



TOWARDS SMART ZERO CO₂ CITIES ACROSS EUROPE
VITORIA-GASTEIZ + TARTU + SONDERBORG

Deliverable D.5.3: Sonderborg Building Retrofitting Complete

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Abbreviations and Acronyms

Abbreviation/Acronym	Description
SmartEnCity	Towards Smart Zero CO ₂ Cities across Europe
B42	Housing Association B42
SAB	Sonderborg Housing Association
SOBO	Housing Association SOBO

Table 1: Abbreviations and Acronyms

0 Publishable Summary

The building retrofitting demonstration area in Sonderborg, DK contains different types of residential buildings from 1950-1980`s. All demonstration buildings are owned by social housing associations in Sonderborg.

In Sonderborg 34% of the inhabitants are living in social housing association buildings. In this project activities of different housing associations in the same area are demonstrated. This is a replicable situation in a large part of Europe.

Three social housing associations in Sonderborg are involved in the building retrofitting project:

- SAB – Sonderborg Housing Association.
- B42 Housing Association.
- SOBO Housing Association.

SAB and SOBO have each one of their housing departments involved in the project, and B42 has five departments involved.

The seven different departments have in total 45 buildings with 1.400 residents in 815 apartments and a floor area of 66.000 m².

Energy retrofitting measures

The seven departments have implemented different energy retrofitting measures, including: Insulation of facades, airtight constructions, new low energy windows and doors, new ventilation systems with heat recovery replacing traditional exhaust air ventilation systems, new outdoor LED street lighting in the surrounding ground areas and in stairwells, automatic heating control systems in district heating supply of the buildings, improvement of indoor climate, installation of in total 6.000 m² of building integrated solar photovoltaic plants for electricity supply with focus on good architectural integration of the solar panels in roofs.

The average energy savings in the seven departments is expected to be 30%.

Purpose and target group

This report includes a description of the completed energy retrofitting measures in the involved housing buildings.

Furthermore, there is a description of the decision-making process for the energy retrofitting measures, a description of the design phase, the tendering phase and a description of the implementation phase.

The purpose of the deliverable is to inform and inspire other housing associations and other homeowners in Europe how to reduce energy consumption in their buildings and how to solve challenges in connection with the financing process and the decision process prior to the implementation.

The target group is primarily administrators of housing associations and owners of apartment buildings.



1 Introduction

Three social housing associations in Sonderborg, DK are involved in the building retrofitting task:

Sonderborg Housing Association (SAB), Partner 16

Housing Association SOBO, Partner 17

Housing Association B42, Partner 18

SAB and SOBO each have one of their housing departments involved in the project, and B42 has five departments involved.

The seven different departments have in total 815 apartments with 1.400 residents.

Objectives of the actions

The objectives of the measures are to reduce the energy consumption for the residents, to improve the indoor climate in the buildings and to assist Sonderborg with the aim to become a CO2 neutral City in 2029. Furthermore, the objective is to install systems increasing the intelligent operation of the buildings to assist Sonderborg to be a Smart Energy City. Here is focus on lighting demand control, heating demand control and intelligent control of the solar panel's contribution correspondent to the electricity demand.

1.1 Purpose and target group

The deliverable includes a description of the completed energy retrofitting measures in the involved housing association buildings.

Furthermore, there is a description of the decision-making process for the energy retrofitting measures, a description of the design phase and the tendering phase and a description of the implementation phase.

The purpose of the deliverable is to inform and inspire other housing association and other house owners in Europe how to reduce the energy consumption in their buildings and how to solve challenges in connection with the financing process and the decision process prior to the implementation.

The target group is primarily administrators of housing associations and owners of apartment buildings.

1.2 Contributions of partners

The following Table 2 depicts the main contributions from participant partners in the development of this deliverable.

Participant short name	Contributions
ZERO	Author of this deliverable
SAB	Technical and process input to building retrofitting measures.
B42	Technical design and process input to building retrofitting measures.
SOBO	Technical and process input to building retrofitting measures.

Table 2: Contribution of partners

1.3 Relation to other activities in the project

The following Table 3 depicts the main relationship of this deliverable to other activities (or deliverables) developed within the SmartEnCity project and that should be considered along with this document for further understanding of its contents.

Deliverable Number	Contributions
D.5.2	This deliverable provides the overall description of the decision-making process and the tender process.

Table 3: Relation to other activities in the project

2 Objectives and expected Impact

Objectives

The demonstration area in Sonderborg contains different types of residential buildings: A) The inner-city part of Sonderborg with demonstration of brick buildings from 1950-60's. B) An "outer residential building's" outside of the central part dominated by social housing building blocks typical with 2-4 storeys built as concrete elements. For Sonderborg's strategy as a sustainable community it is most important to maintain/develop these residential areas into attractive housing areas. This being challenged by reduction of potential residents by outsourcing of industrial working places.

The layout of the demonstration area has been defined by A) Having demonstrating buildings from 1950-1980's, including older buildings from central and more "outer ring" parts of Sonderborg. B) Building retrofitting shall fit into the retrofitting time schedules of the social housing associations.

A total of 51 buildings have been retrofitted. All buildings are supplied with heat from Sonderborg District Heating Company.

Demonstration buildings are selected according to the retrofitting plans of the involved social housing companies and therefore making implementation and financing more feasible.

Demonstration buildings represent typical, and therefore replicable social housing building types and energy retrofitting measures.

The needs of retrofitting are decided through the building retrofitting plans of the different social housing companies. In this demonstration project is demonstrated retrofitting activities of different social housing associations in the same area. This is a replicable situation in a large part of Europe.

In Sonderborg 34% of the inhabitants are living in social housing association buildings.

Expected impact:

The demonstration buildings consist of the listed 7 social housing departments.

In total 51 buildings with 815 apartments and 66.181 m² of built area.

Department	Street	No. Buildings	No. Apartments	Built area m ²
SAB – 22	Kløvermarken	19	432	32.421
SOBO – 11	Borgmester And.	8	88	8.420
B42-10	Skriveløkken	5	87	6.960
B42-12	Sundquistgade	3	16	2.300
B42-13	Ringbakken	4	48	4.320
B42-21	Morbaerhegnet	10	120	9.600
B42-28	Vissingsgade	2	24	2.160
		51	815	66.181



Department	Street	Energy demand		Energy savings kWh/m ² /year
		Before	after	
		Retrofitting	retrofitting	
		kWh/m ² /year	kWh/m ² /year	
SAB-22	Kløvermarken	139	118	21 (15%)
SOBO-11	Borgmester And.	139	92	47 (34%)
B42-10	Skriverløkken	114	89	25 (22%)
B42-12	Sundquistgade	120	61	59 (49%)
B42-13	Ringbakken	120	73	47 (39%)
B42-21	Morbaerhegnet	114	93	21 (18%)
B42-28	Vissingsgade	122	86	36 (30%)

Figure 1: Expected impact of the energy measures.

The energy demand before retrofitting varies between 114 kWh/m²/year and 139 kWh/m²/year.

The energy retrofitting measures are expected to reduce the energy demand with between 21% and 47% in the different departments.

3 Overall Approach

To achieve the Deliverable describing the building retrofitting completed projects in Sonderborg, DK the following steps have been completed:

- Decision making process for the energy retrofitting measures.
- Technical design of the energy retrofitting measures.
- Tendering process.
- Construction contracts.
- Implementation phase.
- Approval and handover.

Partners involved in these phases have been:

- ZERO – Partner 15 as overall coordinator and technical design.
- SAB – Partner 16 as builder and decisionmaker.
- SOBO – Partner 17 as builder and decisionmaker.
- B42 – Partner 18 as technical designer, builder and decisionmaker.



4 Execution of the energy retrofitting projects

4.1 Decision making process

Organisation of housing associations

The three involved social housing associations are individual legal associations each with their own board of directors, executive committee and their own Chief Executive Officer and administration.

The board of directors is elected bottom up with the following process:

- Each housing department in a housing association elects their own department board at a general meeting for all the tenants in the department. The department board typically has a chairman and 4-6 members.
- Members from all housing department boards in the housing association form a general Forum of Representatives for the whole housing association. The general Forum of Representatives often has more than 100 members.
- The general forum elects an Executive Committee for the housing association with 6-10 members.
- The Executive Committee hires a professional Chief Executive Officer for the housing association.
- The CEO hires the staff members of the administration.

Other important stakeholders

In the energy retrofitting process the following stakeholders are typically involved:

- Housing Association and its organisation as the building owner.
- External design architects.
- External energy design engineers.
- External contractors (carpenters, electricians, plumbing contractors, ventilation contractors etc.)
- Building authorities from Sonderborg Municipality.
- Finance institutions.

The external companies are hired by the housing associations typically after a tendering process.

Decision making process for the energy retrofitting measures

- The Housing Association typically hires an external energy design engineering company. In this project the two housing associations SAB and SOBO have hired the local engineering design company: Danish Energy Management A/S from Sonderborg.
B42 Housing Association has prepared their engineering design and tendering by their own internal technical staff.

- If major building construction works are a part of the retrofitting measures, the housing association will also hire an external architect for the building design work. The housing associations SAB and SOBO did not need a design architect for their energy retrofitting measures.
B42 has hired the local architect company ZENI Architects to assist with design of new facades, roofs and windows constructions.
- The external design companies prepare a proposal for energy retrofitting of the individual departments.
The proposal includes a description of the measures, the expected investments, the expected energy saving in kWh and in currency, finance scheme, influence on the rents of the apartments, the payback period and other positive results of the retrofitting like improved indoor climate, reduction of moisture problems, reduction of maintenance expenses etc.
- The proposal is presented and discussed first with the administration, then with the local department board and finally with all the tenants in the department, who have to approve the proposal and the financial consequences at a general tenants' meeting of the department.
- The tenants vote on the proposal for energy retrofitting, yes or no, and there has to be a simple majority by the tenants present at the meeting to get the proposal approved.
- If the proposal for energy retrofitting measures is approved, the administration contacts the external consultants again to prepare the detailed technical design and the tendering documents.

Actual decision process in the three associations

- SAB organized the annual tenants meeting for the involved Department 22: Kløvermarken/ Hvedemarken on April 26, 2016 at 18 pm, where the proposal for retrofitting measures was presented, discussed and approved.
- SOBO organized the annual tenants meeting for the involved Department 11: Borgmester Andersens Vej on June 16, 2016 at 16 pm, where the proposal for retrofitting measures was presented, discussed and approved.
- B42 organized the annual tenants meetings for the involved departments on the following dates:
 - Department 10, Skriverløkken on June 13, 2017
 - Department 12, Sundquistgade on November 26, 2018
 - Department 13, Ringbakken on May 24, 2017
 - Department 21, Morbaerhegnet on May 14, 2017
 - Department 28, Vissingsgade on November 26, 2018.

The proposals for retrofitting measures were presented, discussed and approved on all the tenants' meetings.

4.2 Technical design

If the planned energy retrofitting measures for each of the departments need an investment of less than 2.5 mio. Euro, it can be expected, that the design work can be done for a salary less than 200.000 Euro, and in this situation the housing association does not need to prepare a tendering process for hiring the external consultant.

The external design engineers and architects now prepare project documents with more details to be handed in for approval by the building authorities in Sonderborg Municipality.

In parallel with the approval process in the Municipality, the design consultants prepare detailed constructions drawings, specifications and descriptions of the planned work to be used in the tendering.

The following energy retrofitting measures have been through a technical design process for each of the three housing associations:

SOBO Housing Association.

- New low energy windows and outer doors in all 88 apartments in the involved Department 11: Borgmester Andersens Vej, 6400 Sonderborg.
- New central heating automatic control equipment and heat exchangers for district heating in each of the four heating centrals in the department.
- New LED outdoor lighting lamps in the area around the 8 apartment blocks.
- 950 m² of roof integrated solar photovoltaic panels, which can produce 160 kW solar electricity corresponding to 160.000 kWh per year.



Figure 2: SOBO Department 11: Seen from above with solar cells.



Figure 3: SOBO Department 11: Building integrated solar cells.



Figure 4: SOBO Department 11: New heat exchanger for district heating.



Figure 5: SOBO Department 11: New low-energy windows

SAB Housing Association

- 3.000 m² of roof integrated solar photovoltaic panels, which can produce 460 kW solar electricity corresponding to 408.000 kWh per year covering 37% of the total electricity consumption in the 432 apartments in the involved Department 22: Kløvermarken/Hvedemarken, 6400 Sonderborg. The 3.000 m² solar panels are divided among the 19 separate apartment blocks, and the solar panels are integrated in roofs towards South, East and West.
- New LED outdoor lighting lamps in the area around the 19 apartment blocks, and in the corridors and basement.



Figure 6: SAB Department 22: Seen from above with solar cells.



Figure 7: SAB Department 22 with building integrated solar cells, in total on 19 buildings.

B42 Housing Association.

B42 has 5 different departments involved in the project.

Department 10, Skriveløkken

- New outdoor LED lamps of 13W, in total 23 pieces to replace existing 60W lamps.
- Internal insulation of 425 m² gable with U-value = 0,35 W/m² °C
- Solar cells of 380 m² to produce 60.000 kWh per year.
- The metering systems in the department was changed from individual main electricity meters in each apartment to a common main meter for all the 87 apartments combined with secondary meters in each apartment.

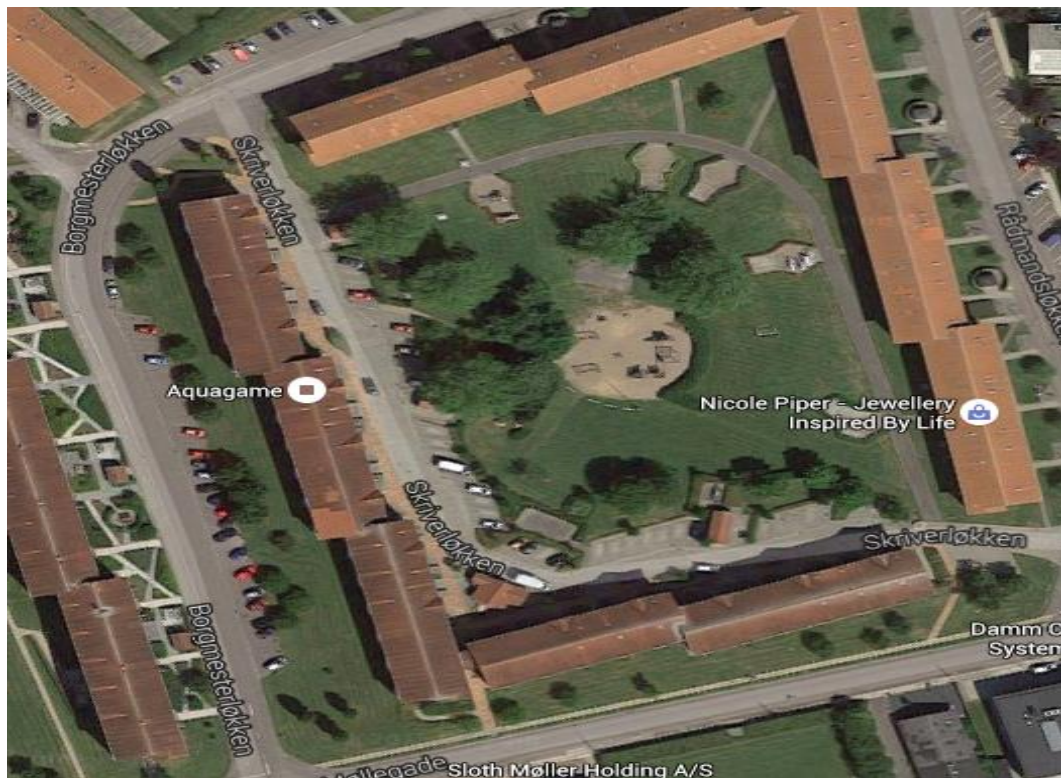


Figure 8: B42 Department 10 seen from above.



Figure 9: B42 Department 10. Solar cells on the roof.

Department 12, Sundquistgade

- Solar cells of 60 m² to produce 10.000 kWh per year.
The metering system in the department was changed from individual main electricity meters in each apartment to a common main meter for all the 24 apartments combined with secondary meters in each apartment.
- New LED lamps in staircases, in total 14 lamps of 10,5 W to replace existing 50W lamps plus 3 new outdoor lamps of 13 W to replace existing 60W lamps.

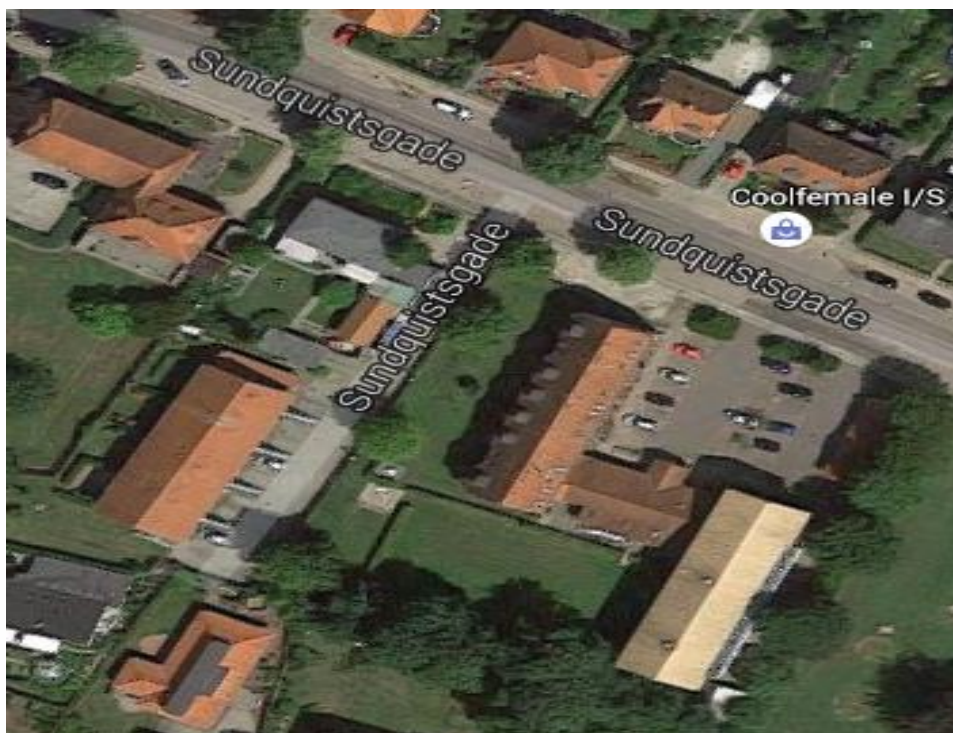


Figure 10: B42 Department 12 seen from above.



Figure 11: B42 Department 12. Solar cells on the roof.

Department 13, Ringbakken.

- New low energy windows and doors.
- External insulation of 3.775 m² facades with 145 mm mineral wool with U-value = 0,23 W/m²°C



Figure 12: B42 Department 13 seen from above.



Figure 13: B42 Department 13. New facade insulation under construction in 2018



Figure 14: B42 Department 13. New façade insulation under construction in 2018.

Department 21, Morbaerhegnet.

- The department consists of 10 individual buildings.
- New ventilation systems with heat recovery efficiency of 85% in each building, to replace old ventilation systems.
- Solar cells of 50 m² combined with a battery solution of 10 kWh in each building.
In total 500 m² solar cells and 10 individual battery systems.
The metering system in the department was changed from a main electricity meter in each apartment to a common main meter for all the 122 apartments combined with secondary electricity meters in each apartment.
The solar cells produce 77.300 kWh electricity per year.
- New outdoor LED lamps of 15 W, in total 20 pieces to replace 80 W lamps plus 18 LED lamps of 21 W in garages to replace existing 36W lamps.



Figure 15: B42 Department 21 seen from above.



Figure 16: B42 Department 21: Solar cells on the roof.



Figure 17: B42 Department 21: Battery solution in combination with solar cells.

Department 28, Vissingsgade

- Solar cells of 50 m² to produce 7.500 kWh per year.
The metering system in the department was changed from individual main electricity meters in each apartment to a common main meter for all 24 apartments combined with secondary electricity meters in each apartment.
- New outdoor LED lamps of 13 W, in total 28 pieces to replace existing 60 W lamps.



Figure 18: B42 Department 28 seen from above.



Figure 19: B42 Department 28. Solar cells on the roof.

4.3 Tendering Process.

The rules for tendering depend on the size of the expected investment, and it depends of the kind of work to be executed.

- If installation of solar panels is the major part of the work to be tendered, as it was for SOBO and SAB, then the tender process has to follow the rules for “Supply Tendering”.
- If the investment in the actual supply tender is expected to be below 400.000 Euro, which it was for SOBO, then the tender can be executed as a so called “Limited tender process”, where you only need to ask 3 suppliers to bid.
- If the investment is expected to be more than 400.000 Euro, which it was for SAB, then the tender process has to be executed as a so called “Public tender process”, with public announcement and a prequalification procedure.

4.3.1 Limited tender process for SOBO Housing Association

The management of SOBO Housing Association decided to invite 3 companies to bid for installation of solar photovoltaic plants.

The three electrical construction companies were:

- EL-Hjørnet i Centrum ApS, Guderup, 6430 Nordborg.
- Elektrikeren ApS, 6400 Sønderborg.
- AT Solar ApS, 6400 Sønderborg.

Tender documents

The engineering design company Danish Energy Management A/S prepared the tender documents consisting of:

- Tender letter dated 21.04.2016
- Technical description dated 15.04.2016
- Drawing documents.
- Description of the actual buildings.
- Pricelist for the bids, dated 21.04.2016.

The tender was a Main Construction Contract including solar panels, installation of the solar panels, all electrical installations and the carpenter work preparing the roofs for solar panels. The bidding companies were asked to deliver two prices, one price for a solution with building integrated solar panels and one price for a solution with solar panels mounted upon the roofs.

Evaluation process

The tender letter specified three evaluation criteria for the bids:



- The production of solar electricity compared to the total installation costs (in Euro per kWh produced). The lowest price for a produced kWh electricity gives the highest numbers in this part of evaluation.
This part of the evaluation counts 40%.
- Technical quality: The technical quality for the proposed products is evaluated from 0-10 points, and this part of the evaluation counts 30%.
- Architectural integration: The architectural and technical solutions for the integration of the solar panels in the roof construction is evaluated from 0-10 points, and this part of the evaluation counts 30%.

Results of the tender process for SOBO

The tender documents were submitted to the invited contractors on April 21, 2016 and the price should be delivered on May 12, 2016.

The result of the tender process was:

Roof integration:

	<u>AT Solar</u>	<u>Elektrikeren</u>	<u>EI-Hjørnet i Centrum</u>
Total price,			
excl. VAT:	2.756.000	2.880.000 DKK	2.932.000 DKK
Investment / kWh:	18,37 DKK	19,20 DKK	19,55 DKK
Evaluation points:	9,40	8,90	8,80

Mounted upon roof:

Total price,			
excl. VAT:	2.038.000 DKK	2.104.000 DKK	2.176.000 DKK
Investment / kWh:	13,40	14,02	14,80
Evaluation points:	8,20	8,0	7,90

From the bidding prices it can be seen, that it, as expected, is more expensive with building integrated solar panels compared to panels mounted upon the existing roof.

It turns out to be 35% more expensive, however SOBO choose the building integration solution of architectural reasons. AT Solar ApS was evaluated to deliver the bid with the lowest price but also with the highest score regarding technical quality an architectural solution.

Construction contract

Based on the result of the bidding process, the company AT Solar ApS was awarded the construction contract, which was signed on May 30, 2016.



4.3.2 Public tender process for SAB Housing Association

Since the investment in the solar photovoltaic project for SAB was expected to be higher than 400.000 Euro, a public tender process was carried out.

Prequalification phase

The first phase in a public tender process is a prequalification phase, where until 5 companies are selected to be invited to bid on the tender project.

Danish Energy Management A/S has prepared an announcement document, which was published in the EU Notice for Public Tender (EU2016/5142-256449) on July 22, 2016.

The announcement document describes the project, the timeline and the criteria to be selected for an invitation to bid.

The tendering included here financing of the total investment, and that was the main reason that not many companies asked to be selected for the bidding process.

The contractor/supplier should provide the financing in addition to delivery and installation of the energy retrofitting measures. The financing is paid back with the actual value of the obtained energy savings. This means, that the residents do not get any savings on their energy bills, until the investments are paid back, but after that period they will have a considerable reduction of their energy bills without having an increase in the rent of the apartments.

SAB Department 22 could not formally provide financial guarantees for all the payment during the period, and this situation prevented a number of companies to submit bids.

Normally 10-15 companies submit proposals to be selected to bid for such a solar photovoltaic project. However, in this case only the following 3 companies submitted their proposals before the deadline August 23, 2016:

- Sustain Solutions ApS
- AT Solar ApS, Sonderborg
- Solarpark DK A/S.

All 3 companies fulfilled the criteria to be prequalified, and all three were invited to submit a proposal and a bid for the solar PV system.

Tender documents

Danish Energy Management A/S prepared the tender documents consisting of:

- Tender letter dated 21.07.2016.
- Technical description dated 05.07.2016.
- Drawing documents.
- Description of the actual buildings.
- Pricelist for the bids, dated 21.07.2016.

The tender documents were publicly available on www.salus-bolig.dk.



The tender was for a main contract including financing, delivery, implementation and full installation of building integrated solar plants on 19 separate buildings in SAB Department 22.

Carpenter construction work for integration of solar panels in the roof was included in the main contract.

Financing relations:

- The main contractor had to finance the total investment.
- The value of the produced solar electricity is used to pay back the financed investment.
- In case the amount of produced solar electricity is less than the predicted/calculated amount,
- then it will take a longer period of time to payback the investment.

Evaluation process

The tender letter specified three evaluation criteria for the bids:

- The shortest payback periods. This part of the evaluation counts 50%.
- Technical quality
- The technical quality for the proposed products and components is evaluated from 0-10 points, and this part of the evaluation counts 30%.
- Architectural integration:
The architectural and technical solutions for the integration of the solar panels in the roof construction is evaluated from 0-10 points, and this part of the evaluation counts 20%.

Results of the tender process for SAB

The tender invitation was submitted to the 3 invited companies on August 30, 2016, and the price should be delivered on September 22, 2016.

It turned out, that the company AT Solar was not able to provide the financing scheme in the correct form according to the tender criteria.

Therefore, SAB only received two bids, which fulfilled the criteria, and the result of the evaluation process was:

	<u>Solarpark DK</u>	<u>Sustain Solutions</u>
Payback period:	14,5 years (10 points)	17,2 years (8,15 points)
Technical quality:	9 points	10 points
Architectural solutions:	4 points	10 points
Total result:	8,5 points	9 points

Construction contract:

Based on the result of the bidding process, the company Sustain Solutions ApS was awarded the main financing and construction contract, which was signed on October 27, 2016.

4.3.3 Tender process for B42 Housing Association

For department 13

For department 13 the company Zeni Architects prepared a so-called limited tendering, where three local construction companies were invited to prepare a bid on the work with external insulation of facades and with new windows.

After evaluation of the offers, the contract was awarded to the construction company SIB Byggeri A/S in Sonderborg.

For department 10, 12, 21, 28:

For those departments the technical staff of B42 Housing Association prepared the invited tender documents and tender process.

The construction contracts were awarded to the following companies:

- AT Solar ApS, Sonderborg for the solar cells projects with the subcontractor EL-Hjørnet i Centrum.
- SH Byggeri, Sonderborg for the gable insulation in Department 10.
- DP Ventilation, Kolding for the new ventilation systems in Department 21.
- Elektrikeren A/S, Sonderborg for the new LED lamps.

4.4 Implementation phase.

After signing the contract with the winning contractors, the implementation phase has started.

4.4.1 SOBO Housing Association

In the contract with AT Solar ApS it was stated, that the construction work should start June 15, 2016 and be finished October 31, 2016, which also was realized.

- The main contractor AT Solar ApS engaged two subcontractors to do a part of the work:
- Hjortgaard A/S, Sonderborg as carpenter doing the preparation of the roof constructions for implementing the solar panels.
- Elektrikeren A/S, Sonderborg as electrician contractor to do the internal electric installation work in the solar system.

In addition to the main contract for the solar photovoltaic plant the following energy measures were also carried out in the period May 1, 2016 to January 31, 2017:



- New windows and outer doors implemented by the contractor Soegaard Byg A/S.
- New heating automatic installed by Erik Smede & VVS, Sonderborg.
- New LED lighting installed by N.H. Jespersen A/S, Sonderborg.



Figure 20: SOBO Department 11: New outdoor LED lamps

4.4.2 SAB Housing Association

In the main contract with Sustain Solutions ApS it is stated, that the construction work should start in the spring 2017 and be finished October 31, 2017. The work was a little delayed and was finished in January 2018.

Sustain Solutions ApS had engaged two subcontractors to do part of the work:

- Hustømmerne A/S, Guderup, Nordborg as carpenter to do the preparation of the roof constructions for implementing the solar panels.
- N.H. Jespersen A/S, Sonderborg as electrician contractor to install the solar panels and to do the internal electrical installations work in the solar system.



Figure 21: SAB Department 22: Inverters for solar cell systems.



Figure 22: SAB Department 22. Solar cells in total integrated on 19 buildings

4.4.3 B42 Housing Association

The construction and technical installation work has been carried out in the period July 2017 to December 2018.



Figure 23: B42 Department 21: New ventilation systems with heat recovery.



Figure 24: B42 Department 13: New facade insulation.

4.5 Approval and handover

After the completion of the construction phase the work has been approved by the housing associations and by the consultants, and the installed solar photovoltaic systems have been connected to the electrical installations in the buildings and to the public grid to deliver the surplus produced solar electricity.

The solar systems have been designed to use 80 % of the produced electricity in the buildings hour by hour and to deliver maximum 20 % to the public grid.

There have been signed contracts with the electricity supply companies, how much they can pay for the surplus produced electricity from the solar plants.

5 Deviations to the plan

The original plan was to submit this deliverable D.5.3 by January 31, 2018 (Month 24).

However the decision making process among the tenants in the seven different housing departments took longer time than anticipated, and therefore it was not possible to complete the practical implementation of the retrofitting measures before month 36.

