate; According to Paris agreement and EU policy zero greenhouse gas emissions must be achieved within a few decades. Whereas some emissions are still allowed in aviation, traffic and a couple of other industries, **building heating and cooling must become completely emission free** even much sooner.

Unique selling point 2.: EU, countries and companies are able to reach the targets in time (3.6.).

Solar, wind and nuclear power have the lowest CO2 emissions. They are being increased within political, physical and economic boundaries and through massive and likely increasing financial support. Electricity is cleaned, but only when it can replace fossil fuels in economically viable ways and guarantee energy supplies. So far this has not been possible without fossiles.

Sometimes the sun does not shine and the wind does not blow. Neither of these, nor nuclear power, is able to balance peak consumption or seasonality and ensure stable energy at affordable prices. Fossil fuels have had to be used to fill the gap because there has not been alternatives. Energiewende in Germany is an expensive example; wind and photovoltaics have been significantly increased but still no reduction in emissions. The costs of the energy system are huge and they are only rising. Solixi solves the problem, making it profitable to increase wind and solar power, while reducing the need and cost of power transmission across all parts of the electrical system. Savings for consumers, industry, traffic and real estates, no emission.

In order to use continuously only clean and fluctuating grid electricity everywhere, local energy production, storage and energy efficiency must be taken to a new level. Solixi does this for all electricity users.

Unique selling point 3.: Solixi support the transition of society as a whole to zero emission energy.

As a result, fossil fuel power plants or burners are no longer needed and oil, coal and gas costs are eliminated. The need and cost of back-up power plants will be reduced. A double power system is not needed. Fossil fuel power plants can **be shut down, all costs are eliminated**. The impact on the trade balance is huge.

Unique selling point 4.: One clean and affordable energy system is enough.

Huge savings are achieved because **solar and wind energy are already almost everywhere the cheapest** means of producing electricity. They are also less needed when Solixi's energy efficiency, heat recovery and local solar energy reduce the need for mains electricity. This saves the land and area needed for solar and wind power.

Solixi and clean grid energy together makes it economically profitable to end burning and emissions while there is no force to compromise on the standard of living. Solixi also gives the freedom to choose the desired indoor temperatures.

Unique selling point 5, Security.: Solixi helps to survive in extreme weather conditions and

crises. Heating and cooling will become more important in the future as extreme weather events increase. Reliable air conditioning and heating save lives and enable society to function even in the event of disturbances. Solixi produces and stores energy locally and can operate for long periods without mains power. Solixi also reduces dependence on foreign energy and imports.

Seven **unique selling points** more are listed in 1.11. Solixi Heat Pump.

Risks. Everyone, except those whose livelihoods and income are at **risk**, are willing to invest for the new Solixi technology, especially when the technology is fully developed and tested and available in the markets without their own capital or risk (2.3.). The investment can be paid by savings, often even in a few years.

2.2. Scale up potential, Blitzscaling

Revenue model is licensing, commercialisation strategy is blitzscaling

Blitzscaling is what we call both the general **framework** and the specific **techniques** that allow Solixi to achieve massive scale at incredible speed;

- The main revenue model is licensing. One contract immediately opens up new markets. (2.3.)
- The target companies are Unicorns in the energy, wholesale, retail and services sectors. These companies already have a customer interface and market position. Some of them are already in Solixi's ecosystem (2.4.4.) and it can be expanded rapidly (2.4.15.).
- The products are ready for massive serial production, main components have been tested. (1.2.)
- Products can be manufactured by several manufacturers.
- No rare materials or minerals or toxic substances are used anywhere
- Strong financial viability, big savings and huge impact (2.1.)
- Savings can be calculated, computed and verified (1.20., 1.21., 1.5.)
- Strong IPR (2.5.)
- Strong logistics; containers, simple products and plenty of models
- [Obvious and clear benefits](#)

Once the financing is arranged (time to market/deployment);

- Pre-sales can begin immediately (2.4.4.); Onninen Ltd. EU wide wholesalers network and other Solixi partners, as well as new licensees and resellers.
- Solixi controller and three software versions can be in the market and on sale in 6-18 months.
- Solixi Water Boiler, all four models, can be in the market and on sale in 3-6 months.
- Solixi Solar Concentrator, all four models, can be in the market and on sale in 6-12 months.
- The whole system with all add-ons (1.2.) can be in the market and on sale in 12-24 months.

2.3. Leasing as a win-win-win commercialization strategy

Commercialisation strategy: For property owners, real estates, occupants, subcontractors, wholesalers, retailers, financiers and for Solixi leasing can be an almost risk free solution.

Indicative math can be as follows, commercial exploitation; Solixi investment is 100k € (100%), with a payback period of 5 years with an annual fee of 20k €. The real estate gets 5,000k € annual and guaranteed savings and pays 15k € each year. Leasing period is 10-20 years, income 150-300k €. The margin is 50-200k € to cover the whole system; Installation, Solixi Control, Maintenance, Insurance, Funding and R&D; malfunction and piloting costs. Still, profits are made after expenses. The business is likely to be profitable from the start. Climate subsidies, grants and carbon tax will further improve profitability. It is clear there is **substantial demand (including willingness to pay - or rather save)** for Solixi Urban Building Hybrid Heating and Cooling System.

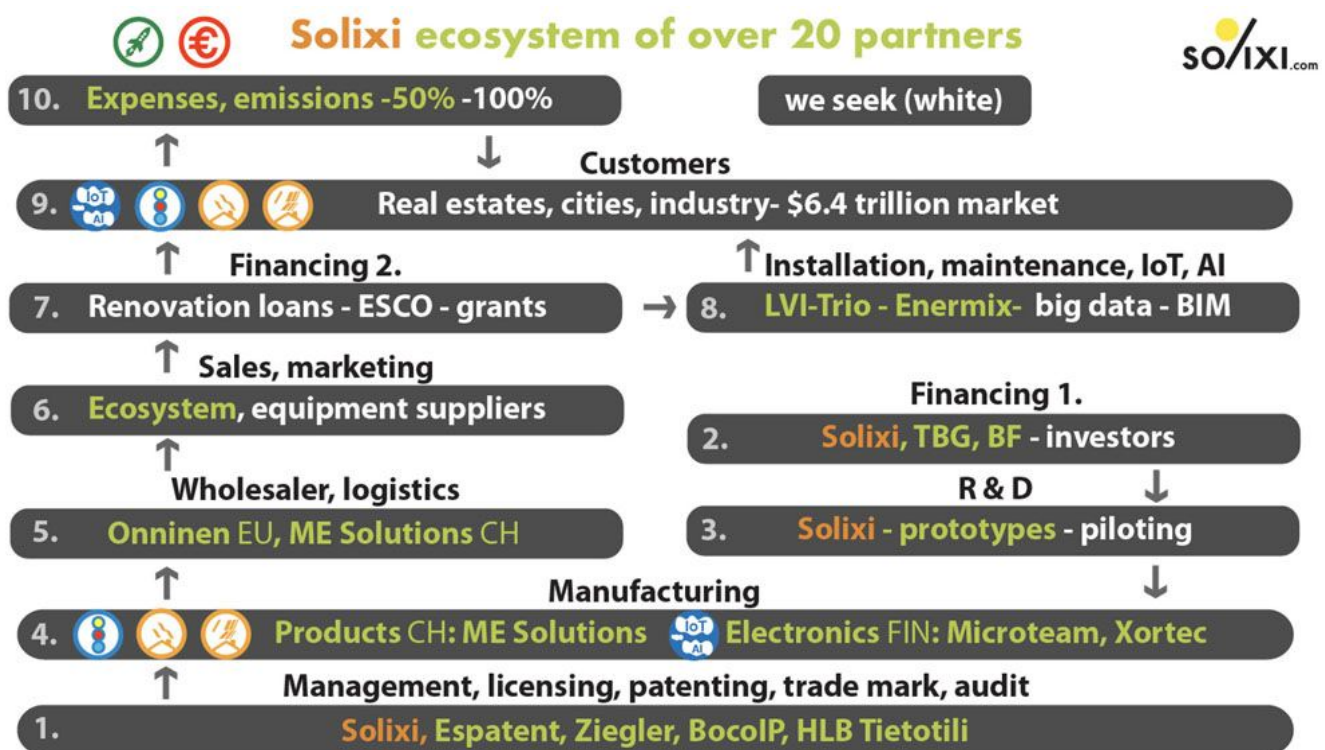
However, the leasing company requires security for the new and unknown business. An important part of this is the Solixi's ability to cope with unexpected costs and risks (1.22.), strong equity. The leasing business model and the desire to profitably switch to clean energy can be so great that it requires large amounts of capital to

finance smooth growth. **Securing funding is absolutely essential for all parties involved.**

Competitors are current market players; primarily companies burning fossil fuels but also clean energy companies when they feel threatened. In the energy sector, the economic benefits and profits are huge. It is clear that they will not accept the new system without criticism and strong opposition. In this case, no facts, emission reductions or consumer savings will be underlined. On the contrary, the facts are distorted. The real and imagined disadvantages and risks are presented as large.

Risks. **Resistance to change** in all its forms is a threat to any new system. Deliberate and unintentional misunderstandings arise and are quickly spread in the media. A large marketing budget is needed to spread the right information and at least prevent some of the above disadvantages. The risk is that there are no resources for this. **Adequate funding** helps to minimize these problems and risks. Solixi needs its own resources to support retailers and sales.

2.4. External Strategic Partners, KPI's



Solixi has a full supply chain (Graph above). Solixi's main roles are in R&D (3.) and in Market Access funding (Graph 2.). The remainder is managed by External Strategic Partners (Graph 4-10) under Solixi's supervision (Graph 1.) as agreed in the agreements and annexes.

Key partners are listed below. **Commitment** at least at the "LoI / MoU" level, piloting and prototyping etc.;

Index; Role (Graph 1-9); Name, link; Country; Years of cooperation; Competence, Commitment

2.4.1.; 3, 4, 5; [ME Solutions](#); China;; 2010 - ; [Agreement](#)

2.4.2.; 4.; [Microteam, Comatec](#); Finland, 2015 - ; [Agreement](#)

2.4.3.; 4.; [Xortec](#); 2018 -, Finland; subcontractor

2.4.4.; 5.; [Onninen](#); Nordics EU; 2018 -; **Annex 3.1., LoI**

2.4.5.; 2.; **Right Move Partners**, Finland; 2019 - ; **Annex 3.2., Agreement**

2.4.6.; 2.; [The Bassiouni Group](#) ([Convergence Finance](#)), NYC USA, 2018-2019; **Annexes 3.3. & 3.4. MoU**

2.4.7.; 1.; [Espatent](#); Finland, EU, USA; 2011 -, [Agreement](#)

2.4.8.; 1.; [BocolP](#); Finland, Global; 2012 -, [Agreement](#)

2.4.9.; 1.; [HLB Tietotili](#); Finland, Global; 2016 -; [Agreement](#)

2.4.10.; 4.; [Alanod](#), Germany, Global; 2012 -; [Subcontractor](#), **Piloting**

2.4.11.; 3, 4, 6; [Fourdeg](#); Finland, EU; 2019 -; **Annex 3.5., MoU**

2.4.12.; 3, 4, 6; [Pilaster](#); Finland, 2019 -; **Annex 3.6., MoU**

2.4.13.; 8.; [Enermix](#), Finland, 2019-; **Annex 3.7., MoU**

2.4.14.; 8.; [Leap29](#), Global recruiting, 2020-; **LoI**

2.4.15.; 6,7,8,9; **The Solixi CRM** (Customer Relationship Management) database contains hundreds of potential partners and licensees worldwide. The database is hosted at [kpi.com](#) and it is collected by Solixi's License Manager Panu Salminen from business cards, events, meetings, partners, internet etc.

CRM is a tool for rapid growth (2.2) and licensing (2.4.).

[Solixi ecosystem](#) page includes more partners and information.

KPI's, Key Performance Indicators; Solixi and its Strategic Partners **are ready to market launch.** We all look forward to funding. Once this is granted, the partners mentioned above can start actions with a delay of a few weeks or months. Pre-sales can begin at the same time. Installations of the systems can begin within a year, subject to certain restrictions. All parts and devices can be retrofitted. Almost all the products mentioned in the application will be on the market within 12 to 24 months.

The **break-even point** is reached in 2022-2023.

2.5. Intellectual property, Patenting

Solixi Oy has following patents and patent applications in force:

Title	Country	Status	Priority Date	Appl. Date	Patent No.	Patent Date
Solar energy harvesting	BE	Granted	04.11.2011	01.11.2012	2773911	12.09.2018
Solar energy harvesting	CH	Granted	04.11.2011	01.11.2012	2773911	12.09.2018
Solar energy harvesting	DE	Granted	04.11.2011	01.11.2012	2773911	12.09.2018
Solar energy harvester	FI	Granted		04.11.2011	123879	29.11.2013
Solar energy harvesting	FR	Granted	04.11.2011	01.11.2012	2773911	12.09.2018
Solar energy harvesting	GB	Granted	04.11.2011	01.11.2012	2773911	12.09.2018
Solar energy harvesting	IE	Granted	04.11.2011	01.11.2012	2773911	12.09.2018
Solar energy harvesting	US	Granted	04.11.2011	01.11.2012	9,739,506	22.08.2017
Renewable energy storing	Europe	Pending	15.11.2013	12.11.2014		

[Espatent](#) , [Solixi patent portfolio](#), Samu Lamberg, European Patent Attorney:

“Solixi Oy has a patent portfolio with patents already granted by or applied from the Finnish patent office, European Patent Office and the USPTO (USA).

The patent portfolio contains one patent family for efficient and distributed solar energy harvesting and another patent family for space and cost efficient energy storage that enables transition to solar heat collectors for virtually all buildings.

Both patent families rely on a number of robust and tested technical building blocks that possess remarkable potential in terms of both business and patenting. The inventions of both patent families are easy to detect: on the roof solar insolation harvesting structures and the high-capacity heat and cold buffers are identifiable through street views and satellite images. AI, IoT, automatisisation and remote control are part of all Solixi innovations and provided by Solixi controller. Moreover, the technical elements are very understandable. “

Freedom to operate is already well guaranteed throughout the world.

The risk is if patent portfolio does not get the funding it needs; it cannot be kept valid and expand the geographical scope. One patent application in the United States is already at risk due to lack of funding (Renewable energy storing).



Finnish Patent and Registration Office has registered ® **Solixi trademark** 15.2.2012 (Reg. no. 254530). The registration of the trademark has been expanded during the spring of 2012 (EU) and 2016-2018 (USA, China, Japan, South Korea) / [BocoIP](#)

SECTION 3 - IMPLEMENTATION

3.1. Team and capabilities

The Solixi basic idea was born in 2007 on an internet discussion forum. Experts in the fields of energy, climate and social sciences who formed the first 4-6 person team. Jyri Jaakkola was the only entrepreneur and the only one who was ready to turn ideas into business. The first patent application was filed in 2011, owner of it was STN Super Travel Net Ltd. Jyri Jaakkola and Darius Duoba designed and innovated early models of solar concentrators and water boilers. STN paid the bills until 2016 (€0,5M) when the travel marketing business was shut down and the company name changed to Solixi Ltd. Jyri Jaakkola has been full time CEO, CTO, CFO, CIO and 100% owner all these years. This has been possible due to large outsourcing and STN's steady incomes. The team and partners has done a lot for free or at very low salaries for many years;



Name, picture; Position; Department; Key Competences; Commitment; Active years, CV annex

Jyri Jaakkola (2,3,4,5,10); CEO, CTO, CFO, CIO; [Energy Innovator](#), [Installations](#), [Piloting](#), [Prototypes in Vantaa](#); 100%; 2007 - , Annex 2.1.

Jouni Heikintalo (8,9); [MES Solutions](#); China subcontracting, Piloting, Prototypes, R&D; Innovator, productization; 20%; 2014- Annex 2.1.

Peter Yan (8,9), 3D designer, China; 2D and 3D modelling; 20%; 2015-

Patrik Ljunqvist (10); Embedded systems Microteam Ltd; Solixi Controller ; 20%; 2015-2019, Annex 2.1.

Darius Duoba (1); [Solixi 3D designer](#), Vilnius; 2D and 3D modelling; 100%; 1994-2015

Panu Salminen, License Manager; Solixi ecosystem, CRM, 1.20.; 100%; 2017-18.

Juha Suni (3); Energy Consultant; HSM Energy Services Ltd.; Assistant in [fairs](#) and events; 10%; 2015-17

Guoyou He (2,5); [China Agent](#) ; Networking and Business in China, [Techcode](#) etc.; 10%; 2016-2019

Ossian Jaakkola (6) (Jyri's son); [Solixi Piloting and installations](#); Assistant; 10%; 2012-2017.

Matti Relander (7); Solixi Piloting; [Installations](#), [Piloting in Kouvola](#), Finland; 30%; 2015 -> ; Annex 2.1.

Sebastian Steuer; [Consultant](#), [Alanod](#) ex-CEO, Solixi CxO; Management; 100%; 2020->, Annex 2.2.

Plan to acquire currently missing competencies. It is obvious Jyri Jaakkola can no longer be the CEO, CTO, CFO, CIO all at the same time and no longer 100% owner and financier. Solixi already has a strong management team (2.4., 3.1.) and only needs funding to activate (3.3.) and strengthen (3.4.) it. [Leap29 specializes in recruiting](#). Financing enables this and offers the opportunity to reward the Executive Team with options and other incentive schemes. There are many companies in the Solixi ecosystem that reinforce Solixi's technology and copyright, acquisitions are a quick way to strengthen at the same the Management Team. The team members are incentivized. Many of them are committed already.

The collage consists of 18 individual photographs arranged in a grid-like fashion. The photos depict various scenes from the SO/IXI 2018 event:

- Top Row (Left to Right):**
 - A display board for SO/IXI 2018 featuring various logos and documents.
 - A large blue screen with a white grid pattern and a stylized 'S' logo.
 - A man in a suit speaking into a microphone.
 - A group of five people (three men and two women) standing together, holding informational brochures.
 - Two men standing outdoors, one in a white t-shirt with 'SO/IXI' and 'Finland' on it, and the other in a dark jacket.
 - A man pointing at a presentation screen that shows a diagram with a sun, a battery, and a car, with text in Finnish and English.
- Middle Row (Left to Right):**
 - A presentation slide titled 'Controller' with icons for 'integrate', 'store', and 'use', and text in Chinese and English.
 - Two men in suits looking upwards.
 - A man in a suit holding a brochure, standing next to a map of Finland.
 - A man in a suit holding a brochure, standing next to a map of Finland.
 - A man in a suit holding a brochure, standing next to a map of Finland.
 - A man in a suit holding a brochure, standing next to a map of Finland.
- Bottom Row (Left to Right):**
 - A man in a suit holding a brochure, standing next to a map of Finland.
 - A group of people standing in front of a building.
 - A man in a suit holding a brochure, standing next to a map of Finland.
 - A man in a suit holding a brochure, standing next to a map of Finland.
 - A man in a suit holding a brochure, standing next to a map of Finland.
 - A man in a suit holding a brochure, standing next to a map of Finland.

Solixi consultants rely on market potential and technology. They all have worked on a success fee basis; [The Bassiouni Group](#) (2018-2019), Right Move Partners (2019-), Guoyou He ([Techcode](#), [TIPark](#), 2017-2019), Paul Amit Babu ([BNA Technology Consulting India](#), Malaysia 2017-2018) - to name the most important ones. Consultants have made Pitch Decks, Investor Teasers, White Papers, Onepagers, LoI's & MoU's, Investment Mandate Letters etc. to attract investment from their network.

1. Events, pitching, match making, calls, all scaled for start-ups with one innovation, not for a system with more than 10 product lines. Usually Jyri do not even have time to read and list the product names (1.2.). [Kasvu open](#) pitching time is 1,5 minutes. Not even these 30 pages are enough to present all the products and services (1.EXCELLENCE 19 pages). Some of them are in the annexes and in [solixi.com](#), some are omitted.
2. Investors prefer simple, single solutions which fit in their current portfolio. A large system is never so simple. Solixi system-level revolution is too radical to fit almost anyone's portfolio.
3. Investors, funds, events and grants are focused on a specific area; Renewables, Energy Storage, Energy Efficiency, Electricity, Internet IoT, Big Data, AI, Clean Technology, Building Modeling, Smart Cities, Climate Actions, Recycling, Energy Renovations, Heat Pumps, Grids, Security etc. Solixi is not clearly a member of any group and is always more or less in the wrong group. Still, Solixi covers all these areas.
4. A company without revenue is worthless for banks, for some investors and public financiers, non-bankable.
5. [Business Angels](#) and seed investors cannot provide large-scale financing the ecosystem (2.4.) and huge impact (2.1.) needs. Later stage investors require first seed investment and revenue before investing.
6. [Plate Company](#) provide loans USD50M -100B and Feasibility Study Service for project financing, among others to clean energy. Solixi Ltd does not have any projects (business model is licensing) , it is non-bankable.
7. Right Move Partners, “*it just can’t be true*”, **Annex 3.2.**
8. [The Bassiouni Group Ltd. Convergence Blended Global Finance](#), 4 persons in 2018-2019, **Annex 3.3., 3.4.**

2016 Solixi was granted a loan from [Business Finland](#) (€ 134,400) to develop the Solixi controller (1.4.). The loan that eventually went into payment (€ 117,000). Repayment begins Aug. 2020.

Why Solixi has a large ecosystem and many consultants?

It is relatively easy to convince energy experts and professionals of [the enormous savings and benefits](#) within a few hours of meetings.

Only a lack of financing prevent the business and its acceleration. (3.3).

3.3. Financing needs; Valuation, Equity, Loan, Ownership, Exit, Risks

Need for investments;

Wide range of innovative products (1.2.), huge markets and impact (2.1.), growth rate (2.2.) and expanding ecosystem (2.4.) with massive serial production (1.22.) require huge investments, hundreds of billions of euros. Because Solixi's business model is licensing, most of these investments are part of the partners (2.4.) normal and profitable business. Solixi's income is just a few percent royalties.

In this scale and scope, however, millions of "seed funding" is needed. As important is securing funding and it's reliability, particularly in terms of climate policy and legislation (2.3.). Funding must be guaranteed and credible to mitigate risks (1.22.), to enable leasing (2.3.) and rapid growth (2.2.).

Break-even point is December 2022; **Financial corporate information Excel file (please ask)**

The valuation of the company is based on the market size, potential, savings, climate benefits and IPR. Year 2015 Solixi value was calculated and estimated by [EPO IP-Score](#) to €138M. After 2015, patenting has advanced and the climate crisis has become more acute. Most products (1.6. - 1.13.) and partners (2.4.) are not included in the evaluation.

Lack of revenue is the main driver of value reduction. Market entry is likely to multiply the value.

Valuation such as **Convertible Note** can be an alternative (agreement reviewed by lawyers exists).

The equity investment and/or loan requested is € X-15M / Blended Finance / Milestones.

Equity share the company plans to give in return is **XX%**.

Apply for grant can be provided as part of blended finance.

Company ownership and capital structure: **CEO Jyri Jaakkola 100%**.

The company is practically **debt-free**; debts [Business Finland](#) and CEO total €0,2M.

Exit strategy; Climate and energy policies are already at the heart of all EU policies. Both are certainly growing trends. Solixi is a political tool that the EU and energy companies will need even more in the future. Exit is not a good option for the EU, if Urban Building Hybrid Heating and Cooling System is a success. If not, the potential buyer of the shares is likely to be an energy company, which has synergies with at least one of the products (1.2.).

Risks: The probability that all products (1.2.) fail everywhere is low. The risk that Solixi will fail without adequate funding is high (1.22.).

3.4. Accelerate your business with EU funding or any acceleration program

The large and international Solixi team (2.4., 3.1.) must work closely with the EU / license holder / investor. Team members need coaching and mentoring to synchronize Solixi business with climate actions, finance and policies. In this way, previously identified **risks can be mitigated**.

3.5. Timeframe and description of implementation

Solixi Urban Building Hybrid Heating and Cooling System has two **Work Packages (3.6.)**, one **Organizational Breakdown Structure** and **Key Performance Indicators (2.4.)**. The business model is licensing and therefore flexible. Almost any resources can be multiplied by licensing and/or subcontracting.

The entire ecosystem is waiting for funding and is ready to start operating **within a few months** after funding is

granted. With the growth factor described, the impact targets (2.1.) will be reached by the **end of 2025. (end month Dec. 2025, Timeframe)**

Solixi presents only one summary, as space is limited to 30 pages for a complete description of the whole system and over 10 product lines. It still contains **comprehensive description of implementation** and, for simplicity and flexibility, can easily be upgraded to meet local market conditions. The summary enable **best value for money** in all buildings and throughout the **EU and globally**.

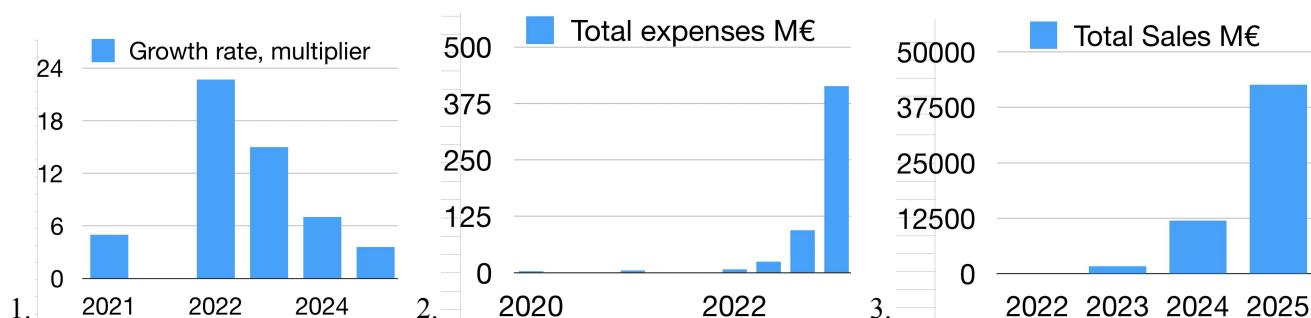
3.6. Summary table of the project, Financial corporate information Excel file

Products and TRL's are described in 1. EXCELLENCE. The target is set in 2. IMPACT.

This is a **Summary table of project** and **Financial corporate information Excel file and technological, practical and economic feasibility of the innovation..**

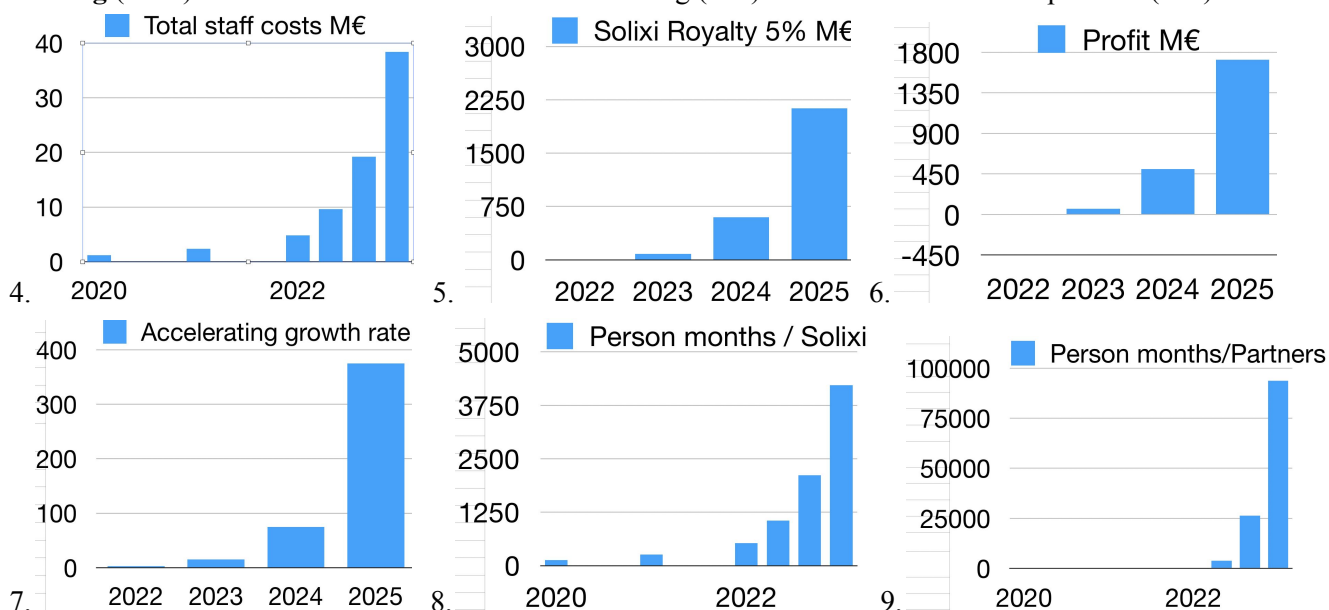
All graphs below are from the same **Financial and corporate information Excel file**, so the summary also mathematically combines elements the way the wholeness is **coherent and plausible;**

Climate actions are urgent (2.1.). All product lines, business tools and models are designed to fulfill the set goal of zero emission EU heating and cooling in **2025**;



Growth in 2020 and 2021 will be based on EUR 15 million in funding for serial production (1.22.) and extensive piloting (2.4.). **Break even point** in **December 2022**. After that, the growth multiplier decreases (Graph 1.) but sales (2.4.) grow strongly (3.).

Growth rate (Graph 1.) can be adjusted by changing the margins (3.6) royalty and financing (2.3. 2.4.). **Need for funding** is obvious in 2020-2022. **Risks:** Previously identified **risks can be mitigated** with **adequate funding** (1.22.). Trust is the basis for additional financing (2.3.) and for the activities of partners (2.4.)



Solixi incomes are royalties (Graph 5.). The percentage can vary according to the need, in summary fixed 5%.

Profitability is excellent in 2023 and beyond (Graphs 5., 6.).

Solixi can also earn revenue from 1.20. Web Calculator. Staff will (Graphs 8.,9.) model the building and make an offer, even in a few minutes for a building (copy and slightly modify). 1.21. Solixi Control can also be a paid service and a source of revenue. Savings (50-90%, in EU hundreds of billions) and benefits (1.1.) also accrue to society and the grid operator (2.1.), not just the property owner.

Growth rate, approach: In this summary, both **services** 1.20 and 1.21 are **free of charge to accelerate growth**. Marketing and other Solixi funded campaigns, subsidies (2.3.) and policy decisions (2.1.2.) regulate growth rate. These actions will be particularly needed in 2024-2025, Solixi's budget is **€ 450M** (Graph 7.).

Of course, a **lower growth rate** is sufficient if the goal is to achieve carbon neutrality in **2030** or **2050**. The pace of Climate Change, Climate Agreements and Climate Commitments require major emissions reductions by 2025. Investing in Solixi's growth is cost-effective and profitable (Graph. 6.) way to achieve the goal.

Work package number; 1.; Work package title; Large market launch

Start year / End year; 2020 - 2022.

Person months; 396 (Graph 8.) Budget, investment, loan; 15M€ (3.3.)

WP description: Resources: Solixi needs four teams and CxO's (3.1.); CEO (Management team), CFO (Financing, Grants, Budgets, EU reports, Licensing), CIO (Marketing, education for 2.4., media relations) and CTO (Technology, system integration, Computing 1.20 and 1.21). **Travel, Equipment, Services, Management Engagement, rewards and bonuses and Other** are included (Graph 4.). CEO is an experienced team founder (Annex 2.1.) and Solixi's knowledgeable staff (3.1.) and partners (2.4.) are ready for large market launch.

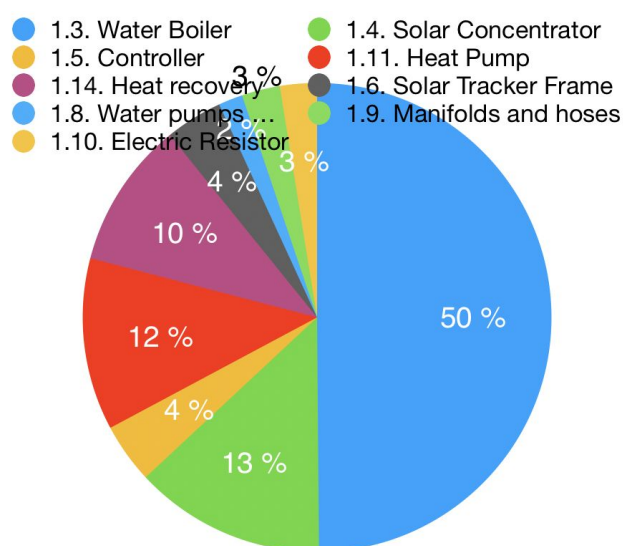
Description of tasks: **2020:** Finishing R&D (1.2.) **2021:** Serial production (1.22.), scale-up (2.2), sales (2.3.).

List of deliverables: 1.2. And 2.4.;

Number; Deliverable name; Type; Dissemination level; Delivery date

1.2.; Solixi products 1.3.-1.14. ; DEM, PU, 6-24 months

There are **375.000 urban apartment blocks in EU** (2.1. Broader impact) **and a need for as many Solixi systems**. The average investment is **€150.000, number of deliverable (smoothed average);**



1 x Solixi 15 MWh Water Boiler Tanks, €75.000. 50%.
 2 x Solixi C46 Solar Concentrator, €20.000. 13%.
 9 x Solixi Controller, €6.000. 4%.
 6 x Solixi Water-to-Water heat pumps, €18.000. 12%.
 3 x Solixi Heat Exchanger units, €15.000. 10%.
 2 x Solixi PV Solar Tracker Frame, €6.000. 4%.
 25 x Solixi water pumps, heat circles, €3.000. 2%.
 Manifolds and Flexible hoses etc., €4.000. 3%.
 13 x Solixi Electric resistors, €4.000. 3%.

Margins:

Prices include a wholesaler margin of 10-30%, a dealer margin 20-40% and Solixi's 5% royalty. VAT 0%.

Installation, Air-to-Water heat pumps (1.12.), PV Panels (1.6.) and Geothermal wells (1.13.) are outsourced to local actors (2.3., 2.4., 2.4.15.). The budget for these is €100.000, **total €250.000 investment**.

For example, removing roof-mounted solar and/or geothermal wells when not appropriate and extending the role of other devices (1.1. Hybrid system 220% ->100%) installation is dimensioned according to the needs of the individual building. Experts (2.4.) and Solixi staff (CTO team) find **the best value for money**.

1.20. 1.21.; Solixi Web Calculator, Solixi Control ; OTHER; PU; 12-24 months

2.5.; IPR ; DEC; PU; 12 months

Do you plan to subcontract any tasks? / Describe and justify the tasks to be subcontracted / Will any of your linked third parties work in the action tasks? / Will you use contributions in kind provided by third parties?; Yes, yes, yes, yes.

Budget in detail in **Financial and corporate information Excel file** and **descriptions** in 2.4. Strategic Partners and related annexes.

There are several ways to achieve goals, accelerate business and arrange financing;

Solixi guarantees and pays advances for the work of its subcontractors, can be a type of bank. If the risk materializes, Solixi Ltd will suffer losses. If the business starts as planned, Solixi will get back the warranty and earn royalties. The warranty may also be a stock purchase or acquisition when the integration benefits and added value are significant. The strategy requires capital (15M€) as part of **risk mitigation**. By licensing Solixi outsources much of its business and **unique selling points** to subcontractors and partners. Royalties are income and comparable to a share issue or investment.

One major licensing agreement with a unicorn can bring immediate profitability and secure financing (2.4.5.).

Solixi will likely get access to United States and Canada financial markets (2.4.6.).

The company may also be listed on the stock exchange.

All this is realistic after the investment and funding (3.3.).

Work package number; 2. Work package title; Profitable Blitzscaling

Start year / End year; 2022 - 2026. **Person months;** 132.000 (Graph 9.) **Investment;** 0M€, profitable business.

WP description; Profitable (Graph 6.) Blitzscaling (2.2., 2.3), **Financial and corporate information Excel file.**

Number; Deliverable name; Type; Dissemination level; Delivery date

2.1.-2.4.; Full Impact; OTHER; PU, EU 100% Clean Heating and Cooling; 24-60 months

