Mistra Urban Futures Report
2019:3

Co-creation for socio-ecological urban development?

The case of Gröna Solberga

Liisa Perjo
Peter Bjerkesjö

i samarbete med

Author: Liisa Perjo & Peter Bjerkesjö, IVL Swedish Environmental Research Institute Ltd.
Funded by: Mistra Urban Futures Stockholm NODE
Report number C 451
ISBN 978-91-7883-119-7
Edition Only available as PDF for individual printing

IVL Swedish Environmental Research Institute Ltd.
P.O Box 210 60, S-100 31 Stockholm, Sweden
Phone +46-(0)10-7886500 // www.ivl.se

This report has been reviewed and approved in accordance with IVL's audited and approved management system. It is also published as IVL Report C 451.

Table of contents

Summary 4

Sammanfattning 6

Introduction 8

Co-creation for socio-ecologically sustainable development 9

Co-creation in urban development 9
Urban living labs as co-creation arenas 9
Socio-ecological urban development 10
Analytical framework 12

Methods 13

Co-creation and socio-ecological urban development in Gröna Solberga 14

Initiation phase 14
Implementation phase 16

Coordination and planning 16
Recruiting SMEs 17
Communication 18
Co-creation for socio-ecological urban development during implementation 18

Case studies on pilot projects in Gröna Solberga testbed 20

Bioteria 20
Refo 21
Kretsloppsbolaget 22

Conclusions 24

The Gröna Solberga testbed as a dynamic co-creation process 24
Integrating social and ecological sustainability perspectives in Gröna Solberga 25
Co-creation in Gröna Solberga as a learning process 26

References 28

Summary

This report presents the results from a study on how co-creation to promote socio-ecologically sustainable urban development took place in the research and demonstration facility (testbed) "Gröna Solberga". The testbed was established in a rental housing area in Southern Stockholm called Solberga, with the aim to find solutions to the housing sector's sustainability challenges. In Gröna Solberga, IVL Swedish Environmental Research Institute and the public rental housing company Stockholmshem invited small and medium-sized companies (SMEs) to test green solutions for the housing sector, in cooperation with tenants. The establishment of the testbed was made possible by funding through the European Regional Development Fund (ERDF).

The report takes its point of departure in research on co-creation as a process of different actors making something together (e.g., product, service or process innovation), or learning something together (building new knowledge and networks through collaboration). Research on urban living labs as co-creation arenas is also used to analyse Gröna Solberga. Typical of urban living labs is to focus on co-creation of innovative solutions in real world environments, which is also the case in Gröna Solberga.

The concept of socio-ecologic urban development is used to study how considerations of ecological and social sustainability are included in Gröna Solberga. Earlier research has identified a need for better understanding of the linkages and potential conflicts between social and environmental sustainability. The concept of socio-ecological urban development highlights the need to better integrate social and environmental improvements in urban environments.

The empirical part of the study analyses co-creation and socio-ecological sustainability aspects in the planning and implementation of the testbed's activities. The results show that co-creation during the planning phase took place primarily between IVL and Stockholmshem, while rental housing tenants were not involved. During the implementation phase, IVL and Stockholmshem in cooperation chose which SMEs to include in the testbed. The SMEs then worked together with IVL and Stockholmshem in planning and implementing the SMEs pilot projects. Tenants were involved when the SMEs pilots were tested. During the implementation phase, a local group for urban farming was also formed, and the local Union of Tenants became more actively involved in Gröna Solberga through a project on sharing between tenants.

The idea of establishing a testbed for SMEs to test green solutions for housing sector came originally from IVL who received funding from the European Regional Development Fund to establish a testbed. In Gröna Solberga, practical co-creation took place when the different actors' goals and competences meet in a real-life context where different regulatory and technical limitations set the framework for testing new solutions. Gröna Solberga as a living lab evolved over time in terms of actors' roles and influence on the process. We conclude that co-creation in long-term testbeds and living labs should not be studied as stable entities but should instead be seen as dynamic processes where different framework conditions influence and transform co-creation and the roles of actors over time.

In Gröna Solberga, the co-creation between IVL and Stockholmshem broadened the scope of the testbed as IVL's more technically-oriented environmental perspectives where combined with Stockholmshem's interest in developing the housing area and including social sustainability perspectives. However, there was limited explicit consideration and lack of explicit analyses of the interplay of environmental and social aspects of the testbed and the activities conducted within its

framework. More careful consideration of social and environmental aspects in planning the pilots could have been useful to ensure that environmental projects can be designed to also strengthen social values in the area, and vice versa. More active involvement of tenants early in the planning process could also have given the testbed access to tenants' knowledge that could have been used to ensure that the planned activities respond to the challenges the tenants identify in their everyday life.

At the time of writing, the original funding for the testbed had ended, which will further influence the involvement of actors, since IVL's involvement was financed by the project funding. The local Union of Tenants has in turn become more active, and tenants are likely to become a more central part of the co-creation in Gröna Solberga. This in turn is likely to influence the focus areas of the testbed that will continue to live on and develop past the original project period.

This study of co-creation processes in Gröna Solberga has been funded by Mistra Urban Futures.

Sammanfattning

I den här rapporten redovisas resultaten från en studie om samskapande (co-creation) processer för att främja socioekologiskt hållbar stadsutveckling i testbädden ”Gröna Solberga”. Testbädden etablerades i bostadsområdet Solberga i södra Stockholm, med syftet att utveckla innovativa lösningar på bostadssektorns hållbarhetsutmaningar. I Gröna Solberga erbjöd IVL Svenska Miljöinstitutet och det allmännyttiga bostadsbolaget Stockholmshem, möjligheten för små och medelstora företag (SMF) att testa gröna lösningar för bostadssektorn i samarbete med de boende i området. Idén att etablera en testbädd för små och medelstora företag med fokus på test och demonstration av gröna lösningar för bostadssektorn, kom ursprungligen från IVL som för detta syfte hade finansiering från Europeiska regionala utvecklingsfonden (ERUF).

Studien tar sin utgångspunkt i forskning om samskapande som en process för olika aktörer som gör något tillsammans (t.ex. produkt, service eller processinnovation), eller lär sig något tillsammans (bygga ny kunskap och nätverk genom samarbete). För att analysera Gröna Solberga används även forskning om så kallade living labs, som används i städer som samskapande arenor. Typiskt för dessa är att fokusera på samskapande av innovativa lösningar i verkliga boendemiljöer, vilket Gröna Solberga är ett exempel på.

Begreppet socioekologisk stadsutveckling används i rapporten för att studera hur hänsyn tas till ekologisk och social hållbarhet i Gröna Solberga. Tidigare forskning har identifierat ett behov av bättre förståelse av kopplingar och potentiella konflikter mellan social och miljömässig hållbarhet. Begreppet socioekologisk stadsutveckling belyser behovet av att bättre integrera sociala och miljömässiga perspektiv i stadsutvecklingsprojekt.

Den empiriska delen av studien analyserar samskapande och socioekologiska hållbarhetsaspekter i planeringen och genomförandet av de aktiviteter som genomförts inom ramen för testbädden. Resultaten visar att samskapande under planeringsfasen främst ägde rum mellan IVL och Stockholmshem, medan hyresgäster inte var inblandade. Under implementeringsfasen inkluderades även företag som gavs möjlighet att i samarbete med IVL och Stockholmshem planera och genomföra test av sina lösningar och innovationer i Gröna Solberga. Hyresgäster i området involverades under genomförandet av en del av pilotprojekten. Under implementeringsfasen bildades också en lokal grupp för stadsodling, och den lokala hyresgästföreningen engagerades mer aktivt i Gröna Solberga genom ett projekt om delning mellan hyresgäster.

De samskapande processerna i Gröna Solberga har i praktiken skett när de olika aktörernas mål och kompetenser mötts dels i etablering och formering av testbädden som plattform och dels i planering och genomförande av pilotprojekt där olika lösningar testades. De samskapande processerna påverkades även starkt av olika regelverk och fysiska och tekniska förutsättningar som i praktiken satte ramverket för möjligheten att testa nya lösningar. Testbädden Gröna Solberga har utvecklats över tid vad gäller aktörernas roller och inflytande på processen. Vi drar slutsatsen att samskapande i långsiktiga testbäddar och living labs bör studeras som dynamiska processer där olika ramvillkor påverkar och förändrar samskapande och aktörernas roller över tid.

I Gröna Solberga breddade samarbetet mellan IVL och Stockholmshem testbäddens inriktning när IVL: s mer tekniskt inriktade miljöperspektiv kombinerades med Stockholmshems intresse för att utveckla bostadsområdet och inkludera sociala hållbarhetsperspektiv. En slutsats i studien är emellertid att det i praktiken varit begränsad explicit integrering av dessa perspektiv såväl som

analyser av samspelet mellan dem. En mer explicit idé om hur sociala och miljömässiga aspekter kan förstärka varandra i planeringen av pilotprojekt kunde ha bidragit till att säkerställa att miljöprojekt kan utformas för att också stärka sociala värden i området, och vice versa. Att mer aktivt engagera hyresgäster tidigt i planeringsprocessen, kunde också ha gett värdefulla insikter om hur de planerade aktiviteterna svarar på de utmaningar som hyresgästerna identifierar i sin vardag.

I skrivande stund är den ursprungliga finansieringen för testbädden via ERUF slut, vilket ytterligare kommer att påverka aktörernas engagemang, inte minst IVL. Den lokala hyresgästföreningen har i sin tur blivit mer aktiv och hyresgästerna kommer sannolikt att bli en mer central del av samskapandet i Gröna Solberga. Detta kommer i sin tur sannolikt att påverka testbäddens fokusområden framöver.

Denna studie av samskapande processer har finansierats av Mistra Urban Futures.

Introduction

This report presents the results from a research project analysing how co-creation to promote socio-ecologically sustainable urban development took place in a testbed called "Gröna Solberga" in a rental housing area in Southern Stockholm.

The Gröna Solberga testbed was initiated as part of a European Regional Development Fund project called "Grön Bostad Stockholm" that focused on regional low carbon economy. The initial objective of the testbed was to give an opportunity for small and medium-sized environmental technology companies to test and demonstrate sustainable solutions for the housing sector, as well as to increase their visibility. IVL Swedish Environmental Research Institute initiated the testbed project, and was joined by the municipal housing company Stockholmshem, who was interested in setting up a testbed in their housing area in Solberga. Small and medium-sized companies (SMEs) were invited to join the testbed to test their solutions primarily related to storm water, waste and recycling. Rental housing tenants were invited to different activities, mainly to cooperate with the companies in some cases.

In this report, we study how co-creation can take place in a testbed that is in an existing housing area. We study issues such as what aspects characterizes co-creation processes in Solberga, which actors are involved and what roles and influence they have during the testbed planning and implementation. We apply the concept of socio-ecological urban development to study how the co-creation processes contribute to an urban development where both ecological and social sustainability are considered and simultaneously promoted. We study, for instance, how different views of sustainability between the participating actors form and influence the testbed process and its results.

In the first chapter of the report, we review the existing research on co-creation and urban living labs as co-creation arenas, as well as socio-ecologically sustainable urban development in order to build a theoretical framework for our analyses. The later chapters focus on analysing the testbed during planning and implementation phases. After discussing the testbed implementation, we also present three SMEs' pilot projects that took place in the testbed, in order to exemplify the types of pilots that have been included in the testbed. Finally, we provide conclusions and lessons learned on co-creation for socio-ecological urban development in testbeds.

The study was commissioned by Mistra Urban Futures Stockholm NODE and carried out by IVL Swedish Environmental Research Institute between December 2018 and October 2019.

Co-creation for socio-ecologically sustainable development

Co-creation in urban development

The concept of co-creation is used in various contexts spanning from business (often related to customer insight and marketing), to public sector where it is often used in urban planning and public sector service development. Puerari et al (2018, p.4) provide two simplified definitions of types of co-creation: co-creation can mean making something together (e.g., product, service or process innovation), or it can mean learning something together (building new knowledge and networks through collaboration). Actual co-creation processes often combine making and learning (Puerari et al 2018 p.4). The concept of co-creation of knowledge is also used, and it further highlights the act of creating knowledge together.

In urban development and planning, the emergence of co-creation as a concept relates to the overall development that emphasises the need for increased cooperation between sectors, between public and private, and the involvement of citizens and citizen knowledge in decision-making. To respond to cities' pressing environmental, economic and social challenges, public sector actors increasingly see a need to open for both citizen participation and for different types of partnerships with private companies, knowledge organizations and civil society (see e.g. Puerari et al, 2018; Perjo, Fredricsson & Oliveira e Costa, 2016).

In policy discourse, the concept of co-creation is closely linked to innovation. Co-creation is considered a way to experiment and explore innovations between actors who may normally not work together (see e.g. Smas et al 2016). Developing new smart neighbourhood services in collaboration between city administrations, small service provider companies and citizens is an example of an urban development approach where an explicit co-creation approach is taken in order to find and innovative ideas (Perjo, Fredricsson & Oliveira e Costa 2016).

Urban living labs as co-creation arenas

Urban development projects where different types of actors are invited to make something or learn something together are often called urban living labs. Although the living lab concept as such stems from the technology industry's need for user input for marketing and product development purposes, it has increasingly been used when organizing and studying co-creational processes in urban development (Smas et al 2016). Typical of urban living labs is to focus co-creation of innovative solutions in real world environments (Puerari et al 2018). Experimentation, exploration and evaluation are further central characteristics of urban living labs (Smas et al 2016). Innovation testbeds involving various actors in real-world environment are often considered living labs as well, although testbeds do not, by definition, need to focus on co-creation. The Gröna Solberga testbed can be considered a type of living lab as it aimed to involve a variety of actors in testing solutions to sustainability challenges in a real-world environment.

Involving various types of actors is central to urban living labs and they often include public sector actors (such as municipal planners), knowledge institutions, private companies (including SMEs),

citizens and civil society organizations (Menny, Palgan & McCormick 2018; Puerari et al 2018). It is considered central to involve all actors early in the urban living lab processes to ensure influence from different types of actors (Menny, Palgan & McCormick 2018). In co-creation processes it is also considered central to include different kinds of knowledges of different actors, and for example recognise that the inhabitants of an area have knowledge of local everyday life practices.

Leminen (2013) divides living labs into four different types based on their main driving actors. Provider-driven and utilizer-driven living labs are coordinated top-down. In provider-driven living labs researchers use the living lab for developing new knowledge. In utilizer-driven living labs companies start living labs to develop and test their innovations. Enabler-driven and user-driven living labs are in turn organized bottom-up and based on validating grassroot level ideas. Enabler-driven labs can be for example coordinated by the public sector or NGOs to solve societal problems. User-driven living labs focus on local inhabitants and solving their everyday problems.

A Swedish mapping of living labs (Andersson, Ernits & Stoltz 2018) divides living labs into four categories based on their focus. Technically-oriented labs focus on developing or applying products or technical services based on cooperation and user involvement. Socially-oriented labs focus on social needs and solving societal challenges by bringing together researchers, politicians, municipal officials and local actors and inhabitants. Policy-oriented labs aim at reaching societal change by bringing together actors across sectoral barriers to experiment and evaluate policy solutions. Transition-oriented labs or transition labs aim to grasp societal challenges from different perspectives and combining technically- and socially-oriented labs.

Socio-ecological urban development

Sustainable urban development has for a long time been included in practically all Swedish cities' plans and it is common for cities to include sustainability as an overarching goal. During recent years, researchers have however started to point out that urban sustainability measures in cities exclusively focus on environmental sustainability while considerations of social sustainability aspects have been lacking (see e.g., Ström, Molnar & Isemo 2017; Tunstöm, Gunnarsson-Östling & Bradley 2015; Tunström 2017). In this chapter, characteristics of social sustainability are first discussed, and then followed by a discussion concerning the intersections of social and environmental sustainability, and the need for combining social and environmental considerations.

Social sustainability has gained more visibility in the Swedish planning discourse in recent years, but the understandings and applications of the concept still vary (Ström, Molnar & Isemo 2017; Tunström 2017). In general, social sustainability measures in urban planning focus either on solving social problems, or on improving and strengthening the positive qualities of a place, e.g., by strengthening the local community and local development by for example promoting local engagement and local identity or creating meeting places (Tunström 2017).

Social sustainability can be promoted both through the design of planning processes (e.g. participatory processes), and through their results (e.g. through more inclusive spaces as a result of a transformation process) (Lind & Mjörnell 2015; Tunström 2017). In terms of processes to promote social sustainability, the possibility to influence one's living environment is important. Ensuring that inhabitants can influence the decisions and plans that influence their environment is seen as a way of promoting social sustainability. Co-creation and public participation are considered to contribute to increased social sustainability both through increased democracy and through strengthened social cohesion (Tunström, Gunnarsson-Östling & Bradley 2015). The results of

urban development projects can, in turn, promote social sustainability if they for example provide new places for the inhabitants to meet or if they create employment opportunities for socioeconomically vulnerable groups in the area (Tunström 2017).

It is, however, important to note that citizen dialogues or a new physical meeting places do not automatically improve social sustainability (Tunström 2017). Social sustainability is place-sensitive, and to address social aspects in an area, knowledge is needed on, among other things, the existing socioeconomic structures in the area and the different inhabitants' access to services and social meeting places in the specific place (ibid). Citizen involvement and co-creation processes with citizens with different types of backgrounds are one way of including local knowledge in planning processes, and thereby to contribute to the developments better fitting the local conditions.

In addition to the need of improving the way in which social aspects and consequences for different groups are taken into consideration in urban development, there is also a need for better understanding of the linkages and potential conflicts between social and environmental sustainability (Tunström, Gunnarsson-Östling & Bradley 2015). Social and ecological sustainability can support one another, but they may also conflict with each other, for example if the potential social consequences of environmental measures for different groups are not analysed and addressed (Tunström 2017).

The concept of socio-ecological urban development ("socioekologisk stadsutveckling") has been used to highlight the need to better integrate social and environmental improvements in urban environments (Tunström, Gunnarsson-Östling & Bradley 2015). Socio-ecological urban development seeks ways to include social aspects in environmental projects, and environmental aspects in social projects (ibid). Socio-ecological urban development relates to the concept of environmental justice that considers aspects of conflict and power in the environment discussion. It emphasises the need for holistic approaches in addressing ecology and economy where policies contribute to just distribution of both environmental resources and negative environmental consequences between groups and generations at local, national and global levels (Hagbert et al. 2018).

Lack of consideration of social consequences in environmental sustainability projects risk resulting in socially unsustainable effects. An empirical study on energy renovations in rental housing has however shown that when connections between ecological and social aspects occurred in the studied projects, they did not stem from explicit ambitions, but instead occur as "positive externalities" that were not analysed or explicitly planned for (Persson 2018). In a Swedish context, increased rents after energy efficiency renovations in rental housing is a well-known example of environmentally sustainable projects that may result in socially unsustainable results and spatial injustice. Raised rents may force low-income tenants to move out of their homes, which in turn may lead to gentrification and segregation (see e.g., Stenberg 2015; Tunström 2017).

Citizen involvement in environmental projects is a practical example of how social and environmental sustainability can be linked, as citizens are given the possibility to influence their living environment while also engaging in improving environmental sustainability in their area (Tunström, Gunnarsson-Östling & Bradley 2015). The concept of social innovation has also become increasingly popular during recent years when describing different types of initiatives that meet social needs. There is no single shared definition of social innovation, but the approaches labelled as social innovation tend to focus on societal needs, co-creation between public, private and third sector, citizen involvement and empowerment and adapting solution to local preconditions (Gustafsson & Netz, 2018).

Practical examples of socio-ecological approaches mentioned by Tunström, Gunnarsson-Östling & Bradley include shared pools of tools and equipment which can decrease the need for private consumption and living space, and thereby have the potential of contributing to environmental sustainability. At the same time, the approaches can increase the possibility for meetings between inhabitants and build social contacts. Different types of shared spaces are also mentioned and can be used both to promote shared activities and to inform about sustainability issues or for demonstration projects. Other sharing projects such as cargo bike pools can also promote both environmental and social sustainability by providing environmentally-friendly transport on one hand, and on the other hand ensuring mobility options for inhabitants without access to private vehicles.

Analytical framework

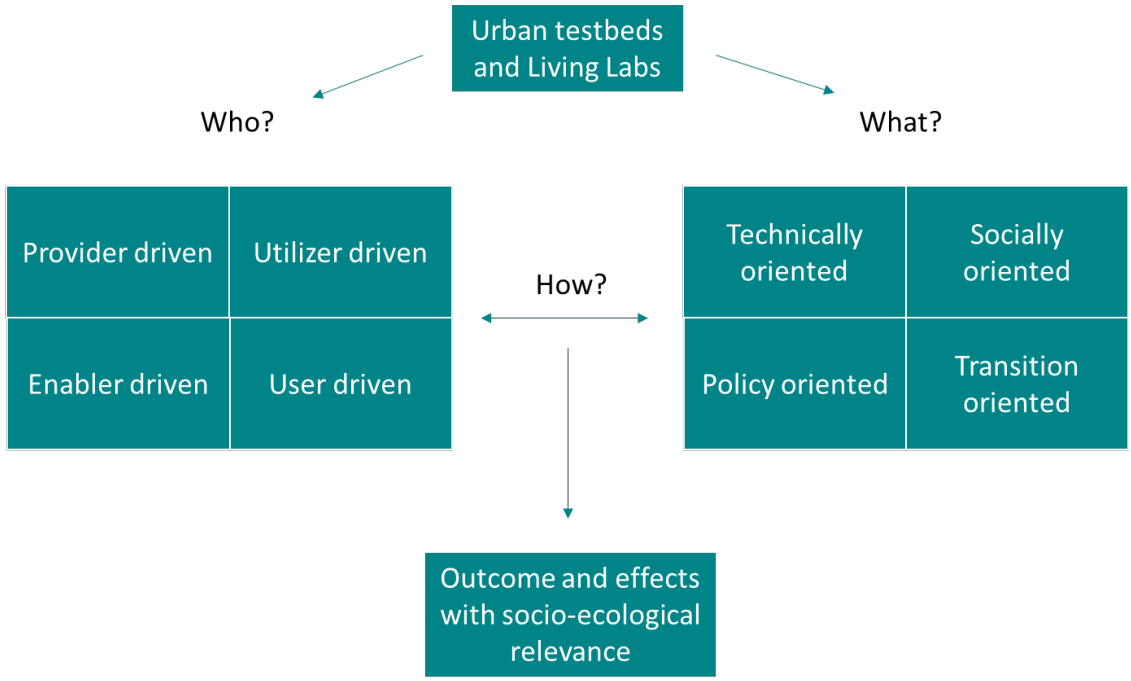
The initial theoretical review can be summarized into an analytical framework. The concept of co-creation is relatively well established in the literature. However, the opposite is the case of socio-ecological urban development. In particular, the concept of social sustainability is multifaceted and can have different meanings in different contexts. For example, it may relate to participation in decision-making and planning processes, social capital or social justice. In the empirical parts of this report, we take a broad approach to social sustainability and investigate what types of social aspects are taken into consideration in Gröna Solberga.

Important issues to study in the case of testbed Gröna Solberga are:

- What characterizes the co-creation processes in Gröna Solberga?
    - Who was involved in initiating and implementing the testbed?
    - What are the roles of the different actors? Which actors initiate processes and what influence do the different actors have on the planning and implementation of the testbed?
    - How are the different actors' perspectives and objectives contributing to the co-creation process?
- How are social and ecological perspectives considered and included in the planning and implementation of Gröna Solberga?
    - Are linkages, synergies and potential conflicts between goals identified and been made visible?

The analytical framework of the study is summarized in figure 1 below. We want to emphasize that social and ecological aspects can be considered in both the design of co-creation (who, what and how) within a testbed and that co-creation outcome and effects can have both social and ecological goals and consequences.

Figure 1. Analytical framework for studying co-creation processes in the Gröna Solberga testbed



Methods

We study the co-creation processes around innovative solutions during the different phases of the testbed's lifetime (initiation and implementation) and additionally focus on three SME pilot projects within the testbed as case studies. The empirical interview material of the study was collected between December 2018 and October 2019. It offers a good opportunity to study the evolution of the testbed and the pilot projects over time as well as to draw conclusions on the barriers and possibilities to co-creation between actors in testbed settings in rental housing areas.

The analysed data consists of semi-structured interviews with project leaders and project workers from IVL Swedish Environmental Research Institute, coordinators from the municipal housing company Stockholmshem, three SMEs involved in the studied pilot projects and a representative from the local branch of the Swedish Union of Tenants ("hyresgästföreningen"). Participatory observation has taken place during meetings and in two open house events for Solberga tenants in May and October 2019 where we have discussed Gröna Solberga with visiting tenants and participating SMEs who presented their ideas to the tenants. The material has been complemented by document studies consisting of, for instance, meeting minutes from meetings between the involved actors, written agreements and contracts between actors, and project plans. Content analysis methods were used to analyse the data in relation to the analytical framework.

The Gröna Solberga testbed is still being implemented at the time of writing this report, and the data used is only representing the relatively early stages of the testbed implementation, until October 2019.

Co-creation and socio-ecological urban development in Gröna Solberga

This chapter presents how co-creation took place in Gröna Solberga, and discusses the Gröna Solberga testbed from a socio-ecological urban development perspective. The first part focuses on the initiation and planning phase of the testbed. The second part discusses the implementation phase when various pilots were implemented. After that, we present three SME pilot case descriptions in order to provide a more in-depth description of how co-creation took place in three SMEs specific pilot projects that focused on waste (Bioteria), re-use workshops for sustainability (Refo) and aquaponics (Kretsloppsbolaget).

Initiation phase

In 2016, IVL received funding from the EU Regional Development Funds (ERDF) for a testbed as part of the larger cooperation project called Grön BoStad Stockholm. The aims of the Grön BoStad Stockholm were to create cross-sectoral cooperation with the goals to create growth in SMEs, contribute to regional low carbon economy and to decrease segregation. The Grön BoStad project included a work package that focused on creating testbeds for environmental technology companies within the housing sector and increase their visibility.

When planning for the testbed, IVL mapped other existing testbeds in the housing sector (see Karlsson et al 2017). From a co-creation perspective, the results of the mapping highlight the essential role of trust and division of risks between actors in testbeds in the housing sector. Open and innovative culture facilitated by transparent documentation were identified as success factors. The analyses of existing testbeds further show that the studied testbed had challenges in engaging the tenants, and some of them had instead focused on cooperating only with representatives from housing association boards who are responsible for energy issues. It however seems that the studied testbeds had primarily been established in owner-occupied housing cooperatives instead of rental housing areas where the preconditions for cooperating with tenants are different compared to owner-occupied cooperative housing.

During the summer 2017, IVL announced that it was looking for a real-estate owner who wanted to test solutions for sustainable housing. In the announcement, IVL defined the goals of the testbed as follows:

- Supporting the transition to low carbon economy by promoting the development of new technologies, processes and services
- Contributing to removing SMEs' growth barriers
- Increasing the visibility of new sustainable technologies, processes and services
- Making the testbed a long-term initiative that continues after the Grön BoStad Stockholm project is finalised

As the testbed was implemented with funds from ERDF, the goal formulations also needed to contribute to the overall aims of the ERDF Operational Programme, that in turn contributes to

reaching EU level goals. The three thematical goals in the ERDF Operational Programme for Stockholm region were related to strengthening research, technical development and innovation; increasing the competitiveness of SMEs; and supporting low carbon economy in all sectors (Stockholm County Administrative Board 2014).

The municipal rental housing company Stockholmshem was one of the real-estate owners who expressed interest to establish a testbed in its housing stock. According to the interviews, Stockholmshem was chosen by IVL because of its large property stock, and because it had experience of implementing sustainability projects in its other rental housing areas. Stockholmshem also had interest in establishing activities in one of its housing areas where not much development activities had taken place.

IVL had identified six thematic areas that they proposed for Stockholmshem to work with. Stockholmshem chose to focus on two of those (stormwater and waste). The process of preparing an agreement between IVL and Stockholmshem was longer than expected since it was found important to ensure that the agreements enabled pilot projects while at the same time ensuring that there would be no costs that would make Stockholmshem increase rents. The binding agreement also defined areas of responsibility. It stated that IVL would be responsible for the project at the testbed level, and each pilot project would have a separate agreement between the implementing SME, IVL and Stockholmshem where the SME would carry the main responsibility.

At Stockholmshem the initiative to join the project was taken by individual employees with interest in sustainability issues who wanted to build on earlier sustainability projects implemented in other suburbs. According to Stockholmshem, there had not been any development initiatives taken place in Solberga for a long time, and they wanted to use the project to make the area livelier and more attractive, while at the same time ensuring that rents are not increased. The company also saw the project as a way to find the green solutions that they identified they needed in Solberga and other housing areas built during the same time period. The goal was to get access to solutions that the company would need (for example related to storm water in cellars), but that have not yet been available at the market.

After agreeing to establish a testbed in Solberga, IVL and Stockholmshem developed a shared project plan for Gröna Solberga in late 2017. The project plan introduced a more social and place-based goal for the project that was added to the technical and economic goals of IVL's original project plan for Grön BoStad Stockholm (see bullet points above, page 14). The goal added was to "Contribute to developing the tenants' outdoors and indoors environment and thereby their comfort".

From a co-creational perspective, IVL had the biggest influence in defining the project during the initiation phase. The need for a testbed in the housing sector was identified by IVL, and IVL's own research was the basis of initiating the testbed. The ERDF Operational Programme and the EU priorities behind it acted as an important framework for this, as the testbed's goals needed to be formulated in a way that they would contribute to reaching the goals that were set at the programme level. However, the research-based and technology-focused perspectives were complemented by a more socially-oriented perspectives during the discussions with Stockholmshem.

During the initiation phase, bringing together the environmental sustainability perspectives of IVL and the social perspectives of Stockholmshem seemingly enabled a broader view of sustainability including both social and ecological issues in the formulation of project goals. The interconnectedness and mutual consequences of the social and environmental goals however do

not seem to have been closely discussed during the planning stage. From the socio-ecologic urban development perspective, it seems that the effects and potential contribution of the environmental technology pilots on social sustainability were not explicitly taken into consideration during the planning stage.

The principles of co-creation and socio-ecological urban development also emphasise the involvement of citizens early in the processes to ensure their democratic influence and that the planned actions respond to their needs and build on local knowledge and resources. In Gröna Solberga, the initiation phase did not involve the tenants of the neighbourhood in defining problems or needs to address. However, according to Stockholmshem, they attempted to take contact with the board of the local Union of Tenants early, but with limited success. The current chairperson of the association also notes that the previous board was not very active, and that the new board that was chosen in spring 2019 became more active in developing Solberga.

Implementation phase

Implementation of Gröna Solberga consisted of activities at testbed level and at the level of individual pilot projects where the SMEs' solutions were tested. Activities such as coordination, recruiting SMEs, overall planning, and PR and communications took place at the testbed level.

Coordination and planning

IVL, Stockholmshem and a PR company were involved in planning, coordination and communication at the testbed level. At the pilot project level when individual SME's solutions were tested, IVL and Stockholmshem worked together with SMEs to plan and implement the SMEs' pilot projects in the area. IVL was responsible for the overall coordination of the project and acted as the primarily contact to SMEs. Stockholmshem was responsible for contacts and cooperation with their tenants, and it was defined early in the project that contact with tenants should not take place directly by IVL or the SMEs without the involvement of Stockholmshem. Stockholmshem was also primarily responsible for establishing contacts and cooperation with external (often municipal) actors that were needed to implement pilot projects.

Regulatory frameworks functioned as important co-creation enablers and delimiters in Gröna Solberga, and they required involving and coordinating a variety of external actors. The interviewees note that pilot projects that imply physical change in the environment were difficult to implement because physical constructions on the ground, for instance, require involving a large variety of actors, such as the local water and waste management, traffic management or other parts of the city administration. Public procurement rules further influenced the possibility to test physical installations since Stockholmshem cannot legally commit to procuring the tested solutions after the pilot project ends. Therefore, the SMEs had to risk installing structures that later are not purchased by Stockholmshem and need to be removed. The co-operational and regulatory challenges related to testing physical installations might have contributed to non-technical and social projects being implemented instead, such as recycling workshops.

Internal cooperation and engaging employees and directors at different levels internally in Stockholmshem's organisation was time-consuming and dependant on individual employees' efforts of engaging other departments, directors and employees with different kinds of competences, perspectives, goals and areas of responsibility. Especially when physical changes are implemented in pilot projects in an existing rental housing area, very different kind of competences

and professional groups need to be convinced to be involved in the project and to see the benefits from participating in testing something new that adds to their regular tasks and might involve risks in areas they are responsible for.

Those involved in coordinating Gröna Solberga identified early that it was an organisational challenge to make different professional groups (e.g. social scientists and technical specialists) to understand each other's perspectives and to "speak the same language". Resources in terms of competent personnel with ability to address these challenges was essential. Meetings and discussions at different levels of the organisation were conducted on ongoing basis, taking up a large share of the responsible coordinator's time. This illustrates well that testing new sustainable solutions in existing housing areas does not only require co-creation between different types of actors and sectors, but new forms of co-creation and cooperation also need to be established internally within larger organisations.

In addition to the SME's pilot projects, both IVL and Stockholmshem linked other initiatives and projects to Gröna Solberga that were not funded with Gröna Solberga's project funding. Stockholmshem initiated a group for tenants interested in urban gardening and implemented the initiative under the umbrella of Gröna Solberga. IVL received funding for a project on sharing economy, and together with Stockholmshem decided to use Solberga as a pilot case for testing how tenants could share resources.

During the early stages of implementation, the local Union of Tenants or tenants in general were not involved in the planning and coordination between IVL and Stockholmshem, but a new board for the Union of Tenants was chosen in April and started actively to initiate own local projects such as transforming an empty local market square into a lively meeting place, and starting a group who repairs clothing together. The new board was contacted by IVL and Stockholmshem and asked to join the new sharing project, that would use Solberga as a pilot, in order to ensure that the tested sharing solutions respond to the tenants' needs. Through the sharing initiative, the board has also become more closely linked to the overall Gröna Solberga project.

In fall 2019, the local Union of Tenants representatives were also invited to a meeting between Stockholmshem and IVL to plan for further cooperation in Gröna Solberga. At the time of writing, the Union of Tenants was in the process of developing ideas on how their initiatives could be linked to Gröna Solberga and Stockholmshem. The chairperson considers that better cooperation between Stockholmshem and the Union of Tenants is needed in order to, on one side, ensure that initiatives fulfil tenants' actual needs, and on the other side ensure that initiatives do not only build on local enthusiasts' voluntary work which makes the initiatives vulnerable and dependent on individual tenants. According to Stockholmshem, they also see their own role as a facilitator who supports the tenants based on the tenants' needs.

Recruiting SMEs

Implementing the testbed was dependent on identifying and attracting suitable SMEs who wanted to test their solutions related to storm water and waste in an existing housing area. In addition to testing their solutions, the companies were provided media visibility by an PR agency. IVL could also finance verification projects for SMEs to for example calculate the climate effects of the SMEs' products. These studies were conducted by IVL or other consultancies with relevant competence.

IVL was responsible for marketing the project to SMEs and recruiting suitable SMEs. The criteria were that the companies needed to be small or medium-sized, located in the Stockholm region and

work with green urban development in the fields that were relevant to Gröna Solberga, i.e. stormwater and waste. There was no clear definition of what kinds of ideas would be considered "green solutions". The small amount of small and medium-sized companies particularly within the waste sector was a challenge and finding interested and suitable companies and recruiting them was more time-consuming than expected. IVL was responsible for identifying SMEs and initiating contacts, and IVL and Stockholmshem decided together which companies to work with.

Interviewees from both IVL and Stockholmshem note that establishing the testbed and getting pilots started took longer time than expected. This contributed to some of the initially interested SMEs to drop out as their time perspectives and planning horizons are shorter than those of big municipal companies such as Stocholmshem. It was challenging for small companies to take the risks that were needed in order to join the testbed.

Communication

PR and communication activities had a central role during the implementation phase. An external company was hired to make the testbed and the participating SMEs visible in media. The increased visibility for SMEs was considered an important selling point when attracting SMEs to the testbed. Visibility in local, national and international media was also later considered to internally increase the interest and commitment to the project at different decision-making levels at Stockholmshem.

The communication activities mostly focused on communicating in media, and slightly less on communicating with tenants locally. Information about Gröna Solberga was provided to the tenants on Instagram and in entrance halls of buildings. When the testbed was launched in late 2018, an open house event was organised for the tenants to inform about the planned pilot projects. In May 2019, another open house event was organised where SMEs that were implementing or planning to implement projects in the area had the possibility to meet tenants and the tenants received information about planned activities. In October 2019, another open house event presented current SME activities as well as the urban gardening initiative and the sharing initiative. The events were reported on in local media.

Stockholmshem's representative notes that it was challenging to communicate the goals and idea behind the Gröna Solberga testbed to the tenants and make them understand the project. This can be related to the testbed being formed based on the activities the involved SMEs want to conduct. Early in the project, were there were no SME project established yet, the actors had difficulties in explaining to tenants what the testbed would mean. The actor structure of IVL, Stockholmshem and SMEs was also found difficult for many tenants to grasp. The interviewed representative for the local Union of tenants notes that some tenants experienced lack of information about the project as a problem. Before they were informed by the new board of the Union of Tenants in summer 2019, IVL and Stockholmshem did not know or have access to local information channels such as local Facebook groups or the Union of Tenants' Facebook groups that could be used to better communication with tenants, as these existing channels are already actively used.

Co-creation for socio-ecological urban development during implementation

In summary, IVL and Stockholmshem remained the main co-creation actors during the implementation phase. Establishing co-creation and involving the right persons in Stockholmshem's own organisation was crucial and time-consuming. Co-creation with the SMEs

during the implementation phase took place in form of negotiating and exploring ways to test each SME's ideas in real-life environment where various technical and administrative barriers set the framework conditions.

The solutions that the companies wanted to develop in the testbed mainly consisted of solutions that have not yet been market-launched on a large scale or tested in an existing residential area such as Solberga. Co-creation processes in Gröna Solberga did not include for example identifying needs and potential solutions together. Instead, co-creation took place when the solutions were tested and applied to new use and new environment. Co-creation processes was formed when the SMEs' solutions met with the physical rental housing area with tenants, regulatory, legal and property technical issues. IVL's and Stockholmshem's respective expertise were brought together to respond to the challenges that arose when the solutions were to be tested in this new environment.

During the implementation stage, the tenants' role was primarily to participate in activities implemented in the pilot projects. They were not involved in choosing which pilots would be implemented but could participate in activities initiated by SMEs, for example workshops to re-use textiles. The urban farming initiative also invited tenants to grow vegetables together. Based on discussions with tenants during the open house events, as well as interviews with the representative of the local Union of Tenants, tenants were primarily positive to the project even if they were not involved in its planning, and in some cases found communication about it to be lacking. As the implementation phase proceeded, the local Union of Tenants became more active and started to get involved in Gröna Solberga, for instance through their involvement in a project on sharing between tenants that was initiated by IVL and Stockholmshem with other funding sources, but that was linked to Gröna Solberga.

SMEs were also mostly involved in their own activities and were not involved in decision-making at testbed level. Some of the SME representatives note that they had hoped for more possibilities for co-creation and networking between the different participating SMEs at the testbed level, instead of SMEs in most cases only working in their own separate pilot project.

IVL's environmental sustainability goals and the goals related to SMEs' growth (also stemming from the goals set by the ERDF programme) and the sustainability perspectives of Stockholmshem were combined during the implementation stage. Co-creation with Stockholmshem contributed to IVL's environmentally and technically oriented goals to be completed with Stockholmshem's interest in the social development of their housing area. The partly differing perspectives of IVL and Stockholmshem become visible when comparing these actors' views on which pilots to implement and which of the implemented pilots are considered successful. Stockholmshem was less interested in purely technical projects that were not visible to their tenants, whereas more technical projects with potential from an environmental sustainability perspective were considered more relevant by IVL who, as the project leader, also was responsible for reaching the innovation and SME goals that stemmed from the ERDF programme's aims. In the interviews, an example of a green-blue roof project was mentioned, where a roof garden would have been established, but where tenants would not have access to it for technical and safety reasons. Together with technical challenges, this was a reason for why Stockholmshem did not consider the project interesting, and it was not implemented. Projects that directly involved tenants and had a more explicit social focus were considered more valuable for Stockholmshem. For instance, a project where tenants were invited to workshops on recycling ("Refo") is mentioned in an interview as a good project from Stockholmshem's perspective.

However, even if the involvement of the two actors with different sustainability focus areas contributed to combining environmental and social sustainability when implementing the testbed, there was not explicit considerations of their interplay during the implementation stage. More careful consideration of social and environmental aspects in planning the pilots could have been useful to ensure that environmental projects can be designed to also strengthen social values in the area, and vice versa. More active involvement of tenants early in the project could also have given the testbed access to tenants' knowledge that could have been used to ensure that the planned activities respond to the challenges the tenants identify in their everyday life.

At the time of writing, the project funding from ERDF had ended, but the plan was to continue the work with Gröna Solberga. New companies are invited to join, but separate funding will need to be applied for case by case if funding is needed. IVL also planned to start a network with the involved companies for matchmaking and mutual learning. At the time of writing, Stockholmshem was still planning for the next steps of the initiative together with the other actors. They found that the process to make the concept known among tenants has been time-consuming, and that Gröna Solberga had become an established concept that the tenants know about and were positive towards. Stockholmshem therefore planned to continue the work with Gröna Solberga in different forms. The local Union of Tenants also planned to engage more with Stockholmshem and take lead in finding stable forms of cooperation when implementing different types of activities, also relating to the sharing project.

Case studies on pilot projects in Gröna Solberga testbed

Three SMEs' pilot projects are described below. The SME case studies describe the co-creation processes in three examples of pilot projects and discusses the Gröna Solberga testbed from the participating SMEs' perspectives.

Bioteria

Bioteria is a biotech enterprise with 35 employees. In Gröna Solberga, they installed a waste disposal house for tenants' waste, where biological micro-organisms are used to make the waste containers odourless. The micro-organisms replace traditional chemicals and ozone, and the building's electricity need is covered by solar panels on its roof.

Bioteria's solution was already being used in public facilities, such as kindergartens, but it had not been tested in housing areas where needs for waste management are different from those in public facilities. Bioteria's Gröna Solberga project plan also includes investigating the possibility to use the micro-organisms to turn organic waste into planting soil that tenants could use for urban gardening. Furthermore, testing remote controlling the facility is included in the project plan. The planting soil pilot and activities related to sensors are planned to take place in fall 2019 and had not taken place at the time of writing.

Learning about applying their solution in housing areas was one of the main reasons for Bioteria for getting involved in the testbed. They had experienced a lack of available testbeds and they considered Gröna Solberga as a good opportunity to get a physical location to test their solution, and to get better understanding of how their solutions can be used in housing areas. They were also interested in possibilities to network with other environmental technology SMEs.

Planning of the pilot project took place in meetings between Bioteria, IVL and Stockholmshem. IVL's role was to coordinate the process, call for meetings and ensure progress. IVL functioned as Bioteria's main contact point and as a link between Bioteria and Stockholmshem. Establishing the waste disposal house took longer than expected, but as Bioteria had previous experience on working with large public organisations and in constellations with many different actors, it was prepared and able to adapt. They think that for a smaller company, it would have been more difficult to handle the delays.

Finding a suitable location for the building was time-consuming. The local public water and waste management company needed to be involved in the discussions since they needed to ensure that the building location and design is accessible for their waste disposal personnel. Furthermore, negotiations were needed to set out which actor would for example be responsible for the costs from paving the area with asphalt which needed to be done. The original plan for the house's location was also changed because the planned spot was used by the tenants for sunbathing and coffee breaks. Bioteria visited the site themselves, but also received information about the place-specific preconditions and tenants' views by Stockholmshem's local personnel with more knowledge of the conditions in the area.

Bioteria's building could be in place until the end of the project, and afterwards Stockholmshem needs to find a public procurement solution as it had not been able to procure the building during the project period because of public procurement rules of the EU project. According to Bioteria, it was a risk for the company to invest in establishing a test facility that might need to be removed afterwards, and where there were no guarantees of continued business with the client (Stockholmshem). They note that if their company was smaller, they would probably not be able to get involved. At the time of writing, Bioteria was working on finding a solution with Stockholmshem that would also imply similar waste disposal buildings being installed in other locations by Stockholmshem.

According to Bioteria, the biggest benefit from participating in Gröna Solberga was the possibility to learn how their solution could function in housing areas, and to get feedback and information from Stockholmshem concerning their needs in housing areas and about technical issues from IVL. Because the waste disposal building was used by tenants in their everyday life, Bioteria also received feedback from tenants concerning the functioning of the solution. The contacts with the tenants have taken place when Bioteria's personnel has visited the site, as well as via Stockholmshem's technicians who are in contact with tenants in their daily work, but no formal mappings or questionnaires had been conducted at the time of writing. According to Bioteria, the tenants have been positive to the new waste disposal building. Bioteria also finds that their visibility in media has clearly increased because of the PR activities in the project. Their expectation on interaction and networking with other companies has in turn not been fully fulfilled.

Refo

Refo is a small company working with education on sustainability and circularity, and selling products based on recycled materials. In Gröna Solberga, Refo organised three tenants' workshops to discuss sustainability, as well as to remake and fix clothes and other products.

The company joined Gröna Solberga because it wanted to develop its communication strategy and better understand their potential customers. The aim was to learn more about their potential clients who could be interested in buying Refo's recycled products. Refo also utilised a PR agency affiliated with Gröna Solberga who helped Refo with customer analysis and social media

marketing. Refo had had difficulties in communicating the value of their product to potential clients and considered Gröna Solberga as a good possibility to understand how and what kinds of products are demanded in the market. A handful of tenants participated in their first two workshops, but the number of participants increased to 35 people in the third and final workshop.

Refo's activities in Solberga were planned during meetings between Refo and IVL. Stockholmshem was not closely involved and IVL functioned as a facilitator and link between Refo and Stockholmshem. Invitations to tenants were distributed in entrance halls in the buildings and the workshops were advertised on instagram. Refo representatives however found that lacking communication between the company, IVL and Stockholmshem had negative influence on the efficiency of their project. They also consider that the roles of the different actors could have been more clearly defined earlier in their pilot project. The different time perspectives between a small company and the big organisations of IVL and Stockholmshem was an additional challenge, and Refo found that it took too long time for IVL and Stockholmshem to conduct agreed activities. This was problematic for the small company with few involved employees whose ability to pay themselves their own salaries were dependent on the company's progress.

According to Refo, the main benefit for them in Gröna Solberga was networking with individuals who are interested in sustainability issues. They note afterwards that as a very small company, more practical help with developing social media presence would likely have been more useful than the customer analysis that was conducted by the PR agency. Refo also would have preferred the testbed to have more opportunities for co-creation between the participating small and medium-sized companies who then could create and test new ideas together. They consider that more developed internal communication and transparency of the different companies' activities could create a feeling of community and common goals between the participating companies.

Kretsloppsbolaget

Kretsloppsbolaget is a small company that have developed a concept for growing fish and vegetables in residential areas. In Solberga, Kretsloppsbolaget designed and built a demo plant for growing fish and vegetables based on aquaponics. The aquaponic plant consists of fish tanks with *Niltilapia* and three different types of growing beds for growing vegetables and spices such as basil and coriander.

The initial contacts and ideas for developing a cultivation plant adapted for residential areas were based on personal networks between Kretsloppsbolaget and project managers at IVL. An important base for the concept has been to utilize existing, heated facilities. The idea is based on the potential in using energy in existing premises and buildings more efficiently in many residential areas. The project therefore addresses several environmental and climate related challenges as well as a social component when the idea is that the tenants will run the facility.

The work on investigating the prerequisites for an innovation project began in winter 2018. Several practical challenges had to be addressed, such as identifying a suitable basement space and adapting it based on the requirements of the facility. This involved access to heat, electricity, ventilation, water and light. It took time to handle the practical challenges and a caretaker at Stockholmshem with interest in sustainability issues had a key role in making the project possible and resolving the challenges. The plant was completed in February 2019 and cultivation began at the end of February/March same year.

An important part of the concept was also to engage and educate tenants so that they could eventually take over the operation of the facility. Initially, it was difficult to get tenants interested - the company recieved support contacting tenants by Stockholmshem - and a group of interested and engaged tenants was formed. Kretsloppsbolaget then arranged training sessions for the resident group to build knowledge of how the facility can be serviced. There has been great dedication from the involved group of residents, and Kretsloppsbolaget worked with the operation of the facility together with the group during spring and summer 2019.

Kretsloppsbolaget received technical knowledge support to develop and build the facility as well as knowledge support regarding fish farming via IVL. However, a challenge has been to develop a sustainable business model for small-scale aquaponic plants. Questions have been: How should the offer be designed? Who are the customers? What is their willingness to pay? How should fish and vegetables be distributed to customers?

Potential customer groups identified by the company are housing companies such as Stockholmshem or housing cooperatives. Also, schools and school kitchens could, in addition to their own production of food, use this type of facility in educational activities. Restaurants could also be a potential market.

In parallel with the work on the operation of the plant, Kretsloppsbolaget has worked to market their solution to different target groups. They have for example developed their website to make it a more efficient marketing channel. The aquaponic plant in Solberga has generated a great deal of media interest both locally and nationally and a film has been produced and published on Kretsloppsbolaget´s webpage. The media interest has been driven by marketing efforts through the project Grön BoStad Stockholm.

The aquaponic plant was one of the first innovation projects initiated and has therefore been important for establishing Gröna Solberga as a testbed and generate attention both externally and internally, especially in Stockholmshem's internal organization. The project also generated a great deal of media interest, which has helped to increase the interest for the testbed.

For Kretsloppsbolaget, the expected results of the project have been to:

- Develop knowledge on how a facility can be built and commissioned
- Develop knowledge on how to optimize ongoing operations and make sure plants and fish are doing well
- Develop knowledge about the potential market and how a business model can be designed
- Generate attention and publicity about the plant and market it to interesting customer groups
- Explore methods for building commitment and working with training towards residents in the area so that they eventually can take over the operation of the facility.

Kretsloppsbolaget benefited above all from the media attention that the project generated, and the company received market exposure that would not have been possible without the collaboration with IVL and Stockholmshem. The fact that well-known organisations such as IVL and Stockholmshem are behind the project gives Kretsloppsbolaget's concept legitimacy. At the same time, the project gave Kretsloppsbolaget knowledge about how to collaborate with a large housing company and how to develop a concept for residents to take over operation of a facility. The technical support from IVL was also considered valuable. However, more effective support would have had to include more concrete support for developing a business model. At the time of

writing, the project is still running and discussions are ongoing about how the plant will be continued in Solberga.

Conclusions

In this chapter, we summarise the main conclusions from the analyses of co-creation for socio-ecological urban development in Gröna Solberga. Firstly, we discuss the co-creation processes in Gröna Solberga, and present lessons learnt concerning how co-creation was organised. Secondly, we discuss how social and ecological sustainability aspects were integrated in Gröna Solberga.

The Gröna Solberga testbed as a dynamic co-creation process

Gröna Solberga can be analysed based on the two types of living lab categorisations presented in the literature review by Leminen (2013) and Andersson, Ersnits & Stoltz (2018). They divide living labs into different types based on type of actors initiating and driving the process forward (Leminen 2013) and based on what kinds of activities the living labs focus on (Andersson, Ersnits & Stoltz 2018) (see page 8). Gröna Solberga has characteristics of various categories in both the actor-wise categorisation and the focus area categorisation. Both the actors' roles and the focus areas have also developed and transformed during the Gröna Solberga development process.

Gröna Solberga was originally initiated by a research institute as a "provider-driven" lab with a focus on technical solutions in the areas of stormwater, waste and recycling, an orientation derived from an external and market analysis of existing testbeds. As Stockholmshem joined the process, the project plan was complemented by goals that were more based on the needs of this specific actor in this specific area to solve societal challenges, going towards a more "enabler-driven" approach. Co-creation in Gröna Solberga took place primarily between IVL and Stockholmshem in the planning stages, and between IVL, Stockholmshem and SMEs in later stages. During the early stages of Gröna Solberga, tenants' influence was very limited, but at the time of writing the local Union of Tenants board was taking a more active role aiming to link its activities with those of Gröna Solberga and Stockholmshem. If the Union of Tenants succeeds in bringing its issues on the agenda, Gröna Solberga may in the future also get more characteristics of a "user-driven" living lab that builds on local inhabitants' everyday problems. IVL's role is in turn expected to decrease as the ERDF project funding ended, although Gröna Solberga continues beyond the original ERDF project.

Analysed in terms of Leminen's categorisation of living labs into provider-driven, enabler-driven, utilizer-driven and user-driven, Gröna Solberga living lab is not a stable entity that can be placed into one category following the non-dynamic categorisations. Instead, we conclude that real-life environment living labs such as Gröna Solberga that take place over a longer period need to be considered and studied as dynamically changing processes where different actors' roles and influence evolves over time. Co-creation processes are also strongly influenced by the type of solutions being tested, which can also vary over time.

In the co-creation literature and research, focus is often on co-creational methods (e.g. workshops or similar) and how those contribute to co-creating new products or knowledge. In Gröna

Solberga, practical tools and methods for co-creation were not central. Instead, in Gröna Solberga the co-creation takes place when the different actors' goals and competences meet in a real-life context where different regulatory and technical limitations set the framework. Specific methods and tools are not used in a systematic way or considered important.

In Gröna Solberga, the involved SMEs already had concepts and solutions they wanted to test, and there was no co-creation process that would, for example, invite tenants to develop new innovative solutions with SMEs, IVL's researchers and Stockholmshem. Instead, the practical co-creation in Gröna Solberga took place when different actors' (primarily IVL, Stockholmshem, SMEs) differing goals and competences met in the context of an existing housing area, where different regulatory and technical limitations set a framework. When the SMEs' solutions were planned to be tested in the new context of an existing housing area, knowledge from the SME, IVL's scientific and technical knowledge and Stockholmshem's local knowledge and competence on technical aspects and various regulations were brought together in order to investigate how the testing could be implemented. Practical co-creation took place in the meeting of these different types of knowledges and competences. A conclusion from the study is also that there is often an important influence of differing competences and organizational structures within (as well as between) organisations on co-creation processes. In practice, managing internal organizational structures and different competencies can be an extensive task.

Tenants were involved in the execution of the pilot projects, but not in planning - at least until the new local Union of Tenants board started to actively engage. The co-creational aspects of Gröna Solberga could have been strengthened by bringing together the SMEs and tenants to co-create at the level of testbed from the beginning, and for example bringing them together to discuss what kinds of challenges needed to be solved in Solberga, and what kind of solutions could be developed to respond to those needs. Allowing more co-creation between SMEs who now worked separately in their own projects also could have brought about new ideas and cooperation forms.

Studying Gröna Solberga further emphasises the need for co-creation and cooperation within organisations, as a prerequisite for co-creation with other actors. Especially large organisations with different types of competences, interests and mandates need to continuously communicate with and engage both directors and employees in order to ensure that they share a common understanding of priorities and are willing to test new ideas beyond their everyday work.

The study has also highlighted the challenge when small companies work with large organisations with different time perspectives. The processes in Gröna Solberga have been time-consuming for all actors and some small companies have not been able to follow through. It has been a major challenge to find SMEs that are prepared to take the risk and invest the time and energy required. There is a major business risk especially for smaller companies to prioritize innovation activities and involvement in co-creation processes in testbeds like Gröna Solberga, where the larger actors running the testbeds have longer time perspectives and more time-consuming processes of internal coordination and communication.

Integrating social and ecological sustainability perspectives in Gröna Solberga

In terms of the content-wise focus of the testbed, Gröna Solberga should be seen as a dynamic process, where the involvement of different actors over time changes the testbed's focus. Referring to Ersnits & Stoltz (2018) categorisation of living labs based on their focus areas into technically-

oriented, socially-oriented, policy-oriented and transition-oriented labs, Gröna Solberga had characteristics primarily of a "technically-oriented" lab and "socially-oriented" lab. "Transition-oriented" labs bring together technical and social solutions, and Gröna Solberga could also be considered as a type of transition-oriented lab. However, we conclude that the perspectives are primarily handled "side by side" instead of integrated in a systematic approach throughout the process of building up the testbed as well as designing individual pilot projects.

When it comes to the testbed's focus areas, the co-creation between IVL and Stockholmshem complemented IVL's initially technically-oriented approach with Stockholmshem social focus as a public rental housing company. From the perspective of combining ecological and environmental sustainability consideration and striving for socio-ecologically sustainable urban development, co-creation between IVL and Stockholmshem contributed to a more holistic approach. Stockholmshem's social sustainability interest added to IVL's focus on environmentally sustainable technical solutions that in turn was derived from the goals of the EU programme that financed IVL's involvement in the testbed. At the time of writing, the testbed is no longer receiving EU financing from the ERDF programme, which may also influence its future focus areas, as the testbed no longer needs to aim at reaching the SME growth and low carbon economy goals set by the programme.

However, interplay and potential conflicts of social and environmental goals in Gröna Solberga and the associated pilot projects were not analysed and explicitly taken into consideration neither in planning nor in implementation. The possibility of reaching the testbed's goals could have been strengthened by acknowledging and planning for how, for instance, the environmental technology-oriented pilots could be designed to contribute to strengthening the social values in the area. Instead of implementing social and environmental projects separately, a more systemic approach is needed that looks at how social and environmental sustainability can be strengthened during all stages, i.e. during planning and implementing projects.

Here co-creation and early influence of tenants on pilots taking place in their everyday environment is an important element. Early involvement of tenants can both ensure that the needed local knowledge can be included in planning different projects, and to ensure local democracy and the possibility to influence. More active involvement of tenants would also enable building on existing local structures and social networks and, for instance, finding the right communication channels that are already used by the tenants. Due to inactive previous board of the local Union of Tenants, Stockholmshem did not engage with them early in the project, but it could have been beneficial to search for other forms of cooperation with tenants when the connection with the union was not possible to establish, e.g. in form of tenant representative participating in meetings. At the time of writing, a new board of local Union of Tenants has become active and a process of finding forms for cooperation between them and Stockholmshem is ongoing, although, no conclusions on the results can yet be drawn.

Co-creation in Gröna Solberga as a learning process

Overall, Gröna Solberga has already seen a series of transformations during its first year of operation. Gröna Solberga has been a dynamic process both in terms of actors involved and their roles, and in terms of focus areas.

Gröna Solberga will continue to evolve as the roles of the involved actors, and thereby the focus areas, change. Gröna Solberga has been a learning process for both IVL and Stockholmshem, and both organisations acknowledge that the processes have taken longer time than expected. At the

time of writing, the ERDF funding that was used to initiated Gröna Solberga has ended which means that the goals set in the initiation phase no longer have a direct influence on the process.

Co-creation between IVL and Stockholmshem has given both organisations new knowledge on the possibilities and challenges that need to be tackled when implementing a testbed and innovation projects to test new green solutions in existing housing areas. The complexity of co-creation between a research institute, a public housing company, SMEs and rental housing tenants in this context has also been highlighted in this report. As noted, the co-creation between these actors also enabled a broader perspective on sustainability, where both social and environmental perspectives where included. From a learning perspective, the testbed has also benefited the SMEs as it has provided them with experience on how to work in collaboration with a large housing company, a research organisation and in some cases also tenants to develop and implement new solutions in existing housing environments. The experience from Gröna Solberga has shown that there is a potential to co-create sustainable solutions in this complex context and that each of the involved actor contribute in the process.

More efforts are however still needed on how to practically analyse and take into consideration the interlinkages and potential synergies and conflicts between the environmental and social goals in planning and implementation. From a co-creational perspective, closer co-creation with tenants already in planning stages, and between SMEs, could also be beneficial for the future development of the testbed.

One of the original goals for Gröna Solberga was to establish it as a testbed for SMEs that will continue to live on after the end of the project funding. At the time of writing, Gröna Solberga seem to have become a platform that will continue to be active. After the initial stages with limited involvement of tenants, Gröna Solberga has now also evolved into a platform for Stockholmshem for developing closer cooperation with the local Union of Tenants and other tenants. It is also still possible for IVL (or other research organizations) to continue test and demonstrate solutions in Gröna Solberga and build on the relationships and structures that have been established.

References

Andersson, L., Ernits, H. & Stoltz Eh, A-K. (2018). Från living labs till transition labs - En forskningsöversikt och kartläggning av innovationsmiljöer för hållbara städer. Vinnovarapport VR 2018:3. Available at: https://www.vinnova.se/contentassets/f7b65278f6274c11a2ad5d865896073d/vr_18_03.pdf

Gustafsson, F. & Netz, A. (2018). Social innovation i Sverige. Kartläggning av ekosystemet för social innovation. Vinnova rapport VR 2018:1. https://www.vinnova.se/contentassets/57040657589945c2b86c356f6d6b5d4f/vr_18_01t.pdf

Hagbert, P., Finnveden, G., Fuehrer, P., Svenfelt, Å., Alfredsson, E., Aretun, Å., Bradley, K., Callmer, Å., Fauré, E., Gunnarsson-Östling; U., Hedberg, M., Hornborg, A., Isaksson, K., Malmaeus, M., Malmqvist, T., Nyblom, Å., Skånberg, K. & Öhlund, E. (2018) Framtider bortom BMP-tillväxt. Slutrapport från forskningsprogrammet 'Bortom BNP-tillväxt: Scenarier för hållbart samhällsbyggande.' KTH Skolan för Arkitektur och Samhällsbyggnad, 2018.

Karlsson, A., Adolfsson, I., Lätt, A. & Strandberg, J. (2017). Erbjudande och erfarenheter från befintliga testbäddar inom bostadssektorn. En rapport från projektet Grön BoStad. IVL rapport Nr C 247. Maj 2017. https://www.gronbostadstockholm.se/wp-content/uploads/sites/15/2017/09/Testb%C3%A4ddsinventering-2017-Gr%C3%B6n-BoStad-Stockholm.pdf

Leminen, S. (2013) Coordination and Participation in Living Lab Networks. *Technology Innovation Management Review*, 3(11): 5-14

Lind, H. & Mjörnell, K. (2015) Lärdomar och framtida forskning. In H. Lind & K. Mjörnell (Eds) (2015) Social hållbarhet med fokus på bostadsrenovering – en antologi. Sustainable Integrated Renovation Report 2015:4. Pp.

Menny, M., Palgan, Y.V., McCormick, K. (2018) Urban Living Labs and the Role of Users in Co-Creation. *GAIA - Ecological Perspectives for Science and Society*, Volume 27, Supplement 1, 2018, pp. 68-77(10)

Perjo, L., Fredricsson, C. & Oliveira e Costa, S. (2016) Public-Private-People partnerships in urban planning. Baltic Urban Lab Working Paper no 1.

Persson, T. (2018). Mot en socio-ekologisk stadsutvecklingsprocess. En studie av potentialen för social och ekologisk hållbarhet vid energirenovering och stadsutveckling i miljonprogrammets bostadsområden. Masteruppsats i tillämpad klimatstrategi. Lunds universitet.

Puerari, E.; de Koning, J.I.J.C.; von Wirth, T.; Karré, P.M.; Mulder, I.J.; Loorbach, D.A. (2018) Co-Creation Dynamics in Urban Living Labs. *Sustainability* 2018, *10*, 1893.

Smas, L., Schmitt, P., Perjo, L., Tunström M. (2016) Positioning urban labs – a new form of smart governance? Conference publication. REAL CORP 2016 – SMART ME UP! How to become and how to stay a Smart City, and does this improve quality of life? Proceedings of 21st International Conference on Urban Planning, Regional Development and Information Society.pp. 919-923. https://repository.corp.at/179/

Stenberg, J. (2015) Medskapande renovering. In H. Lind & K. Mjörnell (Eds) (2015) Social hållbarhet med fokus på bostadsrenovering – en antologi. Sustainable Integrated Renovation Report 2015:4. pp. 77-88.

Stockholm County Administrative Board (2014) Operativt program inom målet investering för sysselsättning och tillväxt. https://www.lansstyrelsen.se/download/18.6ae610001636c9c68e57c81/1527081574820/Operativa%20regionalfondsprogrammet%20Stockholms%20l%C3%A4n%202014-2020.pdf

Ström, L., Molnar, S., Isemo, S. (2017) Social hållbarhet ur ett samhällsplaneringsperpektiv - en kunskapsöversikt. Mistra Urban Futures Rapport 2017:4.

Tunström, T., Gunnarsson-Östling, U., Bradley, K. (2015). Socioekologisk stadsutveckling – Begrepp och lokal praktik. Arkitektur Förlag AB, Stockholm

Tunström, M. (2017). Social hållbarhet och stadsutveckling. Det politiska, det praktiska och den byggda miljön. Arkus skrift no 76.

IVL Swedish Environmental Research Institute Ltd.
P.O. Box 210 60 // S-100 31 Stockholm // Sweden
Phone +46-(0)10-7886500 // www.ivl.se

Mistra Urban Futures strives towards Realising Just Cities which are Accessible, Green and Fair.
This is achieved through transdisciplinary co-production and comparative urban research at
Local Interaction Platforms in Cape Town, Gothenburg, Kisumu, Sheffield-Manchester and Skåne.
It is funded by the Mistra, the Swedish Foundation for Strategic Environmental Research,
the Swedish International Development Cooperation Agency (Sida), and a Gothenburg consortium.

MISTRA URBAN FUTURES
Postal address: Chalmers University of Technology, SE-412 96 Göteborg, Sweden
Visiting address: Läraregatan 3, Göteborg, Sweden
www.mistraurbanfutures.org

MISTRA URBAN FUTURES

CONSORTIUM: CHALMERS UNIVERSITY OF TECHNOLOGY | CITY OF GOTHENBURG | IVL SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE | REGION VÄSTRA GÖTALAND
THE COUNTY ADMINISTRATIVE BOARD OF VÄSTRA GÖTALAND | THE GÖTEBORG REGION ASSOCIATION OF LOCAL AUTHORITIES (GR) | UNIVERSITY OF GOTHENBURG