Practical approach to energy efficiency investments in small ports

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Interreg
Central Baltic

CB SMALL PORTS

CBSmallPorts – Energetic Small Ports in the Central Baltic Region – REPORT

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Abbreviations

AM	Airiston Matkailukeskus Oy or Airisto Strand, Pargas, Finland
BKG	Bläse Kalkbruk Gotland, Lärbro, Sweden
EVAK	Eesti Väikesadamate Arenduskeskus, Pärnu, Estonia*
FHH	Foundation Hiiumaa Harbors, Kärdla, Estonia
SAMK	Satakunta University of Applied Science, Satakunta, Finland (lead partner)
UTU	University of Turku, Turku, Finland
XAMK	South-Eastern Finland University of Applied Sciences, Kouvola, Finland
Metsähallitus	Finnish state-owned enterprise (that produces environmental services for a diverse customer base, ranging from private individuals to major companies), Vantaa, Finland
PVGIS	Photovoltaic Geographical Information System developed by the Joint Research Centre (JRC) of the European Commission. Link: https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html

*The lead partner was informed about financial difficulties of the project partner EVAK in the late summer 2021. After meetings and discussions with the lead partner, project partner EVAK and the CB representative, it was agreed that a change in the partnership would be the best solution in order to fulfill the work in the different work packages. The new partner, NGO Small Ports Competence Center, will take over the responsibilities and remaining budget of project partner EVAK. Project partner Eesti Väikesadamate Arenduskeskus MTÜ / Estonian Small Harbor Development Center (EVAK) will be substituted by MTÜ Väikesadamate Kompetentsikeskus (NGO Small Ports Competence Center) during the early 2022.

As no formal decision has yet been made on the project modification at the time of writing this report, the name of the old partner EVAK will still be used.

1. Introduction

The Central Baltic area of the CBSmallPorts project is formed by areas in Finland (including Åland), Sweden, Estonia and Latvia. The area is known as a boating and sailing region with various types of small ports. Some of the ports are located next to large cities, others in the areas of natural parks, but in general, it can be said that all the small ports provide quality services to boaters and other users of the small ports. In the Central Baltic area, several small ports have already performed a lot of activities and investments both in safety and resource efficiency services.

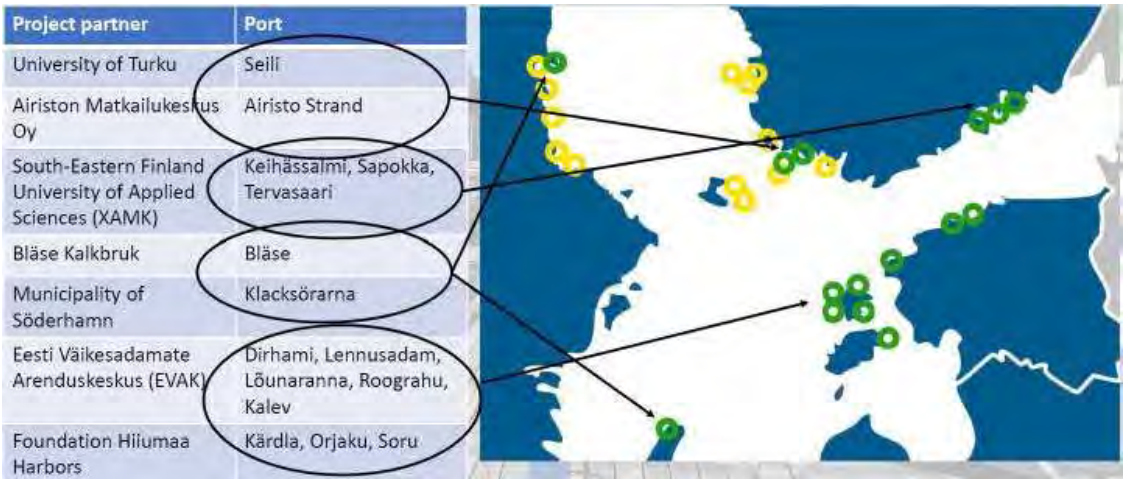
In the CBSmallPorts project activities, the main theme is climate friendly leisure time in small ports, with a focus on energy supply and use — especially on the efficient use of energy by boaters and other small port users. The objectives of the project can be achieved through strengthened cooperation. The main reason for collaboration is that despite being located in different areas, the small ports all face the same issues: short sailing season, competition of people's time and limited financial and skills resources for the port development.

Several EU-funded projects have worked to improve the safety and infrastructure of small ports in recent years. In the CBSmallPorts project, new investments were made concentrating this time in energy efficiency. All together 15 small ports in Finland, Sweden and Estonia had new investments which are described in detail later in this document (the report was completed by the end of 2021 and at that time not all investments had been completed, see chapter 3.4). Although concentrating on a limited number of guest ports, these ports will act as reference for all kinds of small ports in the Central Baltic area. For example, private sailing club ports can apply the best practices and the lessons learned from this project in the investments they are planning for the development of their own private small port.

2. Purpose of this report

This report gathers the information of practical work done and knowledge gained during the CBSmallPorts project's small port investments. The idea is to summarize the best practices suitable for small port's energy efficiency development. The report includes technical information and tendering process data on energy efficiency related investments done in small ports within the CBSmallPorts project i.e., products and services purchased from the budget of the CBSmallPorts project. The report also discusses possible new technologies and their use in the investments made.

The 15 investing small ports were: In Estonia: Dirhami, Lennusadam, Lõunaranna, Roograhu, Kalev, Kardla Marina, Orjaku Marina and Soru Marina; in Finland: Seili, Airisto strand, Sapokka, Tervasaari and Keihässalmi; and in Sweden Klacksorörna and Bläse Kalkbruk. See map in figure 1 for more detailed locations of investing ports in the Central Baltic area. Table 1 shows the investment targets of the investing ports and the amounts budgeted for them. Figure 2 shows the distribution of investment budgets among the partners and the total budget of the CBSmallPorts project, 769 936 EUR.



Project partner	Port
University of Turku	Seili
Airiston Matkailukeskus Oy	Airisto Strand
South-Eastern Finland University of Applied Sciences (XAMK)	Keihässalmi, Sapokka, Tervasaari
Bläse Kalkbruk	Bläse
Municipality of Söderhamn	Klacksörarna
Eesti Väikesadamate Arenduskeskus (EVAK)	Dirhami, Lennusadam, Lõunaranna, Roograhu, Kalev
Foundation Hiiumaa Harbors	Kärdla, Orjaku, Soru

Figure 1. Investing ports of the CBSmallPorts project marked with green circles.

Table 1. Investment targets and budgets.

Project partner	Port	The target of the investment	Budget, €
University of Turku	Seili	Service premises renovation (two saunas)	33 000 €
Airiston Matkailukeskus Oy	Airisto Strand	Floating piers x 2, solar power plant	159 500 €
South-Eastern Finland University of Applied Sciences (XAMK)	Keihässalmi Sapokka Tervasaari	Modernize the power line (from air to underground) Solar power plant, led light posts, led area lighting Guest harbor area led lighting	77 000 €
Bläse Kalkbruk	Bläse	Solar power plant, electricity / water / light to piers, pier maintenance, septic waste pumpout station	107 200 €
Municipality of Söderhamn	Klacksörarna	Solar power plant x 2 (off-grid) and lighting Fresh (drinking) water well and pump (manual)	30 049 €
Eesti Väikesadamate Arenduskeskus (EVAK)	Dirhami Lennusadam Lõunaranna Roograhu Kalev	Floating piers, solar power plant LED lights & service posts to piers Wind generators Solar power plant Heating system renovation, solar light system	321 187 €
Foundation Hiiumaa Harbors	Kärdla Orjaku Soru	Smart lighting Smart lighting & service posts Smart lighting & service posts	42 000 €

Project partner	Investment (€)
University of Turku	33 000 €
Airiston Matkailukeskus Oy	159 500 €
XAMK	77 000 €
Bläse Kalkbruk	107 200 €
Municipality of Söderhamn	30 049 €
Eesti Väikesadamate Arenduskeskus (EVAK)	321 187 €
Foundation Hiiumaa Harbors	42 000 €
TOTAL	**769 936 €**

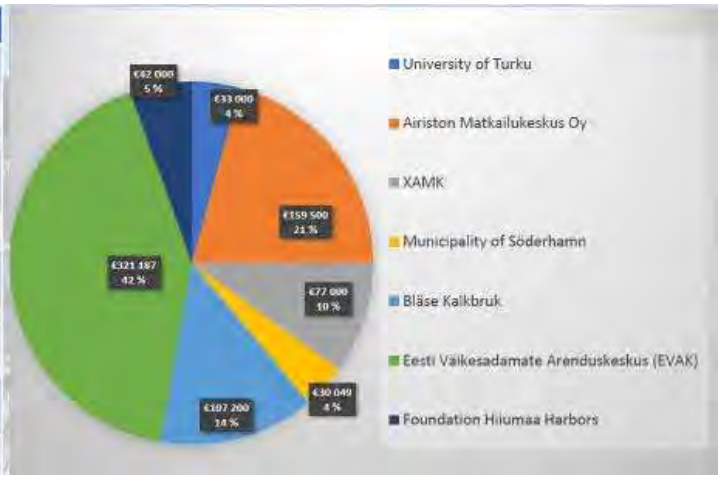


Figure 2. Distribution of investments in CBSmallPorts.

Based on the collected information, best practices on energy efficiency investments are summarized for the use of all small ports interested in developing their own energy efficiency.

3. Data collection methods

The starting point for data collection methods were the responsibilities and competencies of each partner for their own investments. In addition, data collection was strongly affected by the covid-19 pandemic, which did not allow physical small port visits during the investment phase. These factors led to a further increase in the responsibility of each partner in drafting and writing this report. The leader of the work package prepared the template for the report, in which each investing partner was required to produce text regarding their own investments. The content of the report was drafted similarly for each small port, which aims to make it as easy as possible for the reader to compare the investments of the different small ports.

Each small port has following structural descriptions: General description of the port, short description of the made investments, investment steps, technical specification related to investments and finally lessons learned chapter.

3.1. Technical specifications and new technologies

Details of the investments in terms of technical specification and documentation were gathered in the level they had been provided by the suppliers and contractors of each port investment. Technologies seen as new to small ports development and energy efficiency are separately highlighted.

3.2. Tendering

Details of the tendering processes related to the new investments were gathered at a level seen useful for small port owners and operators planning to develop their port.

3.3. Expert work by partners

In addition to previously mentioned issues information was gathered and gained also through expert work and sharing of information and communication between the partners over the investment related issues. Communication was handled primarily remotely due to covid-19.

3.4. Final content and shortcomings in data collection

The data collection for the report was generally successful. However, for a few small ports, the implementation of investments was delayed and therefore this report does not provide information for all partners, ports and investment steps. At the time of the publication of the report, not all information was available on the following ports due to delays in the implementation of the investment; Keihässalmi, Dirhami, Lennusadam, Lõunaranna, Roograhu, Kärdla, Orjaku, Sõru and Klacksörarna. However, the investments are scheduled to be completed as planned by the end of summer 2022.

3.5. Responsibilities for investment implementation

In principle, each partner is responsible for making their own investments. All partners investing in their small ports will participate in collecting and documenting the needed information from the small ports in their area.

3.6. Investment steps and schedules

The project plan specifies that the investment will be carried out in accordance with the following steps:

1. Decision making/selection of products
2. Plans and drawings
3. Public procurement
4. Purchasing, installation, initialization

The idea was that the project partners were sharing knowledge and experiences during the investments on the decision making, planning/selection of products, public procurement for investments, drawings, selected products, installation, initialization of products, maintenance and documentation.

Unfortunately, this idea was not fully realized partly due to Covid-19 restrictions and lack of physical meeting and relations building between the partners in the beginning of the project. However, an effective and informative exchange of information and experiences took place e.g., in monthly working meetings.

As with projects in general, this project had a pre-planned schedule. The investment steps were to be implemented in five different periods of the CBsmallPorts project. See table 2 for details of project periods.

Table 2. CBSmallPorts, projects periods.

PERIOD	TIME
Period 1	03/2020 - 08/2020
Period 2	09/2020 - 02/2021
Period 3	03/2021 - 08/2021
Period 4	09/2021 - 02/2022
Period 5	03/2022 - 08/2022
Period 6	09/2022 - 11/2022 (final reporting only)

3.7. Risks associated with investments

In the planning phase of the project investments, the following were perceived as the biggest risks of implementation:

1. Keeping the schedule
   The proper investments need several steps and efforts from partners internally, between the partners and co-operation with the relevant stakeholders on the implementation of the investments. This always takes time and changes will occur.

   > Staying on schedule requires good planning and quality implementation.

2. Official paperwork and approval of small port owners
   The investments were made in small ports that the project partners own themselves or that are owned by the municipality. The port owners have planned the investments jointly with other stakeholders and partners. The partners/stakeholders are cities, municipalities, NGOs (non-governmental organization) and one SME (small and medium-sized enterprise, Airisto Strand) that have approved the project and the planned investments, which will ensure the smooth process on paperwork such as procurement which are made following the local regulations and national laws.

   > Succeeding in this operating environment emphasizes the importance of smooth cooperation.

3. Finding the best solutions to small ports with the challenging conditions
   The weather conditions in small ports next to the sea can be harsh due to variation in weather: ice, storms and heavy rain, and intensive sunshine in summer. Also, the systems are used online on season i.e. in summer time, so they are on standby most part of the year.

   > The products and materials need to be selected so that they are suitable to sea weather conditions and need minimum maintenance.

4. Maintenance

   The investments are owned by the project partners during the investments. The ownership will be transferred with an official transfer agreement to the small port owner after investments are made and the partners have committed to transfer ownership of the investment. The agreement guarantees that the object of the investment will also be maintained in the future. Official contract will be made during the project. In cases where the partner owns the port the partners have committed to maintain the investments either by themselves or by agreeing on the maintenance with the port operators.

   > No investment is eternal without maintenance. The agreements guarantee the continuity of the maintenance of the investment made by the project also in the future.

4. Energy efficiency and other investment details of each port

In the following chapters named after the investing port (and investing partner abbreviation in brackets) each investing small port is described and details of the made investments and steps are presented.

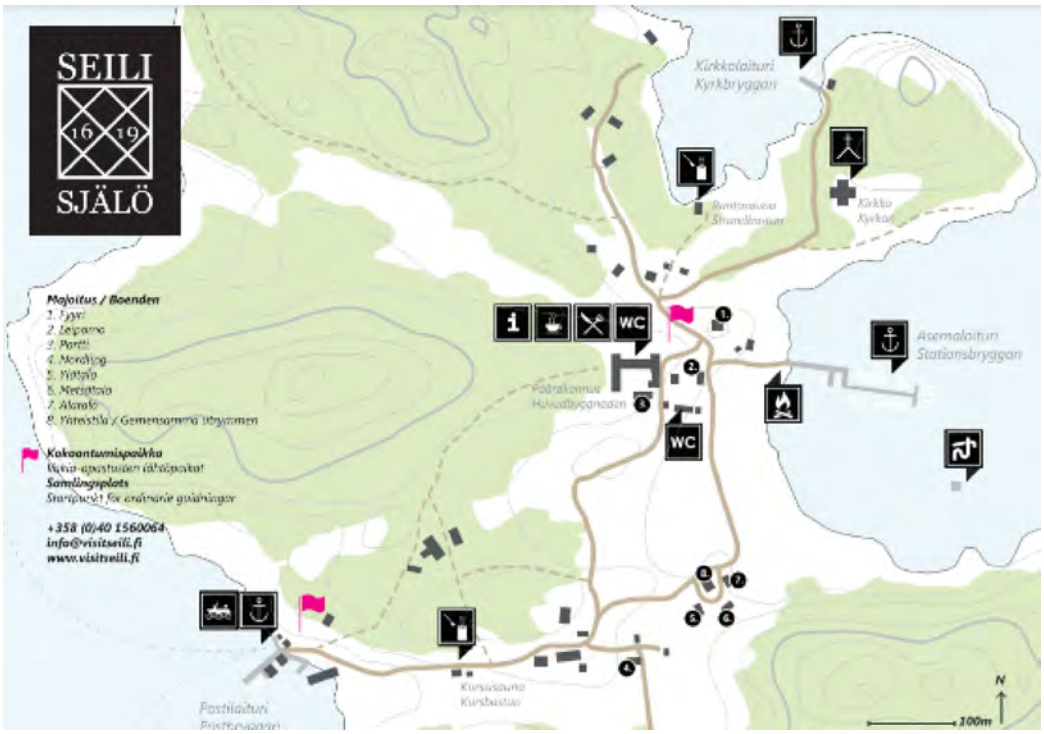
4.1. Seili (UTU)

Seili is an 1,6 km^2 island located in the Sea of Archipelago, in the vast archipelago area of the city of Pargas, Finland (picture 1). Direct distance from Seili to the nearest large population center, the city of Turku and its economic region, is just less than 30 kilometres, which makes Seili a very popular place among archipelago visitors. Seili has a long and fascinating history to offer, in addition to beautiful archipelago sceneries and atmosphere. In the summertime there are daily ferry connections to Seili from three different directions, from Turku, from Nauvo and from Rymättylä Naantali. During the tourism season 2020 Seili had around 22.000 visitors and it is expected that this number will grow.

Picture 1. The island of Seili. © www.visitseili.fi

The island of Seili is partially owned by the University of Turku (UTU) and the Finnish Metsähallitus, and also by a few private owners who control smaller properties on the island. The UTU-owned part of the island contains almost all of the historical buildings on the island, and the Archipelago Research Institute is located in these premises, the main functionality UTU has on the island (picture 2). Previously, in the history of Seili, these buildings have hosted a hospital for leprosy patients and later a mental health institute for women, but since the 1960's the primary function in Seili has been the maritime research institute of UTU. Part of these UTU premises are rented out to an operator company called Rederi Ab Vitharun, who runs a small boat port with 50 visitor berth places and provides restaurant and comfortability services for visitors nearby the port. The Seili guest harbor was opened to the public in spring 2017 and it has become a very popular destination to visit.

From the project's thematic point of view, Seili has quite substantial energy consumption with its many and rather old buildings that are currently heated with direct electric heating.



Picture 2. Map of Seili. © www.visitseili.fi/fi/kartta/

Actions to enhance the poor energy efficiency of Seili premises had been started already before the CBSmallPorts project. For example, a solar power system of approximately 200 m^2 was installed in 2019, producing a total peak power of 41 kWp. Panels of the PV-system are installed partly on the UTU dockyard building at the Postilaituri port and partly on the roof of a workshop building. These two buildings are the newest ones in Seili and could thus be used as a platform for the PV-system. Many of the old buildings in Seili are listed by the Finnish Heritage Agency and follow the relevant legislation. This forms a limitation for improving the energy efficiency in

Seili with visible PV-systems.

One of the essential services offered by Seili guest harbor are the saunas and showers for visiting boaters. Seili has two saunas, which both had a wood burning stove for heating. Acquiring the firewood and transporting it to the island is challenging and expensive, and the heating of the stoves takes working hours and creates air pollution. UTU has committed to decrease its carbon dioxide emissions by 2025 and thus replacing the wood burning stoves in Seili with electric ones supports reaching this target. Heating a wood burning stove for several hours (up to 8 hours a day) also consumes the stoves rapidly, so new stoves were needed to be acquired frequently. When the heating of stoves was partially made by the inexperienced visitors, also the temperature in the sauna's heated room varied significantly, which made some of the sauna users unpleasant with their sauna experience.

Additionally, Seili beach/log sauna had traditional wooden floor structure, which limited its usability for harbor visitors in the end part of the boating season. Due to increased visitor rates since the port's official opening in 2017, the use of these saunas has increased significantly. This has meant increased use of firewood, more work for port operator personnel taking care of heating the stoves and increased moisture and other user-caused load for the buildings' structures, originally designed for much less use. In other words, the Beach/log sauna building, used mostly by the boaters, was in need of a bigger renovation and partial redesign, because its wooden floors could not bear the increased moisture load. By renovating the floors and switching the wood burning stoves to electric stoves makes the Beach/log sauna better for current use rates and the daily life of Seili personnel easier, and provides more stable heat in the saunas, for the comfort of the users.

4.1.1. Investment description

Quoted from the project work plan (in the eMS reporting system), the investment for Seili was described as follows: "Seili service premises renovation (electrical stoves (x 2) incl. necessary installation works, cabeling, floors, etc.)". In practice the plan included two saunas: Beach/log sauna and Kurssisauna, both used by boaters, were renovated so that the old wood burning stoves were replaced with modern and energy efficient, durable electric stoves. Additionally, benches of the beach/log sauna were also renewed because the floor under the benches was rebuilt.

Moreover, in the Beach/log sauna also the traditional type of wooden floors in the shower and heated rooms were redesigned and rebuilt, including now a floor heating and proper isolation to the restructured floors. Earlier there was no isolation in the floors at all, just a bare wooden plank floor with a layer of lacquer on it, which made the floor really cold and poorly drying after intensive daily usage. After a couple of years, when the lacquer wore off, it led to moisture issues and rotting of the floor and thus it needed to be rebuilt. Now the new type of floor with floor heating dries quicker and heat losses through the floors are much smaller. The floor heating naturally increases the electricity consumption in Seili, not to mention the new electric stoves, but during the high season most of this electricity is produced by the 41 kWp PV-system. With the floor renovation, proper drains and plumbing was also added and now the wastewater from the sauna and shower room is directed

to the island's wastewater purification plant for proper purification. See table 3 for investment target, budget and actual costs.

Table 3. Investments for Seili.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Service premises renovation (electrical stoves (x 2) incl. necessary installation works, cabeling, floors, etc.)	33 000 €	43 416,33 €

The increase in actual costs in comparison to budgeted costs are mostly explained by the changes made in the working plan, such as adding the floor heating and additional insulation, and upgrading the electric stoves to a more durable model, which had some cumulative effects to stove stones and guiding units. It was also fairly difficult to estimate the investment budget in advance because the real price level of renovation projects made on a remote island was revealed by the implemented public procurement processes. Thus, this led to exceeding the Infrastructure and Works budget line in UTU budget altogether with 10.416,33 euros. This is approximately 32% more than what was originally budgeted, which can be considered as a moderately exceeding of the original budget.

4.1.2. Investment steps

- *Decision making/selection of products & Plans and drawings*

UTU/project representatives together with the representative of Seili real estate company concluded that there was a clear need for renovation and redesign work in Seili sauna buildings due to previously mentioned reasons (see chapter 4.1). It was decided that the saunas' wood burning stoves would be replaced with proper electric stoves and for the Beach/log sauna part also the wooden floors of heated and shower rooms should be redesigned and rebuilt to better handle the current user rates and increased moisture burden. No new construction permits were needed since the renovation concerned already existing buildings and there were no plans to change their purpose of use either.

The planning of the procurement process and creating the necessary documentation for it was conducted by UTU Project Experts in close cooperation with Seili real estate company, who supplied all the existing technical maps and detailed drawings of the sauna buildings and Seili property area. Since the renovation project included new electricity installations and building of a new floor, new drawings were also needed. These new plans and drawings were acquired from a company by the CBSmallPorts project, after a "bid-at-three" limited procurement process in July 2020.

New electric stoves for Seili saunas were selected by the UTU project management after the procurement process for desired electricity and construction works was completed in February 2021. Then it was somewhat clear how much the renovation works would cost, and what kind of stoves could be acquired in reflection to the project budget for UTU. Essential criteria for selecting the stoves were that they needed to

be adequate in power size for the saunas heated rooms, durable and well tested for the high usage hours and easy to use high quality products, in addition to the price of these stoves. The selected IKI stoves are designed for heavy use and already studied to be energy efficient. Other construction materials used for the renovation, such as the surface materials, were of a more regular type and decisions concerning those were left for Seili real estate company and for the port operator company to choose, based on the choices and recommendation given by the contracted supplier. Such materials were for example the new cables for power supply and the surface tiles (color and size) of the new floors. Naturally, the selected materials needed to be durable and safe for sauna users, for example the floor tiles needed to be non-slippery type i.e. suitable for wet shower rooms.

- Public procurement of the renovation works

The procurement process for acquiring a contractor for the Seili sauna renovation was opened on 22.12.2020. The selected procurement method was a "bid-at-three" procedure since the investment budget of 33,000 € stayed far below the 60,000 € national threshold. The invitation for tenders with all the necessary attachments was sent out to 13 preselected, well-known and trusted construction companies operating in the region of South-Western Finland. The invitation for tenders was divided into three parts:

A) contract for the electrical work only,

B) renovating the sauna and washing room floors of the Beach/log sauna building and

C) as an additional work, renewing the sauna benches of both of the saunas, if needed, and if possible due to budgetary reasons. This concerns only the Beach/log sauna.

The deadline for submitting tenders was set to 22.1.2021 at 4 pm. Five companies out of thirteen expressed their interest towards the Seili sauna renovation project. A site visit for these tenderers was arranged on 12th of January 2021. Two out of five interested bidders participated in the site visit, one cancelled due to poor weather conditions (winter storm) and two informed that they do not need to see the premises under renovation. By the given deadline, altogether four companies submitted their offers and one tenderer was ruled out due to being late.

After the deadline, when opening the received legitime offers, it was revealed that the offers were not comparable. Firstly, since two offers included only one part (A) and two other offers included two parts (A+B and B+C). In addition, the offered prices were given as total prices. Secondly two latter offers also exceeded substantially the set budget limit of 33,000 €. As a conclusion from this situation, UTU had to ask additional clarifications from all tenderers and give a week of additional time for submitting the revised offers. As a result, following revised offers were received

including now also the fifth tenderer, who was also able to give their offer now in time (see table 4 for details).

Table 4. Offer sums received for Seili investments. All sums include VAT of 24 %.

Company	Note!	Part A	Part B	Part C	Total
Company 1	Only part A	24,552 €			24,552 €
Company 2	Parts A, B and C	15,000 €	12,210 €	1,440 €	28,650 €
Company 3	Parts A, B and C	40,176 €	34,100 €	6,076 €	80,352 €
Company 4	Only parts B and C		44,800 €	12,800 €	57,600 €
Company 5	Only parts A and B	43,740 €	29,160 €		72,900 €

Based on the table 4 comparison, the company 2, seemed to be the clear winner having the lowest price with all parts (parts A+B and part C conditionally) included and inside of the budget limit.

However, after checking the winning offer in detail, it was revealed that it did not include the necessary excavation work off about 140m trench for the new required power cable to be drawn between the Seili Beach/log sauna and the nearby Sea Water laboratory of UTU (provides the power supply to the Beach/log sauna). Thus, a new additional one week "bid-at-three" invitation round for tenders for this part was needed and carried out. In this round the invitation for tenders were sent to the company 2 and three other excavation services providing companies. Each company was contacted both by email and phone call reminder. Two offers were finally received and are presented in table 5 below. One company refused to offer and the last one did not even respond at all to the offer request.

Table 5. Offer sums for the additional cable excavation work. All sums include VAT of 24%.

Company	Offer
Company 2	10,912 €
Company 6	2,232 €

To summarize, as the decision criteria for the winning offer and tenderer was the economically efficient price given, the company 2 was selected for the Seili construction works of A+B parts and conditionally for part C if and when needed. For excavation and cable lay down works, the company 6 was selected to implement the work. It is notable that the total price of different offers varies a lot, which is explained mainly by two factors; firstly, the construction site is located on an island, which causes serious challenges for logistics and for the working force, especially when implementing the works early in the spring or late in the fall. Thus, transportation creates additional costs. During winter time it is almost impossible to do construction work in the harsh archipelago conditions. Secondly, the tendering process for publicly funded projects conducted by a public authority (like a university) tends to lead to higher price levels.

This also reflects the over-heated construction business market, when companies have enough easier and more profitable projects elsewhere on the mainland, so they will overprice their offers for this kind of small renovation project.

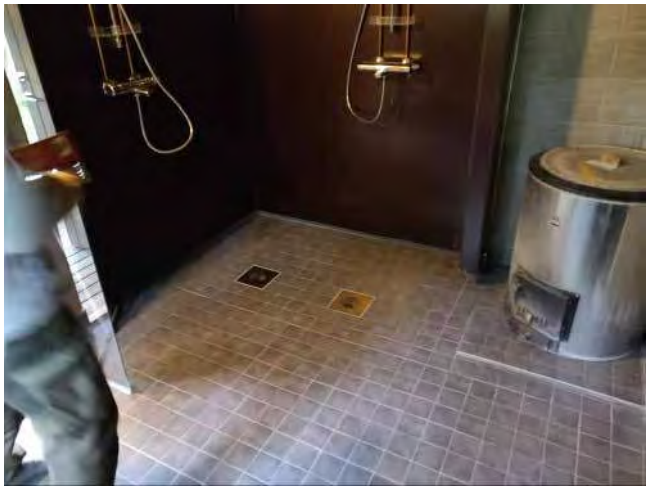
When the offers were received and the price level for the renovation project was formed, and the suitable contractor was found, it was then possible to review the stove selection in relation to the UTU project budget. It was then discovered that the UTU budget in total allows upgrading of electric stoves to more durable models, which will definitely pay off in the long run. Selected IKI stoves are designed for heavy use and are already studied and reported to be energy efficient. Also, the size of the heated rooms affected the stove choice. Seili Beach/log sauna has around 10 m^3 smaller heated room than Kurssisauna has (15 m^3 vs. 25 m^3), so the stove in Beach/log sauna could be smaller (12 kW) than in Kurssisauna (20 kW).

- *Purchasing, installation, initialization*

The renovation works in Seili were started in week 12, after the contracts were signed. Actual starting date was on 22nd of March 2021. This was a month later than expected by UTU and Seili real estate company, because there was relatively short time left until the season opened on 1st of May. The late start was due to the late opening of the procurement process in December 2020, which on the other hand was delayed due to some misunderstandings between UTU and LP SAMK in the planning phase of the CBSmallPorts project. Both parties had different interpretations of the approved project application, which led to a dispute. Clearing these issues during the project implementation required discussion with the financier and some adjustments to the UTU project plan, which all consumed time. Most important adjustment was the inclusion of floor heating in the floor renovation of the Beach/log sauna, which is seen as an essential addition when evaluated afterwards. In the end, the renovation works were finalized in May 2021 and the Seili saunas could be taken into full use in June, just before the high season.

The CBSmallPorts project group made a final inspection visit to Seili on 27-28th of May, during which all the completed works were checked and project signs were installed to both saunas (see pictures 3-6). The Beach/log sauna was also tested by the project group and the team found out it works very well. Testing also revealed a need for a few small corrections that were reported to the contractor, which promised to take care of the corrections by the end of June 2021.


Pictures 3 and 4. New electric stove in Kurssisauna building and a sign about the EU investment. © Teemu Heikkinen




Pictures 5 and 6. Renovated shower and heated rooms of the Beach/log sauna building. © Teemu Heikkinen

4.1.3. Technical specifications of the investment

The technical details of the new electric sauna stoves for Seili are as follows:

Picture 7.
Pillar-IKI 12kW.
© www.ikikiuas.fi

IKI-stove, pillar-IKI 12kW, for 14-24 m³ saunas, with separate control unit

Product and technical info:
Wattage: 12,0 kW
Height: 140 cm
Diameter: 34 cm
Size of the heated room: 14-24 m³
Minimum height of the heated room: 210 cm
Fuse: 3 x 20A, Cabling: 5x6S
Amount of stones: 180 kg (max)
Recommended diameter of stones: Ø 10-15 cm
Weight without stones: 33 kg

Safety distances:
Sideways: 150 mm
Benches: 100 mm (-rail)
Inner roof: 950 mm

Warranty: 2 years for households / 0,5 - 1 year for community / professional use depending how heavy the usage is. (When used in community / professional usage, the stones of the oven have to be stacked at least three times a year during the warranty time. Otherwise, warranty is aborted. Stones need to be replaced at least once a year and replacement needs to be documented. Ceramic stones are forbidden, except KERKES ceramic stones.

Picture 8.
Pillar-IKI 20kW.
© www.ikikiuas.fi

IKI-stove, Pillar-IKI 20kw, for 18-32m³ saunas, with separate control unit

Product and technical info:
Wattage: 20,0 kW (10 + 10 kW)
Height: 130 cm
Diameter: 54 cm
Size of the heated room: 18-32 m³
Amount of stones: 380 kg (max)
Recommended diameter of stones: Ø 10-15 cm
Weight without stones: 33 kg
Fuse 3 x 35A, cable 5x10S

Safety distances:
Sideways: 200 mm
To benches: 200 mm (-rail)
Inner roof: 1000 mm

Warranty: 2 years for households / 0,5 - 1 year for community/professional use depending how heavy the usage is. (When used in community / professional usage, the stones of the oven has to be stacked at least three times a year during the warranty time. Otherwise, warranty is aborted. Stones need to be replaced at least once a year and replacement needs to be documented. Ceramic stones are forbidden, except KERKES ceramic stones.

4.1.4. Lessons learned

The old phrase "well planned is half done" really holds true. It is crucial to do the planning phase properly, especially when a concrete investment project is under implementation. Of course, surprises do happen and project personnel becomes wiser during the implementation phase, and estimated timetables have to stretch for various reasons, but quite many of these challenges can be taken into account already in the planning phase. Though, when one is renovating old buildings or constructing new on old structures, you cannot be fully confident what kind of surprises are hidden below the surface. It is impossible to be fully prepared for those in advance, and some flexibility in the timetable or budget is a necessity. Still, one can plan the major lines in advance and set the target of the renovation fairly easily.

When planning a renovation project, it is good to keep in mind that practically always when implementing bigger changes or modifications in the electricity distribution or relevant fixed installations inside of a building or outside in the territory, like in this case changing the sauna stove type to electric one and installing an electric floor heating, also **new electric design work and drawings are needed. Another important issue to solve is the need for a building permit** and the level of the permit needed, if needed at all. In the case of Seili, no permits were needed, because the purpose of the buildings did not change, room areas nor supporting structures were not changed and the renovation happened indoors, i.e. the outlook of the buildings did not change.

In the case of island location, with no road access all the way to the construction site, **logistics plays a big role** in project expenses and schedule, and needs to be considered carefully when planning the investment and its implementation. Some flexibility needs to be considered in the planning phase and when making purchases, very precise lists of supplies are needed.

It may be difficult to get reasonable offers from the suppliers located and used to operate on the mainland, and thus there can be substantial variation between the offers. This also reflects the **overheating of the construction business markets** and thus it might be very difficult to get a committed supplier to implement the project in the archipelago area. Using local suppliers might be beneficial, because they are used to operate in archipelago areas and there might not be any additional costs for transportation of machines or equipment.

Good relations and communication skills between the contractor and customer are very important to make everything work smoothly and get the target reached. It is understandable that companies implementing a construction project in very remote locations want to get the work done in intensive periods and this approach leaves less room for advance discussions. In addition, **the number of contracted suppliers affects how smoothly the work proceeds.** It is the easiest option when there is only one contracted supplier, who can control the timetable. With two or more suppliers, coordinating the timetable might become challenging.

4.2. Airisto Marina (AM)

Airisto Marina is a small boat port located in a horseshoe shape bay (picture 9) at the west end of the Stormälö island in Pargas, Finland. The bay opens to the west, and is very sheltered for wind directions between west-north-west and south-west (295° - 225°). Airisto Marina has altogether 110 berths for boats and good service level with petrol station, shop, restaurant, septic waste pump out station, service building with sauna, showers and toilets, kids playground, sandy beach, mini golf and tennis etc.

Picture 9. Airisto Marina. © Jussi Sutela

Airisto has a long history of being a tourism destination, since it was one of the first destinations opened in Finland. The first building in the Airisto Holiday Centre, a restaurant with a motel, was founded by the Tourist Association of Finland already in 1941. Ever since Airisto has been developing as it is nowadays with its diverse portfolio of services. The current small boat port was formed and built in 1993 and as it is almost 30 years old, it is in clear need of renewal. At the same time, it is worth updating this small boat port to be an energy efficient green port.

4.2.1. Investment description

Quoted from the project reporting system eMS, the investment for Airisto Marina included "floating piers x 2 and solar panels and distribution system". By the end of May 2021, the new floating piers had been installed (see picture 12) but the ordered PV-system was not. The delay of installation is explained by the global shortage of components and challenges with deliveries due to the Covid-19 pandemic. Solar panels of the 22.25 kWp sized system were finally installed on the flat roof of the restaurant building (picture 16) by the end of October 2021.

While being still in good reusable condition, the electric posts and pier fingers were taken from the old piers and moved to the new ones. See table 6 for investment target, budget and actual costs.

Table 6. Investments for Airisto Marina.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Floating piers x 2	120 000 €	144 000 €
Solar panels and distribution system	39 500 €	24 500 €

The actual costs of the floating piers exceeded the planned budget by 24 000 euros. This is explained by the more complex and expensive anchoring of the new floating piers than estimated during the tendering process. The anchoring needed to be done with the safety-first principle, so that the secure mooring of visiting boaters is the first and most important priority.

On the other hand, the PV-system acquired (as large as possible, installed on the roof of Airisto restaurant) became cheaper than what was anticipated in the planning phase. The selected place (the only possible) for the panels affected the total price offered, and as a general tendency, the average price level of solar panels is constantly decreasing over time.

4.2.2. Investment steps

- Decision making/selection of products plans and drawings

The plans and drawings for the new floating piers and for renewing the whole small boat port of Airisto were existing already before the CBSmallPorts project started. Thus, it was very well known beforehand what kind of floating piers were needed. This information was then utilized in the public procurement process for acquiring the new floating piers. The PV-system did not need any specific plans or drawings, just technical specifications for the tendering process. The drawings of the building on which the PV-system was installed already existed, and the bearing capacity of the building was estimated beforehand.

- Public procurement

Because the budget for the new floating piers was more than 60 000€, the tendering announcement was published in the Hilma portal, the national tendering announcement portal in Finland. The selection criterion of the winning offer was the lowest price given. The PV-system supplier for Airisto small boat port was selected through a bid-at-three process, because the budgeted sum was less than 60 000 €. Again, the selection criterion was the lowest price given. In the public procurement documentation, the specifications for the floating piers and the PV-system were clearly defined.

- Purchasing, installation, initialization

Delivery of the new floating piers (pictures 10 and 11) took place in May 2021, pretty much in the planned schedule and conveniently for the start of the boating season. On the contrary, the delivery of the PV-system was substantially delayed due to international challenges with component supply. Originally, the delivery of the PV-system was planned to take place also in May, but it actually happened at the end of

October 2021 (picture 12).

Pictures 10 and 11. Two new concrete pontoon guest piers in Airisto Marina. © Teemu Heikkinen

Picture 12. Airisto Marina restaurant and the PV panels. © Veijo Pönni

4.2.3. Technical specifications of the investments

Floating piers

The new floating piers or jetties needed to be suitable for their purpose and to the location where those were installed. Target length of the first floating jetty set was 57 meters and the width of the concrete deck needed to be 2.4 meters. The second jetty set had a target length of 72 meters and the width of the deck was the same as the first jetty. Walking bridges with sloping ramps and rails (1.6 x 8.0 meters) were needed for both jetty sets. Material of the walking bridges could be either steel or

wood, attached to a wooden fixed pier with hinges.

The requirements for the jetties were:

- Concrete: 45 N/mm² waterproof plastic fiber concrete, stress class EN 206-1, Environmental classification XS3 and XF4
- Core of the jetty: EPS 60, density 15/m³, breaking load (cutting) 108 kN/m2
- Steel reinforcements and hasps needs to be hot dip galvanized
- Deck height 0.45 – 0.50 m, including the concrete deck
- Minimum length of single piece of a jetty needed to be at least 12 meters
- Jetties need to have connective dwells, so that the pieces of jetties can be connected to each other with flexible rubber-bolt joints
- Tensile strength of the joint at least 2x180 KN
- Connective dwell needs to have a steel-concrete structure, which enables the rubber-bolt joint to adjust until the dwell structure breaks
- Wooden collision rafters installed on both sides, size of the wooden rafter at least 95 x 145 mm
- All parts made of metal, such as bolts, fittings and fasteners need to be hot dip galvanized
- Anchoring made with bottom weights, each piece of a jetty needs to have at least four shafts for anchoring
- Shafts need to be accessed from the deck side, so that adjusting is possible on the deck
- Each jetty pontoon must include tubes (2+2) of 110 mm diameter

The minimum specs for anchoring were:

- Four connecting points in each piece of a jetty, to be connected with bottom anchorage of 2 500 kg
- Anchoring chains are hot-dip galvanized with long type of links, optionally either DIN 763 chain 20 mm or DIN 763 Grade 40 chain 16 mm, with applicable shackles
- The water depth in port varies between 5-15 meters, so anchoring chain needs to be reserved at least 30 meters per each pair of anchorage

Solar panels and distribution system

The requirements for the PV-system designed to Airisto Marina were as follows:

- single crystal panel, with minimum nominal wattage of 365 Watts
- The module efficiency of a single crystal panel has to be at least 19 per cent
- Warranty of a single crystal panel has to be at least 12 years. Panels has to produce electricity at least with 90 percent of nominal efficiency after 10 years of installation and at least with 80 percent efficiency after 25 years of installation

- Power cut of network voltage needs to cut off the connection from PV-system towards the power network
- Inverters manufacturer warranty has to be at least 7 years
- Inverters has to be model of three-phase inverter
- Inverter has to be able to be installed either to indoors or outdoors, and it has to bear the weather conditions typical for Finland
- Inverter has to be classified at least to IP65, and it needs to be ready for either fixed or mobile internet connection
- Solar panels need to be equipped with power optimizers, so that the shadow-problems are minimized (at least one power optimizer / two solar panels)
- Installation rack for panels has to be made of aluminum, stainless steel or hot-dip galvanized steel

4.2.4. Lessons learned

When planning to invest in a solar power system, it is important to ensure, before the call for offers, that you get the needed **permit from the municipality construction supervision** for the planned places for the panels. In the Airisto case this was not a serious challenge, because in the tendering announcement all possible places for solar panels were listed. But as a general rule, it is a good starting point to open the communication with the municipality construction authorities at an early stage of the planning process, just because sometimes the permission process might take time. In addition, if those buildings for which the PV-system panels are planned to be installed, are old and historically valuable, they may also require permits from the Finnish Heritage Agency or other similar organization in your area looking after historically valuable places and buildings. It is quite common that these kinds of buildings do not get the permission for such a visible change in outlook as PV-systems are. This should be considered already in the planning phase.

With the floating piers part of the project, the situation with the construction permission was quite challenging for a moment. **The permit for floating piers requires a hearing with neighbors owning the water area**, and like in many places around the archipelago, the ownership of neighboring water areas is very fragmented. This was the case with the Airisto small boat port as well and organizing such a hearing seemed impossible. The challenging situation was solved by purchasing the port water area by the port owner, and thus the ownership was concentrated to single hands.

4.3. Sapokka (XAMK)

Sapokka small port is the main guest port of the city of Kotka (picture 13). Kotka is a city on an island, in the embrace of the Kymijoki river, on the shores of the Eastern Gulf of Finland. Sapokka is within walking distance from the city center of Kotka. The port offers boaters a variety of services. In the area of the guest harbor you can find e.g. a boat station (fuel, groceries), sauna, restaurant, café and rental bikes. All city services are located nearby. The port offers berths for about 60 visiting boats and draught up to 3.5 m.

Picture 13. Sapokka, Kotka. © Jussi Sutela

The city of Kotka is named after the island (Kotkansaari, Kotka island in English) on which the city center is located. Sapokka guest harbor and the whole Sapokanlahti (Sapokka bay in English), on the south-east side of the city, is the yachting center of Kotka (picture 14). In addition to hosting local yacht and boat clubs, it is also the home of a modern guest harbor. The services offered are typical for a modern Finnish harbor. The services include 60 guest berths, showers and saunas, electricity on the piers, waste disposal etc. The harbor office is located in the cafeteria just off the jetties and there are a couple of restaurants in the vicinity and also the Meriniemi summer restaurant in the lovely Kotka yacht club building. Sapokka guest harbor is municipally owned, but its practical operations are run by a private company.

Picture 14. Map of Sapokanlahti (Sapokka bay), Kotka.

4.3.1. Investment description

The goal of Sapokka's investment was to make the Sapokka harbor area cozier, safer and more energy-efficient. According to the plan, the investments included a solar power plant, new led light posts to serve electricity to boaters and light the pier area and new led area lighting. These investment targets were planned as early as autumn 2019, when the plans were discussed with the representatives of the city of Kotka, which owns the port. The planned budget for these investments was 27 000 €. The investment process was scheduled to begin in August 2020 and to end in September 2021. See table 7 for investment target, budget and actual costs.

Table 7. Investments for Sapokka.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Solar power plant	27 000 €	11 935 €
Led light posts		11 732,88 €
Led area lighting		

4.3.2. Investment steps

- Decision making/selection of products, plans and drawings

Sapokka's investments were tentatively planned in 2019. After the start of the project in 2020, the city's representatives were the first to be contacted and it was determined whether the need for the investments was still the same. It turned out that the situation was still the same for the LED light posts and the solar power plant, but the area lighting would later be implemented as a separate entity, possibly covering the entire Meriniemi area and would be significantly more expensive than budgeted for the project. Due to this, the planning for the project focused on led light posts and a solar power plant.

New guest boat piers had been designed and already partially implemented in Sapokka, for which the LED light post investment suited very well. The lighting posts in the other part of the guest boat pier had already been partly renewed during the previous summer, but the investment on the other side was to be implemented during 2021 (pictures 15 and 16). To reach a coherent renewal, posts similar to those already installed on the earlier renovated pier were selected as products. The need for new led light posts was six pieces.

Pictures 15 and 16. The light posts on the new and old pier in spring 2021. © Jussi Sutela

Regarding the solar power plant, the main responsibility for the site planning was with the city of Kotka. The solar power plant was planned on the roof of the sauna/service building (picture 17) next to the Sapokka guest harbor and this building is owned by Kotkan Julkiset Kiinteistöt Oy, a subsidiary of the city of Kotka. The orientation of the pent roof of the building is very suitable for a solar power plant — facing south / southeast and the roof is only affected by a small shading on the west side.

Picture 17. Sauna/service building in Sapokka. © Jussi Sutela

Based on the planning process, it was concluded that a system with a maximum power of about 17 kWp would be suitable for the available roof.

- Public procurement

Regarding the LED light posts, the tender documents were prepared in cooperation with XAMK and the port owner, the City of Kotka. The city's desire was to have similar service pedestals for the new pier as for the guest pier renovated the previous summer, so the exact specs were easy to determine. Requests for quotations were sent in mid-May 2021 to three suppliers. The lowest price was used as the selection criterion for the tender, and based on this, one of the companies was selected as the supplier.

For the solar power plant, a call for tenders was also issued in May and sent to five suppliers on the last day of the month. Invitations to tender were sent to five local companies and in order to ensure the comparability of tenders, the offer request limited the size of the system to 12-13kWp. This size of the system would already be sufficient for production, and, in addition, the roof of the sauna could be filled efficiently with this solar panel field. The lowest price was used as the selection criterion for the tender, and based on this, one of the companies was selected as the supplier.

- Purchasing, installation, initialization

For the LED light posts, the selected company's order confirmation was received at the beginning of June and the LED light posts were delivered to Kotka to await installation. The new guest pier had been installed by the City of Kotka at the beginning of June 2021, and the installation of the LED light posts began in June and ended in July (picture 18).

Picture 18. Sapokka's new guest pier and new led light posts in July 2021. © Jussi Sutela

Regarding the solar power plant, the order from the selected company could be confirmed in July due to for example holidays. In addition, the delay in the schedule was caused by the final permit requested from the subsidiary that owns the building,

to install solar panels on the roof of the sauna building. Permission to use the roof was finally obtained on 19th of July, when the order confirmation was also made. According to the original request for quotation, the installation of the system was to take place during July. Due to the subscriber's schedule delay, it was expected that the installation schedule would take place later than planned. Fortunately, the selected company was able to start the installation right at the beginning of August. The installations were carried out on an efficient schedule and the system was already operational in the second week of August 2021 (pictures 19 and 20). Due to the delivery difficulties of the original panel supplier, the supplier had to be changed after the accepted offer. However, this did not affect the properties or overall pricing of the solar power plant.

Picture 19. Sapokka's new solar power plant in August 2021. © Jussi Sutela

Picture 20. Sapokka's new solar power plant in August 2021. © Jussi Sutela

4.3.3. Technical specifications of the investment

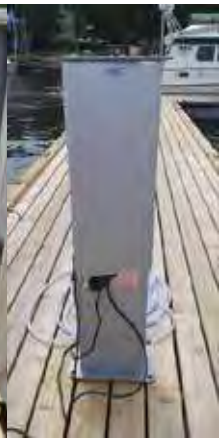
Sapokka's investment consisted of two separate entities; led light posts for the new guest pier and solar power plant on the roof of the sauna building.

Led light posts: The posts were intended to be similar to those already installed. The properties of the posts included electricity, water and light (pictures 21 - 22). Further

details and specifications on the posts can be found in figure 3. A few individual features;

- 4 sockets 16A/230V
- 1 socket outlet 16A/400V
- Led hat lamp 10W
- Water point behind the hull





Pictures 21 and 22. Close-up of Sapokka's new led light posts. © Jussi Sutela

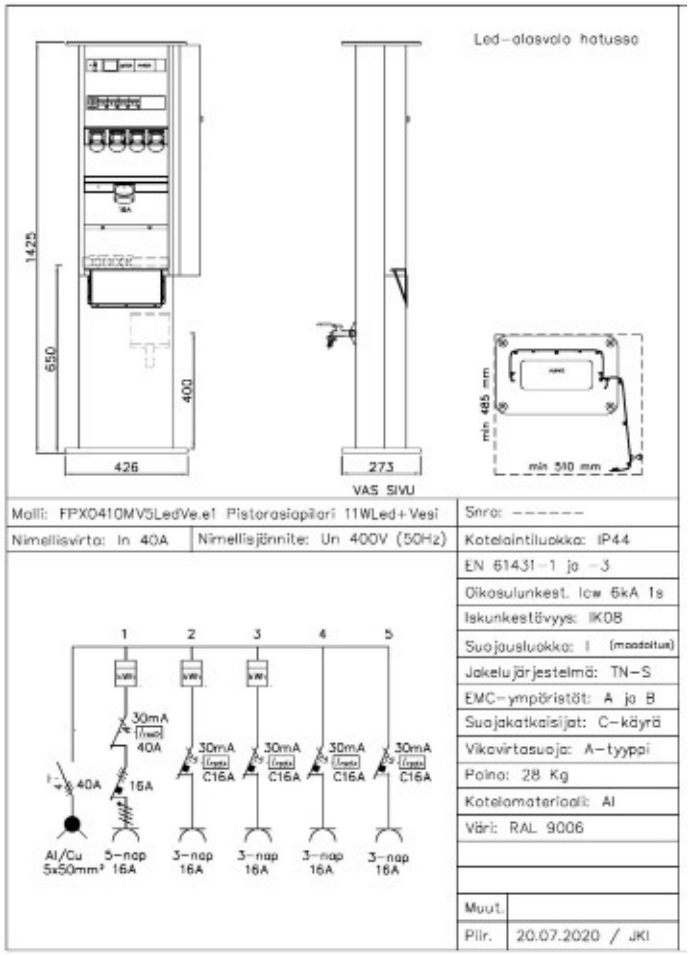


Figure 3. Technical specification of the LED light posts for Sapokka, Kotka.

Solar power plant: The roof of the sauna building placed a size limit on the system. According to the tender documents, the system size was 12-13 kWp. The system offered by the selected company was 12,2 kWp and included 33 solar panels (Longi HALF CUT 370W). Due to delivery difficulties with this panel, the panel was replaced with a similar TrinaSolar 370W HALF CUT panel. The panel was promised a mechanical warranty of 12 years and a power warranty of 25 years. The inverter of the system is Solis 15.0kW, which has a 10-year warranty and includes free WIFI-online monitoring option.

4.3.4. Lessons learned

The right contacts and cooperation with them – Municipal buildings in particular may, for example, be owned by a separate subsidiary. These issues need to be known in good time and are part of a quality planning process.

Necessary permits – When planning to invest especially in a solar power system it is important to ensure that the necessary permits are in place to install the solar panel field at the planned location.

Ongoing collaboration and communication – it must be continuous, up-to-date and both parties must be kept up to date.

4.4. Tervasaari (XAMK)

Tervasaari is the quest harbor of the city of Hamina. Tervasaari is a centuries-old trading place and harbor, and one of the oldest Finnish seaports. The name Tervasaari refers to tar, which was one of the important export products to Europe. Tervasaari guest harbor is located about a kilometer from Hamina city center and offers a variety of services for visiting boaters. In the area of the guest harbor you can find e.g. a boat station (fuel, groceries, rentals, playground), sauna, restaurant and beach. The port offers berths for about 40 visiting boats and draught up to 4,0 m. Two old ship museums are open to the public at the harbor with lightship s/s Hyöky and icebreaker m/s Merikarhu. The services and historical sights of the city of Hamina are within a walking distance.

Tervasaari is not only a guest harbor, but a versatile leisure destination, which is a common living room for both Hamina residents and tourists (picture 23). Services are provided by Boat Station Rampsi, in connection with which food and drinks are served at the sunny Rampsi Kitchen & Lounge.

Picture 23. Tervasaari, Hamina. © City of Hamina

The city of Hamina is currently building a new central park area called Oolanninpuisto (picture 24) in Tervasaari. The guest harbor forms an essential part of this new leisure park area.

Picture 24. Oolanninpuisto, a recreational park in Tervasaari. © Jussi Sutela

4.4.1. Investment description

The goal of Tervasaari investment was to make the Tervasaari harbor area cozier, safer and more energy efficient. According to the plan, the project included an investment to build LED-lighting to the guest harbor area. Preliminary investment plans were made as early as September 2019, when the City of Hamina Development Manager was informed about the opportunity to participate in the CBSmallPorts project. See table 8 for investment target, budget and actual costs.

Table 8. Investments for Tervasaari.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Guest harbor area led lighting	25 000 €	22 940 €

4.4.2. Investment steps

- Decision making/selection of products, plans and drawings

In autumn 2019, it was planned that the investment would be implemented as part of a larger Oolanninpuisto pier renovation during autumn 2020 - spring 2021. After that, the plan was not returned until the summer of 2020, when the CBSmallPorts project was actually launched. During the rest of 2020, a discussion was held with representatives of the city of Hamina. The Development Manager involved in the planning phase had retired, so the contact persons had changed. Due to the urgency of the new manager, the implementation of the project and real cooperation was not achieved until the winter of 2021. The site was finally visited in February 2021, after which things progressed rapidly. The cooperation with the city engineer of Hamina worked great, a few online meetings were held, together with the project's energy efficiency expert Teemu Heikkinen from SAMK. The lighting plans and product selection for the pier area were completed in early March.

The lighting plan included the acquisition and installation of 13 new lighting poles with LED-lights. According to the plan, the city of Hamina will contract for electrical wiring for the new pier, as well as the foundations for the poles and the poles including the lamps will be acquired as part of the CBSmallPorts project. The layout of the pier area is shown in figure 4.

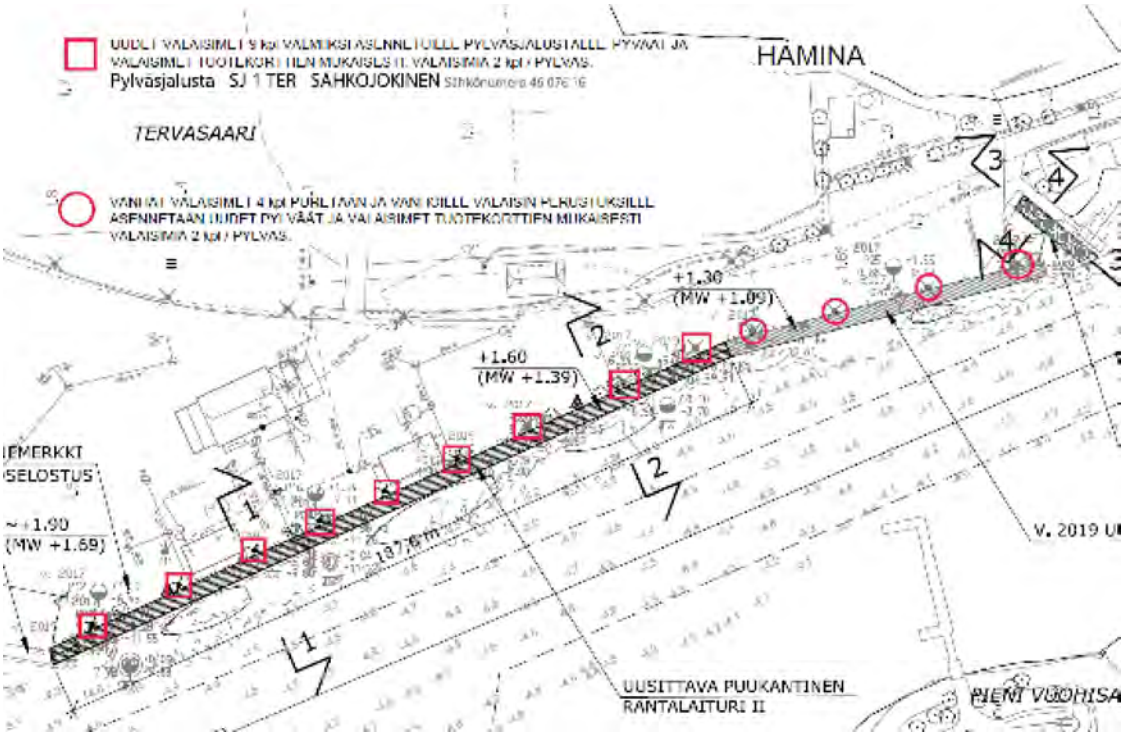


Figure 4. Layout of Tervasaari pier area.

-Public procurement

The invitation to tender was sent mid-March to three local suppliers. A response time of approximately two weeks was given and an offer was received from all three by

the deadline.

The planned budget for the investment was 25 000 € and the values of the bids varied between 43 000 € and almost 47 000 €. It was immediately clear that the investment could not be fully financed through the project – something else had to be invented. The starting point of the owner of the pier was that LED-lighting would be installed on the new pier. The fact that the project budget would not be enough to carry out the entire investment could not be a reason not to renew the lighting. As a result, it was decided to re-tender the lighting, with XAMK requesting a tender for 7 luminaires (pole and luminaires with their installations) and the city of Hamina for the remaining six luminaires. Otherwise, the content of the invitation to tender remained the same as the original. New invitations to tender were sent to the same operators on 12 April 2021 and again all three replies were received. In the new tender, bid levels remained within budget and a final comparison of bids and supplier selection could be made. The lowest price was used as the selection criterion for the tender, and based on this, one of the companies was selected as the supplier. The offer for seven luminaires was 22 940 €.

- Purchasing, installation, initialization

The award decision was made on 19th of April 2021, which included a two-week appeal period. Based on the winning offer, the delivery time of the poles was about 5 weeks, and the delivery time of the lamps was about 8 weeks from the order. That is, installations were able to begin in late June. In early June, the new pier was renovated, and the lamp bases were ready (pictures 25-27). Finally, the installations were completed and received end of July/ early August 2021 (picture 28).

Picture 25. Tervasaari pier area in early June 2021. © Jussi Sutela

Pictures 26 and 27. Tervasaari pier area in early June 2021. © Jussi Sutela

Picture 28. Tervasaari pier area in early August with the new area lighting. © Jussi Sutela

4.4.3. Technical specifications of the investment

The lighting of the pier was designed by the city of Hamina. They had a clear idea of what kind of light poles and lamps were desired for the new dock. The drawing of the selected light post, Albany 2 MIDI can be found in figure 5 and the selected LED-lamp in picture 29.

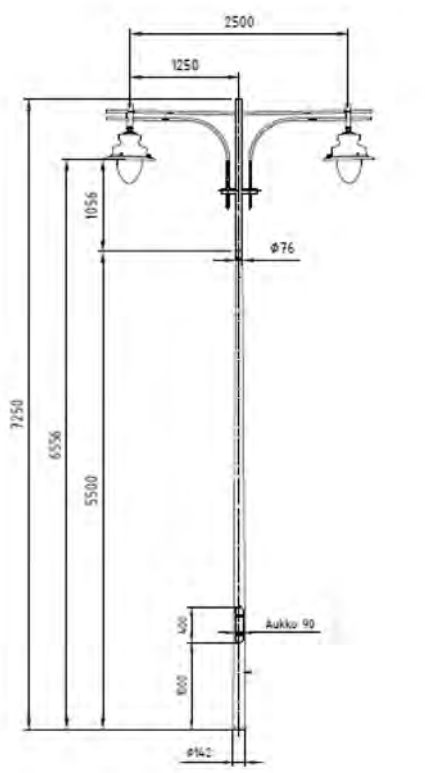


Figure 5. The drawing of the selected light post, Albany 2 MIDI.

Albany LED

LED

Albany LED is a versatile classic luminaire available now in LED version. Victorian era design combined with modern LED-technology enables classical lighting in different areas of the city.

Picture 29. Selected LED-lamp, Albany LED from Schrèder for Tervasaari.

The Albany LED luminaires are composed of an upper and a lower body of spun aluminum and a protector, made of UV-resistant polycarbonate. Albany Midi-LED can be fitted with 16, 24, 32 or 48 LEDs and a series of lenses that cover a wide range of photometric solutions. In this case, the 48 LED/50W version was chosen as the luminaire type. The selected LED color temperature was 4000K (natural white) and the lamp produces a luminous flux of 8400 lm. Other specifications can be found in table 9.

Table 9. Technical specifications of selected lamp, Albany Midi-LED.

E Number	Type	Product name	Base	Kg	Length	Width	Height	Windage	Luminous flux
Albany Midi 4000 K									
45 344 81	ALBALD 004503 D880 ON	ALBANY MIDI 16LED 5068 26W 3600LM /40 CL2	LED	8,0	590	580	583	0,286 m²	3600 lm
45 344 82	ALBALD 004502 D880 ON	ALBANY MIDI 16LED 5102 26W 3600LM /40 CL2	LED	8,0	590	580	583	0,286 m²	3600 lm
45 344 83	ALBALD 004504 D880 ON	ALBANY MIDI 24LED 5068 38W 5000LM /40 CL2	LED	8,0	590	580	583	0,286 m²	5000 lm
45 344 84	ALBALD 004505 D880 ON	ALBANY MIDI 24LED 5102 38W 5000LM /40 CL2	LED	8,0	590	580	583	0,286 m²	5000 lm
45 344 85	ALBALD 004506 D890 ON	ALBANY MIDI 48LED 5068 50W 8400LM /40 CL2	LED	8,0	590	580	583	0,286 m²	8400 lm
45 344 86	ALBALD 004507 D890 ON	ALBANY MIDI 48LED 5102 50W 8400LM /40 CL2	LED	8,0	590	580	583	0,286 m²	8400 lm
45 344 87	ALBALD 004508 D880 ON	ALBANY MIDI 48LED 5068 73W 11000LM /40 CL2	LED	8,0	590	580	583	0,286 m²	11000 lm
45 344 88	ALBALD 004509 D880 ON	ALBANY MIDI 48LED 5102 73W 11000LM /40 CL2	LED	8,0	590	580	583	0,286 m²	11000 lm

4.4.4. Lessons learned

The right contacts and cooperation with them – The contact persons for this acquisition changed during the project and it took some time to find the contacts with whom the acquisition was eventually completed.

Ongoing collaboration and communication – It must be continuous, and both parties must be kept up to date. The goal of both parties is the same – to get the investment done, so there needs to be positive pressure to communicate.

Choice of procurement format – for example, reverse bidding. In reverse bidding, the maximum purchase price is determined in advance, i.e. prices do not compete. Tenderers therefore compete exclusively on quality factors. In this case, for example, a reverse tender could have produced the same result more quickly and re-tendering would have been avoided.

Detailed planning, attached to the offer request – If an individual and precise call for tenders is sought, the annexes must also be at the same level. Inaccuracies in the appendices cause unnecessary additional clarifications, which is time-consuming and stretches schedules.

4.5. Keihässalmi (XAMK)

Keihässalmi, a small and old fishing port near Pyhtää, offers its visitors limited services (e.g. boat slip, waste collection point and septic waste disposal). The port offers berths for about 10 visiting boats and draught up to 4,0 m (picture 30).

Picture 30. Keihässalmi, Pyhtää. © CB-project 30Miles

4.5.1. Investment description

The goal of the Keihässalmi investment was to make access to the Keihässalmi guest harbor easier. According to the plan, the project included investment to modernize the power line and transfer the line from air to underground.

Preliminary investment plans were made as early as June 2019, when the municipality of Pyhtää had discussions with the owner of the power line. At that time, the municipality of Pyhtää had also entered into a letter of intent with the developer of the area, which agreed that the area would be inhabited, and the existing small port would be developed. Changes to the power line would be part of this development work. At that time, the cost of modifying the power line was estimated at around 32 600 €.

As a funny detail, it can be mentioned that the contact person of the municipality of Pyhtää became an employee of the city of Hamina during this process and acted as the contact person of Hamina in Tervasaari's investment. See table 10 for investment target, budget and actual costs.

Table 10. Investments for Keihässalmi.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Modernize the power line and transfer the line from air to underground	25 000 €	34 184 €

4.5.2. Investment steps

- Decision making/selection of products, plans and drawings

As mentioned earlier, planning for power line modifications had already begun during 2019. At that time, there was no information yet on the implementation of the CBSmallPorts project. After the CBSmallPorts project was confirmed in early 2020, Keihässalmi's investment was planned as part of this project. The initial plans were already very close to the final plans, only the cost estimate increased slightly. The Keihässalmi network plan can be seen in the figure 6.

Figure 6. Network plan of Keihässalmi, Pyhtää.

As Keihässalmi's investment is one large entity, it could not be scaled or reduced. The investment was either made or not made. At the application stage and budgeting of the CBSmallPorts project, there was no precise information on the actual cost of this investment. For these reasons the budget had to be increased for this investment to cover the costs now known. The difference in budgets was 9184 €.

- Public procurement

The mentioned company owns the power line located in the Pyhtää municipality area, which is the subject of this investment. This company has made a framework agreement with the infrastructure company, which covers the construction and service of the electricity distribution network. The agreement is concluded for the years 2021–2023, and it is possible to extend it until 2027. The value of the agreement is approximately five (5) million euros annually.

The company carried out a tender for the framework agreement as a public procurement during April-August 2020. The framework agreement with the infrastructure company, covers electricity network construction work, connection investments, maintenance, troubleshooting and backup, logging assistance and cable displays. As a result of this framework agreement, no public tender was launched for this CBSmallPorts investment.

- Purchasing, installation, initialization

The offer to XAMK made by the mentioned company was approved at the end of March 2021 and the subcontractor was able to start terrain planning for the necessary permits in May. Modernization of the power line needs a special "Permits under the Water Act". The average target processing time of a water permit application at the Regional State Administrative Agency is 9 months. In mid-October, the network owner announced that the appeal period for the permit application had expired, and that construction work could begin in week 42/2021. Unfortunately, there has been need for further clarification during the permit process, which has delayed the investment. Finally, at the end of December 2021, modifications to the power line were launched and the cable was laid underground on a fast schedule. During the spring of 2022, the old high voltage cable poles will be dismantled separately.

4.5.3. Technical specifications of the investment

The basic idea of the investment was to modernize the 20 kV power line and transfer the line from air to underground. The cost structure of the investment consisted of the dismantling of the old overhead cable and the installation of a new underground cable. According to the plan, the new cable will be installed 315 meters on the ground and 180 meters on the seabed. A 95 mm2 high voltage cable is used as the new cable. In addition, one high voltage pole will be renewed.

4.5.4. Lessons learned

Special permits required for investments – The permit issues required for investments must be clarified in good time when planning the project. Processing permits can take up to several months and affect schedules.

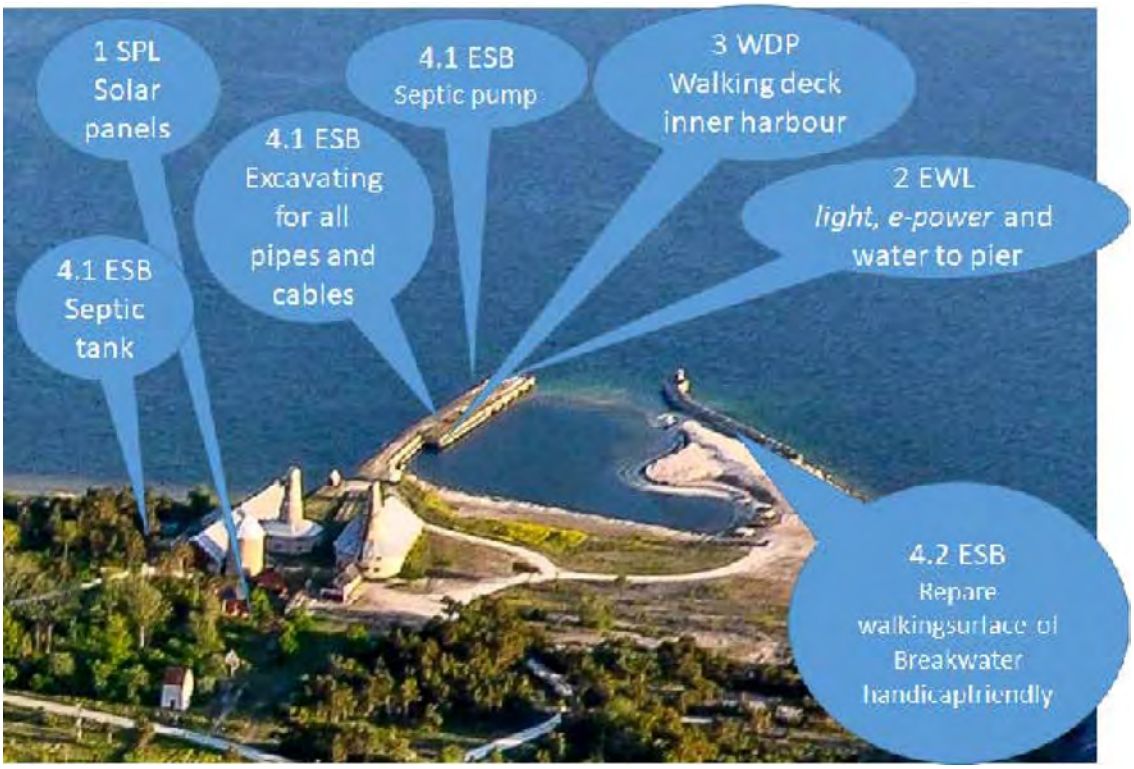
Framework agreements – In modifications to the electricity network, the network owner's framework agreements and their use must be taken into account when making network modifications. Often in these situations, procurement can be done through framework agreements. Especially in the case of a site that requires special permits, e.g. in this case, modifications to the high-voltage electricity network.

4.6. Bläse Kalkbruk (BKG)

Bläse Kalkbruk small port is located in Lärbro Sweden, in the north-western end of the island of Gotland. It is the guest port of the industrial museum of Bläse. Since 1984, this port and museum have been developed to a popular meeting-place for local, national and international guests. The museum and port offer facilities such as small port, museum, restaurant, train to stone-quarry, service house and an interesting nature and lime-stone-coast.

4.6.1. Investment description

In BKG many different investments were implemented ranging from a large solar power system and service posts to walking decks and septic waste pump out station. Investments included lots of designing and digging cables and pipes underground. See picture 31 for the different investments and table 11 for investment targets, budgets and actual costs.



Picture 31. Bläse Kalkbruk and placement of the investments. © Leif Ortman

Table 11. Investments for Bläse Kalkbruk.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Solar Panel Energy (SPL) (Solar panel plant contract, roof-turret, upgrading el. and integrate solar system, document. & drawings)	48 700 €	37 946,19 €
Electricity, Water and Light to Piers (EWL) (Equipment installation, electricity installation, device for installation, document. & drawings)	12 500 €	10 437,87 €
Walking Decks at Piers (WDP) (Iron frames / wooden deck maintenance, recast surface of one pier)	18 400 €	7 500,41 €
Emptying Septic Tanks from boats (ESB) (Digging for all pipes and cables for all investments. repair Breakwater, install septic tank on land and pump on pier)	27 600 €	20 093,1 €

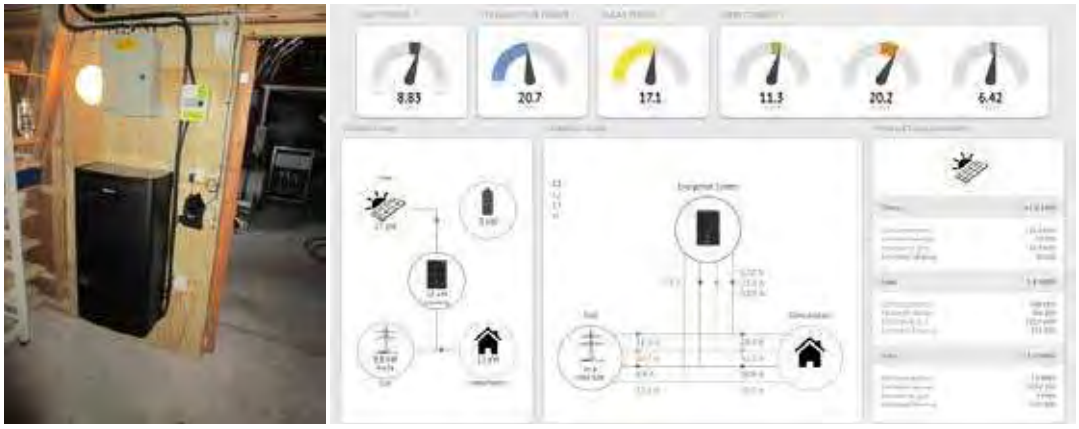
4.6.2. Investment steps for solar panel energy (SPL)

- Decision making/selection of products, plans and drawings

Decision making and selection of products was done together with the project team, local steering group and the board of Bläse Kalkbruk. In the application phase, the motivation for solar power was to get a secure cost-effective and environmentally friendly power source for Bläse Kalkbruk port and other services' electricity consumption. Bläse and Gotland had a history of having power cuts and a self-sufficient energy source seemed like a good option for securing the power supply.
In the beginning batteries were supposed to be included in the system but this was later seen as a too expensive option at this point. Instead, a system with the possibility to later add batteries and having energy consumption monitoring and automatic leveling of different electrical phases was seen as feasible. Additionally, the power grid stability in Gotland had been improved and there were now fewer power cuts.

In the plans and drawings phase, the implementation was designed so that the PV system would be a grid-tied system with a sized capacity of 30-34 kWp of nominal output power. The southeastern roof of the limestone-barn was seen as the best place for a panel field. Size of the site's main fuse is 63A which practically limits the possible maximum installed inverter output to 43.6 kW.

The roof surfaces are anti-corrosion plated roofs with solid wood roof truss (15x15cm) and with 2 supporting points from frameworks with the same dimension. The panels are fastened to vertical metal beams who are directly screwed to the roof trusses. The main fuse for the panels is indoors directly under the panels. See pictures 32 and 33. The main fuse for the house property is outdoors 30 meters away.



Pictures 32 and 33. Ferroamp inverter, main fuse for system and other gear installed and monitoring dashboard view. © Leif Ortman and Teemu Heikkinen (screenshot)

- Public procurement

Calls for an offer were sent to three suppliers in Gotland. Suppliers from the mainland of Sweden showed no interest in offering likely due to long ferry connections and additional costs because of it. Finally, two complete offers were received from which the cheapest one was selected. The backgrounds of the two tenderers were checked to be OK by the local tax office.

- Purchasing, installation and initialization

Installation of the PV system and electricity upgrading works started in September 2020 and were completed at the end of October. During the inspection done by the local electricity network operator it was found out that the cable from the main fuse center to the sub center on the quay was too weak to withstand the electrical loads on the renewed electrical system. For this reason, the cable had to be changed to a thicker one. The old cable was reused between the service pedestals on the quay.

A 31.6 kWp PV system with 81 panels was installed on the Bläse bistro restaurant building (picture 34). Solar inverter was installed indoors with related equipment (picture 32). The Azimuth of the panel field is about 60° to East from South and the inclination of the roof and panels about 45°. According to European commission PVGIS simulation software, the estimated annual shadeless production for this system in Bläse is about 28 MWh. The work of the installation was slightly delayed due to the delays in component deliveries from China. The installation was affected by a week.

Picture 34. Bläse Kalkbruk restaurant building with 31.6 kWp of panels installed. © Leif Ortman

According to the Ferroamp monitoring portal, the Bläse Kalkbruk PV plant has been online and operational since 31st of October 2020 and the installation was completed a day before. By 10th of October 2021, it has been producing 25.3 MWh of which 16.4 MWh (65%) has been self-consumed and the rest 8.9 MWh sold to the grid. From figure 7 graph it can be seen that during summer somewhat all solar production was self-consumed. In April and May there was a bit more need for grid export.

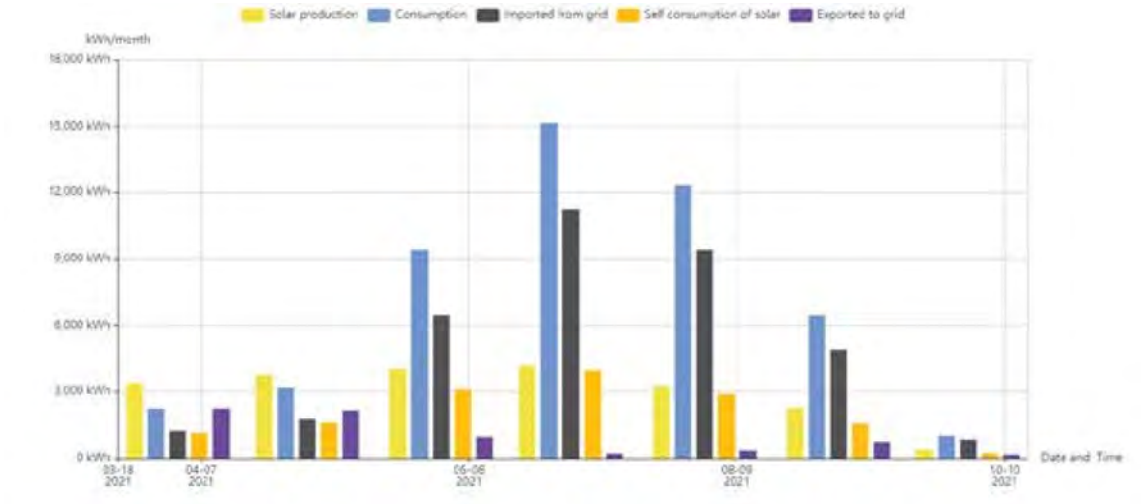


Figure 7. Electricity production and consumption data from Bläse Kalkbruk PV plant.

4.6.3. Investment steps for electricity, water and lighting to piers (EWL)

- Decision making/selection of products, plans and drawings

Decision making and selection of products was done together with the project team, local steering group and the board of Bläse Kalkbruk. The idea was to expand the area lighting, water and electricity supply services for the whole guest port. Altogether eight service pedestals were decided to be installed with needed features to cover the whole guest pier area with lighting and water and electricity services.

Plans and drawings included deciding and making drawings for exact places of service pedestals, planning the connection points for electricity and water connections, updating the related technical drawings for new cables, pipes and connections. Protection tubes were to be used with electric cables and water pipes.

In the beginning of the project part the power requirement of different electric loads and equipment were summed. At this point it was noted that the existing cables to the quay were not strong enough for the new load and needed to be replaced with bigger ones to avoid power failure. As the old cables already were in protection tubes the change went fairly smoothly.

- Public procurement

Invitation for tenders was sent to three companies of which two answered. Finally, two complete offers were received and both with a secured background and tax-status. After checking with the local steering-group and Bläse board the cheaper one was selected (Difference of 41 592 SEK = 4166 EUR). The company also had the best external references.

- Purchasing, installation and initialization

Installation work started after the excavation work in the quay was completed in the middle of November 2020. The work was delayed because of bad weather conditions but before Christmas the lighting was on and the whole installation was completed in the middle of January 2021. All installed service pedestals have LED lights on top, five have additional power sockets for boats and two of them also have water taps to provide water for visiting boats. Additionally, a power connection point for septic waste pump out station was added. All connections have a 16A fuse. See pictures 35-38.


Pictures 35 and 36. The Sub-fuse box on quay and cable installations. © Leif Ortman


Pictures 37 and 38. New water, electricity and light service posts on the pier at Bläse Kalkbruk. © Leif Ortman

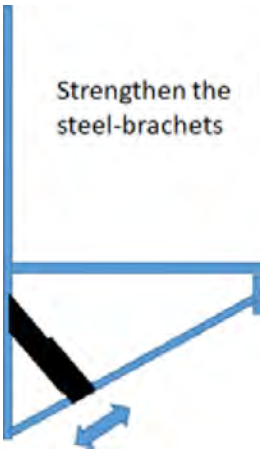
4.6.4. Investment steps for walking decks (WDP)

- Decision making and selection of products

Decision making and selection of products was done together with the project team, local steering group and the board of Bläse Kalkbruk. The goal was to restore the walking bridges at the inner harbor side of the quay. The iron braces had to be strengthened and some of the wooden boards had to be changed to be able to use the inner harbor again.

Needed measures were:

- Repairing and strengthening the walking decks for better mooring in the inner harbor.
- Strengthening the supporting iron brackets of the walking decks. See picture 40.
- The woodwork of the walking decks needs to be maintained. See picture 39.
- Install new staircases from the walking decks to the quay and two safety ladders from water to the walking decks. See pictures 41 and 42.



Pictures 39 and 40. Part of the renewed walking decks and new stairs up to quya from the walking deck and illustration of the strengthening measure. © Leif Ortman

Pictures 41 and 42. The safety-ladders from water to the walking deck. © Leif Ortman

- Public procurement

The invitation for tenders was sent to two groups of companies. One group for strengthening brackets/braces and one group for the woodwork. Three inquiries for each group.

- Purchasing, installation and initialization

The invitation for the bracket restoration gave two complete offers and the cheapest offer, that was 13300 SEK (1332 EUR) lower, was selected. Both companies were "clean" from a financial and taxing view. The work started in the middle of September 2020 and finished 10.5.2020. One bracket was so rusty that it had to be changed.

The invitation for the woodwork gave one complete offer (16 000 SEK = 1600 EUR) and the company-check was OK. The other two companies were fully booked. This work started when the bracket restoration was finished in June 2020. During July 2021 the walking decks were completed with two additional safety ladders.

4.6.5. Investment steps for the septic waste pump-out station (ESB)

- Decision making and selection of products

Decision making and selection of products was done together with the project team, local steering group and the board of Bläse Kalkbruk. This project ESB has two target areas:

ESB.1

- Excavation for all cables and pipes at the quay
- Installation of a septic waste pump-out system

ESB.2

- Repair the walking concrete surface of the breakwater to make it handicap-friendly and generally more accessible

- Public procurement

Invitation for tenders were sent to two groups of companies. One group for ESB.1 and one group for the ESB.2. Three inquiries for each group.

- Purchasing, installation and initialization

The invitation for ESB.1 gave two complete offers and the cheaper one was selected being 10000 SEK (1000 EUR) lower. Both companies were "clean" from a financial and taxing view.

The work with ESB.1 started in the middle of September 2020 and finished 5.2.2021.

BKG asked for an offer for three different septic waste pumps with specification of maximum distance to septic tank on land. The chosen pump was Latrina Mini, the cheapest with enough power. Latrina is the dominating septic pump brand at Gotland.

The invitation for ESB.2 gave one complete offer (120 000 SEK = 12 000 EUR) the company-check was OK. The other two companies were fully booked and could not free the right equipment for the work. This work started in the middle of July 2021 and was finished 13.8.2021. See pictures 43 - 48.

Pictures 43. Pump delivered and picture 44 Pump on quay. © Leif Ortman


Pictures 45. Installing the septic waste tank and picture 46. Excavation work on quay. © Leif Ortman


Pictures 47 and 48. ESB.2 Concrete casting ongoing and results for breakwater. © Leif Ortman

4.6.6. Technical specifications of the investments

Solar Panel Energy (SPL)

PV system installation consisted of 81 pieces of 390 Wp Futura Sun panels, a Ferroamp EnergyHub XL28kVA solar inverter as the main components. See Ferroamp datasheet in table 12.

The orientation of the roof and PV system is not ideal for the location since with ideal setup the estimated production output would be about 32.5 MWh instead of the now estimated 28 MWh. The production concentrates a bit more on morning hours when again the consumption of the site is typically at highest in the afternoon. Some tall trees shading the roof from the southeast side were cut down during the PV system

installation but there are still trees that cause some shading when the sun is not yet high enough. Trees naturally have other values too and it remains to be seen and evaluated later if more shading trees are cut down.

Table 12. Ferroamp EnergyHub datasheet.

	EnergyHub XL	
AC-sidan		
Nominell växelström	21 kVA	28 kVA
Reaktiv effektkapacitet	Full kapacitet på 4 kvadrant inom den aktuella gränsen	
Nominell växelspänning	230/400 VAC	
Nominell nätfrekvens	50 Hz	
AC kontakt	5-trådad (L1, L2, L3, N, PE)	
Säkringar	MCB type B, 32 A	MCB type B, 40 A
DC-sidan		
DC-buss spänning, V_{DC}	760 V (nominell)	
DC-buss spänning räckvidd, V_{DC}	720 - 800	
Högsta DC-buss ström, $I_{DC max}$	29 A	38 A
DC-buss kontakt	4-trådad (DC+, M, DC-, PE)	
Max effektivitet DC till AC	98.5 %	
Max effektivitet AC till DC	98.0 %	
DC-buss kommunikation	Narrow band power line communication (PLC)	
Fysikaliska egenskaper		
Dimensioner H x B x D	220 x 520 x 650 mm	
Vikt	36 kg	
Färg	Svart	
Installation		
Omgivningstemperatur[1]	-10°C – 45°C	
Luftfuktighet	0 – 95% RH icke kondenserande	
Förseglingsgrad	IP 21	
AC kontakt	Phoenix VC-AMC-5, screw terminal max 10 mm²	
DC-buss kontakt	Phoenix VC-AMC-4, screw terminal max 10 mm²	
Antal parallellt kopplade EHUB	Upp till 1000 kVA	
Längsta DC-buss kabellängd [2]	200 m	
Mätningsdata	AC x 3: spänningar, ström, fasvinklar, DC: spänning, ström	
Anslutningar	Ethernet, USB, CAN	
Compliance		
LVD	EN 62109-1, EN 62109-2	
EMC	EN 61000-6-2, EN 61000-6-3	
Nätinkoppling	EN 50438:2013	
RoHS	Ja	
Skyddsfunktioner	AC överspänningsskydd, DC överspänningsskydd, DC-buss kortslutning, Överhettning	

In addition to good electricity production and consumption monitoring capabilities of the Ferroamp inverter, the EnergyHub has a novel feature of automatically leveling the energy production and consumption between different electrical phases. This is likely to increase the self-consumption share of the produced solar energy compared to a regular solar inverter since in a regular 3-phase solar inverter, the produced solar power is distributed evenly between all three phases independent of what is the actual load of each phase. With the implemented solution in BKG the produced power is shared based on instantaneous loads i.e. actual power needs of each phase. In practice the phase with the highest load gets the biggest share of the production i.e. saving at the same time the often unwanted and potentially costly power consumption peaks of the facility's power consumption. Loads of each electric phase depend on which electrical loads (devices) are connected and operated in that phase. See picture 38 for details of the monitoring and phase leveling.

Electricity, water and lighting to piers (EWL)

Three types of lighting poles (a total of eight poles) were installed in the investment (see figure 8):

1. B-poles: Three light poles with LED-lamp. Two located in the beginning and one at the end of the quay.
   Wiring: Cable SIXV 3G2,5, Fuse 10A, LED-light, IP44, 230V

2. BE-poles: Three light poles with LED-lamp and 4-sockets. One in outer harbor side and two at the inner harbor side of the quay. Wiring: Cable NIXV 5G10, Fuse 16A, 230V/16A CEE, earth fault circuit breaker, IP44

3. BEV-poles: Two light poles with LED-lamp, 4-Sockets/pole and water-tap. Both locating at the outer harbor side of the quay. Wiring: Cable NIXV 5G10, Fuse 16A, 230V/16A CEE, earth fault circuit breaker, IP44

All lightnings are LED-type and all the sockets have fuses of 16A. The sub-fuse box on the quay has main-fuses of 25A with feeder cable RW-K 5G25.

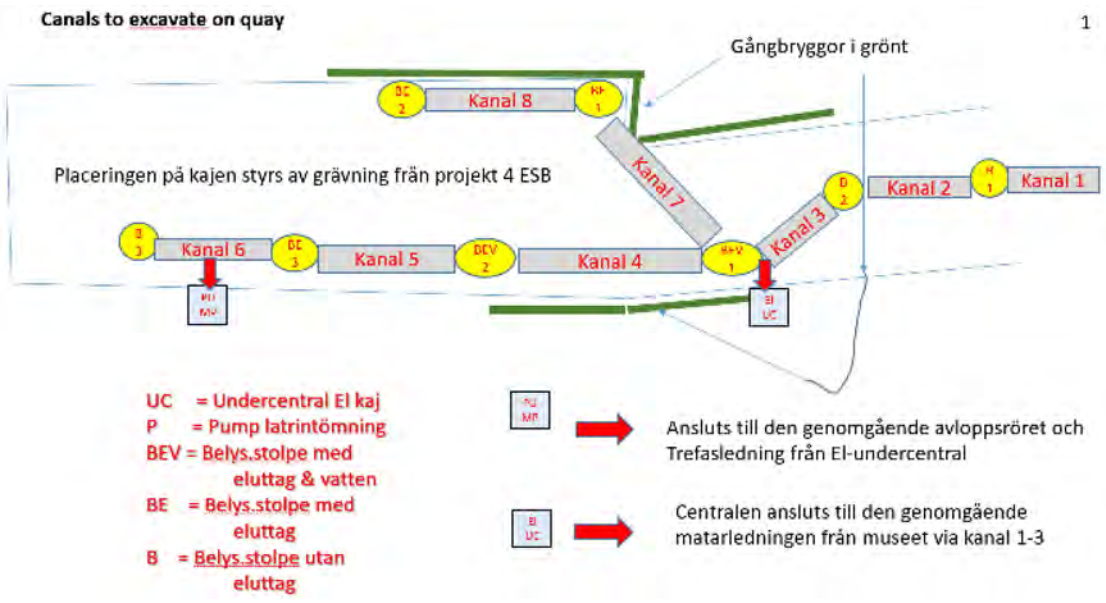


Figure 8. Location of lighting and service poles and cable canals.

Septic waste pump-out station (ESB)

The investment was carried out by digging a cable and a 40mm pipeline into the quay area and a septic waste pump-out station (PU MP in figure 8) for boats was installed, see figure 8 and 9. Model of the pump is Latrina-mini and it's situated at

the outer harbor side of the quay (more detailed technical information can be found at (http://www.latrina.se/produkter/latrina-mini/).

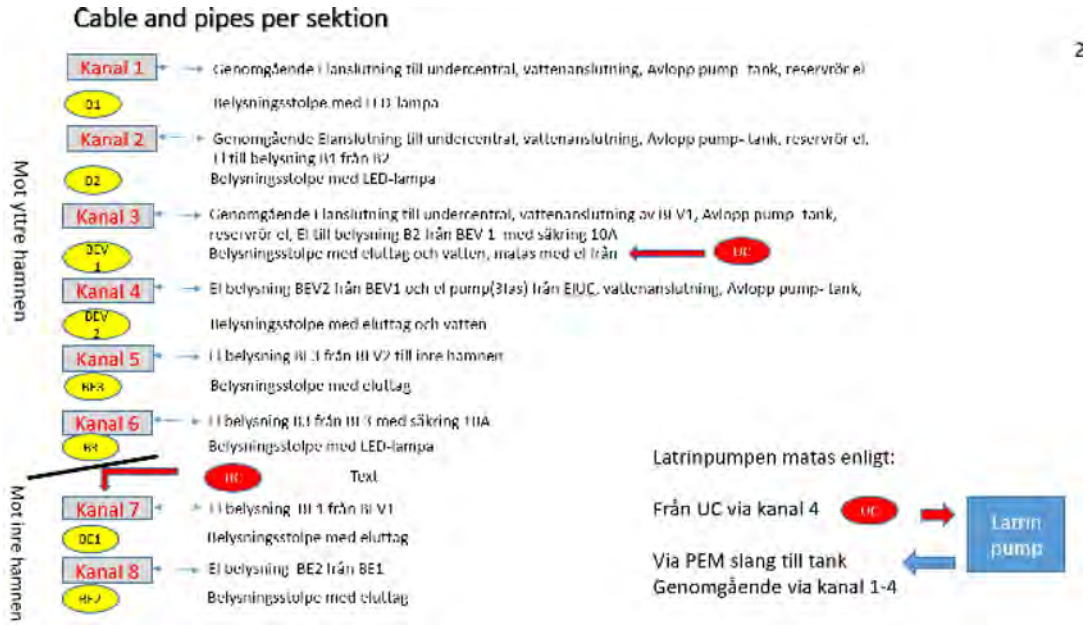
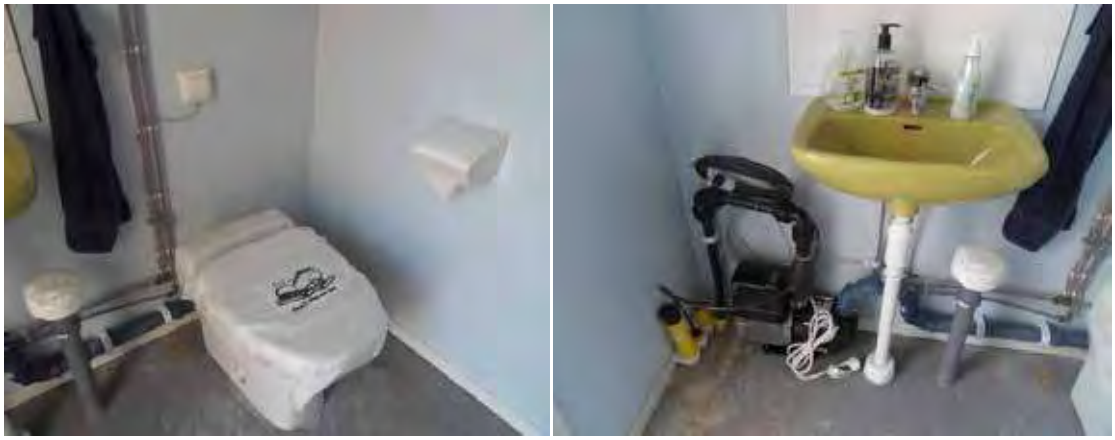


Figure 9. Cable planning in quay-area.

The pump tank (volume of 6 m3) is located on land, about 200 meters away and they are connected by a 40mm pipe. In addition, a toilet was installed with a vacuum pump (pictures 49 and 50).



Pictures 49 and 50. A toilet with vacuum pump. © Leif Ortman

4.6.7. Lessons learned

When you have several contractors at the same site it is important to coordinate their actions and prioritize the working-space. In this case it was practical and effective to gather all excavation work for the same contractor. It lowered the set-up times and transports etc.

It was important to specify what had to be done, delivered and billed during each CBSmallPorts project period already in the tender request.

When having different electrical installations in the property, it is important to secure that the existing electrical network can feed all parts. In this case, nothing that had already been done in previous projects had to be done again, only the existing supply cable on the pier had to be replaced with a stronger one.

If construction work is done during the peak season for the small port and vacation time for contractors, it is important to pre-plan at the level of working dates.

4.7. Klacksörarna (Söderhamn)

Klacksörarna is one of the approximately 500 islands in the archipelago of Söderhamn. Klacksörarna is located in a scenic part of the archipelago and has a basic level of service consisting of garbage disposal, dry toilet, barbeque areas, bathing area and a jetty for overnight boats. The municipality of Söderhamn has its own Archipelago department managing a total of 15 small ports with various levels of services.

4.7.1. Investment description

The municipality of Söderhamn is constantly striving to develop its small ports from both the service and safety point of view. Klacksörarna, which is located in the outer part of the archipelago, lacks an electricity network and water system. The port is well visited by boaters and therefore there is a need for the investments. See table 13 for investment target, budget and actual costs.

Table 13. Investments for Klacksörarna.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Solar energy for and lighting	20 750 €	All invoices not yet received (Estimated 11 245 €)
Fresh (drinking) water well and pump (manual)	9 299 €	All invoices not yet received (Estimated 5 850 €)

4.7.2. Investment steps

- Decision making/selection of products, plans and drawings

In internal meetings, the project team and the Archipelago department planned investments and implementations. After an inventory of the energy needs, the determination of specification and investigation of the locations for constructions, the decision on the installation of an off-grid photovoltaic system of electricity for lighting and charging mobile devices was made. A water vein at a suitable location was found and decision on digging a well was made.

- Public procurement

Three electrical installation suppliers were given the opportunity to submit a tender on the basis of the specification. One of them submitted a quote that was accepted. The area's only supplier of excavation work in the archipelago was asked to tender for the work. The offer was accepted.

- Purchasing, installation, initializing

The construction works were started by Skärgårdsenheten Söderhamn staff in June 2021. Building materials were purchased at companies with framework agreements. Electrical installations began in late June but were not completed until the end of October due to delays in construction works (pictures 51-55). The work on the well started in late August. The well was dug, and the well pipe was mounted (picture 56). The water level in the pipe is estimated at 50-100cm. Due to delivery problems from the manufacturer of the water pump, the entire facility was completed in November.

Picture 51. Northern pier: There was space for the solar power equipment in the existing toilet building. © Per-Olov Persson

Picture 52. Northern pier: Box with sheltered USB-socket for charging mobile devices. © Per-Olov Persson

Picture 53. Northern pier: Solar cell on a special mounting and safety lighting at the gangway. (Toilet building in the background) © Per-Olov Persson

Picture 54. Southern pier: The existing waste sorting building is being expanded with space for a solar panel and equipment room. © Per-Olov Persson

Picture 55. Southern pier: The newly built sauna was equipped with lighting and USB-socket. © Stefan Lindgren

Picture 56. The fresh water well is 6m deep in total and the water level is 50-100 cm. © Per-Olov Persson

4.7.3. Technical specifications of the investment

PV systems

Two separate identicals, each with a 135W PV-panel, a 20 Amp MPPT-solar charge controller and two 260Ah AGM-batteries. Each system supplies light sensor-controlled safety LED-lights and time-controlled convenience LED-lights. Each system also has USB-sockets for charging mobile devices.

Fresh water well

Total depth of the well is 6 m. The water level in the pipe is estimated at 50-100cm. The hand-operated pump is made of cast iron.

4.7.4. Lessons learned

Procurement – Work carried out in the archipelago takes longer and becomes more expensive than the corresponding work on land. If the supplier makes reservations in the quote - Expect additional costs. As a municipality - By using already procured suppliers, the chance of delivering "the right product at the right price at the right time" increases.

Selected products – Keep it simple, the investment must be maintained for a long time. Simple construction = simple maintenance.

Implementation – During holiday period/high season "everything else" stands still. It is difficult to coordinate several suppliers. Establish a schedule in collaboration with everyone involved. In the archipelago environment, weather and wind may also affect the implementation. You can perform many tasks by yourself, but far from all.

4.8. Dirhami (EVAK)

Dirhami is a vital stopover harbor for sea travelers from Finland, Sweden and Estonia located in the distant north-west corner of Estonian mainland. It has no city nearby but all important services are still available (e.g. fuel, fish restaurant and hotel).

4.8.1. Investment description

The reason for participating in the CBSmallPorts project was the need for additional berth places i.e., new piers to have more capacity for visitors. The solar power system is justified to serve boats with electricity in a more energy efficient and sustainable way and to improve the small ports reputation as a nature friendly port. See table 14 for investment target, budget and actual costs.

Table 14. Investments for Dirhami.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Floating piers with solar panels	37 000 €	Ongoing

At the time of publishing the report, no additional information was available for Dirhami due to some delays in the investment implementation. However, the investment is scheduled to be completed as planned by the end of summer 2022.

4.9. Lennusadam (EVAK)

Lennusadam small port is the seaport of the Tallinn Maritime Museum. Lennusadam and the museum is a popular day-visit destination with 15 visitor berths and 40 home berths for local boats. All small port services and cultural services are available for boating visitors.

4.9.1. Investment description

The lighting of the small port piers needed renovation and update to new and more energy efficient technology. Due to being a popular area in a big city there was still a need to have proper lighting on piers both for safety and security reasons. See table 15 for investment target, budget and actual costs.

Table 15. Investments for Lennusadam.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
LED lights & service stands	28 687 €	27 266.40 €

4.9.2. Investment steps

- Decision making/selection of products

The old service stands were worn, partly broken and using fluorescent lighting and clearly needed replacement while the piers itself were still in good condition. The casing of the existing service stands was made from plastic, worn out by the sun and weather and thus fragile.

The project team and key persons planned the investment and their implementation in the internal meetings and in smaller appointments. At the 02.02.2020 meeting, the Harbor Manager and Seaplane Harbor Head of Corporate Services decided that old service stands needed to be replaced. In total the need was for 30 stands of which 18 should have only LED light, 12 should have additional electricity and water service. It was decided that these service stands should be replaced with new modern ones made from aluminum. See pictures 57 and 58 for old and new service stands.

- Plans and drawings

New service stands were planned on five floating piers, 30 stands in total. The plan was to replace the old ones. New stands are made out of aluminum and with LED lights. See figures 10 and 11 for harbor map and drawings of the service stand.

- Public procurement

The public procurement process meant for investments for 30 000 - 60 000 € was used. The procurement data was uploaded to the Estonian procurement online system where everyone can see it and make an offer. This way it was more transparent and easier to follow for everyone. Suppliers with proper products could then make offers based on the information in the system. This way there was no need to send separate requests for offers to suppliers. Since it was quite a specific product there are not too many companies who can offer these in Estonia.

The Harbor Master describes the bidding process as follows: "*Procurement was finished on 6.5.2021 and we received two offers. The one who had the lowest bid had all their documents filled correctly and they filled all the criteria we had. According to the law we have to wait one week in case a second company who made a higher bid would like to protest. In case there are no protests we can go on with signing the contract on week 20. After that contract partner has 12 weeks to install the service pedestals to Seaplane Harbor.*"

- Purchasing, installation, initialization

LED lights and service stands were delivered and installed in one day on 13.8.2021.

Pictures 57 and 58. Old and new service stands in one of the piers in Lennusadam. © Lauri Väinsalu

4.9.3. Technical specifications of the investment

Technical specifications of the Lennusadam investment can be seen from figures 10 and 11.

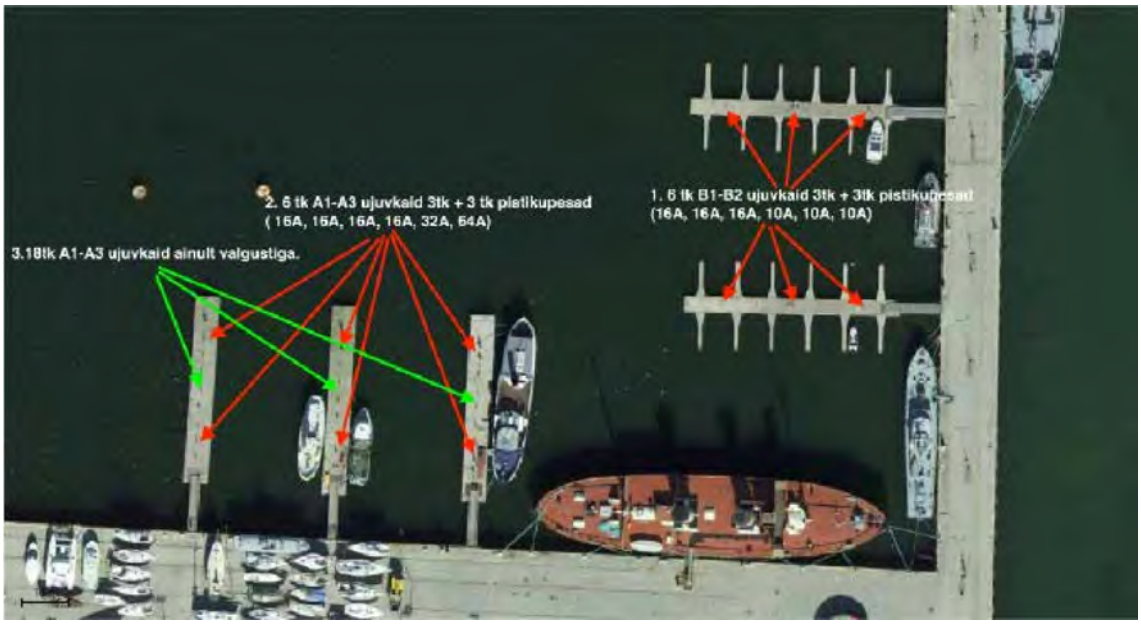


Figure 10. Map of the Lennusadam small port with service stand specs. © Lauri Väinsalu

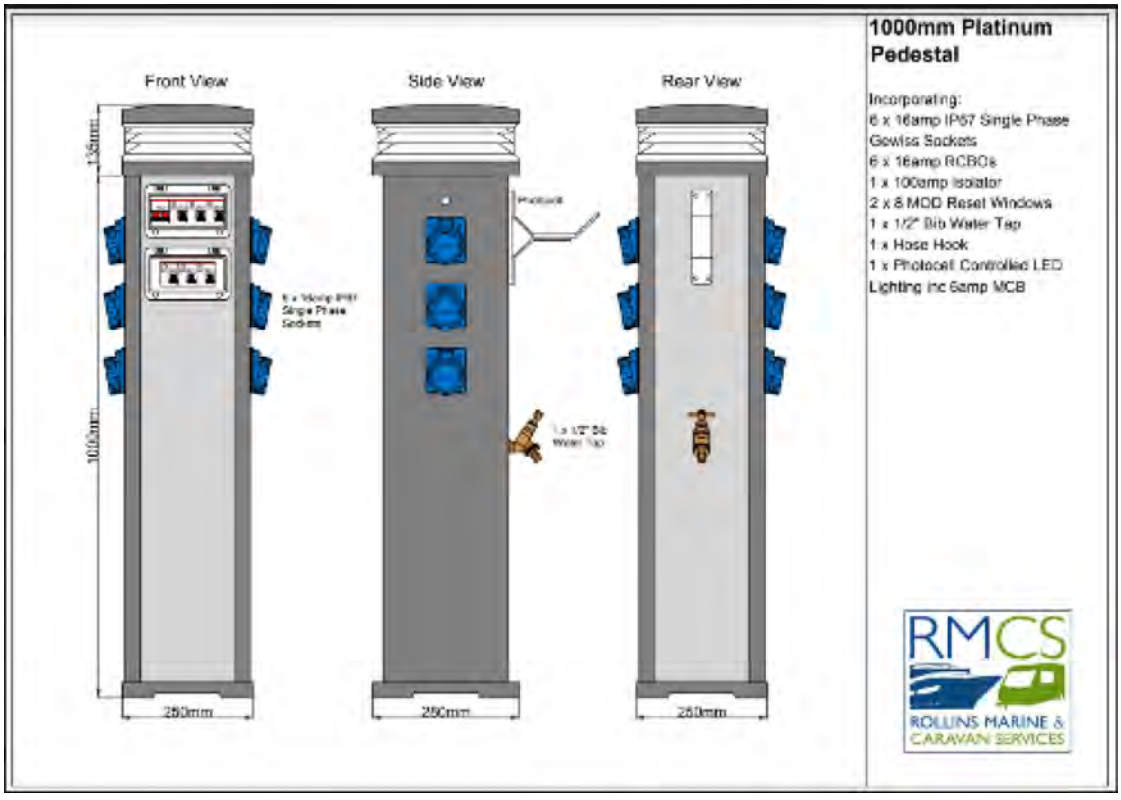


Figure 11. Specifications of the service stands installed in Lennusadam piers.

4.10. Lõunaranna (EVAK)

Lõunaranna is a popular stopover and visiting harbor in the south coast of the island Muhu. It is located nearby to one of Estonia's few Michelin-rated countryside restaurants Pädaste. No city or shop nearby, but all essential harbor services are available (fuel, car rental, bar, camping, hostel and saunas). The port is a privately owned small port and it already has a solar panel solution providing about 50% of the energy for the harbor and its services. With the aim to reach a fully self-sufficient energy supply, the plan is to install a wind generator to become energy neutral.

4.10.1. Investment description

The investment plan was to build a wind energy generator to Lõunaranna and the budget for that was 40 000 €. See table 16 for investment target, budget and actual costs.

Table 16. Investments for Lõunaranna.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Wind generators	40 000 €	Ongoing

At the time of publishing the report, no additional information was available for Lõunaranna due to some delays in the investment implementation. However, the investment is scheduled to be completed as planned by the end of summer 2022.

4.10.2. Investment steps

- Decision making/selection of products

The plan was to install a 7-12 kW wind turbine in the port, ca. 20 m from the coastline. According to the requirements of the Ministry of Defense, the peak height of the wind turbine shall not exceed 27,2m above the sea level. Coordinated project documentation for the local government was not required. Only a constructing notice was required for the turbine.

- Plans and drawings

The investment is planned to be divided into four stages:

1. Establishing the access and service road, electricity and data cable lines

- Establishing a 230m road (gravel covered) from mostly local materials. Installation of electricity and data cables. Costs 4986,1 EUR + VAT

2. Establishing the concrete foundation for the turbine

- Concrete foundation for the wind turbine, volume depends on the type of turbine chosen. Approximate cost 4600 EUR + VAT

3. Purchasing and transportation of the wind turbine

- Purchasing the wind turbine, approximate cost 26 000 EUR (July 2021)

4. Installation of wind generator and connecting the turbine into the electricity grid

- Public procurement

The key person planned and selected the implementer of the investment in May 2021. A local company was selected as the contractor, tender from 23.04.2021.

4.11. Roograhu (EVAK)

Roograhu is a cozy guest marina next to Kärdla airport on the north coast of island Hiiumaa. It is famous for its pizza restaurant which is open all around the year. The services include a small hotel, a sauna and boat winter storage but need improvements in energy efficiency with solar panels.

4.11.1. Investment description

The investment plan was to build a solar power plant in Roograhu with the budget of 34 000 €. See table 17 for investment target, budget and actual costs.

Table 17. Investments for Roograhu.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Solar panels	34 000 €	Ongoing

At the time of publishing the report, no additional information was available for Roograhu due to some delays in the investment implementation. However, the investment is scheduled to be completed as planned by the end of summer 2022.

4.11.2. Investment steps

In the planning phase the idea was to install solar panels to the roof of the port building. The number of solar panels is selected based on the building's roof surface area and maximum electric connection power to the electricity network, which is 40 kW.

4.12. Kalev (KJK)

Kalev Yacht Club is a home harbor for almost 170 small crafts, there are 20 docking spaces for guest boats. Kalev offers e.g., the following services: sauna, showers and electricity, waste handling (bilge water, oil and batteries) and winter storage for boats.

4.12.1. Investment description

The investment plan was to build a geothermal heating system and solar power system. The big harbor area (200 berths of which 10 for visitors) needs to be illuminated, surveyed and harbor building and repair facilities consume a lot of energy. The idea was to replace the old gas-based heating system with heat-pumps using the seawater as heat source and partly to use solar energy to run the new system when applicable. Also LED lights were intended to be used to make the harbor more energy efficient. See table 18 for investment target and budget.

In October 2021 the investing partner EVAK and Kalevi Yacht Club announced that the club is not administratively able to implement the project investments within the planned terms of the CBSmallPorts project. The reason is that the boiler house to be renovated is located in an old building to be demolished. The plan was that the building would have been demolished in the second half of 2021 and that the heat pump system planned in the CBSmallPorts project would have been built together with the new harbor office building. However, the start of the whole new clubhouse construction project has been delayed, so it is not possible to start the construction of a new building and a new boiler room in 2021. It is unclear when the construction of the new house will actually begin. That is why Kalev Yacht Club's participation in the project was both technically difficult and risky in terms and dates that Kalev Yacht Club decided not to continue with it. The solar power system investment was cancelled for the same reasons.

Table 18. Investments for Kalev.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Ground/sea water heating system (heat pump)	134 300 €	Cancelled
Solar lights system	47 200 €	Cancelled

4.12.2. Lessons learned

The investment plan for Kalev was canceled in October 2021, however, lessons can also be learned from this case. The importance of planning and scheduling cannot be overemphasized in regard of investments. They should also take into account possible delays and at the same time be realistic about possible changes in schedule. Getting projects through within a fixed schedule is even more risky when the implementation of the project investment is dependent on the progress of preceding actions, in this case rebuilding a whole building, which is not entirely in the hands of the project partner.

4.13. Kärdla Marina (FHH)

The history of the Kärdla harbor is closely tied to the history of the Kärdla Broadcloth Factory: the harbor was built to facilitate the transportation of raw material for the factory as well as its products. The Kärdla harbor was constructed in 1849; the old harbor was destroyed in the war in 1944.

The reconstruction of the Kärdla Marina began in 2012 and 2014 was the first season for the reconstructed harbor (picture 59). The new marina can moor 88 vessels, it is sheltered from the winds and offers a variety of services. Kärdla marina is within top 10 harbors in Estonia by berths and also by the number of visits.

Picture 59. Kärdla Marina. © www.eastbaltic.eu/kaardla-marina/

4.13.1. Investment description

The investment in Kärdla marina integrates or replaces lighting systems with modern ones, with the possibility to control lighting and energy consumption more efficiently. Some old service posts with light, damaged by salty water, are replaced. See table 19 for investment target, budget and actual costs.

Table 19. Investments for Kärdla Marina.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Cost effective and smart lighting for harbor and harbor facilities	18 000 €	Ongoing

4.13.2. Investment steps

For effective decision-making, the audit was first done to evaluate the present electrical installation. The purpose was to find out the best ways to achieve energy efficiency. Based on the audit, the tender will be called out for both design drawings and installation work to be done by the same company. Works at the harbor are expected to be done during the 2021/2022 winter.

4.13.3. Technical specifications of the investment

Outdoors, general lighting will be replaced with modern solutions. Indoors, motion sensors will be added to service rooms to decrease the lights-on time. Three service posts with lights on Northern quay need to be replaced due to salty water damage (picture 60).

Picture 60. Layout plan of Kärdla Marina. © www.eastbaltic.eu/kaardla-marina/

4.13.4. Lessons learned

Even at newly built harbors one can find outdated technical solutions which need to be modernized to maximize the benefit from the investment.

It is good to have preparations done (proper documentation, audit, decisions about needed investments) and to advance the electrical installations at the harbor little by little. And then, when a possibility comes to enter some project, there is no need to use time on all this.

4.14. Orjaku Marina (FHH)

Orjaku Marina has 73 berths, the maximum depth is 2,7 m, mooring is offered alongside or on a buoy (picture 61). At harbor has a restaurant, village house, concert house and a brand-new service house with all amenities. The nearest shop is 4 km away and the nearest town is 7 km from the harbor. On Kassari island there are many summer cafes to discover – each one of them with their unique and fresh local flavors.

Orjaku harbor was established in the early 1900's. Coastal inhabitants founded Orjaku for servicing fishing boats and smaller cargo ships. The coastal fishing tradition is alive even today and there are many fishermen who earn their everyday living by fishing with nets and traps. Situated near the nature conservation area, it is a famous spot for birdwatching. Local village-life is very active and during the summer almost every weekend a concert or other event is held – not crowded, not loud, but always busy and active – Orjaku has earned its unique image as a "must see" harbor.

Picture 61. Orjaku Marina. © www.eastbaltic.eu/orjaku-harbor/

4.14.1. Investment description

The investment in Orjaku marina replaces some old service posts and add general lighting to the harbor area. See table 19 for investment target, budget and actual costs.

Table 19. Investments for Orjaku Marina.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Smart lighting & service posts	12 000 €	Ongoing

4.14.2. Investment steps

For effective decision-making the audit was first done to evaluate the present electrical installation. The purpose was to find out outdated or even dangerous parts, but mostly to know the best ways to achieve energy efficiency. Based on the audit, the tender will be called out for both design drawings and installation work to be done by the same company. Works at the harbor are expected to be done during the 2021/2022 winter.

4.14.3. Technical specifications of the investment

No precise technical specifications to provide before the tender, but the aim is to replace old service posts and add more modern lighting to the new quayline. Also, some general lighting is added to the harbor area for safety reasons. Before these works can be done, two old switchboards need to be replaced.

4.14.4. Lessons learned

The harbor has been built over a long time in separate parts, starting from the 1970s. For many buildings and installations documentation and drawings are missing. So, it needs extra effort and time to find them or to order new ones based on the situation as much as it is possible to follow.

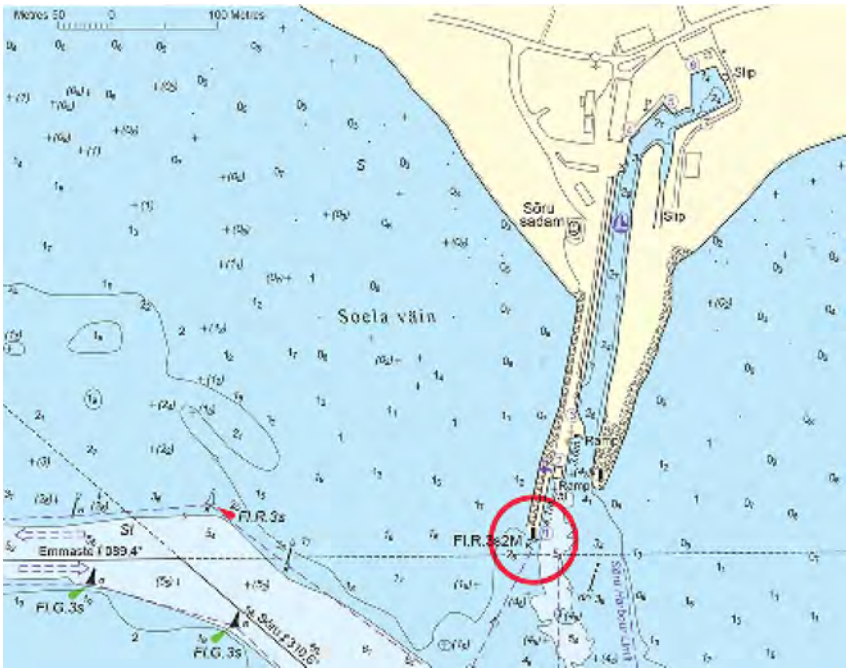
It is hard to find bidders, because works on an island are more expensive and complicated, not attractive for mainland companies. Local companies are overloaded with previous work, and this could double both wait-list and work time itself.

4.15. Sõru Marina (FHH)

Sõru marina is an old fishing harbor which has 40 berths and four parking spots for caravans (picture 62). In the harbor, there is the Sõru Museum, the Maritime Centre, and the boat shed. The Sõru Pub is open in summer and the Sõru Maritime School offers sailing lessons for children and adults. The harbor is a well-known venue for festivities, most popular being Sõru Jazz and Sõru Saund.

Picture 62. Sõru marina. © www.eastbaltic.eu/soru-harbor/

The marina is neighbored by Sõru Port, a state-owned port responsible for organizing the ferry connection between two biggest islands of Estonia, Saaremaa and Hiiumaa. During the winter 2021/22 Sõru harbor will be widened to the east, resulting in a new quayline for bigger boats and a new slipway, together with dredging works, providing berthing possibilities to boats with bigger depth (picture 63).



Picture 63. Layout plan of Sõru marina. © www.eastbaltic.eu/soru-harbor/

4.15.1. Investment description

The investment in the Sõru Marina will replace old service posts, add new service posts to new quayline and add some general lighting to the harbor area. See table 20 for investment target, budget and actual costs.

Table 20. Investments for Sõru Marina.

INVESTMENT TARGET	PLANNED BUDGET	ACTUAL COSTS
Smart lighting & service posts	12 000 €	Ongoing

4.15.2. Investment steps

For effective decision-making, the audit was first done to evaluate present electrical installation. The purpose was to find outdated or even dangerous parts, but mostly to know the best ways to achieve energy efficiency.

Based on the audit, the tender will be called out for both design drawings and installation work to be done by the same company. Works at the harbor are expected to be done during spring 2022 along with simultaneous construction works at the east side of the harbor.

4.15.3. Technical specifications of the investment

No precise technical specifications to provide before the tender, but the aim is to replace six old service posts, add two new to additional berths in the old side of the harbor and two to the new quayline. Also, some general lighting is added to the harbor area for safety reasons. Together with these works some electrical connections need to be renewed.

4.15.4. Lessons learned

Problems were similar to other Hiiumaa harbors – it is hard to find companies to take part in the tender due to the extra costs related to working on an island. In addition, in Sõru the oldest parts are from the 1950s and documentation is missing for both the buildings and installation.

5. Best practices from CBSmallPorts investments

The purpose of this report was to gather information on the practical work done and information gained during the CBSmallPorts project's small port investments. The idea was to collect best practices suitable for developing energy efficiency in a small port.

During the planning phase of the CBSmallPorts project, the following aspects were identified as the main risks in the implementation of investments:

1. **Schedule tightness –** Staying on project schedule requires good planning and quality implementation.
2. **Official paperwork and approval of small port owners –** Succeeding in this operating environment emphasizes the importance of smooth cooperation and trust between the stakeholders.
3. **Finding the best solutions to small ports with their environmental conditions –** The products and materials need to be selected so that they are suitable to sea weather conditions and need minimum maintenance.
4. **Maintenance –** No investment is eternal without proper maintenance. The agreements guarantee the continuity of maintenance of the investment made by the project also in the future.

During the implementation of the investments, the project partners responsible for the investments have made their own observations, which are compiled in this report. To summarize these findings and experiences, a summary of the best practices based on the CBSmallPorts project has been compiled in this final section of the report. The findings are summarized under the following steps, which were also used in the CBSmallPorts project. A new component was added to these steps as **Communication and cooperation**, which connects all steps of the investment process.

Plans and drawings

1. Port operations and investment planning before the implementation (outdated technical solutions can also be found in newly built ports)

In the daily life of port operations, it is good to be precise (relevant documentation and drawings, auditing, decisions and reflections on the necessary investments) and to take the development actions like electrical installations of the port gradually forward. If and when the opportunity comes to implement the planned investments with the help of external funding, e.g. by participating in an EU project, there is no need to waste time on all of this. Plans made in haste are usually not the best ones and may neglect the holistic view. For example, is the current electric network of the port strong enough for the load brought by the new PV system.

2. The importance of planning and scheduling the investment

Projects must always be prepared for possible delays since there are almost always some and their impact on the implementation of the whole project should be considered. In addition, it should be taken into account that the need for special permits is very common when building something new or making bigger changes to existing buildings or infrastructure. These permits and actions could include building permit, hearing of neighbors, permits for changes to historic buildings, water work permit, etc. As one of the partners rightly said, the old phrase "well planned is half done" really holds true.

Decision making/selection of products

As for the selected products, it should be noted that they should operate in a harsher environment than in normal inland conditions. The salty marine environment combined with possible storms, water level fluctuations, intense sunlight and harsh winters places special demands on the durability of the selected equipment. As a rule of thumb, it can be generalized that the selected products should be kept as simple as possible, because the investments must be maintained for a long time. A simple and durable construction also means simpler maintenance.

Additionally, energy efficiency related technology and equipment mature and get better year by year, so it is good to be up to date on this development when selecting products. A good example from this project is the PV system installed in BKG offering novel features in increasing the self-consumption share of the produced solar energy and thus increasing the profitability of the investment.

Public procurement

The importance of planning is emphasized at the latest in the tendering stage. The plans and possible drawings must be sufficiently detailed to enable the invitation for tenders to be drawn up with precision. The absence of some relevant information can significantly delay schedules due to supplementation requests or even re-tenders. It is also important to note that all necessary plans and annexes must be attached to the tender documents. Quality invitation for tenders makes it much easier to

compare and select from the received offers.

A few project sites encountered the problem of obtaining little responses to calls for tenders. The unifying factor in these cases was the location of the site in the archipelago, to which transport connections and access in general is more difficult and time-consuming compared to mainland sites. In general, it can be said that it can be difficult to find contractors, especially for sites in the archipelago. And if they are found, the budgeting and planning should be prepared for higher pricing than in the mainland. During the investment in this project, the impact of the Covid-19 pandemic was also noticed; the rise in the price of raw materials and components, as well as problems with their availability, were reflected in the overheating of the construction market and the rise in the price level of offers.

One of the issues raised concerned tendering methods. In the investments made in the CBSmallPorts project, the selection of offers was almost in every case based on the lowest price. In a project with a tight budget fixed already at the planning stage, this poses certain challenges in the context of tendering. If the port owner making an invitation for tenders does not have very accurate information on market prices, the bids received may come as a big surprise compared to the budget in use. Especially if the investment budgets are drawn up quickly and with low planning. This can easily cause unwanted over or under spending that requires additional management work.

One option could be to use reverse bidding. In this tendering model, the call for tenders is based on the available budget, i.e., the maximum price to be paid has been decided in advance. Here instead of price, bidders compete with other factors like equipment quality and service level. Reverse bidding could produce a higher quality result faster and re-tendering due to high price levels could be avoided. In addition, the money budgeted for the investment could be used more efficiently. This would again ease the work from the project management and modification point of view.

For some of the investments made, it was also possible to use existing and previously tendered framework contracts of the site owner. These should be taken into account already at the investment planning stage. Otherwise, extra work is needed during the tendering process in confirming there are no restrictions for using these existing framework contracts.

Purchasing, installation, initialization

Regarding the implementation of the investments, it became clear that construction work carried out in the archipelago takes longer time and becomes more expensive than the corresponding work on the mainland. In these cases, the importance of logistics and its management is further emphasized. In addition, in the climate and operating environment of the archipelago, weather, wind and water level variations can have an impact on the implementation.

The implementation of the CBSmallPorts project investments also showed that when a site is contracted by several separate contractors, the good coordination is important. It can even be said that it is difficult to coordinate several suppliers in an archipelago

environment. Guidance on this challenge could be planning schedules in collaboration with everyone involved.

Communication and cooperation

The importance of communication and quality cooperation can never be overemphasized. Good communication skills are needed and relations between the contractor and customer are very important. As mentioned earlier, also the number of contracted suppliers affects how smoothly the work and communication proceeds. For a few investments, the initial difficulties were due to a lack of real contacts or that they were not immediately found. Especially with investments in municipality owned small ports, finding the right people from the beginning of the project makes the process easier and on schedule. Once the right stakeholders are found and networks created, collaboration, communication and trust must be also maintained during the whole project.