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A PLANNING PERSPECTIVE

EU STRATEGY FOR THE BALTIC SEA REGION
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Urban solar energy planning in Sydvästra Lund 2016-2018

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Content

1 Introduction

The City of Lund, located in the Skåne region with 115 000 inhabitants, has an ambitious programme for renewable energy and reducing greenhouse gas emissions. The city is planning for the development of a new urban district, Sydvästra Lund (Southwest Lund), which also includes a new train station. The train station is planned to be ready 2024. Ensuring a high share of renewable energy supply is an important aspect in planning for this new district. The city of Lund is especially considering possibilities for solar energy installations in the new area. The pilot project within the BEA-APP project has investigated how the City of Lund can optimise for solar energy installations early in the planning process, in the new area Sydvästra Lund.

1.1 Description of the area

Sydvästra Lund is an urban area in the City of Lund that will be transformed into a new mixed residential area. Today (2018) there is a train track, a large industrial area, a waste water treatment plant, residential buildings, a sports facility and unexploited land located in the area. It is not exactly decided which buildings will remain in the new area but a new train station will be introduced 2024. The area is very likely to have mixed purposes also in future. The study in the pilot project has investigated how to incorporate solar energy in an area where new buildings will be built.

1.2 Methodology

When we started the pilot project, we had the following proposed methodology:

1. Investigate and describe what kind of solar planning tool and/or method there is need for at Sydvästra Lund.
2. Investigate what kind of solar planning tools/methods that are available to use.
3. Decide what tools and methods to use and if development of new tools and methods are needed.
4. Dialogue meetings with stakeholders.
5. Recommendations for solar energy installations in Sydvästra Lund.
6. Decide which facilities the City of Lund can work with directly on their own (if any)
7. Decide how City of Lund will continue dialogue work with developers and constructors
8. Report on the process of solar energy installations in Sydvästra Lund

2 The spatial planning process

To start the work with the pilot project Per-Johan Wik, Skåne Energy Agency, had a meeting with the Director of the Environmental Strategy department in the City of Lund in May 2016. This was a good way to find the right connections within the municipality to continue the work. We found that listed positions below would be appropriate to involve for a start-up meeting in September 2016.

- City Architect for Sydvästra Lund, City of Lund
- Environmental Strategy Officer, City of Lund
- Associate senior lecturer, dep. Energy and Building Design, University of Lund
- Business developer, Kraftringen (local energy company)

2.1 Prerequisites for solar energy in Sydvästra Lund

Since we would like to learn more about spatial planning for solar energy we arranged a meeting with Jouri Kanters, Associate senior lecturer, dep. Energy and Building Design, University of Lund and expert on urban planning for solar energy. Jouri told us about his experiences from the planning process but also stated it is difficult to get entrepreneurs to actually install solar energy even if it is planned for in a new area. The dialog with building entrepreneurs is very important.

Next step was to arrange a meeting with all identified stakeholders important for the planning for Sydvästra Lund. In the last minute the City Architect cancelled the meeting so we had the meeting without her. Jouri Kanters was invited to speak at the meeting about the possibilities to plan for solar energy in a new urban area. We from Skane Energy Agency had experience from solar energy maps, where it is possible to zoom in an area and assess the solar potential on existing roofs or new roofs. Jouri showed that there are also other different tools where you can build new areas in a 3D model and optimise it for solar energy installations. It was decided at the meeting that Skåne Energy Agency should present to the City Architect what kind of tools are available for solar energy planning and the City Architect needed to identify what kind of tools and methods there were need for.

A meeting was arranged with the City Architect for Sydvästra Lund, the Environmental Strategy Officer and Skåne Energy Agency in October 2016. Skåne Energy Agency did present different tools and methods at the meeting:

- Solar energy maps where possible to zoom in and calculate solar energy potential on roof tops.
- Tools for building design (3D models).
- Solar potential studies for urban areas (using 3D models for calculations).
- Definitions in the planning program such as targets for solar radiation on roofs, targets for renewable energy production in the local area and guidelines for orientations of buildings in the area.

The City Architect and the Environmental Strategy Officer decided it was a 3D building design tool and following solar energy potential calculations they were interested of. They wanted to work with a small new area in Sydvästra Lund where an expert consultant would optimise the building design for solar energy installations using a 3D model. Also, calculations for solar energy potential should be done for this area.

At the next meeting we discussed in more detail how the consultant should work with the planning group step by step. Following was decided:

1 Start up meeting– the contracted consultant will get more background information about the project.

2 Workshop – the consultant presents ideas for inspiration about how other cities have worked with solar energy in urban planning and what is the latest concerning technical solutions and design.

3 Working group - the consultant participates in meetings with the City Architect and her planning group to better understand the anticipated design of the area.

4 Solar energy potential - delivery of a 3D-model with optimised building design for solar energy installations for the agreed area in Sydvästra Lund.

It was decided that Skåne Energy Agency would write the request for tender to procure a consultant meeting the needs listed above.

The request for tender was sent out to three consultants where two chose to answer with a bid and one chose not offer a bid. Out of the two, the most suited consultant was chosen. The steps 1-4 with the consultant was carried out during 2017.

Also, the steps 1-4 described in the methodology chapter were carried out during this period.

2.2 Assessing the possibilities of solar energy in Sydvästra Lund

The agenda for the start-up meeting with the consultant was divided into three parts; about the assignment, about the area Sydvästra Lund and about the inspirational workshop. The assignment was looked through and agreed on in detail. The area of Sydvästra Lund was presented to the consultant in more detail by the City Architect. Finally, bullet points for the inspirational workshop were suggested:

- Good examples of solar pV architecture, where solar energy is integrated in the building design.
- Advice for the ratio between building volumes – how can volumes and orientations be optimised?
- Shapes of volumes and buildings
- The new building regulations influence on building entrepreneurs to include solar pV from the beginning
- Advices about possible criteria in the local plan

The presentation for the inspirational workshop could be divided into three parts:

1. Volumes and guidelines: site-specific examples

2. Shapes of buildings and locations

3. Possibilities to influence with local plan

The inspirational workshop was held where the expert consultant presented inspirational solutions for solar energy installations, possibilities to use in the local plan and planning guidelines. In Sweden, a local authority cannot put tougher demands on building solutions than in national construction law. It is up to building entrepreneurs and property owners to install solar energy. Economical profit and deprecation time is of great importance for the will to install solar energy. The local authority can optimise conditions for economical profit and deprecation time by planning for as good solar potential as possible in the city. By optimising the solar potential for the buildings, investments in solar energy will be more profitable both now and in

the future. In the local plan it is possible to decide on orientation, shape and performance for building volumes to have good solar energy potential. By studying the natural shadowing of planned buildings 1st of November 10a.m. to 3 p.m., buildings that are not shadowed are identified to have good solar energy potential. For existing buildings, a solar energy map can be used to identify potential. Many local energy companies provide solar energy maps for the surroundings they operate in. When planning for new areas, a solar energy potential study is of good use. Think about population density in the area. A lower density result in more roof area per person and the possibility to be self-sufficient to a larger degree. Orientate buildings so the roofs and facades receive as much solar insolation as possible. Roofs have the largest potential compared to facades, especially in a city.

Suggestions about criteria to use in local plan to maximise for solar energy in planning process:

- Roof angle can be between [minimum angle] and [maximum angle].
- Highest building height [in meters].
- Highest roof-ridge [in meters].
- Highest total height [in meters].
- Over maximum height, it is allowed for technical devices for local energy production to be installed.
- The roof should be of the type lean-to roof

The orientation and placement of buildings can be regulated by property limits such as the land cannot be build on (dotted land) or buildings should be placed along the property limit line. For saddle roof buildings the solar energy potential on each side is the same when the building is orientated north to south. But as soon the building orientation differ from the north to south angle, the potential will be greater on one side of the roof. One possibility is to use a lean-to roof instead. If the building orientation is east to west, a lean-to roof is a better option. For flat roofs, the orientation is not important. Also, for saddle roof buildings the orientation is not that important, what is lost at one surface is often gained at another surface.

It is difficult to give general advise about urban planning for solar energy. The solar energy potential depends on many factors. There are many solutions that are good and can work from case to case. Develop a land allocation agreement that includes solar energy as part of building design. Also, the land allocation agreement can reward building entrepreneurs with a solid sustainability programme. Use descriptions in the local plan to describe solar energy and solar insolation as important factors in the architectural design. In Sweden, the descriptions in the local plan cannot be used for demanding solar energy installations but to demonstrate the intention from the local authority.

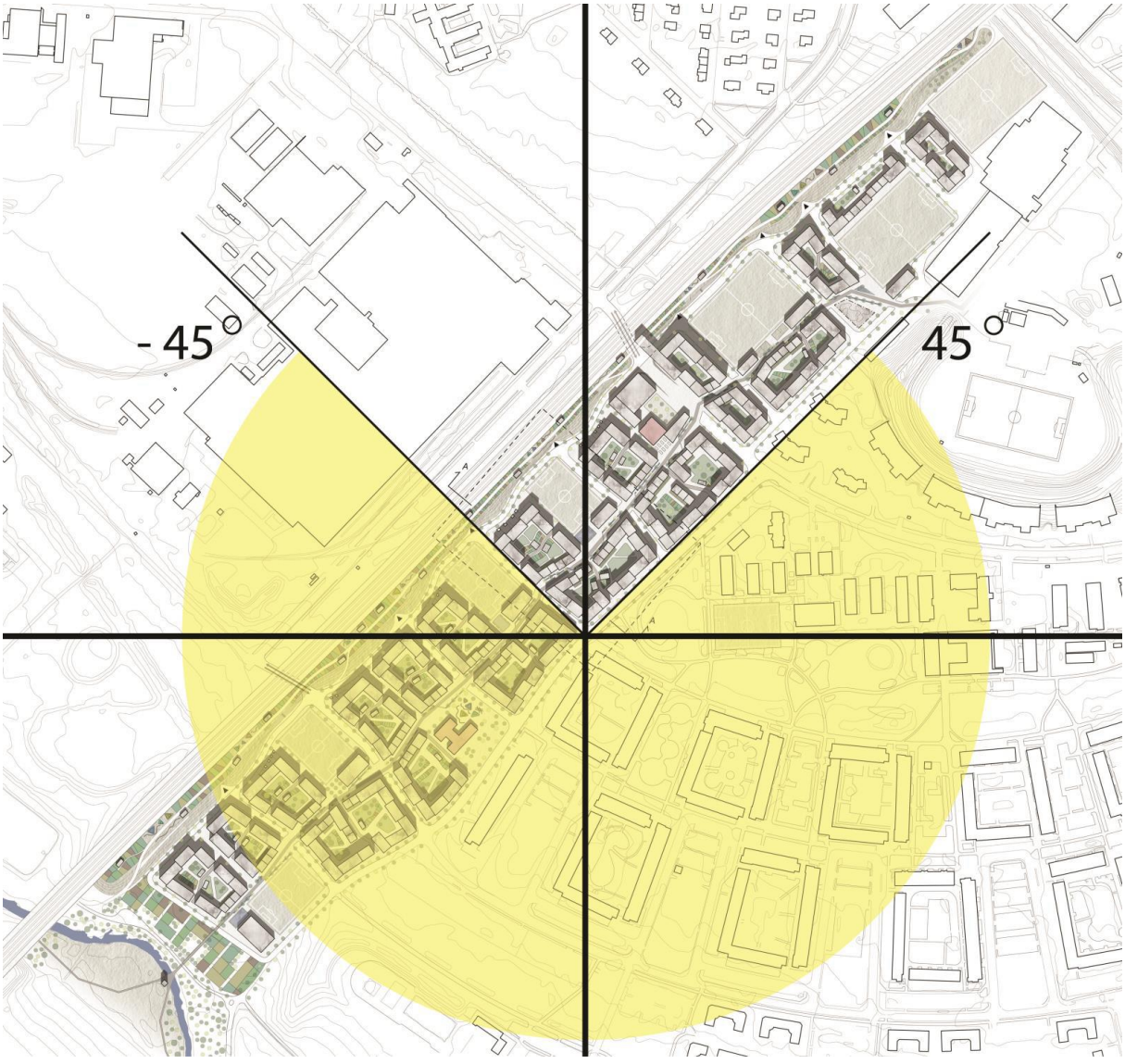
2.3 Designing a city block in Sydvästra Lund optimised for solar energy installations

Since it is very early in the planning process in Sydvästra Lund it is not possible to assess the solar potential for the whole area since building structures, design and volumes are yet not set. In the assignment for the consultant it was included to design a block of buildings in a limited area in Sydvästra Lund, optimised for solar energy installations. The consultant was provided some ideas from the planning group from City of Lund of how an area in Sydvästra could be designed from an earlier architect contest that was organised by the City of Lund.

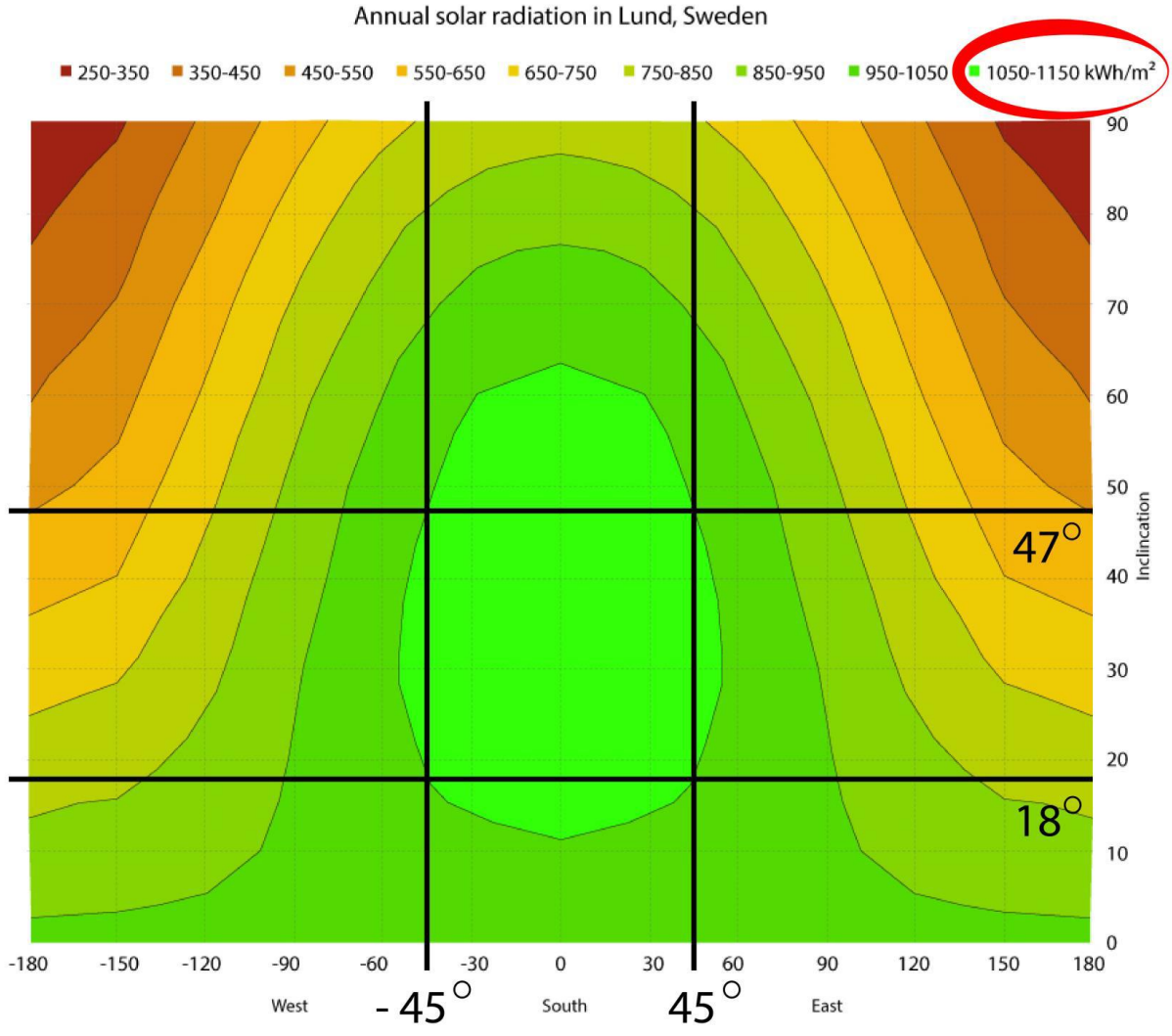
The consultant optimised the fictional block of buildings using the methods presented in chapter 2.2. The consultant identified important steps in the process and made concrete design decisions for the area in connection to the steps.

Step 1: Study the orientation of the buildings in relation to the geographical north-south axle in suggested planning proposal.

Decision 1: Keep the 45-degree orientation of the buildings in relation to the north-south axle and chose a roof angle between 18 and 47 degrees.



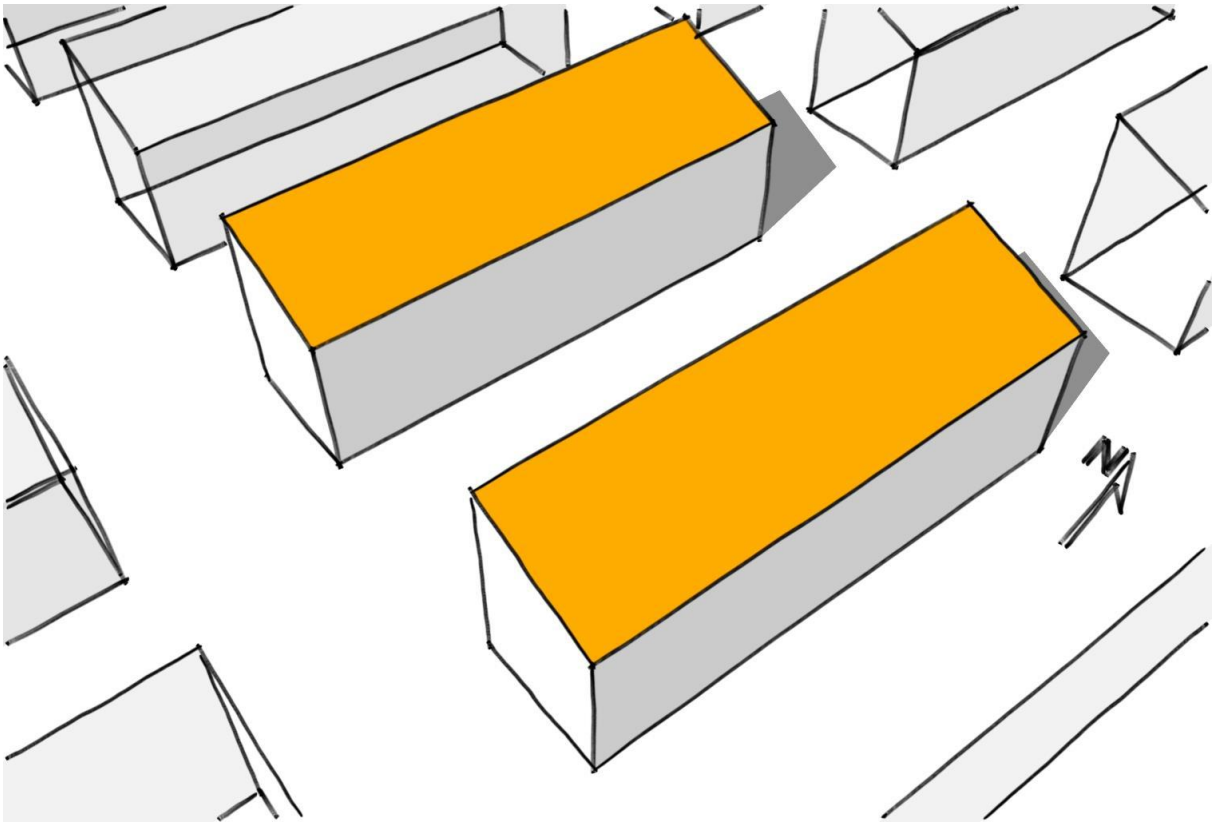
Picture 1: Orientation of new city block Sydvästra Lund.



Picture 2: Diagram showing the solar radiation energy level for different roof angels and leaning.

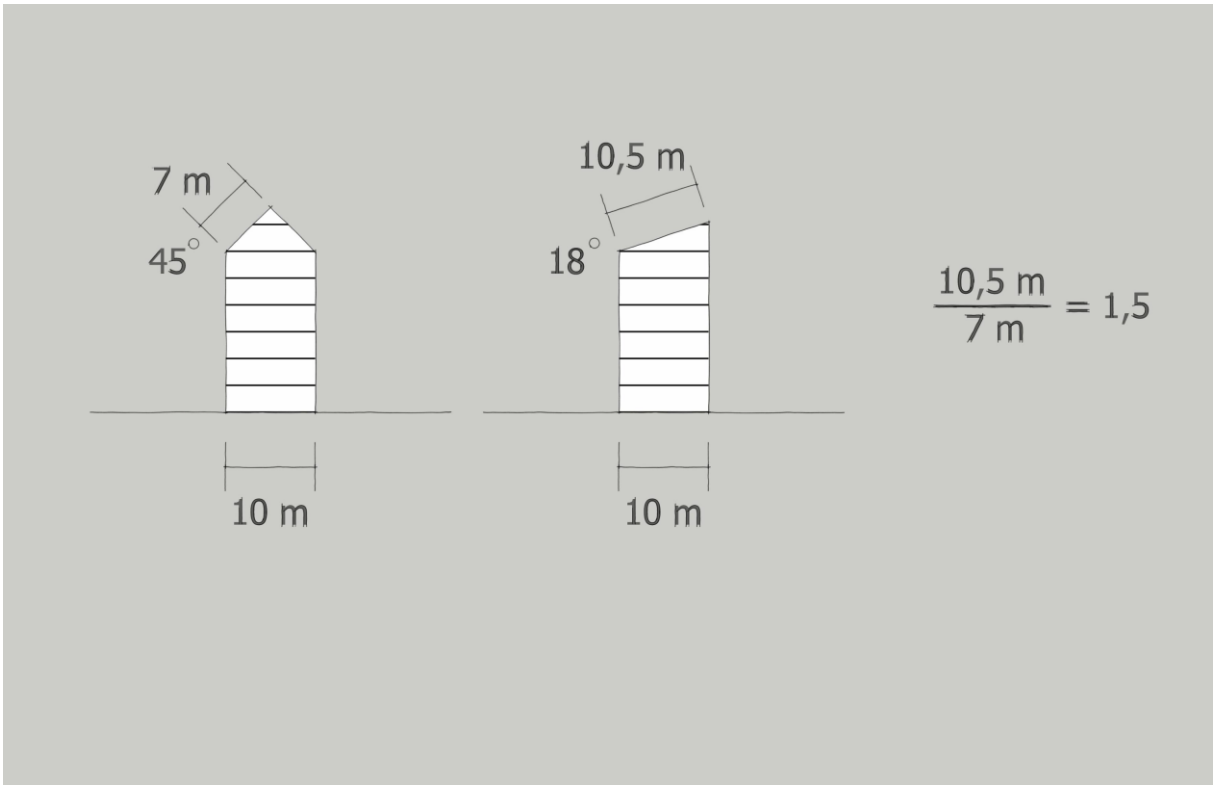
Step 2: Usually solar energy installations are most profitable installed on roofs. Study different types of roofs.

Decision 2: Design the buildings with lean-to roof which optimise solar energy potential.



Picture 3: With lean-to roof the area on the roofs are optimised for solar energy installations.

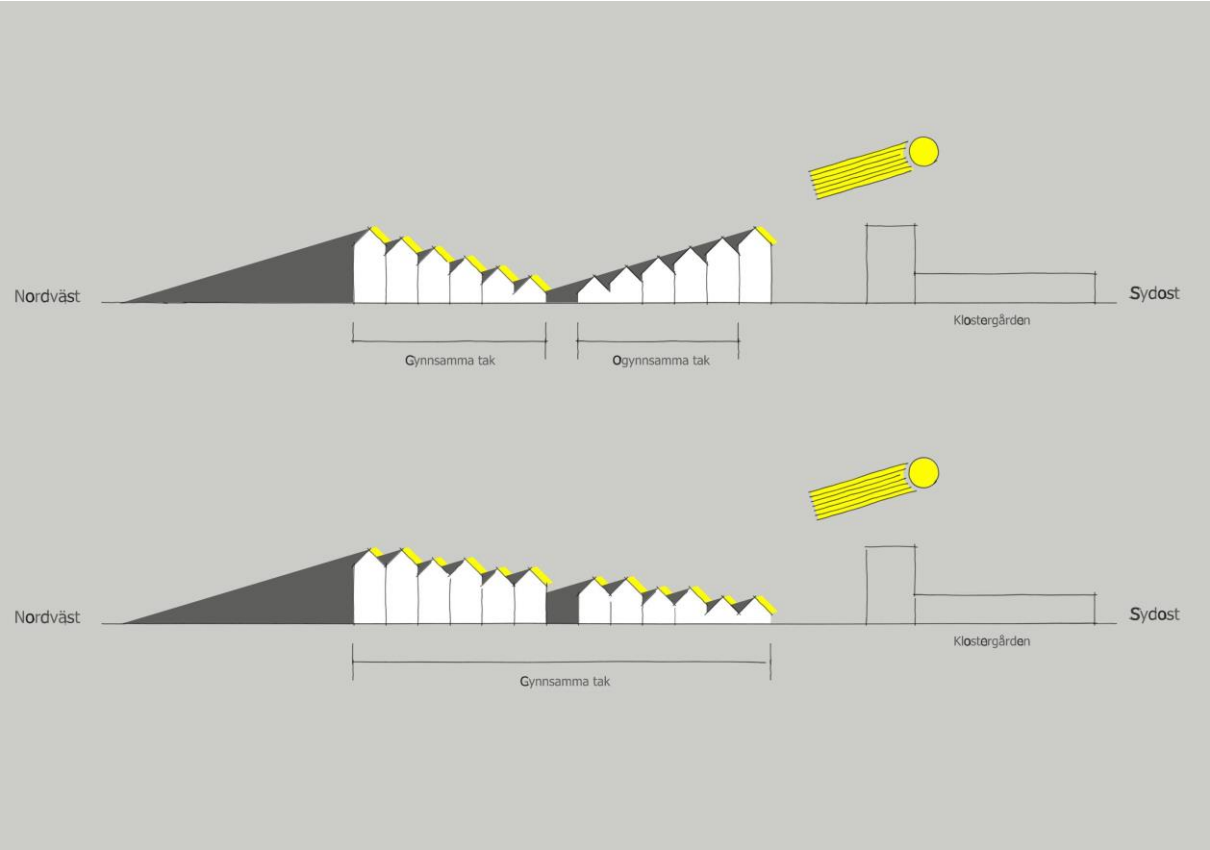
Decision 3: Design the roofs with 18 degrees of angle, which result in a good solar energy potential and also give the buildings a proper look.



Picture 4: With 18 degrees angle on the roofs, the far side will not build more than one extra flat in height.

Step 3: How to avoid that the buildings shadow each other's roofs?

Decision 4: Design a roof landscape so the buildings do not shadow each other´s roofs.



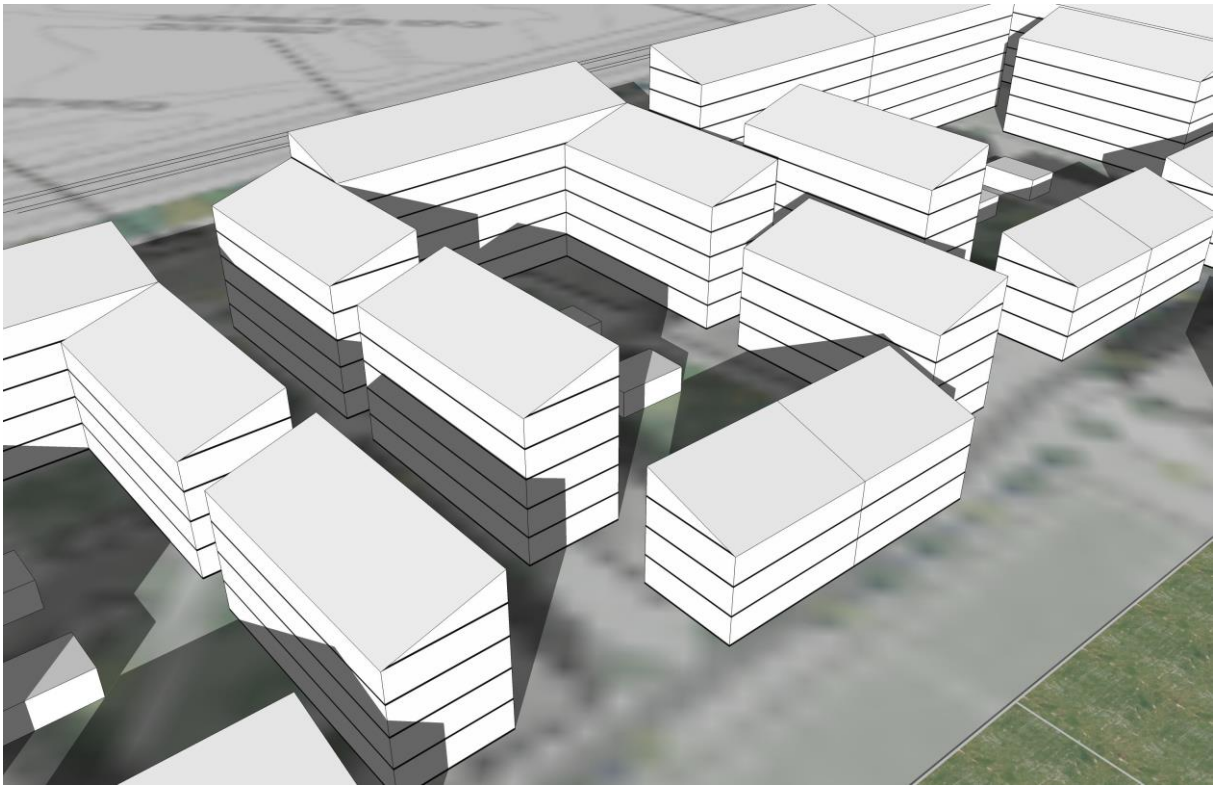
Picture 5: It is important to design the building blocks so the buildings to shadow each other.

Decision 5:

Lower the building height from north west to south east so the buildings don´t shadow each other and as much roof area as possible is suitable for solar energy installations.

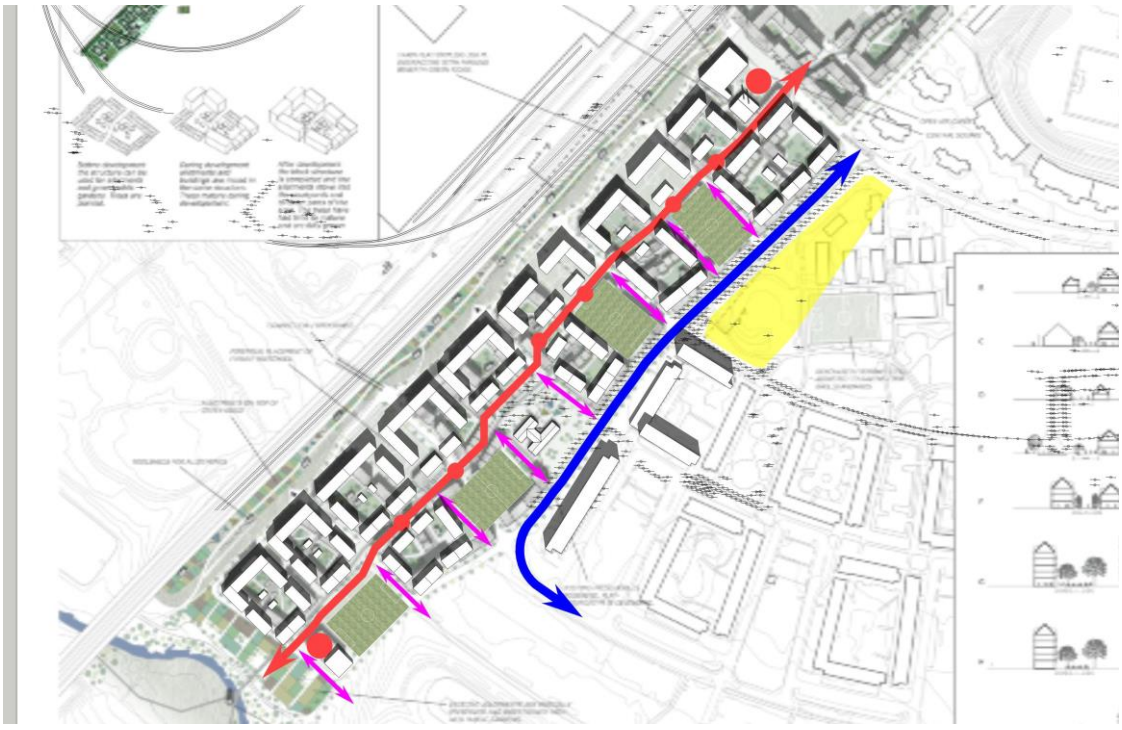
Decision 6:

Make sure the roof landscape has a leaning towards south east and south west.



Picture 6: By designing the buildings lower in south east locations they will not shadow each other and solar energy potential is optimised.

Decision 7: Use the lower buildings and leaning roofs in south east to connect to the existing nearby block of Klostergården.

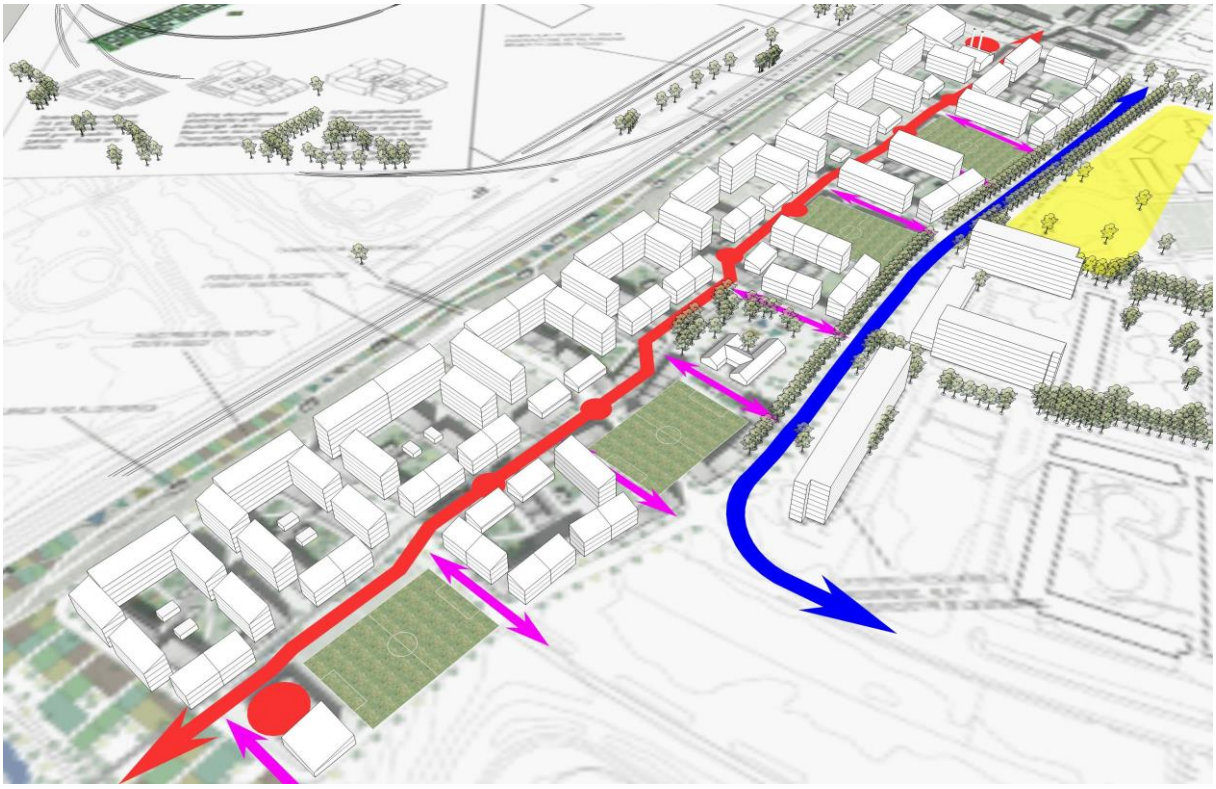


Picture 7: It is important to find connections and bridges to already existing building structures when designing a new block area.

Decision 8: Form follows function. Use the roof landscape as an esthetical concept. Use the structure of the new area as natural connection to the existing area of Klostergården even though the new area will be of a scale closer to citizens.

Decision 9: Design the blocks so solar light reach apartments and inner yards to as large extent as possible. This means open block structures with a large share of standalone buildings.

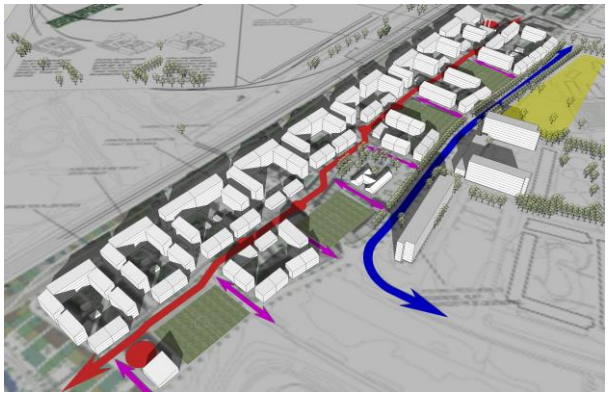
Decision 10: Even though the building height is lowered towards southeast, the strolling path in the middle of the area should be of scale close to citizens. This will be achieved by lower stand-alone buildings along the strolling path. These buildings will also facilitate incidence of light to the inner yards.



Picture 8: By using lower buildings along the strolling path in the middle, the area will feel open and available for citizens.

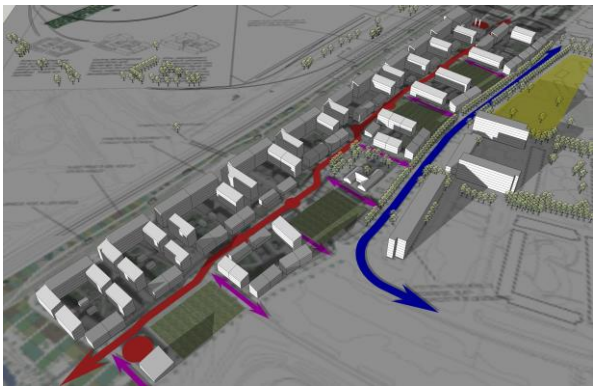
Step 4: If roof areas are not shadowed between 1st of November 10a.m. to 3 p.m. in a solar radiation simulation, they are identified to have good solar energy potential.

Picture 9: Shadowing 1st November 10 am



Picture 10: Shadowing 1st November 12 pm

Picture 11: Shadowing 1st November 1 pm



Picture 12: Shadowing 1st November 3 pm

According to the computer simulation, almost all of the roof area is profitable and suitable for solar energy installations in the new city area. This conclusion relates to step 5 in the proposed methodology, recommendations for solar energy installations in Sydvästra Lund.

2.4 Assesing solar energy potential in Sydvästra Lund

The new block area has a calculated roof area of 22 500 m^2. The roof areas have the orientation of -45 degrees to 45 degrees in relation to the north-south axle. The leaning of the roofs are 18 degrees. The result is that the solar radiation energy level on the roofs is 1050 kWh/m^{2}year.

1050 kWh/m^2 x 22 500 m^2= 23 625 000 kWh/year

Swedish Energy Agency recommend a 15 % level of efficiency for solar pV:s in calculations.

Use a factor of 0,85 for losses according to dirt, resistance, variations in temperature, etc. (Active solar energy in buildings and urban development, Lundgren and Wallin, 2003)

0,15 x 0,85 x 23 625 000 kWh/year = 3 012 187 kWh/year.

The total area of the new buildings (BTA) is 90 250 m^2.

If solar pV:s are installed in all suitable roof area, the new block area can be self-sufficient of energy up to 3 012 187 kWh/year / 90 250 m^2 = 33 kWh/m^2

According to regulations (BBR) at the time, the maximum energy use for non-electricy heated buildings are 80 kWh/m^{2}year and 50 kWh/m^{2}year for electricity heated buildings.

There is also a voluntary standard for low energy buildings (FEBY12) where non-electricity buildings can use 50 kWh/m^{2}year and electricity heated buildings 25 kWh/m2year.

Assumed that new buildings in Sydvästra Lund will be of low energy standard there is a possibility to be self-sufficient from energy from solar pV:s to a large extent in a new area optimised for solar energy installations. Also, this conclusion relates to step 5 in the proposed methodology, recommendations for solar energy installations in Sydvästra Lund.

2.5 Implementing solar energy in Lund

Step 6, decide which facilities the City of Lund can work with directly on their own (if any) and step 7, decide how City of Lund will continue dialogue work with developers and constructors, in the proposed methodology were unfortunately not synchronised with planning process in Sydvästra Lund. The planning process takes much more time than anticipated and the process was simply not at the stage where discussions with developers and constructors are taking place. There was unfortunately also a gap in the process when the first contracted project manager quit her work position and it took about seven months before a new project manager was in place. Anyway, the work with step 6 and step 7 have proceeded with the circumstances above given.

In October 2017 a consultation meeting was held between energy experts in the City of Lund and municipal utilities in relation to the planning and development of a sustainability program for another new city area, Västerbro. The material and findings regarding solar energy planning in Sydvästra Lund were presented during the meeting. From this material, objectives for the sustainability program and related energy objectives for the area of Västerbro were discussed. Also, in February 2018 Skåne Energy Agency had a meeting with the planning group of Västerbro to discuss solar energy installations in more detail. Currently (2018) solar energy installations are discussed with existing property owners in the area of Västerbo.

During May 2018 two presentations were held by the sustainability strategy officer in City of Lund for colleagues in the City Architect Department, where the material and findings regarding solar energy planning in Sydvästra Lund were discussed. About 15 colleagues participated in each of the presentations. The material from Sydvästra Lund is disseminated and available to colleagues in the planning department and also registered in the files for planning material.

The original project manager for Sydvästra Lund quit her work during autumn 2017. It took some time before a new contracted project manager for Sydvästra Lund was in place, until May 2018. A meeting with the new project manager and the working group of Sydvästra Lund was held 27th of June 2018. During the meeting all material and findings from the previous work with optimising Sydvästra Lund for solar energy were presented. The new project manager believed the produced material and findings were of great interest and would bring it with her when working with the design of Sydvästra Lund.

Next step in the planning process for Sydvästra Lund is to develop a proposal for consultation of the area during autumn 2018. After that a more detailed planning proposal will be developed and the aim is that a detailed plan will be developed by 2020 for the area.

The material about solar energy planning in Sydvästra Lund will be used further in different phases in city development projects in the City of Lund. It will be used as planning prerequisites when developing a planning program, as support and aid in detail planning and as inspiration in the implementation phase.

3 Results

The work with solar energy planning in City of Lund has been carried out according to plan. The main results achieved are the planning process itself in City of Lund, the 3D-model material and involvement of stakeholders.

3.1 The planning process

To work with aspects regarding solar energy early in the planning process have been very fruitful. This gives the planners in the municipality the possibilities to think about solar energy aspects and adjust the planning accordingly providing optimal solutions for solar energy. Still it is important to remember it will never be the municipality itself that installs solar energy in a new area as long as it is not the municipality's own buildings. In Sweden, a local authority cannot demand that constructors and developers install solar energy in a new area. What they can do, is to design a new area with the best prerequisites for making installation of solar energy economical profitable and the deprecation time as short as possible. By optimising the solar potential for the buildings in the city, investments in solar energy will be more profitable both now and in the future. In the local plan it is possible to decide on orientation, shape and performance for building volumes to achieve optimal solar energy potential.

The planners for Sydvästra Lund will bring the knowledge about solar energy planning into the future planning for the area. How the new area will be designed is yet not decided but interesting ideas have been presented in the pilot project in Sydvästra Lund.

3.2 3D-model Sydvästra Lund

An expert consultant was contracted to support the planning group in the process and develop a design of a fictional area where the buildings were optimised for solar energy installations. Also, calculations were performed by the expert consultant to show how much renewable solar energy that would be possible to produce from the optimised area. The consultant did a great job and provided the planning group with two large power point presentations. The first one presented inspirational examples of solar energy installations and informed about what possibilities a local authority has in relation to legislation and planning for solar energy. The second one presented the development of a fictional city block area in Sydvästra Lund where all buildings where optimised for solar energy installations. For each design decision for the area, the consultant described what decision he took and why he took it. The material is very pedagogical and will be used by the City of Lund in planning processes for other areas. The consultant also delivered a 3D-model of the area on a computer file, so the municipality can develop and adjust the fictional area themselves.

3.3 Stakeholder involvement

To work with urban planning for solar energy is not a one-man job. Of course the responsible architect for the area is a very important person but to be successful other positions need to be involved. When working with Sydvästra Lund in the BEA-APP project following positions have been involved:

- City Architect for Sydvästra Lund, City of Lund
- Sustainability Strategy Officer, City of Lund
- Environmental Strategy Officer, City of Lund
- Associate senior lecturer, dep. Energy and Building Design, University of Lund
- Business developer, Kraftringen (local energy company)
- Project Managers, Skåne Energy Agency

These are the positions that have been involved in the work very early in the planning process. At a later stage when a more detailed plan has been developed, other stakeholders need to be involved for the implementation of solar energy soloutions. It could be:

- Constructors and developers
- Building owners
- Solar energy installers
- Electricity grid planners and constructors
- Expert consultants

4 Lessons learned

To plan for a new city district takes time, much more time than anticipated. The new train station in Sydvästra Lund will be in place 2024. The pilot project in Sydvästra Lund started in 2016, very early in the process. At that time some dialogue meetings had been held by the City of Lund and an architect contest had been organised resulting in 22 suggestions how the area could be developed. When starting the pilot project there was not really much to relate to regarding planning of buildings and solar energy installations. At first glance it would look like a problem but it turned out to be the other way around. By being part of the planning process in a very early stage it was possible to bring up solar energy on the agenda and gave the planning group the possibility to work in an unrestricted and free minded way about possible solar energy installations. Also, it gave the planning group the future possibility, to plan the area for the best conditions for installation of solar energy before anything is already set and difficult to change when decided.

To bring in an expert consultant that had worked with urban solar energy planning before was very useful. The consultant was able to give the planning group valuable advises and the inspirational examples the consultant presented did give a new perspective on solar energy installations in the planning group. The fictional example the consultant developed in 3D with a block of buildings optimised for solar energy installations, with start of point in one example from the architect contest, was brilliant and gave the planning group valuable insights for the future development of Sydvästra Lund.

One thing no one can rule over but that has great impact in such a project is change of personnel. The original city architect quit her job and the process suddenly lost momentum and almost came to a standstill. For such sophisticated work tasks it can took time to contract a new person, in this case about seven months.

Finally, it was really exciting to work with renewable energy solutions in a modern way and colleagues were very interested to find good solutions to achieve concrete results in the end.