Solar district heating
Instruments for policy and legal framework

Best-practice guide for SDH land area development and multi-coding of areas

Subject:	Best-Practice Policy to improve the regional policy and legal framework
Description:	Best-practice guide and policy recommendations for SDH land area development and double usage of space
Date:	15.11.2018
Authors:	Simona Weisleder and Christian Maaß, Hamburg Institut
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Summary description of the instrument

Region: Metropolitan Region of Hamburg

Partners involved: HIR Hamburg Institut Research

Short description of the measure: Scarcity of areas is a major barrier to implement SDH in urban areas. To overcome these barriers policy instruments are needed to facilitate the usage of urban areas for SDH and for double usages– in parallel and on the same space – with other purposes. The best practice guide points out possibilities to develop SDH areas and double usages of urban areas with best practice examples. On this basis, recommendations for policy instruments to facilitate such solutions are developed.

Initial situation

The Metropolitan Region of Hamburg is an area located in northern Germany with ca. 5 million inhabitants and comprises 28.500 km^2 in four states (Hamburg, Schleswig-Holstein, Niedersachsen, Mecklenburg-Vorpommern).

There are numerous DH networks in all four states of the Metropolitan area, the largest located in the City of Hamburg with more than 400.000 housing unit equivalents connected .

The Metropolitan region is economically propering and has continiously growing population, leading to massive development of real estate for housing and for commercial purposes.

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Figur 1: Administrative districts (Landkreise) of the federal states Hamburg, Schleswig-Holstein, Lower Saxony and Mecklenburg-West Pomerania in the Hamburg Metropolitan Region (Source: Metropolregion Hamburg).

The City of Hamburg has been a forerunner to establish SDH, with projects like Solarsiedlung Bramfeld (Karlshöhe), HafenCity West, the Bavaria quarter and the Energiebunker Wilhelmsburg. However, the share of RES in DH, and in particular the share of SDH, is still neglectable.

The development of SDH projects often fails due to a lack of space. In densely populated urban areas like the Hamburg Metropolitan Region, space is needed for many other competing purposes like housing, traffic infrastructure, industry and commerce, nature conservation or - in the rural parts of the region - for agriculture. Under these circumstances, urban planners have been reluctant to allocate space for SDH as such and it facilitates the implementation of SDH if scarce areas can be used in parallel for other purposes.

Examples of such double space usage are rare and only partially found not in the Metropolitan Region of Hamburg. SDH land area development and double usage of areas for SDH and other purposes is so far hardly addressed in national or regional planning law or other policy instruments. Examples from many regions in the EU show that solutions for SDH land development and for parallel land use through SDH and other purposes

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can be found. To explore the potentials for such land area development in favor of SDH is one of the key measures identified in the in the SDHp2m strategic action plan of the Metropolitan Region of Hamburg.

Objectives

The SDHp2m strategic action plan for the Metropolitan Region of Hamburg points out six relevant categories for land area development and double usage of space for SDH and other purposes:

1. agricultural production (e.g. so called “Solar Neighbourhood Greenhouse”)
2. nature preservation and water protection areas
3. polluted or contaminated or industrial areas (e.g. former landfills or sludge hills)
4. large infrastructure installations (e.g. parking decks, sewage treatment plants)
5. large scale roof areas (on existing and new buildings)
6. areas along traffic routes (e.g. noise protection along motorways or railways)

Some experiences can be transferred from large photovoltaic installations, where multi-coding already is more common, e.g. on large parking decks, as noise protection and on greenhouses. But in several questions it is necessary to investigate the special technical case of double-utilization with solar thermal installations, e.g. the hydraulic system of elongated installations along traffic routes or safety issues roofing parking decks with hot liquids in pipes.

The goal is to identify best practise examples for SDH projects from across the EU, to identify possible opportunities for equivalent projects in the Hamburg Metropolitan Region and to develop policy instruments that foster the development of SDH projects in these respective areas.

Measures and actions

In a first step, best practise examples for the different development areas are sought and analysed.

Secondly, we analysed if, where and how these examples could be transferred to the situation in the Hamburg region; concrete possibilities for project development in the region will be examined as pre-case studies.

In a third and final step, it is analysed what policy options there are to facilitate the land development in the examined fields.

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Barriers and opportunities

1) Development of double utilization for agricultural production

Danish plants are mostly built in rural areas or in the proximity of small and medium sized cities. So far, there are hardly any plants in large cities, mainly due to high prices of real estate and high competing land use pressure.

In Germany, in SDH projects in the rural area the competition to agricultural uses are crucial. The production of biomass generates an important income for the farmers. But comparing the energy output from biomass to solar thermal, it´s a factor of 40-50% for solar.

- **Best practise examples**

The best practice of **"AGRO PV"**[1] try to prove that agricultural production is combinable with energy production – it could be transferred to solar thermal solutions.

The best practice project idea of Hamburg Institut of the **Solar Neighbourhood Greenhouses** combines ground-mounted solar thermal heat plants with urban gardening in greenhouses and straighten community building.

Figur 2: Project idea Solar Neighbourhood Greenhouses (Source: Hamburg Institut)

[1] www.agrophotovoltaik.de

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- **Transferability to the Hamburg region**

In the district of Hamburg-Harburg a recent concept for the sustainable development (”Integriertes Quartierskonzept”) of the neighbourhood ”Südöstliches Eißendorf/Bremer Straße” has examined the possibility of integrating solar thermal heat into the district heating grid of a local housing cooperative. It proposed two possible locations, which would be suitable for a ground-mounted solar thermal heat plant. Today, the respective locations are used for strawberry farming and allotment gardens. One option could be the concept of Solar Neighbourhood Greenhouses.

Figur 3: Project proposal for Solar Neighbourhood Greenhouses in Hamburg-Harburg (Source: Geoportal Hamburg)

2) Development of double utilization for nature preservation and flood protection areas for SDH

- **Best practise examples**

Crailsheim[2] is one of the best-practice examples of a SDH plant regarding nature preservation. By integrating the large solar collection surfaces on the southern flank of a noise reducing berm into an overall ecological concept, the area has become a place with recreational value, and offers suitable habitat for many native plants and animals – a “hot spot” for many rare species is created. With these measures valuable „eco-points“ were collected and thus meant real money which made the SDH plant even more economic feasible.

[2] http://solar-district-heating.eu/Portals/0/NewFolder/BroschüreCrailsheimEN.pdf

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In **Châteaubriant**[3] a SDH plant was built in a flood protection area. In **Graz** the planning for the BIG SOLAR GRAZ[4] project in a water protection area is in an advanced stage. Both projects show that it is advantageous to plan SDH projects in areas where there is no spatial competition with real estate development for housing or with other construction projects. They also show that it is possible to develop SDH projects in coexistence with the preservation of natural resources.

- **Transferability to the Hamburg region**

Land area for compensation measures is very scarce. Ecologic upgrading of formerly intensively used agricultural area could become a business model for farmers.

3) Development of polluted or contaminated or industrial areas for SDH

Judging from the experiences made during the SDH project, it seems that the legal framework to develop SDH projects on contaminated areas seems to be sufficient. There have been numerous developments and feasibility studies. It was found that despite the due caution that has to be attributed for environmental protection, SDH projects are in general feasible on suitable sights.

- **Best practice examples**

There are some best practice examples of SDH on polluted or contaminated areas in Germany as the last year build plant in **Senftenberg**[5]. In August, 2016 on a recultivated landfill site in the town Senftenberg the up to now biggest solar thermal plant of Germany went into operation. With 8,300 m² collector area is it at the same time one of the biggest divices with vacuum tube collectors world wide and the first real tall divice in Germany which feeds into a classical urban district heating grid.

Again in the “Solar Capital” **Graz** the first part of a plant on a former waste disposal site with 2,000 m² - so called HELIOS project - celebrated in 2017 its inauguration.

- **Transferability to the Hamburg region**

Even in Cities as Hamburg with a growing population of actual 1,8 Mio. Inhabitants and therefor an enormous competition on the areas for all purposes, there are potentials for SDH.

The port of Hamburg is the second largest one in Europe and the river Elbe has to be dig out every year for through Hamburg Port Authority (HPA). Hugh sludge harbour dump sites exist, some recultivated and some

[3] http://www.mairie-chateaubriant.fr/medias/2018/01/DP-inauguration-centrale-solaire-14bd.pdf
[4] http://www.solarthermalworld.org/content/austria-big-solar-eur-200-million-investment-graz
[5] http://ritter-xl-solar.com/en/applications/district-heating/senftenberg-ger/

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will be in use for the next 50 years. First discussions with HPA started to find solutions for a multi coded use of these areas.

Figur 4: Sludge harbour dumpsite in Hamburg (Source: HPA)

4) Development of large infrastructure installations for SDH

Similar to the concept of double utilisation of large rooftops for SDH, it is worth to screen areas, which are use mono-functional for large infrastructures as for parking or industrial processes.

- **Best practice examples**

In **Graz**[6] a parking deck of a private company was covered with a completely new rooftop and solar thermal to offer shadow for the cars. In **Thailand**[7] a plant was realised on the production area for canned tuna

- **Transferability to the Hamburg region**

Hamburg Institut developed two ideas: covering the parking deck of a shopping mall in a central district and covering the sewage water treatment basins.

[6] https://www.klimafonds.gv.at/assets/Uploads/Projektberichte/2015/Solare-Groanlagen-2015/B368386-Solare-Groanlagen-publizierbarer-Zwischenbericht.pdf
[7] http://denmark.dk/en/green-living/sustainable-projects/the-danish-clean-tech-sector-sunmark

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In the framework of a district energy concept in Hamburg-Harburg[8] the idea of covering the parking deck on a shopping mall with approx. 11,000 m² was developed. The gained solar heat could be feed in a new district heating grid.

Figur 5: Project idea of Hamburg Institut in Hamburg-Harburg and a built example in Neckarsulm (Source: Geoportal Hamburg + Solites)

While looking for large areas for SDH, the Hamburg Institute developed the idea of realising a solar plant on sewage water treatment basins in Hamburg. The Dradenau sewage treatment plant has extensive secondary clarification tanks, which could be overbuilt by a steel construction with solar collectors. The construction would take over a length of 9.5 m, the load on the concrete partition walls of each basin. The secondary clarifiers have a total area of about 53,000 m².

Figur 6: Project idea of Hamburg Institut on sewage water treatment basins in Hamburg-Dradenau (Source: HSE)

[8] http://www.hamburg.de/harburg/energetisches-quartiersmanagement/10796216/energetisches-quartiersmanagement/

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5) Development of large scale roof areas for SDH

- **Best practice examples**

There are numerous examples across Europe of large SDH-plants on rooftops.

Some of these examples will be looked at closely in this best practise guide. Among the examples abroad are – for instance - plants on commercial roofs as in **Wels**[9] (Austria). In the City of **Hamburg**[10], plants on rooftops of residential and commercial buildings in the HafenCity (West) can be mentioned – on the basis of a state law that allowed the establishment of legally binding regulations for real estate developers to provide a minimum share of heat with RES. The **Energy Bunker**[11] in Hamburg Wilhelmsburg is another well-known best practice example and starting point of a new installed SDH grid in an existing district.

- **Transferability to the Hamburg region**

The existing examples show that SDH plants can successfully be operated on rooftops and that the states have the legal possibilities to establish a regional framework to make SDH on rooftops a mandatory part of real estate development. However, there are still many barriers that keep municipalities from implementing such legal measures: In particular, SDH on rooftops is – in comparison to DH based on fossil fuels, ground mounted SDH or compared to individual heating with natural gas or oil – relatively costly. If SDH is planned on very large rooftops before construction with an integrated solar-friendly building design, these costs can be lowered significantly. Depending on public funding, SDH could be cost competitive with other heating solutions, it could therefore be a promising approach to take advantage of the ongoing construction of many large commercial buildings. Another obstacle to overcome is yet a competition with PV on rooftops. So far, the economic benefits to run a large rooftop PV plant are often higher than to run an SDH plant, while the technical and legal barriers for rooftop SDH are higher than for PV.

One way to increase the available area for solar energy is the building law. In particular, the introduction of a building regulation obligation in the construction of commercial buildings with large roof areas (e.g. from 250 or 500 sqm. roof area with a suitable orientation to thpe south, east or west), which adds the obligation for the simultaneous establishment of a solar thermal or PV system on one minimum proportion of the roof.

It would also be conceivable, but less extensive, to establish a duty according to which such buildings have to be structurally designed in such a way that the subsequent installation of a solar system is possible without significant structural interventions (adequate building statics, installation of devices for the roof attachment of a the system as well as of conduits for wiring).

[9] http://ritter-xl-solar.com/en/applications/district-heating/wels-austria/

[10] http://hafencity.com/upload/files/files/Waermeversorgung_HafenCity.pdf

[11] https://www.iba-hamburg.de/en/projects/energiebunker/projekt/energy-bunker.html

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6) Development of areas along traffic routes for SDH

- **Best practise examples**

Looking at best-practice examples for SDH projects along traffic routes the EU-Life project "**NOISUM**"[12] evaluates this topic. The main objective of the NOISUN project is to demonstrate innovative noise barriers that produce solar energy for distribution to local district heating systems, hence an environmentally sound technology. This will be achieved by installing and evaluating specially adapted solar collectors at a major transport thoroughfare for both road traffic and rail. The project demonstrates that the technology is a well working solution for considerably cutting noise levels from road and rail traffic in European cities, receiving a more attractive near environment, at the same time producing useful energy to the local energy network. Developing a project in a much larger dimension could be very interesting. Especially in urban areas and growing cities the densification of the city along the mobility infrastructures are actual tasks and noise protection plays an important role.

An example from the Netherlands in **Almere**[13] shows that SDH can be integrated in the city and landscape planning – more, that it can be used as a landmark and creative element.

It is worse again to look at the development of the **PV sector**, where in Germany the law gives the possibility of designation areas for PV in a determined corridor along the traffic lines.

- **Transferability to the Hamburg region**

As a logistic hub with the harbor, there are many traffic ways in and around Hamburg. In the next years in the Metropolitan Region there are several new roads in the development and under construction, e.g. motorway A 26 (Hamburg), motorway A 20 (Bad Segeberg) or the western bypass Pinneberg.

[12] https://noisun.wordpress.com/2015/02/05/noisun-nagra-steg-narmare-varen/

[13] http://www.crrescendo.net/almere_noorderplassen.html

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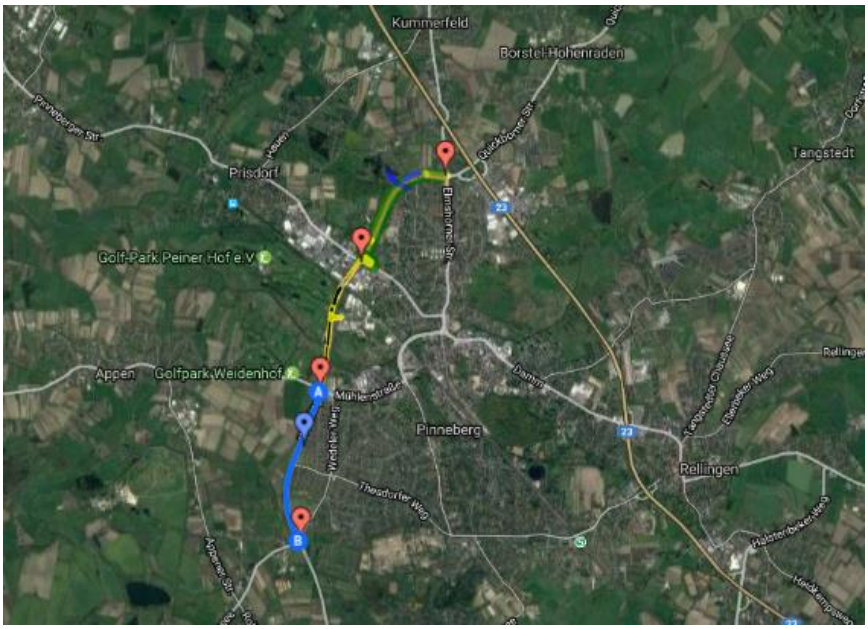
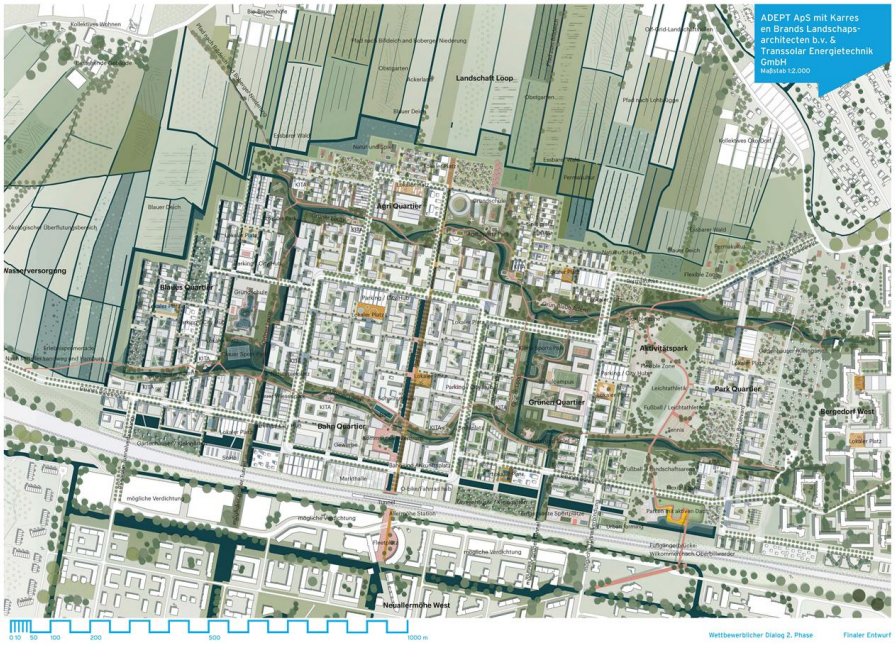


Figur 7: Western Bypass in Pinneberg is under construction – completion until 2019 (Source: Google Maps).

In several urban development projects noise protection plays an important role, e.g. one of the latest projects in Hamburg: Oberbillwerder, where a district with 7.000 housing units and 5.000 working places will be developed along a railway line in the next 5 - 20 years.



Figur 8: Winner of the competition for Oberbillwerder in Hamburg (Source: ADEPT ApS mit Karres en Brands Landschapsarchitecten b.v. & Transsolar Energietechnik GmbH)

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Results

There is a general political will to foster SDH in Germany and there are attractive public funding schemes in place.

Nevertheless the development of SDH is very slow due to other barriers:

- **Lack of economic and legal pressure**

Policy makers must discuss about regulating the use of fossil fuels in the heating sector. Possible instruments could be limits to new decentral heating units running with fossil fuels (as in Denmark) or fixed quotas for renewable energies in the heat supply. In addition, higher taxes on natural gas and heating oil would help renewables to become competitive.

- **Area competition with PV**

SDH competes with PV on the scarce resource of land. While PV can be implemented at many places far away from the cities and towns, SDH depends on land available close to the consumers. To solve this conflict, there should be a planning process at the regional or municipal level that determines which areas should be designated for SDH. This could be done in municipal heat plans (as in Denmark).

- **Regulation and transparency**

In some regions, the reputation of DH is negative due to consumer complaints on prices or transparency. Lack of consumer trust is sometimes an obstacle to the enlargement or new foundation of DH grids. This could be encountered with a stricter policy on pricing, transparency and the introduction of a price regulation.

- **SDH is still not well known as a solution**

Policy can further promote the advantages of solar thermal plants as a cost stable, sustainable and renewable option for DH.

- **Public perception: SDH is “ugly” and spoils nature and landscape**

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Policy has to make clear that energy/ heat production needs area –especially for the heat supply where the production has to be nearby the consumption. Fossil fuels have spoiled for decades nature and landscape – and still do – mostly not in “my backyard” but in other regions and countries.

SDH offers the possibility of integrated concepts where heat production goes along with nature preservation – proven in projects like Crailsheim. Federal, state and local politics should strengthen and implement such concepts and also stimulate the discussion about a new perspective on landscape integrating energy production.

Lessons learned

The concept of multi coded areas for SDH is a promising approach and there is a large and diverse potential. In many cases, large scale projects on these sight can offer competitive prices even if there are additional cost for construction. Sometimes they can be used as “door openers” for the topic and sometimes they stay single solutions. The approach shows clearly that SDH calls for integrated and interdisciplinary working groups.

SDH projects on multi coded areas can be an important urban complement to the “Plug & Play” solutions on agricultural land known from small and medium sized towns in Denmark. For bigger cities and areas in densely populated regions, multi coded areas may be a means to raise acceptance for SDH projects and to increase the production of renewable heat in the required quantity and on an affordable price level.

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