IRIS

Integrated and Replicable Solutions for Co-Creation in Sustainable Cities

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Baseline, ambition, activities, and barriers & drivers for Utrecht lighthouse interventions

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Version	Date	Modifications made by
0.1	30 August 2018	First drat for collection of internal contributions
0.2	14 September 2018	Draft version for internal review (90% version)
1.0	30 September 2018	Final version to be released to the EC
1.1	18 October 2018	Updated version released to the EC

Disclaimer

Executive Summary

This report describes the baseline, ambitions, activities, and the barriers & drivers for each of the five transition tracks (TTs) for the integrated solutions that will be demonstrated in Utrecht. During the development of this reports comparisons were made between reported ambitions and activities set out in the project proposal (DoA), and actual ambitions and activities. Any major deviations that materialized so far are described in this report.

This deliverable is closely related to other deliverables in WP5. Whereas deliverable D5.1 describes the 'what' of the demonstration activities in Utrecht, deliverable D5.2 complements these descriptions by elaborating on the governance, planning and financing of the Utrecht demonstration. Thereby outlining the 'how' of the demonstration. Together these deliverables are the reference document for the actual implementation of the integrated solutions in tasks 5.3 to 5.7 for Utrecht.

This deliverable was furthermore partly developed in parallel and in close cooperation with activities in WP1 on the extraction of requirements for the five TTs, including baseline definition of citizen energy and mobility behaviour, along with setting up of the monitoring principles and early business modelling development.

In order to strengthen cooperation between lighthouse cities and fosters exchange of best practices a harmonized approach was developed among the lighthouse cities Utrecht, Nice and Gothenburg. This resulted in a joint approach and outline for the Deliverables D5.1, D6.1 and D7.1 to ensure harmony and coherency amongst the interventions within the 3 lighthouses. With, however, the flexibility for each LH city to sustain their own methodology to suit their specific context.

The baseline is defined as the situation before any intervention has taken place and against which the impact of interventions is measured. The demonstration area for all the five transition tracks in Utrecht is situated in the district of Kanaleneiland-Zuid and the neighbouring area Westraven . The district is a densely populated multi-cultural district, characterized by social housing, schools and shops and a majority of households with a low income.

The demonstration covers 12 four-storey apartment buildings of social housing corporation BOEX, adding up to 644 apartments with a poor energy profile. The apartment blocks were built in the period 1950-1970, an era marked by the absence of energy regulations. As a result, the apartments are poorly insulated and have a typical energy label E-F.

The demonstration area is furthermore characterized by a mixed energy infrastructure. The current energy infrastructure encompasses an electricity network, a districting heating network and gas infrastructure. Parts of the gas infrastructure are obsolete and either need to be replaced or be taken out of operation in the coming years. The local electricity grid in the demonstration area was designed in the sixties, and is not outlined to accommodate for interventions taking place within the IRIS project, i.e. accommodating for large amounts of renewable energy production and charging of electric vehicles. Currently hardly any renewables are being exploited in the district of Kanaleneiland Zuid, and (public) charging infrastructure for electrical vehicle is not yet developed.

Ambitions for the respective TTs constitute the overall aim and vision of the five transition tracks for the Utrecht demonstration area. Ambitions are outlined in the DoA and were, amongst others, further

developed within the course of the work in WP1. The table below summarises the ambitions set out in the DoA per TT. No major deviations from these ambitions are anticipated at this point in time.

Transition track	Ambition
#1 Smart renewables and closed-loop energy positive districts	Contribute to Near Zero Energy districts by integrating (1) a high share of locally produced and consumed renewable energy at district scale, (2) energy savings at building level, and (3) energy savings at district level
#2 Smart Energy Management and Storage for Energy Grid Flexibility	Integrate smart energy management and renewable energy storage for (1) maximum profits of renewable power, (2) maximum self-consumption reducing grid stress, (3) unlocking the financial value of grid flexibility and (4) optimizing the second life of car and bus batteries.
#3 Smart e-Mobility Sector	Integrate solar powered V2G e-cars, operated in the car sharing system We Drive Solar, as well as solar powered V2G e-buses in the urban mobility system for (1) local zero-emission Mobility as a Service, (2) lower household mobility costs and (3) smart energy storage in V2G batteries.
#4 City Innovation Platform (CIP)	Through cross-cutting open ICT (1) enable the integration of the IRIS solutions, maximising cost-effectiveness of the integrated infrastructure, (2) provide the City Innovation Platform and (c) develop meaningful information services for households, municipality and other stakeholders, together allowing for new business models.
#5 Citizen engagement and Co-creation	Design and demonstrate feedback mechanisms and inclusive services for citizens to achieve that citizens are motivated to (1) save energy, (2) shift their energy consumption to periods with abundant renewables and (3) use shared e-mobility instead of private cars.

Activities encompass the planning of the actual demonstration, including a detailed overview of all the measures that will be implemented to achieve the ambitions set for the demonstration and the timetable for implementation. The table below provides an overview of the measures included in the DoA, that will be implemented in the demonstration area. The table furthermore summarizes the key activities executed in the first year and, if applicable, points out deviation from the DoA for each of the TT.

Transition track	Measures
#1 Smart renewables and closed-loop energy positive districts	• Measure 1: District wide PV
	• Measure 2: LT district heating
	• Measure 3: HEMS TOON
	• Measure 4: NZEB refurbishment
	• Measure 5: Smart (hybrid) e-heating systems
	• Measure 6: AC/DC home switchboxes
	• Measure 7: Smart DC Street Lighting
Key activities year 1: Planning and preparation of refurbishment activities for the first apartment block started (covering measures 1, 2, 4 and 5). First meetings and ideas on citizen engagement trajectory for the Home	

Transition track	Measures
Energy Management System (HEMS) discussed and developed (measure 3). Feasibility study and market assessment for measure 6 finished. Program of requirement under development for measure 7. *Deviations TT#1*: So far, no major deviations are anticipated compared to the DoA regarding the type and size of the measures, only a slide shift in the planning of the distribution of homes to be renovated over the years.	
#2 Smart Energy Management and Storage for Energy Grid Flexibility	• Measure 1: Solar V2G charging points for e-cars/e-vans • Measure 2: Solar V2G charging point for e- buses • Measure 3: Stationary storage in apartment buildings • Measure 4: Smart Energy Management System (EMSs)
Key activities year 1: Plan for the implementation of first 6 V2G charging points (measure 1) completed. Program of requirement for 2nd life batteries drafted and ready to put out into the market (measure 3). Garage boxed for placement of batteries secured and building requirements for usage of garage boxes to store batteries mapped out (measure 3). Mapping of the current status of the electricity grid in the demonstration area and inventory of investments needed to accommodate integrated IRIS solutions (measure 4). *Deviations TT#2*: Anticipated deviations from the DoA concern the planning for measure 1 which will include a more phased demand driven approach.	
#3 Smart e-Mobility Sector	• Measure 1: V2G e-cars • Measure 2: V2G e- buses
Key activities year 1: First cars ready to be introduced in the district area, and plan drafted for a further demand driven roll-out. *Deviations TT#3*: Anticipated deviation from the DoA concern the planning for measure 1 which will include a phased demand driven approach, instead of the introduction of all cars in 2018.	
#4 City Innovation Platform (CIP)	• Measure 1: Monitoring E-Mobility with LoRa network • Measure 2: Smart Street Lighting with multi-sensoring • Measure 3: 3D Utrecht City Innovation Model • Measure 4: Monitoring Grid Flexibility • Measure 5: Fighting Energy Poverty
Key activities year 1: The first year was used to further detail and define the data services, develop a common process for the development of the services, make a clear division of roles in the process, discuss/establish the cooperation/link with activities in WP 3 and WP4 and appoint a data challenger for each of the measures. Furthermore, anticipated activities in the development process for each of the dataservices was outlined. *Deviations TT#4*: So far, no major deviations are anticipated compared to the DoA regarding the type and size of the measures, and planning of the implementation.	
#5 Citizen engagement and Co-creation	• Measure 1: Community building by Change agents • Measure 2: Campaign District School Involvement • Measure 3: Co-creation in Local Innovation Hub • Measure 4: Campaign Smart Street Lighting • Measure 5: VR New Home and District Experience
Key activities year 1: Mapping the individual integrated solutions in Utrecht on the citizen engagement ladder developed within WP 1. Further delineating of citizen engagement activities for measures requiring active citizen engagement either for adoption or co-creating new services/product. Contracting external party to start activities to involve local schools (measure 2). Organisation of 3 co-creating workshops aimed at defining a program of requirements for smart street lighting. Experiences and broader lessons learned on citizen engagement from these workshops were laid down in a booklet, which will be distributed among IRIS project	

Transition track	Measures
team (measure 4). *Deviations TT#5*: So far, no major deviations are anticipated compared to the DoA regarding the type of implemented measures, size and planning.	

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List of Abbreviations and Acronyms

Abbreviation	Definition
CIP	City Innovation Platform
DoA	Description of Action
EU	European Union
FC	Follower City
IS	IRIS Solution
KPI	Key Performance Indicator
LH	Lighthouse
LHCSM	Lighthouse City Site Manager
MaaS	Mobility as a Service
PoR	Programme of Requirements
PV	Photovoltaic
RES	Renewable Energy Sources
TT	Transition Track(s)
WP	Work Package

1. Introduction

1.1. Scope, objectives and expected impact

Objective of this deliverable is to provide a detailed overview of the baseline, ambitions, activities and drivers & barriers planned for Utrecht lighthouse interventions. This deliverable is intended for the following audiences:

- Stakeholders in the Utrecht 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 the 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.

1.2. Contributions of partners

Municipality of Utrecht: overall coordination, producing draft text and match with inputs from WP 1, providing input for tracks #4 and #5, review input from other partners;

- Bo-Ex: coordinate the input for transition tracks #1 and input for #5;
- LomboXnet: coordinate the input for transition tracks #2 and #3;
- Stedin: provide input for transition track #2;
- QBuzz: provide input for transition tracks #2 and #3;
- UU: provide inputs from preliminary results on business models in WP 3, review 90% version of the report.

1.3. Relation to other activities

This deliverable is part of the WP5 “Utrecht Lighthouse City demonstration activities” and closely related to the other tasks and deliverables in WP5. Together with Task 5.2 and Deliverable 5.2 it describes the way the demonstration in Utrecht will be executed. Deliverable D5.1 describes the baseline, ambitions, barriers and drivers and activities of for the five TTs and the various integrated solutions that will be demonstrated. It describes so to say the WHAT of the demonstration activities in Utrecht. Deliverable D5.2 complements these descriptions by elaborating on the governance, planning and financing of the Utrecht demonstration. Deliverable D5.2 describes the HOW of the demonstration.

Both deliverables together form a reference document for the actual implementation of the integrated solutions in tasks 5.3 to 5.7. The relationships between the tasks and deliverables within WP5 are depicted in Figure 1. Figure 1 also shows the relationships with other work packages on the STRATEGY part, with WP1 on the one hand for the Transition strategy and WP9 on the other hand for the KPIs and the monitoring approach and WP3 for the results of interviews with IRIS partners about ambitions and possible business models.

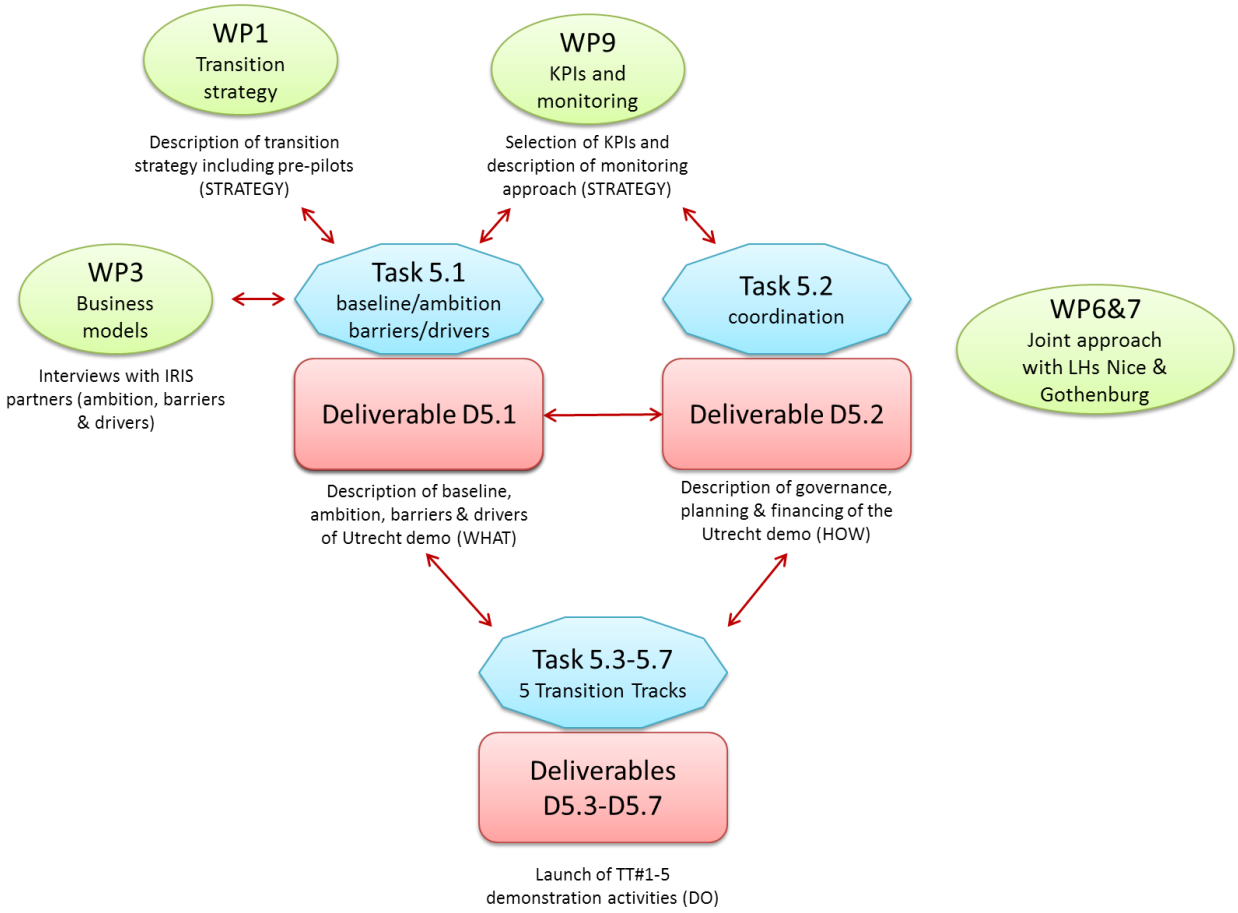


Figure 1.Relation of Deliverable D5.1 to other activities

1.4. Structure of this deliverable

Chapter 2 start with the methodology, followed by an overview of the main characteristics of the Utrecht demonstration area in chapter 3. Chapters 4, 5, 6, 7 and 8 provide a comprehensive overview of the baseline, ambition, barriers & drivers and activities planned for Utrecht for each of the individual transition tracks. Chapter 9 provides and overview of the output to other work-packages and finally chapter 10 holds the conclusions.

2. Methodology

2.1. Introduction: joint approach for LH cities

In order to strengthen cooperation between lighthouse cities and fosters exchange of best practices a harmonized approach was developed among the lighthouse cities Utrecht, Nice and Gothenburg. This resulted in a joint approach and outline for the deliverables D5.1, D6.1 and D7.1 (here after D567.1) to ensure harmony and coherency amongst the interventions within the 3 lighthouses. However, with the flexibility for each LH city to sustain their own methodology to suit their specific context.

2.2. Contents

The DoA states that deliverables D567.1 comprise of a report "Elaborating baseline, ambition and barriers for Utrecht/Nice/Gothenburg lighthouse interventions ". This report therefore provides a detailed overview of

- The baseline situation for the demonstration area;
- The ambitions for Utrecht;
- Planned activities for each of the measures implemented under the various transition tracks;
- Potential barriers and drivers for the lighthouse interventions;
- Monitoring principles and early business modelling development.

2.3. Baseline

The baseline is defined as the situation before any intervention has been made and against which the impact of interventions is measured. Assessment of the 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.

The descriptions of the baseline for each of the transition tracks 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) will be used.

2.4. Ambition

Ambitions for the respective Transition Tracks (TT) constitute the overall aim and vision of the thematic area in question. Ambitions have initially been outlined in the DoA and were further developed in course of the work in WP1. Ambitions for the LH demonstrators were correlated with the original ambitions as stated in the DoA. Any deviations from these ambitions are explicitly stated.

2.5. Activities

Activities include all the measures that will be implemented within the IRIS project to reach the ambitions set for the demonstrations. Activities under the respective TT are outlined in the DoA and were further developed in the course of the work in WP1. Activities for the LH demonstrators have been correlated with the original activities as stated in the DoA. In those cases where these activities are no longer valid, this is explicitly stated.

2.6. Barriers & Drivers

Partners involved in the respective transition tracks have provided the main barriers and drivers affecting the implementation of the integrated solutions. 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. Barriers that might lead to risks are mentioned in deliverable 5.2, in which an overview is provided to mitigate these risks.

2.7. Demonstrated solutions

The overall concept of IRIS is the Transition Strategy comprising of five (5) Transition Tracks (TT) that together provide a universal yet versatile framework to address both common and district specific challenges. Within these five Transition Tracks, IRIS envisions to demonstrate a set of integrated solutions built on top of both mature and innovative technologies. The integrated solutions are defined on the basis of a common-shared know-how interchange among the lighthouse and follower cities, and planning of replication from the early beginning of the project. Table 1 provides an overview of the integrated solutions further detailed towards specific measures, which will be demonstrated in Utrecht, and which are further detailed per transition track in the chapters 4, 5, 6, 7 and 8.

Transition track	Integrated solution	Measures
#1 Smart renewables and closed-loop energy positive districts	1.2: Near zero energy retrofit district	• Measure 1: District wide PV • Measure 2: LT district heating • Measure 3: HEMS TOON • Measure 4: NZEB refurbishment • Measure 5: Smart (hybrid) e-heating systems • Measure 6: AC/DC home switchboxes • Measure 7: Smart DC Street Lighting
#2 Smart Energy Management and Storage for Energy Grid Flexibility	IS-2.1: Flexible electricity grid networks IS-2.3: Utilizing 2nd life batteries for smart large-scale storage schemes	• Measure 1: Solar V2G charging points for e-cars/e-vans • Measure 2: Solar V2G charging point for e- buses • Measure 3: Stationary storage in apartment buildings • Measure 4: Smart Energy Management System (EMSs)
#3 Smart e-Mobility	IS-3.1: Smart Solar V2G EVs charging	• Measure 1: V2G e-cars • Measure 2: V2G e- buses

Transition track	Integrated solution	Measures
Sector	IS-3.2: Innovative Mobility Services for the Citizens	
#4 City Innovation Platform (CIP)	IS-4.1: Services for Urban Monitoring IS-4.3: Services for Mobility IS-4.2: Services for City Management and Planning IS-4.4: Services for Grid Flexibility	• Measure 1: Monitoring E-Mobility with LoRa network • Measure 2: Smart Street Lighting with multi-sensoring • Measure 3: 3D Utrecht City Innovation Model • Measure 4: Monitoring Grid Flexibility • Measure 5: Fighting Energy Poverty
#5 Citizen engagement and Co-creation	IS-5.1: Co-creating the energy transition in your everyday environment IS-5.2: Participatory city modelling IS-5.3: Living labs IS-5.4: Apps and interfaces for energy efficient behaviour	• Measure 1: Community building by Change agents • Measure 2: Campaign District School Involvement • Measure 3: Co-creation in Local Innovation Hub • Measure 4: Campaign Smart Street Lighting • Measure 5: VR New Home and District Experience

Table 1. Integrated solutions (measures) that will be demonstrated in demo area Kanaleneiland Zuid in Utrecht

3. Demonstration area

The demonstration area for *all five transition tracks* is situated in the district of Kanaleneiland-Zuid in the city of Utrecht and the neighbouring area Westraven. This is a residential area of 64 hectares situated in the Utrecht Centre-West area, just southwest of the historic city centre and the Utrecht Central Station. The district is surrounded by two large canals (hence 'canal island'), one of which is used intensively for freight transport (Amsterdam-Rhine Canal) (Figure 2).

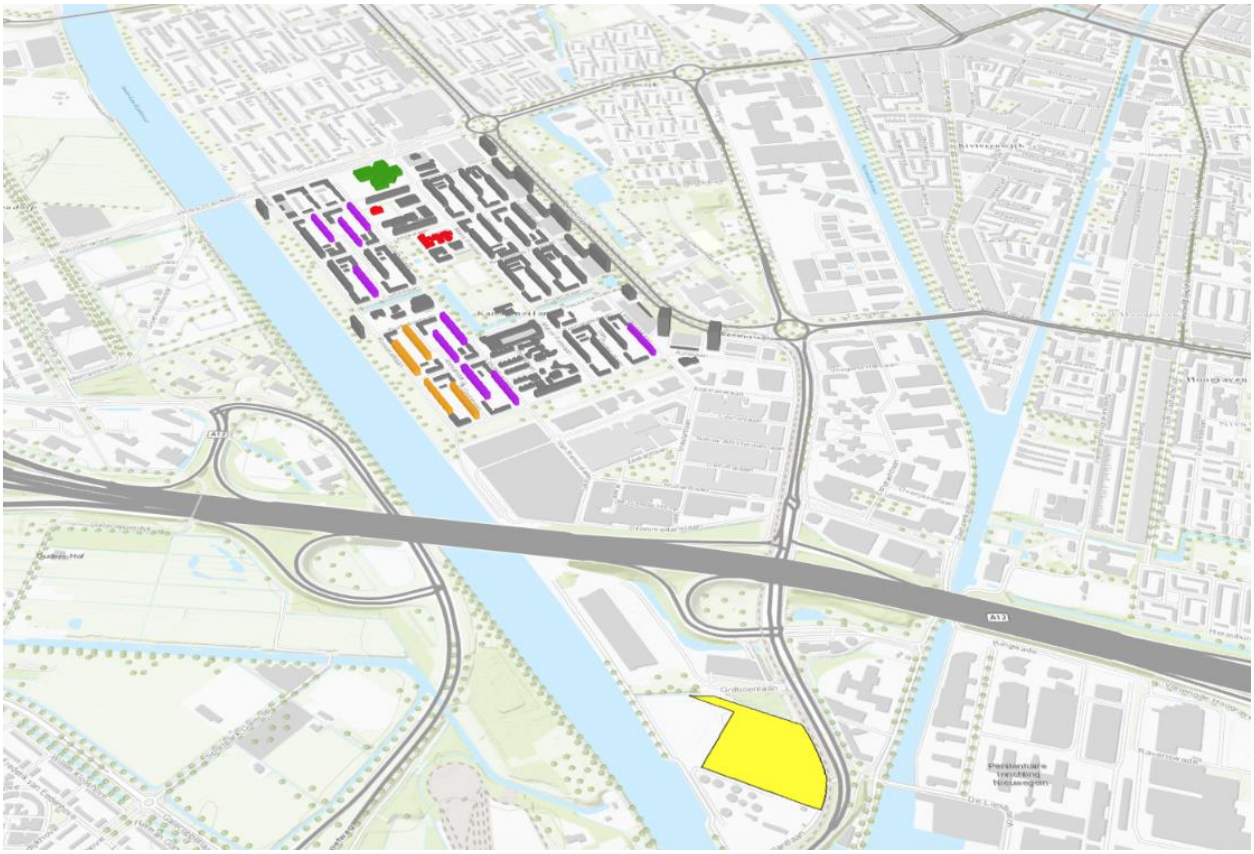


Figure 2. Location of the demonstration district Kanaleneiland Zuid. And Westraven.
Source: Utrecht op de Kaart http://kaartenutrecht-gemu.opendata.arcgis.com/

The district is a densely populated multi-cultural district, characterized by social housing, schools and shops and a majority of households with a low income.

Figure 3 provides an indication on the multi-cultural diversity of the district of Kanaleneiland. The figure on the left shows the representation of various ethnic groups in Kanaleneiland-Zuid compared to the average of Utrecht. The figure shows that Kanaleneiland-Zuid has a high share of people coming from Morocco and Turkey compared to the average representation of these groups in Utrecht.

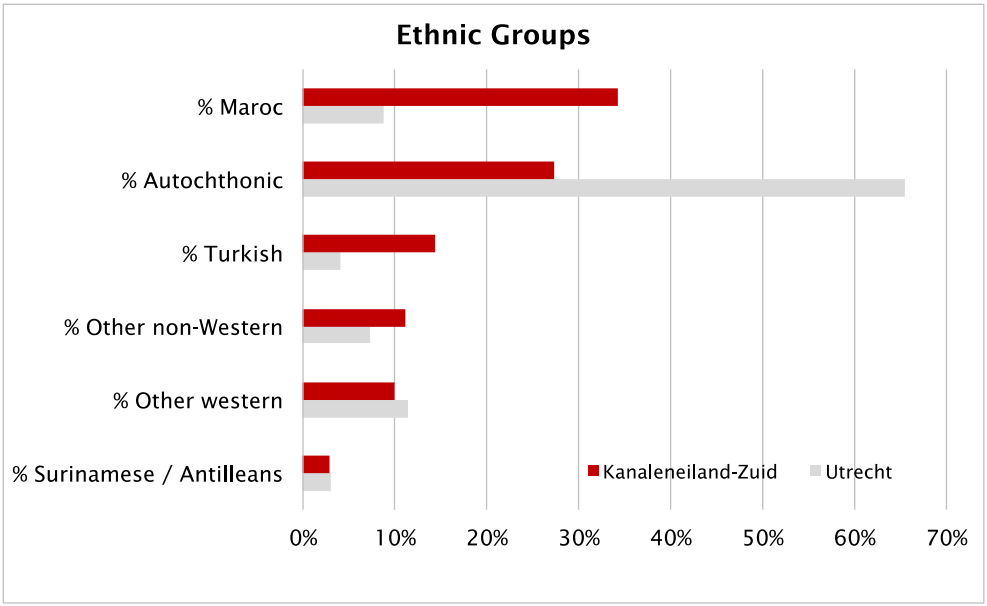


Figure 3. Representation of ethnic groups in Kanaleneiland Zuid compared to average for the city of Utrecht.
Source: WistUData (Augustus 2018)

Figure 5 provides an indication on the income situation for the households in the district of Kanaleneiland-Zuid. The figure shows that compared to the average for Utrecht a higher share of the households is living on low income and receives rent rebates.

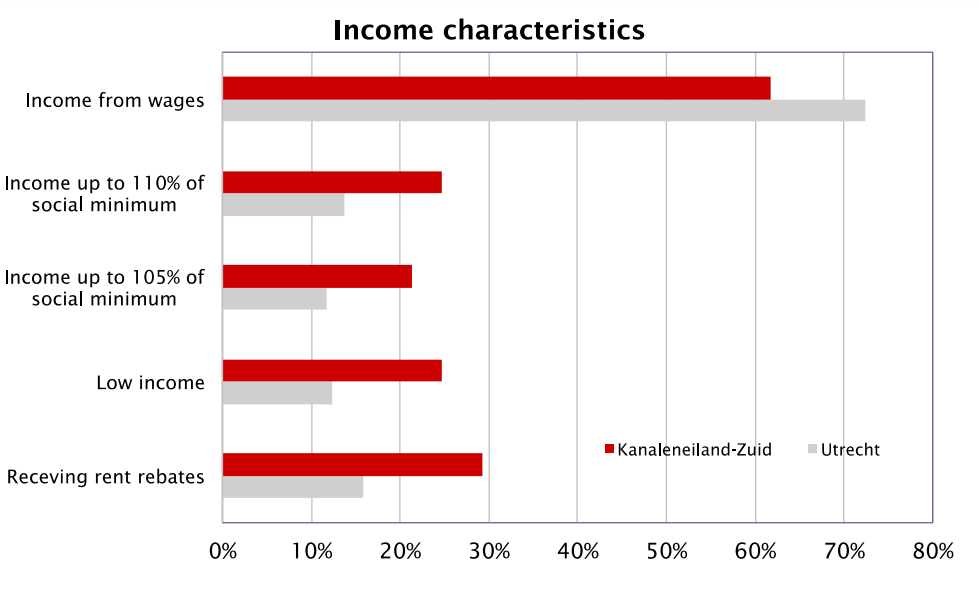


Figure 4. Representation of ethnic groups (left) and income characteristics (right) in Kanaleneiland Zuid compared to average for the city of Utrecht.
Source: WistUData (Augustus 2018)

The district hosts about 40 social housing apartment buildings, some semi-detached and row houses, three schools and some shops. The apartment buildings are owned by three social housing associations

Bo-Ex, Mitros and Portaal. Lighthouse partner Bo-Ex owns 884 dwellings, of which 700 in apartment buildings. Typical housing rents are around €450 monthly.

The demonstration area is characterized by a mixed energy infrastructure. The current energy infrastructure encompasses an electricity network, a districting heating network and gas infrastructure. Parts of the gas infrastructure are obsolete and either need to be replaced or be taken out of operation in the coming year (see Figure 5 and Figure 6).

Figure 5. Current gas infrastructure in the demonstration district Kanaleneiland Zuid: blue: gas pipes need to be replaced in the coming years, red: gas pipes older than 30 years, green: gas pipes younger than 30 years.
Source: Utrecht op de Kaart http://kaartenutrecht-gemu.opendata.arcgis.com/

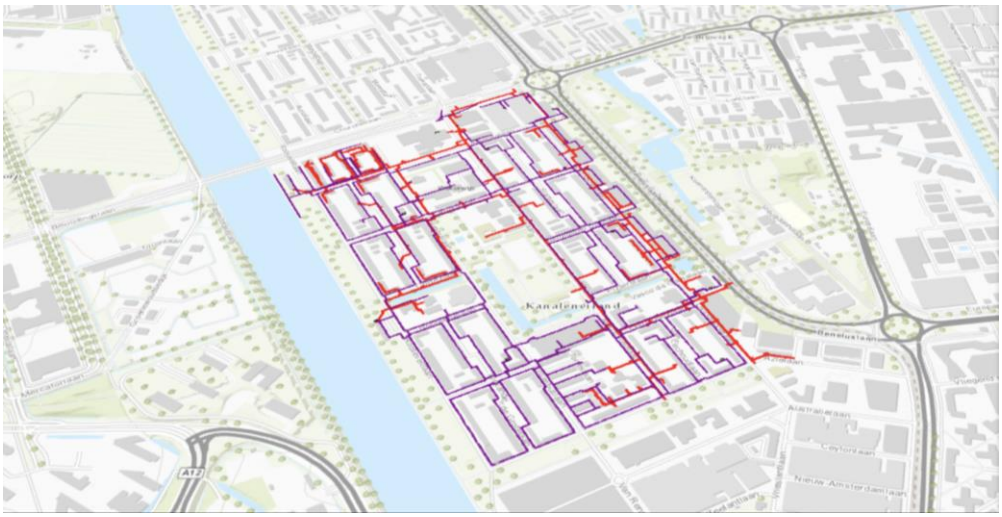


Figure 6. Current district heating and electricity infrastructure in the demonstration district Kanaleneiland Zuid: red: district heating network and purple: low voltage electricity network.
Source: Utrecht op de Kaart http://kaartenutrecht-gemu.opendata.arcgis.com

4. Transition track #1: Smart renewables and closed-loop energy positive districts

4.1. About the demonstration

The orientation to a near zero energy positive district involves a) to maximizing energy production and consumption from RES, b) increasing self-consumption at district scale, c) decreasing the household bills in combination with better comfort levels and d) developing the integration of energy sustainable solutions in a wider area with different individualities.

IRIS aims to demonstrate the integration and use of different technologies in existing apartment buildings capable of covering their energy needs, concerning electricity, heating and cooling. The foreseen demonstrated solutions in Track #1 integrate high renewables penetration (district scale PV), near zero energy housing retrofit, and energy efficient smart street lighting powered by renewables and connected to the district energy system with DC distribution. IRIS sets out to demonstrate how energy streams can be jointly used in such a way that a maximum of RES penetration at district-scale becomes possible (storage of locally produced electricity in 2nd life batteries, electric vehicles and busses is part of this integrated systems, which is described under transition track #2).

4.2. Baseline

The demonstration area has a poor energy profile. Most buildings were built in the period 1950-1970, an era marked by the absence of energy regulations. The apartments are poorly insulated and have a typical energy label E-F. Figure 7 provides an overview of the current status of the energy labels for the buildings in Kanaleneiland-Zuid.

Figure 7. Current Energy labels in the demonstration district Kanaleneiland Zuid, which also includes the 12 apartment building that will be renovated by Bo-Ex.
Source: Utrecht op de Kaart http://kaartenutrecht-gemu.opendata.arcgis.com/

The demonstrations area in Kanaleneiland Zuid includes 12 four-storey apartment buildings of social housing corporation BOEX, adding up to 644 apartments. Of these apartment buildings 8 are of the Intervam type (4 storey high apartment building with 48 apartments) and 4 of the Bredero type (4 storey high apartment building with 65 apartments). Intervam and Bredero are the names of the construction type of the buildings.

Intervam is a system that was introduced to the market by a company called intervam in the ’50 of the 20th century. The VAM system is a mounting construction method. In the factory all necessary elements are prefabricated and on the construction site they are combined into a residential block. This provided the opportunity to significantly speed up the building process in an era with a huge housing shortage after the Second World War. Bredero was a project developer and building company that also offered standardized houses using a mounting method.

Next, 3 school buildings (Kaleidoscoop, Schatkamer, MBO Utrecht) and the local innovation hub Krachtstation are part of the demonstration area (see Figure 8).

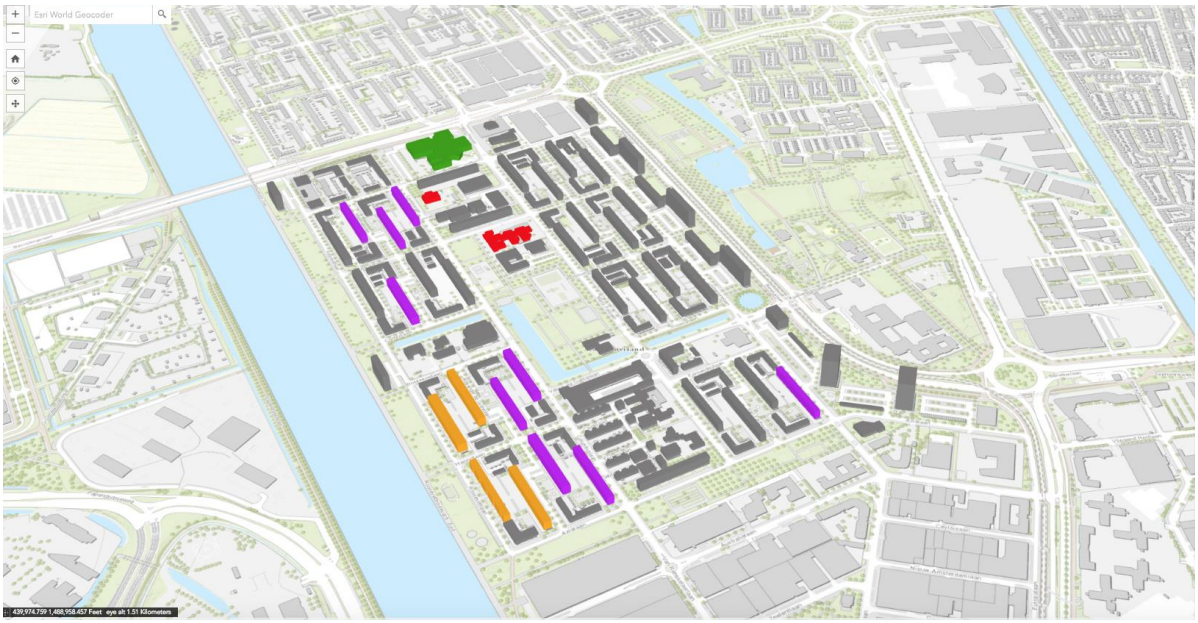


Figure 8. Map of the demonstration district Kanaleneiland Zuid with overview of apartment blocks that will be renovated (marked yellow and purple), involved schools (marked red) and the local innovations hub Krachtstation (marked green). Source: Municipality of Utrecht

The demonstration area is characterized by a mixed energy infrastructure. Of the apartment buildings that will be renovated 8 are currently heated with gas boilers and 4 are heated through the district-heating network (see Figure 9).

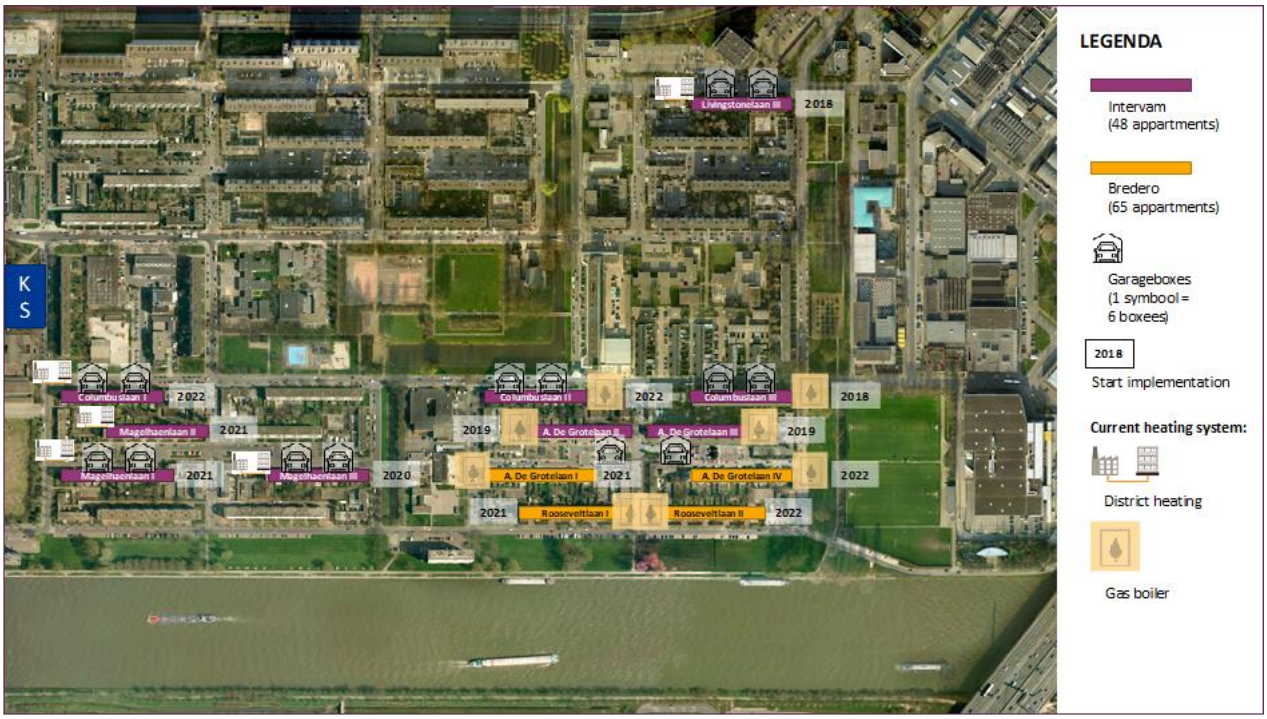


Figure 9. Overview of the apartment building that will be renovated and current energy infrastructure providing the heat

Figure 11 provides an overview of the average annual electricity and natural gas consumption for households in the apartment buildings that will be renovated. Households in the apartment buildings heated by natural gas boilers consume between ~ 1000 and ~1200 m3 natural gas per year. Households in the apartment buildings connected to the district heating network only use natural gas for cooking, and as a result consume lower levels of natural gas. Average electricity consumption for households ranges from ~2000 to ~ 1500 kWh per year. It must be noted that:

- These consumptions are reached at often-low thermal comfort performance (f.i. heating in winter limited to one room only).
- Variations in energy consumption between households in one apartment building can be very large, which has consequences for financial gains that can be achieved through the implementation of the measures within the IRIS project.

Apartment building	Electricity use 2017 in kWh	Natural Gas use 2017 m3
Alexander de Grotelaan II	1819	1043
Alexander de Grotelaan III	1835	994
Alexander de Grotelaan I	1606	1137
Alexander de Grotelaan IV	1589	1226
Columbuslaan I *)	1348	332
Columbuslaan II	1492	1067
Columbuslaan III	1639	1072
Magelhaenlaan I*)	1769	384
Magelhaenlaan II*)	2036	368
Magelhaenlaan III*)	1696	376
Rooseveltlaan I	1694	1067
Rooseveltlaan II	1636	1030

Table 2. Average electricity and natural gas use per household in 2017 for each of the apartment buildings in the demonstration area.
Source: Stedin
*) Natural gas for cooking only. Heating through the district heating systems

Hardly any renewables are being exploited in Kanaleneiland Zuid; only a few PV-panels are installed so far. Kanaleneiland Zuid furthermore applies conventional street lighting, i.e. lamppost are connected to the AC grid and not equipped with smart devices. Current location of lamppost in the area is mapped in Figure 10.

Figure 10. Current location of lampposts in Kanaleneiland Zuid (red dots).
Source: Utrecht op de Kaart http://kaartenutrecht-gemu.opendata.arcgis.com/

4.3. Ambitions

The *DoA states* that Utrecht's ambition is to contribute to Near Zero Energy districts by integrating:

- • A high share of locally produced and consumed renewable energy at district scale
- • Energy savings at building level
- • Energy savings at district level

The applied measures concern integrating (1) a high share of locally produced and consumed renewable power at district scale making PV profitable without subsidies, (2) RES and low temperatures for the district heating system partly serving the district, (3) innovative home EMS TOON, (4) energy savings thanks to refurbishing towards near energy zero building, (5) smart (hybrid) electric heat pumps for heating and hot water, (6) energy savings thanks to smart AC/DC power grid in apartments and (7) smart DC street lighting at district level. Measures 1 to 4 will be integrated and deployed in 12 four-storey apartment buildings adding up to 644 apartments (locations still to be determined). Measures 1 to 4 will be integrated and deployed in 12 four-storey apartment buildings adding up to 644 apartments. Measure number 6 will be demonstrated in 8 apartment houses. The seven measures and the implementation schedule are listed in the table below. Compared to the DoA the planning on distribution of the number of homes that will be renovated over the years has changed (total number of homes, however, stays the same). This changes was introduced since preparing the renovations takes more time, and adapted planning fits better within the investment-portfolio of Bo-Ex. The adapted planning is included in the table below.

	2018	2019	2020	2021	2022
Measure 1: District wide PV		48 homes	144 homes	226 homes	226 homes
Measure 2: LT district heating				96 homes	96 homes
Measure 3: HEMS TOON		48 homes	144 homes	226 homes	226 homes
Measure 4: NZEB refurbishment		48 homes	144 homes	226 homes	226 homes
Measure 5: Smart (hybrid) e-heating systems		48 homes	144 homes	130 homes	130 homes
Measure 6: AC/DC home switchboxes			8 homes		
Measure 7: Smart DC street lighting		50 smart street lights			

4.4. Planning of demonstration activities

4.4.1. *Planning of activities*

Since all measures excluding smart DC street lighting are directly related to the retrofit of the apartment buildings, the overall planning of TT#1 is strongly dependent on the planning of the retrofit activities. Figure 11 shows the planning of the retrofit activities of the 12 apartment buildings. Figure 9 in the previous section provides an aerial view of the district with location of the 12 apartment buildings and a display of the overall planning presented in Figure 11. Preparations for the renovation of the first apartment buildings have started and actual implementation is planned to start at the beginning in 2019.

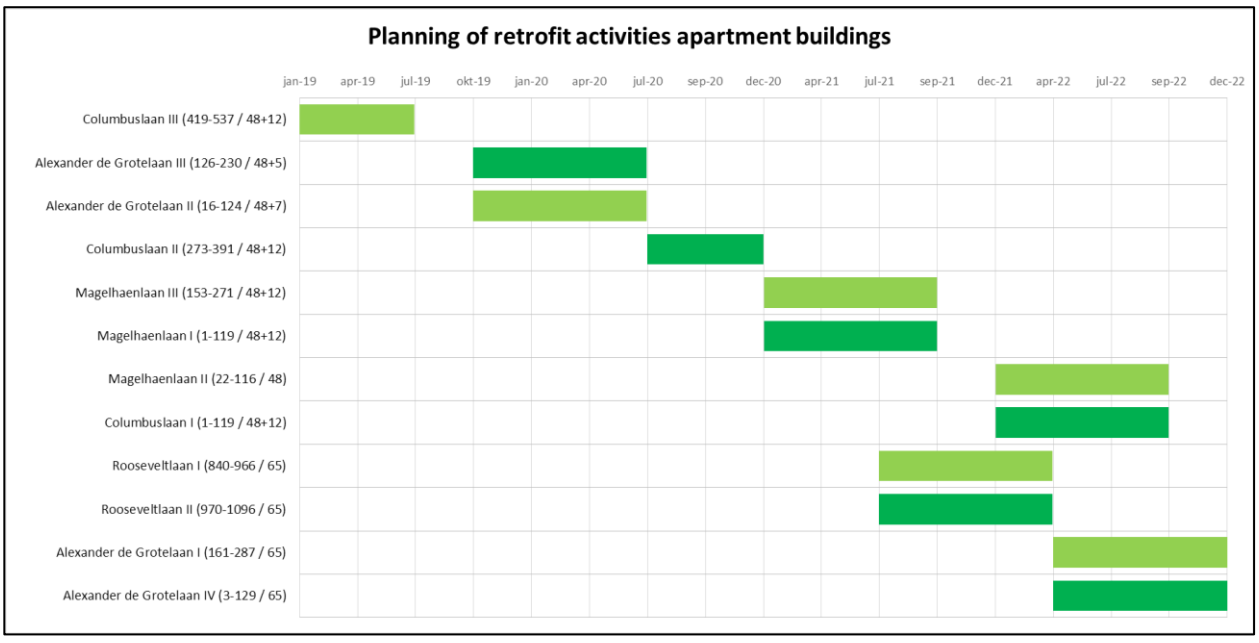


Figure 11. Overall planning of Transition Track #1

4.4.2. *Organisation of work*

Bo-Ex as owner of the apartment buildings, and as TT#1-lead, organizes the retrofit of the apartment buildings. Every apartment building goes through a cycle of activities, part of the standard procedure that Bo-Ex is uses in retrofitting:

- Investigation and research: Every building is inspected and investigated in order to get a clear picture of the current state of the building and the necessary activities;
- Engineering: producing technical descriptions and blue prints, obtaining permits;
- Preparations, purchase of materials and planning of retrofit.

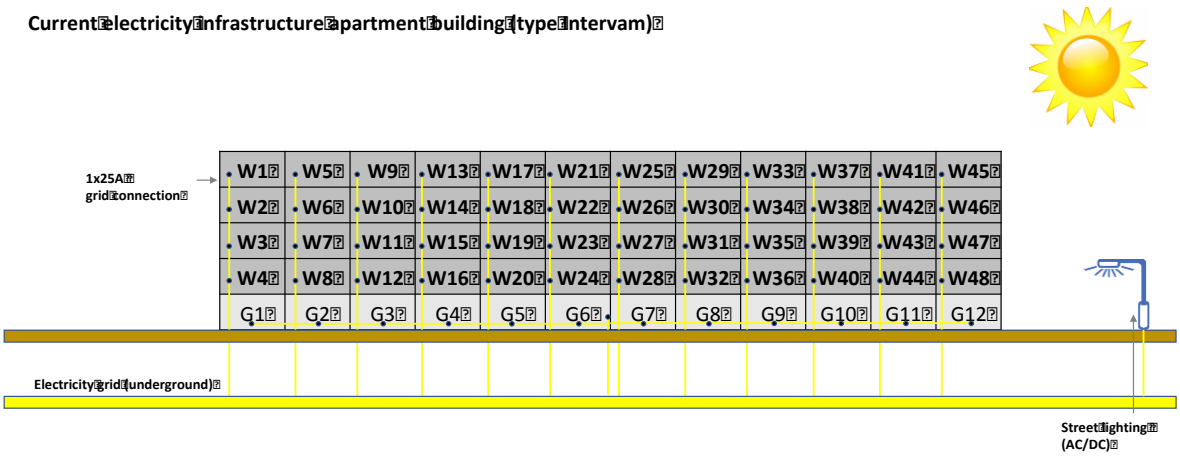
The measures that will be executed as part of the WP5 demonstration activities are detailed in close consultation with IRIS partners from the Utrecht ecosystem and are recorded in program of requirements for every measure. Key partners in TT#1 are:

Bo-Ex	Landlord/owner of the apartment buildings/coordinator of TT#1
Stedin	Owner of the electricity grid and individual grid connections
Eneco	Owner of the district heating infrastructure and connections, supplier of the Toon (HEMS)
Municipality of Utrecht	Responsible of public street lighting
Luminext	Service provider smart street lighting / additional functionalities

4.4.3. Measure 1: PV panels on the roofs of the apartment buildings and the schools

The roofs of the apartment buildings and schools in the district will be equipped with PV-panels. The number of PV-panels that will be placed on the roofs depends on (1) available and appropriate roof surface, (2) efficiency of the PV-panels (i.e. electricity production), and (3) energy usage of the tenants. The PV-panels produce energy and deliver this directly to the specific household / school.

When more PV-energy is generated than used on a specific moment, energy is delivered back to the grid provider. New regulations are under preparation regarding the amount of energy delivery and the tariffs for delivering energy to the grid. Bo-Ex and Stedin work closely together to detail and plan the necessary modifications to the electricity grid and connections to host renewable energy production of the PV-panels. Figure 12 provides an overview of the current (upper), and envisioned (below) integrated energy systems for individual apartment buildings.



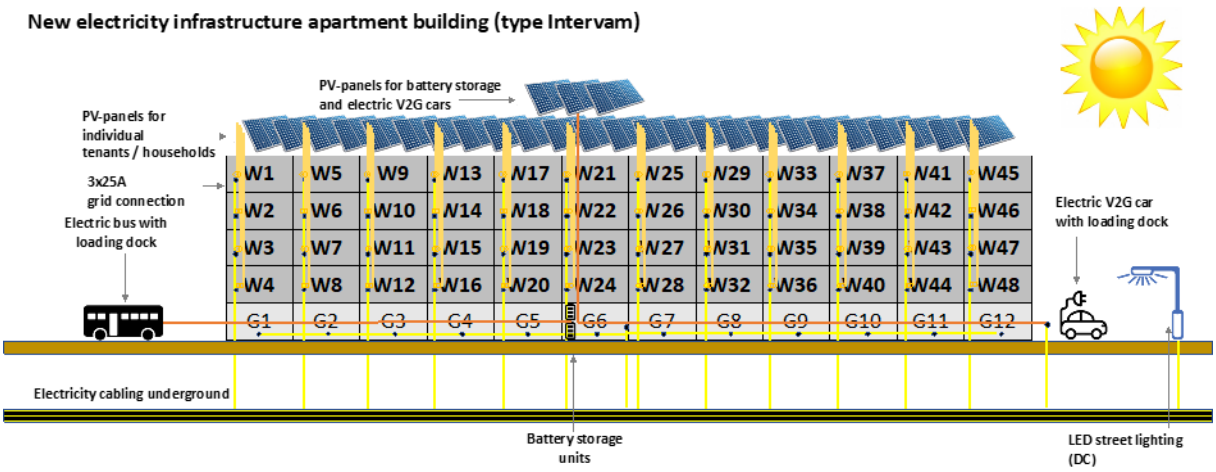


Figure 12. Overview of the envisioned energy system for an apartment building

Figure 13 shows the programme for the scheduled activities for this measure:

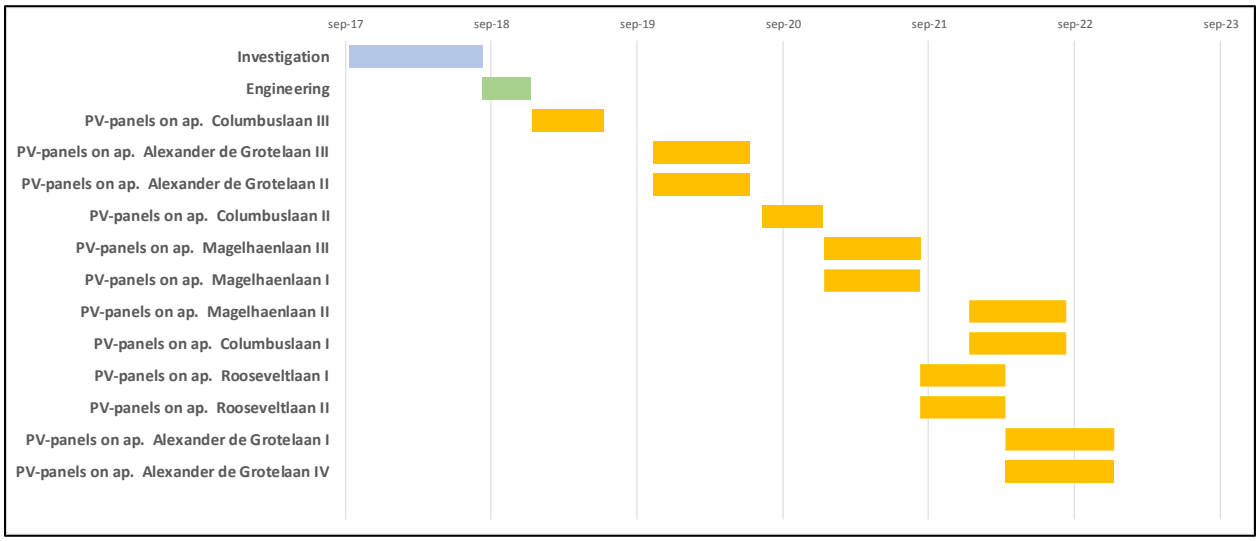


Figure 13. Timing of activities installation of PV-panels

4.4.4. Measure 2: LT district heating

Currently, 4 out of 12 apartment blocks are connected to the district heating (the other eight are connected to the gas infrastructure). This district heating provides hot water for space heating. The current supply temperature of the district heating is 90°C, with the implementation of a low temperature district heating system the supply temperature will be lowered to ≈40°C. An LT systems leads to lower energy losses in the apartment building and in the district heating distribution grid.

Basically, there are two variants of the 644 apartments regarding grid connections and utilities. At this moment 8 apartments have a central gas-heating boiler, and 4 have district heating. Regarding the other utilities, the apartments are almost similar:

- All apartments contain a grid connection to provide in electricity for domestic devices;
- All apartments contain a grid connection to provide in gas for the kitchen (cooking);

- All apartments contain a gas-heating boiler for hot tap water.

Figure 14 shows the current utility facilities and the envisioned facilities for apartment building currently connected to the district-heating grid.

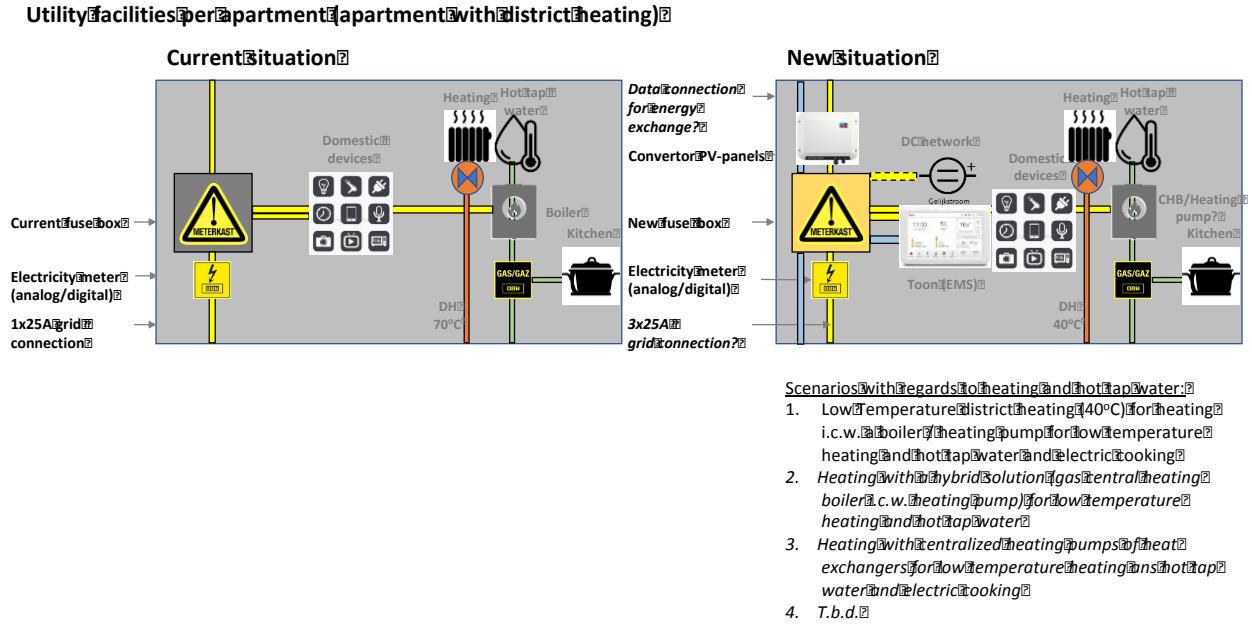


Figure 14. Envisioned sustainable heating system for apartment building on district heating network

Eneco will be involved in the design process of the low temperature district heating system. Together with an external advisor and a contractor, the design of the low temperature heating will be designed. Figure 15 shows the programme for the scheduled activities for this measure:

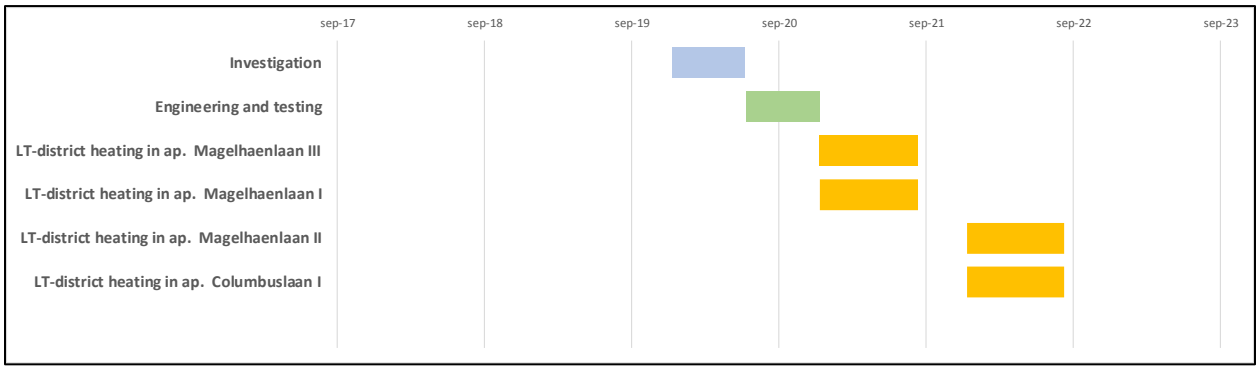


Figure 15. Timing of activities LT-district heating

4.4.5. *Measure 3: Home Energy Management Systems (HEMS) TOON*

The Eneco Toon® (hereafter Toon) is an existing device (7`` display) with proven technology. The main objective of the Toon is to provide information of the energy usage of a household. Since a couple of years, the Toon is already installed in many houses and apartments in The Netherlands, for clients and non-clients of Eneco. The user interface and hardware of the Toon have been adjusted frequently. Other functionalities were added, such as:

- Amount of energy produced by PV panels;
- Monthly energy bill;
- Spoilage checker;
- Weather forecast.

Eneco will be involved in the PoR stage and design process for the apartment buildings. The PoR of the Toon and linked applications depends on the possibilities to adjust the software of the Toon and/or linked applications. Eneco will therefore also be partner in the citizen engagement activities in TT#5. Eneco will install the Toon in every apartment and provide instructions to the tenants. Figure 16 shows the programme for the scheduled activities for this measure:

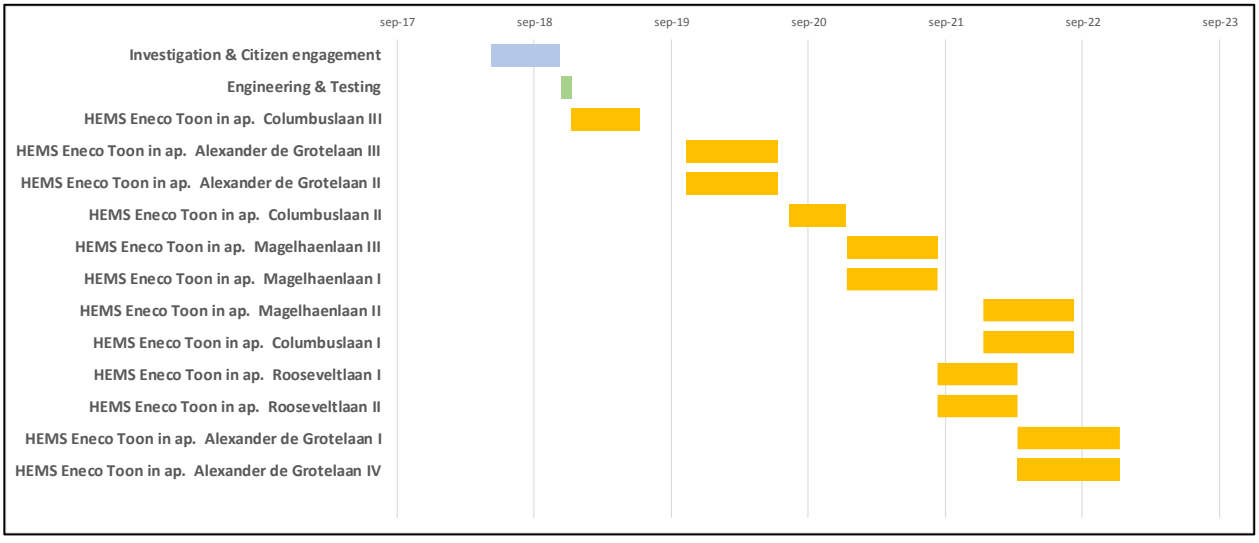


Figure 16. Timing of activities HEMS Eneco Toon

4.4.6. Measure 4: Energy savings as a result of refurbishing towards near energy zero building

Currently the apartment buildings experience high heat losses due to poor insulation. As part of the refurbishment activities to increase energy efficiency the following measures will be implemented:

- New window frames and glazing (double or triple glazing);
- Insulation of outer walls and the ground floor ceiling;
- Improvement of chinks (especially at the connection of the façade with the window frames);
- Mechanical ventilation (with natural or mechanical supply).

Figure 17 shows the programme for the scheduled activities for this measure:

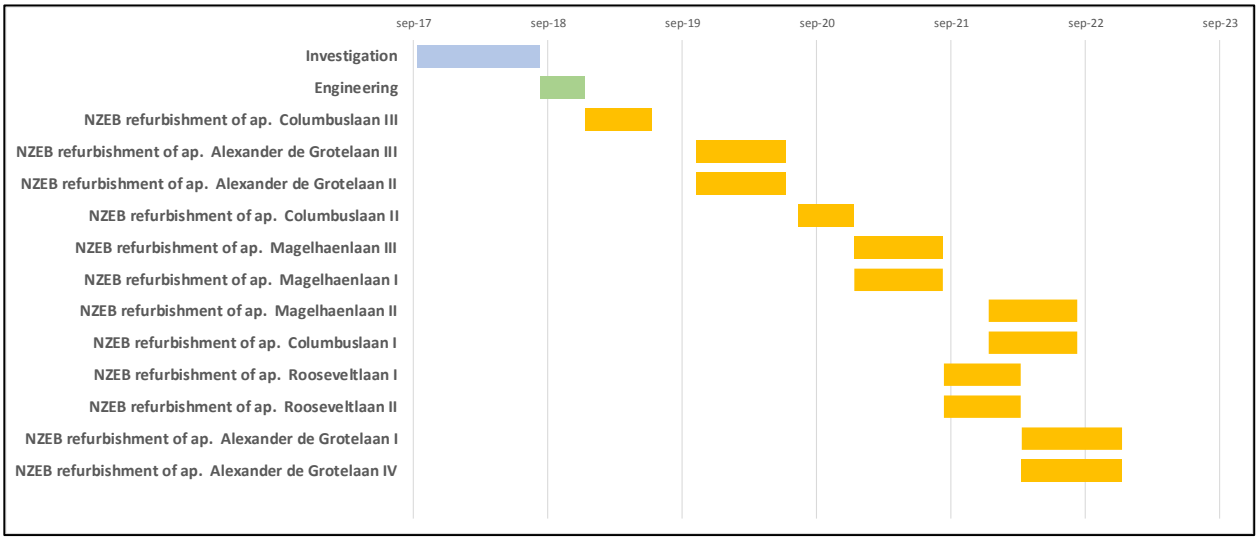


Figure 17. Timing of activities NZEB refurbishment

4.4.7. Measure 5: Smart (hybrid) electric heat pumps for the production of heating and hot water

The smart hybrid e-heating systems consists of devices which will provide heat and hot tap water for the tenants, in 8 of the 12 apartment buildings. The concept of the smart system consists of a central gas-heating device in combination with a ventilation heat pump. The ventilation heat pump uses the heated ventilation air in an apartment to provide heat for space heating. The ventilation air comes from outside or inside, depending on the choice of the ventilation principle applied. This is a hybrid system, since it's combines electrical and gas fed devices.

The smartness of this system consists of the ability to switch between gas and electrical heat. In principle baseload demand for space heating is supplied by the electrical system, whereas peak load in supplied by the gas fed part of the system. Furthermore the hybrid heat pump can provide flexibility in for the electricity grid, by switching to gas-mode in times of high demand for electricity in the area and potential grid stress.

The heat pump either will be installed as an individual solution or as a centralized solution. Eventually every apartment will be equipped with heat pumps combined with a central gas-heating device. But, it's

possible – and worth a research – to find out whether we can make use of centralized heat pumps instead of individual heat pumps. A centralized solution is much more efficient, but requires also an administrative solution to let tenants pay for the individual consumption of the heat pumps. During the design and engineering of every apartment building, both options will be examined.

Figure 18 shows the current situation regarding utility facilities for the apartment buildings heated with natural gas, and the possible utility facilities after the renovation.

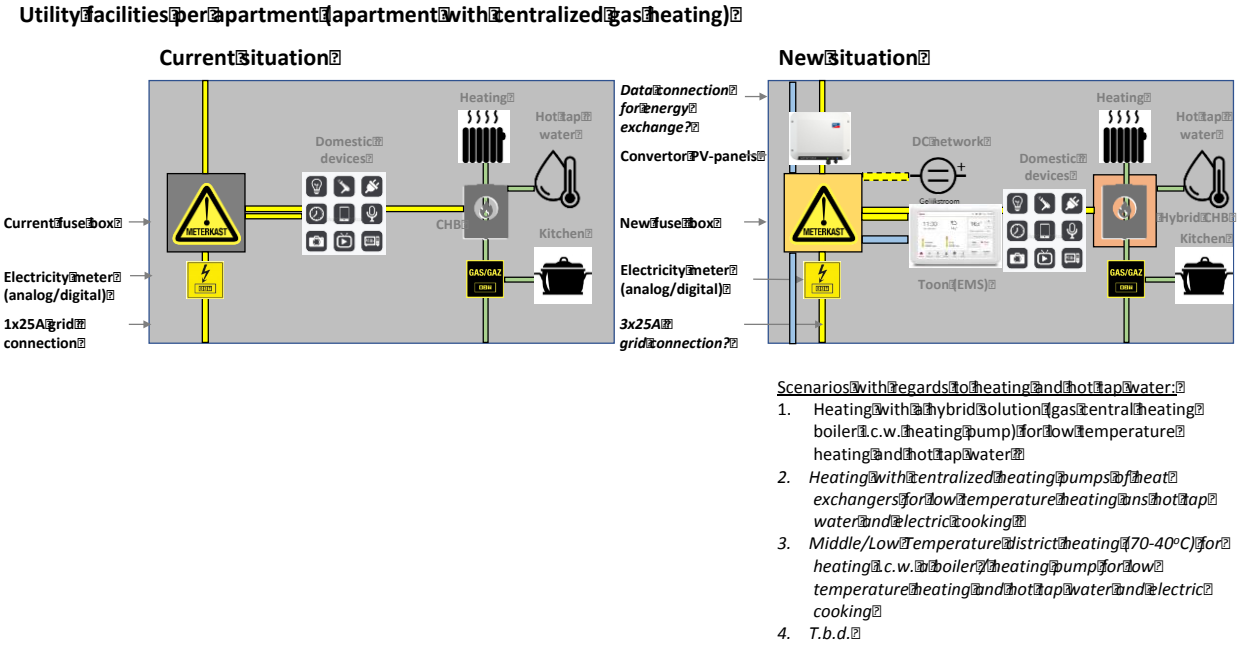


Figure 18. Current situation and potential situation after installation of a smart hybrid heat pump for apartment building currently equipped with centralized gas heating systems.

Figure 19 shows the programme for the scheduled activities for this measure:

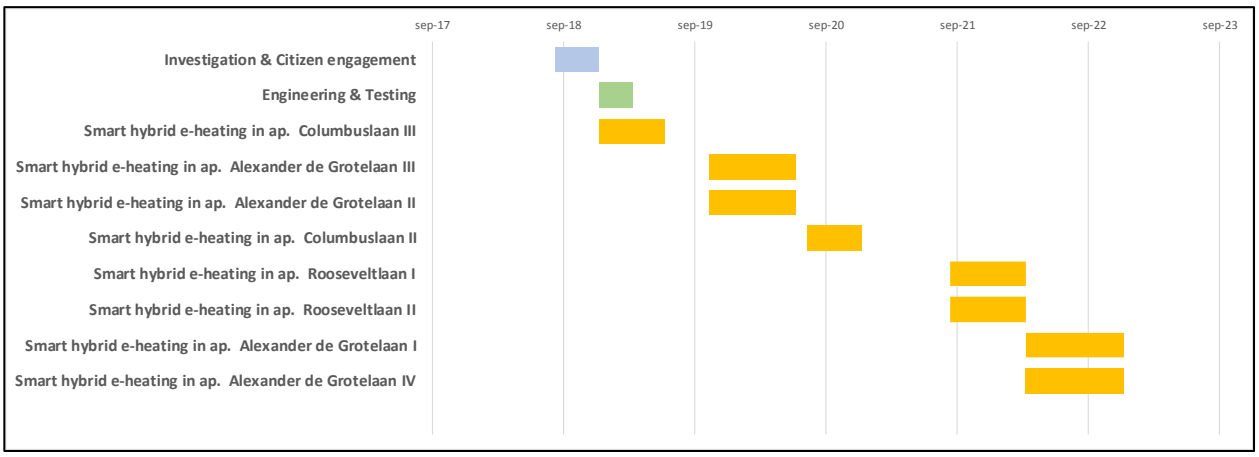
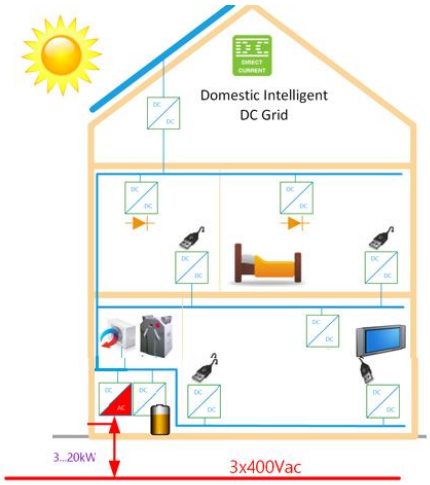


Figure 19. Timing of activities smart hybrid e-heating

4.4.8. Measure 6: Energy savings as a result of smart AC/DC power grid in apartments



Energy savings will also be realised through a direct current (DC) network in a small-scale pilot of 8 houses. Direct current electricity produced with the PV panels on the roof will be directly used in the homes. Usually, generated DC electrify is transformed by a transformer into 230 Volt alternating current (AC). This transformation causes energy losses and by directly using DC these losses are avoided.

Because of the fact that many domestic devices operate on low voltage AC/DC, the question is whether it's interesting to implement a (parallel running) DC network in a house to provide energy for a certain number of devices.

A research project on this measurement, done by students of Utrecht University in the first half of 2018, shows that there are technical and financial possibilities to make a direct current network in an apartment. Basically, there are two options that are interesting for the tenants:

- A full direct current network within an apartment building instead of the existing alternating current network;
- A partially direct current network within an apartment building, parallel to the existing alternating current network.

The research concluded that a full DC network delivers more energy savings, but is more expensive and more complex to incorporate in the existing apartments. Since the pilot will be done in existing apartment with existing tenants, the choice of a partially direct current network looks most sensible. The success of a partially direct current mainly depends on the attitude of residents.

To implement a DC network, it's necessary to have insight in the domestic devices of a (generic) household: which devices can be connected to a DC network directly and what is the impact for the user? To answer these questions, it's necessary to have insight in the tenants kind and usage of devices. With this information we can investigate the possibilities for implementing a DC network and guiding our tenants.

This solution will be implemented in 8 individual homes, because the technology is still very innovative and results from practical experiences are very limited. Part of this engagement activity is to find 8 volunteers who provide the ability to implement a DC network in their house.

Direct Current is currently the only specialized company in direct current applications. Direct Current will be involved in the PoR stage and design process of the apartment buildings. Direct Current will also be partner in the citizen engagement activities of TT#5. Figure 20 shows the programme for the scheduled activities for this measure.

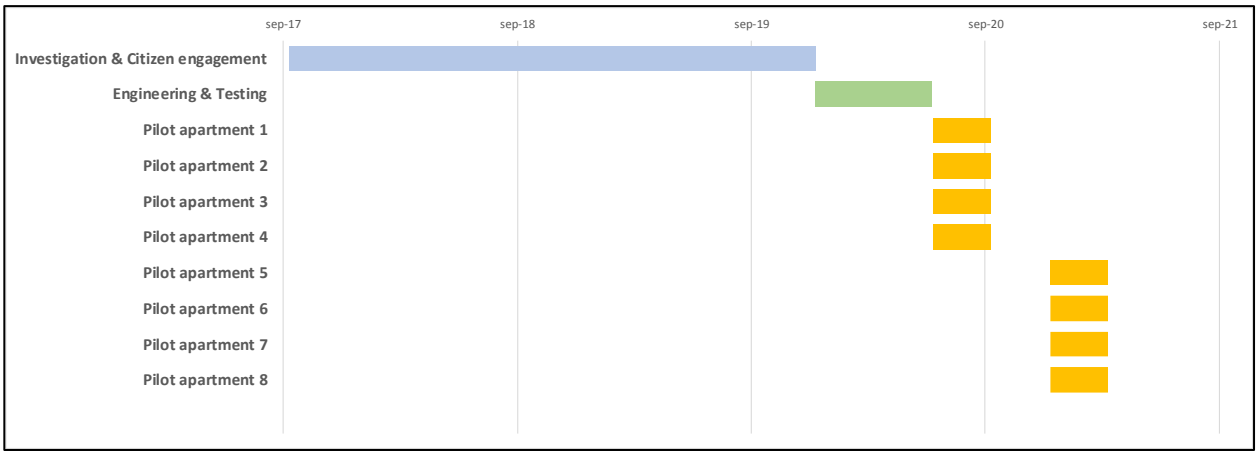


Figure 20. Timing of activities DC pilot 8 apartment dwellings

4.4.9. Measure 7: Smart DC street lighting at district level

This measure compromises energy efficient smart street lighting powered by renewables. Not only the energy efficiency of the Smart street lighting increases by using LED lighting bulbs and direct current (DC), also other functionalities will be incorporated in the street lighting. These additional functionalities are investigated together with citizens of the district. In total 50 existing street lighting poles in the district will be replaced by the smart street lighting.

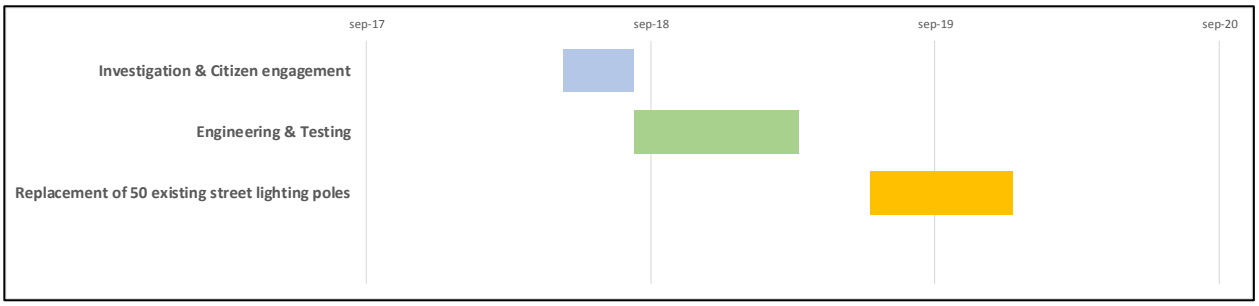


Figure 21. Timing of activities Smart Lighting

4.4.10. Data Collection and Management

Data that will be collected within the demonstration area:

- Energy consumption on the household level. Data collection through the Toon. Because of Privacy legislation, permission of the tenants to obtain this data is required or data need to be anonymised.
- Energy consumption and production on the apartment building level. Data collection through the district.
- Electricity production of the PV panels. Data collection through Electricity (sub)meters.
- Consumption of locally produced electricity with the PV panels. Data collection through smart meters (with the permission of the tenants).
- DC electricity consumed by households (AC/DC switchbox). Data collection through (sub) meters within in the apartment (with the permission of the tenants).
- DC electricity consumed by street lighting. Data collection through (sub)meters.

For the mentioned data of production and consumption, the amount of CO_2 savings can be calculated easily.

4.5. Barriers and Drivers

4.5.1. Political

The Municipality of Utrecht is committed to be climate neutral in 2030. By 2020, the city want to reduce its CO_2 emissions by 30% compared with 2010, and increased the share of renewable energy to 20%. 'Green parties' won the recent elections, the coalition agreement for the city of Utrecht agreed on ambitious and progressive commitments to achieve the mentioned goals. For the coming 4 years (2018-2022) the coalition plans will be spread out and monitored. The IRIS initiative contributes to the commitments and will be used as one of the pilot projects within Utrecht.

4.5.2. Economic

Potential driver for the renovation is the fact that it provides tenants with the opportunity to lower their expenses for housing. This is very relevant as this is a neighbourhood with a high share of low-income households. This is, however, also a potential barrier as tenants are seeking guarantees on presented benefits before they are willing to accept the renovation.

4.5.3. Sociological

To enable the renovation to take place, at least 70% of the tenants need to agree with the renovation plans. In case 70% volunteers all tenants (including tenants who oppose the plans) need to participate in the renovation. This is laid down in the Dutch Civil Code. To acquire this agreement from 70% of the tenants a careful communication process needs to be developed with good communication to clarify pros en cons of various measures.

4.5.4. Technological

Insulations measures that will be applied to reduce energy demand of the apartment building are well knows and have been frequently applied. This also applies for the PV panels that will be placed on the roofs. Experience with hybrid heat pumps are still limited, which means that performance needs to be closely monitored.

4.5.5. Legal/Regulatory framework

- Social housing corporations (through the branch-organization Aedes) in the Netherlands signed a *covenant* with the national government in which they agreed to make investments in energy saving measure in their housing stock resulting in an average label B in 2021.
- The national government provides *financial incentives* to invest in energy savings for social housing cooperation's through a subsidy scheme (called STEP Stimuleringsregeling energieprestatie huursector) with a total budget of 395 million euro. The level of the subsidy depends on the level of improvement of the energy index (EI). This subsidy scheme (STEP) ends in 2018, for 2019 and later new subsidies and regulations are set up right now.

- The national government introduced regulations that provide Housing Corporation's with the opportunity to invoice their tenants an *energy-performance-compensation* (Energy Prestatie Vergoeding EPV in Dutch) when they renovate towards "nearly zero-on-the-meters". In this case tenants no longer receive an energy bill but pay a fixed service fee per m2 based on the energy index realized after the renovation. The EPV provides housing cooperation's with the opportunity to recover part of the required additional investments costs to renovate homes towards nearly zero energy. This regulation is currently practiced in several new build and renovation projects throughout the Netherlands. Experiences so far:
  - Advantages: fixed fee and low risks for tenants, insight in the energy production and consumption by tenants and housing corporations, clear and fair incentive for housing corporations to invest in energy efficient homes.
  - Disadvantages: it's hard to explain the principles of this regulation and pro's/con's to tenants, high costs for additional metering and applications, many requirements and administrative costs to prove that a compensation (EPV) is allowed, less appropriate for users with excessive energy usages.
- Households that produce electricity with PV panels are given the opportunity to balance their consumption and own production (the so-called *balancing regulation*). This means that the energy supplier deducts the produced electricity from the consumption of the customer. As a result, the customer receives the same price (including taxes and transport costs) for the returned energy as he pays for the energy he purchases from the energy supplier at a different time. Due to the relatively high level of energy taxes in the Netherlands this provides an attractive financial incentive for household resulting in average financial payback time for PV panels of 7 years. The current government presented plans to revise this regulation because: (1) they believe that the current scheme is unfair because no energy taxes are paid for the returned energy, resulting in lower tax revenues for the national government that need to be compensated by increasing other taxes, (2) current scheme is too generous regarding provided financial incentives, and (3) it provides no incentives to consume the locally produced electricity also locally (behind the meter).

4.5.6. Environmental

The implemented measures provide the opportunity to achieve a substantial reduction in CO_2 emissions, and to improve the indoor climate of the homes. Implementation of the IRIS solutions also provides the opportunity to improve the surrounding areas by smart "pooling" of plans by the IRIS partners:

- Bo-Ex as responsible party for the apartment buildings;
- Eneco as responsible party for the district heating infrastructure;
- Municipality Utrecht as responsible party for the infrastructure (under and over ground level);
- Stedin as responsible party for the grid and grid connections for gas and electricity.

Jointly elaborating the plan makes it easier to realize integral plans for as well the buildings as well as the infrastructure, with lower impact and higher benefits for the tenants and users.

4.6. Business models

- The housing cooperation Bo-Ex will develop a novel business model to overcome the split incentive for the additional investment required to deliver nearly zero energy buildings. Split incentives occur when those responsible for paying energy bills (the tenants) are not the same entity as those making the capital investment decisions (the building owner). In this model, the benefits associated with the resulting energy savings accrue to the tenant.
- A business model will be created for 600 households, with their own set of PV-panels (collectively placed on the building roofs by Bo-Ex), to exchange solar power. This business model should motivate the households to participate in the IRIS project.

4.7. Conclusions on ambitions and planning of activities

Progress had been made in the implementation of measure under TT 1. Key activities include:

- Planning and preparation of refurbishment activities for the first 2 apartment blocks started (covering measures 1, 2, 4 and 5).
- First meetings and ideas on citizen engagement trajectory for the TOON discussed and developed (measure 3). F
- Feasibility study and market assessment for measure 6 finished.
- Program of requirement under development of measure 7.

So far, no major deviations are anticipated compared to the DoA regarding the type of implemented measures and their size. Regarding the planning a slide shift in the planning of the distribution of homes to be renovated over the years.

5. Transition track #2: Smart energy management and storage for grid flexibility

5.1. About the demonstration

The lighthouse project will demonstrate in the district Kanaleneiland-Zuid how to best deploy district scale storage, combining the batteries from V2G e-cars and V2G e-buses with stationary (second life) batteries in the apartment buildings, supported by open ICT for interconnection, performance monitoring and new information services for aggregators, grid operators, municipality and citizens.

The activities in TT#2 aim to study and demonstrate the use of amongst other 2nd life batteries as an energy storage solution for micro-grid systems operating in a flexible mode. The idea is to use cheap reconditioned batteries, the so-called 2nd life batteries, in citizens' homes and businesses. This allows addressing the set priority of EU policy for circular economy and business development. Such an innovative re-utilization scheme can delay the recycling process and extend the useful lifetime of already exhausted batteries up to 10 years, obtaining in the meantime new revenues. Additionally, by increasing the lifetime value of a battery, the cost for primary and secondary users will lower. Finally, the implication of these second-life batteries enables a faster shift towards an EU renewables-based economy.

5.2. Baseline

The local electricity grid in the demonstration area was designed in the sixties and includes three middle to low Voltage (MV/LV) transformers. This infrastructure is not outlined to accommodate for interventions taking place within the IRIS project (see Figure 27) and without changes there is a high risk of grid-stress occurrences.

Currently hardly any public charging points are available in the district of Kanaleneiland Zuid (see Figure 22).

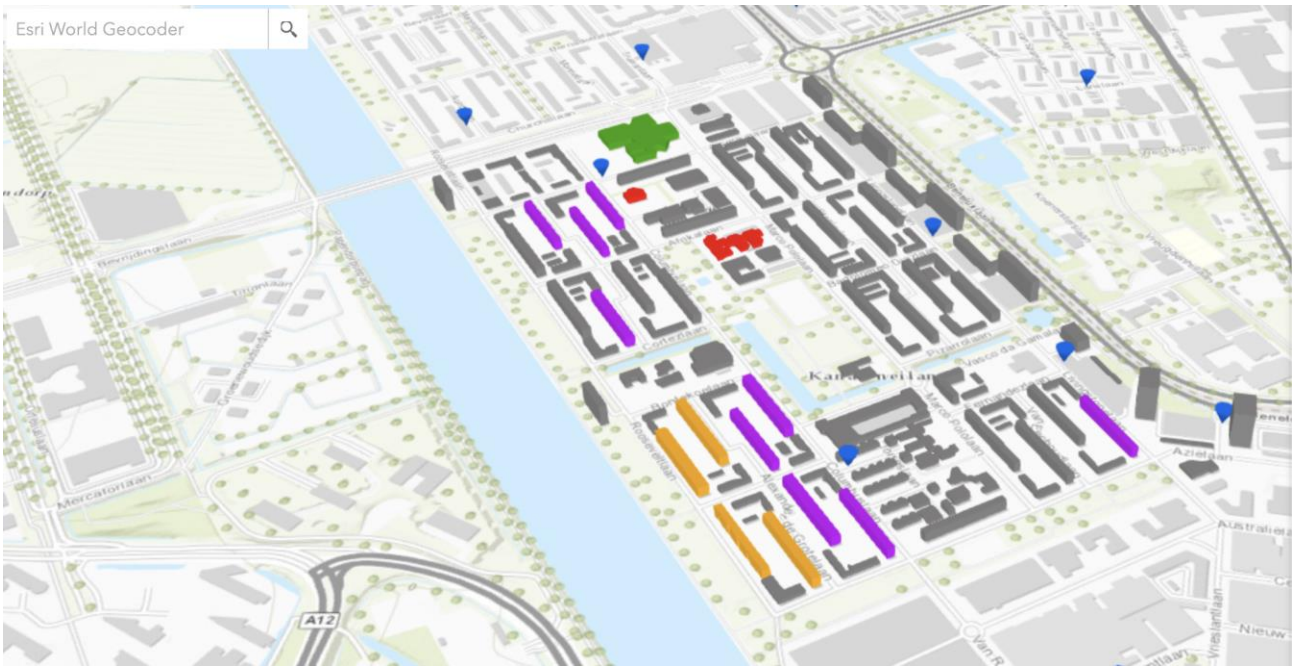


Figure 22. Location of charging points for electrical vehicles in Kanaleneiland-Zuid.
Source: Municipality of Utrecht: charging points are marked in blue

5.3. Ambitions

The *DoA states* that within the IRIS project Utrecht has the ambition to integrate smart energy management and renewable energy storage for

- Maximum profits of renewable power,
- Maximum self-consumption reducing grid stress,
- Unlocking the financial value of grid flexibility, and
- Optimizing the second life of car and bus batteries.

The applied measures include (1) solar V2G charging points and storage in e-cars, (2) the same in e-buses, (3) additional stationary energy storage partly by means of second life batteries in apartment buildings and e-cars (4) smart ICT to interconnect EMSs at home, building and district level, for the integration of maximal renewables production. The lighthouse project will demonstrate in the selected demonstration areas how to best deploy district-scale storage, combining the batteries from V2G e-cars and V2G e-buses with stationary (second life) batteries in the apartment buildings, supported by open ICT for interconnection, performance monitoring and new information services for aggregators, grid operators, municipality and citizens. The measures and *adapted implementation schedule* are listed in Table 3.

Measures	2017	2018	2019	2020	2021
Measure 1: Solar V2G charging points for e-cars/e-vans		~~18~~ 4	12		
Measure 2: Solar V2G charging points for e-buses			10		
Measure 3: Stationary storage in apartment buildings			4 X 300 kWh		
Measure 4: Smart Energy Management System (EMSs)		Start	Extension	Extension	Complete

Table 3. Original implementation schedule TT#2 included in the DoA

5.4. Planning of demonstration activities

5.4.1. Planning of activities

The introduction of district scale storage with 2nd life batteries is closely related to the retrofit activities in TT#1 and with the V2G-vehicles in TT#3. The 2nd life batteries will be placed in garage boxes of in apartment buildings that will be refurbished to NZEB.

The location of V2G-charge points will be near the garage boxes with 2nd life batteries. Furthermore, the introduction of V2G-cars and V2G-charge points will be demand driven. That means that the first V2G-cars and V2G-chargers will be deployed at these locations where it is known that people are interested in the V2G-car-subscription system. The further introduction of V2G-chargers and V2G-cars will be based on the emerging interest of citizens in the demonstration area Kanaleneiland-Zuid. The success of an increasing interest in this new type of mobility service is closely related to the citizen engagement activities in TT#5. Figure 23 depicts the integration of 2nd life batteries in the district management system.

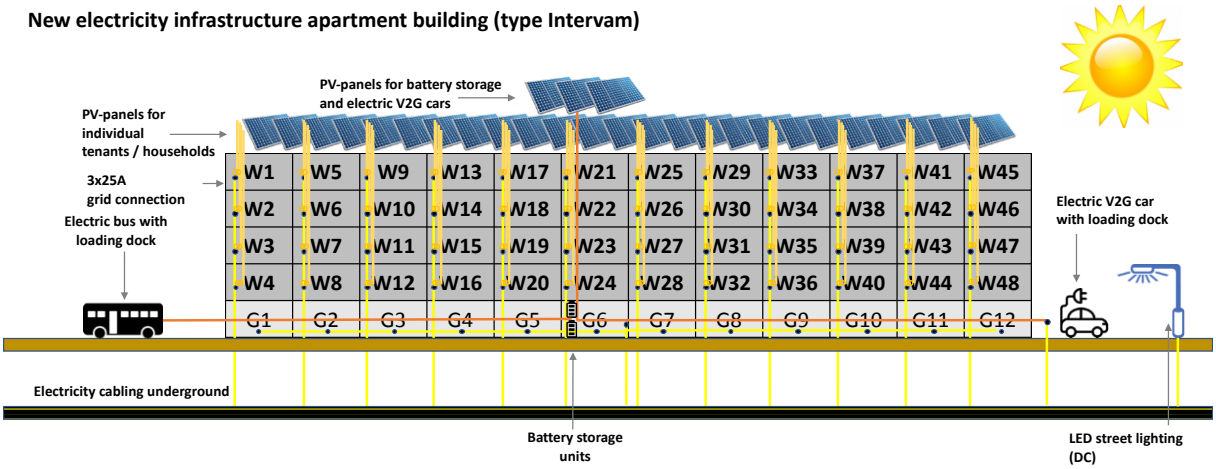


Figure 23. Outline of integration of the 2nd life batteries in the district management system

Figure 24 provides an aerial view of the district depicting the location of the first V2G-chargers, V2G-cars and 2nd life batteries and a display of the overall planning presented in Figure 25.

Figure 24. Aerial view of Kanaleneiland-Zuid with TT#2 planning

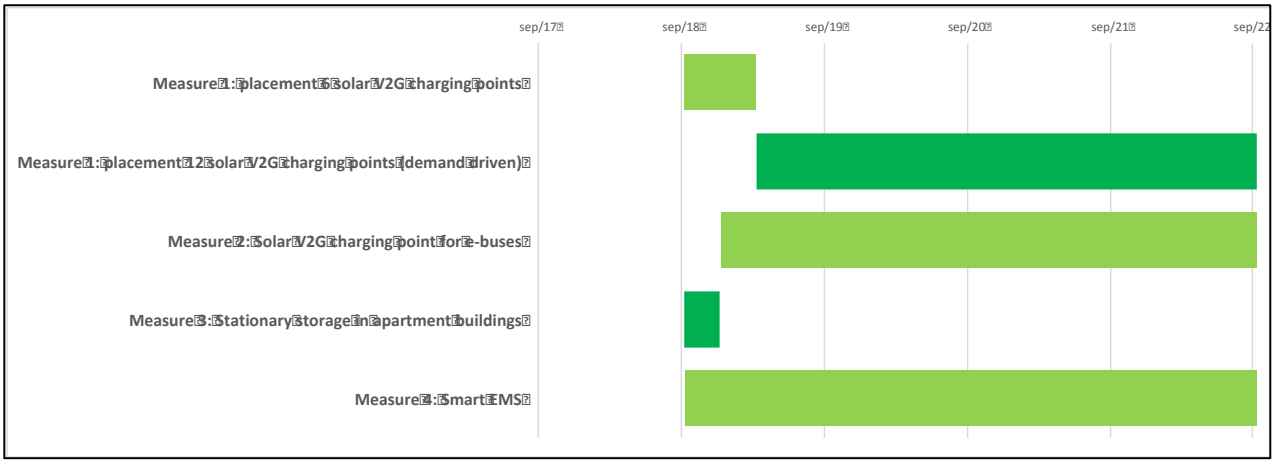


Figure 25. Overall planning of TT#2 activities

5.4.2. Organization of work

TT#2 is connects TT#1 (Smart renewables and closed-loop energy positive districts) and TT#3 (Smart e-Mobility Sector). It aims to realize an electricity grid capable of accommodating renewable energy and providing sufficient flexibility to create a robust grid that contributes to a self-supporting district. Key partners in TT#2 are listed below.

LomboXnet	MaaS “We Drive Solar” provider
Bo-Ex	Owner of the apartment buildings which host PV-panels and 2nd life batteries
Stedin	Owner of the electricity grid and individual grid connections
Eneco	Supplier of hybrid heat pump=0-7 with smart control in light of flexibility

Jedlix	Aggregator and supplier of smart management and charging strategy of 2nd life batteries and V2G-cars and V2G-chargers
Qbuzz	Local bus company, that owns and deploys e-buses and V2G-chargers and creating RES at bus depots with PV-panels

5.4.3. Measure 1: Solar V2G charging points for e-cars

Locally produced solar energy from the PV-panels at the roofs of the apartment buildings is stored in cars via Vehicle2Grid technology: a smart and dynamic quick load- and storage system. This creates flexible storage capacity that reduces peak loads on the power grid. The stored energy is being released to the district at a later time, when energy demand is high.

A total of 18 solar V2G charging points for e cars will be deployed in the demonstration area Kanaleneiland-Zuid. The introduction of the charging points will be demand-driven, with the first 6 charging points to be placed at:

- 4 charging point at the two apartment buildings that are first in the row to be refurbished (east part of the district).
- 1 charging point near the Local Innovation Hub “Krachtstation” (former school building that now hosts start-ups and functions as a meeting place).
- 1 charging point at the parking place of the office of Bo-Ex in Kanaleneiland.

All 4 V2G charging points will be connected to the 2nd life batteries in the apartment buildings.

5.4.4. Measure 2: Solar V2G charging points for e-buses

IRIS partner QBuzz is relocating his bus depot from the Europalaan in Utrecht to Westraven. This is a district just south of Kanaleneiland-Zuid. The roof of the bus depot will be covered with PV panels to produce electricity to charge electric busses. Therefore, QBuzz will realize V2G charging points at its new bus-depot with the objective to demonstrate and optimize bidirectional charging for 10 electric vehicle-2-grid buses. Optimization entails finding a strategy to (1) balance supply of renewable electricity with demand for electricity by the e-buses, (2) minimize load demand and avoids grid stress. In the DoA implementation of the 10 V2G charging points was anticipated in 2019. Actual implementations, however, depends on the pace of the decision-making process for the new bus depot by QBuzz and the province of Utrecht.

5.4.5. Measure 3: Stationary storage in apartment buildings

A total of four 2nd life batteries will be procured by IRIS project partner Bo-Ex and placed in garage boxes of two apartment buildings. The batteries will be connected to the PV-panels on the roofs of the apartment buildings on the one hand and to the V2G-charging points on the other hand. Figure 26 provides an overview of the integration of the 2nd life batteries in the district management system.

The power stored in the 2nd life batteries will be used to charge the V2G-cars, since there are currently still barriers in the legal framework (law and regulative barriers and tax barriers) to use the power stored in the batteries for self-consumption by the tenants of the apartment buildings.

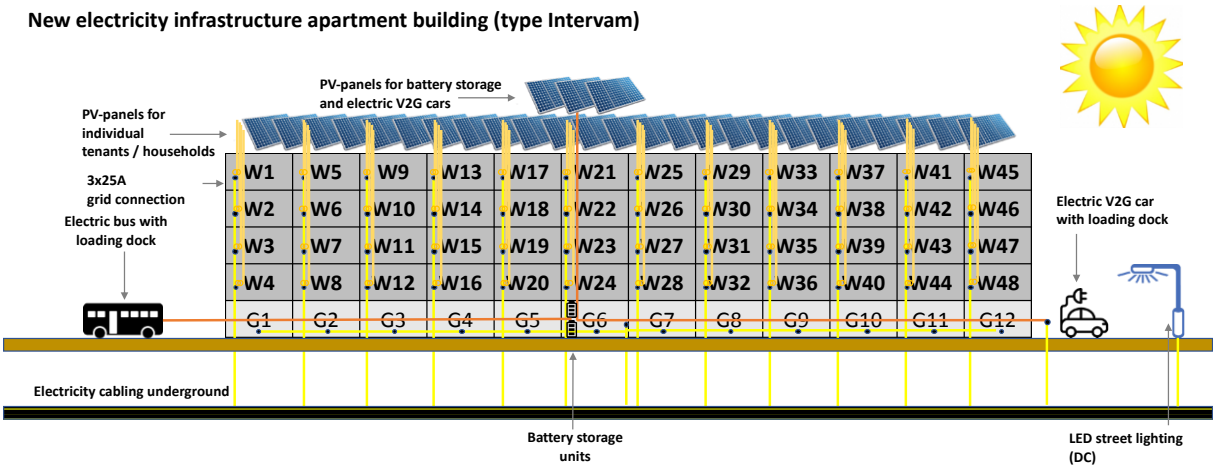


Figure 26. Outline of integration of the 2nd life batteries in the district management system

5.4.6. Measure 4: Smart energy management system

In the demonstration area an integrated smart energy management system will be realised. The district energy system will interconnect energy consumers, energy producers and energy storage providers including the following components:

- PV panels on the roofs of the apartment buildings and the schools
- Solar V2G charged e-cars
- Solar V2G charged e-buses
- Second life batteries in apartment buildings
- Public street lighting
- Smart ICT to interconnect EMSs at home, building and district level, for the integration of maximal renewables production.

The Local electricity grid in the demonstration area was designed in the sixties and will, during the building period of the demonstration, be adapted to fit in all elements as summarized above. In the new situation three additional transformer stations, transforming the voltage from medium voltage to low voltage will be added to the existing three stations in the local low voltage grid. These three additional transformer stations are necessary due to the feed in of large amounts of sun power produced on the apartment buildings. The locations of all 6 transformer-stations are indicated on the map in Figure 27.

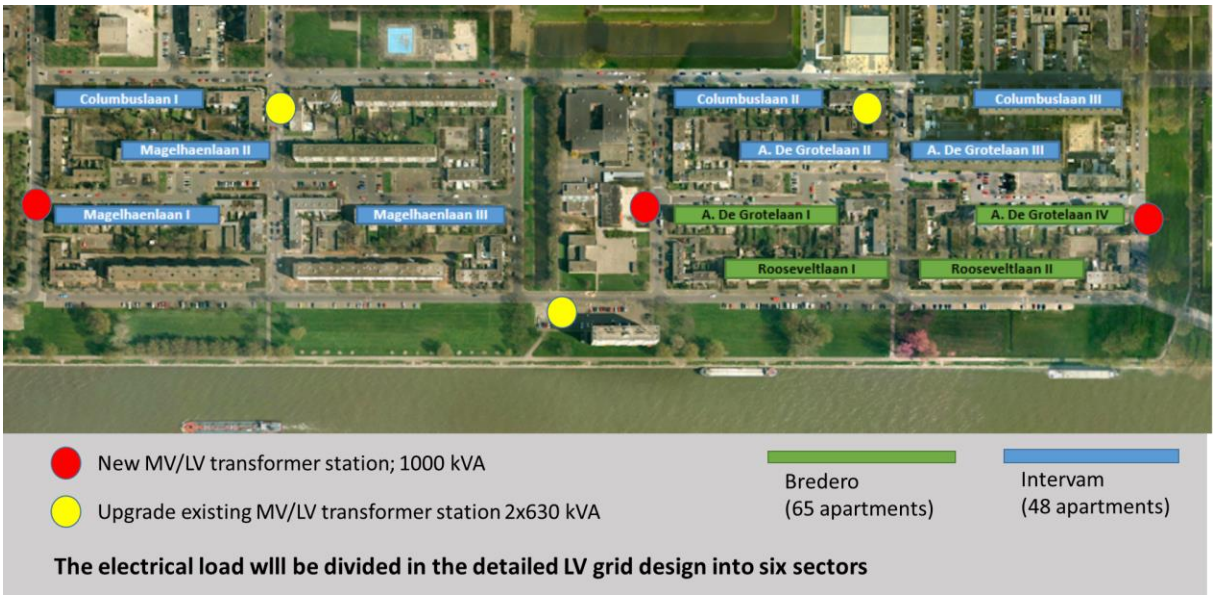


Figure 27. Location behind of the 6 middle voltage station that will be used as test bed to solve congestions points.

The transformer stations will be equipped with additional special measuring sensors to measure transformer and cable loads and power quality to feed the smart energy management system to optimize the energy flows in the demonstration area. A district energy management system will interconnect the EMSs at home, building and district level.

The transformation of the district energy system into a smart district energy system will have serious impact on the energy flows. The apartment buildings are planned to be fed by six medium voltage to low voltage transformation stations. The district energy management system will have a double function:

- During the transformation of the apartment buildings, including installing solar panels, and the introduction of the charging points for electrical vehicles the changes in energy flows will be measures and can be analysed to also estimate the effect on the electricity system when, due to replication, the solutions in the demonstration area are duplicated on a large scale at other places.
- The real time measurements of the electricity flows will be essential input for the aggregator for using flexibility to help Stedin keep the maximum flow within acceptable values, and monitor the status of the grid.

In order to be able to control the load in the electricity distribution grid, accurate data on the status of this grid is essential. Therefore, all homes will be equipped with a smart meter and trafo stations will be equipped with telemetric systems.

In the demonstration area the **Universal Smart Energy Framework (USEF)** will be applied to deliver a market model for the trading and commoditisation of energy flexibility, and the architecture, tools and rules to make it work effectively. In principle USEF comprises of a set of rules and standards for cost-effectively unlocking flexibility in the energy system. The roles as described in USEF and of interest for the IRIS-project are the following:

	A Prosumer can be regarded as an end user that no longer only consumes energy, but also produces energy. USEF does not distinguish between residential end-users, small and medium-sized enterprises, or industrial users; they are all referred to as Prosumers. We also use the term Prosumer for end users that have controllable assets (Active Demand & Supply) and are thereby capable of offering flexibility.
	The role of the Aggregator is to accumulate flexibility from Prosumers and their Active Demand & Supply and sell it to the BRP or Supplier, the DSO, or (through the BSP) to the TSO. The Aggregator's goal is to maximize the value of that flexibility by providing it to the service defined in the USEF flexibility value chain that has the most urgent need for it. The Aggregator must cancel out the uncertainties of non-delivery from a single Prosumer so that the flexibility provided to the market can be guaranteed. This prevents Prosumers from being exposed to the risks involved in participating in the flexibility markets. The Aggregator is also responsible for the invoicing process associated with the delivery of flexibility. The Aggregator and its Prosumers agree on commercial terms and conditions for the procurement and control of flexibility.
	A Balance Responsible Party (BRP) is responsible for actively balancing supply and demand for its portfolio of Producers, Suppliers, Aggregators, and Prosumers. In principle, everyone connected to the grid is responsible for his individual balance position and hence must ensure that at each imbalance settlement period (ISP) the exact amount of energy consumed is somehow sourced in the system, or vice versa in case of energy production. The Prosumer's balance responsibility is generally transferred to the BRP, which is usually contracted by the Supplier. Hence the BRP holds the imbalance risk on each connection in its portfolio of Prosumers.
	The distribution system operator (DSO) is responsible for the active management of the distribution grid and introduces the system operation services defined in the USEF flexibility value chain. The DSO is responsible for the cost-effective distribution of energy while maintaining grid stability in a given region. To this end the DSO will 1) check whether DR activation within its network can be safely executed without grid congestion and 2) may purchase flexibility from the aggregators to execute its system operations tasks.

USEF positions the Aggregator centrally within the USEF flexibility value chain. The Aggregator is responsible for acquiring flexibility from Prosumers, aggregating it into a portfolio, creating services that draw on the accumulated flexibility, and offering these flexibility services to different markets, serving different market players. Flexibility provided by prosumers comprises of a variety of sources, ranging from heat pumps and PV panels with households, to cooling systems at large offices indicated. In return, the aggregator receives the value it creates with the flexibility on these markets and shares it with the Prosumer as an incentive to shift its load. Through the Aggregator, Prosumers gain access to the energy markets. Prosumers can comprise of a variety of stakeholders ranging from households with heat pumps and PV panels to large offices with cooling systems. USEF distinguishes 3 parties with demand for flexibility services:

- The Balance Responsible Party (BRP)
- The Distribution System Operator (DSO)
- The Transmission System Operator (TSO), which is indirectly served by the Aggregator through a BRP.

Detailed specification on the framework can be found in *USEF (2015): The Framework specification 2015*

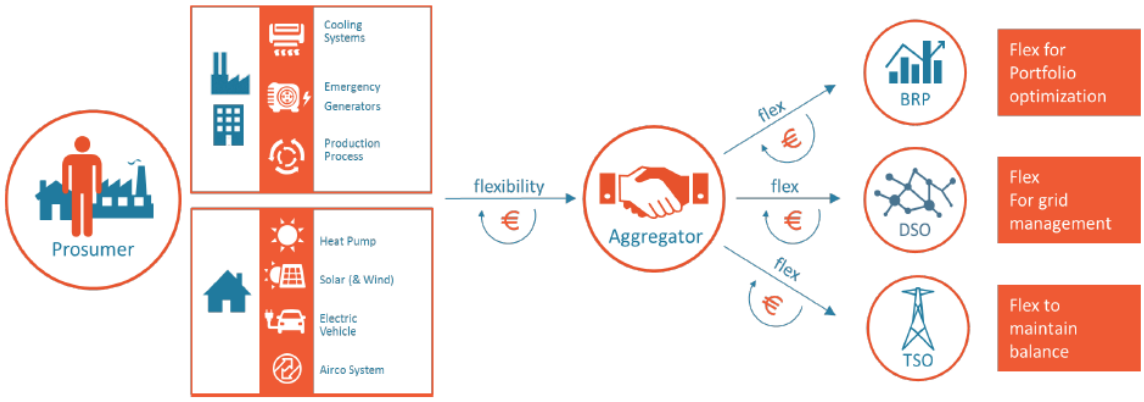


Figure 28. Overview of the USEF model with potential sources of flexibility (left hand side), the role of the aggregator and the demand for flexibility by various stakeholders (right).
Source: USEF (2015) USEF: The Framework explained

5.4.7. Data collection and management

Data that will be collected within the demonstration area Kanaleneiland Zuid and Westraven:

- Real time energy consumption on the household level. Data collection through the Toon. Because of Privacy legislation, permission of the tenants to obtain this data is required.
- Real time energy consumption and production on the apartment building level. Data collection through the district energy monitoring system.
- Real time electricity production of the PV panels on the homes and bus depot. Data collection through electricity (sub)meters.
- Real time consumption of locally produced electricity with the PV panels. Data collection through smart meters (with the permission of the tenants).
- Real time load demand at the 6 LV/MV stations and at the bus depot.

5.5. Barriers and Drivers

5.5.1. Economic

- Investments in 2nd life batteries behind the meter are currently not yet economically viable. Without subsidies there is no business models for operating 2nd life batteries. Legal and financial circumstances need to be changed to ensure replication of the solution.
- Use of 2nd life EV batteries allows addressing the set priority of EU policy for circular economy and business development. The innovative re-utilization scheme can delay the recycling process and extend the useful lifetime of already used batteries up to 10 years, obtaining in the meantime new revenues. Additionally, by increasing the lifetime value of a battery, the cost for primary and secondary users will lower. Finally, the implication of these second-life batteries can enable a shift towards an EU renewables-based economy faster.
- The innovative re-utilization scheme can delay the recycling process and extend the useful lifetime of already used batteries up to 10 years, obtaining in the meantime new revenues.

5.5.2. Sociological

- It is yet uncertain which role households can and are willing to play in offering flexibility to lower grid stress.

5.5.3. Technological

- Equipment to monitoring performance of the electricity grid and the various components of the smart district energy system are well known and broadly available in the market.
- Utrecht has no experience yet in operating 2nd life batteries for storage of sustainable electricity and placing these in garage boxes with the apartment buildings. This implies that the demonstration will need to be carefully designed and performance of the batteries will be closely monitored,

5.5.4. Legal

- The government started a process to revise the electricity regulations with the aim to incentivise stakeholder to provide flexibility resulting in a lowering of the grid stress in periods of high demand or high production with renewable energy sources. Currently a “Regulation experiments under the electricity law” is in place under which stakeholders can apply to be exempted from the rules under the electricity law to e.g. experiment with maximizing electricity consumption behind the meter.
- Current regulatory barriers in the Netherlands for energy storage, in static as well as in E- vehicles these encompass:
    - Current netting rules do not provide any incentive for optimization of storage in batteries behind the meter. E-drivers with (their own) solar panels are not financially stimulated to optimally use the self- generated renewable electricity and the storage capacity from the car for their own electricity (peak) demand. This is the so-called balancing regulation (see section 4.5.5 for more details).
    - Double energy tax discourages bidirectional charging. (Each charging and discharging cycle (bi-directional charging), energy tax need to be paid on either the stored or consumed kWh. Private charging points at low-volume consumers are currently exempted from this rule. It is currently, however, unclear which regime applies to (semi-) public charge points.)
- Uncertainty about the possible use of smart charging for the grid operator’s congestion management. The Electricity Act currently prohibits regional grid operators to own/operated storage capacity themselves. It is unclear whether they may use the flexibility that can be accessed using storage in batteries.

5.5.5. Environmental

- Storage of electricity in 2nd life batteries can potentially lead to lowering of CO2 emissions as it enables higher shares of renewable energy sources to be integrated into the grid and reducing demand for peak capacity (which is usually fossil fuelled).
- The innovative re-utilization scheme can delay the recycling process and extend the useful lifetime of already used batteries up to 10 years. Reducing the mining of new raw materials.

5.6. Business models

The project will develop business models whereby second-life (former automotive) batteries may profitably be used for static energy storage in a building or district. The project will also examine depreciation against longevity of these specific batteries and potential extended use of stationary battery storage (see further details in the section on business models under transition track #3).

Such business models will be coupled to the exploitation of the smart grid and Smart RenewableV2G Charging systems. Extra sources of flexibility emerge from the static storage, the V2G cars and from smart charging of these cars. The project will investigate the exploitation of these extra sources of flexibility in order to:

- Maximize the value of PV electricity production for the houses, which will increase the profitability of the PV and the system as a whole for the housing association and its tenants;
- Minimize local grid congestion, which will lead to cost advantages for the DSO (Stedin) and, because the DSO is IRIS project partner, again increased profitability for the whole system;
- Sell flexibility to the TSO and contribute to their primary reserves, which will lead to additional income to further increase profitability.

These value sources will emerge as a part of the total, complex business case for the smart grid including PV, V2G e-cars and storage, and can lead to more attractive price propositions to the tenants, drivers of V2G cars, housing association and LomboXnet. Of these parties, LomboXnet will most probably be the principal party to carry the business models, but this will also be investigated.

The development of the business models is an extension of on-going activities at several other locations, including living labs in the residential area Lombok and the Jaarbeurs where a static battery is functioning as part of a similar smart grid since spring 2018. During the development of these business cases, attention will be giving to advanced monitoring of the long-term performance of the static batteries, which will provide an important future input to improving the accuracy of business models.

5.7. Conclusion on ambitions and planning of activities

Progress had been made in the implementation of measure under TT 2. Key results include:

- Plan for the implementation of first 6 V2G charging points (measure 1) completed.
- Program of requirement for 2nd life batteries drafted and ready to put out into the market (measure 3).
- Garage boxes for placement of batteries secured and building requirements for usage of garage boxes to store batteries mapped out (measure 3).
- Mapping of the current status of the electricity grid in the demonstration area and listing of investment to accommodate integrated IRIS solutions (measure 4).

Anticipated deviations from the DoA concern the planning for measure 1 which will include a more phased demand driven approach.

6. Transition track #3: Smart e-mobility sector

6.1. About the demonstration

IRIS aims to demonstrate and perform replication studies for the idea of V2G and smart solar power-driven charging stations (*smart solar charging*) linked to a care sharing system, in order to support the demand-supply energy management (with a scheme of smart charging management) at district-level while increasing their large-scale energy storage capacity and promotion of more environmentally friendly mobility solutions.

6.2. Baseline

The district of Kanaleneiland-Zuid has a different profile when it comes to car ownership and choice of transport mode compared to the average for Utrecht. This is illustrated in Figure 29: car ownership is lower compared to the average for Utrecht (left) and use of tram and bus to visit the city centre is higher compared to the average for Utrecht (right).

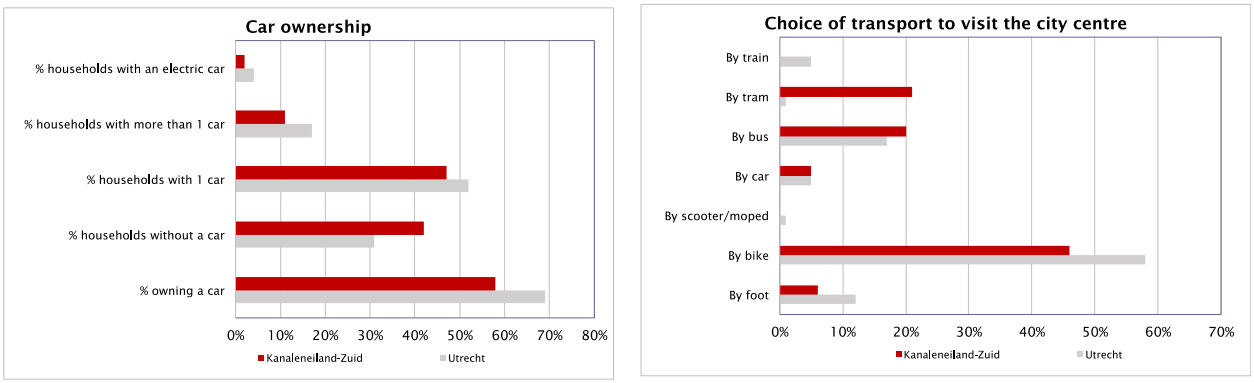


Figure 29. Car ownership (left) and choice of public transport to the city centre (right) for the residents of Kanaleneiland Zuid compared to Utrecht.
Source: WistUData

Figure 30 provides an overview of the number of cars available through various carsharing platforms active in the city of Utrecht. The left picture provides the location of cars available for sharing in Kanaleneiland Zuid and the picture on the right the number of cars available for sharing in various districts in Utrecht. The figure shows that carsharing is less developed in Kanaleneiland-Zuid compared to other district in the city of Utrecht.

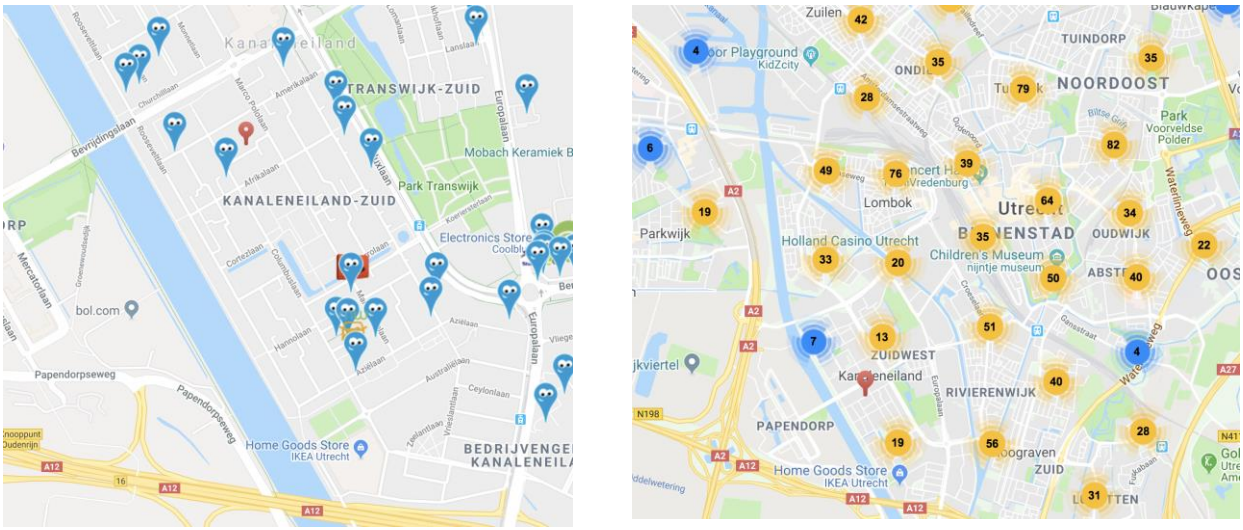


Figure 30. Available cars through various car sharing platform in Kanaleneiland Zuid (left) and in the city of Utrecht (right). Source: https://ritjeweg.nl/

6.3. Ambitions

The *DoA states* that Utrecht's ambition is to integrate solar powered V2G e-cars, operated in the car sharing system We Drive Solar, as well as solar powered V2G e-buses in the urban mobility system for (a) local zero-emission Mobility as a Service, (b) lower household mobility costs and (c) smart energy storage in V2G batteries. Solutions developed in small-scale pre-proposal pilots in the Lombok and Central Station area will be integrated and jointly demonstrated in the demo district Kanaleneiland Zuid, and include the measures in Table4.

Measures	2017	2018	2019	2020	2021
Measure 1: V2G e-cars	0		~~0~~	~~0~~	~~0~~
		14 V2G e-cars We Drive Solar 4 V2G e-vans			
Measure 2: V2G e-buses	10 V2G electric buses	0	143 e-buses	0	0

Table 4. Ambitions TT#3

6.4. Planning of demonstration activities

6.4.1. Planning of activities

Solar charging is realized by the utilization of solar panels on the roofs of 12 apartment buildings that will be renovated by IRIS partner Bo-Ex and on the roofs of 3 schools. An optimal charging algorithm will be developed aimed at maximum utilization of solar electricity production by the electric vehicles taking into consideration the solar production peaks and peak in charging demand.

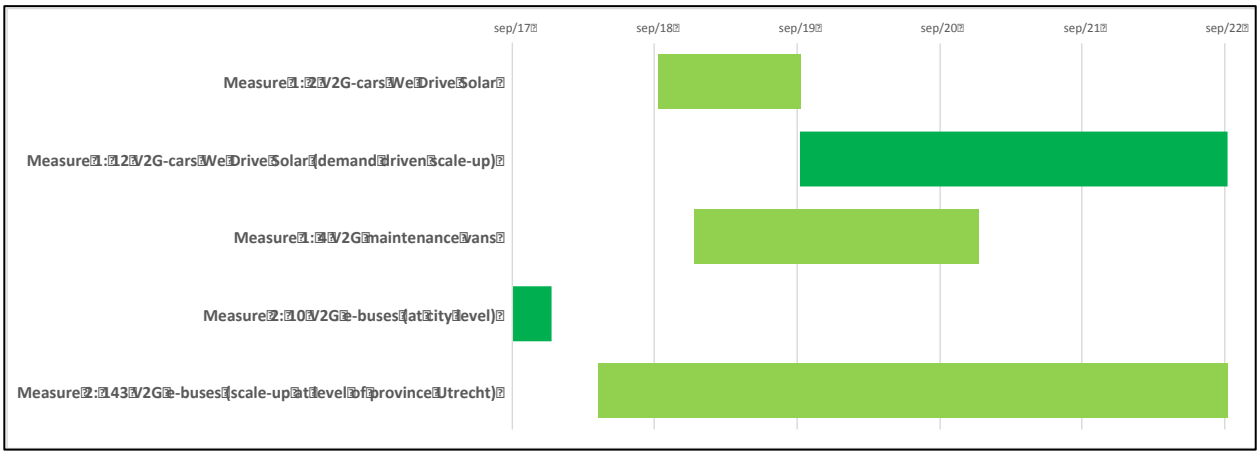


Figure 31. Overall planning of TT#3 activities

6.4.2. Organization of work

LomboXnet is TT#3-lead. The V2G-cars that will be deployed in Kanaleneiland-Zuid have been deployed at several other locations in Utrecht and the region. Therefore the deployment of the V2G-cars in the demonstration area Kanaleneiland-Zuid is an extension of the work done at other location.

For the deployment of the V2G-cars, LomboXnet will work with IRIS project partners and will subcontract companies that can deliver the services needed, like the subscription system, software system etc. Key partners in TT#3 are:

LomboXnet	Coordinator
WeDriveSolar	E-car, reservation app, subscriptions options
Jedlix	Charging point aggregator.
Last mile solutions	Back-office Smart charging
Qbuzz:	Electric busses: batteries and charging

6.4.3. Measure 1: V2G e-cars

The MaaS “We Drive Solar” car sharing system will be demonstrated in the LH demo district by means of 14 solar powered V2G e-cars delivered by Renault. In principle subscription models currently offered in amongst others the Lombok area will be applied for the rollout of the system in Kanaleneiland-Zuid. This roll-out will be demand driven, implying that introduction will follow a phased approach and not all cars and buses will be in operation in 2018. The first car will be placed at the local innovation hub Krachtstation. Together with local partners citizen engagement activities will be organised to investigate demand for car sharing services.

6.4.4. Measure 2: V2G e-buses

V2G e-buses will be demonstrated at the new bus depot of QBuzz in Kanaleneiland Zuid (see section 5.4.4).

6.4.5. Data collection and management

Data that will be collected within the demonstration area include:

- Usage of the e cars: number of km driven, efficiency, charging time. These data will be collected by the provider of the e-car sharing service
- Load profile of electric vehicle: utilization of solar electricity, utilization of battery for electricity delivery.
- Load profile electric e-buses. QBuzz will provide these data.

6.5. Barriers and Drivers

6.5.1. Environmental

In case an electric car replaces a fossil fuel driven car, this leads to reduction of the CO2 emissions, improvement of local air quality and reduction of noise levels.

6.5.2. Political

Besides contributing to the ambitions of the municipality of Utrecht to become climate neutral in 2020 (see TT#2), car sharing reduces the number of cars parked in public space. The city of Utrecht has the ambitions to grow to 430.000 inhabitants in 2040 (an increase with 80.000). Large part of this growth needs to be accommodated within the current city boundaries. This will be realised through more compact building (increase in the number of homes per km2) and at the same time creating an attractive green and healthy environment. Therefore, the city council has the objective to create low-traffic areas amongst others by stimulating car sharing.

6.5.3. Economic

By using the EV Batteries in the energy system an extra business model may be added to the cars, in the form of price bonuses compared to classic EV charging tariffs. At this moment, this business model is in its pilot phase; several aspects are under investigation, see also section 5.8

6.5.4. Sociological

The main challenge is to stimulate citizens in the demonstration and change their habits of using private cars and subscribe to the We Drive Solar car sharing system instead. The population in the pre-pilot area is highly educated, environmentally aware and has above average income. While in the demonstration the population has a relatively low education, income levels are below average and people are less environmentally aware.

6.5.5. Technological

Technical barriers are not anticipated because the technology applied in the demonstration area is already applied in another district in Utrecht.

6.5.6. Legal

- The city of Utrecht incentivizes the use car sharing systems. The municipality e.g. provides incentives to apply for a double-parking license (in districts with paid parking) for one car for households sharing in car in adjacent districts. News construction districts in Utrecht have a high density. In these districts the municipality applies lower parking norm (parking-space that needs to be reserved per dwelling) and actively stimulated the development of MaaS concepts.

6.6. Business models

The value of the demonstration is three-fold: 1) generating the highest value out of 15.000 m2 solar panels and their surplus of solar power, 2) develop charging and discharging algorithms that make it possible that electric buses are charged and can be operated all day at the lowest prices (night time); 3) develop charging and discharging algorithms that result in the highest value of 2nd life batteries for e-buses of the QBUzz partner and for Renault e-cars.

The inhabitants' mobility bills can be reduced by means of a cost-effective car sharing system. A district-wide car sharing system deploying V2G e-cars is seen as a major opportunity, providing affordable mobility, offering grid flexibility thanks to the storage capacity of the V2G-batteries, as well as resulting in low emission and noise levels in the city. In the IRIS project the emerging business model Smart Renewable V2G Charging (see further details with description on solution 3.1) will be further developed and evaluated for replication in other cities, including the following business opportunities: tracking use of car sharing systems at city level; tracking misuse of charging stations for parking only; tracking mobility patterns at district level for planning V2G charging spots and car sharing systems

6.7. Conclusions on ambitions and planning of activities

Key activities in the first year included exploring the market for car sharing services in Kanaleneiland Zuid. This resulted in the introduction of the first WeDriveSolar electrical vehicle before the end of 2018 and a second one in the first quarter of 2019.

Anticipated deviation from the DoA concern the planning for measure 1 which will include a phased demand driven approach, instead of the introduction of all cars in 2018.

7. Transition track #4: City innovation platform

7.1. About the demonstration

Crosscutting ICT allows for the development and implementation of information services for citizens, the municipality and other stakeholders, based upon the integrated infrastructure. To achieve this, open ICT-system and open application program interfaces (API's) are necessary, to establish a City Innovation Platform with the objective to incentivize sharing of data and the development of meaningful data services serving households, municipality and other stakeholders.

7.2. Baseline

The City of Utrecht has worked on an open data strategy since 2015. The strategy is based on actively involving city partners with open data needs. Utrecht collects and shares urban data by means of an open ICT urban data platform (utrecht.dataplatform.nl), offering more than 500 data sets and data services for policy development and urban planning processes. Utrecht also shares real time data on their Data platform, for example about the availability of parking spots for disabled people.

7.3. Ambitions

The *DoA states* that Utrecht has the ambition, through cross-cutting open ICT to enable (a) the integration of the IRIS solutions, maximising cost-effectiveness of the integrated infrastructure. Next, open ICT-systems, open application program interfaces (APIs) and standards provide (b) the City Innovation Platform and (c) meaningful information services for households, municipality and other stakeholders, together allowing for new business models. The objective is to develop services linked to the measures listed in Table5.

Services linked to:	2017	2018	2019	2020	2021
Measure 1: Monitoring E-Mobility with LoRa network	specification	co-creation	demo	demo	demo
Measure 2: Smart Street Lighting with multi-sensoring	specification	co-creation	demo	demo	demo
Measure 3: 3D Utrecht City Innovation Model	specification	co-creation	demo	demo	demo
Measure 4: Monitoring Grid Flexibility	specification	co-creation	demo	demo	demo
Measure 5: Fighting Energy Poverty	specification	co-creation	demo	demo	demo

Table5. Ambitions TT#4

7.4. Planning of demonstration activities

7.4.1. Planning of activities

Development of the data-services in the Utrecht demonstration is closely linked to the implementation of the measures under TT1, 2 and 3, as monitoring data provided through these measures can be used to develop data services. On the other hand the development of data services is linked to effort to increase the number of (publically) available datasets made available through the CIP, which provides opportunities to challenge the market to develop data services.

7.4.2. Organisation of work

As a large number of partners is the Utrecht lighthouse city is involved in the development of the data-service we started with outlining a clear process for the further definition and development of the data-services and distinguishing the roles. The format for the development process for each of the data-services is outline below and includes four major steps.

We furthermore defined the following roles in the development process:

- Data service challenger. This is the party that ultimately contracts the service. This does not have to be the user or end user, e.g. in case the citizen is the end user.
- Data service manager. This is the person responsible for coordinating the establishment of all data services within IRIS. That includes: Ensuring that the challenger for his use-case details the requirements sufficiently in the PoR, setting out the challenge so that possible providers within or outside the IRIS ecosystem can submit an offer, secure selection provider, etc.
- Data service reviewer. Person responsible for guaranteeing development of services connected to the CIP.

Key partners in TT#4 are listed below

Municipality of Utrecht	TT#4 lead and data challenger
LomboXnet	Data service challenger
Bo-Ex	Data service challenger
Stedin	Data service challenger
Utrecht University	Data service manager.
Civity	Data service reviewer

7.4.3. Measure 1: Monitoring E-Mobility with LoRa network

Data service challenger: LomboxNet

Scope: The CIP will be used to exchange monitoring data on the use of the solar V2G e-car sharing system We Drive Solar, the use and misuse of the charging infrastructure and the district mobility patterns. The objective is to develop a data-service with the collected monitoring data.

Anticipated result(s): A data-service aimed at preventing misuse of charging infrastructure and monitoring district mobility patterns.

Provisional outline of activities:

- Workshop 1: Definition of a number of use-cases
- Selecting and contracting a market party, complying with the criteria resulting from workshop 1 that will take up the challenge.
- Workshop 2: Development of scenario's
- Three consecutive workshop (provisional): Design of a mock-up of an application (program of requirements)
- Commissioning to build the application
- Implementation and testing of the beta-version of the application
- Implementation and testing of the final version of the application
- Workshop: final evaluation

Figure 32 shows the program for the scheduled activities for this measure.

Figure 32. Timing of activities of measure 1 - Monitoring E-Mobility with LoRa network

7.4.4. Measure 2: Smart Street Lighting with multi-sensoring

Data service challenger: Municipality of Utrecht

Scope: The objective is to introduce Smart Street lighting In Kanaleneiland-Zuid, which encompasses equipping existing lampposts with smart multi-sensors. Data collected through these sensors should be used to enhance data driven district policies aimed at reducing/minimizing problems faces by the citizens in public space.

To develop a meaningful data service its necessary to get a good insight on the problems faced by the citizens in Kanaleneiland-Zuid in public space, and select problems that potentially can be solved through the introduction of smart street lighting and related data services. Public surveys among citizen in Kanaleneiland e.g. show that dissatisfaction regarding transport above the average for Utrecht; citizens experience more traffic noise and feel unsafe when parking (Source: Buurtmonitor). Other problems that were mentioned during the first design workshop were vermin (rats), youth hanging around and harassing passers-by.

Anticipated result(s): Data services for the citizen in Kanaleneiland-Zuid, which contribute to reducing/minimizing problems faced by the citizens in the public space and can be developed with data collected/linked to smart lampposts.

Provisional outline of activities:

- Workshop 1: Retrieval of wishes, needs & dreams (3 hours)
  - Short introduction to the IRIS project, the concept of smart street lighting and what can be realised within the context of the IRIS project
  - Short introduction to the design thinking process
  - Introduction of participants
- Plenary and working session (in changing compositions) to map major topic in public space, map wishes, needs & dreams
- Workshop 2: Design concepts of solutions meeting wishes, needs & dreams of citizens (3 hours)
  - Short recap of results workshop #1 and introduction to boundary conditions set by the IRIS project for design of solutions concepts.
  - Working sessions in which various design thinking tools are applied to elaborate concept of potential solutions.
- Workshop 3: Pitching: presentation of solutions and selecting a winning concept (1,5 hours)
  - Solution developed in the second workshop are pitched for a jury (Dragons' Den approach1).
  - Further elaboration of the winning solutions from workshop 3 towards criteria for development/realisation of a "proof of concept".
- Implement of the "proof of concept" and demonstrate its feasibility to meet listed criteria.
- Workshop 4: Evaluating the implementation, testing & monitoring of a "proof of concept" for one location.
  - Citizen will be invited to provide feedback and make suggestion for improvements.
- Definition of final criteria for smart street lighting and commissioning for full rollout in Kanaleneiland-Zuid.
- Workshop 5: Evaluation of the rollout of final product/service in the district of Kanaleneiland Zuid

Figure 33 shows the programme for the scheduled activities for this measure, which party took place in the June/July 2018. Experiences and broader lessons learned on citizen engagement were laid down in a booklet, which will be distributed among IRIS project team.

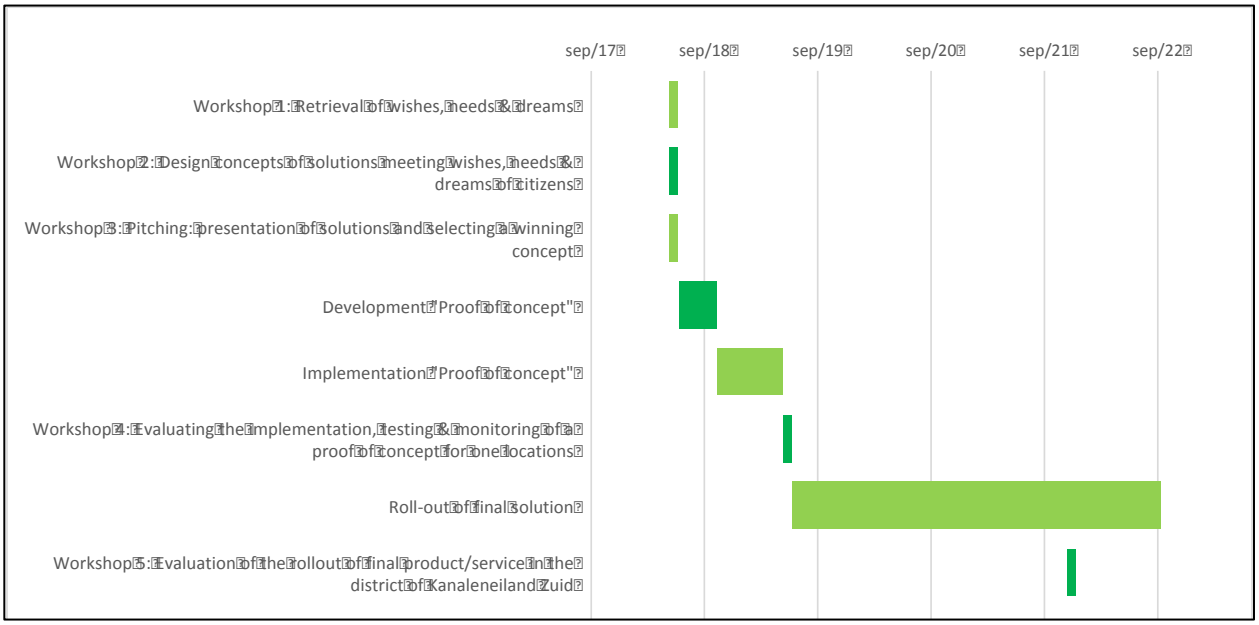


Figure 33. Timing of activities of measure 2 - Smart Street Lighting with multi-sensoring

7.4.5. Measure 3: 3D Utrecht City Innovation Model

Data service challenger: Municipality of Utrecht

Scope: The municipality wants to stimulate the use of 3D home and district modelling as a way to increase citizen engagement in urban planning by as this e.g. offering opportunities for co-creation. Experience shows that participation leads to better projects, better considerations and decision-making and more support for finally selected solutions. The municipality of Utrecht therefore developed a "Participation standard" providing guidelines for civil servants responsible for organizing participation in policy development and project implements.

Amongst others the municipality wants to enhance citizen engagement in urban planning by offering data services to citizens visualizing the impact of different scenario for a specific area by making use of data stored in a 3D data brought together in a catalogue through the City Innovation Platform (CIP).

Anticipated result(s): A data-service that is really helpful to enhance involvement of citizens in urban planning processes

Provisional outline of activities:

- Workshop 1: Definition of a number of *use-cases* by organizing
  - Attendees: relevant stakeholders and end-users
  - Results: definition of a number of relevant use-cases and list of criteria for selection of market party to take up the challenge to develop the data services
  - Program:
    - Short introduction to the IRIS project and the challenge (definition of the problem we want to solve)
    - Short introduction to the design thinking process and tools that will be used.
    - Introduction of participants
    - Plenary and working session (in changing compositions) to map articulate the exact problems (challenge), define a number of use cases and list criteria for selection of the market party.
    - Selecting and contracting a market party, complying with the criteria resulting from workshop 1 that will take up the challenge.
- Workshop 2: Development of use-cases into *scenario's*
  - Lead with market party commissioned to develop the data-service
  - Attendees: relevant stakeholder and end-users
  - Results: Various scenarios and most likely scenario selected.
  - Program
    - Short recap of results workshop #1 and developed use cases
    - Short introduction of the market party
    - Working sessions in which various design thinking tools are applied to elaborate the use-cases into scenario's
    - Working session in which scenarios are scored against nine "living" guidelines for development of digital services and most likely scenario is selected
- Three workshop (provisional): Design of a mock-up of an Application (program of requirements)
- Market party organizes various design session with stakeholders and end-users, in which the selected scenario is translated into a data-service resulting in a Mock-up of an App (program of requirements).
- Commissioning to build the Application
- Introduction of the beta-version of the Application and testing with selected number of end-users
- The App will be demonstrated and continuously tested by end-users, who are encourage to provide feedback on e.g. usefulness, user friendliness etc.
- Feedback will be used to adapt and improve the Application.
- Implementation and testing of the final version of the Application.
- Workshop: final evaluation on results (does the app lead to improvement of participation).

Figure 34 shows the programme for the scheduled activities for this measure.

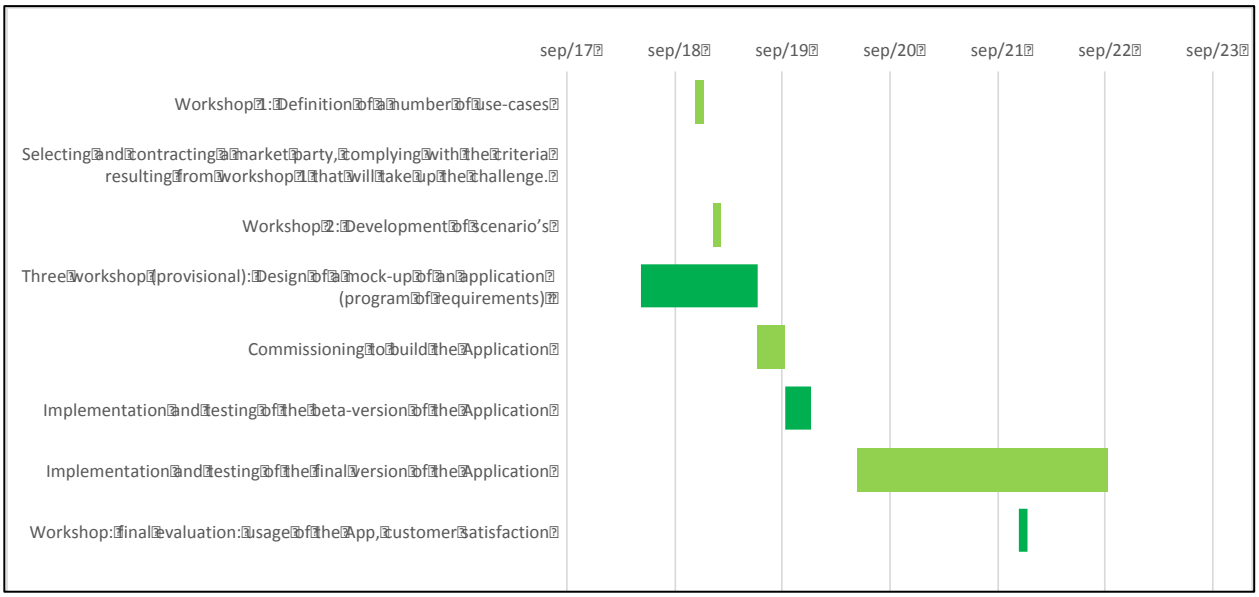


Figure 34. Timing of activities of measure 3 - 3D Utrecht City Innovation Model

7.4.6. Measure 4: Monitoring Grid Flexibility

Data service challenger: Stedin

Scope: As a result of investments made within the framework of the IRIS project the area of Kanaleneiland Zuid will be characterized by massive decentralized PV-production, district wide storage by means of V2G e-car and e-bus batteries in combination with stationary storage and the use of hybrid heat pumps. This could potentially results in congestion in the electricity grid if no measures are taken to better match supply and demand. Stedin will use the USEF framework to develop services targeted at incentivizing market actors to offer their flexibility on the market, with the aim to reduce/avoid grid stress in case of high demand or production of electricity. Flexible sources identified so far within the demonstration area that potentially can provide flexibility include: stationary batteries, batteries in electrical vehicles and (hybrid) heat pumps.

Anticipated result(s): A data-service aimed at market actor to incentive different actors to offer their flexibility on the market.

Provisional short outline of activities:

- Workshop 1: (a) Mapping the district electricity system: sources, demand and supply of flexibility, data and (b) Developing various scenarios for a flexibility market
- Conducting simulation to test various scenario for a flexibility market in Kanaleneiland-Zuid
- Workshop 2: Evaluation/discussion of the model simulations
- (Gradual) Implementation and testing of a market for flexibility
- Workshop: final evaluation

Figure 35 shows the programme for the scheduled activities for this measure.

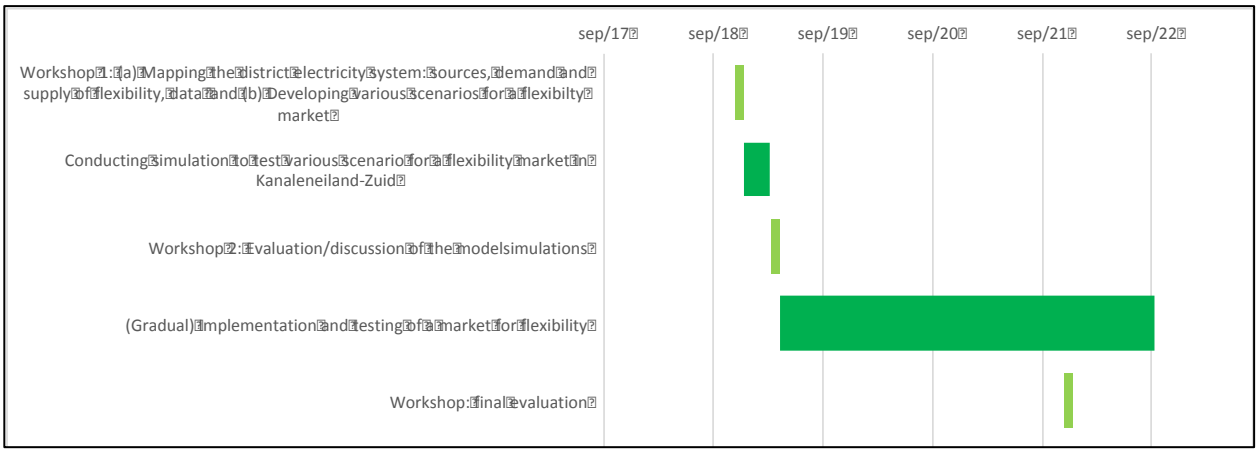


Figure 35. Timing of activities of measure 4 - Monitoring Grid Flexibility

7.4.7. Measure 5: Fighting Energy Poverty

Data service challenger: Bo-Ex

Scope: The objective of the City Innovation Platform (CIP) is to bring together data of housing corporations, the Municipality, and energy grid operators on the energy consumption of citizens. The housing corporation Bo-Ex would like to use these data to develop an early warning system in case tenants have an *extremely high* or *irregular* energy consumption pattern.

Bo-Ex would like its tenants to benefit from the IRIS solutions *financially* (a large part of the households renting an apartment from Bo-Ex have a free disposable income of only 50 euro per month) as well as *socially* (due to financial problems household are often socially isolated). The developed data services should therefore e.g.:

- Warn tenant in case of extreme high or irregular energy consumption patterns by providing them with insight in their energy usage (e.g. compared to their peers) and provide concrete feedback how they can reduce their energy usage.
- Increase disposable income of households or provide discounts to public transport or car sharing services by incentivising tenants to save energy, deliver energy, or provide grid flexibility;

Anticipated result(s): A data service for the tenants of Bo-Ex in Kanaleneiland-Zuid that they are willing to use to reduce their energy costs.

Provisional outline of activities:

- Workshop 1: Definition of a number of *use-cases* by organizing
  - Attendees: relevant stakeholders and end-users
  - Results: definition of a number of relevant use-cases and list of criteria for selection of market party to take up the challenge to develop the data services
  - Program:
    - Short introduction to the IRIS project and the challenge (definition of the problem we want to solve)
    - Short introduction to the design thinking process and tools that will be used.
    - Introduction of participants
    - Plenary and working session (in changing compositions) to map articulate the exact problems (challenge), define a number of use cases and list criteria for selection of the market party.
    - Selecting and contracting a market party, complying with the criteria resulting from workshop 1 that will take up the challenge.
- Workshop 2: Development of use-cases into *scenario's*
  - Lead with market party commissioned to develop the data-service
  - Attendees: relevant stakeholder and end-users
  - Results: Various scenarios and most likely scenario selected.
  - Program
  - Short recap of results workshop #1 and developed use cases
  - Short introduction of the market party
  - Working sessions in which various design thinking tools are applied to elaborate the use-cases into scenario's
  - Working session in which scenarios are scored against nine "living" guidelines for development of digital services and most likely scenario is selected
- Three workshop (provisional): Design of a *mock-up of an App* (program of requirements)
- Market party organizes various design session with stakeholders and end-users, in which the selected scenario is translated into a data-service resulting in a Mock-up of an App (program of requirements).
- Commissioning to build the App
- Introduction of the *beta-version* of the App and testing with selected number of end-users
- The App will be demonstrated and continuously tested by end-users, who are encourage to provide feedback on e.g. usefulness, user friendliness etc.
- Feedback will be used to adapt and improve the App.
- Implementation and testing of the *final version of* the App.
- Workshop: final evaluation: usage of the App, customer satisfaction

Figure 36 shows the programme for the scheduled activities for this measure.

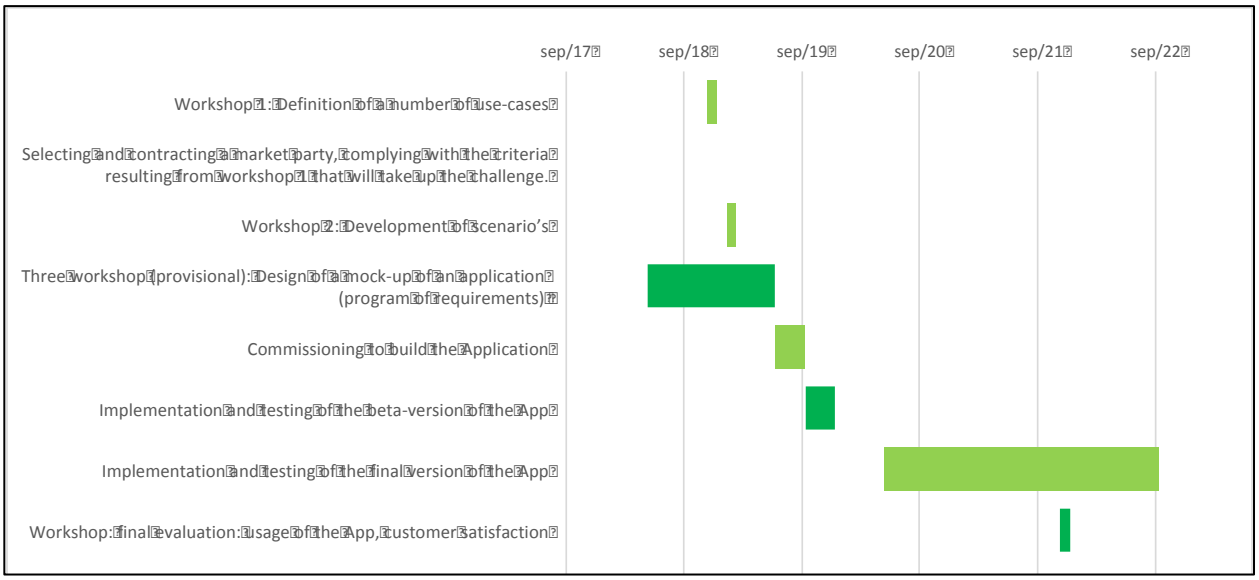


Figure 36. Timing of activities of measure 5 - Fighting Energy Poverty

7.5. Conclusions on ambitions and planning of activities

The first year was used to further detail and define the data servers, develop a common process for the development of the services, make a clear division of roles in the process, discuss/establish the cooperation/link with activities in WP 3 and WP4, appoint a data challenger for each of the measures. Furthermore, anticipated activities in the development process for each of the data-services was outlined.

So far, no major deviations are anticipated compared to the DoA regarding the the type of implemented measures, size and planning.

8. Transition track #5: Citizen engagement

8.1. About the demonstration

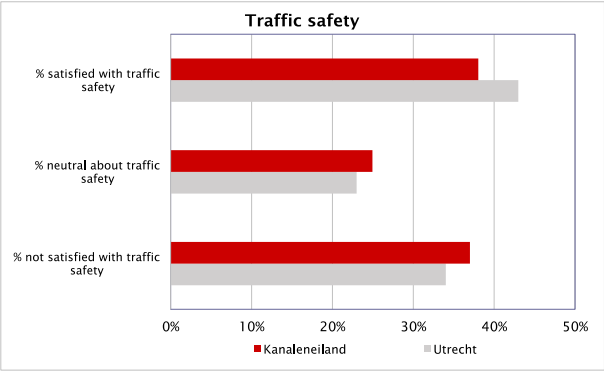
The overall objective for Transition Track #5 is to create a set of choices for citizens that make sustainable energy-and mobility cheaper, more stable and secure, and better accessible. This will be achieved by applying methods for citizen engagement and co-creation to the solutions described under Transition Track #1 to #4. As the transition tracks offer different potential to enhance citizen engagement and co-creation, different (sets of) methods will be applied.

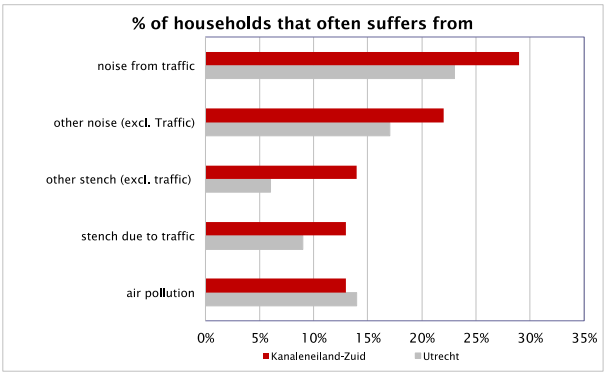
8.2. Baseline

The municipal council of Utrecht has established the "Utrecht Participation Standard" as a method for municipal officials to involve residents, entrepreneurs, organizations and professionals as much as possible and as early as possible in plans and projects of the municipality. This standard included 5 steps:

- Mapping the stakeholders: who are they and what is their interest and influence;
- Determining the desired level of participation: informing, consulting, advising or co-producing;
- Resolve which stakeholders should be asked for input at which level of participation;
- Produce a plan and determine what suitable moments are to invite those involved;
- Decide which means of communication and participation tools are most suited;

This standard is already applied in numerous projects in the district of Kanaleneiland-Zuid and experiences from previous projects will be used in designing the citizen engagement process for the IRIS project. This requires amongst others good knowledge on specific issues at play among households in Kanaleneiland-Zuid (see Figure 37).





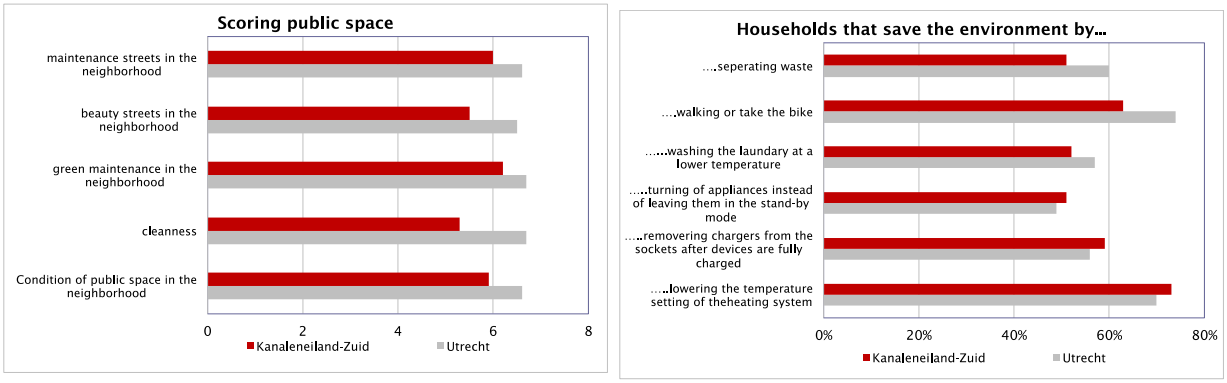


Figure 37. Overview on the relevance of some issues at play for households in Kanaleneiland Zuid compared to Utrecht. Source: WistUData

8.3. Ambitions

The *DoA states* that Utrecht has the ambition is to design and demonstrate feedback mechanisms and inclusive services for citizens to achieve that citizens are motivated to (a) save energy, (b) shift their energy consumption to periods with redundant renewables and (c) use shared e-mobility instead of private cars.

This implies that Utrecht is working on the design of a careful citizen engagement process entailing public engagement at an early stage in order to accommodate wishes and concerns from the citizens. This citizen engagement process has a few key benefits:

- The integrated solutions are designed with user needs and possibilities (e.g. language) in mind
- Because the integrated solutions fit the prospected users living situation better, adoption is higher and it maximizes the chance of long term frequent interaction with the solutions, after the "newness" has faded.
- The citizen engagement process itself increases awareness in the target area and raises public support, both benefiting initial adoption and sustained use.

Table6 lists the envisioned activities from the DoA that will be employed to enhance citizen engagement for the integrated solutions.

Measures/Activities	2017	2018	2019	2020	2021
Measure 1: Community building by Change agents	specification	co-creation	iteration	iteration	deployment
Measure 2: Campaign District School Involvement	specification	co-creation	iteration	iteration	deployment
Measure 3: Co-creation in Local Innovation Hub	specification	co-creation	iteration	iteration	deployment
Measure 4: Campaign Smart Street Lighting	specification	co-creation	iteration	iteration	deployment
Measure 5: VR New Home and District Experience	specification	co-creation	iteration	iteration	deployment

Table 6. Ambitions TT#5

8.4. Planning of demonstration activities

8.4.1. Planning of activities

8.4.1.1. Engagement ladder

Within the IRIS project the Engagement Ladder is used as a reference tool to determine the *possibilities* for citizens to influence decision-making, articulating their needs, challenges and problems. This ladder distinguishes 4 levels of engagement.

- Level 1 of the Engagement ladder consists of IS that have no touch point. These integrated solutions will be implemented with the support of concise communication strategies, informing citizens on the impending changes in their environment.
- Level 2 of the Citizen Engagement Ladder implies the involvement of citizens in actively contributing to the storytelling about the IRIS changes in their own neighbourhood, as part of the communication strategies. These citizens will have a higher level of engagement in being able to effectively communicate the IRIS integrated solutions and objectives from their own citizen perspective.
- Level 3 of the Engagement ladder contains the integrated solutions that allow citizens some kind of agency, control or steering of the integrated solutions. For this we introduce the notion of active touch points. Through these active touch points, citizens should be able to influence the outcomes of the KPI's of the IRIS project through their own behaviour.
- Level 4 of the Engagement ladder contains those integrated solutions where there is an existing touch point that can be adapted, modified, simplified or enhanced within the possibilities of the IRIS project or integrated solutions where new touch points will and shall be developed.

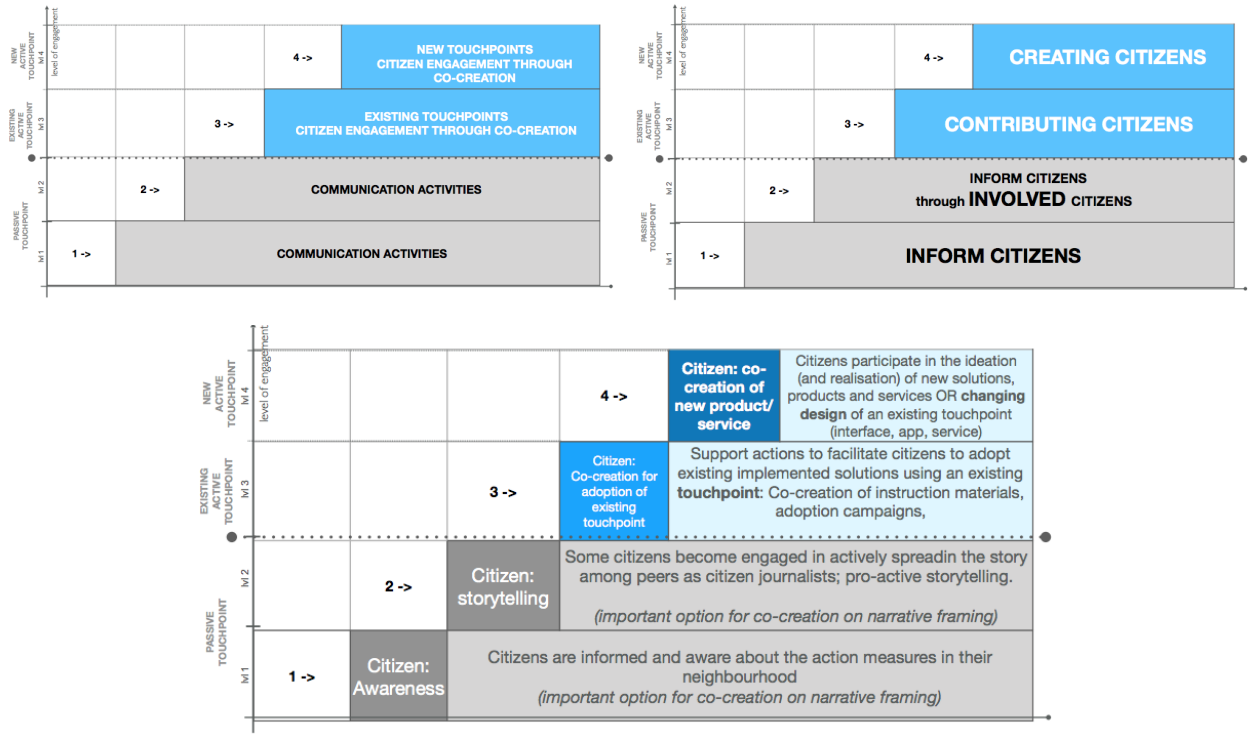


Figure 38. Outline of the citizen engagement ladder with possibilities for involvement of citizen in the implementation of the IRIS measures

8.4.1.2. Detailing of the approach for each step on the ladder

- Informing citizen (level 1): Citizen awareness needs to be for the whole IRIS project. Therefore a key communication message needs to be developed. Guiding principle in de communication are:
  - Focus on the impact of measures on the day-to-day life of citizens and how the measures can help in the challenges of everyday life in an underprivileged district.
  - Due to the sub-average language and education level of a substantial part of the population, information will spread through word of mouth
  - Add content and information to existing channels for citizens rather than the creation of new and unknown channels
  - To increase knowledge of the principles behind the integrated solutions, existing educational materials will be used in combination with physical examples in the district to increase awareness and understanding of the technologies involved.
  - Multichannel approach: website, (existing) educational materials, information through local partners, schools and where necessary door to door information in writing will be used to complement one another.
- Informing citizens through citizen journalism (level1/2): Citizen storytelling will be applied for tor amongst other integrated solutions placed on level 2. Existing volunteer district news networks will be key for the citizen journalism approach, in addition, cooperation with the local primary and community college is in the early stages.
- Contributing and creating citizens (level 3 and 4). The HKU developed a quick scan tool that can be used to map planned measures to be implemented against required citizen engagement activities. This results of this mapping for Utrecht is presented in Figure 39. For the measure placed on level 3 and 4 the HKU developed a co-creating process based on a design thinking approach. This approach will be applied in Utrecht for the integrated solutions on level 3 and 4. A provisional overview of anticipated citizen engagement activities is elaborated in Annex I.

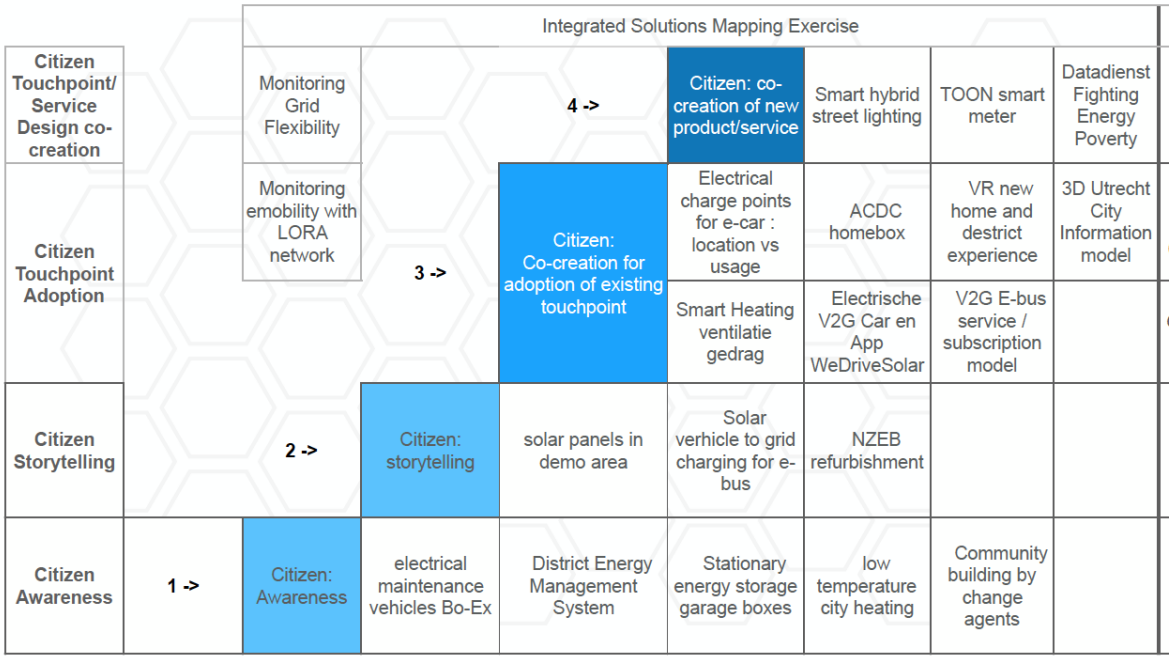


Figure 39. Result of the mapping exercise for Lighthouse city Utrecht.

8.4.2. Organisation of work

The city of Utrecht organizes the citizen engagement activities for all the integrated solutions/measures in track #5 and, where applicable (see figure mapping exercise xxx), also for the measures for TT #1 to #4. For this last group of activities, the citizen engagement process is a co-production between the citizen engagement coordinator and the transition track leader responsible for the measure.

8.4.2.1. Citizen engagement coordinator

To facilitate the citizen engagement process and IRIS communication in the district, a citizen engagement coordinator has been appointed funded by the IRIS project by the city of Utrecht. The appointed coordinator is familiar with the district Kanaleneiland-Zuid and the local problems and challenges. Tasks of the coordinator are:

- Operate as the instigator of the IRIS Platform;
- Organize meetings, including practical matters.
- Create a program of series of meetings and let them evolve in consultation with the IRIS Platform
- Recruit new participants for the IRIS Platform
- Operate as the intermediary between IRIS project (partners) and resident participation.

8.4.2.2. IRIS-platform

For the duration of the IRIS-project, the IRIS platform, consisting of citizens and other stakeholders with a close connection to the district of Kanaleneiland is formed to increase the connection between the project and the inhabitants of the district. The platform is involved in the design stage of the citizen engagement process for each of the measures where level 3 or 4 on the citizen engagement ladder is applied. When measures are implemented into the concept- or prototype phase, the IRIS platform will be consulted to give their feedback. This way, the IRIS platform will help to keep the measures focused

on the goals that were defined in the design stage and helps to implement the measures in such a way that improves adaption, since it fits the day to day needs and abilities of the citizens of the district where they are implemented. The group is also consulted on the general project progress, impact in the district and feedback in general.

8.4.2.3. IRIS platform composition

Ideally, the IRIS platform consists of the same members for the 5-year duration of the project. This is not an achievable goal and a realistic expectation for a volunteer platform. The available time and interest that citizens and other stakeholders is limited and will also fluctuate depending on the personal interest in the topics (measures) that are discussed in the various co-creation workshops and other meetings. Therefore, the IRIS platform is set up in such a way that participants are free to join co creation workshops and other meetings as they please, as long as they accept the ground rule that if something was discussed in a previous workshop it will not be re-discussed unless significant new information is discovered.

The objective is to compose a group, which reflects the demography of the target district, complemented by professionals active in the field (e.g. social workers) with a lot of "customer empathy". In reality, the group composition will be skewered towards higher educated, more caucasian and older than average, because these groups are more likely to be willing to participate. This is something to be aware off, but not an insurmountable problem. Input from other demographics will be sought via other means: e.g. youth workers can represent younger people, street interviews can add viewpoints and cooperation with primary education and community college will also improve representation and reach.

8.4.2.4. IRIS-co creation platform member recruitment

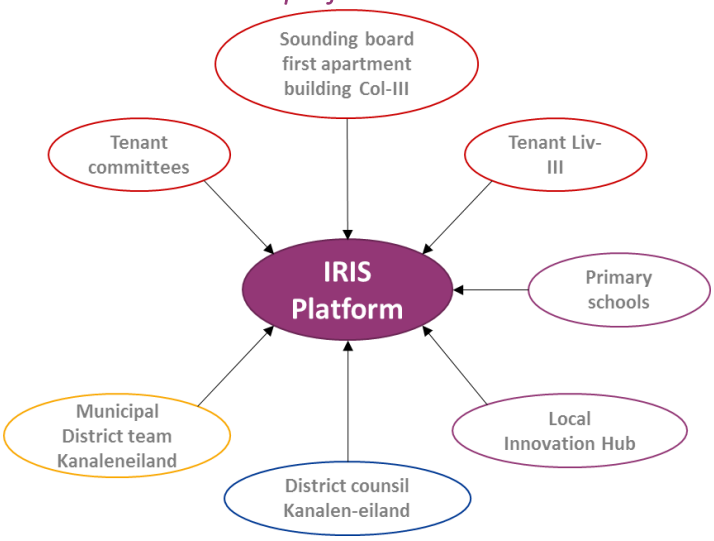


Figure 40. IRIS Co-creation platform

The IRIS platform is formed with residents and stakeholders living and/or working in Kanaleneiland-South. Residents and stakeholders are invited to join through a variety of channels, including media and website, newsletters (e.g. from Bo-Ex), through schools, and through face-to-face conversations with key figures. Platform participants are invited to spread the word and invite interested co-residents and stakeholders from their personal network.

8.4.3. Measure 1: Community building by Change agents

In a low-income multicultural district like Kanaleneiland Zuid, a very significant portion of the population has not finished primary education and has very low written language skills, in any language. As a consequence, people get their information through word of mouth, rather than through written information whether on paper or digital. There are of course also residents who do have better language skills and have no problems consuming written information. Some of them have grown into an informal community or apartment block leader role: they inform their neighbours of current events when they meet in the stairway and when a resident is looking for information, these neighbours are consulted first, before or even instead of professional channels such as the municipality, social workers or the housing corporation. The same citizens regularly visit meetings and events in the neighbourhood for social reasons and to keep track of what is happening in the community. This measure therefore means to inform these community and apartment block leaders of the measures of the IRIS project and their purpose. By informing these community leaders, they can act as change agents for the rest of the community.

A first step in each demonstration district is to identify *change agents*. As part of the first citizen engagement activities for the design of smart street lighting in June 2018 a first mapping exercise was performed by interviewing local housing cooperating Bo-Ex, the municipal district office, district cops and other local enforcement professionals and accompanying them on their rounds through the district. The contacts they have provided have been visited individually and via this snowball method almost all the key formal and informal influencers in the district were involved in the preparation of the citizen engagement process. The existing local news agencies, including local Internet and regional TV network “U in de wijk” (You in the district) and the local volunteer district newspaper developed a keen interest in the project and will be our main partners in the citizen journalism implementation. Next steps:

- The recently formed group of change agents will regularly consulted and be extended for next citizen engagement activities and regularly consulted e.g. when formulating the communication messages for citizens, follow-up of progress on the integrated solutions that they provided their input for (so far this is the smart street lighting, more integrated solutions will follow later in 2018).
- Where applicable, change agents active in the existing volunteer district new networks will be involved as Citizen Journalists: U in de Wijk and the district newspaper have expressed their keen interest.

Throughout the duration of the entire project the network of change agents will be maintained, informed regularly by visiting community events and Bo-Ex meetings with tenants. Figure 41shows the programme for the scheduled activities for this measure.

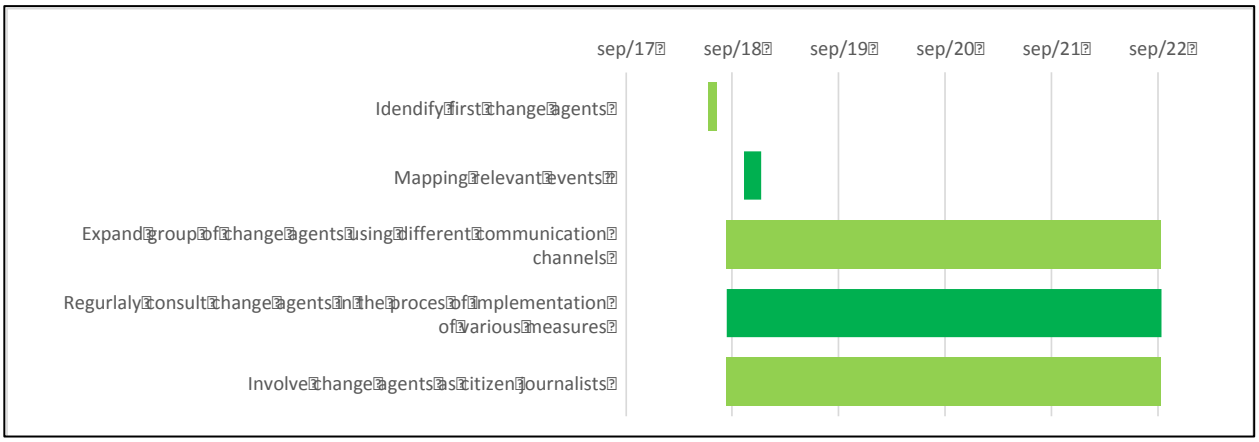


Figure 41. Timing of activities measure 1 - Community building by change agents

8.4.4. Measure 2: Campaign District School Involvement

Three schools in the demonstration district will be involved in the IRIS project. to involve children and parents Through the primary schools Kaleidoscoop and Schatkamer children and their parents will be involved. Professional school MBO Utrecht will be involved by providing training and possibly jobs to youngsters living in the district, while installing and maintaining the integrated smart solutions in the demo district. The premise is that by targeting children and local students their families, living in the district, might familiarize themselves and develop an emotional relationship with the energy solutions their sons and daughters are realizing in their own neighbourhood.

First planned activities:

- Primary schools: two existing sustainability and technology workshops with associated lesson boxes and teacher manuals are being developed to match the technical content of the IRIS project. Next guest lecturers will conduct workshops at both schools. Afterwards on one of the schools teachers should be able to carry out the workshops independently. At both schools it will be discusses and investigated how in the coming years the activities within the framework of the IRIS project can contribute to a structural approach to science and technology education in their curriculum.
- Students within the 2nd and 3rd year of the institution of Bouwkunde (building engineering) are involved in the IRIS project. This involvement consists of elaborating plans and proposals for several items within the building and citizen process. In groups, the students are requested and challenged to make plans for technical and social items:
    - technical: the most efficient design for PV-panels on the roofs of the apartment buildings, options as requested by tenants (e.g. the enlargement of the kitchen/bathroom), solutions to minimize energy/heat losses;
    - social: inquiries for tenants about the process and communication during and after the refurbishment, assisting citizen engagement activities, making video logs (vlogs) about the tenants, impact on the environment and the impact of the construction works to inform and involve people. The first study year (2018-2019), 3rd years students will be elaborating plans for a period of a half-year. After this half study year, the results and assignments are evaluated and improved for further study years.

Figure 42 shows the programme for the scheduled activities for this measure.

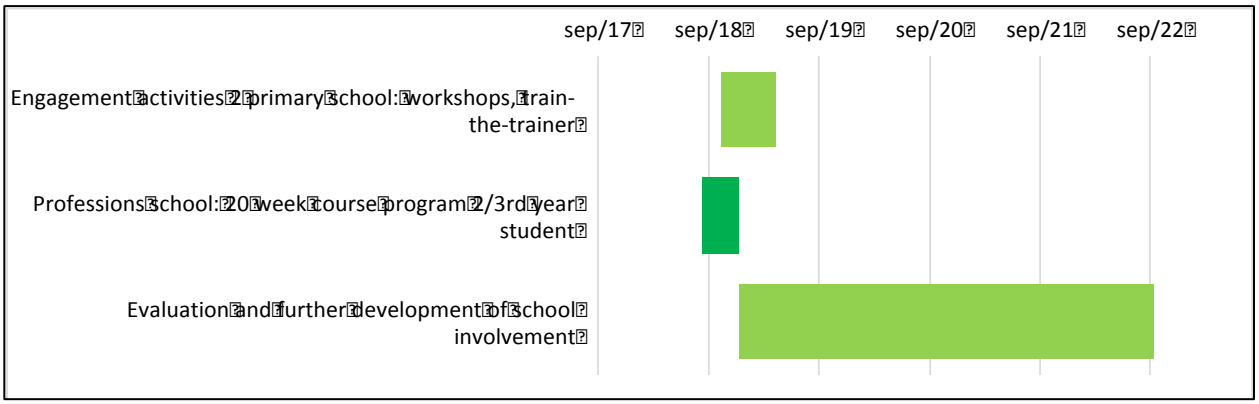


Figure 42. Timing of activities measure 2 - Campaign District School Involvement

8.4.5. Measure 3: Campaign Smart Street Lighting

A campaign for smart street lighting is closely linked to the development of a data-service for smart street lighting and is incorporated in these activities (see 7.4.4).

8.4.6. Measure 4: Creation of local Innovation Hubs

A multi-functional hub for co-creation, user-driven innovation, dissemination and communication in the demo district, will be established in the local innovation hub. This hub provides room to facilitate conversation between local stakeholders, including residents, but will also be used as a meeting place for actual solution design and implementation, allowing for better results and creating faster and more targeted improvements. The hub will e.g. be used to organise the co-creation sessions/workshops for the integrated solutions listed on level 3 and 4 of the engagement ladder.

8.4.7. Measure 5: Virtual reality platform

This activity focus on a virtual reality platform, extending existing Oculus Rift VR experiences for apartment buildings to other new buildings so households can experience their future 'new' home, including infotainment and interactive training about the new smart energy and mobility services they may expect.

In an earlier stage, experiments with 3D visualization have taken place to experience the renewed house of tenants after a refurbishment. This visualization worked well, since almost all apartments are building up the same and by using pictures (old/new) people could image which new parts/products were installed. On the other side, we've experienced that a certain amount of tenants can't 'read' visualizations: they don't understand a visualization and the linked pictures and descriptions to the visualization.

This engagement activity broadens the scope of virtual reality: it will focus on the new homes of the tenants and also on infotainment and training about smart energy and mobility solutions. This means

that tenants will be challenged to find their way in their own house and to find out what's needed to have a better energy usage performance. Hence the objective of this engagement activity is to develop an easy understanding virtual reality experience for the renewed houses of our tenants. Figure 43 shows the programme for the scheduled activities for this measure.

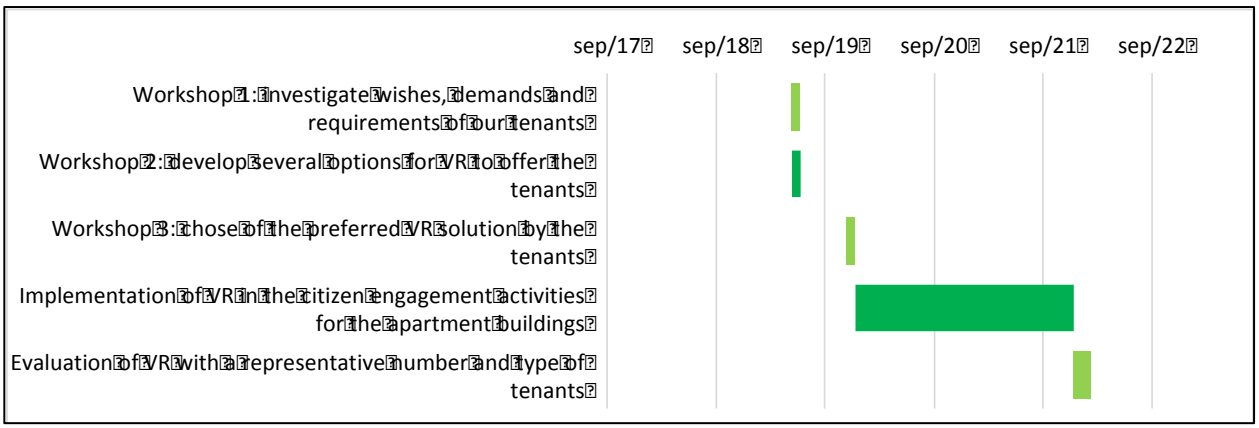


Figure 43. Timing of activities measure 5 - Virtual reality platform

8.5. Conclusions on ambitions and planning of activities

Key activities for the first year included:

- Mapping the individual integrated solutions on the citizen engagement ladder developed within work package 1 by IRIS partner HKU. Further delineating of citizen engagement activities for measures requiring active citizen engagement either for adoption or co-creating new services/product.
- Contracting external party to start activities to involve local schools.
- Organisation of 3 co-creating workshops resulting in a program of requirements for smart street lighting. Lessons learned on citizen engagement from these workshops were laid down in a booklet, which will be distributed among the IRIS project partners.

So far, no major deviations are anticipated compared to the DoA regarding the the type of implemented measures, size and planning.

9. Output to other work packages

9.1. 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.

9.2. 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.

9.3. 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.

9.4. 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.

9.5. Output to Work Packages 5 and 6

This deliverable constitutes the first detailed and coherent description of the Lighthouse City activities in Utrecht 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.

9.6. 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.

9.7. 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.

9.8. 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.

9.9. 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.

10. Conclusions

This report describes the *baseline, ambition, activities, and the barriers & drivers for each of the five transition tracks (TTs)* for the integrated solutions that will be demonstrated in Utrecht. During the development of this reports comparisons were made between reported ambitions and activities set out in the project proposal (DoA), and actual ambitions and activities. Any major *deviations* that materialized so far are described in this report.

This deliverable is *closely related to other deliverables in WP5*. Whereas deliverable D5.1 describes the 'what' of the demonstration activities in Utrecht, *deliverable D5.2* complements these descriptions by elaborating on the governance, planning and financing of the Utrecht demonstration, thereby outlining the 'how' of the demonstration. Together these deliverables are the *reference document* for the actual implementation of the integrated solutions in tasks 5.3 to 5.7. This deliverable was furthermore partly developed in parallel and in close cooperation with activities in WP1 on the extraction of requirements for the five TTs, including baseline definition of citizen energy and mobility behaviour, along with setting up of the monitoring principles and early business modelling development.

In order to *strengthen cooperation between lighthouse cities* and fosters exchange of best practices a *harmonized approach* was developed among the lighthouse cities Utrecht, Nice and Gothenburg. This resulted in a joint approach and outline for the Deliverables D5.1, D6.1 and D7.1 to ensure harmony and coherency amongst the interventions within the 3 lighthouses. With, however, the flexibility for each LH city to sustain their own methodology to suit the specific context.

The *baseline* is defined as the situation before any intervention has taken place and against which the impact of interventions is measured. The demonstration area *for all the five transition tracks in Utrecht* is situated in the *district of Kanaleneiland-Zuid* and neighbouring are Westraven. The district is a densely populated multi-cultural district, characterized by social housing, schools and shops and a majority of households with a low income.

The demonstration covers 12 four-storey apartment buildings of social housing corporation BOEX, adding up to 644 apartments, with a poor energy profile. The apartment blocks were built in the period 1950-1970, an era marked by the absence of energy regulations. As a result, the apartments are poorly insulated and have a typical energy label E-F.

The demonstration area is furthermore characterized by a mixed energy infrastructure. The current energy infrastructure encompasses an electricity network, a districting heating network and gas infrastructure. Parts of the gas infrastructure are obsolete and either need to be replaced or be taken out of operation in the coming years. The local electricity grid in the demonstration area was designed in the sixties, and is not outlined to accommodate for interventions taking place within the IRIS project, i.e. accommodating for large amounts of renewable energy production and charging of electric vehicles. Currently hardly any renewables are being exploited in the district of Kanaleneiland Zuid, and (public) charging infrastructure for electrical vehicle is not yet developed.

Ambitions for the respective TTs constitute the overall aim and vision of the thematic area in question for the Utrecht demonstration area. Ambitions are outlined in the DoA and were, amongst others, further developed within the course of the work in WP1 in the last year. The table below summarises

the ambitions set out in the DoA per TT. *No major deviations* from these ambitions are anticipated at this point in time.

Transition track	Ambition
#1 Smart renewables and closed-loop energy positive districts	Contribute to Near Zero Energy districts by integrating (1) a high share of locally produced and consumed renewable energy at district scale, (2) energy savings at building level, and (3) energy savings at district level
#2 Smart Energy Management and Storage for Energy Grid Flexibility	Integrate smart energy management and renewable energy storage for (1) maximum profits of renewable power, (2) maximum self-consumption reducing grid stress, (3) unlocking the financial value of grid flexibility and (4) optimizing the second life of car and bus batteries.
#3 Smart e-Mobility Sector	Integrate solar powered V2G e-cars, operated in the car sharing system We Drive Solar, as well as solar powered V2G e-buses in the urban mobility system for (1) local zero-emission Mobility as a Service, (2) lower household mobility costs and (3) smart energy storage in V2G batteries.
#4 City Innovation Platform (CIP)	Through cross-cutting open ICT (1) enable the integration of the IRIS solutions, maximising cost-effectiveness of the integrated infrastructure, (2) provide the City Innovation Platform and (c) develop meaningful information services for households, municipality and other stakeholders, together allowing for new business models.
#5 Citizen engagement and Co-creation	Design and demonstrate feedback mechanisms and inclusive services for citizens to achieve that citizens are motivated to (1) save energy, (2) shift their energy consumption to periods with abundant renewables and (3) use shared e-mobility instead of private cars.

Activities encompass the *planning of the actual demonstration*, including a detailed overview of all the *measures* that will be implemented to achieve the ambitions set for the demonstration and the *timetable* for implementation. The tables below provides an overview of the measures that will be implemented in the demonstration area per TT, summarizes key activities executed in the first year and, if applicable, points out deviation from the DoA for each of the TT.

#1 Smart renewables and closed-loop energy positive districts

	2018	2019	2020	2021	2022
Measure 1: District wide PV		48 homes	144 homes	226 homes	226 homes
Measure 2: LT district heating				96 homes	96 homes
Measure 3: HEMS TOON		48 homes	144 homes	226 homes	226 homes
Measure 4: NZEB refurbishment		48 homes	144 homes	226 homes	226 homes
Measure 5: Smart (hybrid) e-heating systems		48 homes	144 homes	130 homes	130 homes
Measure 6: AC/DC home switchboxes			8 homes		
Measure 7: Smart DC street lighting		50 smart street lights			

Key activities in the first year included: Planning and preparation of refurbishment activities for the first apartment block started (covering measures 1, 2, 4 and 5). First meetings and ideas on citizen

engagement trajectory for the Home Energy Management System (HEMS) discussed and developed (measure 3). Feasibility study and market assessment for measure 6 finished. Program of requirement under development for measure 7.

Deviations for TT#1: So far, no major deviations are anticipated compared to the DoA regarding the type and size of the measures, only a slide shift in the planning of the distribution of homes to be renovated over the years.

#2 Smart Energy Management and Storage for Energy Grid Flexibility

Measures	2017	2018	2019	2020	2021
Measure 1: Solar V2G charging points for e-cars/e-vans		~~18~~ *6*	*12*		
Measure 2: Solar V2G charging points for e-buses			10		
Measure 3: Stationary storage in apartment buildings			*4 X 300 kWh*		
Measure 4: Smart Energy Management System (EMSs)		Start	Extension	Extension	Complete

Key activities for the first: Planning for the implementation of first 6 V2G charging points (measure 1) completed. Program of requirement for 2nd life batteries drafted and ready to put out into the market (measure 3). Garage boxed for placement of batteries secured and building requirements for usage of garage boxes to store batteries mapped out (measure 3). Mapping of the current status of the electricity grid in the demonstration area and inventory of investments needed to accommodate integrated IRIS solutions (measure 4).

Deviations for TT#2: Anticipated deviations from the DoA concern the planning for measure 1 which will include a more phased demand driven approach.

#3 Smart e-Mobility Sector

Measures	2017	2018	2019	2020	2021
Measure 1: V2G e-cars	0		~~0~~	~~0~~	~~0~~
		14 V2G e-cars We Drive Solar 4 V2G e-vans			
Measure 2: V2G e-buses	10 V2G electric buses	0	143 e-buses	0	0

Key activities year 1: First cars ready to be introduced in the district area.

Deviations TT#3: Anticipated deviation from the DoA concern the planning for measure 1 which will include a phased demand driven approach, instead of the introduction of all cars in 2018.

#4 City Innovation Platform (CIP)

Services linked to:	2017	2018	2019	2020	2021
Measure 1: Monitoring E-Mobility with LoRa network	specification	co-creation	demo	demo	demo
Measure 2: Smart Street Lighting with multi-sensoring	specification	co-creation	demo	demo	demo
Measure 3: 3D Utrecht City Innovation Model	specification	co-creation	demo	demo	demo

Measure 4: Monitoring Grid Flexibility	specification	co-creation	demo	demo	demo
Measure 5: Fighting Energy Poverty	specification	co-creation	demo	demo	demo

Key activities for the first year included further detailing and defining the data services, developing a common process for the development of the services, making a clear division of roles in the process, discussing/establishing the cooperation/link with activities in WP 3 and WP4 and appointing a data challenger for each of the measures. Furthermore, anticipated activities in the development process for each of the data-services was outlined.

Deviations TT#4: So far, no major deviations are anticipated compared to the DoA regarding the type and size of the measures, and planning of the implementation.

#5 Citizen engagement and Co-creation

Measures/Activities	2017	2018	2019	2020	2021
Measure 1: Community building by Change agents	specification	co-creation	iteration	iteration	deployment
Measure 2: Campaign District School Involvement	specification	co-creation	iteration	iteration	deployment
Measure 3: Co-creation in Local Innovation Hub	specification	co-creation	iteration	iteration	deployment
Measure 4: Campaign Smart Street Lighting	specification	co-creation	iteration	iteration	deployment
Measure 5: VR New Home and District Experience	specification	co-creation	iteration	iteration	deployment

Key activities for the first year included mapping the individual integrated solutions on the citizen engagement ladder developed within WP 1. Further delineating of citizen engagement activities for measures requiring active citizen engagement either for adoption or co-creating new services/products. Contracting external party to start activities to involve local schools (measure 2). Organisation of 3 co-creating workshops aimed at defining a program of requirements for smart street lighting. Experiences and broader lessons learned on citizen engagement from these workshops were laid down in a booklet, which will be distributed among IRIS project team (measure 4).

Deviations TT#5: So far, no major deviations are anticipated compared to the DoA regarding the type of implemented measures, size and planning.