EEPOS - Energy management and decision support systems for energy positive neighbourhoods

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Deliverable 5.1

Baseline report on Finnish Demonstration

Revision **1**

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1. PUBLISHABLE EXECUTIVE SUMMARY

The **Objective** for this report was to define the equipment, protocols and software installed in the Finnish demonstration site in Helsinki. The objectives were met working together with city officials, constructor, board of housing company and the dwelling inhabitants.

Overall aim for the deliverable was to find out concepts for gathering relevant information from the areal level information given by the measuring equipment planned (and executed) to install. The permissions for building and dwelling level installations was essential in this data gathering. And was one of the aims where the EEPOS team may have failed and the purpose of the testing together with user and building level data collection, analyse and affections to building systems intelligent operations managing could have been compromised. The success of all installations is going to give a boost for energy positive neighbourhood level operations discovery.

The work performed has resulted the following major achievements:

- Defining the needed hardware
- Defining the needed software as well as need for software improvements
- Software improvements
- EEPOS system concept installation on areal, building and dwelling level
- Simulation software for fault detection
- Simulation software for engineers to easily discover and access problematic areas
- User interface for examining own energy usage
- Interfaces and data transfer for the control room to monitor and surveillance data gathered from the area

The **Intentions for use and impact** for the work done is to gather data on living environment in order to have equipment setup changes aiming for energy positivity as well as user behaviour changes. The work done for this deliverable is the basis for advanced system and setup changes performed later in EEPOS project.

Dissemination of this deliverable will be taken place as described in D7.3 Dissemination and exploitation task of EEPOS-project.

2. INTRODUCTION (CAV)

2.1 Purpose and target group

The purpose of this document is to describe the starting points of the Finnish demonstrator and to define energy baselines for further assessment. The report is the outcome of Task 5.1 under Work package 5 (WP5) in the EEPOS project. The report will provide all relevant information, which needs to be taken into account for those who want to implement a similar pilot to demonstrate energy management activities in energy efficient neighbourhoods. The report will include technical definitions of the solution which will be implemented in the demonstrator buildings and will prescribe existing frame conditions.

2.2 Contributions of partners

The report was written with contribution of the EEPOS partners: Caverion, VTT, Fatman.

2.3 Baseline

The Finnish demonstration site was changed from the preliminary plan from city of Espoo to the current place in the city of Helsinki as described in EEPOS DoW. The activities was somewhat changed due to the reason the new demonstration site is having District Heating system (CHP) instead of renewable energy option planned to build at the originally planned demonstration site. According to local regulations all buildings must be connected to the District Heating System in areas the District Heating exists.

Despite of the switch of the Finnish demonstration site the planned activities (stated in DoW) of the EEPOS project are to be met utilizing the Merenkulkijanranta area as the demonstration site for EEPOS system.

2.4 Relations to other activities

The input of Task 5.1 is mainly based on the works and results of the work packages 1, 2, 3 and 4, where the EEPOS specific tools and platforms will be developed and tested in prototypes. The Deliverable D4.1 – “Integrated systems ready for demonstration” is a very important input, because it describes all the relevant technical aspects to implement the developed technology in real world scenarios, like the Finnish demonstrator. Furthermore the Deliverable D1.1 – “Validation strategy and application scenarios – revised version” includes the following important information:

- Which number of scenarios will be put when into practice and evaluated at which demonstration site
- How the status of the demonstration sites is defined
- How potential problems arising from the small number of energy sources at demonstration sites, the weak integration of renewable energy sources at demonstration sites and the lack of price fluctuation for end users will be tackled or circumvented.
- What is planned to balance the fact that end-users have no possibilities to change the energy supplier.

On the other hand the results of this report will be used as a basis for the final report of the Finnish demonstration task 5.3 in the Deliverable D5.3 – "Results of Finnish demonstration".

3. PRE-CONDITIONS OF THE DEMONSTRATOR

3.1 Location and scope

Merenkulkijanranta – apartments above water

Merenkulkijanranta is the very first residential area in Finland built partly above sea. The area is located in Helsinki in one of the most respective residential areas. Building at occasionally stormy and windy property at times freezing weather was both difficult yet innovative solutions demanding from both designers and engineers. The ten building modern high class residential area was selected as Construction Site of the Year in 2011.

Figure 1 . Location of the Finnish Replicator site

Scope of construction was to build high class living environment in an ecologically sustainable manner as well as to provide user friendly and easy to use interface for adjusting heating, cooling and HVAC systems. New possibilities utilizing modern automation techniques was considered and implemented. At summer time the cooling of apartments is using sea water energy.

Users habits of using energy and adjusting living conditions are guided to energy friendly using information gathered from automation systems the users are able to follow. Apartments are provided with YIT Niagara equipment that follows and centrally steers HVAC, heating, cooling, sea water and water measurement systems. Included in the system was built a user interface where habitants may with extensive precise adjust individually each rooms with settings of users own choice.

The apartments are connected to Caverion's 24/7 control room where conditions are followed on apartment, house and areal level. Measurement information of the system is stored and analyzed by control room personnel as well as by technicians maintaining the area conditions.

Architectonically the construction area represents ambitious designing together with latest techniques. The buildings are forming a comb arrangement that outlines a terrace overview against shore. The two layer apartments closest and over the sea provides a feeling of living close with the sea environment. The area consists of 225 apartments providing total floor area of 25.000 m².

3.2 Neighbourhood characteristics

The area Lauttasaari is one of the most expensive residential areas of Finland located only couple miles from the heart of Helsinki. The apartments are placed at sea shore, partly above sea. All dwellings are provided with the eTalo network service where inhabitants are able to follow key figures of usage for example temperature individually room by room. eTalo also supplies information on housing company's news, tips to ease living e.g. food markets, and laundry service. Inhabitants may book common sauna and club facilities right from their own apartment. The residential are also offers indoor and outdoor activities like gym and kayaks. Almost 300 car parking facility for cars is located under the spacious courtyard.

The heating for the housing companies is provided by district heating. There for in the EEPOS system heating was not considered as part of the energy positive neighbourhood characteristics.

3.2.1 Merenkulkijanranta as a whole

Figure 2 . Areal figure of Merenkulkijanranta

Merenkulkijanranta was the first construction site of YIT where areal level sea water cooling system was placed. The sea provides energy witch is lead to cooling exchanger from deeper of the gulf. From this exchanger the piping leads to building exchanger.

The housing companies are provided with:

- Sea water cooling (-heating)
- YIT Niagara automation system
- Caverion control room
- Electrical housing handbook (http://www.yitextra.fi)
- YIT RAMI (Reporting And Monitoring Instrument)

3.2.2 Phase I – Klyyssi

Real Estate information:

Information	Data
Apartments	32
Elevator	Yes
Car parks for sale	33
Energy class	A2007
Heating	District heating
Additional Service	Access control, Building systems control, Building company extranet
Property	Own

Table 1. Characteristics of housing company

Klyyssi is shown at Figure 2 as house number 6.

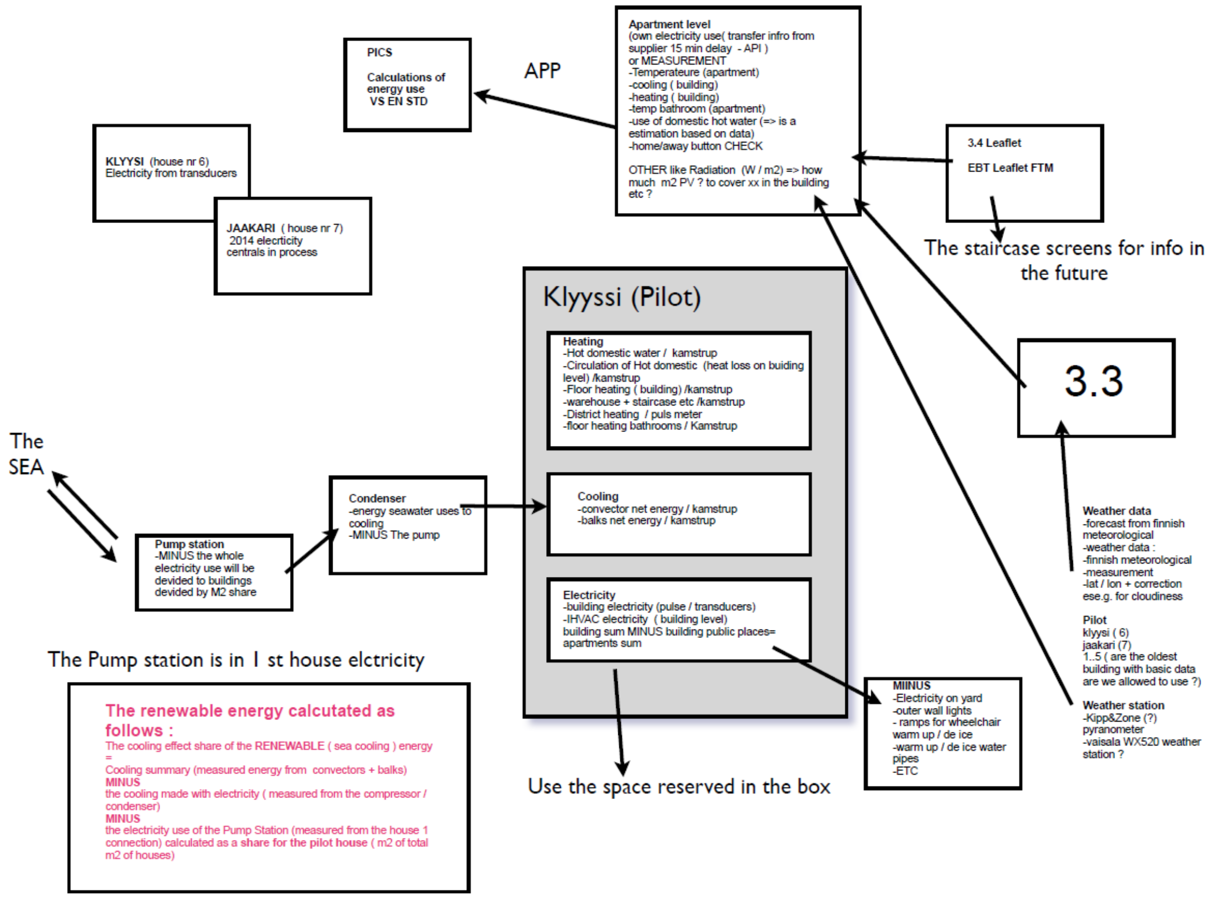


Figure 3 . Klyyssi pilot software and EEPOS connections (applies to Jaakari also)

3.2.3 Phase II - Jaakari

Real Estate information:

Information	Data
Apartments	51
Elevator	Yes
Car parks for sale	60
Energy class	A2007
Heating	District heating
Additional Service	Access control, Building systems control, Building company extranet
Property	Own

Table 2. Characteristics of housing company

Jaakari is shown at Figure 2 as house number 7.

3.2.4 Decision making system for housing company

As Merenkulkijanranta area is a high class area most inhabitants are technology driven. Tenants have been attracted from the very beginning of EEPOS team first contacts to participate EEPOS project as end users. First contacts to housing company and tenants took place in 2012 as EEPOS team members visited housing company management meeting with the constructor to advice what the energy positive neighbourhood is about and what will be the characteristics.

City officials are giving some guidelines as building construction methods. These methods are being considered by constructor, building systems company (Caverion) and EEPOS team. According to these guidelines EEPOS team has developed a plan on what to measure, show to tenants, the ability for tenants to adjust settings and how this interacts with the objectives of EEPOS project. These plans and changes to the plans have to be accepted by the housing company management. The management consists of tenants voted to the management group. The management group grants permissions on measuring, adjusting and equipment installation. In addition to this the each apartment inhabitants need to be asked permission also. As EEPOS represents new technology it has been relative easy after the housing company acceptance to find tenants interested in taking part of EEPOS as end users.

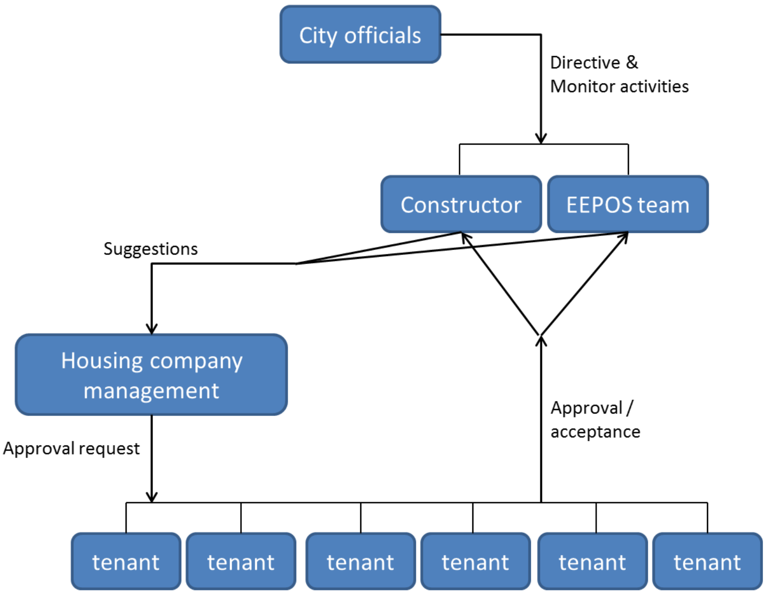


Figure 4 . Decision making model for Merenkulkijanranta

So far at September 2014 tenants are not yet able to make many adjustments according to data and figures they are receiving form eTalo and EEPOS system. Some remote adjustments can be made (e.g. cooling can be put off-house position using mobile device) but mostly the tenants are so far able to follow the status situation of their energy usage and climate conditions. Users are able to adjust manually climate conditions and energy usage according to the statistics they follow. So far The project has raised the awareness of tenants and is a self-educating process where EEPS team has estimated a 15% saving may be made for each housing company. In the future the tenants are able to follow renewable energy level via their User Interface.

3.3 Building technical system characterization

Speciality: in the area exists Sea water cooling – heating for all housing companies.

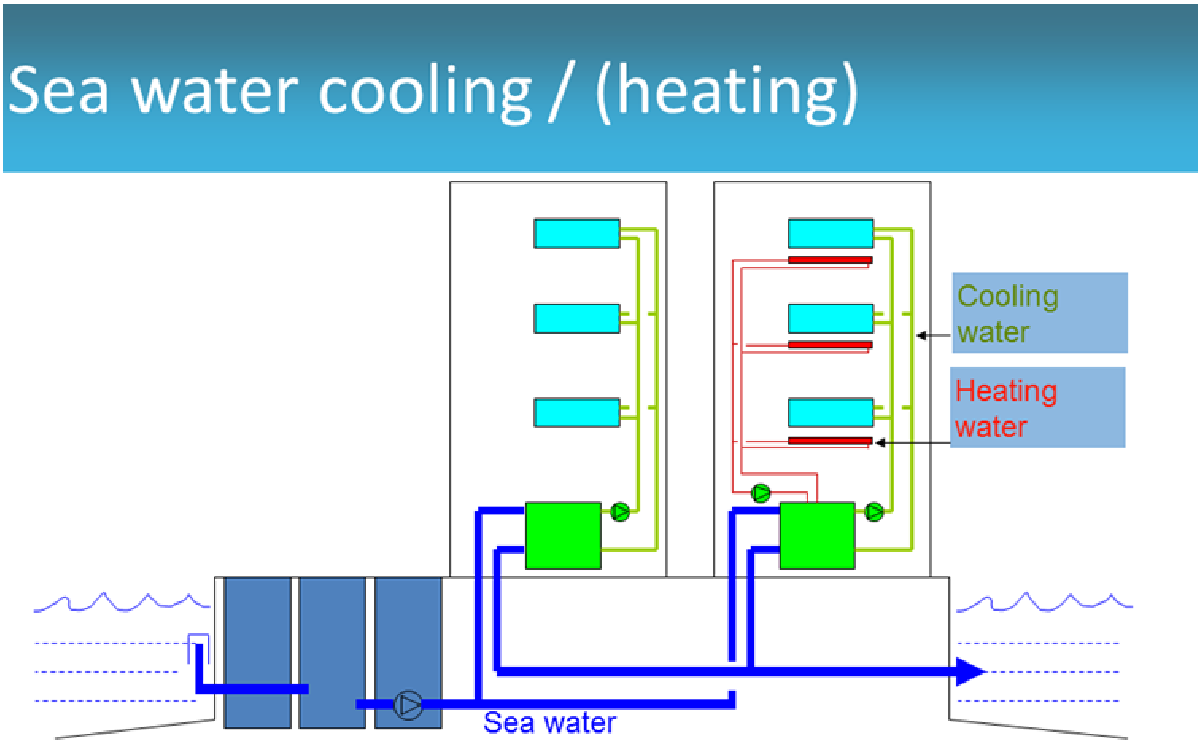


Figure 5 . Sea water cooling – heating chart

In the buildings the following characteristics exist:

- Real time remote monitoring
  - Web based user interface
  - Extensive data collection
  - Ease process adjusting
  - Analysing fault
- Dwelling level water consumption measuring
  - Ultra sound technics, buss interface
  - Enabling consumption based invoicing
- Condition control using room adjustments
  - HVAC
  - Chilled beam
  - underfloor heating
  - Fan Convector
  - temperature measuring, condensation guard
  - Energy saving using home – out switch
  -

Figure 6 . Water consumption measuring

Reporting & monitoring information

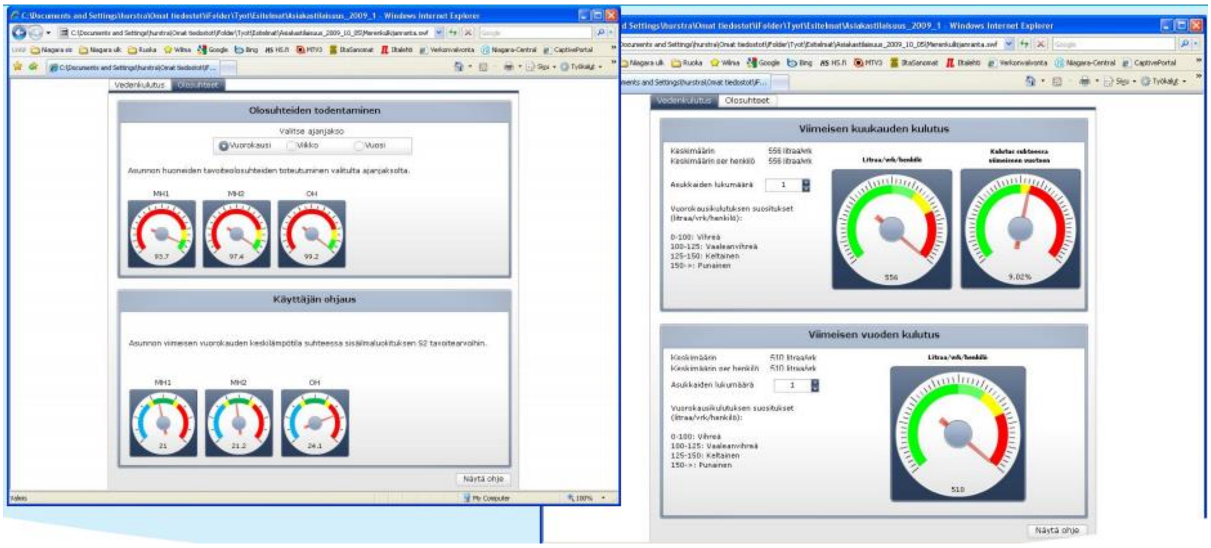


Figure 7 . Monitoring and reporting information screens

Niagara

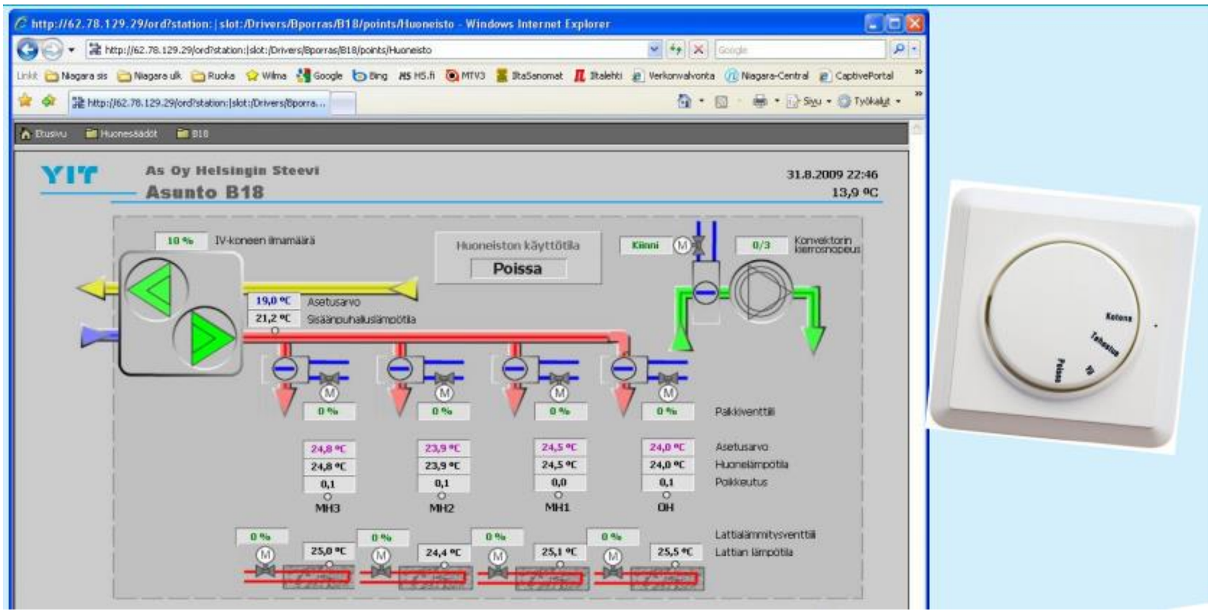


Figure 8 . Monitoring interface top on Niagara framework

The Niagara Framework is a helpful tool for buildings towards more energy efficient, reducing energy usage and driving down costs. Niagara Framework also enables to reschedule operations in buildings which helps cutting down peak loads. Today, there are over 235,000 instances of Niagara operating in 45 countries worldwide in office buildings, manufacturing plants, mission-critical facilities, hospitals, educational and government campuses, military bases, hotels, retail stores, airports as well as dwellings.

Built on an open architecture, the Niagara Framework merges multi-vendor automation systems and real-time integration into a single, extensible platform that monitors, manages and controls the power consumption of all building systems and drives energy efficiency and reduces energy costs. Niagara takes into account all critical areas that form the subsystems that make a building function including lighting, heating, ventilation and air-conditioning (HVAC), security, and energy management. It allows devices to share information with each other and streamlines them into a common system where management can control and monitor the buildings' operations.

Niagara has removed the barriers to assess the proprietary and legacy data from different systems in a facility. It is the bridge between systems and devices and simplifies the process of connectivity and integration that makes building and facility management easier.

Niagara is a scalable platform that delivers measurable ROI enabling users to capture the benefits of integration, automation and energy control of their buildings and maximize the value of information in real-time contained within them.

In addition to integrating energy consuming devices and systems within a building and getting them to work together to be managed, controlled and operate at optimum levels, Niagara also includes energy measurement and verification tools options that allow users to implement the most efficient and sustained energy strategies in a building today.

As a real-time integration platform and automation infrastructure, Niagara allows users to deploy optimal energy and environmental management strategies that notifies about events before they occur and provides users with the tools to execute control such as schedule and temperature adjustments or activation of on-site generation. Niagara interacts in real-time, with the systems that control the energy consuming and generating equipment in a facility.

The technology also enables users to collect information and benchmark buildings to expose operational inefficiencies. From a green building perspective, Niagara allows users to capitalize on accurate and concise intelligence relating to the energy performance of a building in order to achieve lower energy consumption and enhanced efficiencies.

4. Technical aspects of EEPOS implementation

4.1 Architecture of ICT systems

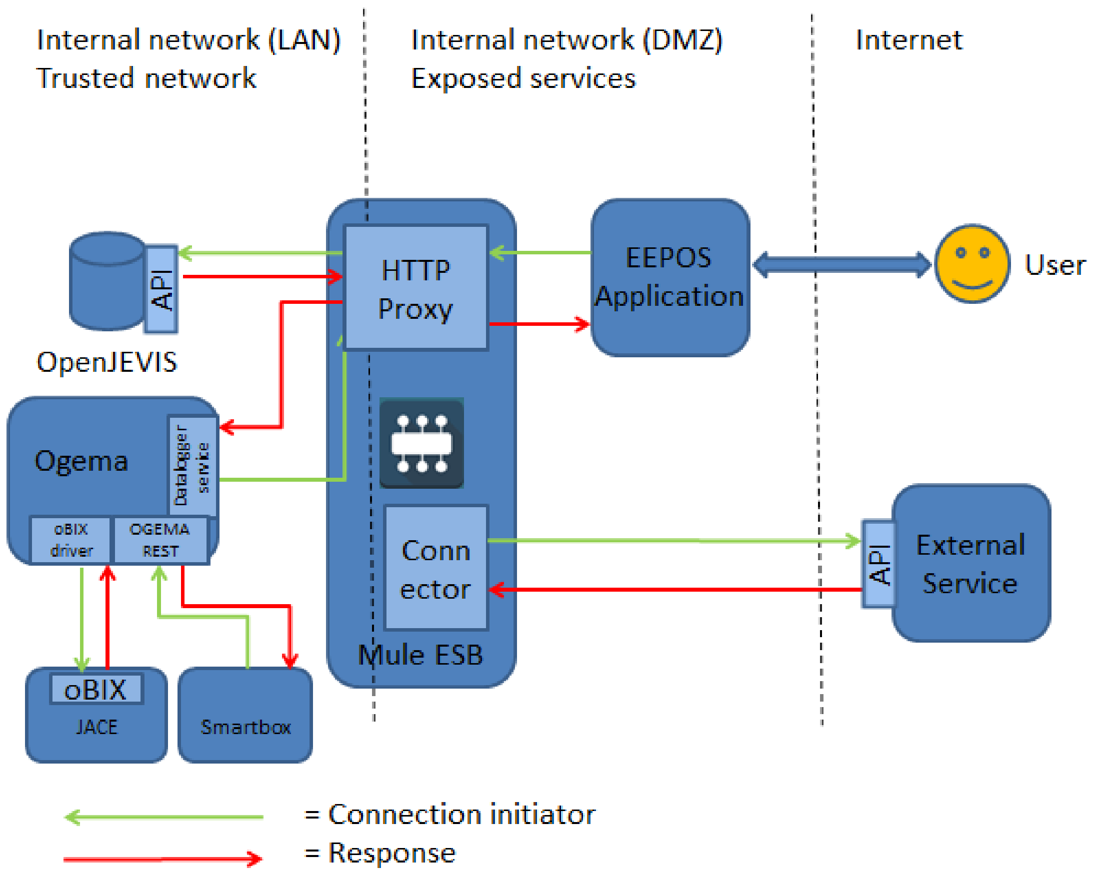


Figure 9 . System architecture from D3.1

Finnish demonstration utilizes the architecture specified in T3.1. Caverion Jace devices are used as data source and currently they are routed directly utilizing oBIX. Using the proxy and the OpenJEVIS database are planned to be added later. OpenJEVIS and Mule ESB are already set-up and Fraunhofer IWES is working on a Ogema driver that can communicate with Jace and OpenJEVIS using oBIX. However we don't have the exact schedule when this will be available.

For EEPOS application we are using the Energy Brokering Tool (T3.2) and End-User Collaboration Tool (T3.4).

Jace devices locates in the building and all of the other components are used from the cloud. For this demonstration it is suitable solution, for production use in real case there is lots of redundancy and security issues that would need more advanced solutions.

4.1.1 Concept of hardware system

IN NEIGHBOURHOOD

Heating (one for each condominium)

Merenkulkijanranta area is connected to district heating and has its own heat exchangers for domestic hot water and heating networks. Heat is being extracted to apartments via floor heating. Staircases and other rooms in shared use are heated by radiators. In addition, Klyyssi condominium has a separate heating network for floor heating in bathrooms.

- Web server; Tridium JACE 660
- Controller; Caverion UIO032
- District heating control valves / actuators; Belimo R..D, HRYD24-SR
- Temperature sensors, heating network; Produal TEAT NTC10
- Temperature sensor, domestic hot water; Produal TENA NTC10
- Heating network pressure sensors; Produal VPL 16
- Energy meters, water; Kamstrup Multical 402, 602
- Energy meters, electricity; Carlo Gavazzi EM21, EM24

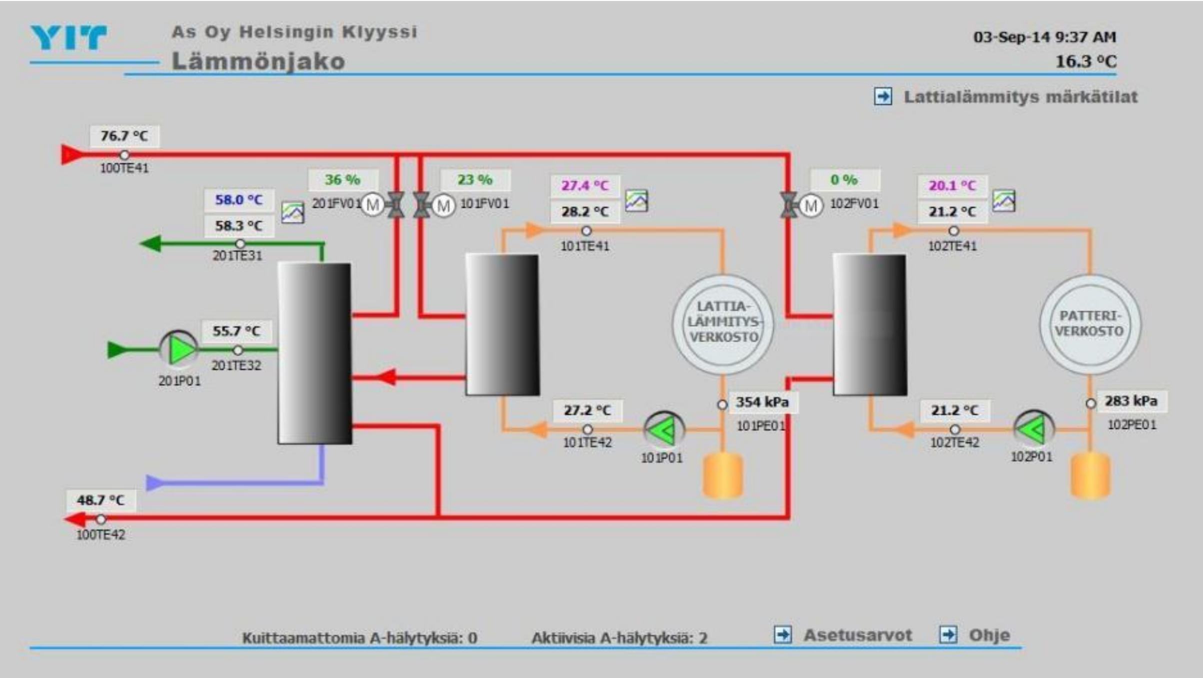


Figure 10 . District heating process view for remote controlling

Cooling (one for each condominium)

Merenkulkijanranta condominiums are equipped with water chillers that use sea water in their condensing circuits. Cooling water is then shared for fan coil unit network and chilled beam network. Fan coil units are equipped with drains but chilled beams are not, so chilled beam network has its water temperature controlled by dew point of the outdoor air to prevent condensing. Pressure differential over each cooling network is kept constant by circulation pumps controlled by pressure differential sensors.

- Controller; Caverion UIO032
- Temperature sensors; Produal TEAT NTC10
- Cooling network pressure sensor; Produal VPL16
- Cooling network pressure differential sensors; Produal VPEL 4.0/6.0
- Control valve / actuator; Belimo H540B / NVC24A
- Energy meters, water; Kamstrup Multical 602
- Energy meters, electricity; Carlo Gavazzi EM21, EM24

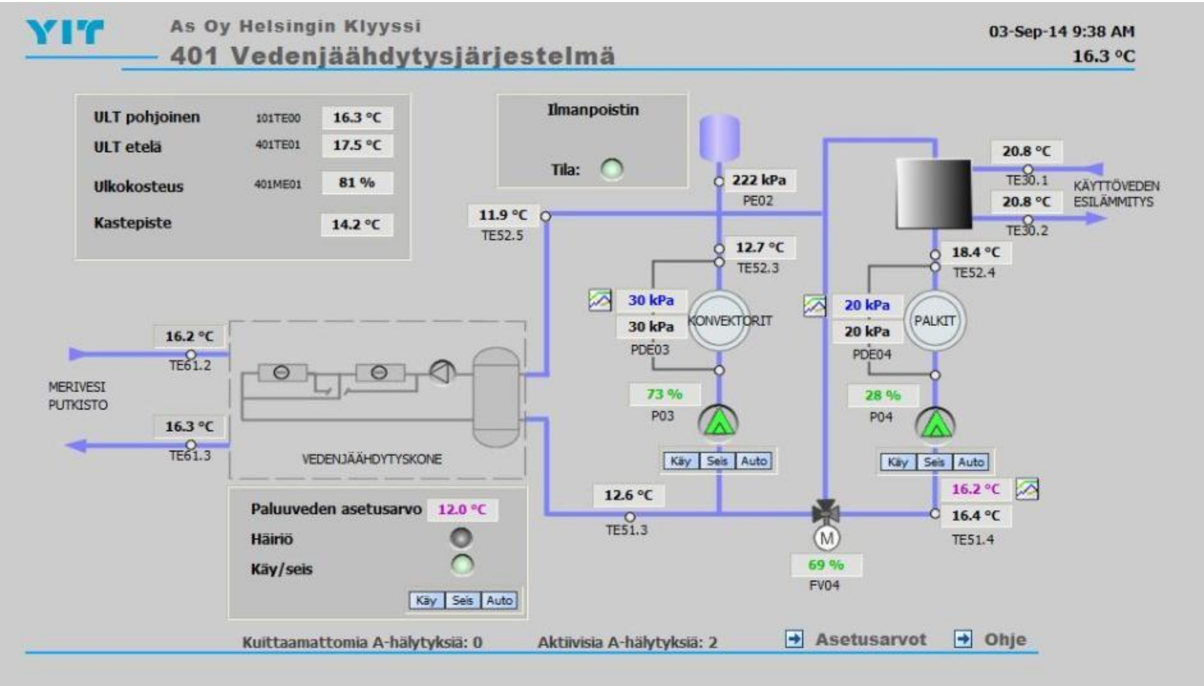


Figure 11 . Cooling network process view for remote controlling

Seawater pumping station

Merenkulkijanranta condominiums are connected to circulating sea water network that is used for water chiller condensing circuits. Pressure in the network is maintained by a pumping station equipped with two sea water pumps controlled by a pressure sensor.

- Web server; Tridium JACE 230
- Controller; Caverion UIO 032
- Temperature sensors; Produal TEAT NTC10
- Seawater network pressure sensors; Produal VPL 16
- Seawater level sensors; Labko DMU 08S
- Frequency converters for pump drive; Danfoss FC100

Other devices in common

- Weather station; Vaisala WXT-520
- Pyranometer; Kipp & Zonen CMP6

IN DWELLINGS

Dwellings are equipped with room controllers controlling heating, cooling and ventilation. Each apartment has one or two fan coil unit and each bedroom or living room has one or multiple chilled beams. Heating is executed by floor heating which has different circuits for each bedroom and living room. Bathroom has its own floor heating connected to a separate network. When temperature rises, floor heating is first deactivated, then chilled beams are activated and at the same time ventilation is increased by controlling the air handling unit. If temperature keeps rising, fan coil unit is then activated. Room temperature can be set by a set point knob installed into each bedroom and living room affecting to all heating and cooling equipment at the same time.

Chilled beams are equipped with condensation detectors that are activated if excessive humidity is causing the chilled beams to condensate despite chilled beam network temperature being controlled by outdoor dew point. When activated, condensation detectors close the valve in that particular chilled beam and turn the fan coil unit on to dry out room air.

Apartment is equipped with mode selector that includes four different modes:

1. “At home” Heating and cooling follow room temperature set point devices. Air volume is controlled by cooling.
2. “Away” Heating set points are lowered and cooling is turned off to save energy. Ventilation is reduced.
3. “Night” Ventilation is not increased by cooling and fan coil unit is limited to run only at slowest speed to minimize noise.
4. “Ventilation increase” Heating and cooling follow room temperature set point devices. Air volume is increased to maximum.

These basic settings for inhabitants are the first step for users to be involved and participate energy consumption savings and towards the aim of achieving neighbourhood level energy positivity. This also serves as a first step towards requirement based indoor conditions which means for instance that inhabitants may in practise adjust level of ventilation according to their personal preference.

Each apartment has two water meters; One for cold and one for hot tap water. Water meter readings are read remotely by JACE servers.

Room temperature and water consumption data is read from JACE servers to external YITextra server. An internet portal is created for dwellers to observe their apartments’ room temperatures and water consumption .

- Room controller; Caverion UIO032
- Air handling unit; Enervent Piccolo Eco ECE
- Fan coil unit; Chiller BOX
- Chilled beams; Halton, active type
- Chilled beam valves / actuators; Danfoss RA-C 15 / TWA-A
- Condensation detectors; Thermokon WK01
- Floor heating valves / actuators; Uponor
- Room temperature sensors; Produal TEHR NTC10
- Floor temperature sensors; Produal TEL NTC10
- Bathroom extraction air temperature sensor; Produal TEK NTC10
- Apartment operation mode selector switch; Thermokon WRF06S
- Water meters; Kamstrup Multical 62

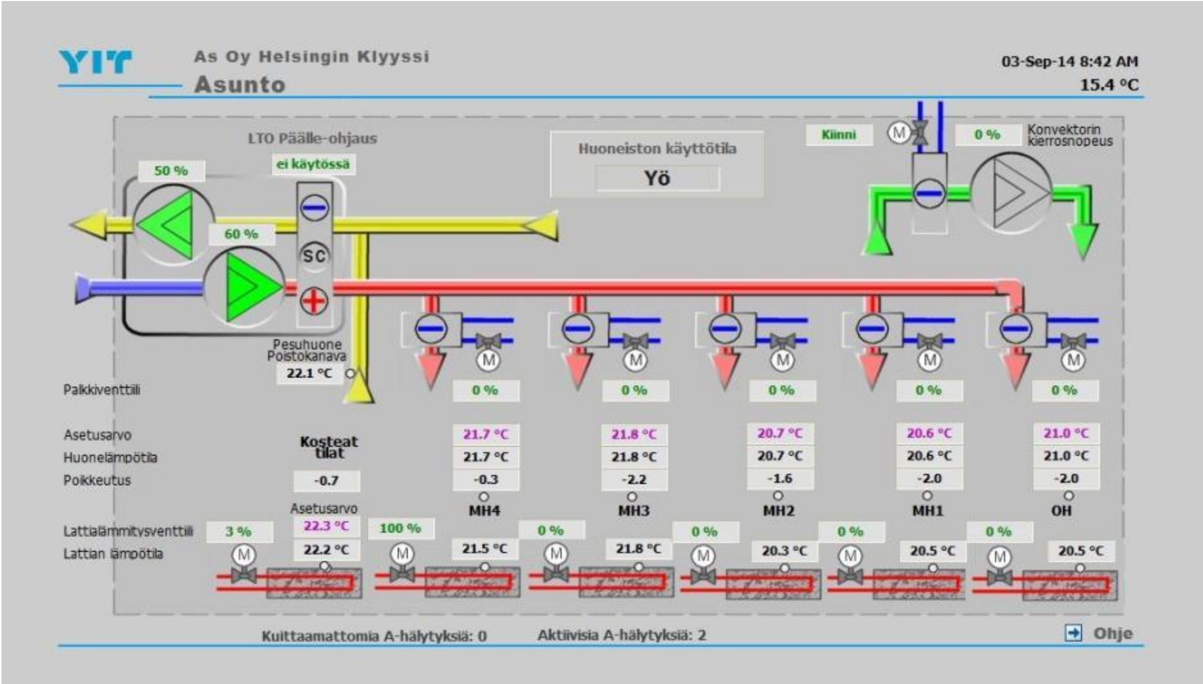


Figure 12 . Apartment process view for remote controlling

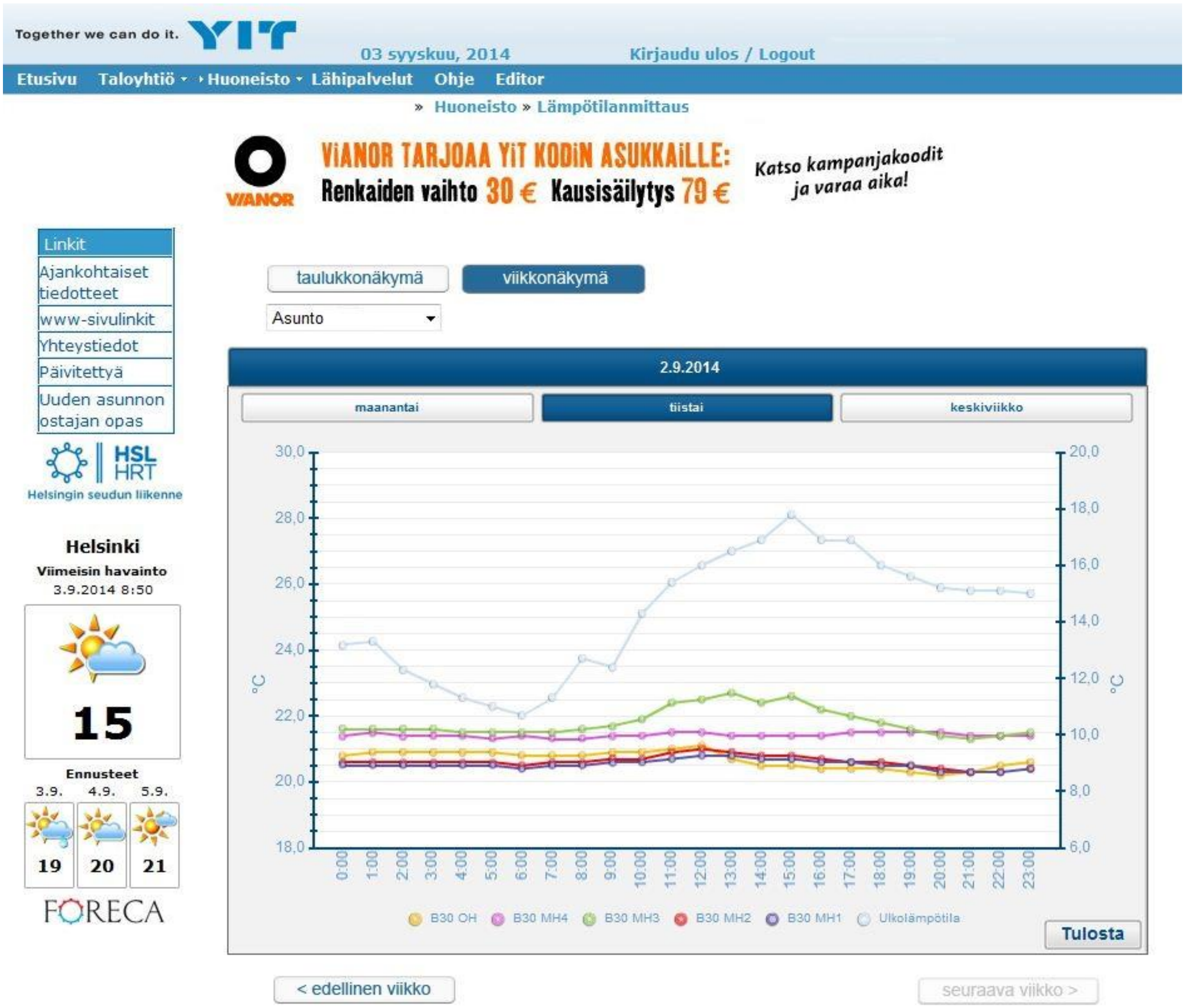


Figure 13 . Temperature view for resident
The upper curve is outdoor temperature as other curves are indoor temperatures in different rooms in a dwelling

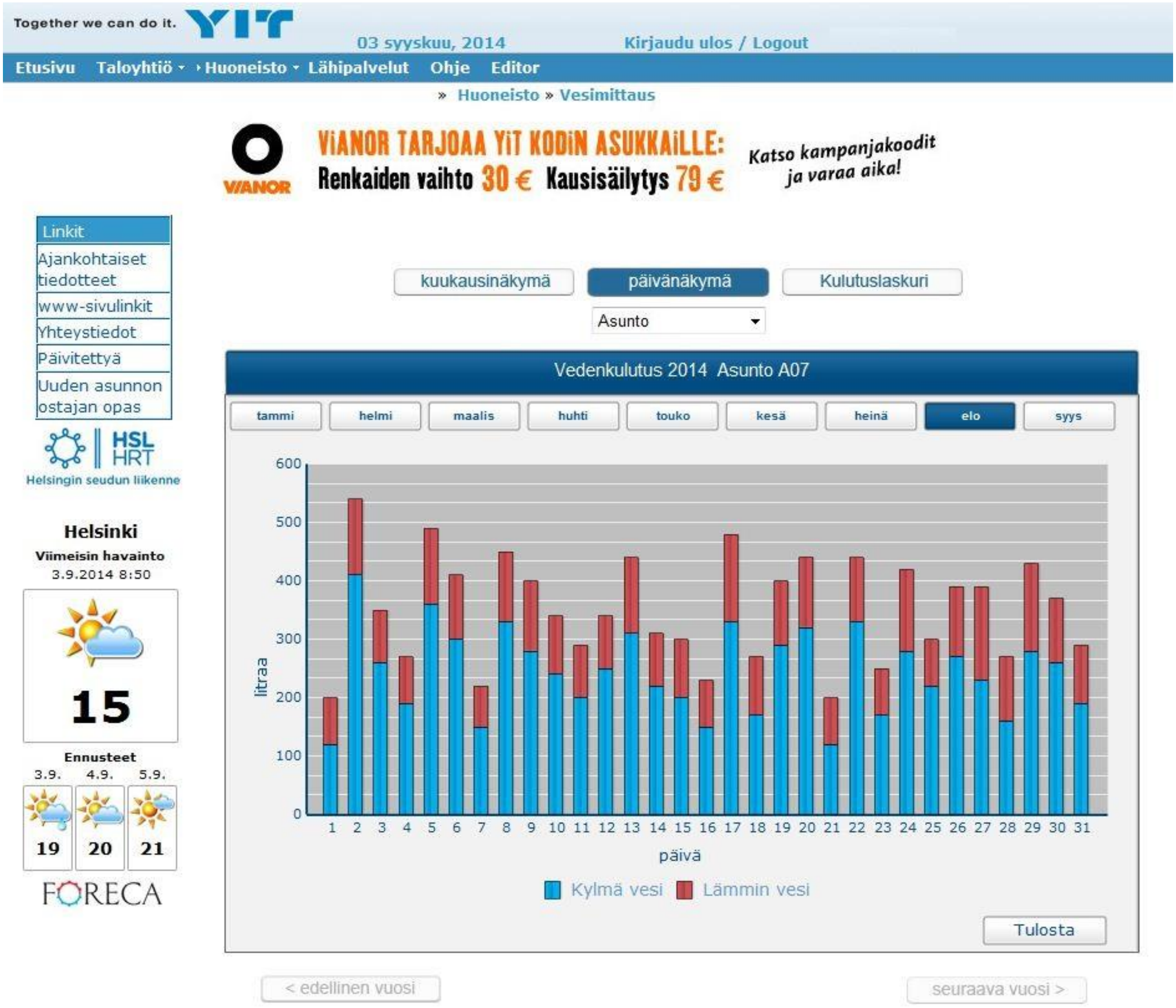


Figure 14 . Domestic tap water consumption view for inhabitants in eHouse
Cold water by blue, hot water by red colour

4.2 EEPOS Applications

4.2.1 Applications in FIN demo

In the Finnish demonstration JACE web servers monitoring pumping station's and Klyyssi condominium's HVAC processes and storing data are connected to internet. Data is being collected to external systems via oBIX interface.

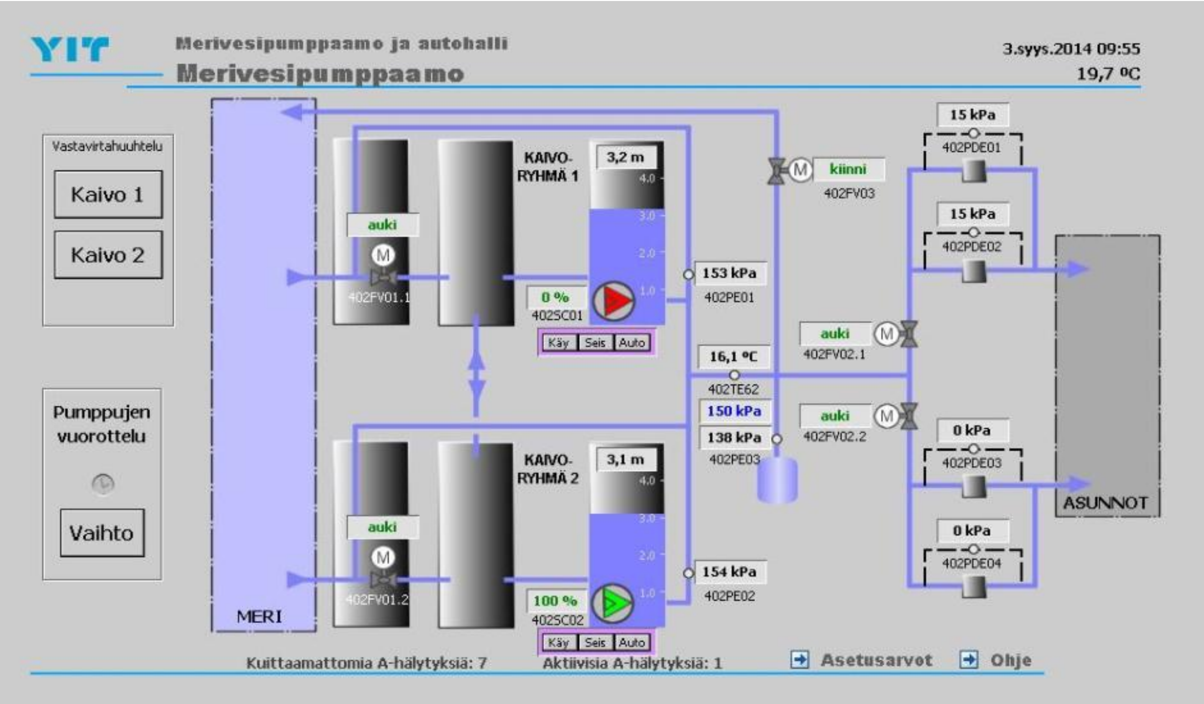


Figure 15 . Seawater pumping station process view for remote controlling

To integrate diverse systems a physical connection to a device's network is required. The Java Application Control Engine (JACE) is the mechanism that provides this connectivity to systems within a building. By connecting common network protocols such as LonWorks, BACnet, and Modbus, along with many proprietary networks a unified system without seams emerges. Scalability and reliability concerns are avoided with the unique distributed architecture that a network of JACE's creates.

The Finnish Demonstration Team will make guidelines for automatic software adjustments to achieve results on correct improve settings. Before applying automatic changes the adjustments will be closely manually verified. This is because the conditions in dwellings must not be compromised in case of incorrect automatic adjustments cause no malfunctions are allowed in real living environment.

4.2.2 Utilisation in neighbourhood

Merenkulkijanranta HVAC processes are monitored and controlled by a remote control room. JACE web servers are being used for controlling processes, displaying graphical process views, collecting data and sending alarms when some measured value goes out of normal range.

4.2.3 Utilisation in dwellings

Finnish demonstration dwellings are equipped with multiple temperature sensors. Data from those sensors are collected by JACE. And the data can be monitored by a remote control room. All apartments have an easy interface for end user to control their indoor conditions. The controller enables end user to make effect their apartment by four preset programs that makes effect on heating, cooling and ventilation. Programs are call “normal”, “boost”, “night” and “absence”. The status of controller can be monitored from the control room.

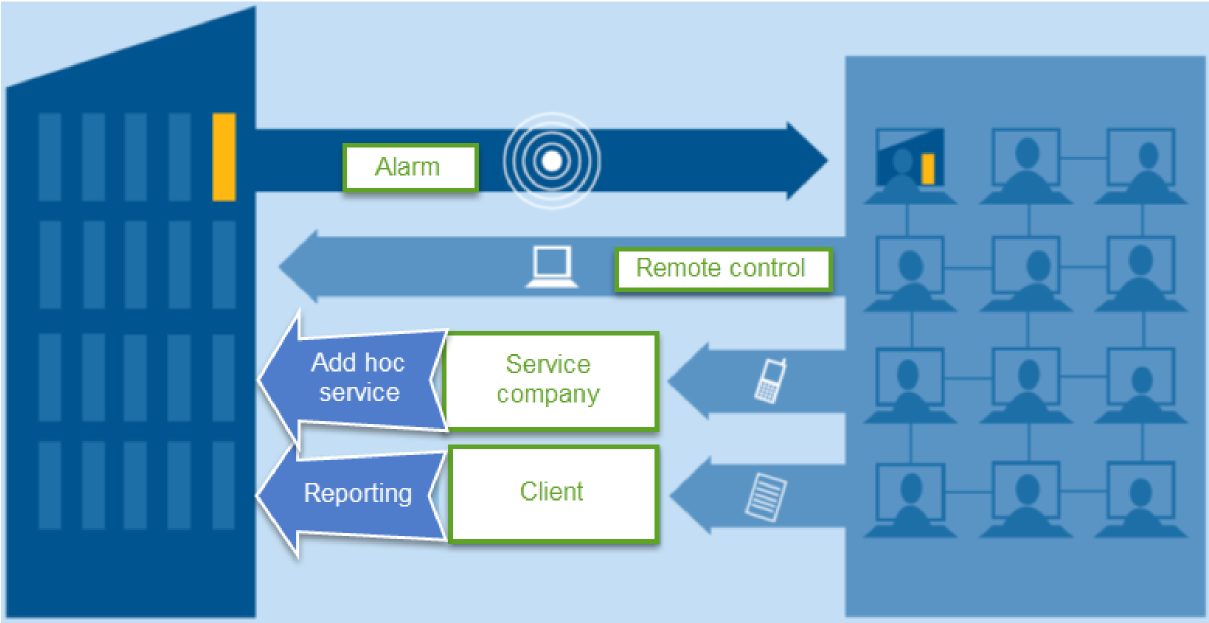


Figure 16 . Control room

The 24/7 control room monitors data coming from EEPOS system and assists the engineers on fault situation handling as well as have the possibility to make adjustments of their own.

All inhabitants are personally invited to involve in EEPOS demonstration. In the case accepting the invitation, their dwellings are equipped with electricity meter as well.

4.3 Implementation and testing of EEPOS in FIN demo

The Implementation of the sensors was done in February-May 2014. The original idea is to test first the existing JACE => oBIX => test Eepos Applications "on site/ live". The final version, however is intended to go all the way according the system description (D3.1).

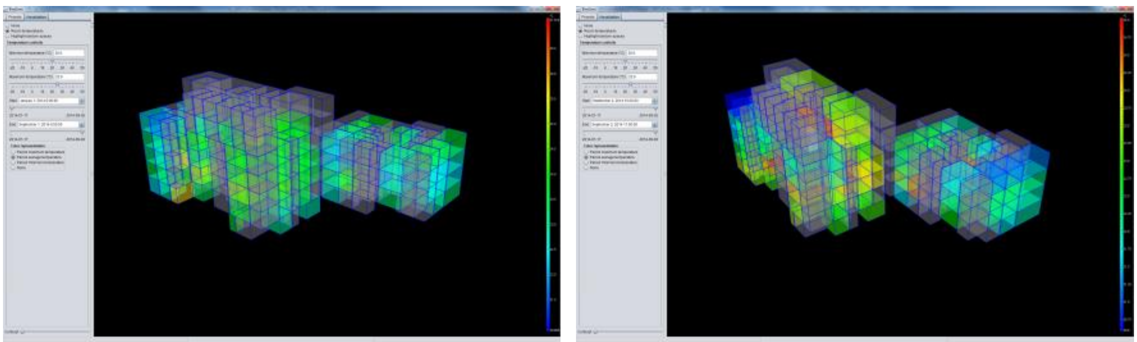


Figure 17 . Historic data monitoring (left) and real-time data transfer (right) testing of JACE => oBIX => EEPOS application in Finnish demonstration (Case Klyyssi building in Merenkulkijanranta)

Similar testing is done also for VTT's energy consumption fault detection tool (Figure 18) and energy consumption forecast tool (Figure 19).

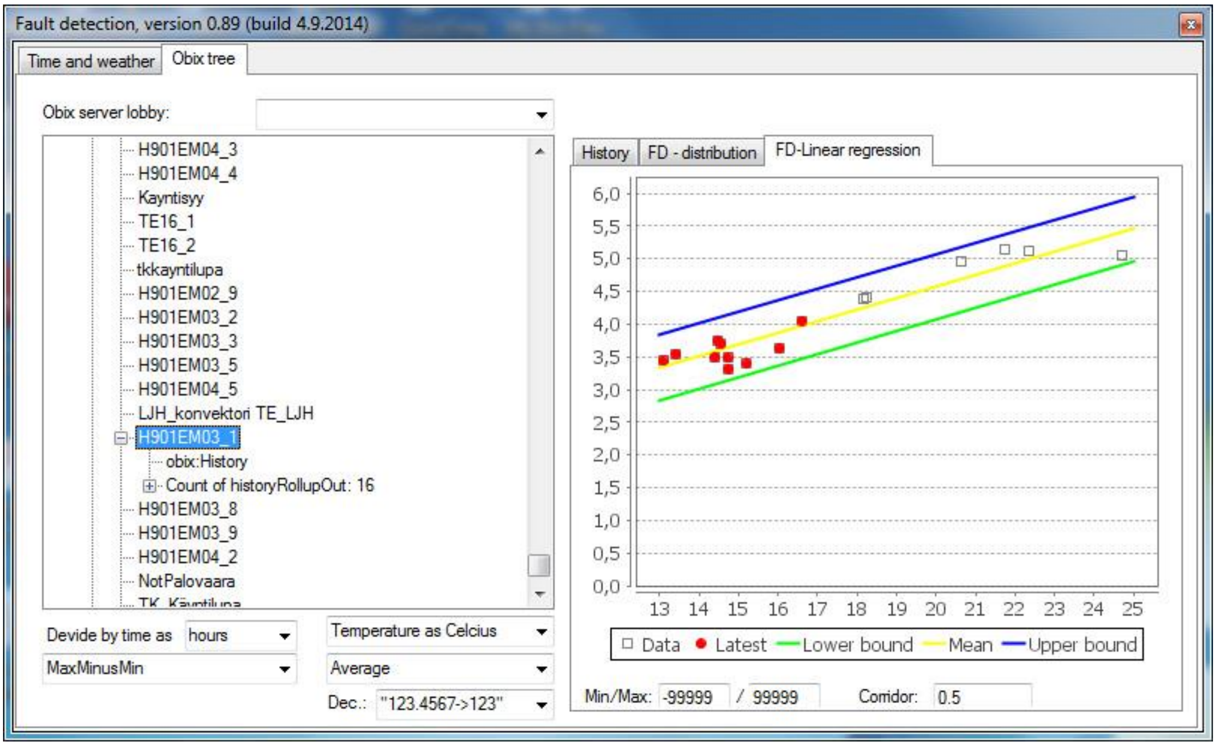


Figure 18 . Testing of VTT's building energy consumption related fault detection software (case: Merenkulkijanranta, seawater cooling)

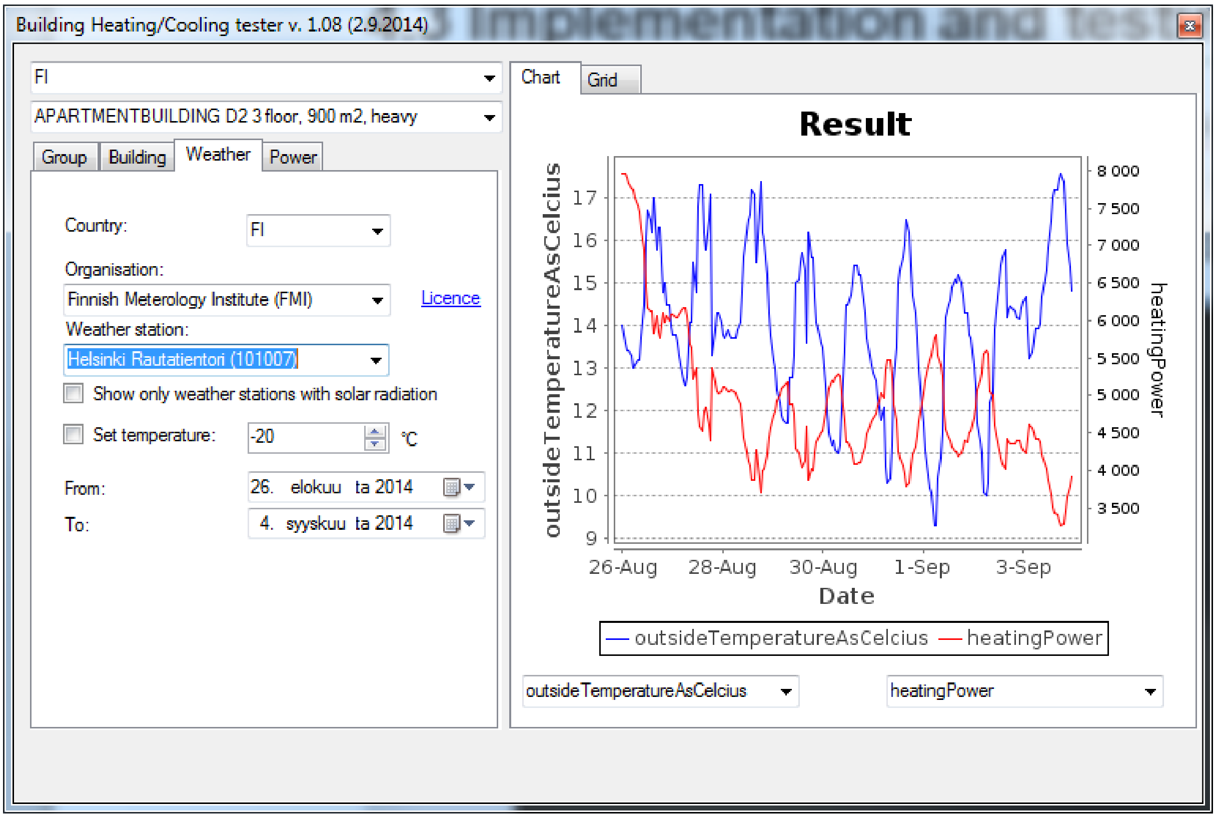


Figure 19 . Testing of external VTT web service based building heating power simulator (26.8. – 2.9.2014) and related 48 hour open weather data (online external service) based building energy consumption forecast (2.9. – 4.9.2014)

Testing of Unity Game Engined based EEPOS application are shown in Figures 20 and 21.

Figure 20 . Testing of Unity Game Engine based 3D virtual model (Android version) in the Merenkulkijanranta pilot area

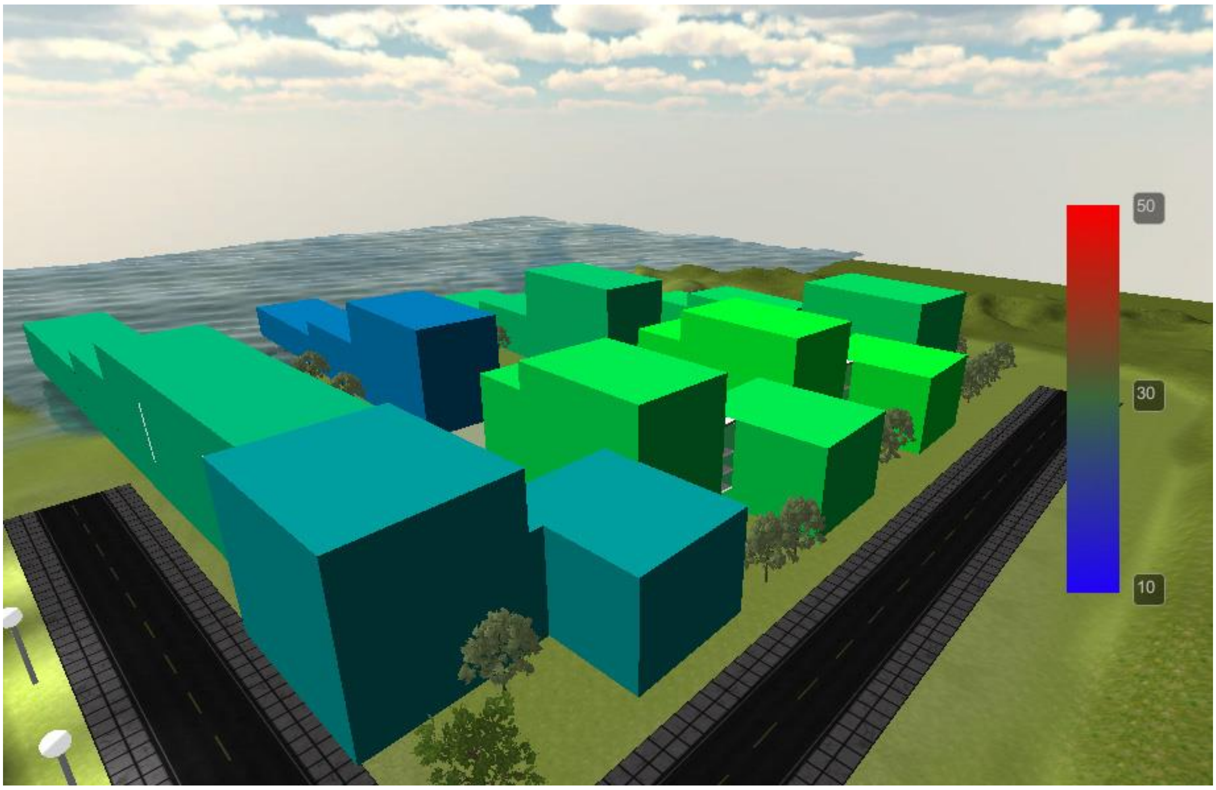


Figure 21 . Testing of Unity based application (browser version) for building level KPI data visualising (Case: building energy consumption data)

The pre-testing of EEPOS (Ogema) system is planned (in DoW) to take place in WP4. The system was planned to test one whole month before any actual installation. In practice there are now parallel tasks because the installations had to be made to be in project main-timeline. The advantage of this kind of parallel activities is that the testing in WP4 can now continue as much as needed within the piloting period of WP5.

During the last year of the EEPOS project we will be installing EBT tool to be used in the Finnish Demonstration. Currently we don't have the exact list of available data points and some of the integration work is still delaying the actual installation of EBT.

We will be demonstrating the following features:

- Measuring of the seawater based cooling and calculation of its impact on co2 emissions and cost savings
- Simulation of solar energy. We have installed a weather station with pyranometer to measure the solar radiation in the site. This will be used to calculate what if scenarios
    - o How many square meters of solar panels is needed to make whole cooling zero-emission based in addition to seawater cooling
    - o Calculate ROI of the panels needed
- Provide reports of total energy usage and carbon footprint
- Provide concept of proof how tenants could buy energy from the housing company
    - o This will be only simulation since product is way too experimental to do actual tenant pilot in this stage.
- Provide information for tenants using the already installed infoscreen system

Figure 22 . Scouting for the installation location of the weather station

EBT will be offered as SaaS-service from Fatman Oy's servers and planned users include specialists from Caverion, VTT and Fatman, and housing company personal and maybe few tenants (under negotiation).

Current estimate for the installation is Q4 of 2014. Original date was planned to be right after the summer, but situation at the site and the other tasks has delayed the time table.

5. ENERGY BASELINES

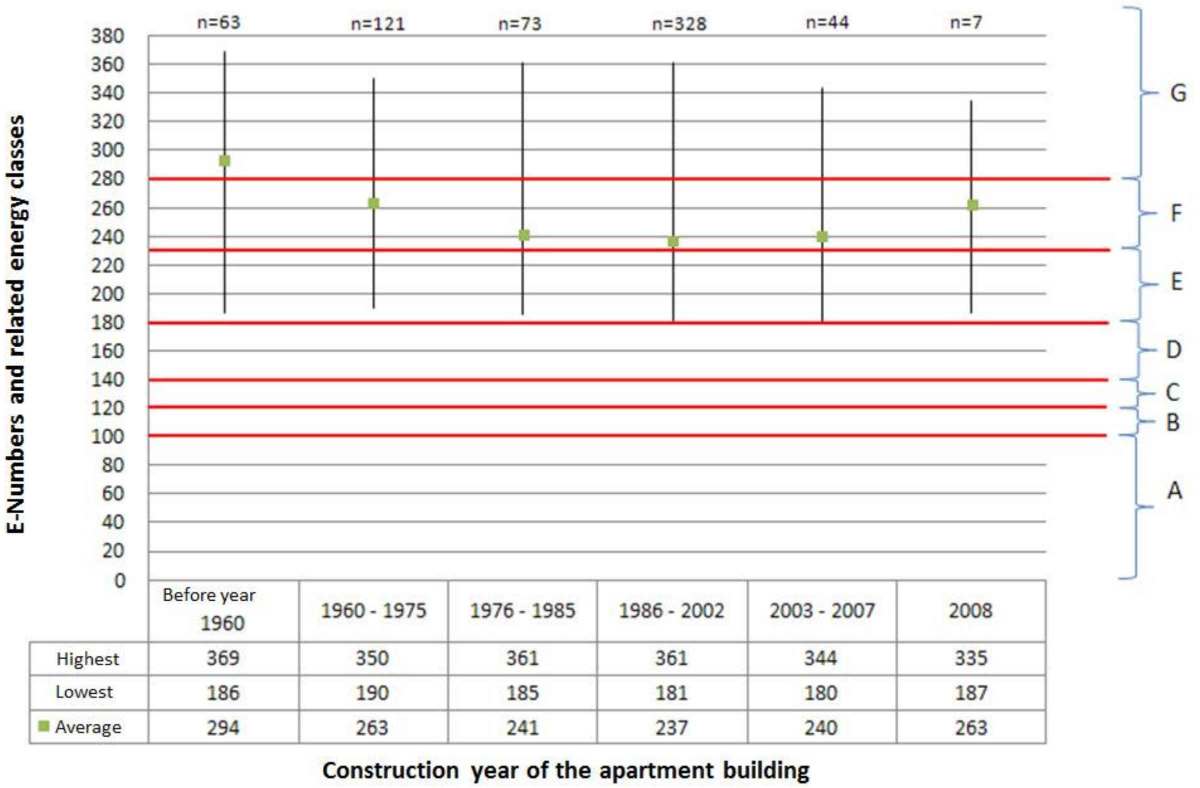
The energy consumption baseline in the case of Klyyssi does not exist because the house is new. However the previous buildings in the neighbourhood can be used to the energy baseline as far as the technology is the same. The housing companies are a lot alike but not identical. Some of the developments have been taking place during the years e.g. the floor heating is now all water while it was electricity heating in bathrooms in first housing companies.

Other energy baseline is the Finnish energy classification system. More precise in Finland new apartment buildings are classified (energy certificate) in energy classes from A to G using E-number. Class A is the most energy efficient and class G is the most energy consuming one. The E-number (building total annual energy consumption per building gross area) includes building heating, ventilation, cooling, lighting and consumer electronics related energy consumption. The E-number does not include car heating, outdoor lighting and other building outdoor area related energy consumption and only bought energy is included in the calculation. In addition the calculation of E – number takes into account different forms of energy, having different coefficients as follows: electricity 1.7, district heating 0.7, district cooling 0.4, fossil fuels 1.0 and renewable fuels 0.5.

Building energy class	Building total annual energy consumption per building gross area [kWh/m^{2}a9
A	0 … 75
B	76 … 100
C	101 … 130
D	131 … 160
E	161 … 190
F	191 … 240
G	241 …

Table 3: Energy classes and related limit values for apartment buildings in Finland

Third energy baseline is statistical data of 727 apartment building related energy consumption in different parts of Finland.



	Before year 1960	1960 - 1975	1976 - 1985	1986 - 2002	2003 - 2007	2008
Highest	369	350	361	361	344	335
Lowest	186	190	185	181	180	187
Average	294	263	241	237	240	263

Figure 23: Statistical data of apartment building (located in different part of Finland) related energy consumption and related E-numbers [1]

These energy baselines can be utilized in benchmarking and energy saving calculations.

5.1 Energy production

Merenkulkijanranta belongs to district heating area, therefore no independent power station.

5.1.1 Seawater cooling

The seawater cooling is the only real renewable energy on the neighbourhood. The measurement of the renewable energy's is measured using energy use (cooling) minus the electricity consumption (for cooling) minus electricity of pumping station (actually the share of the Klyyssi of all neighbourhood). The information gained is the real time information of the renewable energy in service.

Figure 24 . EEPOS team and the some pipes and valves of the seawater cooling system

For EEPOS new huge energy meters we installed e.g. seawater flow and energy measurements (Figure 25) and connected to the oBIX based data collection system.

Figure 25 . Huge energy meters installed for seawater flow and related energy metering

5.1.2 PV simulation

The main objective of this project is ICT solution supporting RES based energy positive neighbourhood. Relating that the main Key Performance Indicator (KPI) is the neighbourhood energy positive index in studied year.

The main idea in PV simulation is to calculate the needed PV panels (m2) for the neighbourhood in the case that the neighbourhood energy positive index is not positive. The weather data from pyranometer (solar energy W/m2) will be utilized in the simulations.

5.2 Energy consumption

5.2.1 Electricity consumption

Due to the practical reasons the electricity floor heating is not used in the couple of latest houses and they can’t be compared to the Klyyssi in that sense.

5.2.2 Heating and cooling consumption

The cooling solution in apartment level is chilled beam.

Figure 26 . Chilled beam for cooling the apartment (picture taken at construction phase)

The heating and cooling consumption baseline will be taken as a estimate based on the older houses in the neighbourhood with the same technology. The heating per m^2 is then estimated to match the Klyyssi amount of m^2.

6. CONCLUSIONS

Currently the available equipment for monitoring energy usage and system functions are out there in the markets. No new equipment needs to be developed in order to have the measurements needed for EEPOS to run. On the software side it is not that easy to find software or software vendors to full fill the needs for new kind of idea like EEPOS platform. There for new software has been developed to match the needs of EEPOS.

Together with the ideas of energy positivity, EEPOS system and equipment available the EEPOS team was able to set up measuring equipment and environment in the Lauttasaari area. Working closely with the construction company, housing company and building systems company the EEPOS team may monitor data and adjust energy flows in respect of the KPI's considering also forecasts and user behaviour.

The data monitored will be compared to buildings in the same neighbourhood area for calculating the energy efficiency. As for this calculation the EEPOS team is able to make conclusions (later in deliverable 5.3) whether the idea of energy positivity may be achieved and by which means. The district heating (produced by nearby CHP facility) does not allow the Finnish Demonstration to achieve energy positivity in the areal level but the need for renewable energy sources may be calculated upon the measurements gain using EEPOS system.

Out of different energy systems the project aims will be calculated and compared to energy positivity. The deliverable 5.3 will demonstrate guidelines to achieve the energy positivity and what system setting must exist to achieve the objectives.

6.1 Summary of achievements

To the new high class apartments we were able to install the equipment necessary for monitoring energy consumption on different kind on energy environments. Both areal energy sources and local consumption points are now covered with monitoring and surveillance.

New equipment was installed to buildings as well as new methods of data transfer from measurement point was discovered. Programs have been developed in this EEPOS project to analyse and sophisticate data given by the measuring.

Mobile solutions for viewing problem areas (if it is a building or just one dwelling) was developed. By these new solutions both users and engineering personnel may easily discover location for non-conformity's of conditions. Mainly these mobile functions are presented at chapter 4.3.

6.2 Relation to continued developments

The ability to remotely monitor areal, building level and dwelling points is going to give us data needed to make system adjustment method process. In the process of controlling consumption and energy production the needed methods will be evaluated upon the measurements of consumption and production of energy as well as user behaviour knowledge.

Since the measurements have just started in Jaakari we do not yet have much data to base adjustment routines to. That will be covered when deliverable 5.3 will take place at month 36 of EEPOS project. At building Klyyssi data already exists for a short period of time. As we are able to measure the just installed weather stations reports related to consumption and forecast we will be able to more precisely analyse the differences of forecast/actual weather compared to consumption and the adjustments needed in order to achieve energy positivity.

The WP5 is strongly related to the different Tasks in the WP1-5 as all of the findings and developments shall be tested in real life environment. The WP5 can also provide input to WP6 for any dissemination activities. The developments in WP5 will be a basis for further demonstrators, which might be set up in following projects.

The industrial partners of EEPOS project have benefitted by new software developed and new methods of measuring and analysing data. These improvements have already been adopted by Caverion and Fatman to further develop measuring and the analyzing they have in other building and areal projects. One of the most important improvements for Caverion was the mobile solution developed by this deliverable.

6.3 Other conclusions and lessons learned

In Finland it is not at all certain new methods and testing equipment may be placed on buildings. At construction phase the building inspector officials are looking closely the plans and drawings in order not to let the builder have too many changes to systems. Quite often the areal construction protocol is stating what kind of equipment must and must not be placed on the property. There for the construction companies together with the building inspector officials have to be persuaded to support new idea. As the new ideas are accepted it is then relative easy to set measuring equipment and monitor building level data.

To access the dwellings with monitoring and measuring equipment the inhabitant of the dwelling need to accept the idea to be monitored. This project is giving much information to the user about how to enhance the living conditions and make savings simultaneously. Therefor the EEPOS team has been able to attract tenants to participate. But it is not enough to have access to an individual dwelling because the inhabitant of the apartment not really owns the apartment but shares of the whole housing company. Any equipment that is attached to the building are owned not by inhabitants but by the housing company (closets, refrigerator, oven, building system components, etc.). So the housing company also has to accept and adopt the new ideas (e.g. new equipment owned and in responsibility of the housing company). In a housing company board all inhabitants of the company are to be heard and discussed. Without this discussion and voted acceptance from the board no extra equipment can be installed. This means it is both time consuming and taking negotiation skills from the personnel willing to have equipment and monitoring in the housing company premises. For the EEPOS team it took quite an effort to have all these parties acceptance to benefit EEPOS project. This acceptance procedure was started already in the phase where EEPOS DoW was written.

As a positive lesson there is a positive impact of the EEPOS group visiting to the housing company's establishment meeting. Even though the new interface (gaming type) is not yet in the end-user testing phase , there has been request by the inhabitants that they would like to join the test. The inhabitants already have the eTalo view for residents for the own dwelling data. Obviously- as anticipated in the DoW- they are interested to have more info and additional interface.

7. ACRONYMS AND TERMS

CHP ....Combined Heat and Power.

EBT ....Energy Brokering Tool.

eTalo............................eHouse, Neigbourhood area level intranet.

HVAC..........................Air condition system.

Jace ....Java applicEation Control Engine.

oBIX ....Open Building Information Xchange system.

ROI ....Return of investment.

YIT RAMI...................Reporting And Monitoring Instrument.

8. REFERENCES

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