POCITYF
Factsheets for solutions adopted in Alkmaar

INTRODUCTION

These factsheets have been developed within **Alkmaar ecosystem**, one of the Lighthouse Cities of POCITYF. These **multidisciplinary and complementary integrated solutions** focus on **achieving energy savings** and **enabling locally produced/consumed renewable energy**.

In the factsheets you will find **key technical information** to replicate these solutions as well as **cultural heritage-related considerations** and the **impact on community**. The ambition is to make Europe the leading continent in the realization of a **self-sustainable, environmental-friendly and citizen-centred living environment in urban districts**.

Find more at https://pocityf.eu/solutions

ENERGY TRANSITION TRACK #1

- ATES
- Cascaded Heat pump
- District Heating Connection (DHC)
- Phase Change Materials
- Thermoacoustic heat pump
- Solar roofs and facades
- BEMS (Building Energy Management System)
- Combined solar roof and facade
- Circular roofing material
- Waste management tools (Madaster)
- Insulation with circular materials
- Triple glazing
- ATES (Aquifer Thermal Energy Storage)
- Solar roofs and facades

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement N° 864400.

ATES

DESCRIPTION

The goals of implementing an aquifer thermal energy storage (ATES) are to reduce the consumption of fossil energy and to increase the amount of locally produced energy specifically to be used as the primary source for heating, hot water, cooling, condensation retreatment and electric power in De Meent (PEB 1.1). This way, De Meent will become fully energy positive, without using natural gas.

More information related to the low temperature waste grid is found at IE 2.2.3. General information about the installations and energy consumption of De Meent is found in the general part of the PEB descriptions of De Meent.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

High, when a building is being isolated well.

Already demonstrated in Lighthouse cities: Yes

Cultural heritage compliance: Context dependent

PERFORMANCE

Temperature difference over the ATES: max 6°C.
Total energy supply (cold): 371 MWh;
Total energy supply (heat): 2279 MWh;
Doublet capacity: 185 m3/h;
Max water volume to be pumped: winter 400.000 m^3 and summer 250.000 m^3.

COST

€955.000

DIMENSION

The ATES is located underground.
ATES needs a water carrying layer (aquifer, preferably sand) at a depth of 150 to 500 meters beneath the surface. In Alkmaar the depth is 185 meters.

TIME

Operation since march 2023

Monitoring starts August 2023

SAFETY

Safety inspection/maintenance for the heat pumps and ATES is once a year.

SUSTAINABILITY

The ultimate goal is to realise a collective heat and cooling system in Olympiapark Alkmaar. Multiple buildings are linked to one collective heat and cold source network, where ATES is used for seasonal buffering. The function of the ATES is to supply the remaining 25% to 35% of the heat by using a heat pump if there is insufficient waste heat available from the ice machines. With the ATES the Meent reduces its gas consumption with 95%.

KEY REQUIREMENTS

ATES needs a water carrying layer (aquifer, preferably sand) at a depth of 150-500 m beneath the surface. In Alkmaar the depth is 185 meters. The relevant technical elements of the ATES concern an innovative hot/cold storage, heat matcher, heat pump, buffer vessel, existing ice machines, existing consumers of heat and cold within De Meent, piping system and thermal smart grid.

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

De Meent is located on the Olympiapark in Alkmaar, an area focused on sports and leisure activities. De Meent includes an ice rink, a top sports hall and gyms, tennis courts, various catering establishments, sports medical support and a fitness room. The total complex has an area of ca 5 ha. The Ates is located at the north and south of the Meent.

TIMELINE

The ATES is operational since April 2023.

DETAILS

The ATES is over dimensioned so that besides The Meent, also the nearby plots - hotel (under development), health centre (under construction) and an office building (under development) can be connected in the near future. This will create a locally optimized heating and cooling system, thermal storage with multiple sources.

TARGETED OUTPUT

The aims are: reduction of consumption of fossil energy with 95% and increasing the amount of locally produced energy specifically to be used as the primary source for heating, cooling and power in De Meent. In this way, De Meent will become fully energy positive.

IMPACT ON COMMUNITY

The transfer from gas consuming installations to electricity driven installations has an impact on the technical engineers from Alkmaar Sport. Their whole way of working has changed. It will take a while before they are used to the new system. For the tenants and users of Alkmaar Sport, the impact was manageable.

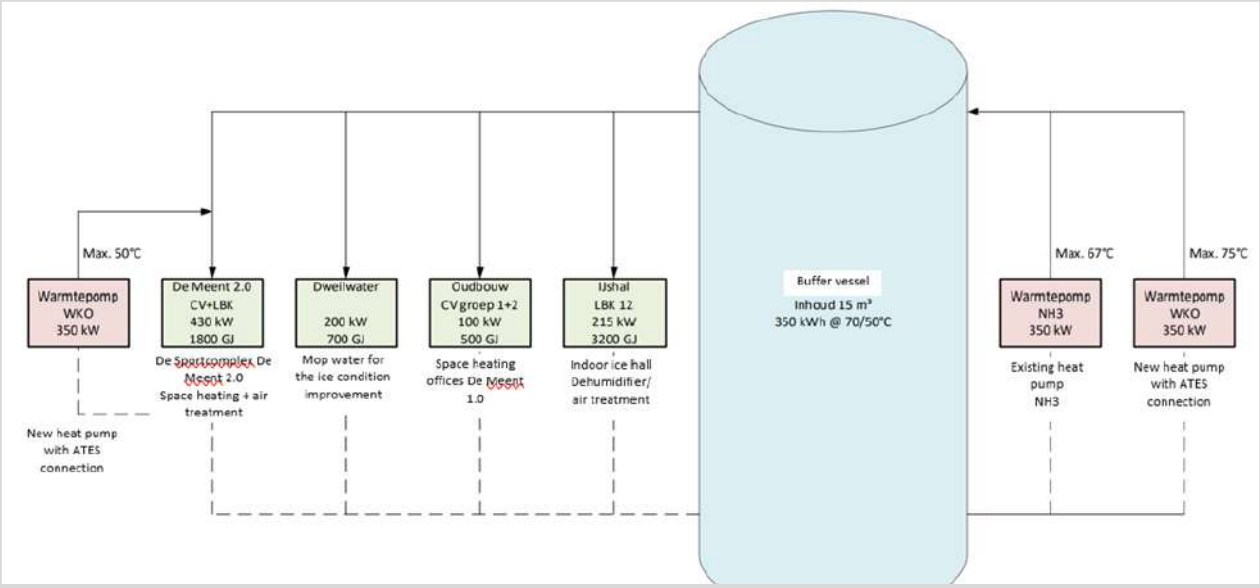
CULTURAL HERITAGE BUILDINGS COMPLIANT

Installation of an ATES requires drilling in the underground and replacement of existing heating appliances. The solution is therefore relatively difficult to implement in existing cultural heritage buildings. In specific cases an ATES could be installed when there is sufficient space for construction without harming the existing building. The ATES could therefore be considered as a useful solution when certain criteria are met. For example it requires a specific underground geology and the technical expertise to install an ATES without impact on the existing (cultural heritage) building.

OTHER COMMENTS – OPEN CONSIDERATIONS

The Ates at the Meent is over dimensioned. The municipality is working on the realisation of a collective heat and cooling system in Olympiapark Alkmaar. 6-7 buildings are linked to one collective heat and cold source network, where the ATES of the Meent is used for seasonal buffering.

Cascaded Heat pump



DESCRIPTION

This solution is constituted by multiple heat pumps in a cascaded system, and these will be used to replace gasburners. There is an advantage to the operation of multiple heat pumps working simultaneously. One of them can provide a base load and a secondary (or multiple) starts their operation when demanded, to cope with a fluctuating demand. This structure prevents a system which is constantly turning on and off. This has a negative effect on the lifespan of the system. Furthermore, the redundancy of multiple heat pumps can make possible for them to regulate and divide the performance to the optimum COP of the system.

This Innovative Element (IE) constitutes of multiple smaller heat pumps (7) in a cascaded system that are be demonstrated at De Meent (PEB 1.1). These installations will replace natural gas burners.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

High potential

Already demonstrated in Lighthouse cities **Yes**

Cultural heritage compliance **Context dependent**

PERFORMANCE

- 4 heat pumps of 50 KW (heat up water to 35°C);
- 3 heat pumps (heat up water to 65°C)
- COP: 4.06 kW/kW;
- SCOP: 5.19 kW/kW (comfort 30-35°C);
- SCOP: 4.35 kW/kW (comfort 47-55°C);
- Unit power consumption: 15,7 kW;
- Cooling capacity: 33.1 kW;

COST

€1.750.000,00

DIMENSION

- 4 new pumps and 3 old pumps
- 5x5 m3 (total 25 m3) buffer vessels
- 1 heat pump for the “Ice Machines” TR01: 350 kW;

TIME

Operational since march 2023

Monitoring starts August 2023

SAFETY

Safety inspection/maintenance for the heat pumps is once a year.

SUSTAINABILITY

Through the installation of the heat pumps and usage of the residual heat of the icing machine, gas burners are no longer needed (e.g. no CO_2 emissions)

KEY REQUIREMENTS

- Space required for a technical engineering room
- For a better performance: source with residual heat (like an icing machine)

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

The area is Sportcomplex de Meent, in particular two technical rooms (n° 2 and 4).

TIMELINE

1. Preparation phase (research, design): The detailed engineering for the integrated heating (and cooling) system, including the cascaded heat pumps was carried out from June 2021 until June 2022. The heat pumps were ordered in March 2022.

2. Delivery of the materials, equipment and technology: The heat pumps, and related equipment, were delivered in August 2022.

3. Installation//implementation of the innovative element; The first heat pumps was installed in week 43 of 2022 and final heat pumps were installed in week 47.

4. Operationalization phase: The heat pumps were operationalized in the first week of February 2023.

5. Monitoring phase; Monitoring started May 2023.

DETAILS

Manufacture: Carrier

- Type: 61WG045 water-cooled heat pump;

- Heating capacity: 48.6 kW;

- Energy Efficiency ratio (EER): 3.09 kW/kW;

- COP: 4.06 kW/kW;

- SCOP: 5.19 kW/kW (comfort 30-35°C);

- SCOP: 4.35 kW/kW (comfort 47-55°C);

- Unit power consumption: 15,7 kW;

- Cooling capacity: 33.1 kW

TARGETED OUTPUT

The Meent consists of 2 parts: The old part of the sports complex, the Meent 1.0, and the new part of the sports complex, the Meent 2.0. Four heat pumps of 50 KW each heat up water to 35 ºC for the Meent 2.0 and the remaining 3 heat pumps heat up water to 65 ºC for Meent 1.0 (older part), which will be stored in a 5x5 m3 (total 25 m3) buffer vessels. The ice machine (nr 8) heat pump with 350 kW (K91) also heats up water to 70 ºC when the ice machines are in process. When this heat pump of the ice machine is switched on, the other pumps will be working on a lower frequency or stopped. All the energy is stored in the buffer vessels and will be used for heating the building, condensation retreatment (internal ice rink) and hot water production (ice machines and dressing rooms) for the Meent.

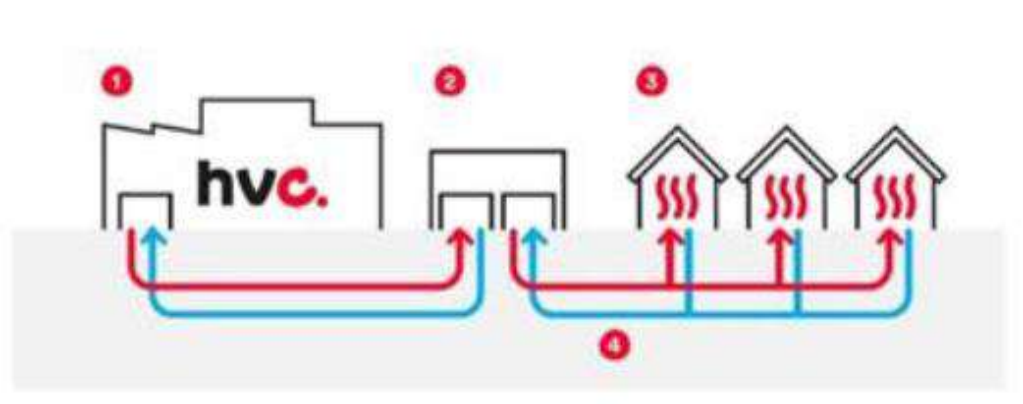
IMPACT ON COMMUNITY

The transfer from gas consuming installations to electricity driven installations has an impact on the technical engineers from Alkmaar Sport. Their whole way of working has changed. It will take a while before they are used to the new system. For the tenants of Alkmaar Sport, the impact was manageable.

CULTURAL HERITAGE BUILDINGS COMPLIANT

Cascaded heat pumps require quite some space. In order to install such a system, there should be sufficient space in a cultural heritage building to install such a system. Next to that it is required that a building is being isolated in a good way. Without good isolation a cascaded heat pump system cannot work since it uses a low temperature heating and cooling system. This solution is therefor not suitable for all cultural heritage buildings, but could be a solution when certain criteria are met.

District Heating Connection (DHC)



DESCRIPTION

As part of POCITYF, the existing district heating connection of Alkmaar is extended with two apartment buildings at the Dillenburgstraat. With reference to the figure above: (1) in this DHC water is heated at the Biomass Energy Plant. (2) This hot water is pumped to the various transfer stations in the city via an underground and insulated main network. In the transfer station, the pipeline network branches out to the homes and businesses that are connected to the heat network. (3) The hot water flows through a heat unit (in the meter cupboard) into the heating system of the home. The heat exchanger in the heat unit heats the cold tap water. (4) After heat has been released in the home, the cooled water flows back to the heat source via a return pipe. There the water is reheated and the process repeats. This IE is connected to the 'Indirect delivery sets' (IE 2.2.4), allowing for a separation between temperature and pressure between the internal and external installations.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N/A

Already demonstrated in Lighthouse cities Yes

Cultural heritage compliance Yes

PERFORMANCE

82% reduction in CO2 reduction compared to heating with natural gas

COST

To be defined

DIMENSION

Design inlet temperature: 70° C

Design return temperature: 40° C

TIME

Realization started March 2021

Completed January 2022

SAFETY

Heating via a heat grid instead of natural gas, which makes the in-house system safer.

SUSTAINABILITY

82% reduction in CO2 emissions

KEY REQUIREMENTS

- The heating installation of the houses/apartments need to be able to heat with water from 70 degrees, instead of the old heating temperature of 90 degrees. In order to make it possible to heat the buildings with a lower temperature additional insulation and/or new radiators are required.
- A suitable location for the installation of the heat exchanger and inhouse distribution system within the building.

- Make the installations for a suitable price, in order to make them affordable for the residents.

ENVISAGED DEMONSTRATION IN POCITYF

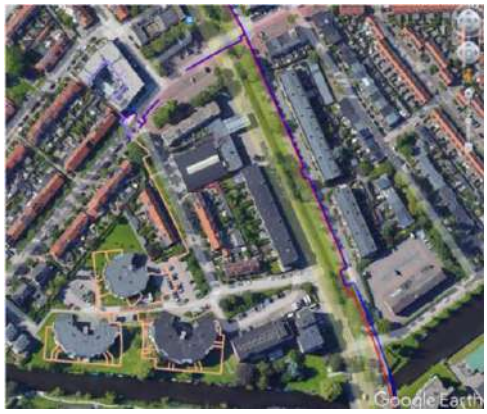
LOCATION

The heat network runs from HVC's bio-energy plant on the Jadestraat in Alkmaar via Boekelermeer, Overdie, Kooimeer, Oudorp, De Nollen and Vroonermeer to the municipalities of Broek op Langedijk and Heerhugowaard.

The 2 apartment buildings at the Dillenburgstraat Alkmaar, in the southeast of Alkmaar, are in the centre of the district heating network.

TIMELINE

- January 2019 – Start engineering/preparation phase
- September 2020 – Order of the materials has been placed
- March 2021 – Start of realization phase
- January 2022 – End of realization phase, installation is completed



DETAILS

Both building have been built in 1997 and are 25 years old. The first building, Dillenburgstraat 130-150, contains 21 apartments, with an average size of 70 square meter. The second building, Dillenburgstraat 151-182 contains 32 apartments with an average size of 60 square meter.
The Woonwaard apartments at Dillenburg in 2021 have been connected to the existing heat grid (red and blue lines) via a secondary heat net (orange lines). In each apartment the indirect delivery sets have been installed and are now taking care of heat supply. The heat supply will be monitored as part of the POCITYF project.

TARGETED OUTPUT

Two apartment blocks, with a total of 53 apartments, connected to the (existing) heat grid in Alkmaar. Additionally gas stoves were replaced with electrical induction stoves, making the apartments entirely free from natural gas. The old gas meters and infrastructure have been removed

IMPACT ON COMMUNITY

The switch from heating with natural gas to a heat network does impact the installations within the apartments. The gas boilers need to be replaced, and in some cases new radiators need to be installed since the heat grid has a different temperature range.

The installation caused some disruption within the house/apartment but only for a limited time. After installation the total system does not take up more space than the old system, therefor disruption is only caused during the installation.

CULTURAL HERITAGE BUILDINGS COMPLIANT

Technically cultural heritage buildings can be connected to a district heating. Existing gas boilers and radiators can be replaced without large impact on the building. However since the DHC operating temperature is lower than the temperature range of gas boilers the technology works better if the buildings are better insulated. The DHC should therefor often be combined with other measures as well in order to make it funtion properly in older buildings. The main limitation of district heating for cultural heritage buildings is therefor the insulation, which may have a larger impact on the building. The potential degree of usefullness for district heating is therefor highly dependent on context.

OTHER COMMENTS – OPEN CONSIDERATIONS

When the first apartments were connected, the heating system did not operate as expected. The pumps in the distribution system were designed to feed a total of over 100 apartments. Since only a few apartments were connected at that time the pumps produced too much pressure, causing the pumps to switch off. In order to solve this problem the pumps were temporarily reduced in power until the other apartments were connected as well. This should be taken into consideration for future expansions of the district heating network.

Phase Change Materials

DESCRIPTION

Phase Change Materials (PCM) store thermal energy, thereby reducing energy losses and overall primary energy consumption for heating and cooling purposes. PCM's allow heat to be stored once a certain temperature is exceeded and the same heat to be released once the temperature drops below a certain temperature in which the molecules transition from solid to fluid and vice versa. This innovative elements is being demonstrated at InVesta's center of expertise.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities No

Cultural heritage compliance No

PERFORMANCE

50% reduction in cooling capacity

40% reduction in energy consumption for cooling

20% reduction in gas usage

COST

N.A.

DIMENSION

600 x 600 mm tiles

200 m^2 total installed ceiling

TIME

Ordered November 2021

Installed June / July 2022

SAFETY

Meets the safety requirements in place

SUSTAINABILITY

Average reduction of CO_2-emissions of 13kgCO_2/year per m^2 office space

KEY REQUIREMENTS

This specific version of the PCM Ceiling has been made easy to apply in office buildings, since it is highly comparable with industry standard office ceilings. Therefor it is relatively easy to install and apply in such buildings. This makes this ceiling more difficult to apply to non-office buildings such as residential or utility buildings. A key requirement for this innovative element is therefor an office building.

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

This innovative element is demonstrated at the InVesta center of expertise, located at the Diamantweg 38 at the Boekelermeer industrial park.

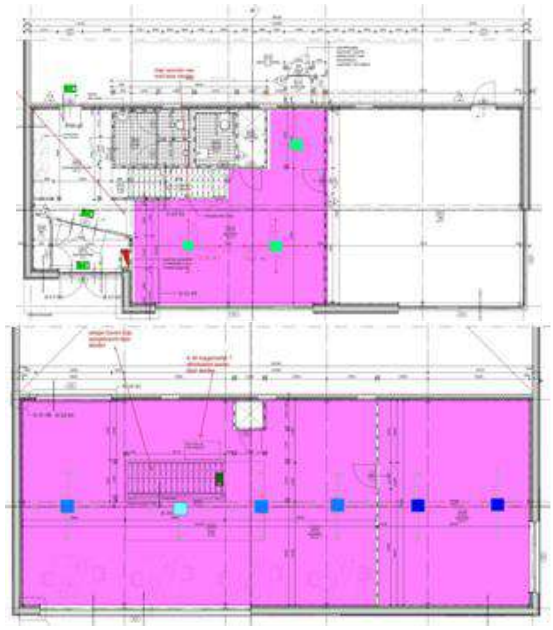
TIMELINE

In November/December 2021 the order was given to Climate Orange Autarkis.

The Phase Change Materials were delivered in June of 2022

The Crystal Climate Ceiling was installed in June/July of 2022

DETAILS



The developer of the phase change materials installed at InVesta is Orange Climate Autarkis. They have developed the Crystal Climate Ceiling (C3). This is an innovative climate ceiling made from Phase Change Materials, in this case a water/salt solution. This solution can liquify and solidify at a preferred temperature. According to Autarkis their C3 climate ceiling solution realises:

- 50% reduction of total cooling capacity
- 40% reduction of total energy capacity for cooling
- 20% reduction of gas usage
- An average reduction of CO2 emissions of 13kg CO2 / year per m2 of office space

Autarkis has installed 200m2 ‘Flush in’ 600 x 600 C3 PCM climate ceiling at the ground floor and first floor of InVesta’s center of expertise. The drawings display in pink where the C3 climate ceiling is installed in the ground (upper picture) and first floor (lower picture) of the office area.

TARGETED OUTPUT

The output of this innovative element is a ceiling made of Phase Changing Materials, improving the energy effectiveness of the building by storing and releasing heat at the desired moments. The image shows the PCM ceiling, which can hardly be distinguished from a regular office ceiling.

IMPACT ON COMMUNITY

With regards to appearance there is no impact on the users of the office space since the ceiling made of PCM can hardly be distinguished from a regular ceiling. With regards to sustainability and comfort there are only benefits, since the phase changing materials reduce the need for heating and cooling, keeping the indoor temperature more stable at reduced costs.

CULTURAL HERITAGE BUILDINGS COMPLIANT

The ceiling made of PCM in this form is mainly suitable for office spaces. The 600 x 600 tiles are an industry standard making it easy to apply in office buildings. This specific type of PCM would not be suitable for cultural heritage buildings, since it would appear the appearance of the indoor area of these buildings.

Thermoacoustic heat pump

DESCRIPTION

A 'standard' air-water or air-air, low temperature, heat pump is a well-established technology that has proven to be a good solution for replacing natural gas for heating and cooling purposes. However, the efficiency of these standard heat pumps is highly dependent on outdoor weather circumstances. Furthermore, especially for poorly insulated dwellings, this standard heat pump is often unsuitable as a substitute for more traditional – such as a gas-boiler – heating methods. Also, traditional heat pumps:

- Are expensive, compared to the gas boilers that they intend to replace;
- Are not always suited for existing houses, as they can't reach high temperatures;
- Generates noise;
- Mainly use HFC (hydrofluorocarbon refrigerants) with high Global Warming Potential (GWP).

The thermoacoustic heat pump (TAHP), an innovative heat pump that operates on the principles of sound waves, could be a solution for poorly insulated dwellings and buildings. The specific goal of this innovative element is to pilot the technology at InVesta's center of expertise (PEB 1.4) (and compare it with the performance of a more standard heat pump). It contributes to the goals of POCITYF by offering an alternative and sustainable solution for heating and cooling provisioning that might be well suitable for older dwellings and historic buildings.

The technology is developed by an Alkmaar start-up called Blue Heart Energy. Their technology, a 'thermo-acoustic heart', will replace the mechanical heart of a water/water heat pump. Their technology:

- Efficiently works with every temperature input and output (70 to 175°F) making it suitable for both new and existing houses;
- Is silent;
- Works with Helium, with a Global Warming Potential (GWP of 0), as a medium and without refrigerants;
- Has a superior Seasonal Coefficient of Performance (SCOP);
- Has a simple architecture and is easier to install, enabling a 50% cost reduction for the end consumer.

The TAHP has a rather low TRL (Technology Readiness Level) of 6. As a result, so far only a prototype has been bee developed and tested by Blue Heart Energy. Blue Heart Energy expects to manufacture a first batch of 30 TAHPs in 2023. The plan is to test one of the first batch at InVesta's center of expertise in configuration with the PVT panel as the heat source for the heat pump.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities N

Cultural heritage compliance Y

PERFORMANCE

Capacity: 6 KW

COST

N.A.

Source temperature range: -20°C to +50°C

DIMENSION

55 x 50 x 55 cm

TIME

Preparation phase started November 2021

Delivery expected 2024

SAFETY

N.A.

SUSTAINABILITY

No refrigerants with Global Warming Potential

KEY REQUIREMENTS

The thermoacoustic heat pump is currently under development, therefor not all of the key requirements are known. However in comparison to a regular heat pump the thermoacoustic heat pump has several advantages. The heat pump does not contain any harmful refrigerants, will be easier to install saving costs and will be able to provide heating at higher temperatures then other heat pumps, making the heat pump suitable for more (older) buildings.

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

This innovative element is demonstrated at the InVesta center of expertise, located at the Diamantweg 38 at the Boekelermeer industrial park.

TIMELINE

A first batch of thermo-acoustics is planned to be developed by the end of 2023. One thermo-acoustic heat pump of this batch will be delivered to InVesta by the end of 2023 or beginning of 2024.

DETAILS

Technical specifications:
Capacity: 6 KW;
Dimensions: 55 x 50 x 55 cm;
Helium at 60 bar;
Refrigerants: None;
Global Warming Potential (GWP): 0;
Source temperature range: -20°C to +50°C;
Sink temperatures: +7°C to +80°C;
Potential heat sources: Ground, Brine, Water, Air, District heating and Photovoltaic thermal (PVT) panels;
Potential applications: Underfloor heating, Air heating, Radiators, Domestic Hot water (DHW), and cooling

TARGETED OUTPUT

The thermoacoustic heat pump will be installed at InVesta in order to provide a sustainable heating source for the building.

IMPACT ON COMMUNITY

Compared to traditional heat pumps the TAHP could have a positive impact om the community since it requires less adjustments to the building and produces less noise. However since the technology is still in development the exact characteristics still need to be determined.

CULTURAL HERITAGE BUILDINGS COMPLIANT

The Thermo Acoustic Heat Pump is able to deliver heat at much higher temperature compared to traditional heat pumps. Therefor the TAHP could potentially be installed in Cultural Heritage Buildings since these buildings in general need a high temperature heat source to fulfil their heating demand. This makes the TAHP potentially a sustainable heat source for older buildings.

OTHER COMMENTS – OPEN CONSIDERATIONS

The biggest barrier that has been faced and is still ongoing is that the Technology readiness level (TRL) of the technology is currently lower than expected during the proposal phase of POCITYF. As a result, the technology is most likely to be only tested for a short period of time at InVesta's center of expertise after which it will likely undergo more tests at a different location. In this regard, the technology will be deployed as a 'pilot' instead of a 'demonstration'.

Another potential barrier is the tie-in of the technology in the broader thermal energy system of InVesta's center of expertise. The heating and cooling system at InVesta comprises of PVT panels (that produce thermal energy) (IE 1.1.14), a buffer vessel, a more standard water/water heat pump, the TAHP(, and a hydrogen solution (IE 2.1.12)). That being said, the configuration of the TAHP with the PVT panels is indicated to be a good match by Blue Heart Energy.

Solar roofs and facades

DESCRIPTION

In order to become an energy positive building, InVesta demonstrates varies innovative elements focussing either on mitigating energy losses through the application of highly thermal resistant (and circular) insulation materials and triple glazing or on producing energy. In order to produce sufficient green electricity and energy for the building three types of panels are installed at InVesta center of Expertise. These panels are regular solar panels on the roof, Building Integrated PV (BIPV) panels on the south side of the building and Photovoltaic thermal (PVT) panels on the roof.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities N

Cultural heritage compliance N

PERFORMANCE

PV panels: 47,172 kWh/year

BIPV panels: 6,160 kWh/year

PVT panels: 7,200 kWh/y and 48GJ/y

COST

N.A.

DIMENSION

PV panels: 120 panels of 1855 x 1029 x 35 mm

BIPV panels: 30 panels of 1000 x 1650 mm

PVT panels: 24 panels

TIME

Start ordering materials in May 2022

PV panels installed in August 2022

Fully operational in Q2 2023

SAFETY

All installations are in line with the general safety requirements with regards to PV and PVT.

SUSTAINABILITY

Aim of becoming a Energy Positive Building

KEY REQUIREMENTS

This innovative element requires sufficient available space on the roof and/or façade of a building. Solar panels are modular and can therefor be placed quite flexible, however in order to become an energy positive building a considerate amount of space is needed for sufficient energy production. Placing solar panels on the roof and façade can sometimes require the right permits, in the case of InVesta, being located on a business park, this was not a big challenge. However buildings located in protected area's might face this issue. Additionally sufficient capacity on the local grid is needed when the panels are connected to the grid.

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

This innovative element is demonstrated at the InVesta center of expertise, located at the Diamantweg 38 at the Boekelermeer industrial park.

TIMELINE

May 2022: Order placed for all panels, inverters and other materials

July 2022: Solar panels delivered

August 2022: PV panels installed

December 2022: BIPV panels delivered

Q2 2023: PVT and BIPV panels to be installed

Q3 2023: Monitoring period expected to start 2 months after the entire system being operational.

DETAILS

Regular solar panels on the roof
- Number: 120 panels
- Type: Jinko Tiger N-Type Mono-facial All black
- Capacity: 395 Wp/panel with a total of 47.4 kWp
- Dimensions: 1855 x 1029 x 35 mm (length x width x height)
- Set-up: East-West
- Electricity production: 47,172 kWh/year

Building integrated PV (BIPV) panels on the southern facade of the building (shown in picture)
- Facade area: 50 m2
- Type: SolarVisuals energy production facade panels
- Capacity: 154 Wp/m2 with a total of 7.7 kWp
- Dimensions: 1000 x 1650 mm (length x width)
- Set-up: southern facade
- Electricity production: 6,160 kWh/y

Photovoltaic thermal (PVT) panels on the roof
- Number: 24 PVT panels
- Capacity: 380 Wp/panel with a total of 9.12 kWp
- Set-up: East-West
- Electricity production: 7,200 kWh/y
- Thermal energy production: 48 GJ/y

TARGETED OUTPUT

Next to mitigating energy losses through the application of highly thermal resistant insulation materials and triple glazing, InVesta implements and demonstrates a variety of innovative solar panels with the ultimate goals of becoming energy positive. Through the combinations of using regular PV, Building Integrated PV and PVT panels sufficient electricity and thermal energy is harvested. In combination with other innovative elements InVesta aims to become a positive energy building.

IMPACT ON COMMUNITY

InVesta is located at the Business Park Boekelermeer, construction of the building is according to the existing zoning plan and in line with the Energy Innovation park. There is hardly no impact on the community due to the location of the building. InVesta however contributes to the energy ambitions of Boekelermeer, contributing to a more sustainable business park.

CULTURAL HERITAGE BUILDINGS COMPLIANT

The innovative element demonstrated at InVesta, being Solar roofs and facades is unlikely to be compliant with cultural heritage buildings. Placing solar or PVT panels on the roof or façade of a building has an impact on the exterior of the building, which is often not allowed on cultural heritage buildings. Potentially solar panels can be placed out of sight on the roofs of some cultural heritage buildings, however this is highly dependend on the regulations in place.

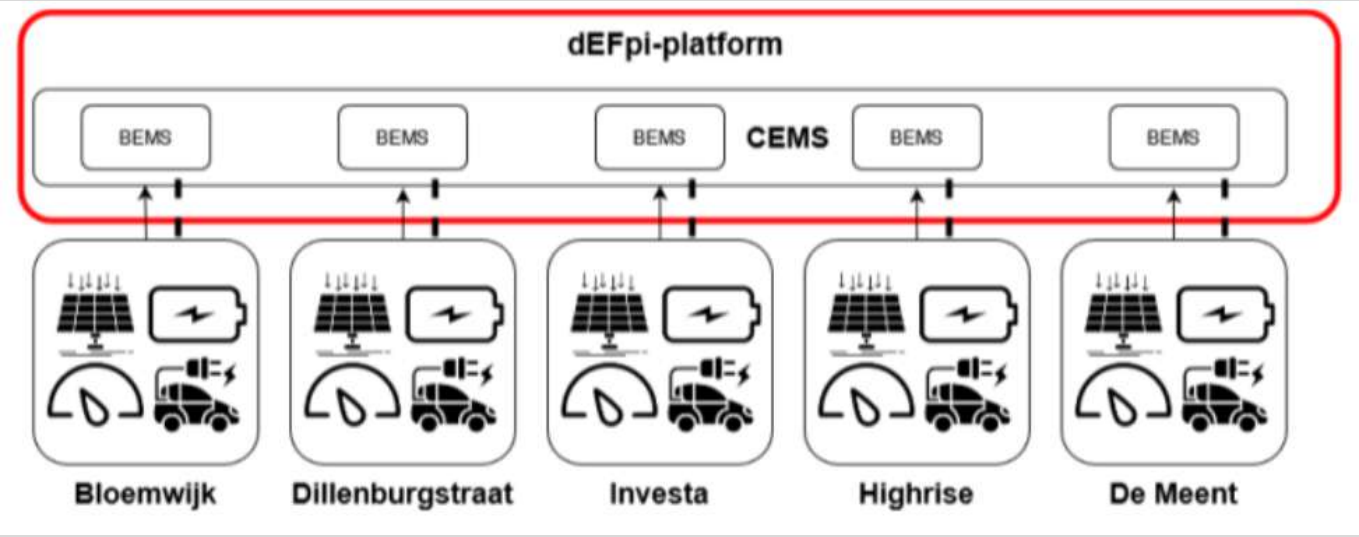
OTHER COMMENTS – OPEN CONSIDERATIONS

One of the barriers that InVesta faced/faces when it comes to the demonstration of IE 1.1.14 – Solar roofs and facades – are the long delivery times for material and equipment. This resulted in a (potential) delay in the demonstration of the solar panels and could also affect the planning of the other innovative elements. An important lesson learned is that initial estimated delivery times are often an underestimation of the reality and that the order is best to be given as soon as possible.

Another barrier was the unforeseen increase in material and equipment prices. Nowadays, similar to the belated delivery times, it is a common barrier faced within and outside the energy sector. InVesta initially planned to implement solely aesthetic building integrated PV panels that showcases the InVesta logo. However, due the financial considerations, InVesta decided to purchase both, aesthetic and less aesthetic, solar panels at the southern facade. This decision was reinforced by the fact that BIPV panels, compared to regular solar panels on the roof, have limited solar panels, which makes the investment price in €/Wp less attractive.

Finally, there is the issue of grid congestion. As a result of growing demand and supply of renewable electricity, the grid capacity has reached its limits. As a result, a growing number of regions within the Netherlands, including the Boekelermeeer in Alkmaar, where InVesta is situated, cannot connect new premises with a relatively high electricity demand and/or electricity feed in to the electricity grid. Since the center of expertise will host multiple demonstration projects with a significant electricity demand, InVesta also encounters this issue. Multiple solutions are currently being explored, and one potential solution has been identified that has the potential to solve this issue by the end of spring 2023.

BEMS (Building Energy Management System)



DESCRIPTION

The IE BEMS (building energy management system) will be used to monitor (and potentially control) energy assets throughout the pilot sites within the POCITYF-project. Per pilot area (respectively de Meent, Dillenburg, Highrise, Investa and Bloemwijk) the relevant energy devices will be connected to the dEF-Pi platform. The connections to this platform with the purpose to enable energy monitoring and control is called the BEMS. Since the platform transforms the specific data 'language' of all different instruments to a uniform communication protocol called S2, the IE Reflex of TNO is able to communicate with the devices and to manage them in favour of energy efficiency. Lastly, the BEMS of all pilots will be connected to the InHolland database.

In essence, the BEMS thus (I) monitors the performances of energy devices of all abovementioned pilot areas and (II) enables the possibility to manage and control the devices of the selected pilots in favour of energy efficiency.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities

Yes

Cultural heritage compliance

Yes

PERFORMANCE

Monitoring energy assets, collecting data which can be used to understand and improve the connected energy assets.

COST

N.A.

DIMENSION

The BEMS is mainly online

TIME

Each Innovative Element has been added to the BEMS when it was installed.

SAFETY

N.A.

SUSTAINABILITY

(Potentially) improving the effectiveness of energy initiatives.

KEY REQUIREMENTS

Establishing the connection of the energy devices to the dEF-Pi platform can be done both virtually and physically. If the device is already monitored, a virtual connection (API) will be established with the backoffice of the specific device via the communication protocol.

In case an online connection is not possible, a physical link will be implemented by means of a Raspberry Pi. This electronic instrument is connected to the specific energy device. On the Raspberry Pi, the dEF-Pi software is installed with accompanying modules that will interface the hardware in question.

A challenge with regards to the Raspberry Pi, is the fact that this instrument should be connected to the internet. In most cases this needs to be done by an internet cable. Furthermore, the aim is to generate anonymized, non-personal data with the dEF-Pi platform

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

Each pilot consists of specific energy devices. All these devices will be, either virtually or physically, connected to the dEF-Pi platform and monitored. All pilots have in common that their energy consumption will be monitored. The devices of de Meent, Investa and Bloemwijk will be used in the Reflex platform of TNO through dEF-Pi to enable the opportunity to manage and control.

DETAILS

The software innovation called “dEFpi-platform” is an open-source platform on which energy flexibility can be used on the grid. It is possible to enclose data onall energy-related devices in an area (devices that generate, consumeor store energy). This data is translated touniform ‘language’ (S2-interface) for all devices, expressing flexibility (the possibility to control the amount of energy on the grid) of each device. Third parties can monitor and control the energy grid withthis software implication.

De Meent: Neroa will connect to the local BEMS of Firan in De Meent.

Dillenburg: Dillenburg will be provided by a connection to the heating grid with indirect delivery sets and will be installed with PV-panels (212 JASolar 365 Wp solar panels, Heat/cold meter of HVC (to measure the heat usage of consumers)),

Highrise: On top of the Highrise building a so-called Powernest will be implemented. This construction contains the following devices: 912 PV-solar panels and Iwell 35 kWh battery.

Investa: Within the future building of Investa the dEF-Pi platform will be connected to the following energy devices: Ferroamp Energyhub 84kW, 5 Nilar batteries cabinets. 34,5 kWh per battery, 50 façade solar panels, 120 PV-solar panels, 30 Triple Solar PVT heat pump panels.

Bloemwijk: Within the future apartments and houses the dEF-Pi platform will be connected to the following energy devices: 55 PV-solar panels (woningen en appartement tezamen), RESU 6.5 LG batteries, The Nibe Fighter 1255 heat pump for the apartments, The Panasonic Aquarea heat pump for the houses, GoodWE Smart Meters, GW3048-EM hybride inverter.

IMPACT ON COMMUNITY

The innovative element is a mainly online tool, monitoring and potentially control other energy initiatives. By monitoring the data and allowing control the energy initiatives can be optimised in order to make them more effective. There will be no physical nuisance or impact on the community, only better insights in existing energy infrastructure which results in a higher effective use.

CULTURAL HERITAGE BUILDINGS COMPLIANT

This innovative element concerns the monitoring of specific energy initiatives. The Building Energy Management System itself does not physically impact cultural heritage building. Since the BEMS always connect to energy initiatives the compliant factor is therefor dependent on the connected initiative(s), and not on the BEMS itself.

Combined solar roof and facade

DESCRIPTION

The highrise building at the v.d. Veldelaan uses a large amount of electricity. Not only for the apartments itself, but also for the central facilities of the building (mainly lighting, ventilation and or the elevators). Woonwaard aims to locally generate a lot of electrical power for the building. The target is to cover as much electrical energy use as possible, by placing a large number of solar panels. However, as a result the of the limited roof are the total of number of solar panels is limited.

As a solution for this challenge two specific innovative elements are combined; a “lifted” solar roof with vertical solar panels on all sides of the elevated structure and on the southern facade. A traditional solar system on the roof would lead to the installation of about 310 solar panels for a total of 130 apartments (2,4 panels per apartment). This would only cover about 35% of the total electricity use of the building.

The lifted solar roof and solar facade will make it possible to mount a much larger number of solar panels on the building. In addition to the solar panels, a battery for storing the solar power will be mounted. This system will be able to cover at least 95% of the total annual electricity use of the building with an average amount of sun hours.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities No

Cultural heritage compliance No

PERFORMANCE

Covers at least 95% of electricity demand

Capacity: 380 ~ 405 W/ panel

Expected total produced energy: 248,000 kWh per year

COST

Exact costs not known (yet)

DIMENSION

Expected number of panels to place: 910

Size per panel: 1722x1134x30 mm

TIME

Building permit issued in August 2022

Construction finished March 2023

SAFETY

Construction meets safety standards and is compliant with the building legislation

SUSTAINABILITY

Solar panels will generate 95% of the building’s energy usage, including the buildings services such as lighting and elevators

KEY REQUIREMENTS

Installing enough solar panels to provide sufficient electricity for an apartment building requires a lot of space. Which is by definition limited due to the amount of apartments compared to the total roof area. Additionally the available roof surface is further reduced by local installations, air handling unites, exhaust ducts, elevator shaft etc. This innovative element requires a lifted solar roof, creating more space for solar panels. This construction requires a strong structure since the whole building will be taller and heavier. Additionally the solar façade requires a strong structure as well since the façade has to be mounted firmly against one of the sides of the building.

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

High Rise Building at the Van de Veldelaan Alkmaar.

TIMELINE

- Building permit issued in August 2022
- Materials delivered November 2022
- Construction start November 2023
- Operational March 2023

DETAILS

On top of the eleven story building, a steel construction from 3.5 meters will be constructed. On top of this construction a solar roof will be mounted. Since the panels are mounted on top of this construction the total gross area of the roof can be used and there is no limitation by other installations on the roof. In addition to that the steel construction provides an extra facade at the complete circumference of the building, which can be used for placing vertical solar panels. Together with the solar façade around 910 solar panels can be placed.

The solar panels will have the following characteristics:
-Type: Canadian Solar Full-black HiKu6/395
- Capacity: 380 ~ 405 W/panel
-Dimensions: 1722 x 1134 x 30
-Total electricity production:248,000 kWh / year.

Based on the construction and the orientation from the building not all the panels will have an optimal orientation to the sun, therefor the actual power generated per panel will variate.

TARGETED OUTPUT

The innovative element will produce nearly enough renewable energy to supply all apartments with sufficient electricity. Additionally, all central facilities (lighting, ventilation and elevators) will be supplied as well.

IMPACT ON COMMUNITY

Since the appearance of the buildings will change due to the innovative element, an architect was consulted. In consideration with the architect and the esthetical committee of the municipality two variants have been worked out. The tenants and local residents have been involved in the decision-making process after which one of the two variants has been chosen. By this the change of appearance has been chosen in close consideration with the local community.

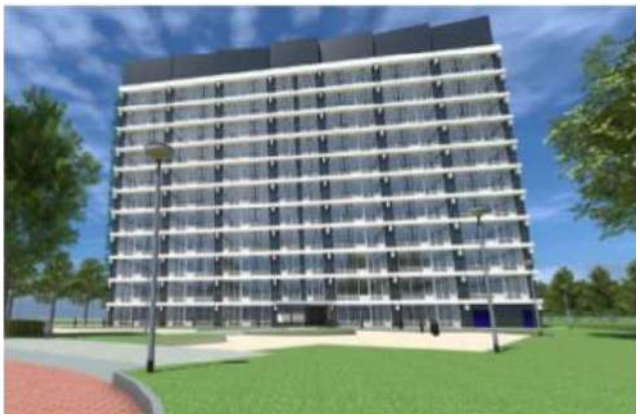
The installation of the innovative element will cause disruption to the tenants and local residents. This disruption will be mainly noise related. By combining the construction works with the implementation of other innovative elements the disruption time is kept to a minimum. Also, the disruption is temporary. While the benefits for the tenants are permanent.

CULTURAL HERITAGE BUILDINGS COMPLIANT

The combined solar roof and facades is especially designed for highrise buildings. In general, these types of buildings are not granted a cultural heritage status. Additionally the innovative element changes the appearance of the building, therefor also not making it suitable for cultural heritage buildings.

OTHER COMMENTS – OPEN CONSIDERATIONS

In order to make a final decision between one of the two designed variants, Woonwaard has consulted the tenants and the people that live directly opposite of the building. By taking the opinions of the people who live there into account there is a better support base for the permit that is acquired for the building activities. In the end the left variant has been chosen.



The initial plan from Woonwaard was to realize a “Power Nest”, a combination of wind turbines and solar panels on the highrise building at the vd Veldelaan. Unfortunately, this solution turned out not to be feasible. The existing construction of the building was not able to cope with the forces that would be generated by the power nest, without mounting excessive extra steel constructions inside the building. Next to that it turned out that maximum size of the power nest that could be realized on this building was not able to generate the amount of electricity that was calculated in the original plans. This led to the situation that Woonwaard had to search for another solution.

Circular roofing material

DESCRIPTION

On top of the highrise building at the v.d. Veldelaan a steel construction with solar panels will be mounted. The roofing material of the building is near the end of its lifespan and the isolation of the roof could be further improved. Because of the planned works on the roof of the building for the solar panel construction, this is also the right moment to renew the roofing material combined with improving the isolation.

Regular isolation and roofing materials are not circular. In fact, the most used roofing material on these type of buildings is bituminous roofing, a not sustainable, not recyclable, contaminant and fossil petroleum product. A new material on the market in The Netherlands is Leadax, a material made out of the waste of the foils in multiple layer laminated glass, called polyvinyl butyral (PVB). Woonwaard intends to use this roofing material to renew the roof of the highrise building at the van de Veldelaan, in combination with placing the steel construction with the solar panels.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities

No

Cultural heritage compliance

Yes

PERFORMANCE

Expected lifetime of Leadax: 25-30 years

Leadax can be recycled up to 7 times

COST

Context dependent

DIMENSION

Weight: 1.8 kg/m^2

Thickness: 1.5 mm

Total area: 800 m^2

TIME

Installation started October 2022

Installation finished December 2022

SAFETY

Pressure and fire resistant, in accordance with the building and insurance requirements.

SUSTAINABILITY

Circular materials instead of non-recyclable materials based on fossil fuels.

KEY REQUIREMENTS

The isolation material in this case has to be pressure resistant because of the use of the roof for major building installations. Next to the pressure resistance, the isolation material has to be fire resistant, based on the rules of the building regulations and the requirements of the insurance companies, especially in combination with the large solar panel system that is planned on top of the building.

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

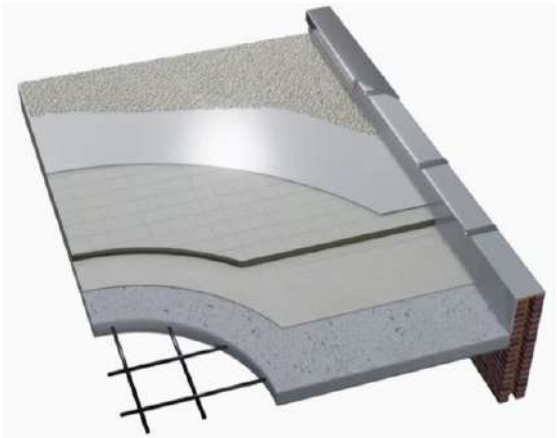
High Rise Building Van de Veldelaan Alkmaar.

TIMELINE

In October 2022, Woonwaard together with the BOS Installatiewerken started the implementation of the circular roofing material at the Highrise building. It has been finished in December 2022. The roofing material should be operational for about 25-30 years. In the first 2-3 years the roof will be inspected once every year. After this period,it will be part of the system of regular inspections (every 3-4 years) carried out at all the apartment buildings of Woonwaard.

DETAILS

A new material on the market in the Netherlands is Leadax, a material made from the waste of the foils from multiple layer laminated glass such as the front windows of cars. The material is called polyvinyl butyral (PVB) and, until now, has only been used on a small-scale roof. The about 800m2-roof at the Highrise is the first one of this size to be covered by this new roofing material. Lessons will be learned on how the material will behave over a long lifetime span (at least 20 years) and next to that experience will be gained on how the processing and mounting of the material works in “real life”.



TARGETED OUTPUT

At the highrise building first the old ballast material (mostly gravel) will be removed and set aside. The foundations of the new steel construction for the solar panels will be put in place. Then a layer of 80 mm PIR isolation will be applied on top of the old roof to improve the isolation as far up to new construction values as possible. Next, the new Leadax roofing material will be applied that will be put loose on top of the new isolation material. After that, the old ballast material will be re-used and put back on the new roofing material. By applying the additional isolation and the new roofing material in this way, the waste that will come off the old roof by the renovation will be reduced to a minimum.

IMPACT ON COMMUNITY

During construction there will be some nuisance for the tenants of the high rise building, and potentially people living nearby the building. After construction there are no negative effects for the tenants. Only positive effects as they benefit from sustainable and improved isolation.

CULTURAL HERITAGE BUILDINGS COMPLIANT

Since this innovative element regards the roofing of buildings, it does not impact the general characteristics of a building, making it in general suitable for buildings with cultural heritage. However per building it needs to be established if this material can be used, based on the characteristics of the building. The solution is most useful for planned renovation works on the roofing material or for newly constructed buildings.

Waste management tools (Madaster)

DESCRIPTION

Madaster is a land registry for materials. Buildings are registered in this online platform, including the materials and products they contain. Documenting, registering and archiving materials in buildings and structures makes reuse easier, stimulates smart design and eliminates waste. Every building becomes a depot of materials.

Re-use of materials demands registration about the location, amount and material types. The use of Madaster facilitates this. The contractor (Jorritsma Bouw) has registered the buildings in Bloemwijk witch are part of the POCITYF project at Madaster. Madaster generates an actual and detailed material passport of the buildings, thereby providing insights in the level of circularity of the buildings and visualisation of the value of the materials at the time of construction and demolition.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities

No

Cultural heritage compliance

Yes

PERFORMANCE

Gives insight in materials in buildings, increasing the potential of reusing and recycling building materials.

COST

N.A.

DIMENSION

The Madaster system is fully online

TIME

New entries in the Madaster system can be realised quickly, depending on the availability of data on the materials used.

Entry of Bloemwijk in Madaster completed in November 2022

SAFETY

Increases safety for renovation of reconstruction works in the future, since all materials in the buildings are mapped in Madaster, and available for the contractor.

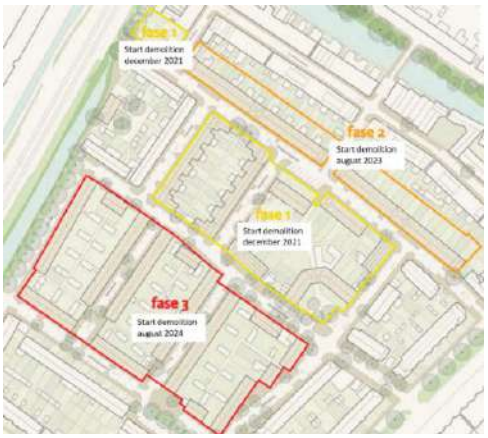
SUSTAINABILITY

Increases the potential of re-use of materials after the life cycle of the building, therefor promoting circularity.

KEY REQUIREMENTS

Requires sufficient data on the materials that are used in a building. For POCITYF newly constructed buildings in Bloemwijk will be mapped in Madaster, therefor data on the materials is relatively easily available and delivered by the contractor. Contact with Madaster is required.

ENVISAGED DEMONSTRATION IN POCITYF



LOCATION

The houses and apartments are located at the Eikelenbergstraat, Tulpstraat, Boomkampstraat and the Dahliastraat in Alkmaar. These buildings will be entered in Madaster,

TIMELINE

Van Alckmaer will demolish 179 dwellings – of which 164 rental and 15 owner-occupied – and rebuilt 170 new dwellings within the Bloemwijk area. This demolition and rebuilding process will proceed in three stages ("fases") of which the first stage will be part of POCITYF. The first demolitions started in December 2021. After which construction of the new buildings started. The materials used for construction will be logged in Madaster end 2022/beginning 2023.

DETAILS

De madaster material passport will be demonstrated throughout all constructed single-family houses and apartments.

Madaster considers the earth as a closed system where there should not be any waste. Through registration and documentation of products and materials used in the built environment, they can be reused in a circular economy and waste can be eliminated. Madaster Foundation facilitates the realization of an economy where material consumption can last for future generations through circularity. It supports the development of concepts and solutions that enables the registration, documentation, storage and exchange of data regarding materials, components and products used in our living (built) environment. A prerequisite for these concepts and solutions that Madaster Foundation supports is that data must be available for the commons – individuals, businesses, organisations, science, education, NGO's, governments, etc. – as efficiently as possible through a sustainable service that is compliant with data privacy and security requirements.

The use of this innovative element helps Van Alckmaer to map the resources, such as installations and building materials in their buildings. Future actions regarding maintenance, renovations or demolishment are made easier since all information with regards the used materials and installations can be found in the online tool. The use of Madaster helps improve the ability to re-use materials and become more circular. Also, the tool provides insights in the environmental impact such embodied carbon and use of scarce or toxic materials of the constructed buildings and/or dwellings.Van Alckmaer's constructor, Jorritsma Bouw, entered the construction materials in the Madaster catalogue. Most energy related installed were not entered in the catalogue as the exact type and brand of these installations were not known by the time of entering the project in Madaster.

TARGETED OUTPUT

An online database with all sorts of information about the materials that are being used for the construction in Bloemwijk. Madaster creates a Material Passport for each building, this passport shows which materials and products are included in the building, as well as their impact on circularity and the environment, and their potential residual value. With this passport it is easier to keep track of the materials used, making later renovations or demolitions easier. It also increases the circularity of buildings, since it is easier to see which materials can be re-used and which cannot.

IMPACT ON COMMUNITY

There will be hardly any impact on the community, since Madaster is an online tool. Most of the data of materials used in buildings is known, especially with construction of new buildings there is no need for physical inspection. In case of entering existing buildings into Madaster a physical inspection could be required in order to map all the used materials, in the case where not all materials are known. This could lead to some disruption in the functioning of the building, although it will be temporarily.

CULTURAL HERITAGE BUILDINGS COMPLIANT

The main take away for Madaster is to map all materials in a building, in order to be able to reuse them again once a building will no longer function. This circularity of materials is less useful for cultural heritage buildings, since demolition and reuse of their materials is hardly happening, because cultural heritage buildings will not be demolished and used for something new. However for more temporary buildings Madaster is a good management tool in order to increase the circularity of building materials. Additionally it can be useful for renovation works as well, since the materials in the existing building are known, and therefore the renovation materials can be chosen based on this data. This makes Madaster in potential also compliant for cultural heritage buildings. However the tool is more useful when all used materials are known and there is a high change of renovation or re-use in the future.

DESCRIPTION

The most sustainable energy is the energy not being used. With this fact kept in mind, the first aim of Insulation with Circular materials is to minimize heat losses at dwellings and buildings. Also, insulation materials are often based on new raw materials, toxic and disregarded after its lifetime at a dwelling or building. Therefore, the second aim of the implementation of this innovation element is the usage of non-toxic, second-life materials or organic materials. The innovative element is being implemented at the demonstration site of Bloemwijk and InVesta.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities No

Cultural heritage compliance Partly

PERFORMANCE

Bloemwijk: Thermal conductivity of 0.022 W/(m.K)

InVesta: Thermal conductivity of 0.038 W/(m.K)

COST

Not known (yet)

DIMENSION

Isovlas panels: 1200 x 600 x 60 mm

TIME

Bloemwijk: terraced houses, installed September 2022

Bloemwijk: apartments, installation started November 2022, will be finalised in February 2023

InVesta: installed May 2022

SAFETY

All insulation material is compliant with the building legislation and safety standards

SUSTAINABILITY

Isovlas: 100% sustainable and ecological

KO Enertherm PIR: contains 8% recycled PET-bottles and is reusable

KEY REQUIREMENTS

Houses need double outside walls (spouwmuren) for the material to be applicable.

LOCATION

Bloemwijk: The houses and apartments in Bloemwijk are located at the Eikelenbergstraat, Tulpstraat, Boomkampstraat and the Dahliastraat in Alkmaar.

InVesta: is located at the Diamantweg within the Boeklermeer Business Park, in the southeast of Alkmaar.

TIMELINE

Bloemwijk:

Van Alckmaer has demolished 179 dwellings – of which 164 rental and 15 owner-occupied – and will rebuild 170 new dwellings within the Bloemwijk area. This demolition and rebuilding process will proceed in three phase of which the first phase, containing of 42 apartments and 11 houses, will be part of POCITYF.

The insulation with circular material at the terraced houses of Bloemwijk is implemented in September 2022. The implementation of circular insulation materials at the Hulsthof apartments has started in November 2022 and is scheduled to be finalized in February 2023.

InVesta:

The Isovlas circular insulation material and Knauf inner wall system at InVesta's center of expertise were installed in May 2022. The final go for the to be installed Isovlas was given by March 2022 after which the contractor installed the wall system and insulation material within two months.

DETAILS

Bloemwijk:

The constructed terraced houses and apartments and Bloemwijk will have an energy need below 50 kWh/m²/year and some even below 30 kWh/m2/year. In order to achieve the insulation values, and to comply with the circularity requirements of the installed materials, the constructor of Van Alckmaer placed IKO Enertherm PIR (polyisocyanurate) panels. This material fits the POCITYF purpose to the implement circular insulation materials as it consists of at least 8% recycled PET-bottles and can be re-used after its end-of-life at the Bloemwijk dwellings. The insulation material reaches a thermal conductivity of 0.022 W/(m.K).The left picture below displays the IKOEnertherm PIR panels and the right picture shows the installed panels at one of the terraced houses at Bloemwijk.

Investa:

The program requirements, drafted together with NEC and the municipality of Alkmaar, set out the minimum thermal resistance of the office area of the InVesta's center of expertise:
- Rc-value floor = >5 m2K/W
- Rc-value facade = >6.0 m2K/W
- Rc-value roof= >6.5 m2K/W

The contractor, Tervoort, together with InVesta explored potential insulation material that meets the thermal resistance and circularity requirement. Eventually, Tervoort installed Isovlas insulation panels at the inner walls that were provided by Stiho. The dimensions of the panels are 1200 x 600 x 60 mm (length, width, thickness) and have a thermal conductivity of 0.038 W/(m.K). Isovlas construction insulation is 100% sustainable, ecological and cradle-to-cradle. An impact analysis was conducted based on four principles of sustainability to determine the sustainability performance of the material throughout its lifetime. The principles of a completely sustainable product are:
- No more and faster extraction of raw materials than nature can process.
- No more and faster usage of toxic elements than nature can process.
- No faster degradation of nature than it takes to heal such as deforestation, construction, pollution, etc.
- No activities to hinder people in basic needs such as health, safety, human rights, etc.

Next to the implementation of Isovlas in the inner walls, the inner walls themselves are also circular. Tervoort installed Knauf hybrid circular (inner) wall systems. These systems use old 'harvested' and new dry/plaster walls. Through the combination of (re-)using old and new panels the system is more circular than traditional inner wall system without compromising the performance of the system. Key specification of the Knauf hybrid (inner) wall systems are:
- Unique sustainable inner wall system with re-used/harvested drywall panels
- Wall system with a 25% reduced environmental impact
- Similar performance compared to conventional systems
- Material can be re-used after its lifetime

TARGETED OUTPUT

The expected output are energy efficient buildings with minimal heat losses, by the use of insulation materials that have a minimal environmental impact by being circular and made from sustainable raw materials.

IMPACT ON COMMUNITY

Since the insulation is added during the construction of the Bloemwijk residences and InVesta there is very little negative impact on the residents and surrounding community. Yet comfort and sustainability for the users increases whilst the energy costs are substantially reduced. Adding the insulation to existing buildings will cause larger disruptions for the owners/users, however this effect is temporarily, while the benefits are permanent.

CULTURAL HERITAGE BUILDINGS COMPLIANT

This Innovative Elements tests the use of circular isolation in double walls (spouwmuren), which is required in order to place the isolation. Many historical buildings do not have double walls, as this was not a common building technique since only a few decades. Therefor this isolation can probably not be integrated in many heritage buildings. However the IE is located inside the walls and therefore not visible, so if it is applied in heritage buildings with double walls, it does not change the outside appearances. To conclude, in general this solution is not useful for cultural heritage buildings since a double wall is required. More useful for renovation and newly built buildings.

Triple glazing

DESCRIPTION

The innovative element of Triple Glazing will be both tested in newly constructed houses in Bloemwijk (PEB 1.3), and at the experise centre InVesta (PEB 1.4).

Bloemwijk

Jorritsma Bouw, a construction company that is awarded the construction of the new building blocks at Bloemwijk, applies an energy concept based on the Trias Energetica:

- Limit the energy demand (highly isolated outer shell).
- Use of renewable energy (heat pumps, heat recovery ventilation and solar panels).
- If fossil fuels are required, use them as efficient and clean as possible (via innovative installations).

The general challenge that this “triple glazing” Innovative Element (IE) aims to overcome relates to the first aspect of the Trias Energetica. Triple glazing, with its high insulation level, reduces the heat that is lost through the windows. An additional benefit of the use of triple glazing is that it serves as an excellent acoustic wall and has a low solar entry factor (G-value), meaning that it keeps out the outside heat during the summer and keeps the heat inside during the winter.

The specific challenges in implementing this IE in (social) housing development are both technical (it needs non-standard window frames) and financial (more expensive than the alternative). This demonstration aims to show that the use of the IE is both technically and financially feasible for (social) housing developments. The picture below showcases the implemented triple glazing as part of the first terraced houses being finalized by February 2023.

InVesta

As of January the 1st 2021 newly constructed dwellings and utility buildings in the Netherlands are legally obligated to be (nearly) energy neutral, or in Dutch '(bijna) energieneutraal' (BENG). This BENG is part of the Trias Energetica, a three-step strategy to make an energy efficient design for dwellings and (utility) buildings. To calculate the energy performance of these newly constructed dwellings and buildings there are three BENG indicators:

- BENG-1 – Total energy demand indicator (kWh/m2)
    - This indicator covers the total energy usage of the heating and cooling system of dwellings and buildings
- BENG-2 – Primary fossil energy indicator (kWh/m2)
    - This indicator covers the total primary fossil fuel energy usage
- BENG-3 – Share of renewable energy (%)
    - This indicator covers the share of renewable energy sources (RES) of the primary energy usage

In the case of the first BENG indicator, utility buildings such as InVesta are required to have a total energy consumption of ≤90 kWh/m2. An energy efficient building envelope with limited energy losses forms a key element in this indicator. To comply with this first BENG requirement, InVesta aims to minimize heat losses during the winter and heat entering the building during the summer. Through the demonstration of triple glazing with accompanying well insulated frames, and in combination with the demonstration of circular insulation materials, InVesta will keep heat losses to a minimum.

InVesta's centre of expertise has been delivered in July 2022 at the Diamantweg 38 in Boekelermeer industrial park (Alkmaar). The center of expertise, whose dimensions are 20 x 28 meter, will cover +/-375 m2 workplace, +/-65 m2 laboratory and +/-200 m2 office place (first and second floor). The picture on the left showcases the building and also indicates the triple glazing that will be demonstrated in the front and right façade of InVesta's center of expertise.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities

Yes

Cultural heritage compliance

Context dependent

PERFORMANCE

Expected insulation level: 0.60 W/K*m^2*K (combination of frame and glass)

COST

More expensive than 'regular' or double glazing, but highly dependent on size and supplier

DIMENSION

Frames need to be bigger, to support the triple glazing

TIME

Bloemwijk: Construction of the dwellings started in 05-22 and is finished in 01-23, the apartments will be finished in 07-23. The triple glazing will be installed during this construction

Investa: Construction started 12-21, triple glazing was installed in 05-22 and the building has been completed in July 2022

SAFETY

Manufactured according to the glass standard requirements

SUSTAINABILITY

Insulation will be better compared to normal glazing, reducing energy losses

KEY REQUIREMENTS

Triple glazing is thicker and heavier than other types of glass. Therefor it needs non-standard window frames and is more expensive than the alternatives. Placing triple glazing in existing buildings does therefor sometimes require the replacement of the window frames as well.

LOCATION

Bloemwijk: The houses and apartments are located at the Eikelenbergstraat, Tulpstraat, Boomkampstraat and the Dahliastraat in Alkmaar.

InVesta: Investa is located at the Diamantweg in the industrial area Boekelermeer

TIMELINE

Bloemwijk: Van Alckmaer will demolish 179 dwellings – of which 164 rental and 15 owner-occupied – and rebuilt 170 new dwellings within the Bloemwijk area. This demolition and rebuilding process will proceed in three stages ("fases") of which the first stage will be part of POCITYF. The first demolitions started in December 2021. Bloemwijk: Construction of the new dwellings started in 05-22 and is finished in 02-23, the apartments will be finished in 07-23. The triple glazing will be installed during this construction.

Investa: Construction started 12-21, triple glazing was installed in 05-22 and the building has been completed in July 2022

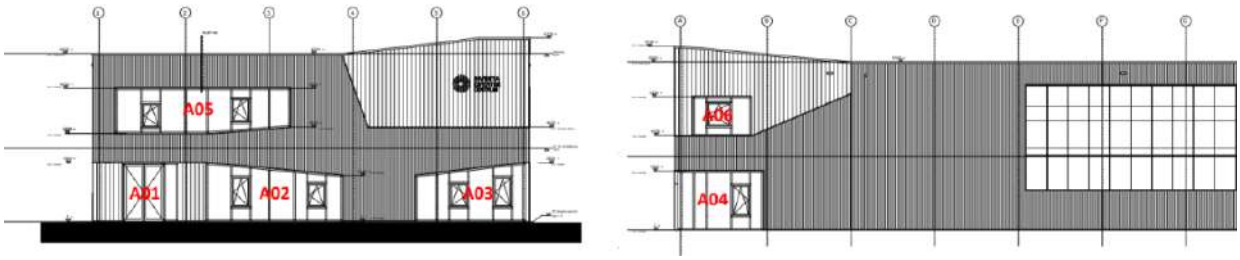
DETAILS

Bloemwijk

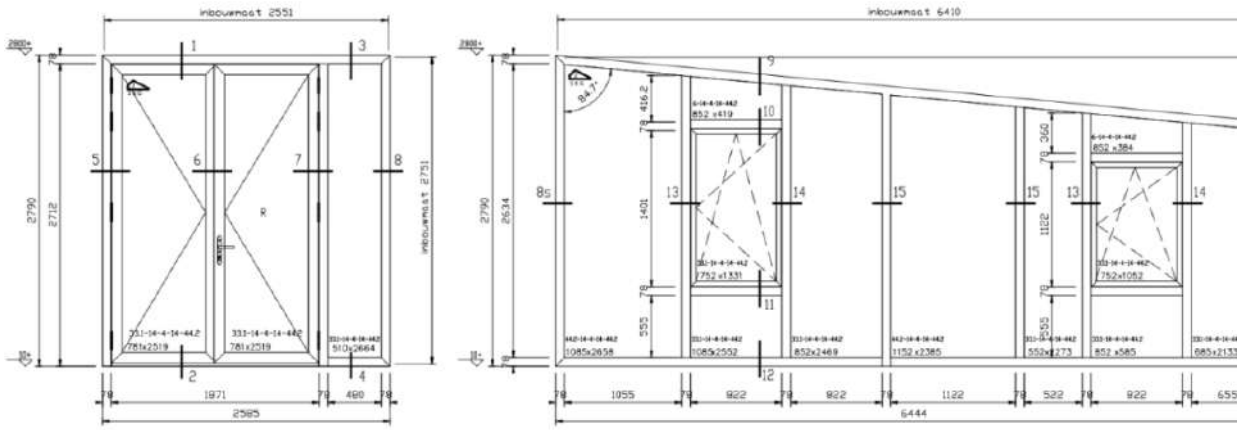
The constructed terraced houses and apartments and Bloemwijk will have an energy need below 50 kWh/m²/year and some even below 30 kWh/m2/year. The insulation value of the to be installed triple glazing was set at 0.60 W/m².K.The window frames at the first 11 terraced houses are delivered by Scheuten and installed by the contractor (Jorritsma Bouw) in September/October 2022. The installed glazing is triple layered Isolide glazing.

Investa

The frames including triple windows are delivered by Akuflex and installed by the contractor (Tervoort). The windows have a heat loss rate (U) of 0.6 W/m²K. The dimensions of the window frames are provided in the picture below:



A02 A01



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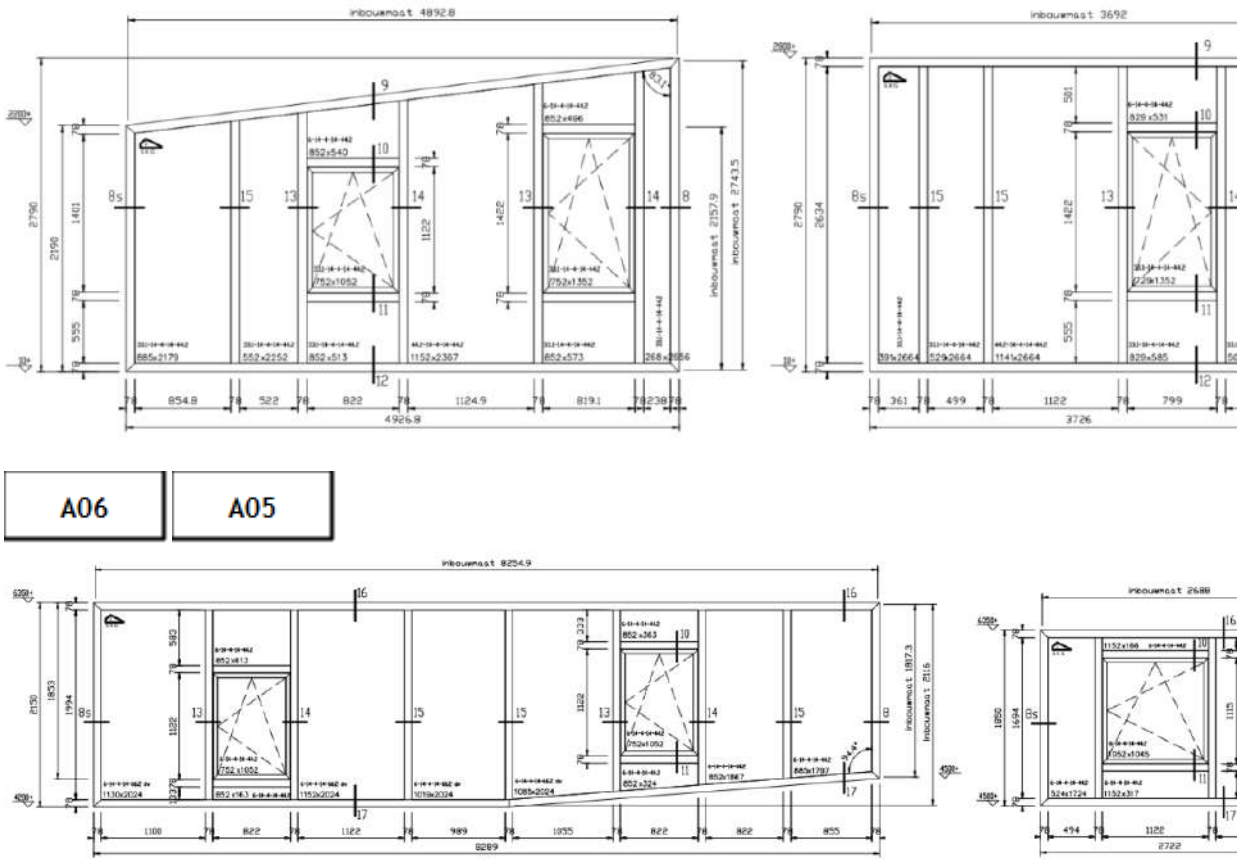


TARGETED OUTPUT

This demonstration aims to show that the use of the IE is both technically and financially feasible for (social) housing development. The triple glazing will decreases the heat losses and increase the comfort and energy efficiency of the buildings. Moreover, the monitoring will show the value of the use of this IE for the improvement of the insulation values and – therefore – the energy efficiency of the buildings.

IMPACT ON COMMUNITY

This Innovative Element will be installed during the construction of newly built buildings, therefor there is no (extra) impact on the community. Installing in existing homes would be more invasive due to the need to replace existing windows, however the nuisance can be kept to a minimum. Also the disruptions will be temporary, while the benefits are permanent.

CULTURAL HERITAGE BUILDINGS COMPLIANT

Triple glazing requires bigger frames, as the glazing is thicker than regular glass. Cultural heritage buildings in general still have original glazing, which does not insulate well. Replacing this glazing would in many cases mean replacing the frames as well, which could have an impact on the cultural heritage. Depending on the building and local regulations triple glazing could not be applied in all historical buildings. Therefor this solution is mostly useful if window frames already meet the requirements or can be adjusted without too much impact.

OTHER COMMENTS – OPEN CONSIDERATIONS

The Innovative Elements is only one part of state of the art insulations for buildings, combined with well insulated frames and other circular insulation materials it will minimise the heat losses in the winter and heat entering in the summer. Increasing the sustainability and comfort in these buildings.

ATES (Aquifer Thermal Energy Storage)

DESCRIPTION

The Aquifer Thermal Energy Storage (ATES) will provide renewable source-heat for the heat pumps in the 42 Hulsthof apartment buildings of Bloemwijk. The heat pumps provide the heating and cooling demand of the apartments. The ATES consists out of vertical heat exchangers that are drilled into the ground and are connected to individual heat pumps. Above the heat exchangers, the foundation/base of the apartment building is placed. The ground source/water heat pumps will be connected to the sources. The heat pumps will use the stored heat in the soil for heat provisioning in the cold seasons, and during the summer season the heat pumps will give off the heat to the soil to (passively) cool down the apartments at Hulsthof. By using a closed system the ground source will not be depleted.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities: No

Cultural heritage compliance: Context dependent

PERFORMANCE

Total capacity of the ATES: 120 kW

Capacity of the heat pumps: 5 kW

COST

N/A

DIMENSION

The ATES is underground

The connected heat pumps are 1800 x 620 x 620 mm.

TIME

Operational in July 2023

Monitoring starts August 2023

SAFETY

Safety inspection/maintenance for the heat pumps once a year

SUSTAINABILITY

The ATES in combination with heat pumps will supply space heating and domestic hot water to the apartments.

KEY REQUIREMENTS

An ATES requires a specific underground geology in order to be able to store and extract heat from the soil, therefor this innovative element is not suitable for all locations. Additionally the constructions and drilling of an ATES is highly specialised

and requires the right expertise from the installer, which are currently very limited available in the Netherlands due to high demand.

ENVISAGED DEMONSTRATION IN POCITYF

LOCATION

The ATES will be demonstrated in the 42 Hulsthof apartments, located in the Bloemwijk Neighbourhood in Alkmaar.

TIMELINE

- The heat exchangers of the ATES have been drilled in August 2022
- The heat pumps are scheduled to be delivered in May 2023
- The heat pumps will be installed in May / June 2023
- The ATES will be operational in July 2023
- The monitoring of the ATES will start within two months after it is operational

DETAILS

This overall all-electric heating concept is connected to a closed source in the soil. By utilizing a closed system that not only extracts but also inserts heat, the ATES is prevented from exhaustion. The total capacity of the ATES is +/- 120 kW and the connected individual heat pumps will likely be the Nibe F1255 heat pump with a capacity of 5 kW. The image shows the connection to the ATES in the foundation of the apartments.

TARGETED OUTPUT

This innovative elements has a targeted output of 42 apartments connected to the Aquifer Thermal Energy Storage, thereby being connected to a sustainable heat source. By utilizing a closed system that not only extracts but also inserts heat, the ATES is prevented from exhaustion and therefor renewable. By implementing this innovative element there is no need for the use of natural gas for heating, therefor the apartments are all-electrical.

IMPACT ON COMMUNITY

In this case the ATES has been installed during the construction of apartments, thereby not causing extra disturbance to the neighbourhood. Once finalized the ATES will provide renewable, affordable and comfortable heat and cooling to the apartments. It might take some time for the tenants to get used to the system, since the heating system is different than a system which relies on natural gas.

CULTURAL HERITAGE BUILDINGS COMPLIANT

Installation of an ATES requires drilling in the underground and replacement of existing heating appliances. The solution is therefore relatively difficult to implement in existing cultural heritage buildings. In specific cases an ATES could be installed when there is sufficient space for construction without harming the existing building. The ATES could therefore be considered as a useful solution in when certain criteria are met. For example it requires a specific underground geology and the technical expertise to install an ATES without impact on the existing (cultural heritage) building.

OTHER COMMENTS – OPEN CONSIDERATIONS

Construction of an ATES requires dedicated knowledge. Due to the large amount of work with regards to ATES it takes a lot of effort to find drilling companies being able to do the work.

In the early stages the ATES required permits from the municipality. Applying for this type of permit was relatively new for Van Alckmaer and required some effort in order to figure it out. However the process went smoothly.

It should be noted that the ATES in combination with the ground source heat pumps will only be used for the heating demand of the Hulsthof apartments. For the terraced houses individual air/water heat pumps will be installed that operate independently from the ATES. Those heat pumps will be individual heat pumps with a capacity of 5 kW. The individual air/water heat pumps will be connected to the low-temperature heating system of the house.

Solar roofs and facades

DESCRIPTION

Jorritsma Bouw, a construction company that is awarded the construction of the new building blocks at Bloemwijk, applies an energy concept based on the Trias Energetica:

- Limit the energy demand (highly isolated outer shell),
- Use of renewable energy (heat pumps, heat recovery ventilation and solar panels),
- If fossil fuels are required, use them as efficient and clean as possible (via innovative installations).

The most urgent challenges at the different buildings blocks in Bloemwijk that are solved by this Innovative Element (IE) are the replacement of fossil fuels by renewable energy sources and the creation of energy self-sufficient building blocks. These challenges relate to the 2nd aspect of the Tris Energetica.

The old building blocks use natural gas to cover the heat demand and grey electricity from the electricity grid for the electric appliances. In the new building blocks, solar panels will generate green electricity that that will not only (largely) cover the direct electricity demand of the blocks, it will also (largely) cover the heating demand via by the use of heat pumps. This way, the IE creates more energy self-sufficient building blocks (over 90%) whose CO2 emissions are greatly reduced.

INDICATORS

POTENTIAL DEGREE OF USEFULNESS

N.A.

Already demonstrated in Lighthouse cities Yes

Cultural heritage compliance Context dependent

PERFORMANCE

Annual electricity production estimation: around 310.000 kWh/year

Expected life cycle: 20 years

COST

Partly paid by the tenants via a fixed rate per panel, per month included in the service fee

Monthly rate paid by the tenants will always be lower than the monthly earnings of the panels, so the tenants will benefit

DIMENSION

Ja Solar 395wp: 1722x1134x30 mm

Amount: 635 panels

Hyundai VG 395wp: 1719x1140x35mm

Amount: 187 panels

TIME

First phase will be realised in January 2023

Second phase will be realised in July 2023

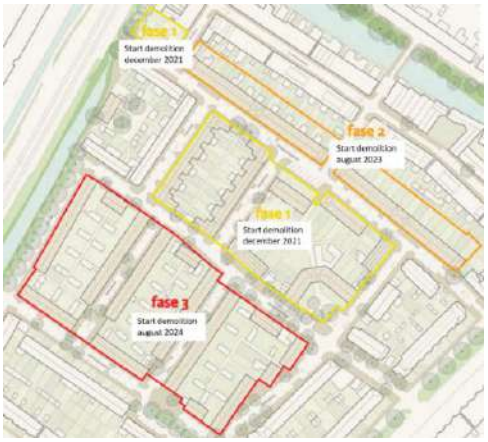
Small risk of fire, this is reduced with proper installation.

The panels will generate sufficient green electricity to make the neighbourhood net positive

KEY REQUIREMENTS

For the innovative element of solar panels on buildings of a housing cooperation clear agreements between the corporation and the tenants need to be made. Since the investment is made by the corporation, but the tenants benefit through their electricity bills, clear funding and ownership schemes need to be in place. This requires cooperation between the tenants and the housing corporation. Additionally the roofs need to be eligible for PV-panels, and generate sufficient electricity to make the business model feasible for both the housing corporation and the tenants.

ENVISAGED DEMONSTRATION IN POCITYF



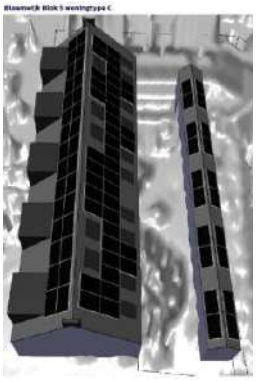
LOCATION

The houses and apartments are located at the Eikelenbergstraat, Tulpstraat, Boomkampstraat and the Dahliastraat in Alkmaar.

TIMELINE

Van Alckmaer will demolish 179 dwellings – of which 164 rental and 15 owner-occupied – and rebuilt 170 new dwellings within the Bloemwijk area. This demolition and rebuilding process will proceed in three stages of which the first stage will be part of POCITYF. The first demolitions started in December 2021. After which construction of the new dwellings and apartments started shortly after.

The solar panels on the roofs of the dwellings has been installed in January 2023. The solar panels on the roof of the apartment blocks is scheduled for Q2 of 2023, since the apartment blocks are still under construction.



DETAILS

A Positive Energy Building (PEB) can be created by maximizing the Renewable Energy Sources (RES) and minimizing the total energy consumption of that building. To achieve the maximization of RES, Van Alckmaer demonstrates Solar roofs and facades (IE 1.1.14)through the installment of PV panels on top of the roofs and sheds of the terraced houses and on top of the apartments blocks of Bloemwijk (PEB 1.3).

In total, 822 solar panels will be installed at the 11 terraced houses and 42 apartments of Bloemwijk with 143 panels being installed on the roof of the terraced houses, 44 at the sheds of the terraced houses, and 635 being installed on the flat roof of the 'Hulsthof' apartments. The image shows the configuration off the solar panels on the terraced houses.

Terraced houses
-Number: 187 panels: 143 (roof) and 44 (shed) panels (17 per dwelling)
-Type/brand: Hyundai
-Capacity: 395 Wp/panel with a total of 74 kWp
-Micro-inverter: Enphase
-Set-up: North-Northeast and South-Southwest
-Electricity production: 70 MWh/year

Apartment blocks
-Number: 635 panels
-Type/brand: Ja Solar
-Capacity: 395 Wp with a total of 251 kWp
-Set-up: flat on the roof of the apartments
-Electricity production: 240 MWh/year

TARGETED OUTPUT

The old building blocks used natural gas to cover the heat demand and grey electricity from the electricity grid for the electric appliances. In the new building blocks, solar panels will generate green electricity that that will not only

(largely) cover the direct electricity demand of the blocks, but also cover the heating demand by the use of heat pumps. This way, the IE creates energy self-sufficient building blocks whose CO2 emissions are greatly reduced.

IMPACT ON COMMUNITY

In order to make the buildings energy efficient they had to be replaced. The buildings have been demolished and replaced by new houses and apartments. The residents have been offered to return to the newly build homes, which some of them did. The replacement impacts the community greatly, but benefits the tenants greatly in the long run by providing them with new, energy efficient and comfortable homes.

CULTURAL HERITAGE BUILDINGS COMPLIANT

In this scenario the older buildings have been replaced by newly build houses and apartments, this part of the element is not compliant with cultural heritage buildings. Since cultural heritage buildings will not be demolished and replaced. The funding and ownership scheme between the housing corporation and tenants can however be replicated to other housing corporations. The element concerns placing PV-panels on the roofs of buildings, which is not always allowed on cultural heritage buildings since it may impact the appearance of the building. Therefor this innovative elements is mostly applicable for non-cultural heritage buildings such as newer buildings and apartment blocks.

OTHER COMMENTS – OPEN CONSIDERATIONS

Van Alckmaer investigated the application of integrated solar panels in roofs and facades. This resulted in 2 problems:

1.) Integrated solar panels become hotter causing a reduced efficiency and thus less production of renewable electricity. As the Energy Performance Allowance (Dutch regulation that become law in October 2016 aimed to solve the so-called ‘split incentive’ problem of housing corporations) demands a very high amount of solar electricity production, we need every available square meter on the roofs and cannot afford reduced efficiency due to the application of integrated solar panels.

2.) Integrated solar panels are difficult with regards to insurance. Several insurance companies are not willing to insure integrated solar panels on apartments’ buildings. The Dutch branch organization for solar energy (Holland Solar) experienced this also last years. This problem is still not solved, causing that the application of integrated solar panels for Van Alckmaer as irresponsible.