General remarks

All formulas are defined for one fixed timestamp. For most use cases aggregation will be necessary.

Scopes

Scope 1-3 are defined by the Greenhouse Gas Protocol.

Scope 1

Description: Direct emissions from sources that are controlled by the company/ grid (energy production, vehicles ...).
Visualization: Stacked area chart.
Variables:

- LocalEnergySource: Local energy production types. (solar and biogas)

- GeneratedEnergy: Energy produced on-site (Production_of_CHP_kW + Production_of_PV_kW)

- EmissionFactor: Emission factors are values that quantify the amount of carbon emissions produced per electricity unit like kW. (tbd)

Formula:
$$S_1 = \sum_{\text{LocalEnergySource } i} (\text{GeneratedEnergy}_i * \text{EmissionFactor}_i) \tag{1}$$

Scope 2

Description: Indirect emissions resulting from the generation of purchased energy (electricity, heat ...).
Visualization: Stacked area chart.
Variables:

- 50H_EnergySource: All types of energy sources of the electricity mix. (column names of SMARD_50Hz.csv)

- PurchasedElectricity: Amount of electricity that was bought from the grid. (Grid_Reference_SMARD_kW)

- ShareInMix: Share of all power generation types in the electricity mix (calculated with SMARD_50Hz.csv)

- EmissionFactor: Emission factors are values that quantify the amount of carbon emissions produced per electricity unit like kW. (tbd)

Formula:
$$S_2 = \sum_{\text{50H\_EnergySource } i} (\text{PurchasedElectricity} * \text{ShareInMix}_i * \text{EmissionFactor}_i) \tag{2}$$

KPI's

KPI 1: Self consumption

Description: KPI that measures the proportion of electricity that is on-side generated and consumed.
Visualization: Donut chart that represents percentages (values: 0-100%).
Variables:

- Consumption: Energy consumed on-site (Total_Load_kW).

- GeneratedEnergy: Energy produced on-site (Production_of_CHP_kW + Production_of_PV_kW)

Formula:
$$K_1 = \min(\frac{\text{Consumption}}{\text{GeneratedEnergy}}, 1) \tag{3}$$

KPI 2: Autarky

Description: A concept closely related to self-consumption. It measures the percentage to which a grid system is self-sufficient in terms of energy production.
Visualization: Donut chart that represents percentages (values: 0-100%).
Variables: See KPI 1
Formula:

$$K_2 = \min(\frac{\text{GeneratedEnergy}}{\text{Consumption}}, 1) \tag{4}$$

KPI 3: CO_2 Savings

Description:
Visualization: Donut chart that shows CO_2 in kg (tbd)
Variables:

- 50H_EnergySource: All types of energy sources of the electricity mix. (column names of SMARD_50Hz.csv)

- Consumption: Energy consumed on-site (Total_Load_kW).

- ShareInMix: Share of all power generation types in the electricity mix (calculated with SMARD_50Hz.csv)

- EmissionFactor: Emission factors are values that quantify the amount of carbon emissions produced per electricity unit like kW. (tbd)

- GeneratedEnergy: Energy produced on-site (Production_of_CHP_kW + Production_of_PV_kW)

- S_1, S_2: see scope 1 and 2

Formula: (tbd)

$$K_3 = \sum_{\text{50H\_EnergySource } i} (\text{Consumption} * \text{ShareInMix}_i * \text{EmissionFactor}_i) - S_1 - S_2 \tag{5}$$

$$K_3 = \sum_{\text{50H\_EnergySource } i} (\text{GeneratedEnergy} * \text{ShareInMix}_i * \text{EmissionFactor}_i) - S_1 \tag{6}$$

KPI 4: Cost Savings

Description: Comparing costs with and without the local energy production.
Visualization: Donut chart that shows Euros (tbd)
Variables:

- Consumption: Energy consumed on-site (Total_Load_kW).

- ElectricityPrice: Market price of electricity (ENTSOE api).

- SolarOpCosts: Operational costs of the solar panels. (tbd)

- BiogasOpCosts: Operational costs of the CHP powered by biogas. (tbd)

- PurchasedElectricity: Amount of electricity that was bought from the grid. (Grid_Reference_SMARD_kW)

Formula:

$$\text{CostsWithoutLocalGrid} = \text{Consumption} * \text{ElectricityPrice} \tag{7}$$
$$\text{CostsWithLocalGrid} = \text{PurchasedElectricity} * \text{ElectricityPrice} + \text{SolarOpCosts} + \text{BiogasOpCosts} \tag{8}$$
$$K_4 = \text{CostsWithoutLocalGrid} - \text{CostsWithLocalGrid} \tag{9}$$