[Indsæt partnerlogo]

Data in Energydata.dk

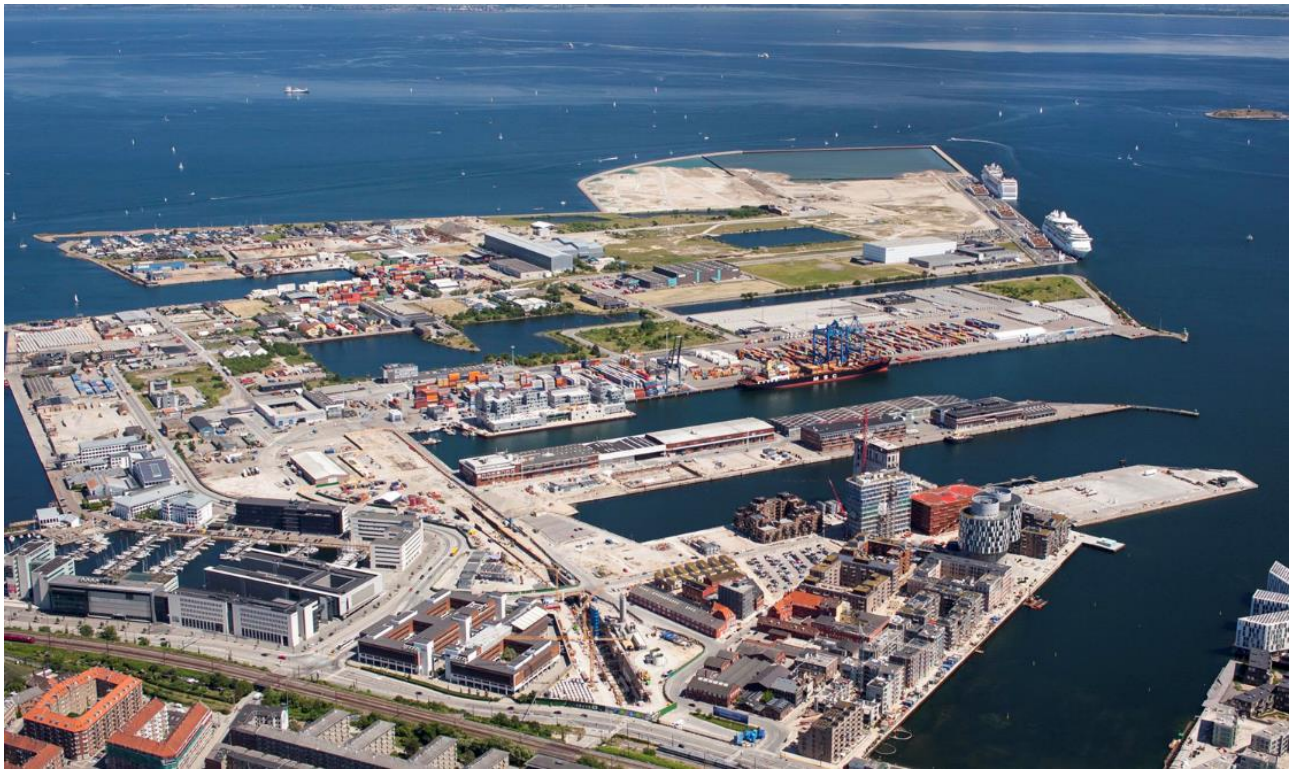

Photo: By & Havn / Ole Malling

DTU

Anders L. Kragh

November 26, 2018

Public deliverable ☐

Confidential deliverable ☐

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Preface

EnergyLab Nordhavn – New Urban Energy Infrastructures is an exciting project which will continue until the year of 2019. The project will use Copenhagen's Nordhavn as a full-scale smart city energy lab, which main purpose is to do research and to develop and demonstrate future energy solutions of renewable energy.
The goal is to identify the most cost-effective smart energy system, which can contribute to the major climate challenges the world are facing.

Budget: The project has a total budget of DKK 143 m (€ 19 m), of this DKK84 m (€ 11 m) funded in two rounds by the Danish Energy Technology Development and Demonstration Programme (EUDP).

Forord

EnergyLab Nordhavn er et spændende projekt der løber til og med 2019. Projektet vil foregå i Københavns Nordhavn, og vil fungere som et fuldskala storbylaboratorium, der skal undersøge, udvikle og demonstrerer løsninger for fremtidens energisystem.
Målet er at finde fremtidens mest omkostningseffektive energisystem, der desuden kan bidrage til en løsning på de store klimaudfordringer verden står overfor nu og i fremtiden.

Budget: Projektets totale budget er DKK 143 mio. (EUR 19 mio.), hvoraf DKK 84 mio. (EUR 11 mio.) er blevet finansieret af Energiteknologisk Udviklings- og Demonstrationsprogram, EUDP.

For other information regarding EnergyLab Nordhavn, please contact:

EnergyLab Nordhavn Secretariat
Center for Electric Power and Energy, DTU Electrical Engineering
Elektrovej
Building 325
DK-2800 Kgs. Lyngby
Denmark

E-mail eln@dtu.dk
Tlf. +45 45 25 35 54

www.energylabnordhavn.dk

Table of Contents

List of Abbreviations

Resumé

This document describes the data in the energydata.dk database, in short DMS (data management system) for the EnergyLab Nordhavn project.

If (or when) you find a mismatch between what you observe and what is described, please notify Anders Laage Kragh, alkragh@elektro.dtu.dk

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Version Control

Version	Date	Author	Description of Changes
0.1	20-09-2018	Anders Laage Kragh	First released version (based on a detail version of similar doc)
1.0	30-09-2018	Anders Laage Kragh	First released version, after great help from John Hegelund, ABB
1.01	02-10-2018	Anders Christian Laage Kragh	Minor update on HOFOR data
1.02	04-10-2018	Anders Christian Laage Kragh	Minor update on HOFOR data
1.03	26-11-2018	Anders Christian Laage Kragh	Chapter 7 (CO2 data) and chapter 8 (battery data) added.

Quality Assurance

Author	Reviewer	Approver
		WPL group

Status of deliverable		
Action	**By**	**Date/Initials**
Sent for review	[name, organisation]	
Reviewed		
Verified		
Approved	WPL group	

1. Domain and data structure for data from Nordhavn

This document describes the data in the energydata.dk database, in short DMS (data management system) for the EnergyLab Nordhavn project.

Datasets are defined according to the specification defined in the documents "energydata.dk data model" and Datastructure for data in Nordhavn living lab

2. Domains

Access to data are controlled by data domains. These are created for general (open data), personal data (sensitive data), business critical data or data covered by a NDA. Therefore, the following domains are created:

- Energylab Nordhavn
- Energylab Nordhavn/HOFOR
- Energylab Nordhavn/Radius
- Energylab Nordhavn/KNX

In the domain Energylab Nordhavn the following data will be stored:

- Nordpool el-spot prices
- SGU (Smart Grid Unit) data
- CleanCharge (charging data for cars)
- Weather forecast (from MeteoBlue)
- CIS - data from weather station at Copenhagen International school
- Danfoss Heat Boost Station

The above data is neither person sensitive, business critical or covered by a NDA.

In the domain Energylab Nordhavn/HOFOR data from HOFOR will be stored, this data is covered by a specific NDA and is business critical.

In the domain Energylab Nordhavn/Radius data from Radius shall be stored, this data is person sensitive and is business critical.

In the domain Energylab Nordhavn/KNX measurements from the apartments in these building:

- Sundmolen

- KPC
- Frihavnstårnet

will be stored. The data is person sensitive.

3. Data in the Energylab Nordhavn domain

The domain Energylab Nordhavn contains data from the sources:

- Nordpool (el-spot prices)
- SGU (smart grid unit)
- CleanCharge (charging data for cars)
- Weather (from MeteoBlue)
- CIS - data from weather station at Copenhagen Internal School
- Danfoss Heat Boost station

3.1 Nordpool

The data set contains price information for electric power (per MWh) available at Nordpool. Data are the hourly spot prices for eastern Denmark published every day for the coming day including the average price for the coming day. Prices are available in DKK and Euro. The time zone is Copenhagen time including daylight saving, therefore for the day in the spring and autumn where the clock is adjusted due to daylight saving contains respectively 23 and 25 prices.

Data element	Explanation
Time	Copenhagen time zone
Price DKK	Price per MWh in DKK
Price Euro	Price per MWh in Euro
Average price DKK	Average price per MWh in DKK for the day
Average price Euro	Average price per MWh in Euro for the day

Table 1 Power spot prices for eastern Denmark

3.2 SGU – Smart Grid Unit

The SGU measures frequency, voltage, current, peak current, Cos φ, active, reactive and apparent power as well as the direction of each. In addition, the temperature of the central unit is measured.

Whenever there is a change in a parameter, the new value (not the change) is logged and time stamped, UTC time.

Data element	Explanation
Serienumber	Serie number for the SGU
Vendor	Supplier of SGU
Placement	Address for the placement of the SGU
Temperature top	resolution 0,1 C
frequency	resolution 0,001 Hz
RMS voltage L1-N	resolution 0,1 V
RMS voltage L2-N	resolution 0,1 V
RMS voltage L3-N	resolution 0,1 V
Cable outlet 1: Neutral average current	resolution 0,1 A
Cable outlet 1: L1 average RMS current	resolution 0,1 A
Cable outlet 1: L2 average RMS current	resolution 0,1 A
Cable outlet 1: L3 average RMS current	resolution 0,1 A
Cable outlet 1: L1 peek RMS current one period	resolution 0,1 A
Cable outlet 1: L2 peek RMS current one period	resolution 0,1 A
Cable outlet 1: L3 peek RMS current one period	resolution 0,1 A
Cable outlet 1: L1 power factor	resolution 0,01
Cable outlet 1: L2 power factor	resolution 0,01
Cable outlet 1: L3 power factor	resolution 0,01

Table 2 Data fromSmart Grid Unit in Nordhavn

3.3 CleanCharge

The data set contains data for use of the charge stations for electric cars at the parking house in Nordhavn. The data charging information is from several charge stations and many users.

The data contained for each charging is:

Data element	Explanation
Charge point no.	Number for the charger
Chargepoint	Charger type
Plugtype	Plugtype
Charge Type	AC / DC
Connection Begin	Starting time for the charging (CET / CEST)
Connection End	End time for the charging (CET / CEST)
Amount	Amount in kWh

Table 3 EV charging data

3.4 Weather forecast from MeteoBlue

Data for a basic weather forecast, cloud and solar forecast from MeteoBlue for the Nordhavn area is available.

The data (weather forecast) are updated twice a day; at midnight and noon. The time for the update is part of the data. The forecast is for the coming 180 hours, with prediction per hour.

The basic data includes this information:

Data element	comment
time for model run and update	time and date ISO 8601
Precipitation	mm, water amount
Snow fraction	procent, 0 = rain
Temperature	C, 2m above ground
Wind speed	m/s, 10m above ground
Wind direction	degrees, 10m above ground
Relative humidity	procent, air humidity
Is-daylight	1= day, 0= nigth. Triggered by the brightness of the light, which has to be enough to read outside

Table 4 Basic forecast from MeteoBlue

The cloud data includes this information:

Data element	comment
time for model run and update	data and time for weather forecast, ISO 8601
low clouds	procent, cover of the sky 0-4 km

mid clouds	procent, cover of the sky 4-8 km
high clouds	procent, cover of the sky 8-15 km
total cloud cover	procent, cover of the sky
sunshine time	minutes per hour with direct sunligth

Table 5 Cloud forecast from MeteoBlue

The solar data includes this information:

Data element	comment
time for model run and update	time and date ISO 8601
GHI	W/m2 Global Horizontal Radiation
DIF	W/m2 Diffuse Radiation
DNI	W/m2 Direct Normalized Irradiance (Radiation)
GNI	W/m2 Global Normalized Irradiance (Radiation)
Extra terrestrial solar radiation	W/m2 Extraterrestrial solar radiation

Table 6 Solar forecast from MeteoBlue

The details of the forecast can be found in these two documents; basic and cloud information and detail solar information.

meteoblue_API_dat
a-packages_images_

meteoblue_Solar_Te
chnical_Specificatio

3.5 CIS – weather station at Copenhagen International School

Copenhagen International School is equipped with a weather station. Data from this weather station is available in energydata.dk.

The data contained is:

Data element	Explanation
Time	Date and time for sampling, time zone is UTC

SPN_Total	W/m2
SPN_Diffuse	W/m2
Temperature	C
Humidity	procent
Windspeed	m/s
Zenith	°
Azimuth	°
DNI	W/m2

Table 7 Data from CIS weather station

3.6 Danfoss Heat Booster Station

A heat booster substation (HBS) is located in Havnegade, Nordhavn for a multifamily building for operation in ULTDH system. A heat pump (HP) is boosting the district heat (DH) supply temperature up to a level where domestic hot water can be produced, but optionally also boost the temperature for the heating system.

The system contains two ECL regulators (ECL1 and ECL2) and data from each of these regulators are logged in the DMS every 10th second.

.

The data contained is:

ECL-1

Data element	Explanation	Comment
Time & Date Stamp	[dd:mm:yyyy hr:mm:ss]	time for reading, CET (winter time) or CEST (summer time) depending on dayligth saving
-1-ECL1	ms	tick, time stamp in ms
T DH common return (S2)-2-ECL1	[°C]x100	
T L-HP flow to tank (S3)-3-ECL1	[°C]x100	
T S-HP flow to circ. (S4)-4-ECL1	[°C]x100	
T L-HP return (S5)-5-ECL1	[°C]x100	
T tank top #1 (S6)-6-ECL1	[°C]x100	
T tank #2 (S7)-7-ECL1	[°C]x100	
T tank #5 (S8)-8-ECL1	[°C]x100	
T tank #3 (S9)-9-ECL1	[°C]x100	

T tank #4 (S10)-10-ECL1	[°C]x100	
T S-HP to evap. (S11)-11-ECL1	[°C]x100	
T S-HP circ. return (S12)-12-ECL1	[°C]x100	
T tank outlet (13)-13-ECL1	[°C]x100	
T S-HP evap. out (S14)-14-ECL1	[°C]x100	
T DH flow (S15)-15-ECL1	[°C]x100	
Q L-HP evap. (F1)-16-ECL1	[l/hr]x10	
Q L-HP cond. (F2)-17-ECL1	[l/hr]x10	
Q L-HP ref. evap. (ECL code to be updated)-18-ECL1	[l/hr]x10	
T S-HP set circ.-19-ECL1	[°C]x100	
Valve pos. L-HP Q evap.-20-ECL1	[0-1000]	
Valve pos. L-HP Q cond.-21-ECL1	[0-1000]	
Valve pos. S-HP Q evap. -22-ECL1	[0-1000]	
On/Off S-HP (R3)-23-ECL1	[0-1]	
On/Off L-HP (R4)-24-ECL1	[0-1]	
On/Off circ. Pump (R5) > ECL2-25-ECL1	[0-1]	
On / Off S-HP (R6)-26-ECL1	[0-1]	
CS S-HP prio. valve (TR3) = Heat. Return-27-ECL1	[0-1]	
Triac S-HP priority valve-28-ECL1	[0-1]	
CS S-HP prio. Valve (TR5) = Tank Bottom-29-ECL1	[0-1]	
Triac S-HP priority valve-30-ECL1	[0-1]	
-31-ECL1	[-]	State in ECL regulator, currently not used
-32-ECL1	[-]	State in ECL regulator, currently not used
-33-ECL1	[-]	State in ECL regulator, currently not used

P L-HP-34-ECL1	[kW]x10	
-35-ECL1	[-]	State in ECL regulator, currently not used
E L-HP-36-ECL1	[kWh]x10	
-37-ECL1	[-]	State in ECL regulator, currently not used
-38-ECL1	[-]	State in ECL regulator, currently not used
-39-ECL1	[-]	State in ECL regulator, currently not used
P S-HP-40-ECL1	[kW]x10	
-41-ECL1	[-]	State in ECL regulator, currently not used
E S-HP-42-ECL1	[kWh]x10	
-43-ECL1	[-]	State in ECL regulator, currently not used
-44-ECL1	[-]	State in ECL regulator, currently not used
Q S-HP evap.-45-ECL1	[l/hr]x10	
-46-ECL1	[-]	State in ECL regulator, currently not used
-47-ECL1	[-]	State in ECL regulator, currently not used
-48-ECL1	[-]	State in ECL regulator, currently not used
-49-ECL1	[-]	State in ECL regulator, currently not used

Table 8 Data from HBS ECL-1 regulator

ECL-2

Data element	Explanation	Comment
Time & Date Stamp	[dd:mm:yyyy hr:mm:ss]	time for reading, CET (winter time) or CEST (summer time) depending on dayligth saving
-1-ECL2	[-]	tick, time stamp in ms
T heat flow (S3)-2-ECL2	[°C]x100	
T DHW flow (S4)-3-ECL2	[°C]x100	
T heat return (S5)-4-ECL2	[°C]x100	

T return DHW prim. (S6)-5-ECL2	[°C]x100	
DHW flow sw (S8) (0=flow)-6-ECL2	[0-1]	
T DHW circ. Return (S9)-7-ECL2	[°C]x100	
T CW (S11)-8-ECL2	[°C]x100	
T set heat flow-9-ECL2	[°C]x100	
T heat ret. Limiter set-10-ECL2	[°C]x100	
T DHW set-11-ECL2	[°C]x100	
T circ. DHW set-12-ECL2	[°C]x100	
CS DHW prim. pump-13-ECL2	[0-1000]	
CS DHW circ. pump.-14-ECL2	[0-1000]	
On/Off pumpe prim. DHW-15-ECL2	[0-1]	
On/Off heat circ. pumpe-16-ECL2	[0-1]	
CS heat (M2)-17-ECL2	[-]	
CS heat (M2)-18-ECL2	[-]	
T circ flow EM-19-ECL2	[°C]x100	
T circ return EM-20-ECL2	[°C]x100	
Q circ EM-21-ECL2	[l/hr]x10	
P circ EM-22-ECL2	[kW]x10	
Vol circ EM-23-ECL2	[liter]x0,01	
E circ EM-24-ECL2	[kWh]x10	
T DHW EM-25-ECL2	[°C]x100	
T CW EM-26-ECL2	[°C]x100	
Q DHW EM-27-ECL2	[l/hr]x10	
P DHW EM-28-ECL2	[kW]x10	
Vol DHW EM-29-ECL2	[Liter]x0,01	
-30-ECL2	[-]	Currently not used
-31-ECL2	[-]	Currently not used
-32-ECL2	[-]	Currently not used
-33-ECL2	[-]	Currently not used
-34-ECL2	[-]	Currently not used
-35-ECL2	[-]	Currently not used

E DHW EM-36-ECL2	[kWh]x10	
-37-ECL2	[-]	Currently not used

Table 9 Data from HBS ECL-2 regulator

4. Data in the HOFOR domain

Data from HOFOR for district heating delivered to a number of buildings in Nordhavn is available in Energydata.dk. Data for consumption the previous day is made available the next day. Data from 1 January 2017 is available. The meters are read every hour and the following data is available, see Table 10 HOFOR meter reading data Table 10

Data element	Explanation
Date and time	ISO 8601, time for reading, CET (winter time) or CEST (summer time) depending on dayligth saving
installation number	The id number for installation
street	adress
postal code	number
meter number	The id number for the meter, will change if the meter is replaced
energy	MWh
volume	m3
duration	h
inlet temperature	C
return temperature	C
temperature difference	C
actual power	kW
actual flow	L/h
forwarded energy*	m3C (volume * temperature)
returned energy*	m3C (volume * temperature)

Table 10 HOFOR meter reading data

*Forwarded and returned energy are only available on some meters.

5. Data in the Radius domain

Data for the individual households and commercial consumers power consumption (from Radius) are available in Energydata.dk. The power meters for a number of consumers, (households and commercial customers) are read every hour. For different reasons, the meter readings are made available monthly. However work is ongoing to have more frequent data available.

Data from 1 January 2017 is available. The following data is available, see Table 11

Data element	Explanation
Point_of_delivery_ID	Point of Delevery - customer identification (PoD)
10KV_Radial	Identification of radial
Netstation	ID for net station
Nettype	Net topologi
Transformernr	ID for transformer connected to netstation
Udføring_LV-strækning_skab	LV implementation or cable section
Skabsnr	Cabinet number
Grid_connection	Location for connection the customer
Floor	Floor for installation, PoD, ref street and house number
Street	Street for installation, PoD
House_Number	House number in street for installation, PoD
Read_timestamp	time for reading, CET (winter time) or CEST (summer time) depending on dayligth saving
Consumption previous hour	consumption, kWh

Table 11 Data from Radius power meters

See the area here and the installation addresses here

6. Data in the Nordhavn/KNX domain

This domain contains data in three sub-domains:

- Sundmolen
- KPC
- Frihavnstårnet

Data in the Sundmolen domain contains very detailed data for 19 apartments in the Sundmolen buildings including wall temperature sensors for 10 apartments. This is further described in chapter 6.1.

The KPC domain contains data for 4 apartments in the KPC building. In these apartments, demonstrations of buildings thermal capacity are executed.

The Frihavnstårn domain holds similar detailed data as for Sundmolen but include the option for smart start of domestic appliances but no wall temperature sensors are included.

6.1 Data from Sundmolen apartments

Data from these apartments are grouped into these groups and sub-groups:

- Wall sensors
- Light sensors
  - Switch
  - StatusSwitch
  - MovementPresenceDetector
  - ActualBrightnessVaue
- Heat sensors
  - HeatControlValue
  - StatusControlValue
  - SetpointDisplay
  - OperatingMode
  - BasicSetPoint¨
  - HeatControlPump
- Indoor climate
  - ActuelTemperatur
  - ActuelCO2
  - ActuelHumidityValue
- Consumption (heat and power)
  - ElectricityMeterTotal
  - Heatmetering
  - Domestic water use
  - ElectricityMeterOnRoom
- SocketOutlets
  - SocketOutlets_Controls
  - SocketOutlets_Status
  - SocketOutlets

6.1.1 Sensors from wall temperature measurements

This group contains all wall temperature sensors.

Data element	Explanation
Date and time	ISO 8601, UTC

Wall temperature	Celcius

Data is logged every minute (60 seconds) and whenever there is a change in the temperature > 1 C

The naming of the data set indicate the sensor location and type.

The location and type is given by: TTxxyy,

where xx tells the type of sensor and yy the positioning, ref the Figure 1 - Figure 3

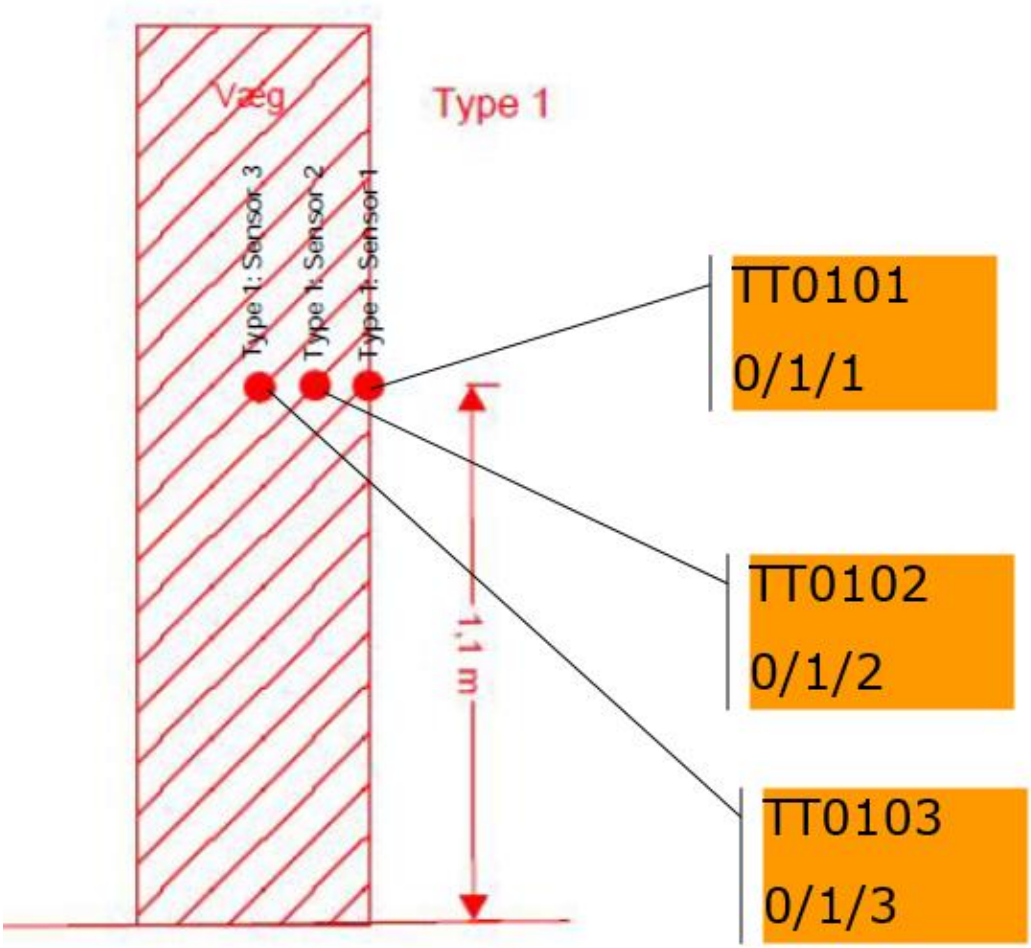

Figure 1 Wall sensor type 1 positioning

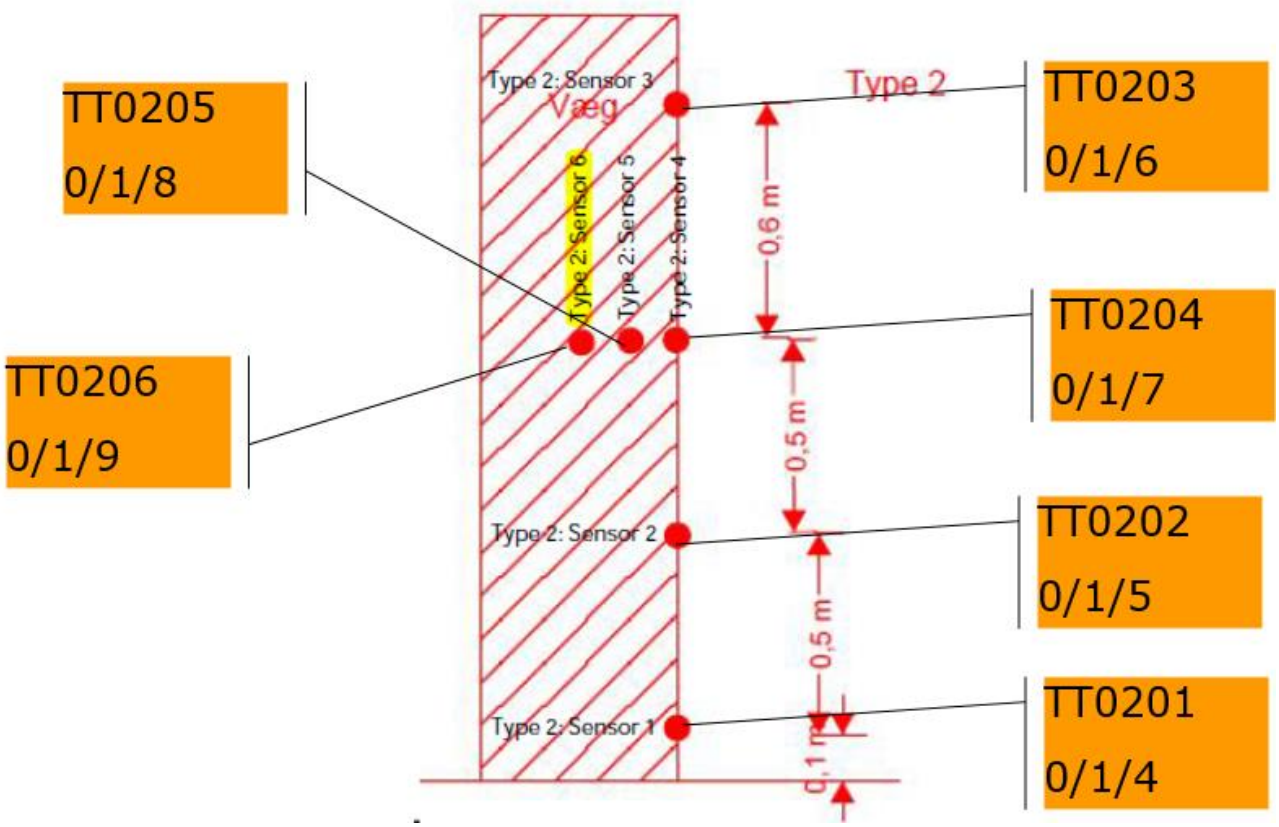

Figure 2 Wall sensor type 2 positioning

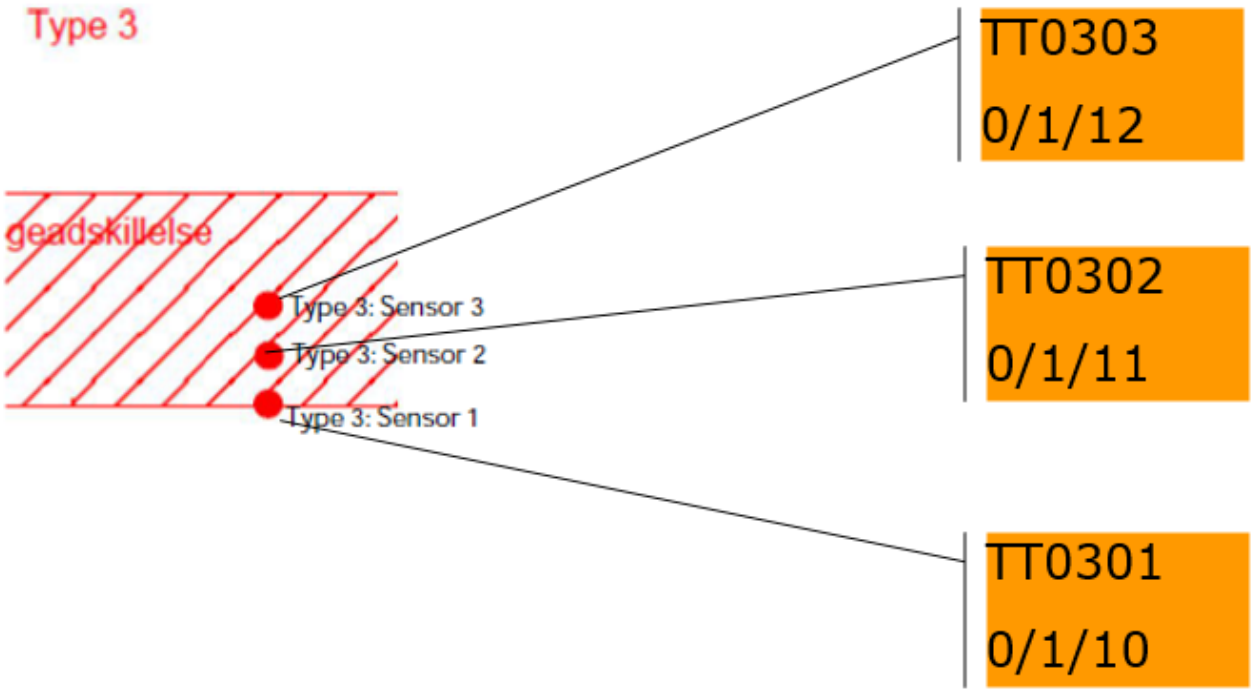

Figure 3 Ceiling sensor (type 3 sensor) positioning

6.1.2 Light sensors

This group contains light sensors. The following sub-groups exist:

- Switch
- StatusSwitch
- MovementPresenceDetector
- SlukAlt
- ActualBrightnessVaue

The naming of the dataset indicates the location of the sensor. Please refer to apartment drawing for details and naming.

6.1.2.1 Light sensor - Switch

Data element	Explanation
Date and time	ISO 8601, UTC
Switch – status	Integer (0 / 1), 0: off, 1: on

Data is logged when the switch is activated (on / off).

6.1.2.2 Light sensor - StatusSwitch

Data element	Explanation
Date and time	ISO 8601, UTC
Switch – status	Integer (0 / 1), 0: off, 1: on

Data is logged when the switch is activated (on / off) and every 60 second. The signal is a kind of acknowledgement to the activation in 6.1.2.1.

6.1.2.3 Light sensor - MovementPresenceDetector

Data element	Explanation
Date and time	ISO 8601, UTC
Presence	Integer (0 / 1), 0: no one present, 1: a person is present

A PIR sensor detects if a person is present (movement) in the room, if there has been no one present in 30 minutes, a “0” is reported. The 30 minutes timer is reset whenever there is movement.

6.1.2.4 Light sensor - SlukAlt

Data element	Explanation
Date and time	ISO 8601, UTC
“Scene values” (KNX naming)	See below

When the switch “slukAlt” is pushed, then all lights and all sockets (with a few exception) in the apartment is turned off – a scene value of “1” is logged.
If there is movement in the apartment, (the PIR sensor detects movement) then a scene value of “2” is reported and all sockets are turned on.

Scene 1 values are reported at changes.
Scene 2 values are reported at movement in the apartment – even if the sockets are “on”.

6.1.2.5 Light sensor - ActualBrightnessVaue

Data element	Explanation
Date and time	ISO 8601, UTC
Brightness	Lux

Data is logged every 30 sec.

6.1.3 Heat sensors

This group contains heat sensors. The following sub-groups exist:

- HeatControlValue
- StatusControlValue
- SetpointDisplay
- OperatingMode
- BasicSetPoint
- HeatControlPump
    - HeatControlPump_ControlLogic

- HeatControlPump_Permanent_ON
- HeatControlPump_Status
- MeteringcurrentCirculatingPump

The naming of the dataset indicates the location of the sensor and a new value is logged when a change happens including a time stamp.
Please refer to apartment drawing for details and naming.

6.1.3.1 Heat sensors - HeatControlValue

Data element	Explanation
Date and time	ISO 8601, UTC
Heatcontrolvalue	%

Heatcontrolvalue can take the value 0% or 100% - reported at changes.

6.1.3.2 Heat sensors - StatusControlValue

Data element	Explanation
Date and time	ISO 8601, UTC
Statuscontrolvalue	Integer - boolean

Statuscontrolvalue can take the value 0% or 100% and reported at changes (as a kind of acknowledge) and every 60 sec.

6.1.3.3 Heat sensors - SetpointDisplay

Data element	Explanation
Date and time	ISO 8601, UTC
SetDisplayValue	degC

Setpointdisplay contains the temperature setpoint from basicsetpoint or user changed value, that the temperature regulation aims to achive and the value is displayed in the display. If the Operating mode, see 6.1.3.4, is active then corresponding temperature is logged and displayed.

6.1.3.4 *Heat sensors - OperatingMode*

Data element	Explanation
Date and time	ISO 8601, UTC
OperatingMode	Integer

OperatingMode, can take the following values:

- 1 - Comfort
- 2 - Standby
- 3 - Eco
- 4 – Frost (protection)

New values are logged at changes.

6.1.3.5 *Heat sensors - BasicSetPoint*

Data element	Explanation

BasicSetPoint: The setpoint (temperature) that the regulator operates towards, e.g. 23 C. The data (value) is not logged, but data can be written to this variable – set point value. For current target temperature read the SetPointDisplay value, see 6.1.3.3

6.1.3.6 *Heat sensors - HeatControlPumpControlLogic*

Data element	Explanation
Date and time	ISO 8601, UTC
HeatControlPump_ControlLogic	Integer - boolean

HeatControlPump_ControlLogic is used to turn on / off the heat pump for the floor. 1: on; 0: off.

Data is logged at changes.

6.1.3.7 *Heat sensors - HeatControlPump_Permanent_ON*

Data element	Explanation

Date and time	ISO 8601, UTC
HeatControlPump_Permanent_ON	Integer - boolean

HeatControlPump_Permanent_ON: used to permanent switch on the floor heating circulation pump.

6.1.3.8 Heat sensors - HeatControlPump_Status

Data element	Explanation
Date and time	ISO 8601, UTC
HeatControlPump_Status	Integer - boolean

HeatControlPump_Status: report back the status of the floor heat circulation pump, 1: on; 0: off.

Data is logged every 60 sec and at changes.

6.1.4 IndoorClimate sensors

This group contains IndoorClimate sensors. The following sub-groups exist:

- ActuelTemperatur
- ActuelCO2
- ActuelHumidityValue

The naming of the dataset indicates the location of the sensor and a new value is logged when a change happens including a time stamp.
Please refer to apartment drawing for details and naming.

6.1.4.1 Heat sensors - ActuelTemperatur

Data element	Explanation
Date and time	ISO 8601, UTC
ActuelTemperatur	degC

Data is logged every 5 minutes and if there is a change > 0.5 C

6.1.4.2 Heat sensors – ActuelCO2

Data element	Explanation
Date and time	ISO 8601, UTC
ActuelCO2	ppm

Data is logged every 60 sec.

6.1.4.3 Heat sensors – ActuelHumidityValue

Data element	Explanation
Date and time	ISO 8601, UTC
ActuelCO2	% - note values must be multiplied by 0.4

Data is logged every 60 sec.

6.1.5 Consumption sensors

This group contains all sensors for consumption. The following subgroup exist:

- ElectricityMeterTotal
  - Meters for electric prower consumption
- Heatmetering
  - Meters for district heating (Kamstrup meter)
- Domestic water use
  - Meters for use of hot and cold water
- ElectricityMeterOnRoom
  - Meters for use of power in rooms and appliances

6.1.5.1 ElectricityMeterTotal

This group contains sensors for the following metering:

- Active energy (kWh)
- Active power total (W)

- Active power per phase L1- L3 (W)
- Current per phase L1- L3 (A)
- Voltage per phase L1- L3 (V)
- Frequency (Hz)

Data is logged every 60 sec, time is logged in UTC.

6.1.5.2 Heatmetering

This group contains sensors for the district heating use and include the following meters:

- Volume (l)
- Volume (m3)
- Delivered energy accumulated (MWh)
- Delivered energy accumulated (kWh)
- District heating return flow temperature (degC)
- Temperature difference in flow (K)
- District heating forward flow temperature (degC)
- Delivered power (W)
- Flow (m3/h)

Data is logged every 5 minute, time is logged in UTC.

6.1.5.3 Domestic water use

This group contains 2 metering for respectively hot and cold water use, measured in l (liters).

Data is logged every 60 sec, time is logged in UTC.

6.1.5.4 ElectricityMeterOnRoom

This group contains meters for measure:

- Meter reading power (W) (accumulated usage)
    - Values are logged every 60 sec
- Active power (W)

    - Values are logged every 5 minutes and at changes > +/- 2 W
- Current (A)
    - Values are logged every 5 minutes
- Voltage (V)
    - Values are logged every 5 minutes

for the following appliances:

- Dryer
- Washing machine
- Ventilation
- Owen
- Cooking plate, A – C
- Dishwasher
- Quooker (boiling tap water)
- Microwave oven

Time is logged in UTC.

Further current is measured for lighting, please refer to apartment drawing for details. Measured in A and logged every 5 minutes and time stamped in UTC.

6.1.6 SocketOutlets Sensors

This group contains all sensors for socket outlets. The following subgroup exist:

- SocketOutlets_Controls
    - Logical value, changes are logged
- SocketOutlets_Status
    - Logical value, changes are logged and value is reported every 60 second
- SocketOutlets_MeteringCurrent
    - Current in A, logged every 60 second

SocketOutlets_control are used to change the status (turn on or off) of a socket. SocketOutlets_Status “acknowledge the new setting and report recurrently the setting (value).

SocketOutlet_meterringcurrent measure the current (A) for the socket.

The time (UTC) is logged, please refer to apartment drawing for details and naming.

6.2 Data structure for KPC

The KPC project is about temperature measurements in 4 apartments. In total 16 sensors are installed in each apartment complemented by 4 controllers per apartment.

The naming of a data set follow the structure as described here:

- <Energylab Nordhavn/KNX data/KPC><KPC/apartment¤/sensor_#>
- <Energylab Nordhavn/KNX data/KPC><KPC/apartment¤/operation_#>

Where:

¤ is number for the apartment; 1..4
is the number for the sensor / controller; 1..16 / 1..4

Temperaure is measure in C and “operation control value” as an integer. Values are logged when changed and time (UTC) is recorded.

Data is logged every minute (60 seconds) and whenever there is a change in the temperature > 1 C – to be confirmed

6.3 Data structure for Frihavnstårnet apartments

The Frihavnstårn domain holds similar detailed data as for Sundmolen but include the option for smart start of domestic appliances but no wall temperature sensors are included. Data from 11 apartments are available.

Additional data set for dimming and brightness shall be described

6.3.1 Datasets

The same data sets as described in chapter 6.1 except subchapter 6.1.1 are available for Frihavnstårnet. However as the aparments in Frihavnstårent are larger there will be more rooms and consequently more sensors, but the same logic applies. Therefore please refer to chapter 6.1 for description of the data.

7. Data for CO2 forecast and power break down

Information about *forecasted carbon intensity* and *forecasted power consumption breakdown* is available from Tomorrow for the Nordhavn location.

7.1 Data description

The forecasted carbon intensity includes forecast for CO2 (in gCO2eq/kWh) for the coming 48 hours and for the latest past hour estimate. The forecast contains 48 data set; a data set for the forecast 1 hour ahead, a data set for the forecast 2 hours ahead etc up to 48 hours ahead. New data sets (e.g. forecast) are available every hour so for each day there will be 24 forecast for 1 to 48 ahead.

The *forecasted power consumption breakdown* includes forecast for the coming 24 hours and the latest past hour estimate for from where the power originate divided into these production types:

- Biomass
- Coal
- Gas
- Hydro
- Nuclear
- Solar
- Wind
- Unknown

The power production is measured in MW.

The power break down includes forecast for 1 hour ahead, 2 hours ahead up to 24 hours and new forecast is made available every hour.

8. Battery data

A battery is installed in the Lüders parking house delivering mainly frequency reserve and peak shaving to EnerginetDK. The solution consist of an ABB battery management system and is accessible through RTU (remote terminal unit).

The set-up is shown in Figure 4

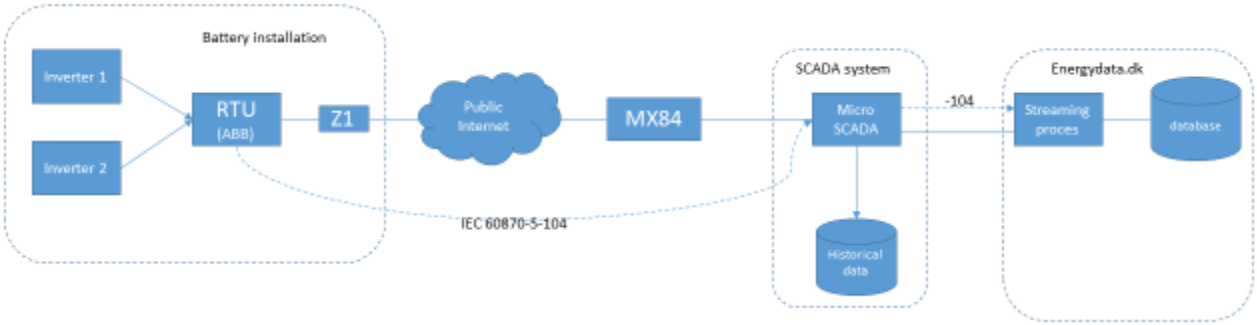

Figure 4 Power grid - battery solution

The battery solution consist of two batteries each with an inverter (INV1 and INV2). Data from each of the batteries (inverters), auxiliary equipment and operation mode is collected and stored in energydata.dk.

Note: This will be implemented in Q4 2018 / Q1 2019

8.1 Data description

The available data is shown in Table 12

Measurement	Comment
DPI breaker status	Breaker 10Kv open/closed – connection to transformer station
Operation mode FDR	Frequency operation mode active
Operation mode peakshaving	Peakshave operation mode active
Operation mode SOC management	State of Charge operation mode active
Frequency	Frequency
NGT08	Current on radial to transformer statiom
NGT65	Current on radial to transformer statiom
AUX supply Electric Potential	Voltage on the supply for the auxillery equipment
AUX supply Electric Current I1	Current phase 1 for the auxillery equipment
AUX supply Electric Current I2	Current phase 2 for the auxillery equipment
AUX supply Electric Current I3	Current phase 3 for the auxillery equipment
AUX supply Electric active energy	Active energy for the auxillery equipment
AUX supply Electric reactive energy	Reactive energy for the auxillery equipment
INV1 Electric active energy	Voltage on the supply for the inverter 1
INV1 Electric reactive energy	Current phase 1 for the inverter 1
INV1 Electric Current I1	Current phase 2 for the inverter 1
INV1 Electric Current I2	Current phase 3 for the inverter 1
INV1 Electric Current I3	Active energy for the inverter 1
INV1 Electric Potential	Reactive energy for the inverter 1
INV1 StateOfCharge	State of charge inverter 1
INV2 Electric active energy	Voltage on the supply for the inverter 2
INV2 Electric reactive energy	Current phase 2 for the inverter 2
INV2 Electric Current I1	Current phase 2 for the inverter 2
INV2 Electric Current I2	Current phase 3 for the inverter 2
INV2 Electric Current I3	Active energy for the inverter 2
INV2 Electric Potential	Reactive energy for the inverter 2
INV2 StateOfCharge	State of charge inverter 2

Table 12 Data from battery solution

Data is updated when ….. to added after implementation