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Deliverable 7.1

Report on baseline, ambition & barriers for Gothenburg lighthouse interventions

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Task:	T7.1: Elaborating baseline, ambition and barriers for all GOT lighthouse interventions
Lead Beneficiary:	JSP
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Disclaimer

Executive Summary

This Deliverable reports on baseline, ambition and barriers for Gothenburg lighthouse interventions. Its aim is to provide a precise and realistic specification of ambitions, activities and planning for each of the interventions planned in Gothenburg LHC. The deliverable was developed in parallel and in close cooperation with activities in WP1 on the extraction of requirements for the 5 Transition Tracks, including baseline definition of citizen energy and mobility behaviour, along with setting up of the monitoring principles and early business modelling development.

The report has been assembled with contributions from and in dialogue with each of the Task leaders in the Gothenburg consortium. During the development of the document comparisons have been made between reported ambitions and the ambitions originally set out in the project proposal/DoA in order to highlight any major discrepancies that may have materialised.

The report addresses the following audiences:

- Stakeholders in the Gothenburg ecosystem as it provides a detailed overview of the solutions that will be implemented by each of the partners;
- Stakeholders in the demonstration districts as it provides them with overview of the solutions and on how local stakeholders will be involved;
- Project partners in the other lighthouse and follower cities;
- Broader public interested in the details of the demonstration.

The Deliverable will facilitate the common understanding of the demonstration activities and the action plan foreseen within local ecosystems as well as between LH and follower cities. The detailed and updated descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this Deliverable will allow the Steering Committee of the project to assess the current status and compare with what is stated in the DoA, ensuring that quality assurance and control aspects are covered and that appropriate mechanisms to identify, anticipate, communicate and mitigate potential risks and deviations in the project may be activated.

The structure for the three Deliverables D5.1, D6.1 and D7.1 were also developed with a joint approach (together with Nice and Utrecht) amongst LH which has enabled transversal conclusions whilst giving emphasis to the Gothenburg context.

This report, thanks to its content of detailed information concerning the planning and implementation as well as the ambitions and perceived barriers is shown to have bearing on almost every other Work Package in the project.

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List of Abbreviations and Acronyms

Abbreviation	Definition
AWL	A Working Lab
BIM	Building Information Modelling
BIPV	Building Integrated Photovoltaics
Brf	“Bostadsrättsförening”, Housing Association
CIM	City Information Model
DoA	Description of Activities
EU	European Union
FC	Follower City
GHG	Greenhouse Gases
IoT	Internet of Things
LH	Lighthouse City
PET	Personal Energy Threshold
PV	Photovoltaics
RES	Renewable Energy Sources
WP	Work Package

1. Introduction

1.1 Scope, objectives and expected impact

The objective of this Deliverable is to provide a detailed overview of the baseline, ambition & barriers for Gothenburg lighthouse interventions. This deliverable is intended for the following audiences:

- Stakeholders in the Gothenburg ecosystem as it should provide a detailed overview of the solutions that will be implemented by each of the partners;
- Stakeholders in the demonstration districts as it should provide them with overview of the solutions and on how local stakeholders will be involved;
- Project partners in the other lighthouse and follower cities;
- Broader public which is interested in the details of the demonstration.

This Deliverable will facilitate the common understanding of the demonstration activities and the action plan foreseen within local ecosystems as well as between LH and follower cities. The detailed and updated descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this Deliverable will allow the Steering Committee of the project to assess the current status and compare with what is stated in the DoA, ensuring that quality assurance and control aspects are covered and that appropriate mechanisms to identify, anticipate, communicate and mitigate potential risks and deviations in the project may be activated.

1.2 Contributions of partners

- Trivector: Provided input for Transition Track #3
- Riksbyggen: Provided input for Transition Track #1, Transition Track #2
- Akademiska Hus: Provided input for Transition Track #2
- HSB: Provided input for Transition Track #5
- Metry: Provided input for Transition Track #4
- Göteborgs Stad: Provided input for Transition Track #4, Transition Track #5
- Johanneberg Science Park: Overall coordination, producing draft text and match with inputs from WP 1, review 90% version of the report.

1.3 Relation to other activities

- The elaboration of this Deliverable has been connected to the work done to provide material for Deliverables 1.1 to 1.6: including the description of pre-pilots, demonstration activities, barriers, drivers and regulatory framework for implemented solutions for each track
- WP 3: Business models: We have used preliminary results from interview with partners in the Gothenburg ecosystem

- WP4: The work carried out by partner GOT in T4.1 and T4.3 has provided important input to the definition of the demonstration activities planned for Gothenburg's TT#4

1.4 Structure of the deliverable

- **Chapter 2** deals with the methodology of the work carried out to compile this report. This includes a description of the way the baseline, ambition, barriers and drivers have been determined, including the definitions used for those terms
- **Chapter 3** describes the baseline, ambition, barriers and drivers for the Gothenburg interventions in IRIS Transition Track #1. The chapter also contains a detailed description of the planned interventions and demonstrators.
- **Chapter 4** describes the baseline, ambition, barriers and drivers for the Gothenburg interventions in IRIS Transition Track #2. The chapter also contains a detailed description of the planned interventions and demonstrators.
- **Chapter 5** describes the baseline, ambition, barriers and drivers for the Gothenburg interventions in IRIS Transition Track #3. The chapter also contains a detailed description of the planned interventions and demonstrators.
- **Chapter 6** describes the baseline, ambition, barriers and drivers for the Gothenburg interventions in IRIS Transition Track #4. The chapter also contains a detailed description of the planned interventions and demonstrators.
- **Chapter 7** describes the baseline, ambition, barriers and drivers for the Gothenburg interventions in IRIS Transition Track #5. The chapter also contains a detailed description of the planned interventions and demonstrators.
- **Chapter 8** describes the relevant output of this work package, task and deliverable to other work packages, tasks and deliverables in the IRIS project
- **Chapter 9** contains the conclusions
- **Chapter 10** lists the references used in the report
- The **Annexes** contain timelines for the planned demonstrators in Gothenburg

2. Methodology

2.1 Preliminaries and context

The draft of deliverables D5.1, D6.1, D7.1, D5.2, D6.2 and D7.2 (hereafter D567.1 and D567.2, respectively), alerted lead-editors to the need of operating a joint approach in order to ensure harmony and coherence amongst the interventions within the 3 lighthouses. Such a harmonized approach aims to foster exchange of best practices. The recurrent identification of a need for a joint approach led D567.1/D567.2 lead-editors to organise a dedicated Working session "Session 1B: Lighthouse Cities site exchange" that was held in conjunction with the Consortium Plenary Board in Goteborg (M6) – 27-29th of March 2018.

Conclusions of this Working session were to set-up a "joint approach team" between LH's that aims at facilitating benchmarking and collaboration during the deliverable writing process. It was decided that this "joint approach team" would learn by doing, and therefore would adopt a common methodology (including information sharing, collaborative development process, chapter structure, etc.) focusing in the first stage on both D567.1 and D567.2 and aiming at lasting during the whole project lifecycle.

Additional conclusions of the workshop were that despite the need for a joint approach, LH cities all have their own specificity due to for instance local context, geographical features, national financial and legal regulations, etc. Consequently, when appropriate, some chapters will be tailored to the specific circumstances of each LH.

In summary, the three lighthouse cities Utrecht, Nice and Gothenburg have adopted a joint approach for the Deliverables D5.1, D6.1 and D7.1 while maintaining their own methodology that fits in with the specific LH context.

The work involved in compiling the deliverable has been aided by the description of the pre-pilots, demonstrations and foreseen replication per transition track made in WP1. Furthermore, the meetings and interviews with GOT IRIS and ecosystem partners to validate whether the ambition level is still current, the interviews performed by WP3 on business models, the questionnaire initiated by WP4 on data, standards etc for City Innovation Platform (CIP) and the meetings with IRIS partners aimed at detailing the demonstration activities, gaining insight in barriers and drivers has provided valuable input to the process.

The D5.1 and D7.1 reports are providing precise and realistic specification of ambitions, activities and planning for each of the interventions planned, running in parallel and in close cooperation with activities in WP1 on the extraction of requirements for the 5 Transition Tracks, including baseline definition of citizen energy and mobility behaviour, along with setting up of the monitoring principles and early business modelling development., while the D6.1 report seeks to establish a baseline review from which it is possible to move to relevant objective-setting, elaboration of adequate action plan and monitoring.

In D6.1, the work has been dedicated to the collection of data in Nice LH for the definition of the SWOT, (Strengths, Weaknesses, Opportunities and Threats) analysis, in view of designing a portrait of the local ecosystem from which it is possible to characterize the drivers and barriers of Nice in relation to the other IRIS LH cities. The selection of actions and measures will be based on the careful estimation of risks associated with their implementation, especially when significant investments are planned. The SWOT analysis will be performed to determine the strengths and weaknesses (in terms of energy and climate management), as well as the opportunities and threats (in terms of district replication opportunities) that could affect the action plan.

Data for the SWOT analysis has been collected from all three LH in order to establish a control group and enable the comparison between Nice LH and its peers.

2.2 Definitions

Baseline

With baseline, we understand the situation before any intervention has been made. Assessment of baseline is a very important step in any project or transformation process, as without it we are not able to judge a) where improvements are needed; b) what level of improvement or transformation has been achieved as the result of the intervention.

Baseline assessment takes different forms depending on the nature and scope of the intervention.

The baseline descriptions for the Gothenburg interventions have been made by the LH partners involved in the respective demonstrators. In many cases, the Pre-Pilots listed in the DoA serve as the baseline for a particular Transition Track. The work carried out in WP1 where Pre-Pilots and demonstrations have been described has provided input for this Deliverable. The descriptions constitute the state of the practice prior to LH interventions. In some cases, when there is no prior state (in the case of a new building, for instance), reference data (for instance average values for existing buildings or values stipulated by law, regulations, standards or city databases with statistics of demo area) have been used.

Ambition

Ambitions for the respective Transition Tracks constitute the overall aim and vision of the thematic area in question. Ambitions have initially been outlined in the project application and DoA and further developed in course of the work in WP1.

Ambitions for the LH demonstrators have been correlated with the original ambitions as stated in the DoA. In those cases where these ambitions are no longer valid, this is explicitly stated.

Barriers & Drivers

The main barriers and drivers that affect the implementation of the LH demonstrators have been provided by the partners involved in the respective demonstrators. In some cases, when there is not a 100 % certainty that the barrier will materialize, barriers may be viewed as risks. In the same fashion, drivers may be viewed as opportunities.

2.3 Map of Demonstration Area

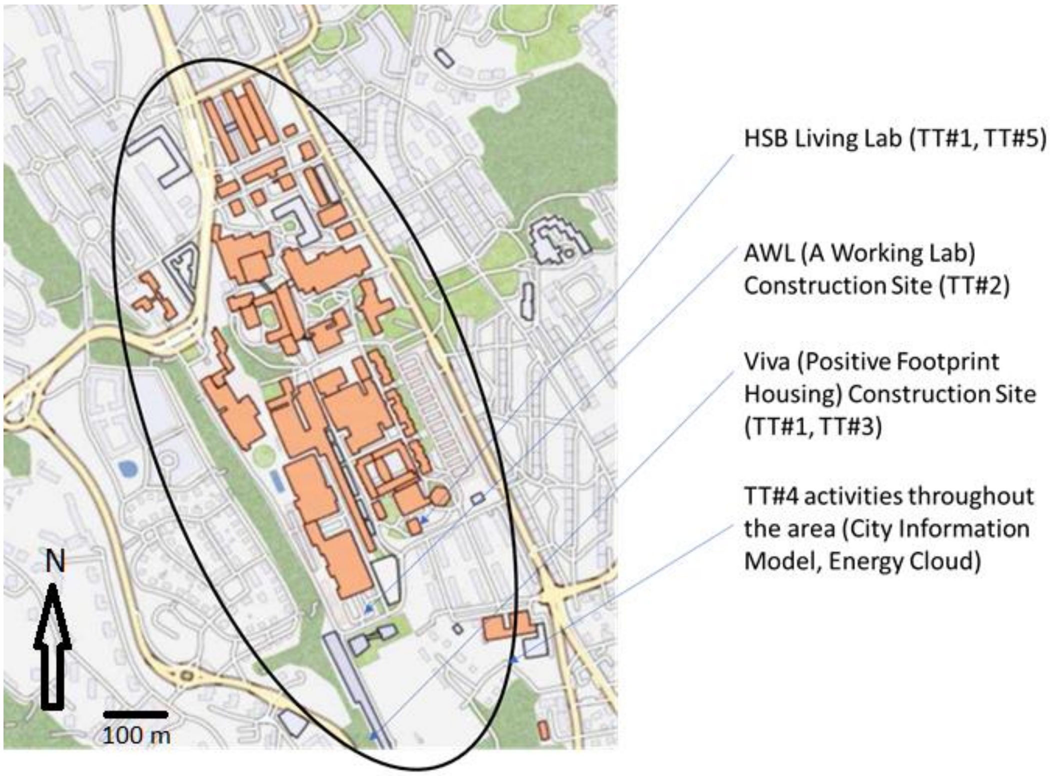

Figure 1 Map of Johanneberg Demonstration Area

The demonstration area for Transition Tracks #1, #2, #3 and #4, respectively, is concentrated to Chalmers University of Technology campus Johanneberg and its direct vicinity in Gothenburg (See Fig. 1). The area includes buildings with lecture rooms and offices for approximately 15,000 students, researchers and others, as well as some buildings with housing for students. Currently, the new housing project with 132 apartments (directed mainly to non-students), Brf Viva, is under construction, near the campus area.

In addition to the IRIS project, the various stakeholders at campus (property owners, the university, research institutes etc.) are engaged in several initiatives in sustainable energy, housing and transport solutions and IRIS will leverage from these. The most important initiatives are Riksbyggen's Brf Viva, Akademiska Hus's AWL ("A Working Lab) construction project, HSB Living Lab and FED: Fossil Free Energy District. Brf Viva and HSB Living Lab are presented under Transition Track #1, AWL and FED under TT#2 However, they all present some overlap on both Transition tracks.

For Transition Track #4, the City Information Model (CIM) will be demonstrated using data sets collected outside of the Johanneberg district (more pertinent data can be found in other parts of the city), and the Energy Cloud will be implemented in the building stock of the campus's property owners.

The demonstration area for Transition Track #5 will consist of the geographical area served by the electric bus service ElectriCity, connecting Johanneberg Science Park and its sister park Lindholmen Science Park. Fig. 2 shows the situation of the Johanneberg district in Gothenburg.

Figure 2 Campus Johanneberg Area in Gothenburg

2.4 A note on planning of the demonstration activities

In a 5-years cooperation project, diverse factors can suggest changes from the original planning and the real implementation of activities: maturity of technologies available, evolution of prices of furniture and energy, turnover of staff and board, internal reorganization of companies and public authorities, new strategic plans.

In the following chapters, the best currently available plans for the respective Transition Tracks, subject to change, are presented.

3. Transition Track #1 – Baseline, ambition, barriers and drivers

3.1 About the demonstrators

The GOT demonstration area is concentrated around Campus Johanneberg, placed in the central city part with the same name. In the direct vicinity to campus, Riksbyggen currently constructs a new housing cooperative, Viva, with a total of 132 apartments. Viva is the result from an innovation process, led by Riksbyggen and involved a number of local partners, e.g. Johanneberg Science park, Chalmers, RISE (Research Institute of Sweden), City of Gothenburg, the local energy utility Göteborg Energi, architects and consultants. The process was initiated in 2010 and two years later it was established as "Positive Footprint Housing" with all above-mentioned partners.

Viva aims at being the most innovative and sustainable housing project in the country and a number of integrated solutions aiming at more renewable electricity generation, electric vehicles and Mobility as a service, energy storage, heating and cooling are performed in Viva and included in IRIS as demonstrators. Compare the sketch shown in Figure 3.

The aim is to create solutions that enable a positive energy balance in districts and create an attractive, social inclusive campus and neighbourhood.

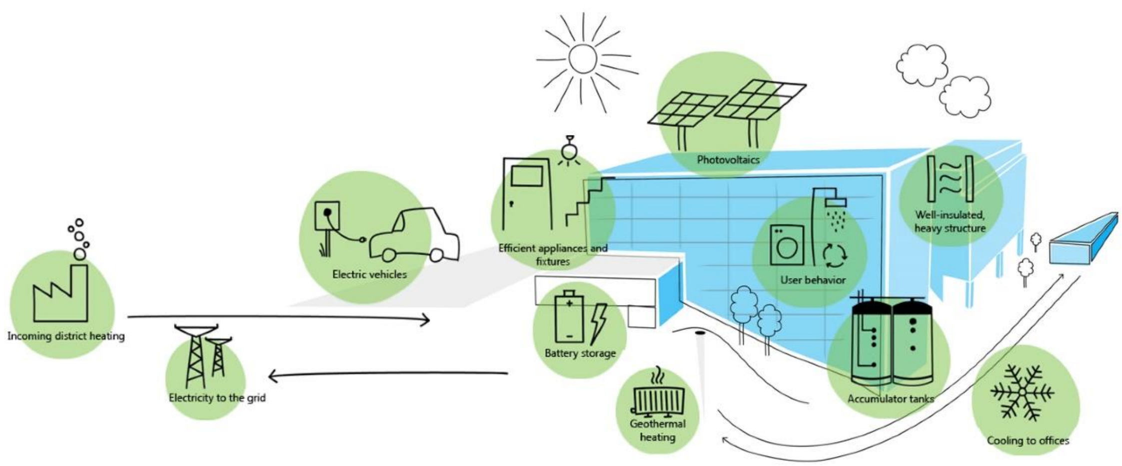

Figure 3 The components of the flexible energy system in Riksbyggen's housing association Viva

HSB has its Living Lab placed at campus Johanneberg. The Living Lab is the home for some 50 students, but at the same time a research, test and demonstration environment for e.g. energy efficiency, resource optimisation, electricity generation, laundry habits, cooking possibilities and son on. In IRIS, HSB Living Lab contribute with a demonstration and evaluation of so called BIPV, Building Integrated Photo Voltaics. This means solar panels for renewable electricity generation that can be mounted on houses instead of other construction material in new built houses or in connection to renovation of the façade or roof exchange.

Figure 4 A bird's eye's view of the housing association Viva

3.2 Baseline

Riksbyggen's Brf Viva (Fig. 4) is built on land that is previously undeveloped (Fig. 5), in an area that is not very dense, although with quite high multi-family houses (3-10 stores). The area used to hold an open-air parking lot with around 20 parking spaces and a forested slope. Hence, the baseline for the project is no house at all.

Instead, a relevant baseline to compare with is a reference building that would have been built without all the innovation work that has been done for Viva, that simply follows national regulations.

For a standard, reference building, the highest allowed energy use is 90 kWh/m2 and year, according to the Swedish Board of Housing (Ref 3). A reference building would have an energy system without the demonstrators that are included in Brf Viva. It would have either district heating or downhole heat pumps, not both. It would have accumulator tanks and its structure would influence the thermal inertia of the building.

Figure 5 The site of Brf Viva prior to development

A relevant baseline for the demonstration of BIPV, Building Integrated Photo Voltaics for solar electricity generation, would be solar cells placed as an extra layer on the façade and on the roof, in connection to renovation of the same. An economic comparison is therefore made with solar PV put on top of a standard construction element. This comparison and evaluation constitute the demonstrator in IRIS.

Main KPI's for transition track #1 are presented in Table 1.

Table 1 KPI's for GOT Transition track #1

KPI – Key Performance Indicator	Target value
Energy consumption, on sub-district (Viva) level	< 24 kWh/m2/a
Peak power shaving	> 80% (Viva)
Net energy surplus, on sub-district (Viva) level	> 10 MWh
Solar PV for electricity generation integrated	10 kW (HSB) + 140 kW (Viva)

3.3 Ambition

Due to Swedish cold winters, the building standard in the country is relatively high. The last decades´ society discussion, nationally and internationally, on sustainable development has led to the fact that high ambitions in energy performance for new built projects are expected. Swedish Green Building Council (SGBC), member of the international World Green Building Council, certify buildings according to sustainability index called Miljöbyggnad (Eco-building) Bronze, Silver and Gold.

Riksbyggen, that contribute with six demonstrators in IRIS Transistion Track #1, has decided that all their new production in multi-story houses with three or more floors will be certified according to SGBC´s Eco-Building level Silver. In Brf Viva, Riksbyggen take these ambitions several steps further.

Brf Viva is the result of many years of research on how to build and live as sustainably as possible . The research, called Positive Footprint Housing, was conducted in cooperation between Riksbyggen, Johanneberg Science Park, Chalmers, RISE (Research Institute of Sweden) and the city of Gothenburg. The project has viewed sustainability from many aspects, both social, environmental and economic (Fig. 6). The result aims at being the most innovative and sustainable housing project and is used as a demonstrator in IRIS.

Figure 6 Sustainability aspects studied during the project Positive Footprint Housing, which resulted in Brf Viva

HSB wants to be an important player for sustainable society. With the ambition to influence the whole society in a positive direction, the company contributes to better conditions for accommodation and the residents. HSB works to increase the value of membership and the customer offering with sustainable services and products, which will also be resource efficient, have low climate impact and are produced under good conditions. HSB wants to influence society in the right direction.

HSB has with its HSB Living Lab taken large investments in order to enable research and development in the area of e.g. energy efficiency and resource optimization. The demonstrator in IRIS is one part of this ambitious package of new technology that has the chance to be tested and evaluated in HSB Living Lab.

The results from the evaluation of BIPV will, if the technology proves successful in terms of environmental and economic sustainability, be replicated in the company's large portfolio of multi-family houses, of which a large proportion will have to be renovated within the near term.

Currently, HSB owns and coordinates about 4,000 rental properties and housing associations in Sweden, which corresponds to roughly 300,000 apartments. Some 100-150 (around 3 %) multi-family houses within this real estate portfolio are subject to façade and/or roof renovation yearly. Not all can be refurbished with building integrated solar panels, but there is a large potential for replication.

3.4 Planning of TransitionTrack#1 activities

3.4.1 Objectives – transition track #1

Gothenburg's ambition is to extend further the already available positive energy district by integrating (a) a high share of locally produced and consumed renewable energy at district scale, (b) energy savings at building level, (c) energy savings at district level and (d) storage and transfer between buildings of surplus energy.

In the Riksbyggen/Viva demonstration area, it is not the individual elements of the solutions but rather their composition that will allow the future deployment of the proposed Solutions in larger areas. To build resilience and diversity in the self-sufficient energy system, several elements are designed and will be applied (See Fig. 7).

HSB will focus their demonstrator activities on evaluation on solar panels, integrated as façade and roof construction elements. The renewables production is connected to batteries for grid flexibility and other added values.

The demonstrators included in transition track #1 are:

1) Demonstration of at least 200 kWh electricity storage in 2nd life automotive (bus) batteries powered by 140kW local PV
2) Demonstration of heating from geo energy with heat pumps (2-300 m deep boreholes),
3) Demonstration of cooling from geo energy without chillers
4) Demonstration of local energy storages consisting of water buffer tanks, structural (thermal inertia of the building) storage and long-term storage in boreholes
5) Demonstration of seasonal energy trading (cooling in summer season) with adjacent office block
6) Development and demonstration of advanced Energy Management System to integrate PV, DH, grid and all abovementioned storage options to achieve peak shaving and minimal environmental impact
7) Demonstration of how Building Integrated Photovoltaics (BIPV) can be used in façade renovation process

3.4.2 Description of scenario – transition track #1

Table 2 Facts about Brf. Viva and HSB Living Lab

Building name	Brf Viva	HSB Living Lab
Picture		
Building category	Multi-family house	Student apartments and living lab
Building owner	Riksbyggen (private)	HSB (private)
End of construction	November 2018 (1st phase), January 2019 (2nd phase) and April 2019 (3rd phase)	September 2017
Total floor area (m²)	11 200 m²	18 000 m2
Total height (m)	35 m plus foundation on the highest side.	16 m
Number of floors	11	5
Energy target	Positive energy building	60 kWh/m2
Energy system	District heating & geothermal heating	District heating & geothermal preheating of air(ventilation)
Cooling system	No cooling of apartments, but cooling produced for adjacent office building	No cooling system
PV surface (m²) / electricity capacity	140 kW	50 m^2 / 8.4 kW on the roof and 144 m^2 / 10,12 kW at the façade
Type of storage system (capacity (kWh))	Electric battery (200 kWh)	Electric battery (7,2 kWh)

As can be seen in Table 2, the Riksbyggen houses are currently under construction, whereas HSB Living Lab is already in place. The latter has the purpose of constantly adding and trying new technology and other aspects of living and the demonstrator of façade integrated solar panels are currently under commissioning and evaluation.

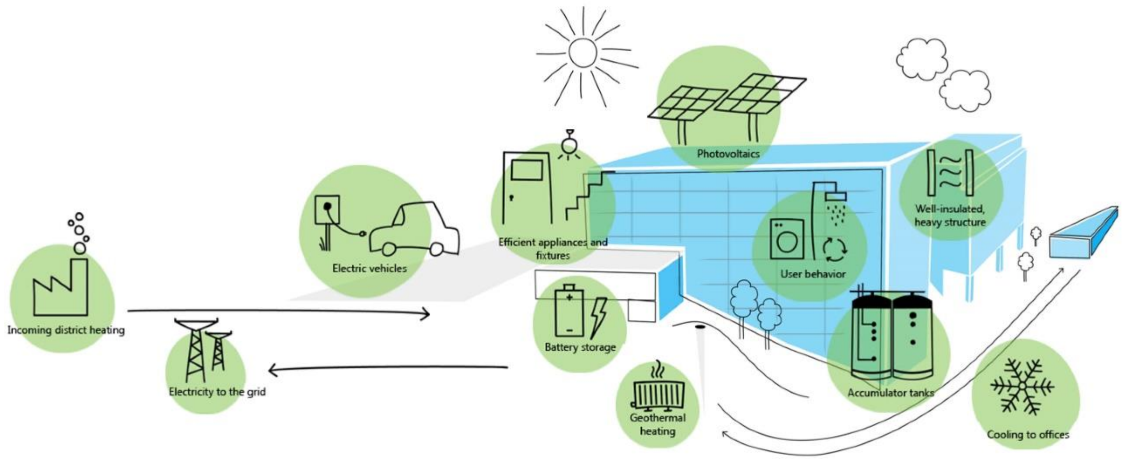

Figure 7 The components of the flexible energy system in Riksbyggen's housing association Viva

3.4.3 Organization of work – Viva:

At this point, there are very few remaining unresolved issues needing more design. Almost everything has been decided and implemented into the mainstreamed construction process.

Among the remaining phases in this are procurement, installations, testing and start of use. Then, it will all be ready for demonstration with presentations, study visits and such.

Key personnel (Riksbyggen unless stated otherwise):

- Peter Selberg, research and innovation strategist at Johanneberg Science Park, funded by Riksbyggen. Task leader for T7.2 and coordinating Riksbyggen's IRIS-activities.
- Patrik Hjelte, project manager of Viva
- Matilda Kjellander, assistant project manager of brf Viva, and Riksbyggen's first contact on IRIS-issues beside economy.
- Charlotta Brolin, sustainability expert working with Viva.
- Anna Maria Walleby, sustainability expert focused on mobility.
- Mari-Louise Persson, national energy strategist.
- Mikael Ahlén, head of division.
- Anders Johansson, assistant head of division and previous project manager of brf Viva.
- Maria Hedlund, economist and Riksbyggen's contact on economic issues.
- Pierre Hult, Max Green and Robin Dunborg, energy engineers
- Helena Nordström, R&D Project Manager at Göteborg Energi, involved in most demonstrators in 7.3.

Sub-contractors involved:

- k21: Peter Fredriksson, construction project manager in a partnership agreement with Riksbyggen. Coordinates the approx. 80 sub-contractors that carry out the actual construction.
- Emma Lund and colleagues at Trivector / EC2B, developing the mobility service that houses the e-vehicles which are being charged by the energy system of Viva.

Researchers involved:

- Francis Sprei, Associate Professor at Chalmers. She studies mobility patterns of the coming residents of brf Viva.
- Ulrika Holmberg, PhD, and Sandra Hillén at the Centre for Consumption Science at the University of Gothenburg. They study the residents' perception of the sustainability-oriented solutions in brf Viva.

Johanneberg Science Park is involved with the coordination of IRIS-activities in Gothenburg, RISE is included in the evaluation of the demonstrators (WP9).

3.4.4 Timing of activities – Viva:

Gantt-charts describing the construction of Viva and the demonstrator activities can be found in Annex 1, Figures 1-3.

Due to added expenses in an updated budget, the deployment of demonstrators 3 and 5 are postponed for gathering additional funding. This is inserted in the Gantt-charts and will not jeopardise the evaluation and other activities in IRIS.

3.4.5 Risks and risk management – Viva:

Table 3 Risks and Risk Management - Viva

Risk	Mitigation strategy
All the craftspeople might not be finished on time	Keep space in the time plan and a few weeks between final inspection and planned occupancy.
Deliveries are late	Decide on items and cost beforehand, and fix a delivery date when needed, rather than sending the complete order when needed.
An agreement with the second property owner involved in the seasonal energy trading might not be possible	Proactive work on a strategic level
System failures and unforeseen issues related to the novelty of the solutions might take substantial time to correct	Conduct careful testing. Three free weeks between final inspection and planned occupancy to correct errors.
Riksbyggen is new to EU-financed projects and might thus miss particularities in such projects when it comes to documentation for instance	Close and diversified contact and communication with the project management and other partners who are more experienced in these situations.
Dependent on deliveries from other partners regarding yet unfinished services, or even lack of clarity regarding distribution of work and responsibilities between partners	Emphasis on communication to be able to deal with issues early on.

3.4.6 Organization of work – BIPV at HSB Living Lab:

Partners involved and key personnel:

- HSB Göteborg: Rickard Malm, Business Developer, David Skarin, Energy specialist
- Göteborg Energi: Helena Nordström, R&D Project Manager
- Chalmers: Zack Norwood

Subcontractor involved:

- Mera Sol – supplier of BIPV and associated equipment

3.4.7 Timing of activities – evaluation of BIPV at HSB Living Lab:

The solar panels were placed on the Living Lab building already in 2017. Evaluation of data from the first 12 months of operation is due to start in October 2018. The whole system with solar PV, a DC connection to a battery and an AC/DC converter to supply the building with electricity, will be evaluated with respect to technical performance and economic parameters.

There are preliminary plans to start two new projects in connection to the BIPV and battery, although they are not included in IRIS. Both projects could start later in 2018.

- Stress-testing of battery
- Installing of USBC/DC-system to allow tenants a direct access via DC to solar electricity and storage in battery. Preliminary start of project: autumn/winter 2018.

A Gantt chart for the activities related to HSB:s BIPV can be found in Annex 1.

3.4.8 Risks and risk management - HSB BIPV

The major risk for BIPB evaluation is the risk for delay, due to lack of access to key persons, who are experiencing severe workload (See Table 4).

Table 4 Risks and Risk Management - HSB BIPV

Risk	Mitigation strategy
Delayed evaluation	Process for finding new key resource is started

3.5 Barriers and Drivers

3.5.1 Summary of barriers and drivers for Smart renewables and closed-loop energy positive districts

Main drivers for more distributed, renewable electricity production, energy efficiency measures and other arrangements for positive energy buildings are the positive expectations and social pressure on really all actors in the construction industry to work for sustainable development. There are also various policy instruments working in that direction, on both national, regional and local level.

Technology development and thus the positive price trend, for example on solar cells, that have been observed in recent years is a very strong driver for realisation.

With new technology there are also barriers in connection to taking market shares, finding the right business models and taking technology from idea to marketable product. Consumer products in particular also place high demands on new thinking patterns and possibly higher levels of knowledge among the public.

3.5.2 Political

Barriers

Differing interests, from the actors that together form an energy system (housing association, energy utility company, property owner, EU-sponsored project(s) etc.) have differing goals for the optimization of the Energy Monitoring System.

Drivers

The majority of political parties in Sweden agree on the need for reducing GHG emissions, so there is unanimous political support for initiatives that will work in that direction. The political will has e.g. been specified in the climate target that stipulates that the West Swedish economy should be fossil-free by 2030.

3.5.3 Economic

Barriers

Large investment costs and long payback times for batteries and other storage options may act as a barrier for market introduction.

Drivers

Higher efficiency, lower consumption and own production will lower the energy costs for property owners and residents.

The cost for installing Building Integrated solar panels (BIPV) has the potential to imply only a small extra cost in comparison to a standard façade element. The added economic value of internal renewable electricity production for many years is a large driver in this context.

3.5.4 Sociological

Drivers
No drivers identified at this stage

Barriers
There could be challenges in the operating phase for the energy management system, if the ownership of the building in question is of another actor. The level of knowledge in energy related questions among the residents in the house might also impose challenges, if the residents also own the apartments.

Renovation of old buildings with BIPV would at present mean a change in the visual appearance of the building. This can make it difficult to gain acceptance from both the residents and the municipality's architects who provide building permits.

3.5.5 Technological

Barriers
The high speed of technology development implies barriers such as mistrust in the business towards unproven technology and lack of a proper standardisation.

Security/ reliability/ serviceability of the whole system remains to be proven.

Drivers
The current technology development in the area of energy efficiency and renewable electricity generation and the possibility to connect all components into a single system, enables the implementation and realisation of the demonstrators in this transition track.

3.5.6 Legal

Drivers
Riksbyggen is technically not a company but an “economic association”. This relieves them from the quarterly economic system and the stress it implies and gives them the possibility to act on a more long-term basis.

Barriers
Fire safety regulations are not up to date for systems with reuse of bus batteries. Could prove inconvenient to comply with.

The pipes with cooling water that connect the two buildings are drawn/lain/positioned on ground that is owned by the municipality. Since this is a new way of conducting energy exchanges, there is no precursor for how to make legal agreements for how the use of the land is allowed to be conducted. Specifically, these types of leases for public land is hereto always written with a three-month cancellation clause, which would make an investment with of 20 years of service life considerably riskier.

There is a barrier in the work of finding the right ways for collection, management, storage and ownership of different kinds of data. Usage is measured on household basis for the sake of individual billing, and usage data is to some extent shared for research, but beyond that it is still undecided. This could lead to data protection issues (advanced Energy Management System)

3.5.7 Environmental

Drivers

The strong commitment from all levels in Riksbyggen in the work with sustainability in Positive Footprint Housing, that led to Brf Viva, has been a strong driving force.

The strong and outspoken will to work with sustainable development, among all actors involved, is a strong driving force in the daily work.

Barriers

The Swedish electricity mix is mainly based on nuclear power (40%) and renewables (56%) (hydro power (40%), wind power (10%) and biofuel-CHP (6%); Electricity mix 2016 – Swedish Energy Agency (2018)) (See Reference 2) and is therefore nearly CO_2 neutral. Better connections with the north-European electricity network has given Sweden a better redundancy in the electricity grid and a possibility to export domestically generated electricity, but also the possibility to rely more on electricity from our neighbouring countries, not necessarily carbon neutral. Therefore, there is a discussion whether electricity driven heat pumps are an environmentally good alternative for heating, when district heating also is available.

4. Transition Track #2 – Baseline, ambition, barriers and drivers

4.1 About the demonstrators

The demonstrators in transition track #2 are located in Akademiska Hus´ new office/innovation building AWL, and in Riksbyggens Viva building, both situated at and in the direct vicinity to campus Johanneberg. Viva contribute with six demonstrators under transition track #1 and is described in Chapter 3.

A Working Lab, AWL, is Akademiska Hus new flagship project, which is currently under construction (autumn 2018). The AWL-building is a building for office space, café, restaurant and meeting places and will act as a centre of innovation project for Akademiska Hus. Already in construction, new and innovative solutions and technologies are tested and demonstrated, e.g. within energy.

The energy ambitions in AWL are high. The building will be certified as Eco-Building Gold, according to Swedish Green Building Council. Energy losses between the production and storage (solar PV and batteries) and the internal electricity consumption in e.g. ventilation fans, lightning and other equipment are minimised by implementing a direct current grid internally in the AWL building. A Phase Changing Material storage for cooling will be demonstrated.

In Viva, 2nd life bus batteries will be demonstrated as electricity storage in connection to the roof-top solar panels. The evaluation of these batteries is included as a demonstrator in transition track #2.

A low temperature (45/30^{o}C) district heating system will be deployed in Viva and demonstrated under this transition track.

Figures 8 and 9 show a visualisation of the AWL building and a map of the area.

Figure 8 Visualisation of the office/innovation building AWL at campus Johanneberg

Figure 9 A map depiction of the Chalmers Campus Johanneberg in Gothenburg. The place for AWL marked in red

Main KPIs for transition track #2 are presented in table 5.

Table 5 Main KPI's for Transition Track #2

KPI – Key Performance Indicator	**Target value**
Energy consumption	< 35 kWh/m2/a
Electricity storage capacity	400 kWh (AWL + Viva)
Cooling storage capacity	350 kWh (in a 1^{st} stage)
	1,350 kWh (in a 2^{nd} stage)
	(possibly 1,700 kWh in total)
Peak power shaving	> 80% (AWL)

Solar PV for electricity generation integrated	200 kW (AWL)

4.2 Baseline

Before the AWL house began to be built (it is currently under construction, August 2018), the area was mainly used for parking purposes. The surrounding buildings are mainly offices for university employees and teaching facilities for students and teachers. There is a mandate from both the municipality and the university to densify the area, both in terms of offices / number of employees and housing. The option to keep the surface as a parking space is not realistic and therefor neither relevant nor interesting as a baseline. The baseline chosen is instead an office building with not as high sustainability ambitions, but rather a standard office building of the same size.

A standard office building would have approximately (maximum) 72 kWh/m^2 and year as energy consumption, according to the Swedish Board of Housing (Ref 3). AWL will be “Eco-Building Gold”-certified, which implies a consumption of less than 35 kWh/m^{2}a (Table 6). The house consists of approx. 9,600 square meters of space for offices and other commercial premises, distributed on seven floors.

Table 6 Planned energy performance vs. baseline - AWL

	AWL – Akademiska Hus´ A Working Lab	**Baseline**
No of floors	7	7
Space area (m^2)	9,600	9,600
Annual energy consumption (kWh/m^{2}a)	< 35	72

4.3 Ambition

Akademiska Hus is a state-owned property company with main assignment to own, develop and manage properties for universities and colleges, with a primary focus on education and research activities.

Figure 10 AWL - Visualisation

Figure 11 AWL - Visualisation

Sketches of AWL

At campus Johanneberg, Akademiska Hus owns and manages a large portion of the buildings that provide premises for the university's operations.

The AWL-building will act as a centre of innovation project for Akademiska Hus. Already in construction, new and innovative solutions and technologies are tested and demonstrated, e.g. within energy. The ambition is to minimise energy losses between the solar panels, the battery storage and the utilise in fans, lightning and other equipment by implementing a direct current grid internally in the AWL building. Figures 10 and 11 show visualisations of the building.

The ambition is to make a whole building that is innovative, and it is therefore seen upon as a lab environment, where Akademiska Hus together with tenants and researchers test and take part in the latest in research and development. The fact that the building will be certified according to the Eco-Building level Gold clearly shows that sustainability is in focus.

Exciting and innovative architecture means, among other things, multifunctional and customizable and spaces will be created for collaboration and flexible workplaces. Opportunities for conferences, smaller workshops and maybe even so-called ALC-Active Learning Classrooms, where the latest in pedagogy can be used, will take place in AWL.

The building will be both public and private. Throughput is of great importance to creativity and the ambition is to maximize innovative collisions between people with different skills and backgrounds. The entrance plan will therefore be open to the university, the square and the ElectriCity bus. In the entrance, visitors will be greeted by a lively area with café, restaurant, meeting places and workplaces.

Ambitions, overlap and exchange with FED – Fossil Free Energy District

In addition to the IRIS project, the various actors at campus, property owners, the university, research institutes, Johanneberg Science Park etc. are engaged in several initiatives in sustainable energy, housing and transport solutions and IRIS will leverage from these. The most important initiatives are Riksbyggen's Brf Viva, Akademiska Hus' AWL project, HSB Living Lab and FED (Fossil Free Energy District). Brf Viva, HSB Living Lab and AWL all take part in the IRIS demonstrators and are presented elsewhere.

FED includes approx. 50 buildings/components for electricity, heat and cooling production, storage and usage and all components are connected in a system and market place for trading of energy between the entities. Figure 12 shows the principal components of the FED project.

FED is financed by the UIA (Urban Innovative Action), which is a part of the European Regional Development Fund. The goal is to optimise the use of locally produced renewable energy and reduce the primary energy imported (partly fossil based) from the outside grid. This is done either by internal, direct transfer or by various kinds of intermediate storages. Project partners are City of Gothenburg, Business Region Gothenburg, Göteborg Energi (local energy utility), Johanneberg Science Park, Akademiska Hus, Chalmersfastigheter, RISE, Chalmers and Ericsson.

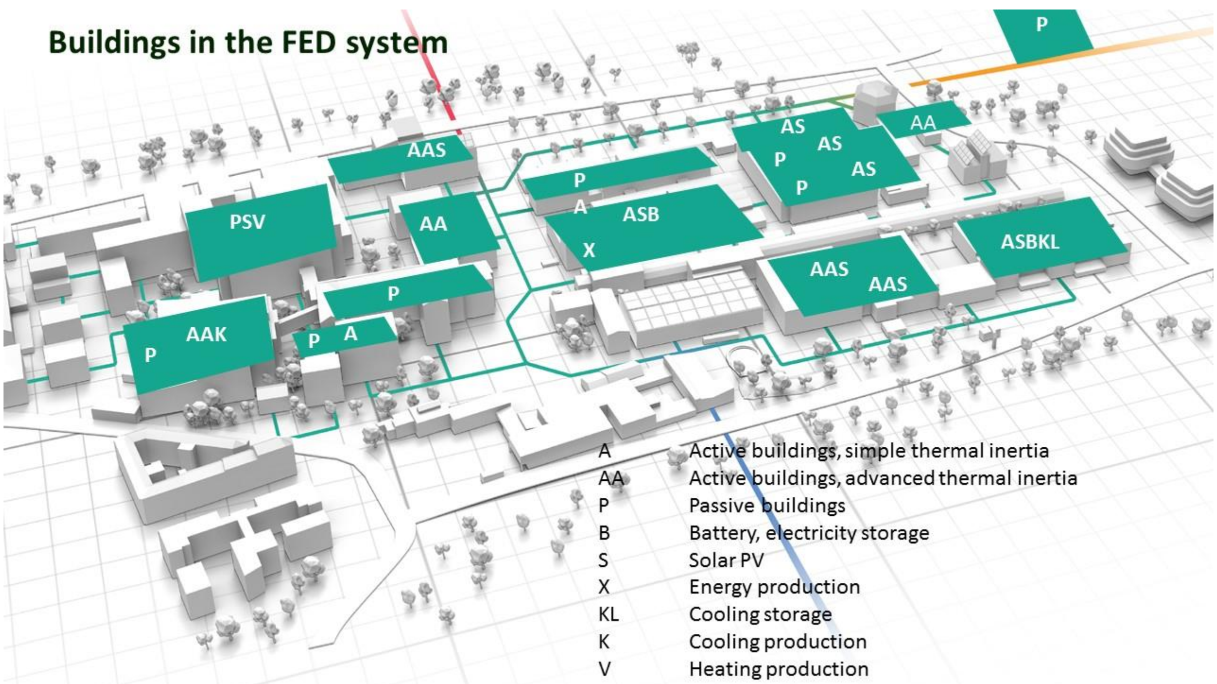

Figure 12 Schematic of the principal components in the FED project

FED and IRIS have common goals and technologies. The PCM cooling storage and DC/PV/Battery system in AWL are both demonstrators in IRIS but included and evaluated also in the FED system.

Riksbyggen´s demonstrator Development and demonstration of advanced Energy Management System in transition track #1 will have a system for benchmark and experience exchange. FED is larger and more complex but Riksbyggen´s system consists of components that are not included in FED, mainly geothermal energy.

FED is finalised in 2019 and aims at a continuation but then in the form a national testbed for fossil free energy district. In that concept, both HSB Living Lab and Riksbyggen´s Viva would be included. The testbed would have support (not necessarily financial) from the Swedish Energy Agency.

4.4 Planning of TransitionTrack#2 activities

4.4.1 Objectives – transition track #2

Akademiska Hus is currently constructing a new seven stories office building at campus Johanneberg, called A Working Lab (AWL). Akademiska Hus is state-owned property company, which implies a special responsibility for being a leader in sustainability. Demonstrators 1 and 3 in the list below are under construction in the new AWL building at campus Johanneberg.

Demonstrators 2 and 4 in the list below are conducted in Riksbyggen's project Viva.

Under transition track #2, Gothenburg will demonstrate:

1) A 350 V DC building microgrid utilizing 140 kW rooftop PV installations and 200 kWh battery storage. The demonstration will include
   (i) PV and battery integration with energy management system,
   (ii) DC installations in building (e.g. LED lighting, pumps, fans and actuators),
   (iii) Regulatory and legislator aspects of DC installations in buildings
2) A low temperature DH 45/30 system for six buildings in Riksbyggen sub-district. Including a shallow geo energy solution where the boreholes also are used as long time thermal storage and to cool nearby office buildings in summertime.
3) A 1 700 kWh PCM (Phase Change Material) pilot facility inside the JSP2-building in order to test different ways of storing energy for cooling purposes to reduce peak cooling power requirement
4) Integration and evaluation of a 200kWh energy storage with 10-14 2nd life Li-Ion batteries from electrical buses during 5-year operation in the Riksbyggen sub-district with 132 apartments that will be finalized in 2018. The batteries will store energy from solar PVs, balancing in that way the load of the building, including the charging of an electric vehicle pool, and providing energy to the grid.

The sketch in Figure 13 shows how the internal direct current microgrid (350 V) will be used to connect the 172kW rooftop PV installation with a 200kWh battery storage. The DC system will feed ventilation fans, LED lightning, pumps and hot water tanks. The PV will charge the battery system when the DC load is low in AWL building.

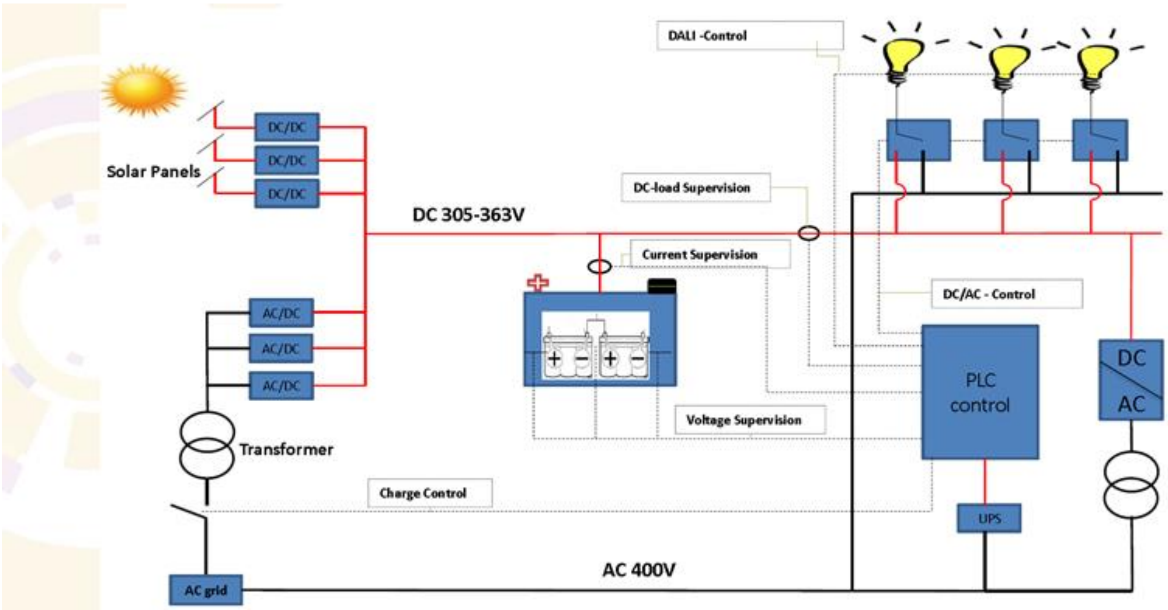

Figure 13 DC system connections in AWL with solar panels, battery and utilisation

In addition to this, GOT will act as receiver for the following solutions demonstrated by UTR and NICE: (i) Smart solar V2G EV charging and (ii) Wireless inductive charging.

4.4.2 Description of scenario – transition track #2

Characteristics of AWL and Brf Viva are shown in Table 7.

Table 7 Characteristics of AWL and Brf Viva

Building name	**A Working Lab – AWL**	**Brf Viva**
Picture		
Building category	Office building	Multi-family house
Building owner	Akademiska Hus (state owned)	Riksbyggen (private)
End of construction	August 2019	November 2018 (1st phase), January 2019 (2nd phase) and April 2019 (3rd phase)
Total floor area (m^2)	9 585	11 200 m^2
Total height (m)	25 m	35 m plus foundation on the highest side.
Number of floors	7	11
Energy target	< 35 kWh/m^2 and year	Positive energy building
Energy system	District heating & cooling system	District heating & geothermal heating

PV surface (m²) / electricity capacity	On AWL roof: 310 m^2/60kW + On adjacent SB3 roof: 770 m² /140 kW	No cooling of apartments, but cooling produced for adjacent office building
Type of storage system (capacity (kWh))	Electric battery (200 kWh) and PCM as cooling storage (350 kWh, in stage 1)	140 kW

4.4.3 Organization of work – AWL (Akademiska Hus)

There is one project manager for AH's all activities in IRIS. The installations that will be executed as part of IRIS WP7, are divided into two sub-projects: the PCM-project and the DC/battery/PV-project. The sub-projects have one sub-project leader each, acting under the project manager.

Each sub-project has its own AH-internal project engineers. To produce technical descriptions and blue prints, consultants are hired. The PCM, PV, battery and DC systems are procured in collaboration with our contractors, who also help us in the construction and assembly work for the systems.

Key personnel include:

- Per Löveryd, Akademiska Hus; Innovation lead at Akademiska Hus, project manager for the demonstrators and task leader for task 7.3
- Per Löveryd, Akademiska Hus; sub-project leader for PCM-subproject
- Rene Frydensbjerg and Olle Nyström, Akademiska Hus; project engineer for PCM-subproject
- Jonas Hansson, sub-project leader for DC/battery/PV-subproject
- Rene Frydensbjerg, Akademiska Hus; project engineer for DC/battery/PV-subproject
- Kristian Friman, Patrik Lindberg and Kaia Eichler, all consultants/enginers from the consultancy firm ÅF, for assistance of Per Löveryd

Sub-contractors involved:

- LG Contracting: Urban Kalin
- Ventab Styr: Martin Persson
- Byggdialogen: Anders Koppfeld
- Researchers: Professor Angela Sasic Kalagasidis; Assistent Professor, Pär Johansson; Doctoral Student Pepe Tan; all Chalmers

Johanneberg Science Park is involved with the coordination of IRIS-activities in Gothenburg, RISE is included in the evaluation of the demonstrators (WP9). IMCG are involved for project assistance.

4.4.4 Timing of activities – AWL (Akademiska Hus)

A current Gantt schedule for the AWL demonstrators can be found in Annex 2, Figures 1-2.

One deviation from the original plan is the step-wise installation of PCM cooling storage. The risk for insufficient performance and thereby high cost for not enough cooling storage capacity is managed by dividing the investment in two stages. In a first stage, 350 kWh cooling storage is installed. The remaining capacity will be procured and installed after the evaluation of the first stage.

4.4.5 Risks and risk management – AWL (Akademiska Hus)

Major risks associated with demonstrators 1 and 3 can be seen in table 8. The risks for demonstrators 2 and 4 coincide with those discussed under Transition Track #1, in table 2.

Table 8 Risks and Risk Management for demonstrators 1 and 3 in GOT Transition Track #2

Risk	Mitigation strategy
Due to cost increases, PCM capacity may not reach the prescribed value	Look for additional funding for a second-stage installation to reach specified capacity.
For the PCM cooling storage: Get the storage operational in time, due to implementation of new technology	The storage will be installed in two phases where hopefully a smaller scale first can be installed, followed by a second phase to get the full capacity later on.
For the DC/PV/battery sub-project, the largest risk is that the battery and the DC systems are not available from the supplier on time	Close and proactive contact with suppliers and

4.4.6 Organization of work – Viva (Riksbyggen)

See this topic under Transition Track #1 for Riksbyggen. All activities are being dealt with by the same group of people and have a similar risk profile and strategy for mitigation, regardless of transition track.

4.4.7 Timing of activities – Viva (Riksbyggen)

Gantt chart for the activities in demonstrator 2 and 4 can be found in Annex 2.

4.5 Barriers and Drivers

4.5.1 Summary of barriers and drivers for Smart Energy Management and Storage for Grid Flexibility

Main drivers for smart energy storages and electricity grid networks for smarter energy management and grid flexibility are the positive expectations and social pressure on actors in the construction industry to work for sustainable development. There are also various policy instruments working in that direction, on both national, regional and local level.

Technology development within for example batteries and cooling storages, is a very strong driver for realisation.

With new technology there are also barriers in connection to taking market shares, finding the right business models and taking technology from idea to marketable product. Initiatives like IRIS can help overcoming these barriers.

4.5.2 Political

Barriers

Subsidies for introduction of new technology can be complex and subject to political decisions and may therefore constitute a barrier for business model development and market introduction.

Drivers

The majority of the political parties in Sweden agree on the need for reducing GHG emissions, so there is unanimous political support for initiatives that will work in that direction. The political will has e.g. been specified in the climate target that stipulates that the West Swedish economy should be fossil-free by 2030.

4.5.3 Economic

Barriers

It is still difficult to quantify life cycle costs of systems and how large the savings are in reality.

Market introduction may be hard for some technologies, especially TCM, where cooling machines have a strong market position today.

Drivers

A flexible energy system will provide financial benefits by enabling storage of energy and shaving peak consumption, which otherwise often constitute the hours with the highest electricity prices on the spot market.

4.5.4 Sociological

Barriers

No barriers were identified

Drivers

Champions (for example people within a municipality or a company who can inspire others within or outside the organisation) and influencers (similar, but using internet as communication platform) in this field will create a positive social context driving the progress in the right direction

4.5.5 Technological

Barriers

As always with new technology, there is a level of uncertainty. Some solutions may prove more difficult than planned and results may not be as expected. Especially the PCM cooling storage has some technical issues to prove, before being mature enough for the market. Battery technology and direct-current-transfer of electricity need to prove the technology in large scale.

Drivers

Technological development is moving fast in this field and this rapid development is a driver in itself. There is also a good opportunity for publicity when new technologies are implemented and tested in real life.

The close cooperation at campus between the property owners and researchers in various fields (often with Johanneberg Science Park as a facilitator) ensures the utilization of research's driving forces to transform good ideas into business opportunities.

4.5.6 Legal

Barriers

No barriers were identified

Drivers

In the case of FED, there is an exception in the legislation for electricity systems at university campuses. In FED we take maximum advantage of this and can build an own electrical system and act fairly freely within this.

4.5.7 Environmental

Barriers

There is still insufficient information on life cycle environmental benefits/costs for the whole energy systems

Drivers

Flexible energy systems are crucial for the development and market penetration of renewable energy sources, which in turn provides environmental benefits.

5. Transition Track #3 – Baseline, ambition, barriers and drivers

5.1 About the demonstrators

Within this transition track, a new mobility service concept connected to accommodation, will be implemented in Gothenburg. This Mobility as a Service (Maas) is called EC2B, "Easy to be", and offers customers an attractive alternative to owning their own car, allowing easy access to a variety of transport modes (e-cars, e-bikes, public transport etc) in connection to where customers live or work and make their everyday choices for transport. EC2B is developed by the IRIS-partner Trivector, an SME based in Lund in the south of Sweden.

In a first step, the service is developed and offered to the residents in the 132 apartments in Riksbyggen's Brf Viva. In the second phase, EC2B will be implemented in a lighter version among the approximately 15 000 employees and students at Campus Johanneberg.

An innovative feature of the service is that it will **include mobility management elements**, where users at strategic points in time will **receive personal advice** on how to achieve a more sustainable travel pattern, taking their specific needs into account. **The service will be augmented by an ICT system** (a Mobility as a Service/MaaS platform), displaying the different transport options available, handling booking, payment, etc, but also involve guidance and "nudging" features steering users towards greener transport options as well as giving access to a sharing community among users. The core task of TT #3 is to **develop the content of the service and the advisory module as well as to coordinate implementation of the service with the actors involved, including property developer, transport service providers and IT developer**.

Within T7.5 of the IRIS project, EC2B ("Easy to be" or "Easy to B", phonetically written), a new mobility service concept connected to accommodation, will be implemented in the Johanneberg district in Gothenburg. EC2B is a new mobility concept that offers customers an attractive alternative to owning their own car, allowing easy access to a variety of transport modes (e-cars, e-bikes, public transport etc) in connection to where customers live and make their everyday choices for transport (Fig. 14). The service will be augmented by an ICT system which offers the users a seamless transport experience and includes the possibility to create a sharing community among them. Furthermore, EC2B draws upon recent research about how users can be "nudged" towards more sustainable travel habits through receiving personalised information about their travel.

Figure 14 EC2B Schematic

EC2B will reduce car ownership and hence demand for parking space, which creates value for property developers as building parking lots and underground garages is very expensive. This also means space is released that can be used for other purposes, creating a more liveable city (Table 9). In district Johanneberg, the EC2B e-mobility service will be implemented at two different levels (Fig. 15).

a) In Riksbyggen's BRF Viva, tenants in the 132 apartments will get direct access to EC2B through accommodation, with specific measures implemented in connection to the building. The city of Gothenburg works to create favourable conditions for property developers who work with innovative housing concepts that reduce the demand for private car ownership. One example is Riksbyggen's BRF Viva in Johanneberg, where the city has allowed the construction of a property of 132 apartments with no regular parking included. In exchange, the property developer is to implement other measures that reduce the need for private car ownership. Residents will have exclusive access to 4 electric cars (to start with Renault Zoe, later on one or two of these might be exchanged for somewhat bigger models of e-cars), 2 light e-vehicles (probably e-scooters), 4 electric cargo bikes and 5 electric bikes, as well as charging infrastructure for all types of electric vehicles (55 recharging polls for e-bikes, 6 for e-cars and 2 for light e-vehicles).

b) A large share of the 15 000 residents/employees/students in the district (e.g. tenants to Akademiska Hus and their employees and students) will get access to a light version of EC2B, which includes information, digital nudging features, community and access to information on and booking of e-mobility vehicles at several locations around the district but does not include specific measures in connection to each building. A variety of electric vehicles and public transport suppliers already active in the district will provide the transportation services.

Table 9 Rationale for the EC2B Mobility Service

Drivers and identified opportunities	Objectives
Reduce need to build expensive underground parking garages	Reduce demand for parking
Reduce CO_2 emissions	Shift from fossil powered vehicles to e-vehicles

Reduce resource use, optimize land use	Reduce number of vehicles in operation
Reduce costs for users	Offer good value for money transport packages
Increase revenues for mobility service providers	Attract new customers to existing public transport and shared vehicle services

Figure 15 Johanneberg Campus area, where the EC2B service will be implemented within IRIS T7.5

In the transition track, GOT is also measured on behalf of electric buses, electric pool cars and charging stations available in area. Numbers over this are reported, but no specific measures for increased use or similar are included in IRIS.

5.2 Baseline

The mobility situation in the Johanneberg area is strained. Gothenburg, as a whole, is a city planned and built for people driving their car to work and back again. During recent years, the city and the regional public transport company have implemented many measures to change this fact, but a large proportion of residents still use the car for their daily transport.

In the area around campus Johanneberg, main actors such as Chalmers University of Technology, Akademiska Hus, other property owners and the municipality of Gothenburg have been working for several years with a Green Travel Plan for the area. According to this, a prerequisite for expansion and densification of the area is that the total travel by car to and from the area will not increase, compared to today's level.

As of today (September 2018), there is no MaaS available, neither for residents nor for employees or students.

Currently, the city has two electrical bus lines, powered by fully electric and hybrid buses. The first, that has been in operation for some years now, is the bus 55, operating the line between campus Johanneberg/Johanneberg Science park and campus Lindholmen/Lindholmen Science Park. The line is operated by eleven buses, of which three are fully electric and eight are hybrid buses. The bus line 16 is partly operated with two electric, articulated buses.

There is charging infrastructure available for electric vehicles, currently 27.

The plans for expansion of these components can be found in table 11 under the Ambition paragraph. Main KPIs for transition track #3 are presented in table 10.

Table 10 KPI's for Transition track #3

KPI – Key Performance Indicator	Target value
Electric vehicles available in the district	25
New charging stations available in the district	63
MaaS, Mobility as a Service	1

5.3 Ambition

Gothenburg's ambition for the selected demonstration and replication (in the near future) is to develop and demonstrate new solutions for integration of different solutions of mobility. The district has adopted a Green Travel Plan, according to which a prerequisite for the expansion of the area is that the total travel by car to the area will not increase compared to today's level.

The Green Travel Plan contains city policy objectives for the city to grow and densify and car traffic will be reduced, city parking policy, the region's goals for increased public transport and the environment on surrounding streets. Shared mobility solutions will therefore be crucial for the expansion of residential housing and offices. The regional company for public transport, Västtrafik, is working to achieve the goal of reducing CO_2 emissions by 80% by 2020. There are proposed targets to reduce CO_2 emissions by 90% by 2035. This last goal is proposed as environment and climate strategy for Västra Götaland Region, which will be decided later in 2018. When this goal is broken down into real plans for Västtrafik to address, it is clear that the targets will not be reached without a powerful electrification of the bus fleet. The plan is to have practically all urban transport electrified by 2030.

The City of Gothenburg and Västtrafik have together developed and signed a Letter of to assist with the conditions required for electrification. The municipality has also assisted Västtrafik for future traffic procurement.

The plans for the nearest future for switching to electric buses, concern the bus line 60. By the autumn of 2019 this line will also be operated by around ten fully electric buses.

The campus area has started its journey for expanding the charging infrastructure available in the area. Some numbers for expansion are available in table 11.

Table 11 Quantified ambitions of Gothenburg for Transition Track #3

	2017	2018	2019	2020	2021
E-MaaS (Electric mobility as a Service) and EC2B	0	0	1	1	1
Electric buses in public transport (fully electric and hybrid buses)	11 buses (3 + 8)	13 buses (5 + 8)	23 buses (15 + 8)	Information on more investments not available	
Charging infrastructure	27	51	51		

5.4 Planning of TransitionTrack#3 activities

5.4.1 Objectives

The objectives of the demonstrator are to implement and test this new and innovative concept for "mobility as a service", evaluate effects on user behaviour, as well as testing and refining the business model of the service to enable replication on commercial terms.

5.4.2 Description of scenario

Within T7.5 of the IRIS project, the mobility service EC2B concept connected to accommodation, will be implemented in the Johanneberg district in Gothenburg. EC2B is a new mobility concept that offers customers an attractive alternative to owning their own car, allowing easy access to a variety of transport modes (e-cars, e-bikes, public transport etc) in connection to where customers live and make their everyday choices for transport. The service will be augmented by an ICT system which offers the users a seamless transport experience and includes the possibility to create a sharing community among them. Furthermore, EC2B draws upon recent research about how users can be "nudged" towards more sustainable travel habits through receiving personalised information about their travel (Fig. 16).

Figure 16 EC2B Schematic

5.4.3 Organization of work:

Trivector Traffic (and potentially further on EC2B Mobility AB as linked third party) are responsible for implementing the demonstrator (52 PM) in collaboration with Riksbyggen (2 PM), HSB (1PM) and Akademiska Hus (building owner at the university) (1PM). CERTH (1PM) will contribute in the evaluation phase. The responsibilities of each partner are outlined in the Gantt chart.

Key personnel include:

- Emma Lund, Trivector Traffic, task leader and expert on MaaS
- Björn Wendle, Trivector Traffic/CEO of EC2B Mobility AB
- Lennart Persson, Trivector Traffic, expert on ITS
- Caroline Ljungberg, Trivector Traffic, expert on mobility management and nudging
- Charlotta Brolin, Riksbyggen, sustainability specialist, responsible for mobility within Brf Viva
- Rickard Malm, HSB, business developer
- Sofie Bårdén, Akademiska hus, strategic property developer

The provision of the MaaS ICT platform has been subcontracted as foreseen in the grant agreement. The subcontract concerns the work related to setting up and adjusting an existing MaaS ICT platform to the requirements of the IRIS project for use within Johanneberg (Gothenburg), together with support and costs related to license during the pilot period. The procurement was made during the spring of 2018, and after evaluation of the tenders, the contract was awarded to a company called Spacetime, who have now started working on the task.

5.4.4 Timing of activities

A Gantt Chart of EC2B development and implementation can be found in Annex 3, Figure 1.

5.4.5 Risks and risk management

Risk and risk management for EC2B are shown in Table 12.

Table 12 Risk and risk management - EC2B

Risk	Mitigation strategy
Delays in construction work of Brf Viva	No longer relevant. A minor delay occurred during ground works, but now work seems to be on track for occupancy of the first houses in November 2018, which means delays do not impact on the timing of the IRIS project.
Problems involving mobility service providers	Major service providers are now on board, so no longer relevant.
Problems concerning development of ICT platform	A close collaboration is being established with the subcontractor, and payment is related to delivery.
Internal resources not enough to cover need	Work on IRIS project is being spread among a larger number of employees to allow for more flexibility in resource allocation
End users not interested in EC2B	Close dialogue with future users before launch of service
Property developers do not see the value of EC2B	Close dialogue with property developer throughout design of the service to understand their needs
Difficulties to find a working business model	Focus on the life of EC2B post-IRIS, where the service should be viable for replication on commercial terms

5.5 Barriers and Drivers

5.5.1 Summary of barriers and drivers for Smart e-mobility sector

Main drivers for more electric vehicles used in a smarter and more sustainable matter are the positive expectations and social pressure on actors in the automotive industry to produce more environmentally friendly cars, but also on other actors to develop and demonstrate other vehicles and services for transport, both private and public. There are various policy instruments working in that direction, on both national, regional and local level.

Technology development in e.g. battery industry and mobile phones, that have been observed in recent years is a very strong driver for realisation in itself.

With new technology there are also barriers in connection to taking market shares, finding the right business models and taking technology from idea to marketable product. Consumer products in particular also place high demands on new thinking patterns and possibly higher levels of knowledge among the public. The possibility to drive your own car is strongly connected to a sense of freedom and to question this and encourage people to take other ways for mobility is a true challenge.

5.5.2 Political

Drivers

A vast majority of the political parties in Sweden agree on the need for reducing GHG emissions, so there is unanimous political support for initiatives that will work in that direction.

For the fleet of vehicles, there is a national goal in Sweden to be fossil free in 2030. Also locally there is a political support for this development.

Barriers

Curtailing private car ownership or private car mobility are sensitive political issues. This means that politicians may try to delay or avoid making such unpopular decisions.

5.5.3 Economic

Drivers

MaaS connected to accommodation can reduce costs for property developers as it might reduce the number of parking lots they need to provide. It can also lower mobility costs for users if they are able to get rid of their car. For mobility service providers, it might attract new customers.

Barriers

It is difficult to find a business model that works for all actors involved in a MaaS solution. Developing and maintaining the digital platform costs money, and most mobility service providers usually have very low margins, so it is hard to find the additional money to fund this new layer.

Electric vehicles are more expensive than, for example, diesel powered vehicles.

Electric buses demand charging infrastructure, for example fast charging stations at each endpoint of the line. These stations are very costly and higher battery capacity in combination with smaller batteries (or really smaller volume per energy storage capacity) are required in order to achieve a full electrification of the city bus fleet.

5.5.4 Sociological

Drivers

There is a strong societal trend where more and more people are concerned about their environmental footprint. Changing one's mobility pattern is not easy, but experience shows that moving into a new apartment is a window of opportunity for behavioural change.

Areas with fewer cars are perceived as more pleasant and safer by the residents.

Electric buses provide better local environment, with lower noise and local emissions of particles and nitrogen oxides than diesel-powered buses. The social acceptance for this technology exchange is therefore a driver.

Barriers

As the service to be developed here (Maas and EC2B) is primarily aimed at newly built housing projects, it is mainly offered to economically privileged groups.

5.5.5 Technological

Drivers

New digital technology opens new possibilities for shared mobility: it has never been so easy to find information, book and pay for public transport, car sharing and bike sharing. Charging infrastructure for e-vehicles is rolled out at scale and many cities invest in bike sharing schemes. These are all drivers for the development of Mobility as a Service, MaaS.

The bus battery development is fast at the moment. Batteries are today smaller and have higher capacity than just a few years ago. If this development continues in the same direction, a fully electrified bus fleet could be economically feasible.

Barriers

In a MaaS solution, APIs from many different sources need to be integrated, which might be difficult if these APIs do not follow the same standard.

5.5.6 Legal

Drivers

In Sweden, more and more municipalities open up for flexible parking norms, where property developers can negotiate to reduce the number of parking lots they provide for each apartment if they instead implement other measures which reduce car ownership among the residents. This opens a new market for MaaS connected to accommodation.

Barriers

Swedish legislation is not clear on what role public transport can take in relation to MaaS, as public transport is publicly subsidized. This has made public transport somewhat reluctant to engage with private MaaS providers.

5.5.7 Environmental

Drivers

The environment will benefit both from the reduction in number of vehicles in circulation (less resources being consumed), the shift from fossil fuel to e-vehicles, the shift of transport mode for some trips from car to public transport, cycling or walking, and a reduction in the number of kilometres travelled, which we know from other projects is a common outcome when people go from owning a car to relying on shared modes.

Electrified buses are cleaner (both CO_2-wise and local environmental effluents such as NO_x and particulates) and less noisy that diesel-powered buses.

Barriers

Mobility packages that include public transport might shift some journeys from walking and cycling to public transport. Similarly, users who did not previously have access to a car might increase the number of car trips when they get access to a car sharing service in connection to accommodation.
The production of batteries for e-vehicles has a considerable environmental impact, especially before recycling of batteries has been widely implemented.

6. Transition Track #4 – Baseline, ambition, barriers and drivers

6.1 About the demonstrators

6.1.1 City Information Model (CIM)

Gothenburg is in the middle of a major transformation in the city's central areas. This is due to a large infrastructure project (The West Swedish package) as well as an increase in exploitation and urbanization. This is particularly noticeable on the North and South banks of the River as well as in areas around the city.

Such big changes within urban areas will affect many people's lives and force a higher degree of coordination between a large number of actors and organizations. It also requires better information and communication. This could easily be perceived to be a problem, but we wish to see this as an opportunity to take the next evolutionary step in adopting and using new technology in digitization (primarily in the visualization area) and thus achieve an improved citizen engagement and a more effective planning process.

To meet the above challenge, we wish to establish a CIM (City Information Model) and use digitalization (and primarily geospatial data) as a driving force. BIM is the existing well-established approach that most construction companies use to model, build and visualize buildings, bridges and streets. CIM, in its simplest form can be explained as an extension of BIM (Building Information Model) to encompass an entire city.

Today, it is not obvious or easy to access the digital information the city has, either internally or externally.

In order to take first steps to build our CIM we need to take advantage of BIM and the BIM files already delivered to the city. These BIM files should be accessible and connected to a visualization tool. The next step establishing CIM will be to link other types of data with BIM data in CIM. During development of CIM, we will also increase the amount of information procured in BIM models and gradually increase the BIM requirements. In the future you should be able to pick up the CIM data based on different timeframes: both the future and present.

Through our work establishing CIP (City Innovation Platform) as well as the digital model CIM, we hope to be able to:

- Increase citizen and political engagement by using visualization in all projects.
- Increase the level of access to project information internally in each executing organization and partnership organization.
- Facilitate the design work by centralizing and having Web interface where projects can submit and retrieve digital models and information both manually and through an API.

- Save money and reduce environmental impact by streamlining management and planning.
- Minimize errors by facilitating for projects to simulate buildings in an appropriate environment and by increasing transparency at all stages of the planning process
- Inspire innovation through visualization

We wish to demonstrate the following:

- Establish a requirements specification for BIM files so they can be used as input to a CIM
- Describe the process as well as recommendations for management of BIM files for project milestones.
- How BIM files can be validated against the requirements (the validation component in the image below)
- How to store BIM files and data (the storage component in the image below)
- How BIM files and other data sources are used to build up CIM (CIM component in the image below)
- How we can make CIM available for visualization and innovation (API, and Visualization App in the image below)
- How we can make CIM/BIM available so that projects can access information from nearby projects (Via Apps/API in the image below)
- How CIM can be used as part of the public and political engagement through visualization (Via City Planner in the depicted in Fig 17.)

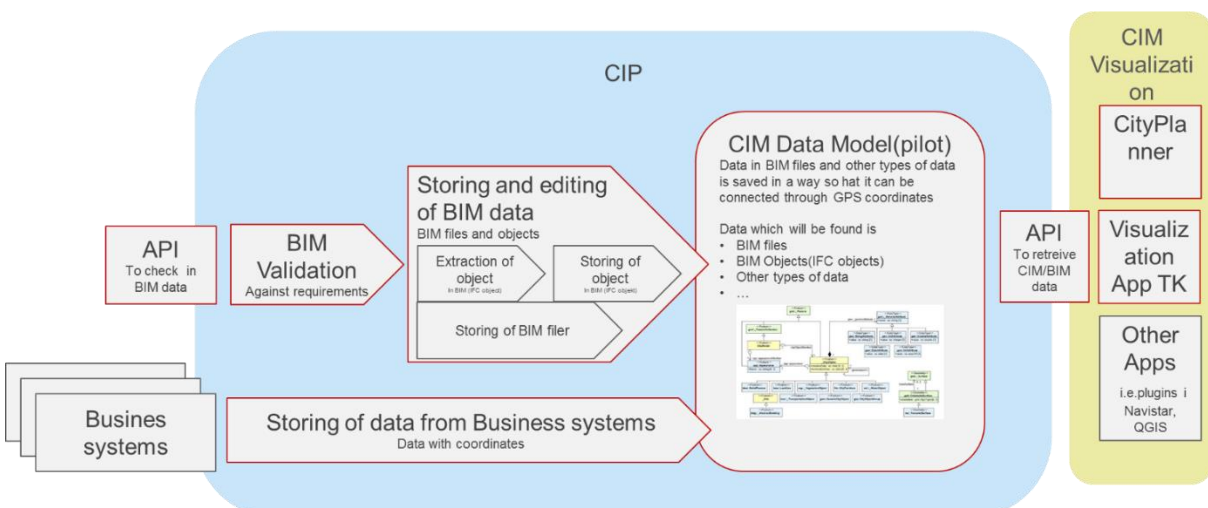

Figure 17 Technical components anticipated as part of the demonstration of CIM in Transition Track #4. The non-red marked components are expected to be developed by someone else

Step 1 of the pilot is to implement this for the Johanneberg district (Fig. 18), with the BIM files owned by the Urban Transport Administration. The area might increase if it is not sufficient for the pilot.

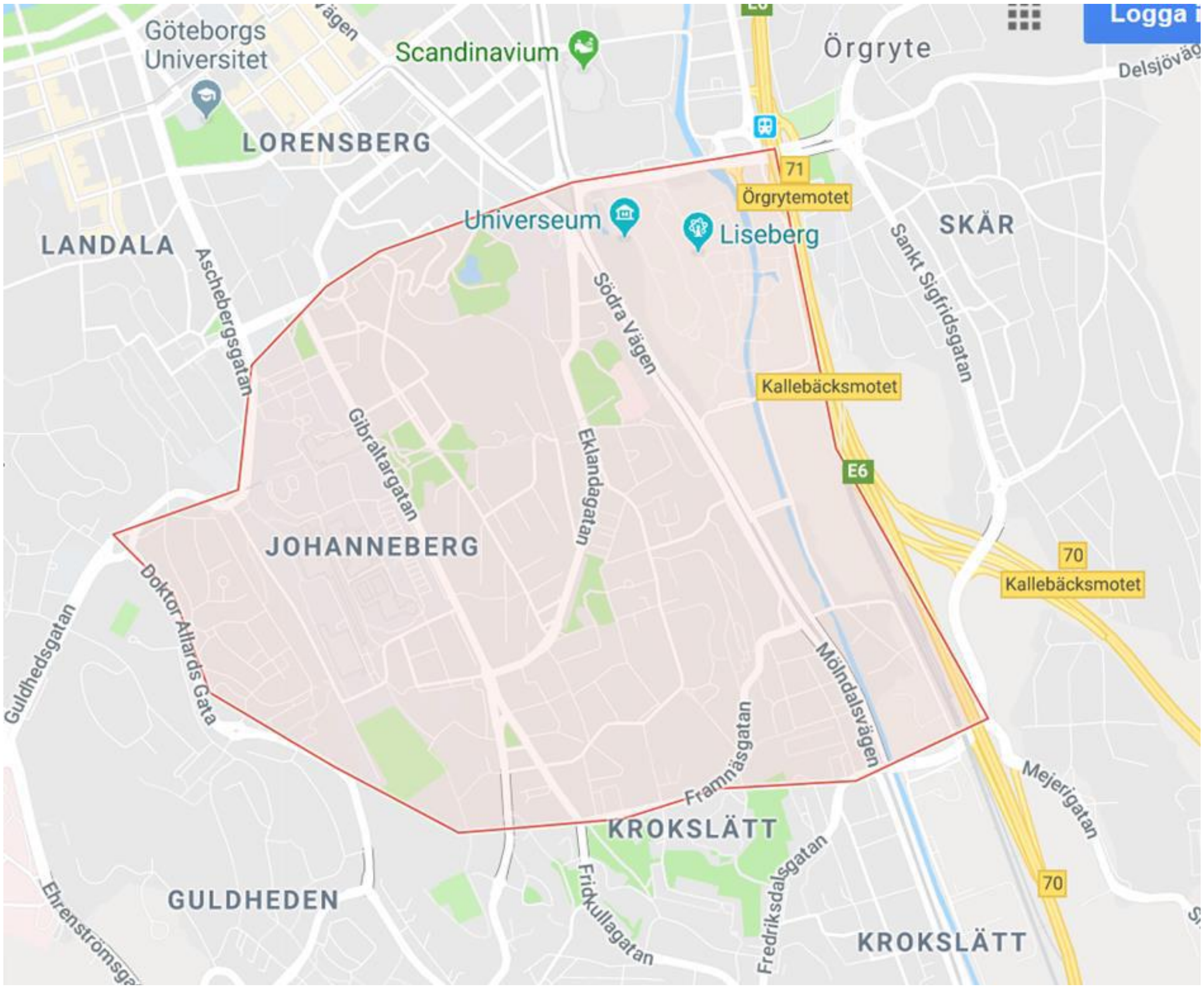

Figure 18 Map of Johanneberg District

6.1.2 Energy Cloud

Research in energy is local and uses sub-optimized data structures for their analyses. Commercial energy services are also based on sub-optimized data structures that make it difficult to scale results to more properties. This includes how to distinguish between different measurables, such as electricity consumption, power generation, a-temp, address or indoor temperature. It is also about what data is available; history, hourly value, monthly reading and what quality it is.

Energy Cloud is a European energy data library and test bed. The data is categorized and follows a unified semantic that enables large-scale replication of data-driven energy efficiency.

With the library, property owners can quickly scale local energy efficiency projects to their entire portfolio. Services such as visualizing to tenants and energy research can also use the library to spread its results internationally without any distribution costs.

6.2 Baseline

Transition Track #4 is directly related to the IRIS project objective “Demonstrate integration of latest generation ICT solutions with existing city platforms over open, standardized interfaces, enabling exchange of data for development of new services”.

Gothenburg has released open data for more than eight years and the work is progressing with a new strategy since 2016 (See Ref. 4). The strategy accelerates the city to be an open and an innovative city, that creates digital services for our citizens and companies (platform Goteborg.se/psidata). According to the strategy, the City of Gothenburg work to share data which is desirable for our citizens. Currently more than 80 datasets are shared as well as more than 20 services. Main focus is Traffic- and environmental data. There are also shared data which is not open to all.

GIS, BIM and CIM: For decades, GIS (Geographic Information Systems) has been used to support the community building area with analyzes and maps as a support in the decision-making process. In parallel, BIM (Building Information Model) has been used to add intelligence in the construction industry. BIM is a powerful approach to smart construction, but information can also continue on the next stage when you want to work with smart management instead. By adding the above techniques you can get something that we can call for CIM, or City Information Modeling, which could be similar to BIM though, in this case, you are starting from the city as a concept, rather than a building or facility. An effect of planning the city through modeling is that it favors in a very clear way the interaction between different disciplines, which in our case consists of different administrations involved in the planning process. At project meetings, different proposals and alternatives can be directly analyzed with regard to traffic solutions and architectural issues.

6.2.1 City Information Model (CIM)

CIM data model:

No CIM data model exists in Gothenburg today.

CIM visualization:

For the citizens and politicians, the current CityPlanner (Fig. 19) is a way to visualize city projects. It uses an interactive 3D map where you can see Gothenburg through a helicopter perspective and it includes some information about larger City development projects on a higher level.

There is no tool to visualize adjacent projects in the same tool.

Figure 19 CityPlanner rendition of the "West Link" infrastructure project in Gothenburg

Data from building projects:

Currently at the Urban Transport Administration, all project data is supplied in 2D. Very few infrastructure projects supply BIM files to the Urban Transport Administration, since this is not a requirement today. Only independent projects provide BIM files on single parts of the project and when the digital models are created by private operators in the planning stage, they are not used by the Urban Transport Administration. They are not stored so that they or the data in them can be reused. There are no specified requirements on the format or on the content of BIM files so BIM files provided might be incompatible with one another.

Other types of data

All Geodata is in 2D.

Not all data is geotagged or has coordinates.

The relevant KPI is: “City Information Model (CIM) Implemented”, the baseline situation being that there is currently no such model in existence in Gothenburg.

6.2.2 Energy Cloud

An “Energy Cloud” will be developed and implemented in the LH district Johanneberg in close collaboration together with real estate owners and other stakeholders. Near real-time data from energy (electricity, heat and water consumption) will be collected, integrated and made available for further analysis, thereby opening up for new applications to optimise energy supply and management in the district.

Research within energy is mostly local and uses sub-optimized data structures for analysis and evaluation. Commercial energy services are also based on sub-optimized proprietary data structures that make it difficult to scale clever applications and innovative solutions to the national, European and international real estate industry and property stock in general. This includes how to define different types of electricity and heat loads, power and heat generation units, a-temp, address and indoor temperature. It is also about how to specify what data is available; data history, time stamps, hourly value, monthly readings and data quality. The challenges facing developers of new energy service applications is in fact very similar to the challenges that faced computer game developers in the 1990s. Each game had specific computer system requirements and if they were not met, the game did not work. Advanced Games with high system demand would only run on a few computers. Games with lower system requirements and less spectacular features on the other hand, could run on all computers and target a much larger market. The most successful games where the ones that managed to find the right balance between attractive features and scalability. The Energy Cloud demonstrator takes inspiration from the gaming world and structures energy data with a semantic and purpose to provide energy service providers a generic platform to easily scale their applications and solutions to buildings and markets in general.

The ultimate value proposition to energy service developers is then simple: Adapt to the EnergyCloud semantic system requirements on energy data and your application will run in any building in Europe and the rest of the world.

The issues described above is very much also true for the buildings stock and real estate actors involved in the Gothenburg demonstrator that includes HSB Living Lab representing the high end of the building spectrum when it comes to advanced and comprehensive sensor and energy data acquisition systems. The demonstrator also includes more standard and generic low-end data acquisition solutions in older office and student housing buildings also on the Chalmers campus as well as some new and ongoing housing development projects in downtown Gothenburg representing the present standard set up for modern commercial building projects including on site electricity micro production, EV charging solutions etc.

The relevant KPI for this demonstrator is “Energy Cloud implemented”. Currently, there is no such system in existence.

6.3 Ambition

6.3.1 City Information Model (CIM)

Gothenburg’s ambition is to take the next step and integrate building data with infrastructure data and urban planning data to realise the City Information Model (CIM), the digital twin. CIM will be a platform to greatly enhance the efficiency of city management and planning, both saving money and reducing the environmental impact.

CIM takes the concept of BIM (Building Information Modelling) to the next level by incorporating city data in the model. CIM is the perfect data platform for the smart city as it includes building data as well as infrastructural, geographical and urban planning information. This needs to be done in steps.

In task 7.6 subtask 1, the City aims to take the first steps and test the concept of CIM (City Information Model) with transport data in a pilot in the district Johanneberg. An investigation is proceeding among the district and the wider areas around for certifying the collection of BIM data in relation to infrastructure. The CIM pilot will be using BIM files and limited city GIS data and some other types of data from the Urban Transport Administration to build up the first CIM data model for the transport sector. We currently foresee the following components to demonstrate from the CIM pilot:

- A description of the CIM data model for the transport sector (e.g. roads)
- A component which validates BIM files against requirements
- A component where BIM files and data can be stored and edited
- The CIM model made available for visualization and innovation through the API and a visualization app and through CityPlanner.
- The CIM model with BIM files made available so that projects can access information from nearby projects via the API in their own tools

6.3.2 Energy Cloud

The ambition with EnergyCloud is to reduce energy consumption in buildings - first at Chalmers Campus of Johanneberg and Gothenburg city, then Sweden and Europe. This will be done by targeting one of biggest bottlenecks for data driven energy savings - access to structured energy data. Energy cloud will collect energy data from buildings in Gothenburg, including micro-production, EV-charging, building control systems, smart meters and tenants. To structure the data a common semantic structure will be identified or, if needed, developed. A tool will be developed to help electricians, installers and facility managers to structure the data produced by the hardware they install, according to the semantic structure.

With the energyCloud and its structured energy data, property owners will be able to quickly scale local energy efficiency projects to their entire portfolio. Services such as visualizing to tenants and energy research can also use the library to spread its results internationally without any distribution costs.

The demonstrators will include contributions from Riksbyggen, HSB, Akademiska hus, Chalmers Fastigheter and Metry. They capture a wide spectrum of user requirements and buildings, from advanced energy research to commercial facility and property management.

Metry´s ambition with Energy Cloud is to reduce energy consumption and optimize the use of energy by promoting digital innovation, at Chalmers and at the campus of Johanneberg, and also to replicate at local, national and European level if possible interest. The demonstration is as well of great interest for the City of Gothenburg likewise real estate owners who are the main target group for making sufficient different within organizing and innovate collection of energy consumption for different demands. This include to develop for example cohesive procedures for gathering energy data and develop standards which is one identified demand and sufficient need for researchers and real estate owners in the LH district.

The partner Metry will manage and lead the development and demonstration of the Energy Cloud, compile needs and responsibilities to define system requirements and semantics. Real estate owners situated in the LH district will be the main target group, but it can also be in the other LH's and FC's. Gothenburg's ambitions are summarised in Table 13.

Table 13 Transition Track #4 Ambitions for Gothenburg

	2017	2018	2019	2020	2021
Measure 1: CIM	specification	co-creation	demo	operation	Iteration
Measure 2: Energy Cloud	specification	co-creation /demo	operation	operation	operation
Measure 3: open data to enhance ICT service supporting district microgrid	specification	demo	iteration	operation	operation

6.4 Planning of Transition Track#4 activities

6.4.1 City Information Model (CIM)

Objectives

The objectives for establishing CIM, the digital city twin, are to:

- Increase citizen and political engagement by using visualization in all projects.
- Increase the level of access to project information internally in each executing organization and partnership organization.
- Facilitate the design work by centralizing and having Web interface where projects can submit and retrieve digital models and information both manually and through an API.
- Save money and reduce environmental impact by streamlining management and planning.
- Minimize errors by facilitating for projects to simulate buildings in an appropriate environment and by increasing transparency at all stages of the planning process
- Inspire innovation through visualization

Description of scenario

The plan for CIM is to combine BIM (building information model), GIS (geographical information systems), visualisation (e.g. 3D) with the possibility to select a timeframe (be it in the future or past) and get all valid information and visualize this information (e.g. on a 3d map). The BIM files will be downloadable.

For the CIM pilot in the IRIS project we will take the first steps in building our CIM by using BIM files and some limited GIS data and other types of data from the Urban Transport Administration within the district of Johanneberg.

Organization of work:

The work will be led by a steering group consisting of managers within the city, mainly from the Urban Transport administration. Preliminary key participants are IT manager, Asset manager, Investment manager and Geodata strategist.

The Urban Transport administration will establish a project group with representatives from different stages of the building process. The project group will be led by the task leader for Task 7.6, Subtask 1.

Tyréns will be developing the majority of components according the city's specifications and requirements. The city will be developing some of the integration components.

It has not been decided on any subcontractors yet but we expect to use the city's frame agreements for IT services and development.

Timing of activities

The work will start with a pre-study with the following preliminary deliverables:

- Prioritized functional demands with mapped stakeholders and information sets
- A simple study of other CIM implementations in the world
- A prioritized list of what other data to provide in the CIM pilot except for the BIM data
- Describe the process as well as recommendations for management of BIM files for project milestones.
- A list of the components in the CIM pilot solution

After that a specification phase will follow with the following preliminary deliverables

- Specification of requirements for each component in the list
- Specification of requirements for the interfaces
- Specification of requirements for BIM files so they can be used as input to a CIM
- A suggestion for management of the components
- A description of the pilot data model for storing BIM data in combination with other data with coordinates
- Implementation plan for the pilot

We are currently foreseeing the following demonstration objects at M30

- A component which validates BIM files against the requirements
- A component where BIM files and data can be stored and edited
- The CIM pilot made available for visualization and innovation through the API and a visualization app and also through CityPlanner.
- The CIM pilot with BIM files made available so that projects can access information from nearby projects via API in their own tools

A timeline for the CIM development can be found in Annex 4, Figure 1.

Risks and risk management

Risks and Risk management for CIM development and implementation are shown in Table 14.

Table 14 Risks and Risk management for CIM development and implementation

Risk	Mitigation strategy
The desired personnel resources with the right competences might not be available	Secure correct personnel in advance. Identify alternatives, this may include tendering consultants.
Not enough BIM data from the Johanneberg District	Major service providers are now on board, so no longer relevant.
Other related city projects that	Raise this to project management for the City of Gothenburg and IRIS in

we are dependent on do not have the same timeline	order to coordinate resources
IRIS's budget not sufficient to cover the high ambitions	External financing must be identified. The Urban Traffic Administration has already identified this risk and will be contributing
The CIM visualisations will generate external input that may overwhelm city personnel	Extra resources may have to be provided by the managers of the city, or we need to advise that response times will be longer

6.4.2 Energy Cloud

The three most important aspects of Energy Cloud are:

- Data from many properties. The more real estate, the greater the spread of projects and services based on Energy Cloud.
- Broad acceptance with property owners. Primarily, structure and semantics must fit the needs of real estate owners, but it is also important to reach out and create a critical mass of affiliated real estate companies.
- Service developers. In order to have services on the platform that scale, there must also be players who develop services. That could include property owners themselves, commercial actors and researchers.

The partner Metry will manage and lead the development and demonstration of the Energy Cloud, compile needs and responsibilities to define system requirements and semantics. Akademiska Hus (AH), Chalmersfastigheter, Riksbyggen (RB) and HSB (HSB) will participate in the development of standards and convey the needs of researchers as well as spread Energy Cloud into its own channels. Make its energy data available (not open but available after approval).

HSB Living lab (HSB), Riksbyggen (RB) and the project FED- Fossil-free Energy Districts (UIA Programme) will set target specifications and participate in pilot projects. Build services on energy data structured according to the semantics proposed, these are counted as "applications" on Energy Cloud.

A timeline (Gantt chart) broken down to activity level can be found in Annex 4, Figure 2.

6.5 Barriers and Drivers

6.5.1 Political

Barriers

There is sometimes a reluctance from politicians to open up access to data for fear of abuse

Drivers

There is a general political drift towards making more data open.

6.5.2 Economic

Barriers

Energy Cloud, Market barriers: A major market barrier for introducing and scaling new energy service applications is the lack of standardization and common energy data semantics across the national and international real estate industry. Although there are several ongoing initiative and efforts in this domain including Real Estate Core, Fi2XML and Fastmarket the process is slow due to different needs among different types of real estate and property owners.

Drivers

Energy Cloud, Market drivers: One of the most significant and important drivers include an increasing use of smart digital solutions by the real estate industry to optimize energy use in the building stock. Efficient building energy management is also growing more and more complex with the introduction of distributed micro energy production, energy storage and integration of buildings with the transport system through EV-charging solutions. This generates more energy related data as well opportunities and challenges to use this data for optimization on individual buildings, blocks of buildings, districts and city level. The optimization objectives and cases include both real-time operation as well as in the planning and strategy phase.

CIM:

The City Information Model could potentially save huge sums for the city thanks to improved quality of planning with the help of comprehensive data from a district

6.5.3 Sociological

Barriers

Energy Cloud, Behavioural barriers: Defining standards are many times easy compared to making organization and humans to adopt them. When it come to the energy data standards in the real estate industry you will typically be challenged by the behavioural resistance by local technician and property management staff responsible for the practical implementation of data standards and structure.

Drivers

Energy Cloud: Broad acceptance with property owners. Primarily, structure and semantics must fit the needs of real estate owners, but it is also important to reach out and create a critical mass of affiliated real estate companies.

6.5.4 Technological

Barriers

CIM:

- There is a lack of standards
- The storing of BIM data will require large storage capacities
- Not many projects deliver BIM data today.

Drivers

Energy Cloud: There is data from many properties. The more real estate, the greater the spread of projects and services based on Energy Cloud.

6.5.5 Legal

Barriers

No legal barriers pertaining to data privacy barriers have been identified. The information provided in the CIM is not personal data.

Energy Cloud, Data privacy: The new GDPR regulation has put more pressure on the importance of data privacy. Uncertainty and lack of competence among real estate industry on the legal implications of the new data privacy rules has created GDPR anxiety although energy data in most cases are not subject to data privacy regulation.

Energy Cloud, Regulatory barriers: Another related regulatory barrier is that ownership of energy data in many cases is distributed on multiple stakeholders (tenants and energy users) in one single building and not only the building owner.

Drivers

CIM : Increase the degree of innovation and increase transparency. Parameters can be measured and monitored and provide support for different types of events and decisions in the city planning process. Energy Cloud, Regulatory drivers: Smart meter regulation

6.5.6 Environmental

Barriers

No environmental barriers have been identified.

Drivers

CIM: The implementation of a City Information Model promises huge environmental benefits thanks to improved planning and greater efficiency in execution, for instance improved logistics when building new houses or infrastructure

Energy Cloud: Inherently, Energy Cloud increases awareness and transparency of the energy usage of companies, buildings and residents and thus provides the foundation for energy savings.

6.5.7 Organisational

Barriers

- The information that will build the CIM for the entire city in the end is owned by different administrative units of the City of Gothenburg. These administrative units are governed by different political boards and have different budgets.
- Geotagging is not a natural part of the process today, this is a new way of working
- Getting everyone to deliver into the model, and keeping the data correct and updated with the ability to update it in an easy way will be a challenge.

Drivers

- Logistic and economic: The urban development plans concerning traffic and buildings in Gothenburg are huge and intense which demand new solutions such as a City Information Model to increase logistic as well as economic aspects.
- The anchoring for the task of CIM has been settled at all levels within the Gothenburg Traffic Office for implementation.

7. Transition Track #5 – Baseline, ambition, barriers and drivers

7.1 About the demonstrators

7.1.1 Min Stad (My City) as a dialogue tool in the city's planning process

My City is a place (tool) to exchange ideas about urban development in Gothenburg (Fig. 20).

A possible development trail for Min Stad, and perhaps the strongest development opportunity for the tool if the ambition is to develop it into a dialogue tool between the municipality and the citizens, is to open the possibility that parts of the planning process's civil dialogue can take place through Min Stad. Such a development opens the possibility of reaching a new user group that is unrepresented today, but it also involves several different deliberations and issues that need to be addressed.

In the Swedish planning process, the prerequisites for, and the possibilities of, civil dialogue are relatively controlled. Dialogue can take place in many different ways and involve many different people and professions. However, in order for the individual's opinion to be given a legal status, it is in principle required that it be provided as a written opinion in which the proposer's identity is ensured. Such an opinion delivered in one of the planning process phases is a prerequisite for the individual to, at a later stage, be entitled to appeal a decision. The individual also must be considered directly affected by proposed changes.

Today, consultation with the public is taking place in the planning process through the presentation of traditional drawings, maps and text documents published on the municipality's website and exhibited at different locations in the city. This happens at some specific stages, where citizens are invited to dialogue and can also comment. During the planning process, the municipality may also choose to hold public meetings in various forms inviting the public to receive information and convey views directly to the city's officials. However, the views expressed in this way are not official in the opinion of the law but must be supplemented by a letter that is diarised by the municipality. Today's civil dialogue is characterized by a high degree of one-way communication, where the municipality collects a large amount of facts and information presented as a static material for citizens to absorb. There are obvious problems that the material is both difficult to access and that it is aimed at certain groups in society. The scope for dialogue is also greatly restricted by the fact that the viewpoint pickup takes place only on specific occasions, usually over a period of six plus three weeks during planning projects that often take two to three years to develop.

Within IRIS, the possibilities for developing Min Stad into an active dialogue tool will be explored. The goal is to spread information more efficiently in a new channel, to reach new user groups and to explore how far the dialogue between the municipality and citizens can be developed within the current legislative framework. A first step may be to, with the help of citizens, find a good form for how data is presented and to link new forms of information into the current dialogue process. In a further development, the tool Min Stad can be developed to present more complex information while allowing the citizen to not only write comments but also modify the proposal presented by the city and / or create their own suggestions in the form of models, sketches or the like.

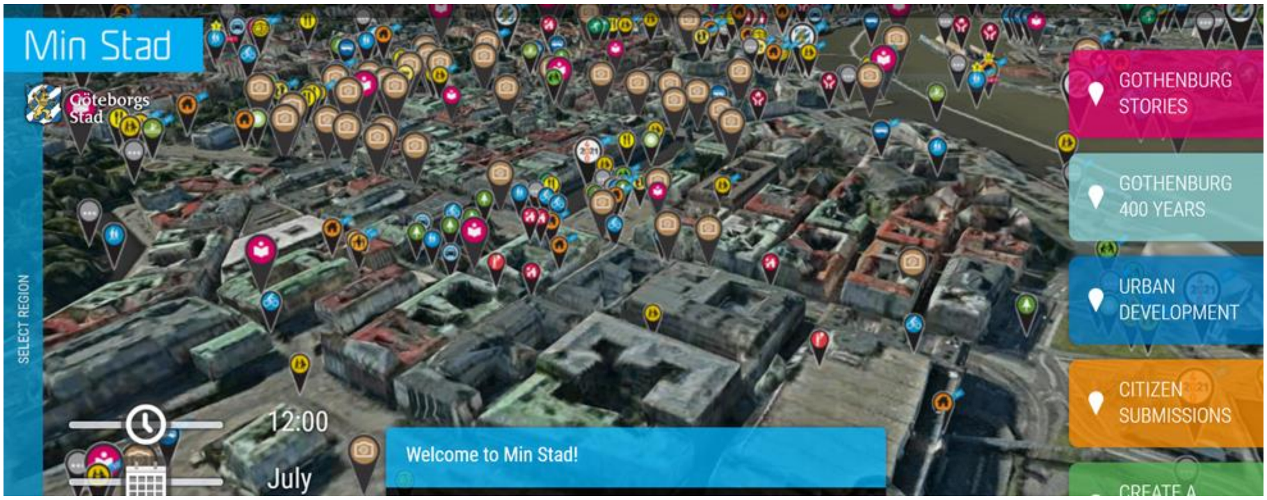

Figure 20 Min Stad introduction page http://minstad.goteborg.se/minstad/index.do?lang=en

Develop and evaluate how to increase citizen interaction and engagement based on models of co-creation and collaborative innovation - The process dimension.

A combination of passive (informed and involved according to HKU categorization) and active (contributing and co-creating) citizens involvement in the development of Min Stad in different phases of development work: idea generation, idea conceptualization, idea assessment. The two different varieties of commitment mean that the role of civil servants in the city and the role of citizens have changed somewhat. When giving citizens the space to actively contribute to development work, the control of the contents is shifted towards the citizen. In the position as passively engaged, you have different rights and obligations than those you have as actively engaged. The two different types of engagement also require specific organization and facilitation to be perceived by both parties as worthwhile and meaningful.

Planned interventions

a) The citizenship engagement model (ME model, Table 15) will provide a starting point for the planned activities within WP7, Task 7.7 Citizen engagement, and the activities will, in turn, contribute to the knowledge about what rights and obligations citizens have in the different types of commitment in each phase. The ME model constitutes the basis for learning and knowledge generation about citizens' involvement and commitment to further development of the Min Stad Platform. The ME model will also provide the basis for discussing what kind of organization and facilitation the different types of citizenship require. Work on the ME model includes the following activities:

- 3 Workshops (Workshops 1-3) in WP 7 Task 7 to talk about 1) What kind of commitment should be used in the different phases of the development of the "Continuous Dialogue", "Inclusive Life" contest and "Smart City Hub" 2) what rights and obligations citizens should have linked to the different types of engagement and phases; 3) how is this commitment to be organized and facilitated

- During a selection of activities, participatory observations will be conducted to see how citizens act.
- Following the activity of citizens involvement linked to the "Inclusive Life contest" and "Smart City Hub", the citizens' perceived rights and obligations will be captured via surveys and / or interviews.
- 3 Workshops (Workshops 4-6) in WP 7 Task 7 where data from surveys and / or interviews are discussed to further develop the ME model and evaluate whether the desired degree of citizens' engagement has been achieved and how this relates to the results obtained through this commitment and how organization and facilitation worked.

Table 15 Citizens' engagement model

		Citizens' engagement			
		Passive (informed and involved)		Active (contributes and co-creates)	
		Rights	Obligations	Rights	Obligations
Idea	Assessment	xxx	xxx	xxx	xxx
	Conceptualisation	xxx	xxx	xxx	xxx
	Generation	xxx	xxx	xxx	xxx

b) Smart City Hub

Today's Min Stad is largely based on the city as a whole. A large amount of information is presented, and residents have the opportunity to engage with the whole city. In today's information society, however, the large amount of information becomes a problem of its own. It is difficult for citizens to find the information they seek in the overflow of information and it is usually from the own geographic context that you are interested in seeking information, what happens near where I live and work. Examples of information that is interesting from such a perspective include: Are there any political decisions that concern my neighborhood? Is there any planning in my vicinity that I may have any comments on? Will road work affect my way to and from work, etc.

A solution to this problem can be a so-called smart city hub. A tool that compiles and filters information based on specified rules and a geographic context. The information that such a tool consumes should be open data provided by the City. Data describing ongoing plans, ongoing street work, planned events or documents, and information stating political decisions, all geocoded to a geographic location or area. In a first step, a preliminary study will be conducted. The preliminary study will highlight citizens' needs, what kind of data that can meet these needs, which data is available for the prototype as open data and how a technical solution can be designed.

In the next step, a prototype is developed based on open source and based on the prerequisites of the preliminary study. The prototype should showcase a possible technical solution and highlight opportunities and issues and provide a basis for continued work on Min Stad 2.0.

c) Continuous Dialogue – Min Stad

Within the framework of IRIS, the possibilities of developing Min Stad into an active and ongoing dialogue tool should be explored. The goal is to spread information more efficiently in a new channel, to reach new user groups and to explore how far the dialogue between the municipality and citizens can be driven within the current legislative framework. A first step may be to, with the help of citizens, find a good form for how data is presented and to link new forms of information into the current dialogue process. In a further development, the Min Stad tool can be developed to present more complex information while allowing the citizen to not only comment but may also modify the proposal presented by the city and / or create own suggestions in the form of models, sketches or the like.

Work in this intervention will be conducted as investigative work, where conditions such as laws and frameworks are highlighted from different perspectives, leading to demonstrations of possible approaches. A number of scenarios and options can be created and evaluated within the smart city hub pilot.

d) Inclusive Life Challenge

As a final step, an open “Hackathon” is organized where the goal is to develop a smart city hub. The starting point for this intervention is all the information gathered in during the previous interventions as well as the citizen's needs based on location and interest and open public data. The hub shall, if possible, provide both the opportunity for reading information as well as interactive dialogue.

7.1.2 Personal Energy Threshold (PET)

Until now, the residents in the HSB Living Lab and HSB building stock have not been able to choose what kind of energy source they want and when to use it. There is also poor feedback on their own energy consumption. The property owners’ knowledge of the individuals’ energy consumption is not visual enough. Therefore, the PET will be demonstrated for evaluation and replication possibilities. The Personal Energy Threshold (PET) is a tool for visualising and optimising residential energy usage for the individual, and is available for smartphones and tablets (Fig. 21-22)

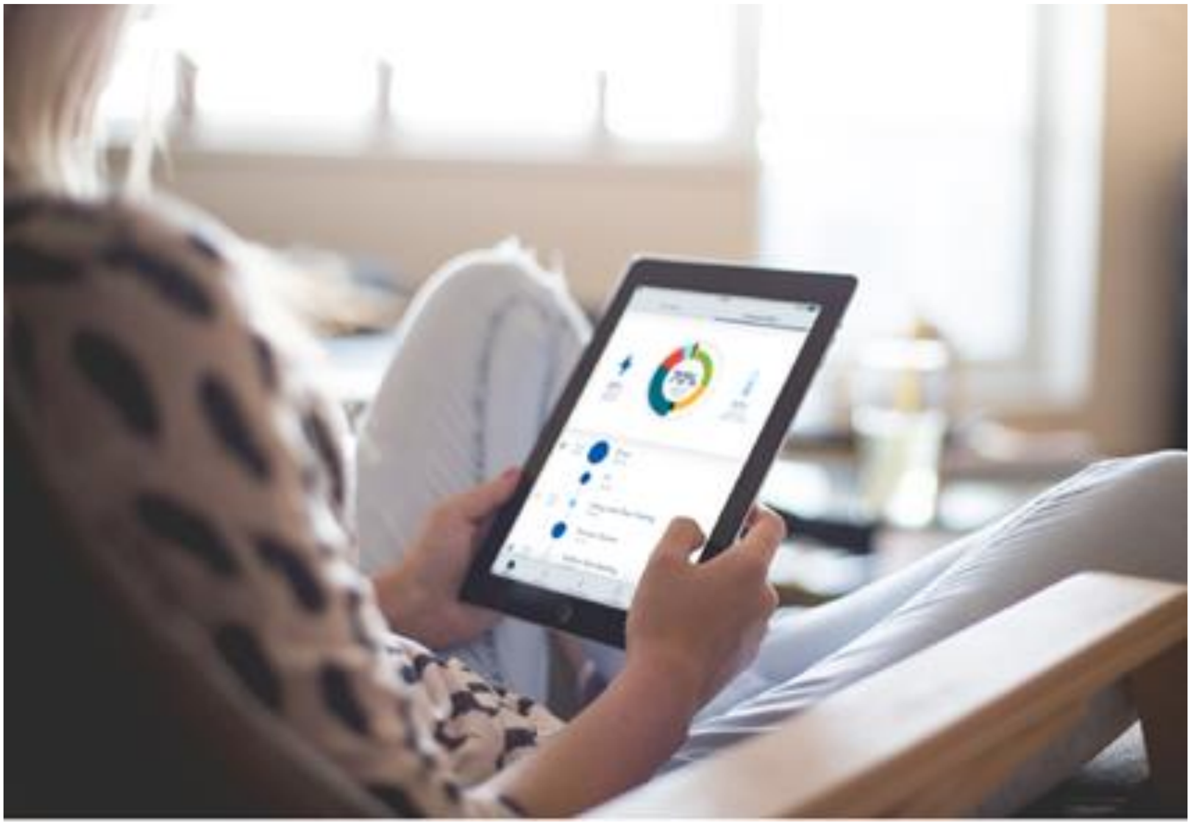

Figure 21 PET on a tablet

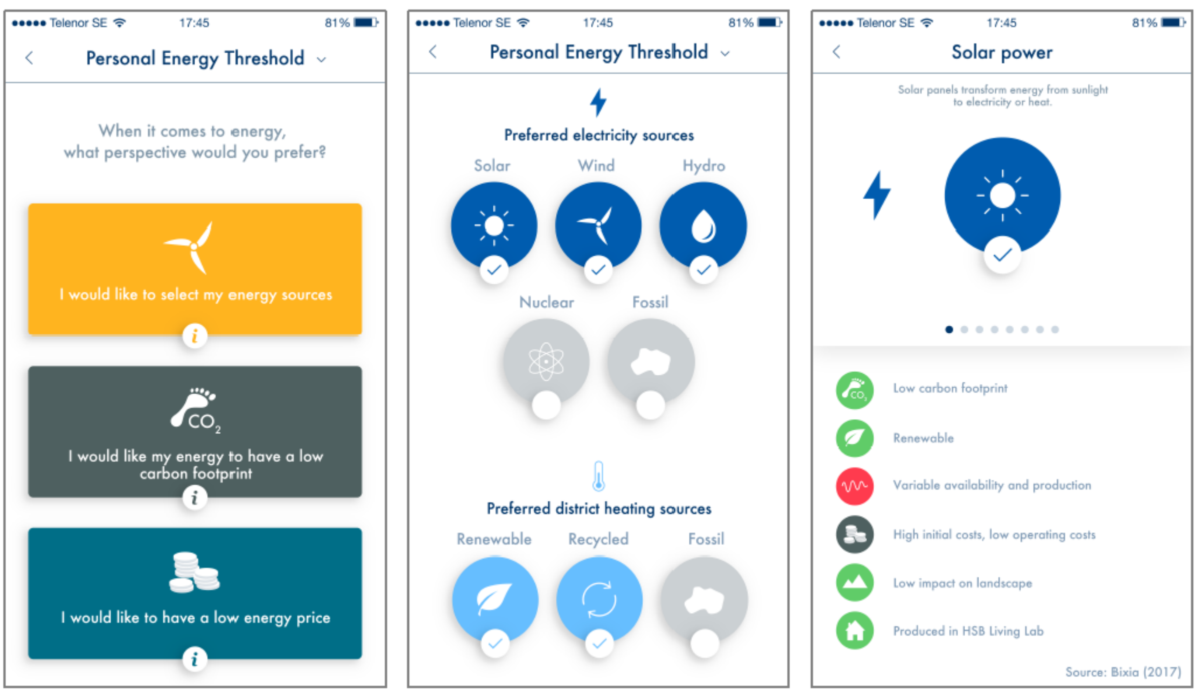

Figure 22 PET data screens on a smartphone

7.1.3 3D BIM

HSB will demonstrate a BIM (Building Information Modeling) based 3D Virtual Reality Environment that will virtually immerse users in the inner workings and properties of a building, providing deeper understanding and involvement in the building's processes (Fig 23). This demonstrator will be housed in the HSB Living Lab, where the innovative environment and extensive sensor network will provide relevant inputs to the demonstrator.

Figure 23 3D BIM application on tablet (from pre-study)

7.1.4 Minecraft® Planning Competition

The intervention involves organising a spatial planning design contest for children and youths based on a Minecraft® model of Gothenburg. The design contest in Minecraft® will be targeted at the new electricity bus line no: 55 and the bus route between demonstration district Campus Johanneberg and Lindholmen. Within the targeted infrastructure bus stops will be specified on themes described in a pedagogic language. Another activity will be the organisation of a spatial planning design contest using the Minecraft® city model aimed at young people ("Model a Better City") Individuals, classes and several schools will build the new attractive society which will eventually be expanded in the building game Minecraft®, with 2021 as the target. Minecraft® focuses on allowing the player to explore, transform and interact with a dynamic game map made of cubic meters of large blocks. Students will be working on the basis of a proper map from the National Land Survey of the area where the ElectriCity bus has its route – from Lindholmen to Campus Johanneberg.

Figure 24 Excerpt from YouTube video about Gothenburg's Minecraft model & the Electricity bus in the LH district

Main KPI’s include: Number of participants in spatial planning contest (target: >100), inflow of ideas for “Green Life” contest (target: 200), infrastructure added to “Min Stad” (>25 % of existing infrastructure in the district).

7.2 Baseline

7.2.1 Min Stad (“My City” dialogue tool)

The City of Gothenburg works with different types of civil society dialogues in various operations and processes in the city. Within urban development, a public tool called Min Stad (“My City”) (Min Stad.goteborg.se) has been developed. In Min Stad, citizens have the opportunity to read others’ or create their own contributions and suggestions regarding urban development. Furthermore, the city presents information in the tool, such as planned urban development projects and anniversary efforts (the city's 400th anniversary). The tool is available in both Swedish and English. Residents also have the opportunity to upload self-contained stories about events or places. The tool has been around since 2012 and is a cloud service constituted by a web portal built around a 3D map as well as an app for mobile platforms. Posts from Min Stad are loaded into the Urban Business Office's internal operating system and are managed as general conditions and inputs regarding the detailed planning process. On the other hand, there is no requirement or any possibility that posts are treated as a legal opinion within the planning process. In order to get there, a study needs to be conducted that highlights the possibility of including this type of input in the process.

7.2.2 Citizens' influence and democracy in the City of Gothenburg.

The City of Gothenburg City Council's overall goal is to increase the opportunities for participation and influence of Gothenburg. This will be done by allowing participation and influence for groups in the city that are usually not active in decision making. The Board of the Consumer and Citizens' Service owns the process of achieving this goal. An assignment that is linked to the goal is that democracy and election-enhancing efforts will take place in the areas with the lowest number of voters; Angered (N Gårdsten), Västra Hisingen (Biskopsgården N) and Östra Göteborg (Gärdsmosse), which in the election to the City Council 2014 had a voting participation of 37.4, 52.6 and 46.1 percent respectively. Västra Hisingen's election participation was lowest in the country.

During the year, discussions are held on the city's functions that involve participation and influence (City Council Office, Youth Council, Electoral Committee, Jämlikt Göteborg ("Equal Gothenburg"), Sports- and Association Administration, Cultural Administration, Social Resource Management and the neighbourhoods, etc.). The purpose of these meetings is to understand the needs and coordinate the work.

In order to work for increased influence, recurring contacts have been taken with the districts with the lowest proportion of voters; Angered, Västra Hisingen and Östra Göteborg. The Bureau for Consumer and Citizens' Service invites consultations with politicians and district directors for the neighbourhoods based on ideas on how the City can support democracy work and how the means available to stimulate increased involvement and influence can be used.

Göteborgs SOM (a yearly opinion poll concerning public attitudes to current issues) is implemented to understand the citizens experiences of local democracy, the ability to influence political decisions and confidence in the municipality's activities, etc. The ambition is to analyse and learn more about the citizens' perspective over a span of years until 2021 in order to take action in places where it is needed.

Jämlikt Göteborg is about Gothenburg being the equal city that contributes to a good life for all. Here the commitment is to support and contribute and to take responsibility for the focus area called participation, influence and trust.

Another group receiving special attendance at the City of Gothenburg are the young voters who now have the opportunity to vote for the first time. Voting when young increases the chance that you will continue it even further in life. The city therefore invests extra on the young first-time voters.

The city is carrying out an annual inventory to see how the city's administrations and companies work with civil dialogue. In this inventory we are considering what kind of dialogues are being conducted. Civil dialogue refers to a politically-driven dialogue, that is, the dialogue created by the politicians and citizens or the dialogue conducted by municipal authorities/ companies, but on the clear assignment of politicians (based on decisions, governing documents or similar).

The above work is a starting point for the development of the Min Stad dialogue tool and the associated areas of action intended to develop within the framework of the IRIS project.

7.2.3 3D Building Information Model

Properties are now being connected to cloud-based systems i.e. sensors that measure energy consumption that are useful for energy monitoring and allows it to be controlled by a mobile phone. The virtual copy of HSB Living Lab has the potential of being a platform for all IoT products. Furthermore, it could also be a digital version of the building that sends notifications for property managers when, how and why to do different kind of services. When starting up a renovation process/new research project the BIM model can be used to simulate different scenarios prior to decision making.

7.2.4 PET

With the PET project’s application, the awareness of energy consumption and its environmental impact will be visual for both the tenant and the property owner within HSB Living Lab in the Lighthouse district and for potential replication in HSBs building stocks. The application will deliver several ways to choose what kind of energy to use, when to use it and what to use it for. i.e the tenant can primarily choose energy produced by the PVs for a certain purpose and when to use it or use a mix of energy with the lowest environmental impact. PV installations are as well increasing in Sweden, and property owners are searching for solutions to deliver PV energy directly to the tenants with the purpose of nudging and awareness of saving energy and climate impact. The PET app can therefore be a very useful and engaging tool for energy distribution.

Energy saving compared to average Swedish buildings: 67 kWh/m2/a, or totally 1,5 GWh/a

7.3 Ambition

Gothenburg’s ambitionary pathways includes measures for citizens engagement and co-creation in district Johanneberg to incentivise citizens to live more sustainably by adapting their behaviour to lower energy use, choose sustainable alternatives and engage in crowd-sourcing activities. In proposals that directly and significantly moves the city / district's residents civil dialogue should always be considered and the position taken at major changes of municipal activities should endeavour to engage in dialogue with citizens. the use of Minecraft® city model aimed at young people (“Model a Better City", (MBC), as part of Track #4 solution City Innovation Modelling” will engage schoolchildren and youths in a city planning challenge using a model of Gothenburg in the popular game Minecraft®, the objective being to reach and animate new and hard-to-reach population groups to involve them in shaping the city of the future. In this case the use of the ElectriCity bus service no. 55 between the Lighthouse district Campus Johanneberg and the district Lindholmen, will be especially targeted for developing the urban planning within the transport distance.Description of scenario

Towards this goal, the following measures will be applied,

(1) the use of Minecraft® city model aimed at young people (“Model a Better City"), as part of Track #4 solution City Innovation Modelling”,
(2) the residential digital assistance citizens engagement activity, the Inclusive Life Challenge
(3) the Min Stad Citizen-sourcing platform, with the following components
    a. The citizenship engagement model (ME model) will provide a starting point for the planned activities within WP7

b. The Smart City Hub (SHC), a tool that compiles and filters information based on specified rules and a geographic context.
c. Continuous Dialogue (CD), to spread information more efficiently in a new channel, to reach new user groups and to explore how far the dialogue between the municipality and citizens can be driven within the current legislative framework

(4) the BIM (Building Information Modeling) platform based 3D Virtual Reality Environment and

(5) the Personal Energy Threshold (PET) energy application.

Gothenburg's ambitions are summarised in Table 16.

Table 16 Gothenburg's ambitions for TT#5

	2017	2018	2019	2020	2021
Measure 1: "Model a Better City"	specification	phase 1	phase 2	phase 3	evaluation
Measure 2: Resident digital assistance	specification	co-creation	deployment	improvement	evaluation
Measure 3: Citizensourcing	specification	phase 1	phase 2	evaluation	iteration
Measure 4: VR BIM	co-creation	deployment	phase 2	evaluation	evaluation
Measure 5: Personal Energy Threshold (PET)	co-creation	deployment	phase 2	evaluation	iteration

7.4 Planning of TransitionTrack#5 activities

7.4.1 Objectives

Per measure the following objectives are listed:

(1) The city will provide a Minecraft® model of the city and invite participating schools, youth organisations, etc to re-model the area connected to the Electricity bus service (including bus stops, pedestrian infrastructure, service offers, etc). A "Hackathon" will be staged where the best suggestions will be awarded.
(2) the residential digital assistance citizens engagement activity, the Inclusive Life Challenge (ICL)
(3) the Min Stad Citizen-sourcing platform, with the following components
   a. The citizenship engagement model (ME model) will provide a starting point for the planned activities within WP7
   b. The Smart City Hub (SHC), a tool that compiles and filters information based on specified rules and a geographic context.
   c. Continuous Dialogue (CD), to spread information more efficiently in a new channel, to reach new user groups and to explore how far the dialogue between the municipality and citizens can be driven within the current legislative framework
(4) the BIM (Building Information Modeling) platform based 3D Virtual Reality Environment BIM, where the aim is to create a virtual copy of the building HSB Living Lab, at the Johanneberg district which will create:
   - a deeper understanding of the buildings infrastructure such as technical systems, sensors, components, spaces, architecture and more.
   - a interactive platform the technical system/users; tenants and facility managers. I.e the virtual copy can send notifications to the facility manager when services are due, information about how to do the service and what components to be purchased.

  - possibilities for doing simulations during prestudy phases in future projects

(5) the Personal Energy Threshold (PET) energy application: the aim is to create an application for residents in the HSB Living Lab, at the Johanneberg district wich will be used for:
   a. a deeper understanding of the tenants' energy consumption
   b. a deeper understanding for the tenants' individual energy consumption
   c. choosing what type of energy source to be used and when
   d. remote control of energy consuming devices
   e. nudging individuals to choose "green" energy such as energy from the installed PVs (façade and roof).

7.4.2 Organization of work:

ME, KD, SHC, ICL

For the four activities described above, we consider the following organization:

- ME (Citizenship Modeling) Overall theoretical umbrella. The work is led by Professor Susanne Ollila, Chalmers with the participation of GOT-SBK Geodata, Strategic and Planning Department, as well as Consumer and Citizenship Service Administration.
- Smart City Hub (SCH) The work is led by GOT-SBK Geodata and / or Consumer and Citizenship Service Administration, supported by GOT-SBK Plans and Strategies.
- KD (Continuous Dialogue) The work is led by the GOT-SBK Planning Department, supported by GOT-SBK Strategies and Geodata.
- ILC (Inclusive Life Challenge) The work is led by GOT-Sbk Geodata, supported by GOT-Sbk Planning and Strategic.

A large part of the practical work on developing the tool can be outsourced to consultants, but as we are limited by public procurement regulations, we are unable at this time to say anything about the consultant, scope or cost of their efforts at this time.

Model a Better City (with Minecraft®)

Project lead: JSP

Technical support: GOT-GOT-SBK (City Planning Office)

The following tasks will be subcontracted according to the plan laid out in the GA

- Project management for the design contest, interacting with personnel at selected schools in the target area, carrying out workshops with students (supplied by consultancy).
- Rental of a data server for 12 months to host the model and the contest entries. (Supplied by hosting service supplier)
- Software licenses for Minecraft® Education.

3D BIM

BIM work organisation to be determined during the autumn of 2018. Due to resource restrictions, the work is expected to start mid-2019.

PET:

- Project owner: HSB Göteborg
- Project leader: Chalmers
- Subcontractor: E-works IT consultant

7.4.3 Timing of activities

A Gantt chart for the tentative plan for GOT-SBK's activities in IRIS TT #5 can be found in Annex 5, Figure 1.

A Gantt chart for the Minecraft® competition can be found in Annex 5, Figure 2.

A Gantt chart for the tentative plan for the 3D BIM demonstrator can be found in Annex 5, Figure 3.

7.4.4 Risks and risk management

Risks and Risk Management for Transition Track#5 can be found in Table 17.

Table 17 Risks and Risk Management - Transition Track#5

Demonstrator	Identified Risk	Proposed mitigation measures
Min stad	Difficulties to obtain data to release in the application	Liaise with the relevant City offices and authorities to secure access to data
Minecraft competition	Not enough contestants	Establish a wide network for marketing the competition and recruiting contestants
PET	Low user acceptance	Make an effort to educate users and help them realise how the app can help them save energy and money
3D BIM	Lack of interest to use and replicate the model outside of HSB Living Lab	Focus on strong communication and on inviting stakeholders to test and

7.5 Barriers and Drivers

7.5.1 Political

Barriers

No political barriers were identified.

Drivers

As has been described in Section 7.2.2, there is great emphasis on citizens' engagement and participation in civic matters from politicians and city management in Gothenburg.

7.5.2 Economic

Barriers

No economic barriers were identified.

Drivers

Personal Energy Threshold (PET) will enable the user to understand and influence his/her energy usage which potentially could result in lower energy bills.

7.5.3 Sociological

Barriers

No sociological barriers were identified.

Drivers

PET: HSB believe that that implementing gamification will boost the nudging impact towards lower and more environmental energy consumption. The energy price in Sweden is very low compared to other European countries so economy as a driver may not be the only necessary way for behavioural change. When implementing gamification, the individual data will be visual. If we choose to compare this data with other individuals one barrier could be the GDPR legislation. Further investigation is needed before implementing gamification

7.5.4 Technological

Barriers

Min Stad: Today, there is no technical solution and / or legal support to cope with citizens' views within the framework of the planning process and other governmental activities that come in other ways than by digital and analogue letters that can be diarised. This needs to be developed.

Min Stad: An acceptable technical solution for identifying the citizen must be introduced if the tool is supposed to be fully used in dialogue. It must be possible to verify the person behind an opinion in order to give them the status of concerned parties at a later stage (if they are directly concerned) and thus have the right to appeal an authority decision. A login with, for example, a Facebook or Google account is probably not enough.

Drivers

PET: The solution works with full effect in properties with RES. This limits the number of properties where it can be used. On the other hand, the PET-solution can be a driver for property owners to install RES solutions. PV installations are increasing, and property owners are looking for solutions to deliver PV energy directly to tenants. The PET app can be a very useful tool for energy distribution.

7.5.5 Legal

Barriers

- Min Stad: Handling of personal data is always a key issue in creating new services and managing citizens' views. Storing personal data is managed according to GDPR.

- Min Stad: Today's planning process governs the views of citizens and other actors in society. It is therefore difficult to process comments and views that come from outside of a so-called consultation process. Within the framework of the IRIS project, we will highlight and see the possibilities for continuous dialogue.
- Min Stad: If citizens change the city's proposal or build own models of alternative development proposals in Min Stad, a function and a procedure must be developed that ensures that the proposal is handled and translated into an opinion given legal status.
- PET: HSB believe that that implementing gamification will boost the nudging impact towards lower and more environmental energy consumption. The energy price in Sweden is very low compared to other European countries so economy as a driver may not be the only necessary way for behavioural change. When implementing gamification, the individual data will be visual. If we choose to compare this data with other individuals one barrier could be the GDPR legislation. Further investigation is needed before implementing gamification

Drivers

A driver for all activities within TT5 ambition and political decision are essential. Digital Agenda for Europe, the Programme for e-society (GOT) is an important driver.

7.5.6 Environmental

Barriers

No environmental barriers were identified.

Drivers

The Personal Energy Threshold (PET) will enable the user to understand and influence his/her energy usage and to actively choose the energy type with the least environmental impact.

7.5.7 Inclusive citizens

Drivers

Min Stad: Included citizens and an equal city is one of the most important issues for the modern city. In Gothenburg segregation is a major problem. Including citizens in the city development process is a way to create bridges between residents as well as include these in development. We must always act proactively to find new ways to include new groups in this process, from children and young people who will live in the future city as well as to newcomers.

7.5.8 Smart City

Drivers

Min Stad: Gothenburg's city view of the Smart City is based on the citizen and that she can live a good life. It is therefore important to have citizens' needs foremost as we create services for them.

8. Output to other work packages

Output to Work Package 1

The detailed descriptions of the demonstrators developed in this deliverable will provide useful input to the KPI definition process in WP1

Output to Work Package 2

The barriers and drivers identified in this deliverable can be used as direct input in the identification and analysis process in WP2, Task 1.

Output to Work Package 3

The detailed descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this deliverable will provide useful input to the development of bankable business models in WP3.

Output to Work Package 4

The detailed descriptions of the activities in Transition Track #4 of the Gothenburg interventions developed in this deliverable will provide useful input to the continued work in the implementation of the City Information Platform in Work Package 4.

Output to Work Packages 5 and 6

This deliverable constitutes the first detailed and coherent description of the Lighthouse City activities in Gothenburg and thus may serve as a yardstick for the other LH Cities in the project to compare and assess their own activities. The collaborative work initiated for the Deliverables 5/6/7.1/2 will be continued during the implementation period of the project, and we envisage that the deliverable documents will serve as a common platform to provide information and facilitate mutual understanding between the LHC´s.

The WP7 activities embracing TT5, will give the excellence opportunity to follow the development and evaluation of how Gothenburg proceed with models for co-creation and innovative collaboration. The city procurement will, within IRIS, have the opportunity to match the need of development of e.g. Min Stad and also learn from WP 5 & 6.

Output to Work Package 8

The detailed descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this deliverable will provide excellent input for setting up replication roadmap and implementation plans for LHC's and FC's.

Output to Work Package 9

The detailed descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this deliverable will provide input to the assessment to develop a coherent monitoring program. The set of KPIs and target numbers will be designed based on the existing and adapted metrics described in this Deliverable and will be developed in cooperation with the LHS in order to evaluate the effectiveness and impact of the cities proposed integrated solutions at different time horizons.

Output to Work Package 10

The detailed descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this deliverable will provide basis and inspiration for the dissemination and communication efforts taking place within Work Package 10.

Output to Work Package 11

The detailed and updated descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this deliverable will allow the Steering Committee of the project to assess the current status and compare with what is stated in the DoA, ensuring that quality assurance and control aspects are covered and that appropriate mechanisms to identify, anticipate, communicate and mitigate potential risks and deviations in the project may be activated.

9. Conclusions

The objective of this Deliverable is to provide a detailed overview of the baseline, ambition and barriers for Gothenburg lighthouse interventions. This deliverable is intended for the following audiences:

- Stakeholders in the Gothenburg ecosystem as it provides a detailed overview of the solutions that will be implemented by each of the partners;
- Stakeholders in the demonstration districts as it provides them with overview of the solutions and of how local stakeholders will be involved;
- Project partners in the other lighthouse and follower cities;
- Broader public interested in the details of the demonstration.

This Deliverable will facilitate the common understanding of the demonstration activities and the action plan foreseen within local ecosystems as well as between LH and follower cities. The detailed and updated descriptions of the demonstrators, as well as their ambitions, drivers and barriers developed in this Deliverable will allow the Steering Committee of the project to assess the current status and compare with what is stated in the DoA, ensuring that quality assurance and control aspects are covered and that appropriate mechanisms to identify, anticipate, communicate and mitigate potential risks and deviations in the project may be activated.

With the above in mind, the following conclusions may be made based on this Deliverable.

Baseline

- Baseline estimations are not always self-evident since many of the demonstrators consist of new developments rather than improvements on existing structures. This means that baseline values must be assumed (from statistics, general practice, regulations, etc) rather than measured.
- Since the selection of KPI’s was not made at the time of writing this report, the quantities measured as baselines could differ from the KPI’s eventually selected.

Ambition

- Ambitions largely remain at the same level as originally stated in the proposal/DoA
- Ambitions are sometimes not clearly formulated, since they may be part of higher-level ambitions that are not wholly attributable to IRIS’s interventions

Drivers and Barriers

- Generally, it seems to be easier to identify barriers than drivers, which in some cases may result in an overly negative tone when describing the planned demonstrators. It is however important to keep in mind the all-pervasive drivers that exist in society and business today that work towards greater sustainability, fossil-independence and improved quality of life. If this is the “default”, the barriers will be more visible than drivers against the backdrop of a generally positive environment.

10. References

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2. Swedish Energy Agency: Energy in Sweden 2018 ISSN 1404-3343
3. Swedish Board of Housing 2018: Building Regulations for Maximum Use of Energy in New Housing
4. City of Gothenburg (2015) Programme and plan for e Society (Swedish): http://www5.goteborg.se/prod/Intraservice/Namndhandlingar/SamrumPortal.nsf/B9785AB0FEECA5ECC1257DF50039BF2E/$File/2.2.8_20150304.pdf?OpenElement

Annex 1 - Timelines for Transition Track#1

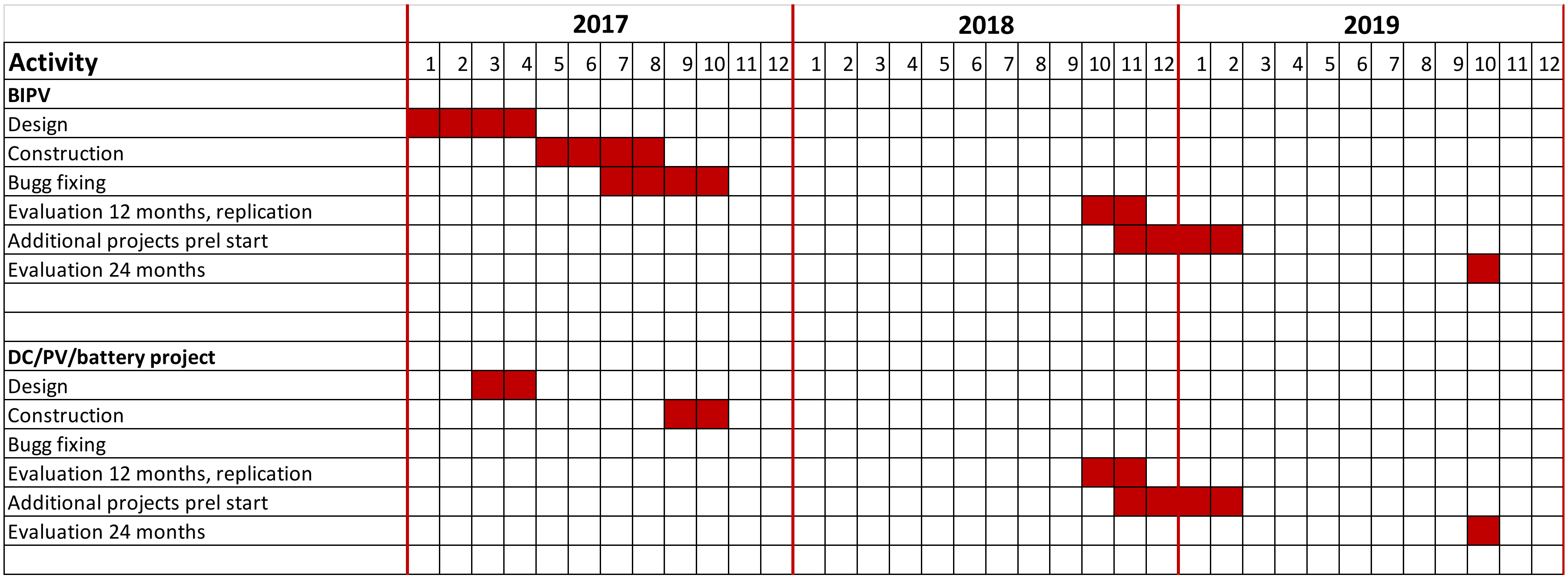

Fig. 1 Gantt chart for HSB demonstrator BIPV at HSB Living Lab in GOT Transitio Track #1

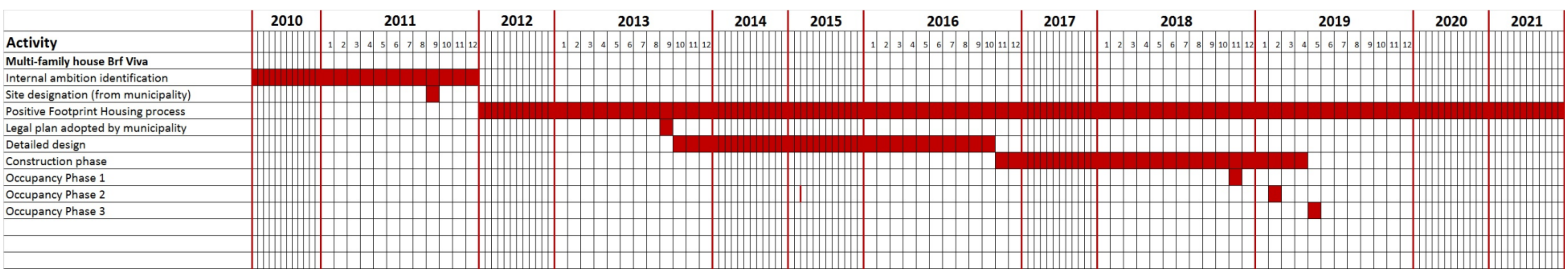

Fig 2 Gantt Chart of Positive Footprint Housing process and construction Riksbyggen's Brf Viva building, in which IRIS demonstrators are located (TT#1 and TT#2)

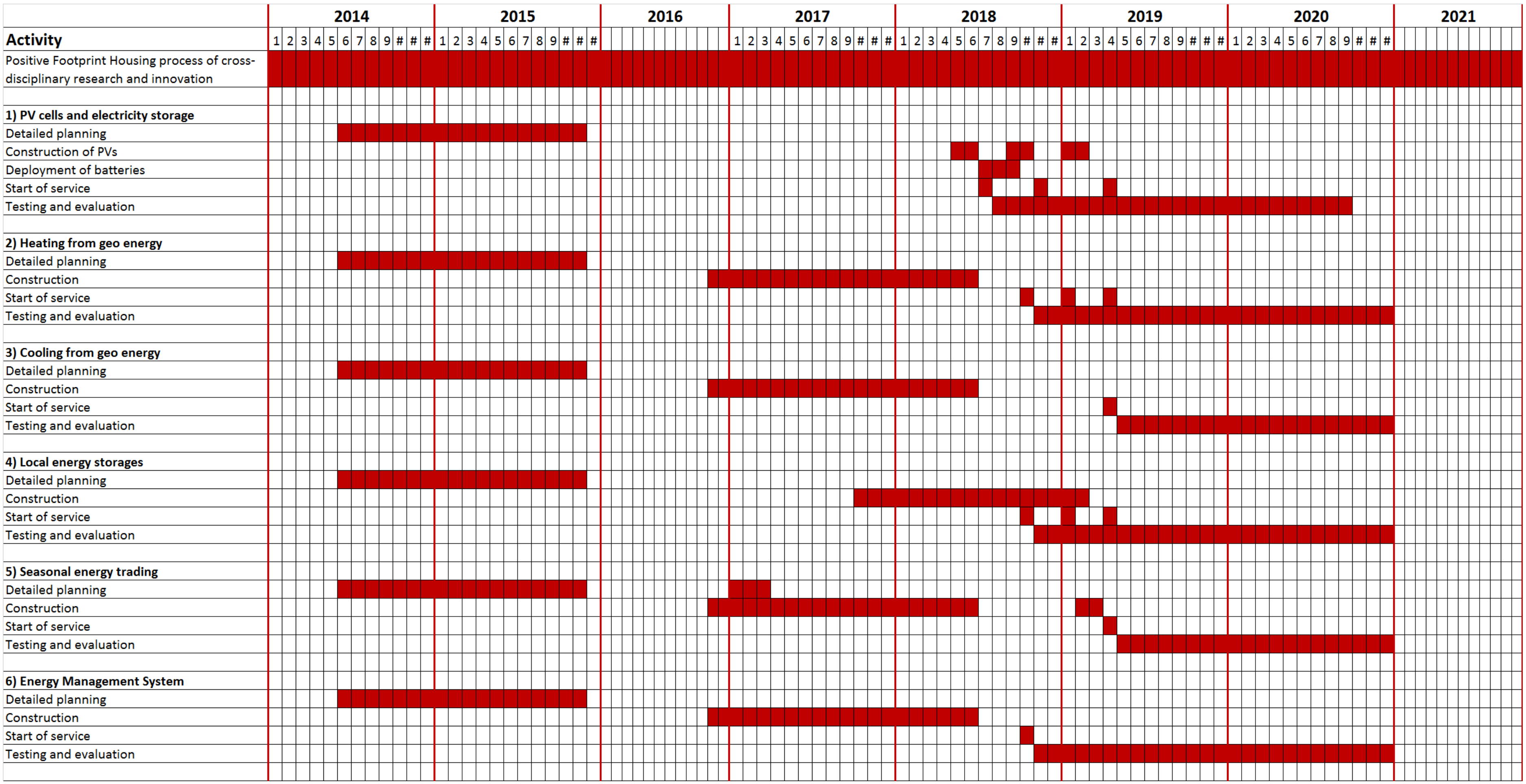

Fig. 3 Gantt Chart of the IRIS demonstrators in Riksbyggen's Brf Viva in GOT Transition Track #1

Annex 2 - Timelines for Transition Track#2

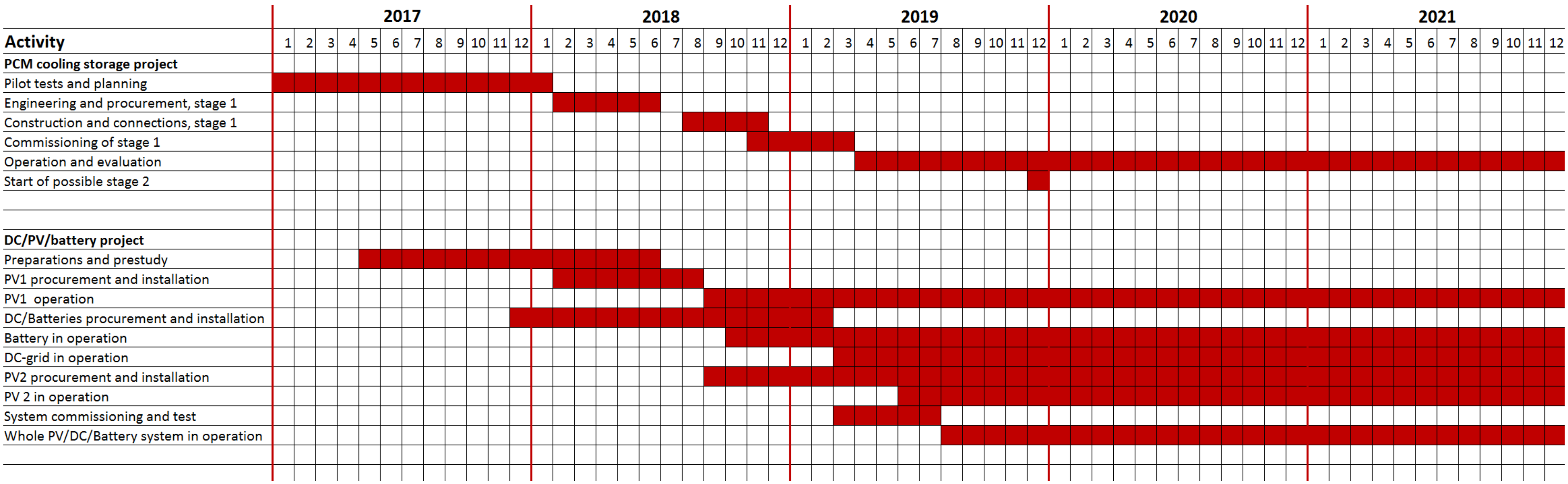

Fig. 1 Gantt chart for Akademiska Hus' AWL demonstrators in GOT Transition Track #2

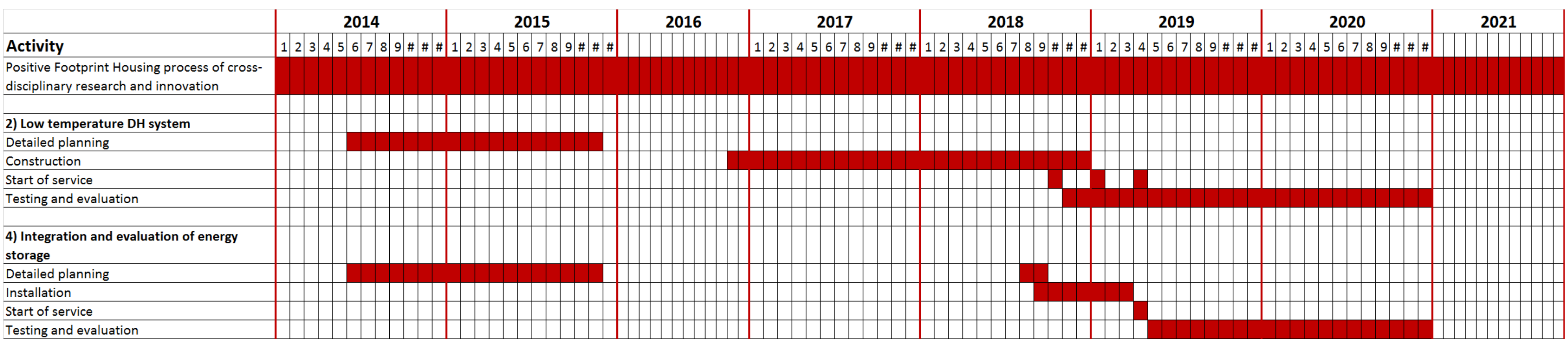

Fig 2 Gantt Chart of the IRIS demonstrators in Riksbyggen's Brf Viva in GOT Transition Track #2

Annex 3 - Timelines for Transition Track#3

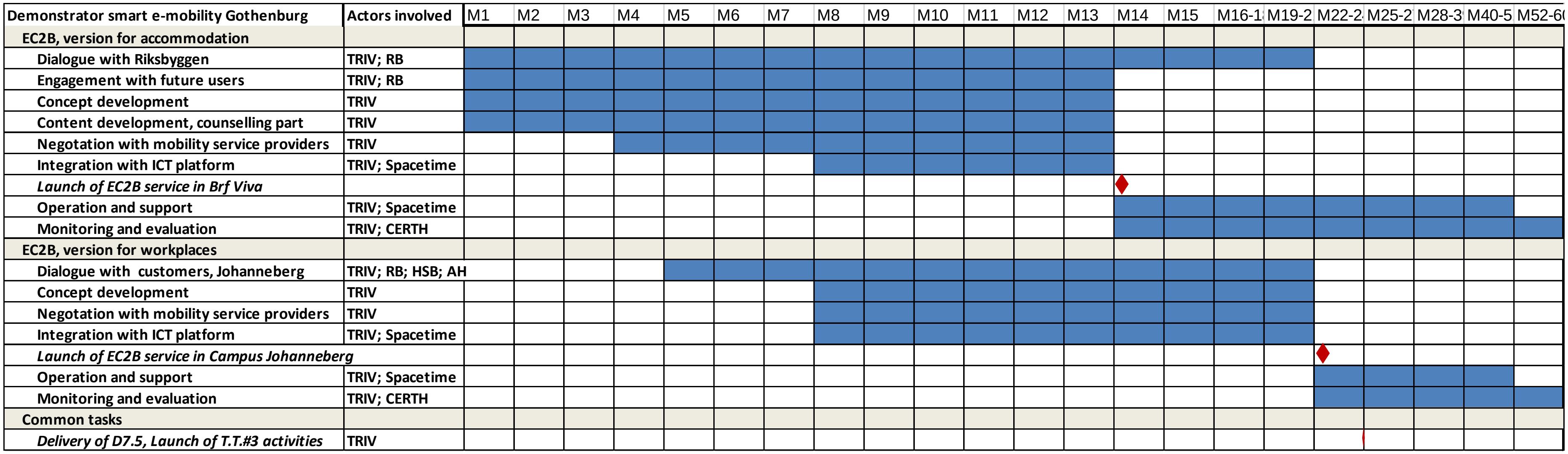

Fig. 1 Gantt Chart of EC2B development and implementation in GOT Transition Track #3

Annex 4 - Timelines for Transition Track#4

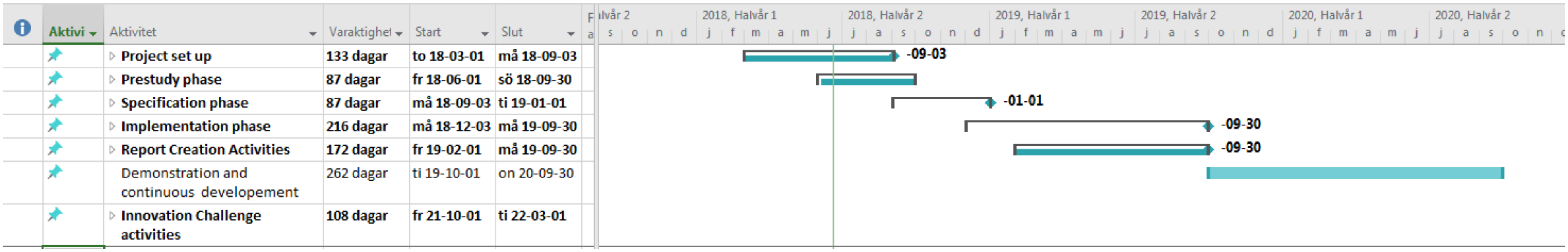

Figure 1 Gantt chart of CIM development and implementation

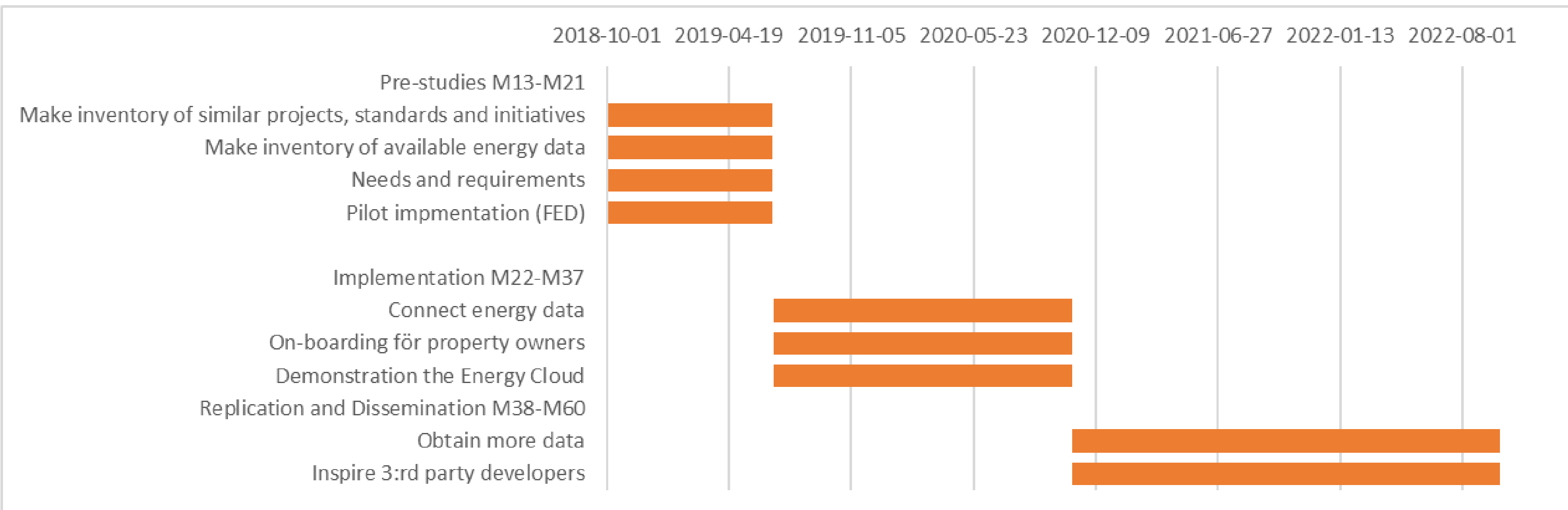

Figure 2 Timeline for Energy Cloud development

Annex 5 - Timelines for Transition Track#5

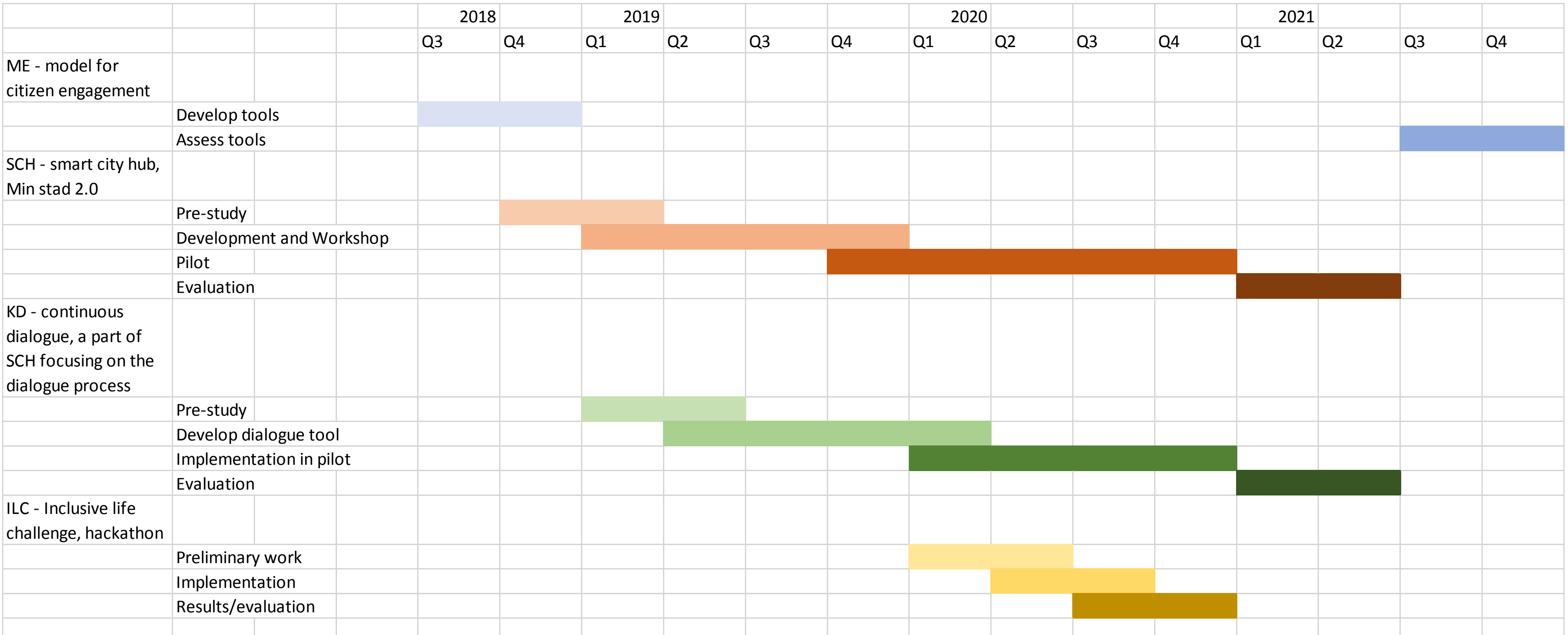

Figure 1 Timeline for IRIS Gothenburg Citizen Engagement activities

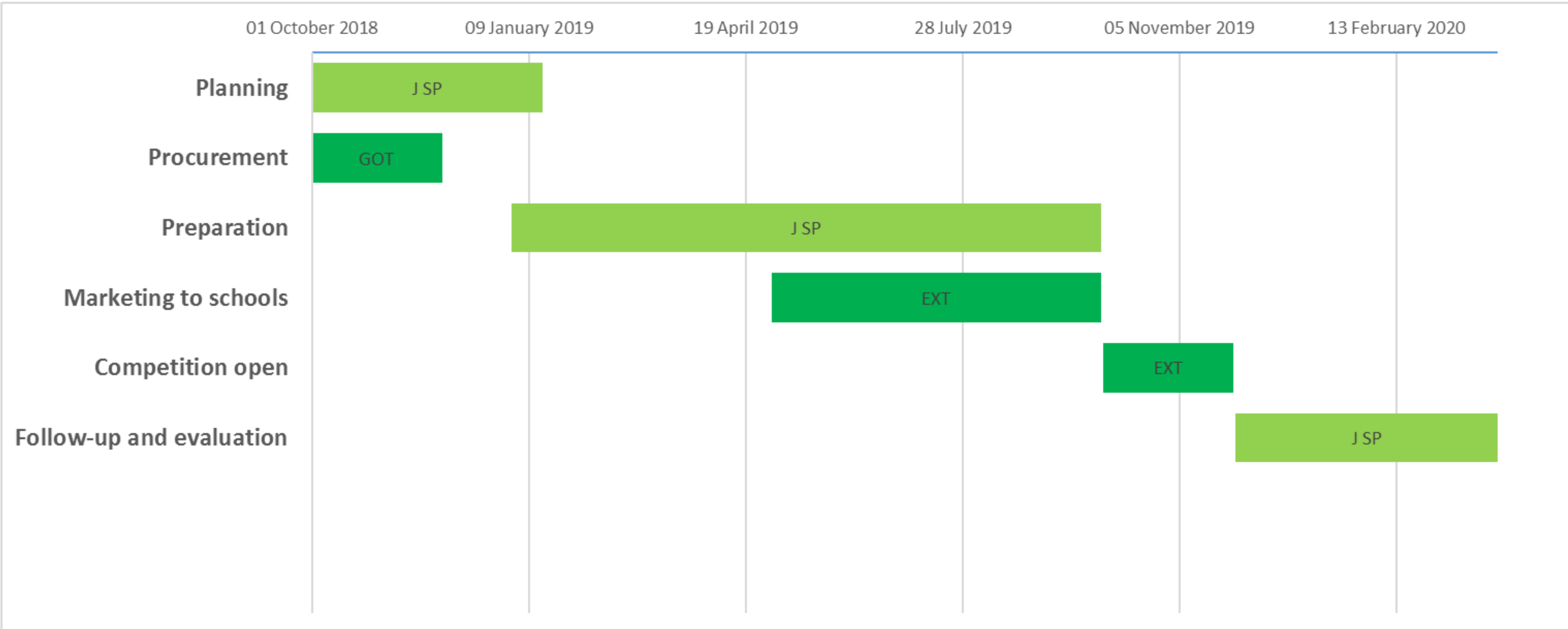

Figure 2 Timeline for Minecraft competition

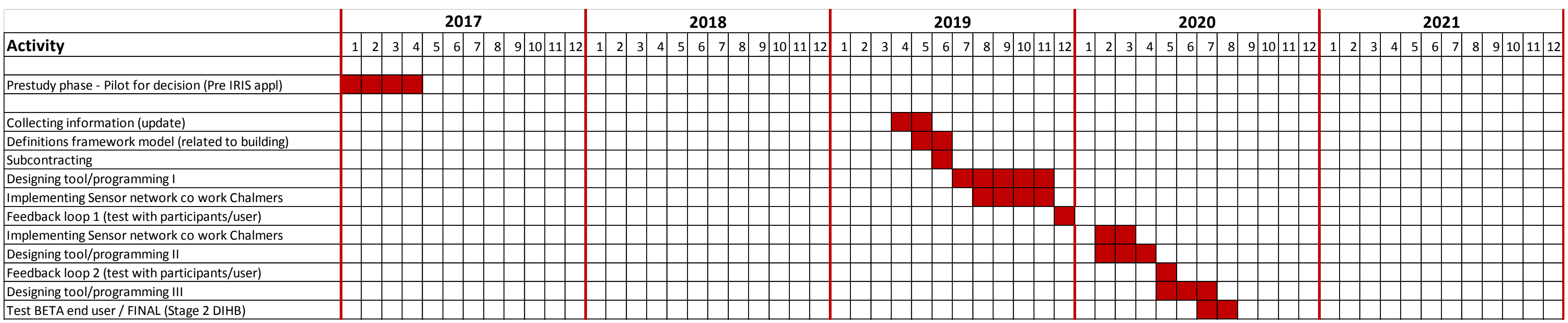

Figure 3 Timeline for 3DBIM demonstrator