

# Verification of monitoring of CO<sub>2</sub> emissions 2018

Review of monitoring report and monitoring tool prepared by Project Zero

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## 1 Verification of monitoring of CO<sub>2</sub> emissions

In mid-2019 PlanEnergi reviewed and verified calculations concerning CO<sub>2</sub> emissions from the Sonderborg area. The calculations were prepared by ProjectZero for the year 2018.

The verification builds on a review of the monitoring report with descriptions of results. It also builds on a review of the monitoring tool that has been used for preparing the results, which particularly includes checks of the data basis, calculation methods and results contained in the tool. This document will explain the review.

The monitoring report as well as the monitoring tool were forwarded by Nicolas Bernhardi. Subsequent to the review process, which included a dialogue on changes, a final and updated version was forwarded in August 2019, which has now been verified by PlanEnergi.

Project manager  
Simon Stendorf Sørensen

Signature



Date

Aug. 23, 2019

## 2 Monitoring report

The results in the monitoring report have been reviewed and compared to the results from the monitoring tool.

In the course of the verification process PlanEnergi forwarded comments on the monitoring report and suggestions for amendments. These were accepted and a final version of the report was forwarded in mid-August 2019. This updated version has been deemed to be in agreement with the results from the monitoring tool.

## 3 Monitoring tool and random check

The monitoring tool has been reviewed in relation to acknowledged allocation methods, factors, formulas and specific calculations contained in the monitoring report.

In connection with this review a range of random checks were made of the calculations. The random checks did not reveal any significant inconsistencies that gave reason for remarks. In the following we will mention some important comments that we found necessary to make when we reviewed the monitoring tool.

### 3.1 Energy producer count

All entries about the electricity and heat production as well as the fuel consumption relating to energy producers have been checked. A few minor typing errors plus some incorrectly registered units were found. These have been rectified.

The electricity and heat production and the fuel consumption reported by the energy producers have also been compared on an overall basis in relation to the previous year.

Total fuel consumption has risen by just under 1% compared to 2017. The rise is related to a small, corresponding rise in district heating production. The reason for this may be that new district heating customers within the boundaries of the municipality are continually connected to the grid.

7% less natural gas is used in the local electricity and heat production; this consumption has generally been falling since 2007. Note also that the use of wood chips for energy production has risen by 7% compared to 2017. Concurrently, a rise of 5% in district heating production based on solar energy has occurred in 2018 compared to 2017.

Note that the Danish Energy Agency's data include businesses that produce electricity for public grids that could advantageously be covered by ProjectZero's monitoring.

### **3.2 Electricity used for production of district heating**

Consumption of electricity for district heating production has been calculated separately and has been reviewed and quality-controlled. A single registration error was found, which has been rectified, and no other comments were necessary.

### **3.3 Consumption of electricity**

The data on electricity consumption collected from the local electricity grid company have been reviewed and quality-assured without any comments, as have the data entered into the monitoring tool about electricity consumption. Note that the grid loss in the electricity grid covers only loss in the distribution grid.

### **3.4 Natural gas consumption for individual heating and process**

The gas consumption data collected from the local gas company have been reviewed and quality-assured. It is remarkable that a rise in gas consumption has occurred – especially because conversions have been implemented from heating by means of individual natural gas into district heating supply. However, it is difficult to state unequivocally whether this has to do with data errors or actual development in consumption. It should be noted that it is necessary to pay attention to next year's data retrieval regarding gas consumption in terms of comparing data from next year with data from this year.

The data on gas consumption entered into the monitoring tool have been reviewed and quality-assured without any comments.

### **3.5 Electricity production from solar cells**

The data on production of electricity from solar cells in Sønderborg Municipality that have been collected from energinet.dk's energy data service have been reviewed and quality-assured without any comments, as have the data entered into the monitoring tool about electricity production from solar cells.

Solar cell production data indicate that electricity production from solar cells has increased by more than 10%. A theoretical effect of 855 kWh pr. kWp is used for production of electricity, which is viewed as a realistic, but also a slightly conservative estimate in terms of the effect of new solar cells (earlier, we have calculated this on the basis of 800 kWh/kWp; however, we now base our calculations on 915 kWh/kWp).

### 3.6 Electricity production from wind turbines

The data on production of electricity by means of wind turbines in Sonderborg Municipality that have been collected from the Danish Energy Agency's master data register have been checked and deemed correct.

Electricity production from wind turbines dropped by 8% in 2018 compared to 2017. The fall was caused by a generally mild wind year (below normal), and the result was a slightly lower production from practically all wind turbines compared to 2017.

### 3.7 Waste treatment

The collected data on waste treatment, including waste incineration in Sonderborg Municipality, have been reviewed and quality-assured without any comments, as have the data entered into the monitoring tool.

It should be noted that the CO<sub>2</sub> emission factor for waste in the Danish Energy Agency's energy statistics for 2017 has been changed in relation to previous years. The agency has adjusted it retrospectively to 2012 while in the monitoring tool it has 'only' been adjusted from and including 2017.

### 3.8 Consumption of diesel by agriculture and forestry

The collected data on diesel consumption by agriculture and forestry in Sonderborg Municipality have been reviewed and quality-assured and a minor formula error was found and corrected. Also the data entered into the monitoring tool have been reviewed and quality-assured.

### 3.9 Industry's energy consumption

The data on energy consumption by industry collected from Statistics Denmark have been reviewed and quality-assured, as have the data entered into the monitoring tool.

It should be noted that the consumption of gas-diesel has been included in relation to industry, which may pose a risk of double counting in that gas diesel consumption has already been included in oil for road transport.

It should be noted that consumption of fuel oil has not been included.

### 3.10 Olie til vejtransport

Consumption of diesel oil and petrol related to transport is, with the exception of buses, based on statements about the vehicle fleet in the municipality. This energy consumption is calculated as a share of the total consumption related to road transport that is stated in the Danish Energy Agency's energy statistics. The calculation is based on national data on the number of kilometres travelled per type of vehicle (Danish Road Directorate, 2018) and on the average standard consumption per type of vehicle (DCE, 2018).

Use of fuel for buses has been allocated in relation to municipalities on the basis of population figures in that the buses are primarily registered in a small number of municipalities.

The data on the fleet of various types of vehicles in Sonderborg Municipality collected from Statistics Denmark, yearly work on traffic relating to various types of vehicles from the Danish Road Directorate, and average fuel economy relating to various types of vessels from DCE have

been reviewed and quality-assured without any comments, as have the data entered into the monitoring tool.

### 3.11 Oil for heating

Data on the number of registered oil-fired boilers collected from chimney sweepers have been reviewed and quality-assured. Consumption of oil for heating is calculated on the basis of counting of oil-fired boilers carried out by local chimney sweepers and on the basis of the development in the total number of oil-fired boilers in Sonderborg Municipality. This consumption is then broken down by segments by means of data from the BBR register. Method:

1. BBR data on BBR code, number of m<sup>2</sup> and year of construction for buildings with registered oil-fired boilers.
2. Theoretical heat demand kWh/year/m<sup>2</sup> per BBR code and year of construction for calculating the heat demand that is to met by means of oil-fired boilers. This includes a breakdown of the figures by segments.
3. The breakdown of the figures by segments remains unchanged, but, on the basis of data from chimney sweepers the number of oil-fired boilers is assumed to be 40% of what is registered in the BBR register. For this reason the heat demand met by means of oil is revised down by multiplying each segment by 0.4.
4. Finally, the theoretical heat demand is divided by the efficiency of oil-fired boilers of 80% in order to establish a fuel consumption that can then be converted into CO<sub>2</sub> emission.

### 3.12 Share of CO<sub>2</sub> relating to co-production of electricity and heating

Random checks have been made of calculations relating to the emission factor for electricity, including the allocation methods 125% and 200%. Method:

1. It is assumed that, in relation to co-production, the largest amount of fuel will be used for electricity production; for this reason a factor of 1.25 is used
2. Total CO<sub>2</sub> emission from fuel consumption (tonnes of CO<sub>2</sub>) \* Total supply of heating (TJ) / Total fuel consumption (TJ) / 1.25 (the 125% method)

### 3.13 CO<sub>2</sub> emission factor for district heating

The CO<sub>2</sub> factor is calculated by dividing the CO<sub>2</sub> emission from the district heating production by the supplied district heating where grid loss is deducted. In terms of power-plant heat production a share of the CO<sub>2</sub> emission is allocated for district heating on the basis of the 125% method. Climate-correction is done by means of degree days.

The calculation of the district heating CO<sub>2</sub> emission factor has been reviewed and quality-assured without any comments.

### 3.14 CO<sub>2</sub> emission factor for electricity

The emission factor for electricity is calculated on the basis of total CO<sub>2</sub> emission from electricity production in Sonderborg Municipality and from CO<sub>2</sub> emission from imported electricity divided by the total consumption of electricity in Sonderborg Municipality. Method:

1. CO<sub>2</sub> emission from local electricity production = CO<sub>2</sub> emission part 1

2. Total local consumption of electricity where local electricity production is deducted = import of electricity
3. Imported electricity multiplied by the Danish Energy Agency's emission factor = CO<sub>2</sub> emission part 2
4. Electricity emission factor: CO<sub>2</sub> emission part 1 + CO<sub>2</sub> emission part 2 / total local consumption of electricity

The data on CO<sub>2</sub> emission factors for electricity collected from the Danish Energy Agency have been reviewed and quality-assured with a single comment about possibly adjusting the CO<sub>2</sub> emission factor for 2017 on the basis of the Danish Energy Agency's updated emission factor.

### 3.15 Heating – breakdown by sectors

- Oil for heating – see comments on BBR register used as data basis.
- Biomass for heating – see comments on BBR register used as data basis.
- Natural gas – BBR.
- District heating – BBR.
- Electricity for heating – the share of electricity for electric heating in homes is estimated on the basis of the difference between electricity consumption in buildings with and without electric heating (based on the number of meters). The share of electric heating in other sectors is estimated on the basis of distribution in the BBR register. Both methods are acceptable.

### 3.16 Other reviewed and quality-assured data

- Population figures relating to Sønderborg Municipality in 2018 from Statistics Denmark.
- Degree days in 2018 from DMI.

## 4 Data basis

The data basis for ProjectZero's monitoring is deemed generally to be of high quality in that it is based on measurement data where it concerns the significant areas. This applies to, for instance, electricity consumption, gas consumption and fuel consumption by local energy producers. The collection of data from the same sources over a period of years also makes possible quality-assurance and hence high quality of data.

For these reasons the data basis is deemed to provide accurate monitoring.

If there is a desire to enhance the quality of the data, the measures described below may be considered.

### 4.1 Measurement data on grid loss in district heating grid (as opposed to assuming a loss of 20%)

Data on grid loss can be collected from the district heating plants, or alternatively from Dansk Fjernvarme (district heating company).

#### **4.2 Measurement data on supply of district heating (breakdown by sectors)**

Data on district heating broken down by sectors could perhaps be collected from district heating plants.

#### **4.3 Waste fractions in Sonderborg as opposed to waste fractions in all of the Nordic countries**

Data on waste that is treated and incinerated in Sonderborg Municipality could be perhaps be collected from the waste management company.

#### **4.4 Degree days relating to the near locality as opposed to degree days relating to all of Denmark**

Degree days can be used that relate to the locality of Sonderborg such as Sonderborg airport as opposed to degree days relating to all of Denmark.

### **5 Conclusion**

On the basis of the review of the monitoring report and the review of the data basis and on the basis of the calculation methods and results in the monitoring tool, the monitoring of CO<sub>2</sub> emissions and energy consumption in 2018 is deemed to be correct, and the data basis for the monitoring is deemed to be of high quality.