TOWARDS SMART ZERO CO_2 CITIES ACROSS EUROPE

VITORIA-GASTEIZ ✣ TARTU ✣ SØNDERBORG

Deliverable 5.6: Report on Electrical Vehicle Chargers in operation
WP5, Task 5.6

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[1] PU = Public
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Abbreviations and Acronyms

Abbreviation/Acronym	Description
SmartEnCity	Towards Smart Zero CO2 Cities across Europe
D	Deliverable
EU	European Union
EV	Electrical vehicle
FC	Follower City
H2020	Horizon2020
LHC	Lighthouse City
M	Project month
SONF	Sonderborg Forsyning (SONFOR)
V3	Version 3
WP	Work package
TEC	Tecnalia Research & Innovation
ZERO	ProjectZero

Table 1: Abbreviations and Acronyms

0 Publishable Summary

This document delivers a summary of the work carried out in relation to installing 31 electrical vehicle (EV) charging points in SmartEnCity Lighthouse Sonderborg, Denmark. The reduction of carbon emissions from transportation is part of the ambitious and prominent goal of the Sonderborg area becoming carbon neutral by 2029.

Denmark has a national ambition of 1 million EVs on the road in 2030 despite the current slow adoption of EVs. To enable this transition from conventional vehicles to EVs, it is important to create a supporting infrastructure in key locations. The locations in Sonderborg have been carefully chosen based on accessibility, tourist attractions, shopping areas and busy intersections.

The leading partners in implementing this demonstration action were Sonderborg Forsyning (SONF) and ProjectZero (ZERO), the coordinating partners of the Sonderborg Lighthouse City demonstrator, the private sector EV developer E.On. as well as supervisors at stores and cases.

Figure 1: Generic picture of the EoN EV charger

1 Introduction

The SmartEnCity project has a wide variety of demo actions, of which one of the focus areas is Smart Mobility. The smart mobility actions aim to explore and implement transportation solutions for the 21st century; the various solutions across the three lighthouse cities focus on zero and low emission transit. In Sonderborg the smart mobility demo actions include the implementation of the biomethane buses, and intelligent EV chargers.

The Sonderborg area (Municipality territory) aims at becoming carbon neutral by 2029. To address all carbon emitting activities in the municipality, resources have been committed to create long term viable development plans. These plans include energy efficiency in buildings, zero emissions transport, and green district heating.

A crucial part of achieving the 2029 goal is to address the 27% of carbon emissions from transportation.[2] The ProjectZero secretariat acts as a catalyst to research, launch and track the progress towards carbon neutrality. The Roadmap2025, created in 2018, represent the common agreed climate action plan – created and (to be) implemented in cooperation with more than 100 local stakeholder and energy experts. The Roadmap2025 is focused on achieving a 75% carbon reduction by 2025 and conversion to e-mobility is an important climate action towards milestone 2025.

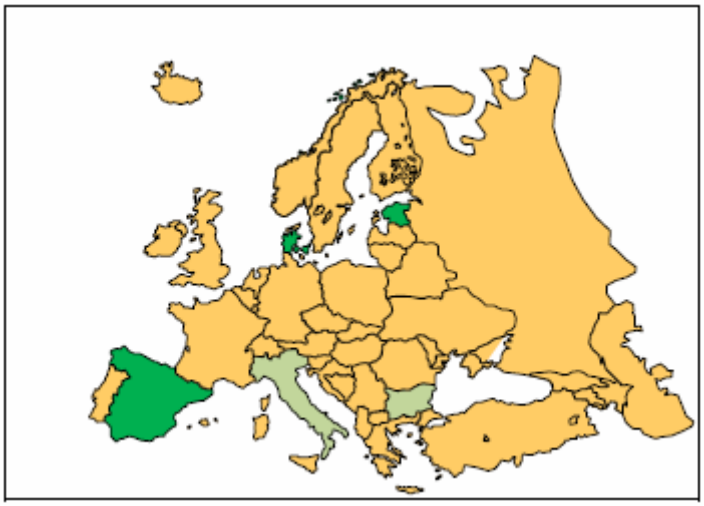

Figure 2: Lighthouse and follower cities in SmartEnCity

[2] Strategisk energiplan for grøn transport 2016

1.1 Purpose and target group

The purpose of this deliverable is to document the details and processes of installing EV chargers in the Sonderborg area. The details include a description of the decision-making processes, and lessons learned from the installation of the chargers.

Target groups include municipalities, NGOs, lobbying and activist groups working for carbon free public transit and others interested in changing to alternative fuel buses.

1.2 Contributions of partners

The following Table 2 depicts the main contributions from participant partners in the development of this deliverable.

Participant short name	Contributions
SONF	Implementation and writing of this deliverable
ZERO	Review of the deliverable, brainstorming on potential locations and installation follow up with location-owners and the installation company
TEC	Review of the deliverable

Table 2: Contribution of partners

1.3 Relation to other activities in the project

The following Table 3 depicts the main relationship of this deliverable to other activities (or deliverables) developed within the SmartEnCity project and that should be considered along with this document for further understanding of its contents.

Deliverable Number	Contributions
D5.1	This deliverable provides the overall description of the current state of the lighthouse city area and will provide a comparison in the future after demo actions have been implemented.
D5.7	This deliverable connects all the demo actions into an ICT platform so data may easily be extracted for evaluation and replication purposes as well as for analyses of impact.
D5.9	This deliverable concludes all SmartEnCity Lighthouse Sonderborg demo actions in the perspective of D5.1 report.
D7.8	Monitoring

Table 3: Relation to other activities in the project

2 Objectives and expected Impact

Smart mobility is part of the Sonderborg Lighthouse Demonstrator tasks in the SmartEnCity project. As part of this, new EV charging stations had to be installed in Sonderborg. During the project phase a total number of 31 new charging outlets was installed, which accomplished the necessary KPI of 30 outlets.

2.1 Objective

The objectives of this deliverable were two-fold; 1) the implementation of EV charging stations, and 2) provide a summarizing of the decision-making process, the lessons learned including scaling of the infrastructure solution – enabling other cities and municipalities to learn from the SEC Sonderborg case and actions.

2.2 Expected Impact and perspective

The implementation of 31 EV charging points in Sonderborg secures a supportive and enticing infrastructure for current and future EV owners, whether local or visiting. With increasing numbers of EVs on the roads, the EV chargers are necessary foundations for an electrified and carbon free future mobility fleet.

Recent LCA-analyses (Klimarådet, Denmark – figure 3) indicates that an EV compared to a diesel car during its lifetime will emit only half the amount of carbon per. km driven.

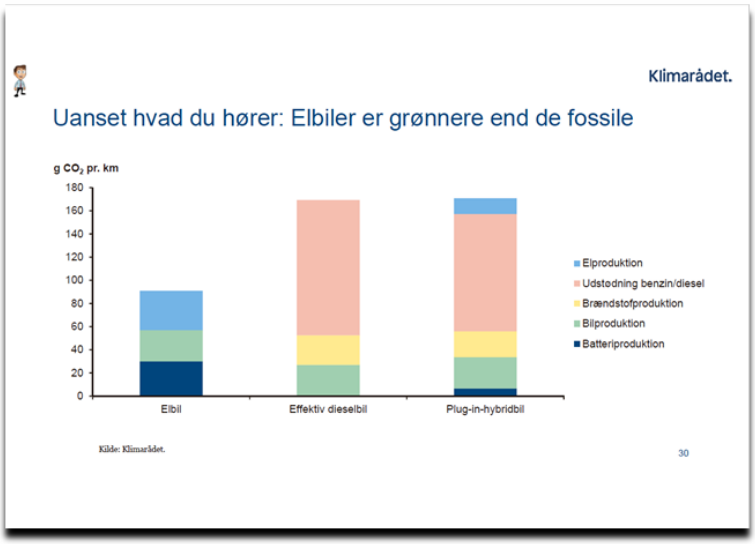

Figure 3: The electrical vehicle creates only half the carbon emissions per km than a diesel car based on LCA-analysis

The impact expected by these activities are to reduce carbon emissions on city levels, and disseminate the lessons learned so the carbon emission reducing activities may be replicated across other towns in Europe, and beyond.

The expected impact is also to implement a larger scale study of the future EV-charging infrastructure in Sonderborg' s urban areas.

3 Overall Approach

In 2007 a Public-Private Partnership (PPP) called ProjectZero was created by collaborative efforts of Sonderborg Municipality, The Bitten & Mads Clausen Fund, The Nordea Fund and Dong Energy.[3]

> "The public-private partnership – ProjectZero – was created to inspire and drive Sonderborg´ s transition to become a ZERO carbon community by 2029, based on improved energy efficiency, conversion of energy sources into renewables and by creating participation of all stakeholders to reach the ambitious goal: CO_2-neutral growth and sustainable urban development."[4]

The ProjectZero secretariat acts as a local catalyst and drive the implementation together with Sonderborg Municipality and local/external stakeholders.

Electrical Vehicle chargers in Sonderborg
The first EV charger in Sonderborg was installed in 2012 by a company called Better Place.[5] Several more have been added in the years since, however, the locations have been chosen on an ad hoc basis driven by local interest.

The locations for installation of the 31 EV-chargers, have been carefully chosen for optimal accessibility regarding tourist attractions, shopping areas and busy intersections. Through the 31 EV charging points implemented during this project and the experience gained, Sonderborg is ready for the next step (full scale) electrification of the private transport.

Sonderborg has by 2019 an estimated number of 100 EVs, of which the majority are being charged at home during the night. Sonderborg receive, being a front runner in reducing carbon emissions, a large number of visitors on an annual basis with either a commercial or private interest in the ambitious goal of carbon neutrality by 2029.

[3] http://www.projectzero.dk/da-DK/TopPages/Om-ProjectZero/Hvem-st%C3%A5r-bag-ProjectZero.aspx , accessed 02.07.2019
[4] http://brightgreenbusiness.com/en-GB/TopPages/About-ProjectZero-2.aspx accessed 02.07.2019
[5] https://www.projectzero.dk/da-DK/Artikler/2012/Februar/S%C3%B8nderborg-er-klar-til-elbilerne.aspx accessed 02.07.2019

Figure 4: Evergreen EV charger at Himmark wastewater treatment facility.

4 Task 5.6 / Electrical Vehicle chargers in operation

The Framework
The task leader, ZERO, delegated the implementation of the EV chargers to SONF from the start of the project. SONF consulted with ZERO and kept ZERO up to date on the developments at all times. Due to SONF´s exit as WP5-leader in the late summer 2019, ZERO accepted responsibility for following up during the physical installation phase.

SONF collected initially offers from 3 different parties; Møldrup El-Service I/S, ZapTec, and E.On. The task had a set budget to comply with, and all offers were evaluated against the budget.

- The first offer, from Møldrup El-Service I/S, was of intelligent Evergreen EV chargers. The intelligence in the EV chargers refers to software which would charge the EV when the national electrical grid had a surplus of renewable energy (mainly solar and wind). The offer also included installation work, which was however a separate cost item.
- The second offer, from Zaptec in Stavanger, Norway was of a different kind of intelligent EV charger. The EV charger comes as an integrated light pole which can be used either as a street light or a source of light in dark parking lots, at the same time there is an indicator at the top of the pole which can be seen from far, and with green or red light indicates whether the charger is in use or available. No installation service was possible, and a local contractor would have to be contacted.
- The third offer was from E.On. and was for a non-intelligent EV charger (regular), as a turnkey solution, although installation cost was a separate cost item. Part of the offer was an integrated prolonged life-time service, and regular access to consumption/occupation data from the EV chargers.

The prices of the offers from Møldrup El-Service I/S and E.On were comparable, and the offer from ZapTec was more than 3 times the price of the two others. Based on the value added from the Evergreen EV chargers with the intelligent software enabling selective charging times based on the amount of renewable energy in the national electrical grid was higher than the non-intelligent EV chargers from E.On.

The choice for supplier was therefore Møldrup El-Service I/S with the Evergreen EV charger. However, this choice was later changes since the supplier/developer of the Evergreen EV charger had difficulties with delivering the promised product. Therefor the Sonderborg partnership switched to E.On as supplier.

The chargers
The Evergreen EV charger's hardware was supposed to be combined with intelligent software to make the chargers intelligent. The software was never properly developed, and the developer of the software (VikingeGaarden) encountered problems when "Evergreen" stopped supplying chargers. The seven intelligent EV chargers purchased at the beginning as a test showed several problems.

1. Firstly, the chargers never turned intelligent since the supplier was unable to deliver on the agreed software.
2. Secondly, the chargers often had errors that had to be corrected manually, which turned out to be a burden some task both resource, time and cost wise.

The Evergreen chargers were all wall-hanging chargers, with one charging outlet, with 11 kWh charging capability.
Each recipient of an Evergreen EV charger pays the electricity consumed directly on the electricity bill for the address where the EV charger is installed.

The E.On EV chargers are non-intelligent, yet the software built into the chargers are able to provide data on consumption, but not live data. The chargers have been tried and tested elsewhere, and no surprises are expected after installation has been completed.

The chargers are all stand-alone chargers, with two charging outlets each, with 22 kW charging capacity, which means when only one EV is plugged into the charger, it will be charged faster than if two EVs are plugged in simultaneously. One car, if it possessed the capability, will be charged with 22 kW, and two cars plugged in simultaneously will charge with 11 kW each.

As the chargers draw a relatively high current it is important to locate them near a power outlet, that can supply the charger with enough current. For this reason, the chargers are located near buildings or power sources to reduce the distance from source to outlet, and thus the cost of installation.

For the chargers located in public parking spaces, an extra fee had to be paid to the DSO to be able to charge at 22 kW[6]. It was assessed that the added value from being able to charge fast far outweighed the additional cost.

Each time an EV owner charges an EV at an E.On charger payment is done through an RFID tag. This payment goes to E.On, which in turn pays the owner of the electricity supply the charger is connected to. For companies like SONF, Bilka and Danish Crown that means E.On transfers the cost of the electricity used, as well as a small percentage on top, to each business at agreed intervals. For chargers located in public parking spaces the payment goes to the grid operator.

A service agreement has been included in the purchase agreement, because SONF has no expertise in servicing such EV chargers, and E.On is accustomed to servicing their own chargers. The E.On chargers are all shown on the online map of chargers. All the chargers are also visible on the Sonderborg CIOP, where so far only location of the EV-charger is available.

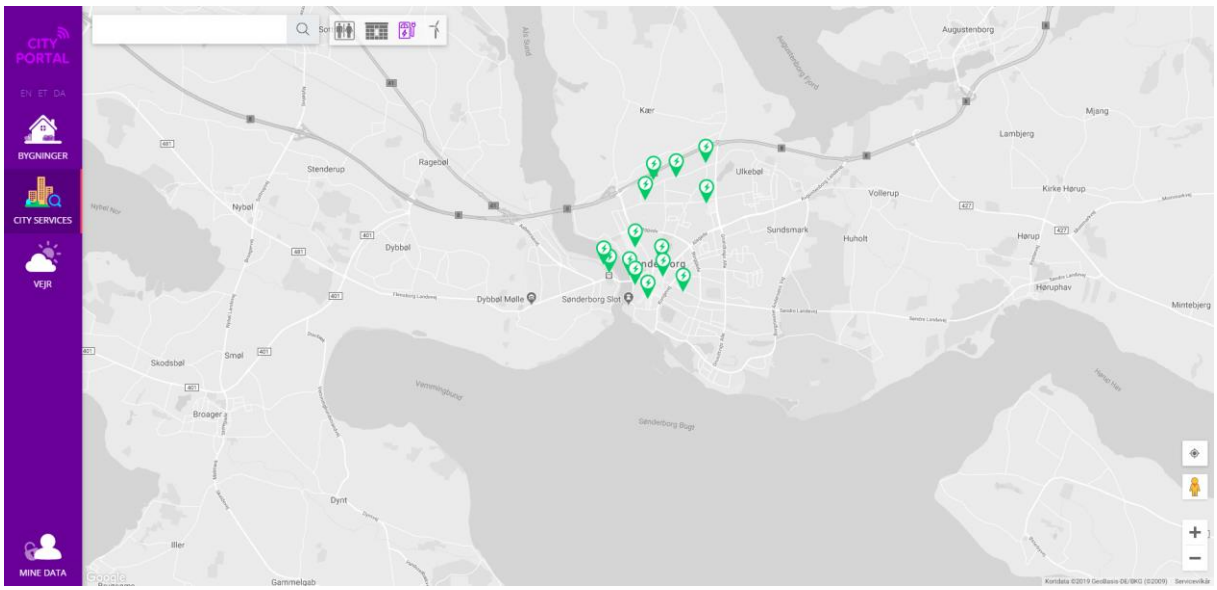

Figure 5: Sonderborg CIOP screen print where existing public chargers already appear

[6] https://www.evonet.dk/professionelle-aktoerer/tilslutningspriser-gebyrer

An international website allows EV-users to identify available public chargers:
https://www.plugshare.com/

The locations
Two separate strategies have been employed to place the chargers in locations with the highest impact.

- The first strategy: The Evergreen chargers with the expected intelligent software would have the largest impact when installed in places where EVs would charge overnight. The national Danish grid has the largest amount of surplus renewably produced electricity at night, and therefore the chargers would attempt to charge the majority of the battery during this time. The chargers were free of charge and included installation.
- The second strategy: The E.On chargers were placed according to where large numbers of vehicles either pass by, or stop for extended periods of time. All of the E.On chargers are publicly available, which increases the accessibility for all EVs to charge in the public sphere.

Multiple locations were identified, all were approached, some rejected due to concerns of less parking spaces for regular cars, or indecision among multiple stakeholders.

Evergreen EV chargers:

3 x 11 kW Ellegårdvej (2 Evergreen chargers not working)
1 x 11 kW Himmark wastewater treatment facility
1 x 22 kW Nordvesthavnsvej (private home)
1 x 11 kW Bjørnøvej (private home)
1 x 11 kW Blæsborg 9 (private home)

E.On EV chargers:

2 x 2 with 22 kW Ellegaardvej 8
3 x 2 with 22 kW Bilka
2 x 2 with 22 kW Danish Crown
1 x 2 with 22 kW Rønhaveplads
1 x 2 with 22 kW Vingården/Sønderborghus
1 x 2 with 22 kW Retten i Sønderborg (Courthouse)
1 x 2 with 22 kW Historiecenter Dybbølbanke (museum center)
1 x 2 with 22 kW Skansen (Sport/event facility)

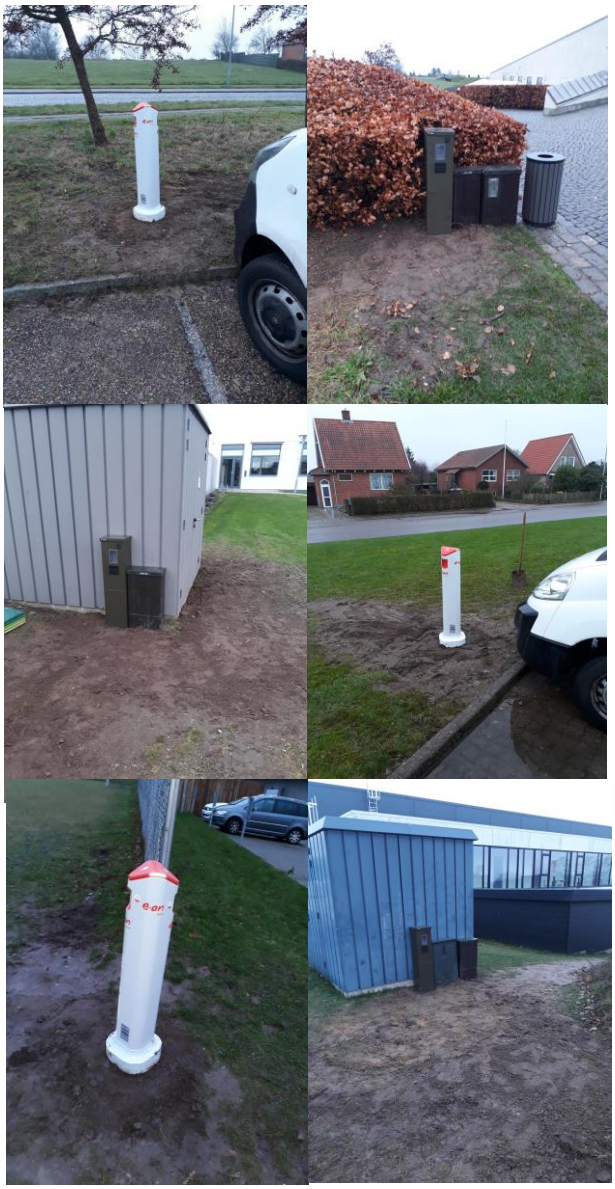

Figure 6: Installed public chargers and metering units

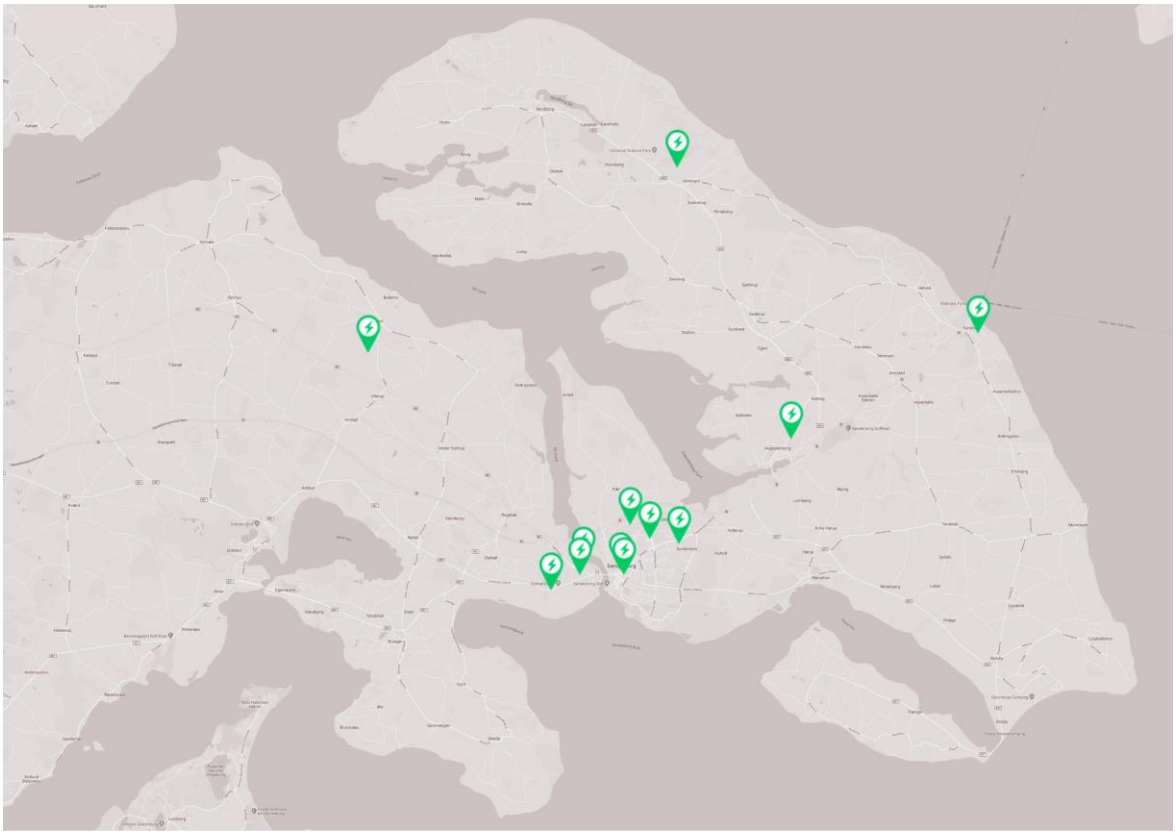

Figure 7: The new installed EV chargers in Sonderborg

Monitoring and evaluation

The monitoring of the Evergreen EV chargers is not possible since the company supplying the software has discontinued the service.

The monitoring of the E.On EV chargers is set up by E.On, with access to the data for SONF and ZERO. This data is not collected live however, but will be collected and reported every 6 months, as defined by the Grant Agreement.

The KPIs relevant for this deliverable are:

There will have to be installed 30 charging outlets in Sonderborg[7].

The above-mentioned actions sum up to 31.

[7] D7.3, p. 30

5 Lessons Learned and scaling perspectives

Throughout the process leading up to the installation of the EV chargers several lessons have been learned. These lessons learned have been collected and described below. They have been listed in unprioritized, and unchronological order.

- Due to national Danish legislation, free giveaways are heavily taxed, which in this case was a problem when EV-owners were offered a free intelligent EV charger, because they were taxed based on the value of the charger. The majority of EV owners that were contacted already had a home charger, naturally, which meant there was no value, and even a cost associated with receiving a free intelligent EV charger. Only three of the EV owners contacted agreed, of which two were in the process of buying EVs, so they did not already have a charging possibility in their homes.

- There can be significant time/response delays when applying for information regarding the point of connection to the public grid for the chargers.

- There are concerns to consider regarding service agreements from large multinational corporations compared to small local suppliers. Disappointingly, SONF will not have access to data from the Evergreen EV chargers because the local/national supplier, a small ICT company (and former SEC-partner), has discontinued the work on these chargers, and therefore no service will be carried out either. Two out of three Evergreen EV chargers at Ellegaardvej 8, DK-6400 Sonderborg have malfunctioned to the point where a decision was made to de-install them. For a long period of time, every time there was a malfunction, the supplier was asked to correct it remotely, which did not work every time.

- Installations can be delayed due to other installations that have to be established by the grit-operators, before a charger can be placed on a public parking area.

- In general, installing chargers in Denmark still is very complicated and incorporates several different entities/companies and stakeholders. There is a need for a further simplification of the process and the billing of charged electricity. This would also reduce the future cost of installation significantly.

Even that 2019 has been another low activity year of EV adaption by car-owners, there is reported a growing number of EV-cars registered in Denmark. An ambitious new Climate Law, approved by almost all parties in the national parliament in December 2019, will together with car manufacturers expected launch of new cheaper and longer range EV-cars, potentially secure a stronger owner acceptance of EV-cars in the future.

Sonderborg Municipality will therefore by the end of 2020 start analyzing opportunities and barriers for future full-scale deployment of electrical vehicles in urban places in Sonderborg municipality. The study will be implemented in cooperation with local and national stakeholders and experts – including the SEC-partner ZERO.

Sonderborg´s next step EV-charging infrastructure initiatives will potentially be coordinated with the other 6 municipalities participating in the Energibyerne.dk (www.energibyerne.dk), which is the national Danish leg of the SmartEnCity Network (www.smartencitynetwork.eu) .

Figure 8: Map of the 7 Energibyerne.dk across Denmark

6 Outputs for other WPs

The electric vehicle chargers do not have a direct influence on other WP's. However, the knowledge that has been gained will be reported in D5.9.

Data from the chargers will be reported as part of the WP7 KPI-reporting.