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# Baseline Emissions Inventory (BEI) elaboration within EMPOWERING project

## Webinar: SECAP Walkthrough Part 1

Empowering Local Public Authorities to Build Integrated Sustainable Energy Strategies

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Christos Tourkolias,  
Energy Policy Analysis DPT,  
Division of Energy Policy and Planning / CRES



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## BASELINE EMISSION INVENTORY

# Baseline Emission Inventory



- The Baseline Emission Inventory (BEI) quantifies **the amount of CO2 (and CO2 equivalent) emitted due to energy consumption** in the territory of the Covenant signatory.
- BEI allows the identification of the **principal sources of CO2 emissions and their respective reduction potentials**.
- BEI is the starting point for the **mitigation actions of your SECAP elaboration**, as it will provide **knowledge of the nature of the sectors emitting CO2** and will facilitate the **identification and prescription of the appropriate actions**.
- BEI should essentially be based on the **final energy consumption data**, i.e. what is consumed by the final end-users (incl. electricity, heat/cold and fuel) within the boundaries of the local authority.



# Methodology for the development of the Baseline Emission Inventory

Step 1: Specification of the baseline year

Step 2: Determination of the boundaries, scope and sectors

Step 3: Selection of the emissions factors

Step 4: Collection of the activity data & development of BEI

The proposed methodological approach can be utilized:

- I. **For the update of the existing BEI**, which were elaborated within the framework of Sustainable Energy Action Plans (SEAPs) for the Municipalities willing to update their SEAPs.
- II. **For the preparation of the new BEI** in accordance with the requirements of the framework of SECAPs for the Municipalities willing to commit to the Covenant of Mayors for the Climate and Energy.
- III. **For the development of the MEI**, which were developed within the framework of SEAPs.

# Methodology for the development of the Baseline Emission Inventory



- A **template** will be prepared in order to facilitate the collection of the **required activity data** and the **calculation of the figures for the estimation of the energy consumption** and the **triggered emissions**.
- **It is strongly recommended** to collect the actual energy consumption data (Option A)
- **When the collection of the actual energy consumption data is not feasible** it is suggested to estimate the required energy consumption data (Option B) under the prerequisite that the assumptions will comply with the requirements of the Covenant of Mayors.



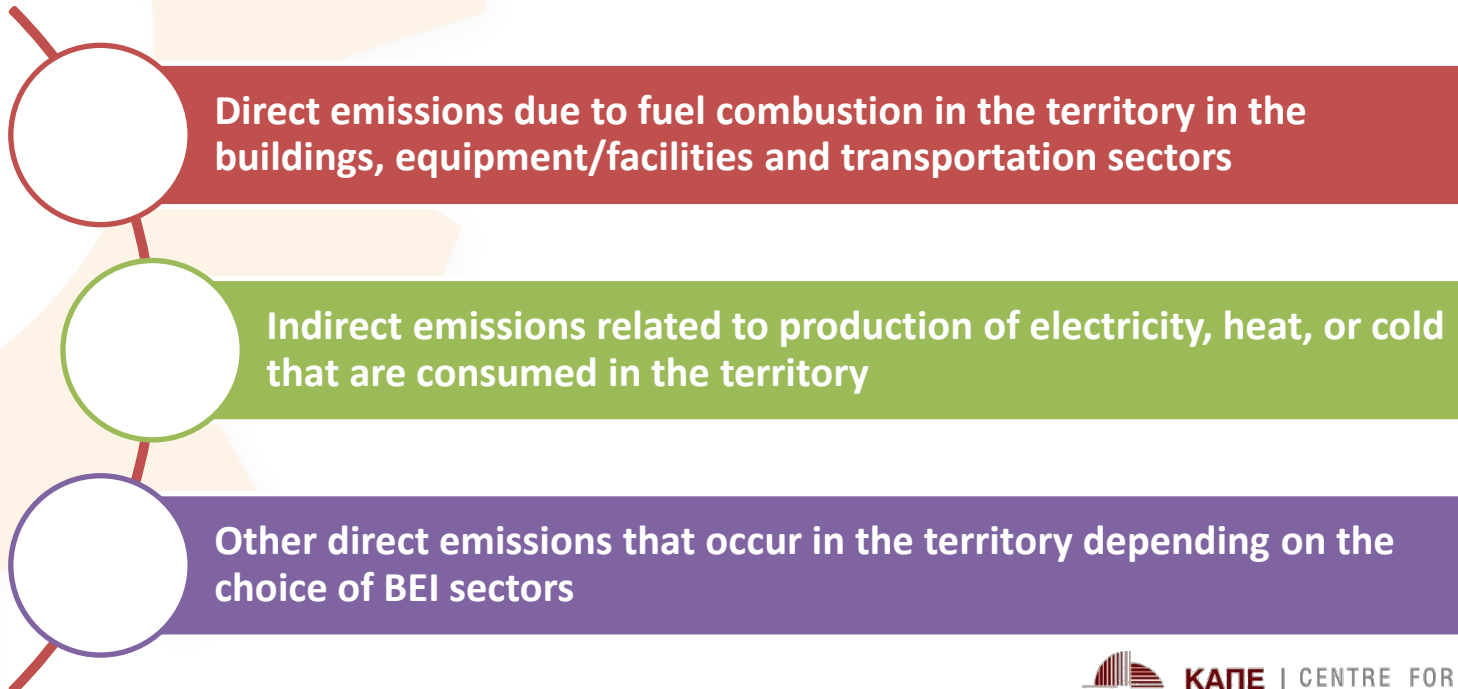
## Specification of the baseline year



- Baseline year is the year against which the **achievements of the emission reductions in 2030** shall be compared.
- **In the case that the local authority is not capable of compiling an inventory for 1990**, the closest subsequent year must be selected under the prerequisite that the most comprehensive and reliable data can be collected for all sectors included in the Baseline Emission Inventory.
- **For countries that are facing deep economic transitions**, it is recommended the selection of a recent year as a baseline year, which is representative for the current economic situation and for which reliable statistical data are available.
- **In case of the MEI**, the current year of monitoring has to be selected as baseline year. Furthermore, the calculation of CO<sub>2</sub> emissions reduction in MEI should follow the same approach as well as the same units should be used.

## Boundaries, scope and sectors

- The geographical boundaries of the BEI/MEI are the **administrative boundaries of the local authority**.
- The BEI (baseline CO2 inventory) will essentially be based **on final energy consumption**, including both municipal and non-municipal energy consumption in the local authority's territory.
- Other than **energy-related sources** may be included.



## Sectors included in BEI

Sector		Description
<b>Municipal buildings, equipment/facilities</b>		Buildings and facilities owned by the local authority. Facilities refer to energy consuming entities that are not buildings, such as wastewater treatment plants.
<b>Tertiary (non municipal) buildings, equipment/facilities</b>		Buildings and facilities of the tertiary sector (services), for example offices of private companies, banks, commercial and retail activities, hospitals, etc.
<b>Residential buildings</b>		Buildings that are primarily used as residential buildings. Social housing is included in this sector.
<b>Public lighting</b>		Public lighting owned or operated by the local authority (e.g. street lighting and traffic lights). Non-municipal public lighting is included in the sector of "Tertiary buildings, equipment/facilities".
<b>Industries</b>	<b>Non-ETS</b>	Refers to manufacturing and construction industries not covered in the EU Emissions Trading Scheme (EU-ETS).
	<b>ETS</b>	Refers to manufacturing and construction industries covered in the EU-ETS. Integrating them in your emission inventories is not recommended, unless such plants were included in previous energy plans and CO <sub>2</sub> emission inventories of the local authority.
<b>Others</b>		Buildings, facilities and machinery of the primary sector (agriculture, forestry and fisheries), for example greenhouses, livestock facilities, irrigation systems, farm machinery and fishing boats.



## Sectors included in BEI

Sub-sector	Description
<b>Municipal fleet</b>	Vehicles owned and used by the local authority's administration.
<b>Public transport</b>	Bus, tramway, metro, urban rail transportation and local ferries used for passenger transport.
<b>Private and commercial transport</b>	Road, rail and boat transport in the territory of the local authority which refer to the transport of persons and goods not specified above (e.g. private passenger cars and freight transport).

## Sectors included in BEI not related to energy consumption

Sector	Description
Waste management	Refers to emissions not related to energy consumption, such as CH <sub>4</sub> from landfills.
Wastewater management	Refers to emissions not related to energy consumption, such as CH <sub>4</sub> and N <sub>2</sub> O from wastewater treatment plants.
Other non-energy related	Refers to any other non-energy related sector. Negative numbers are allowed in this cell, in case you need to report emissions reduction achieved through e.g. green infrastructures (not recommended for achieving the minimum 20% reduction target and only if you have a specific methodology and data to measure all carbon stock change on the territory).

# Energy supply options

Energy supply options		Table
Municipal purchases of certified green electricity		B1
Local/distributed electricity production	Wind	B2
	Hydroelectric	
	Photovoltaics	
	Geothermal	
	Combined Heat & Power	B3
	Other	
Local heat/cold production	Combined Heat & Power	B4
	District heating (heat-only)	
	Other	



## EMISSIONS FACTORS

# Emissions Factors

## Standard' emission factors

- Taking into account the IPCC principles, which cover all the CO<sub>2</sub> emissions that occur due to energy consumption within the territory of the local authority, either directly due to fuel combustion within the local authority or indirectly via fuel combustion associated with electricity and heat/ cold usage within their area. The standard emission factors are based on the **carbon content of each fuel**, like in national greenhouse gas inventories in the context of the UNFCCC and the Kyoto protocol.

## LCA (Life Cycle Assessment) emission factors

- Taking into account the overall life cycle of the energy carrier. This approach includes not only the emissions of the final combustion, but also **all emissions of the supply chain**. It includes emissions from exploitation, transport and processing (e.g. refinery) steps in addition to the final combustion.

# Comparison of approaches for the selection of the emission factors

Advantages	Standard	LCA
Compatible with the national reporting to the UNFCCC	X	
Compatible with the monitoring of progress towards EU's 20-20-20 target	X	
Compatible with carbon footprint approaches		X
Compatible with the Ecodesign Directive (2005/32/EC) and Ecolabel Regulation		X
All emission factors needed easily available	X	
Reflects the total environmental impact also outside the place of use		X
Tools available for local inventories	X	X

- After the selection of the emission factor approach, **the local authority can either use default emission factors or choose other emission factors that are considered more appropriate.**

## Application of the emission factors

- CO<sub>2</sub> emissions have to be calculated for each energy carrier by **multiplying the energy consumption with the corresponding emission factors**.
- There is a **variety of emission factors**, depending on the energy sources and the selected approach:
  - The IPCC provides default emission factors, available from the 2006 IPCC Guidelines<sup>2</sup>. These default emission factors could be replaced by country specific emission factors. The Covenant signatories can also develop their own emission factors based on the detailed properties of the fuels used in their territory.
  - For the "LCA approach": the emissions factors are available from different sources or tools, such as the ELCD database, Ecoinvent-CH, GEMIS Software etc.

# Emissions factors for fossil fuel combustion

SECAP Template	Energy carriers Standard denomination	IPCC		LCA	
		t CO <sub>2</sub> /MWh	t CO <sub>2</sub> eq. /MWh	t CO <sub>2</sub> /MWh	t CO <sub>2</sub> eq. /MWh
Natural gas	Natural gas	0.202	0.202	0.221	0.237
Liquid gas	Liquefied Petroleum Gases	0.227	0.227	n.a.	n.a.
	Natural Gas Liquids	0.231	0.232	n.a.	n.a.
Heating Oil	Gas/Diesel oil	0.267	0.268	0.292	0.305
Diesel	Gas/Diesel oil	0.267	0.268 <sup>a)</sup>	0.292	0.305
Gasoline	Motor gasoline	0.249	0.250 <sup>a)</sup>	0.299	0.307
Lignite	Lignite	0.364	0.365	0.368	0.375
Coal	Anthracite	0.354	0.356	0.379	0.393
	Other Bituminous Coal	0.341	0.342	0.366	0.380
	Sub-Bituminous Coal	0.346	0.348	0.371	0.385
Other fossil fuels	Municipal waste (non-biomass fraction)	0.330	0.337	0.181	0.174
	Peat	0.382	0.383	0.386	0.392



# Emissions factors for RES

SECAP template	Energy carriers		Sustainability criteria <sup>a)</sup>	IPCC		LCA	
	Standard denomination			t CO <sub>2</sub> /MWh	t CO <sub>2</sub> eq. /MWh	t CO <sub>2</sub> /MWh	t CO <sub>2</sub> eq. /MWh
Plant oil	Other Liquid Biofuels	(s)	0	0.001	0.171	0.182	
		(ns)	0.287	0.302			
Biofuel	Biogasoline	(s)	0	0.001	0.194	0.206	
		(ns)	0.255	0.256			
	Biodiesels	(s)	0	0.001	0.147	0.156	
		(ns)	0.255	0.256			
Other biomass	Biogas	-	0.197	0.197	n.a.	n.a.	
	Municipal wastes (biomass fraction)	-	0	0.007	0.107	0.106	
	Wood	(s)	0	0.007	0.006	0.013	
		(ns)	0.403	0.410	0.409	0.416	
	Wood waste	-	0.403	0.410	0.193	0.184	
	Other primary solid biomass	-	0.360	0.367	n.a	n.a	

# Emissions factors for local RES electricity production

Technology	IPCC		LCA	
	t CO <sub>2</sub> /MWh	t CO <sub>2</sub> eq. /MWh	t CO <sub>2</sub> /MWh	t CO <sub>2</sub> eq. /MWh
Wind power	0	0	n.a.	0.020-0.050 <sup>a)</sup>
Hydroelectric power	0	0	n.a.	0.007
Photovoltaics	0	0	n.a.	0.024 <sup>b)</sup>

# Emission factors for electricity by country

Country	IPCC [t CO <sub>2</sub> /MWh] <sup>a, d)</sup>					
	2005	2006	2007	2008	2009	2010
Austria	0.226	0.212	0.202	0.206	0.200	0.204
Belgium	0.288	0.274	0.279	0.269	0.315	0.298
Bulgaria	0.772	0.762	0.880	0.855	0.827	0.823
Croatia	0.328	0.324	0.383	0.333	0.286	0.306
Cyprus	0.875	0.884	0.879	0.868	0.864	0.869
Czech Republic	0.964	0.938	1.012	0.915	0.920	0.935
Denmark	0.411	0.556	0.462	0.426	0.450	0.455
Estonia	0.981	0.868	1.050	0.875	0.766	0.826
Finland	0.182	0.255	0.233	0.201	0.209	0.212
France	0.061	0.054	0.056	0.053	0.057	0.056
Germany	0.619	0.621	0.645	0.626	0.609	0.616
Greece	1.207	1.131	1.178	1.125	1.104	1.126
Hungary	0.563	0.551	0.606	0.593	0.516	0.539
Ireland	0.769	0.726	0.727	0.736	0.702	0.716
Italy	0.491	0.494	0.493	0.484	0.453	0.467
Latvia	0.093	0.121	0.104	0.110	0.117	0.113
Lithuania	0.185	0.144	0.143	0.132	0.161	0.157
Luxembourg	0.428	0.419	0.373	0.320	0.405	0.397
Malta	0.966	1.030	1.048	1.054	1.072	1.052
Netherlands	0.430	0.416	0.427	0.429	0.473	0.452
Poland	1.262	1.243	1.186	1.123	1.141	1.165
Portugal	0.440	0.377	0.339	0.336	0.353	0.361
Romania	0.683	0.741	0.730	0.700	0.652	0.675
Slovak Republic	0.282	0.271	0.241	0.237	0.230	0.240
Slovenia	0.536	0.536	0.539	0.561	0.613	0.582
Spain	0.497	0.451	0.455	0.418	0.378	0.405
Sweden	0.019	0.021	0.023	0.024	0.027	0.025
United Kingdom	0.531	0.554	0.559	0.551	0.521	0.531

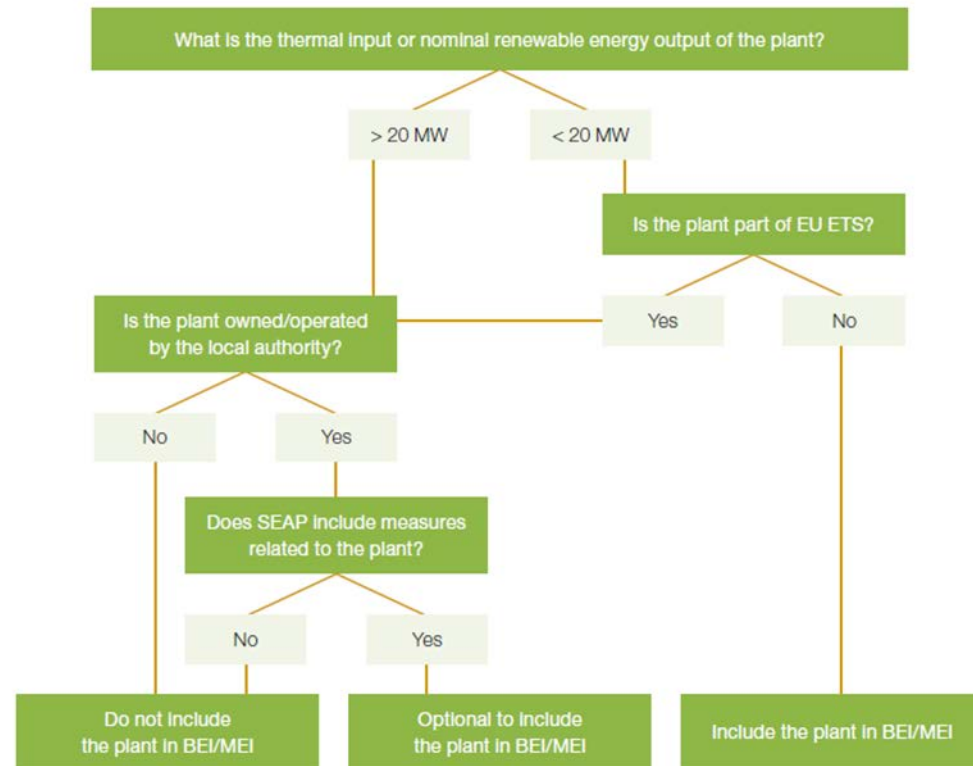
Country	LCA [t CO <sub>2</sub> eq./MWh] <sup>b)</sup>					
	2005	2006	2007	2008	2009	2010
Austria	0.346	0.315	0.294	0.301	0.294	0.301
Belgium	0.418	0.390	0.395	0.373	0.434	0.417
Bulgaria	0.856	0.845	0.971	0.943	0.915	0.910
Croatia	0.537	0.527	0.608	0.534	0.475	0.502
Cyprus	1.020	1.030	1.025	1.010	1.008	1.014
Czech Republic	0.819	0.795	0.855	0.770	0.771	0.786
Denmark	0.673	0.929	0.763	0.699	0.737	0.748
Estonia	1.726	1.528	1.849	1.540	1.322	1.434
Finland	0.345	0.499	0.457	0.383	0.406	0.412
France	0.157	0.141	0.146	0.139	0.148	0.147
Germany	0.709	0.707	0.729	0.707	0.678	0.692
Greece	1.223	1.152	1.195	1.143	1.122	1.144
Hungary	0.675	0.670	0.735	0.711	0.599	0.634
Ireland	0.908	0.862	0.865	0.877	0.838	0.854
Italy	0.721	0.725	0.723	0.710	0.661	0.683
Latvia	0.504	0.608	0.529	0.564	0.610	0.584
Lithuania	0.212	0.165	0.163	0.150	0.180	0.177
Luxembourg	0.699	0.682	0.604	0.514	0.652	0.641
Malta	1.565	1.669	1.697	1.707	1.737	1.705
Netherlands	0.705	0.682	0.709	0.708	0.776	0.743
Poland	1.262	1.241	1.182	1.115	1.125	1.153
Portugal	0.887	0.769	0.690	0.684	0.720	0.734
Romania	1.064	1.146	1.123	1.079	1.008	1.043
Slovak Republic	0.406	0.379	0.335	0.327	0.318	0.334
Slovenia	0.580	0.581	0.582	0.600	0.668	0.631
Spain	0.716	0.652	0.659	0.611	0.557	0.593
Sweden	0.074	0.075	0.076	0.082	0.087	0.083
United Kingdom	0.642	0.669	0.678	0.670	0.631	0.644



# LOCAL ELECTRICITY PRODUCTION

## Integration of local electricity production into BEI

- The local authority is able to include local electricity production into BEI in the case that the following criteria are fulfilled:
  - The **plant/unit are not be included in the European Emissions Trading Scheme (ETS)**.
  - The **plant/unit is below or equal to 20MW<sub>fuel</sub>** as thermal energy input in the case of fossil fuel and biomass combustion plants, or below or equal to 20MWe as nominal output in the case of other renewable energy plants (e.g. wind or solar).
- Assumption that smaller plants/units primarily satisfy the local electricity needs, whereas larger plants primarily produce electricity supplying the larger grid.



## Integration of local electricity production into BEI

- There is also the option to **categorize production units with similar characteristics** such as in the case of solar photovoltaic installations (PVs) or combined heat and power plants (CHPs).
- **Waste incineration plants for electricity production** can be treated similarly to any **other power plants**.
- The **emissions from local electricity production** are estimated, in the case of plants combusting fuel, by using the respective emission factors.
- Instead of purchasing the 'mixed' electricity from the grid, the **local authority can decide to purchase certified green electricity**. Nevertheless, only electricity that fulfils the criteria for guarantee of origin of electricity produced from renewable energy sources set in the Directive 2001/77/EC and updated in the Directive 2009/28/EC can be considered as green electricity.
- The local authority must **report the purchased green electricity** under the corresponding section of the SECAP template.
- In the case that **the standard emission factors are selected, the emission factor for certified green electricity is zero**.

## Integration of local electricity production into BEI



- If the LCA emission factors are used, the local authority has to estimate the LCA emissions of the green electricity purchases (CO<sub>2</sub>GEP) either **by requesting required information from the power provider or by utilizing the default factors provided for local renewable electricity generation.**
- Moreover, there is the possibility the other actors in the local authority's territory to purchase green electricity. Due to the facts that it may be difficult to obtain data about these quantities and the green electricity purchases reduce emissions only in the case that electricity production by fossil fuels is actually replaced by production from new renewable electricity installations, **it is recommended the green electricity purchases of other actors (companies, consumers, institutions, etc.) in the local authority's territory not to be accounted for the calculation of the local electricity emission factor.**
- It should be noted that the increase in local renewable energy production, or the improvements of efficiency in the local energy generation, can be **counted only if the primary aim of these measure is the reduction of the final energy consumption.**



# Calculation of the local emission factor for electricity

- The calculation of the local emission factor for electricity can be performed using the following equation:

- $$EF_E = [(TC_E - LP_E - GEP) \cdot NEEF_E + CO2_{LPE} + CO2_{GEP}] / (TC_E)$$

- $EF_E$  = local emission factor for electricity [t/MWhe]
- $TC_E$  = total electricity consumption in the local authority [MWhe]
- $LP_E$  = local electricity production [MWhe]
- $GEP$  = green electricity purchases by the local authority [MWhe]
- $NEEF_E$  = national or European emission factor for electricity [t/MWhe]
- $CO2_{LPE}$  =  $CO_2$  emissions due to the local production of electricity (as per table C of the template) [t]
- $CO2_{GEP}$  =  $CO_2$  emissions due to the production of certified green electricity purchased by the local authority [t]
- In the case that the local authority is a net exporter of electricity, the following equation can be used:

- $$EFE = (CO2_{LPE} + CO2_{GEP}) / (LPE + GEP)$$





## Calculation of the local emission factor for heat or cold

- The establishment of emission factors for is required the quantities of **heat or cold** that is sold or distributed to end users within the territory of the local authority.
- Firstly, the identification of these plants and units must be occurred with the corresponding quantities of locally generated heat, energy inputs, and corresponding emissions.
- Moreover, there is the **option to categorize production units with similar characteristics** such as in the case of CHPs.
- **Waste incineration plants** for heat production can be treated similarly to any **other power plants**.
- It should be mentioned that the **locally produced heat and cold by end-users for their own usage is included** in the table for final energy consumption.
- In the case that a **portion of the heat/cold, which is produced in the local authority's territory, is exported**, the corresponding share of CO<sub>2</sub> emissions should be deducted during the calculation of the emission factor for heat/cold production.
- In the case that a **portion of the heat/cold, which is consumed in the local authority's territory, is imported**, the corresponding share of CO<sub>2</sub> emissions should be taken into consideration during the calculation of the emission factor for heat/cold production.

## Calculation of the local emission factor for heat or cold

- The calculation of the local emission factor for heat can be performed using the following equation:
  - $EF_H = (CO_{2LPH} + CO_{2IH} - CO_{2EH})/LHC$ 
    - $EF_H$  = emission factor for heat [t/MWh<sub>heat</sub>]
    - $CO_{2LPH}$  = CO<sub>2</sub> emissions due to the local production of heat [t]
    - $CO_{2IH}$  = CO<sub>2</sub> emissions related to any imported heat from outside the territory of the local authority [t]
    - $CO_{2EH}$  = CO<sub>2</sub> emissions related to any heat that is exported outside of the territory of the local authority [t]
    - LHC = local heat consumption [MWh<sub>heat</sub>]
- A similar equation can be utilized for the case of may apply for cold.
- District cooling can be handled similarly as the purchased district heating taking into account that a larger variety of production methods exist.
- It is recommended to contact the district cooling provider so as to obtain for information for the utilized fuels or the consumed electricity for cooling provision.

## CHP

- The allocation of fuel use and emissions can be performed using the following equations:

- $$CO2_{CHPH} = \frac{\frac{P_{CHPH}}{\eta_h}}{\frac{P_{CHPH}}{\eta_h} + \frac{P_{CHPE}}{\eta_e}} \cdot CO2_{CHPT}$$

- $$CO_{2CHPE} = CO_{2CHPT} - CO_{2CHPH}$$

- $CO_{2CHPH}$  =  $CO_2$  emissions from heat production [t  $CO_2$ ]
- $CO_{2CHPE}$  =  $CO_2$  emissions from electricity production [t  $CO_2$ ]
- $CO_{2CHPT}$  = total  $CO_2$  emissions of the CHP plant calculated based on fuel consumption and fuel-specific emission factors [t  $CO_2$ ]
- $P_{CHPH}$  = Amount of heat produced [ $MWh_{heat}$ ]
- $P_{CHPE}$  = Amount of electricity produced [ $MWh_e$ ]
- $\eta_h$  = Typical efficiency of separate heat production (recommended value 90%).
- $\eta_e$  = Typical efficiency of separate electricity production (recommended value 40%).

# ACTIVITY DATA COLLECTION

## Activity data collection - General guidelines



- The data should be **relevant to the particular situation of the local authority**.
- The **data collection methodology should be consistent** through the years.
- The data should **cover at least all sectors in which the local authority intends to take action**, so that the result of those actions can be reflected in the inventory.
- The **sources of data used should be available in the future**.
- Within the limits of possibility, the **data should be accurate, or at least represent a vision of the reality**.
- The **collection process and data sources should be well documented and publicly available**, so that the BEI elaboration process is made transparent and stakeholders can be confident with the inventory.



# Information about the energy carriers



Energy carrier	Information
Electricity	Refers to the total electricity consumed by end-users, whatever the production source is. If the local authority is purchasing certified green electricity, please complete also the cell below the table. In the LCA approach, also the corresponding emission factor needs to be specified.
Certified green electricity	Refers to electricity produced from renewable energy sources covered by Guarantee of origins as per Article 5 of Directive 2001/77/EC, Article 15 of Directive 2009/28/EC and Article 3 (6) of Directive 2003/54/EC.
Heat/cold	Refers to heat/cold that is supplied as a commodity to end-users within the territory (for example from district heating/cooling system, a CHP plant or waste heat recovery). Heating produced by end-users for their own use should not be included, but under the columns of the energy carriers that produce the heat (fossil fuels or renewable energies). With the exception of CHP heat: as a CHP unit also generates electricity, it is preferable to include it under production, especially if it concerns large units.
Fossil fuels	Refers to all fossil fuels consumed as a commodity by final end-users. It includes all fossil fuels bought by end-users for space heating, sanitary water heating, or cooking purposes. It also includes fuels consumed for transportation purposes, or as an input in industrial combustion processes.
Renewable energies	Refers to all plant oil, biofuels, other biomass (e.g wood), solar thermal and geothermal energy consumed as a commodity by final end-users. If peat is consumed within the local authority, it should be accounted for in the 'other fossil fuel' column (even if it is not strictly speaking a fossil fuel).



# Final energy consumption

BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES
Municipal buildings, equipment/facilities
Tertiary (non municipal) buildings, equipment/facilities
Residential buildings
Public lighting
Industry Non-ETS
Industry ETS (not recommended)
TRANSPORT
Municipal fleet
Public transport
Private and commercial transport
OTHER
Agriculture, Forestry, Fisheries



ENERGY PRODUCTION (MWh)	
Electricity	Electricity
Heat/cold	Heat/cold
Fossil fuels	Natural gas
	Liquid gas
	Heating oil
	Diesel
	Gasoline
	Lignite
	Coal
	Other fossil fuels
Renewable energies	Plant oil
	Biofuel
	Other biomass
	Solar thermal
	Geothermal

# Activity data collection - Buildings, equipment/facilities and industries



## Municipal buildings & equipment/facilities

- The local authority should be able to collect accurate and comprehensive energy consumption data related to its own buildings and facilities

## Municipal public lighting

- The local authority should be able to collect all data regarding municipal public lighting

## Other buildings & facilities

- Get data from the market operators
- Get data from other entities
- Inquiries addressed to energy consumers via questionnaires and surveys
- Make estimates







## **Indicative activity data collection procedure for municipal buildings & equipment/facilities**

## Indicative activity data collection procedure for municipal buildings & equipment/facilities



- **Identify all buildings and facilities** owned/managed by the local authority.
- Within those buildings and facilities, **identify all energy delivery points** (electricity, natural gas, heat from heating district network, fuel oil tanks, ...).
- For all those energy delivery points, **identify the person/department receiving the invoices and energy data**.
- Organize a **centralized collection of these documents/data**.
- Select an **appropriate system to store and manage the data** (could be a simple Excel sheet or a more elaborate software, available commercially).
- Make sure the data are **collected and introduced in the system at least every year**. Tele measurement is possible and can ease the process of data collection.
- For the case of the **heating fuel oil** or other energy carriers delivered periodically as bulk, it is suggested the **installation of a measurement device** (such as gauge, meter, etc.). Alternative, **the assumption that the purchased fuel on annual basis is equal to the consumed fuel may be utilized**.
- The quantity of the green electricity can to be derived from the **supplier's invoices**, which indicate the origin of the electricity.



# Indicative activity data collection procedure for municipal buildings & equipment/facilities

- Option A: Actual energy consumption data

Energy carrier		Energy	Unit	Unit
Electricity			MWh	Potential
Heat/cold			MWh	utilization of
Fossil fuels	Natural gas		m3	heating
	Liquid gas		tn	values when
	Heating oil		tn	it is required
	Diesel		tn	
	Gasoline		tn	
	Lignite		tn	
	Coal		tn	
	Other fossil fuels		tn	
	Plant oil		tn	
	Biofuel		tn	
	Other biomass		tn	
	Solar thermal		MWh	
RES	Geothermal		MWh	

# Indicative activity data collection procedure for municipal buildings & equipment/facilities



- **Option B: Estimated energy consumption data**



- **Step 1:** Identification of typical categories of municipal buildings and specification of the main characteristics of each category of municipal buildings (such as average area expresses in m<sup>2</sup>) including the number of buildings
- **Step 2:** Identification of the unitary thermal and electricity consumption of these typical categories of buildings (expressed in MWh/m<sup>2</sup>)
- **Step 3:** Allocation of thermal energy to the various energy carriers
- **Step 4:** Calculation of the final energy consumption for the different energy carriers according to their analysis.

## Indicative activity data collection procedure for municipal public lighting

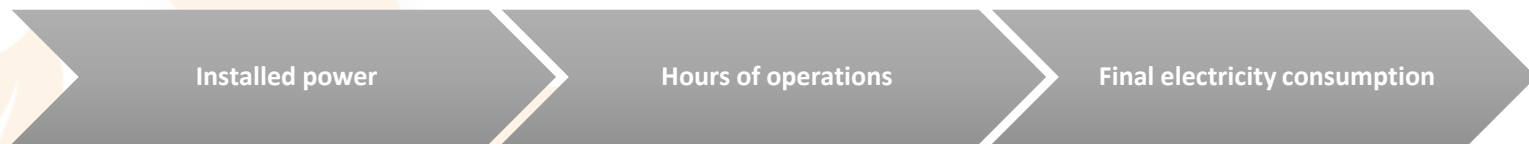


- The local authority **must collect the actual energy consumption data** regarding municipal public lighting (Option A: Actual energy consumption data).
- The **installation of additional meters** is suggested in order to improve the energy data collection especially for cases that an electricity supply point feeds both public lighting and building/facilities.
- **Option A: Actual energy consumption data**

<i>Energy carrier</i>	Energy	Unit
<b><i>Electricity</i></b>		<b>MWh</b>

# Indicative activity data collection procedure for municipal public lighting

- **Option B: Estimated energy consumption data**



- **Step 1:** Identification of the total installed power for the different categories of public lighting expressed in MW.
- **Step 2:** Identification of the total hours of operation for the different categories of public lighting expressed in hours.
- **Step 3:** Calculation of final electricity consumption

## Indicative activity data collection procedure for other buildings & facilities



- Primary, it is recommended to collect **the actual energy consumption data** from the other buildings and facilities (Option A: Actual energy consumption data).
- These sectors include:
  - Tertiary (non-municipal) buildings, equipment/facilities.
  - Residential buildings.
  - Industries (optional, excluding industry part of EU Emission trading scheme).
- The proposed options include:
  - Collection of the required data from the **market operators**.
  - Collection of the required data from other **entities at regional and national level** (such as indicatively from statistical, energy, environmental, or economic ministries or agencies, supporting structures of the Covenant of Mayors, or from regulatory authorities for gas and electricity).
  - **Surveys addressed to energy consumers** especially for energy carriers which do not be distributed through a centralized grid (fuel oil, wood, natural gas supplied in bulk, etc).
  - **Estimations extrapolating to the entire sector using statistical data** related to the territory of the local authority derived from the collected data.



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## Indicative activity data collection procedure for other buildings & facilities



- For the case of the acquisition of the required data, it is recommended the **preparation of a table** in order to facilitate the collection of the activity data from the targeted entities.
- It should be noted that these data are generally considered as **commercially sensitive** and it is suggested collecting them in the appropriate disaggregation.
- Considering the NACE code, it is required dexterous manipulation of the collected data so as to ensure the **appropriate allocation of the data from the various economic activities** to the targeted sectors.
- Furthermore, various data can be **collected by the corresponding Ministry**, which deals with energy issues exploiting the obligation of the energy market operators to provide on request, but not more than once a year, aggregated statistical information on their final customers in compliance with the requirements of the Directive 2006/32/EC on energy end-use efficiency and energy services (Article 6).
- For sectors with a **large number of small consumers** (such as residential sector), it is recommended to conduct a **survey to a representative sample of the population of the local authority**.





## Indicative activity data collection procedure for other buildings & facilities



- For sectors with a **limited number of consumers** (such as in industrial sector), it is recommended to conduct a **survey with the participation of all energy consumers**.
- For sectors with a **great number of different types of consumers** (such as in tertiary sector), it is recommended to conduct a **survey at least to all large categories** (e.g. all supermarkets, hospitals, universities, housing companies, large office buildings, etc).
- The identification of these categories of consumers can be implemented through knowledge, statistical or commercial data or inquiry to the grid operators.
- Regarding the estimations through the extrapolation of the collected data it is crucial to ensure that the **collected data and the extrapolation method provide results that are statistically meaningful**.
- It should be noted that in the case that the **energy consumption data cannot be disaggregated between individual sectors** it is recommended to report the total consumption in the template and do not fill in the data at the sectoral level.
- Furthermore, if there is no the capability to distinguish the municipal consumption from other usages, it is suggested to **subtract the municipal usage from the overall energy consumption of each sector and report each of them in the relevant section of the template** in order to avoid the double counting.



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# Indicative activity data collection procedure for other buildings & facilities

- Option A: Actual energy consumption data

Energy carrier		Energy	Unit	Potential utilization of heating values when it is required	Unit
<b>Electricity</b>			MWh		MWh
			MWh		MWh
<b>Heat/cold</b>	Natural gas		m3		MWh
	Liquid gas		tn		MWh
	Heating oil		tn		MWh
	Diesel		tn		MWh
	Gasoline		tn		MWh
	Lignite		tn		MWh
	Coal		tn		MWh
	Other fossil fuels		tn		MWh
	Plant oil		tn		MWh
	Biofuel		tn		MWh
	Other biomass		tn		MWh
	Solar thermal		MWh		MWh
	Geothermal		MWh		MWh

Fossil fuels

RES

# Indicative activity data collection procedure for other buildings & facilities



- **Option B: Estimated energy consumption data for residential buildings**



- **Step 1:** Identification of typical categories of households and specification of the main characteristics of each category of households (such as average area expresses in  $m^2$ ) including the number of households
- **Step 2:** Identification of the unitary thermal and electricity consumption of these typical categories of households (expressed in MWh/ $m^2$  or MWh/household)
- **Step 3:** Allocation of thermal energy to the various energy carriers
- **Step 4:** Calculation of the final energy consumption for the different energy carriers according to their analysis.



# Indicative activity data collection procedure for other buildings & facilities



- **Option B: Estimated energy consumption data for buildings of the tertiary sector**



**Step 1:** Identification of typical categories of buildings and specification of the main characteristics of each category of buildings (such as average area in m<sup>2</sup> or number of employees or number of beds (for hotels and hospitals)) including the number buildings

**Step 2:** Identification of the unitary thermal and electricity consumption of these typical categories of buildings (expressed in MWh/m<sup>2</sup> or MWh/employee or MWh/bed)

**Step 3:** Allocation of thermal energy to the various energy carriers

**Step 4:** Calculation of the final energy consumption for the different energy carriers according to their analysis.

# Indicative activity data collection procedure for other buildings & facilities



- **Option B: Estimated energy consumption data for industrial units**



**Step 1:** Identification of typical categories of industrial units and specification of the main characteristics of each category of industrial units (such as average GVA in mil. € or total production in tn) including the number of the industrial units

**Step 2:** Identification of the unitary thermal and electricity consumption of these typical categories of industrial units (expressed in MWh/GVA or MWh/tn)

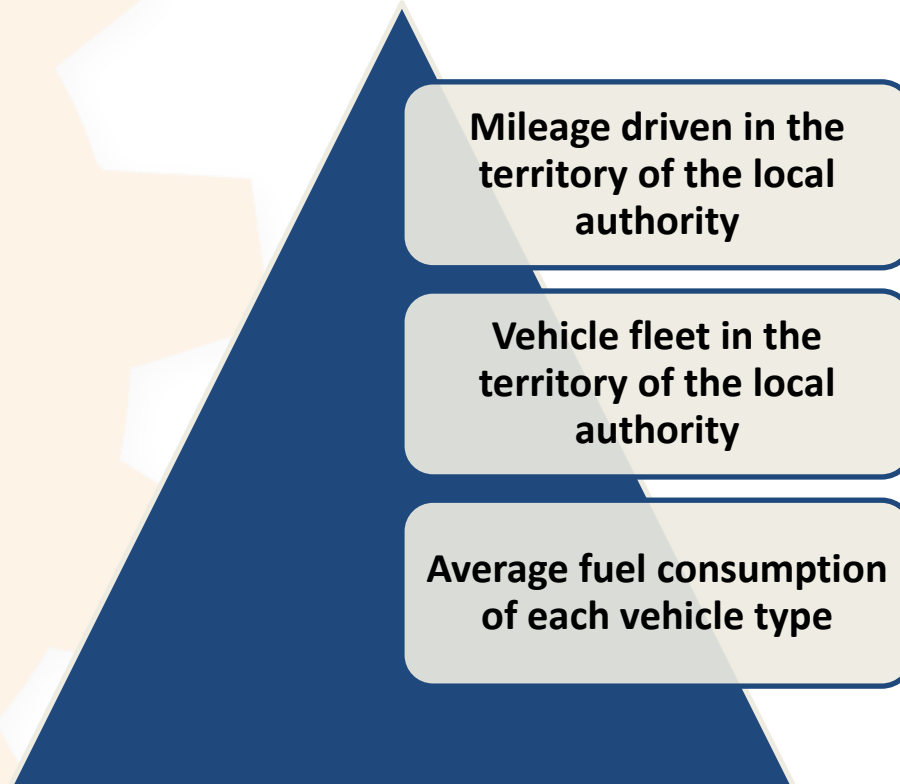
**Step 3:** Allocation of thermal energy to the various energy carriers

**Step 4:** Calculation of the final energy consumption for the different energy carriers according to their analysis.



## Activity data collection - Road & rail transportation

# Activity data collection - Road & rail transportation



# Indicative activity data collection procedure for road transportation



- Road transportation in the local authority's territory consists of:
  - Urban road transportation** including road transportation on the local street network, which is in the competence of the local authority.
  - Other road transportation** including road transportation, which is not in the competence of the local authority.
- It is recommended the inclusion of the urban road transportation into the BEI collecting **the actual energy consumption data** (Option A: Actual energy consumption data).
- Due to the fact that the collection of the actual energy consumption data is not always feasible especially for the case of the road transport that is not in the competence of the local authority, the estimation of the energy consumption can be based on specific assumptions (Option B: Estimated energy consumption data).

Energy carrier		Energy	Unit		Unit
Electricity			MWh	Potential utilization of heating values or fuel densities when it is required	MWh
	Natural gas		m3		MWh
	Liquid gas		tn		MWh
	Diesel		tn		MWh
	Gasoline		tn		MWh
	Biofuel		tn		MWh
Fossil fuels					
RES					



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## Indicative activity data collection procedure for road transportation



- The **mileage driven**, expressed in km, on the street network of the local authority can be estimated exploiting information about traffic flows and length of the street network.
- Firstly, it is recommended to identify the required information from the following data sources:
  - The **transport department of the local authority** providing information about the estimated vehicle flows and mileage driven for transport planning purposes.
  - **National or local street administration** providing information from the conduction of surveys in order to identify the numbers of vehicles passing fixed points, the number of vehicles for different categories, the consumed fuels etc.
  - **Surveys to households** about the coverage of their needs for transportation.
  - **Specialized databases with mobility data.**
- For the case of the local authority's own fleet and public transportation fleet the mileage driven must be derived directly by the **odometers of the vehicles** on annual basis.
- For the case of contracted services for public transport or other services, the information can be derived by from the **operator of the specific services.**



# Indicative activity data collection procedure for road transportation



- The **vehicle fleet distribution**, expressed in number of vehicles, depicts the share of each vehicle type of the identified mileage according to the utilized fuel.
- The fleet distribution must consists of at least:
  - Passenger cars and taxis
  - Heavy and light-duty vehicles
  - Buses and other vehicles used for public transport
  - Services
  - Two-wheelers
- The required data about fleet distribution can be collected by the following data sources:
  - **Traffic flows**
  - **Vehicles registered in the municipality**
  - **National statistics**
  - **Eurostat statistics at national or regional level**
  - **Specialized databases and tools**
- The potential adjustment of the data may be required in order to increase the accuracy of the estimates.



## Indicative activity data collection procedure for road transportation



- **Average fuel consumption**, expressed in lt/km, of each vehicle category depends on various characteristics such as the utilized fuels, the cubism, the age, the driving cycle etc.
- It is recommended to estimate the average fuel consumption of vehicles driving on the street network based on **surveys, derived data from inspection agencies, information on vehicles registered in the municipality or in the region and data obtained from auto clubs and national transport associations.**
- The utilization of the national level average fuel consumption for each vehicle category may lead to biased estimations especially for the case of urban areas. In any case the **average fuel consumption in the local authority's territory must be representative with the corresponding figure at national level** so as to avoid the problem of inaccuracy during the calculations.
- Especially for the case of electric or hybrid vehicles it is suggested **the detailed estimation of the energy consumption data** avoiding the use of national or European average fuel consumption figures.



# Indicative activity data collection procedure for rail transportation

- The **abovementioned methods for road transportation can be utilized also** for the quantification of the energy consumption and the corresponding emissions in rail transportation.
- Mainly, two different types of rail transportation can be identify comprising by electricity and diesel locomotives. The local authority is recommended to collect **actual data about the annual electricity and fuel use directly from the service providers** (Option A: Actual energy consumption data).
- In the case that the required actual data are not available, it is recommended to estimate the energy consumption according to the mileage travelled and average electricity or fuel consumption.

Energy carrier		Energy	Unit		Unit
Electricity			MWh	Potential	MWh
	Diesel		tn	utilization	MWh
	Lignite		tn	of heating	MWh
	Coal		tn	values or	MWh
	Other fossil fuels		tn	fuel densities	MWh
	Biofuel		tn	when it is required	MWh

# Activity data collection - Remaining activities

- Direct contact with the plant managers

**Local heat/cold production**



- Direct contact with the plant managers
- Questionnaires or statistics

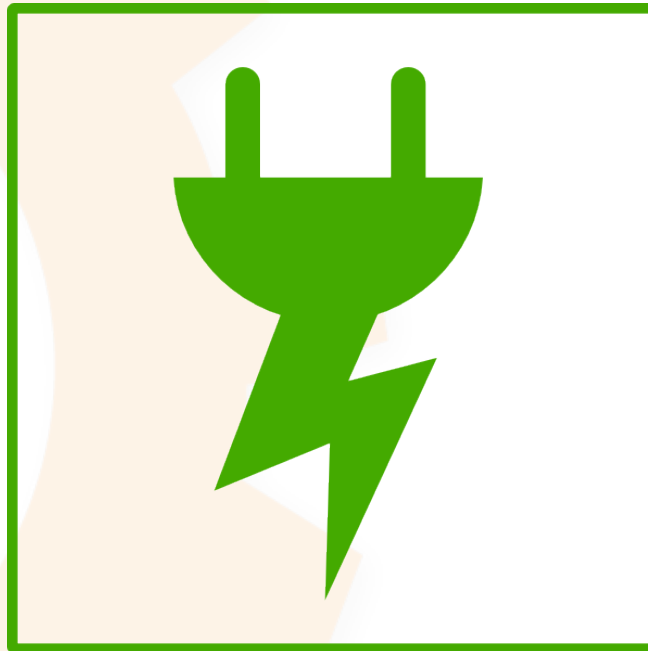
**Local electricity production**



- Methodologies developed by specialized organizations

**Other sectors**





Energy supply

# Energy supply

<b>Municipal purchases of certified green electricity</b>	Renewable electricity purchased (MWh)
<b>Local/distributed electricity production (Renewable energy only)</b>	Renewable electricity produced from wind (MWh)
	Renewable electricity produced from hydroelectric (MWh)
	Renewable electricity produced from photovoltaics (MWh)
	Renewable electricity produced from geothermal (MWh)

**Local electricity production plants (ETS and large-scale plants > 20 MW not recommended)**

**Local heat/cold production plants**



<b>Electricity produced [MWh]</b>	From renewable sources From non-renewable sources
<b>Energy carrier input [MWh]</b>	Fossil fuels-Natural gas
	Fossil fuels-Liquid gas
	Fossil fuels-Heating oil
	Fossil fuels-Lignite
	Fossil fuels-Coal
	Waste
	Plant oil
	Other biomass
	Other renewable
	Other

## Indicative activity data collection procedure for local electricity production



- The local authorities must identify the local electricity production plants and to collect **the required actual data for the estimation of the produced energy** (Option A: Actual energy consumption data).
- For larger plants (such as CHPs), the data should be obtained via **direct contact with the plant managers**.
- For smaller units (domestic PV installations), the data can either be obtained through **questionnaires or derived from statistics related to the amount of installations present in the territory of the local authority** (such as indicatively number of permits delivered if such installations require a permit, number of subsidies granted or regional/national statistics with a sufficient level of disaggregation etc.).
- Moreover, data about the entities that provide electricity to the grid can be collected **by market operators**.
- **Avoid double counting** denoting the emissions in other sector.

Energy carrier	Energy	Unit
Electricity		MWh



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## Indicative activity data collection procedure for local heat/cold production



- The local authorities must identify the local heat/cold production plants and to collect **the required actual data for the estimation of the produced energy** (Option A: Actual energy consumption data).
- The data should be obtained via **direct contact (or questionnaires) with the plant managers**, as mostly large units will be listed here.
- **Avoid double counting** denoting the emissions in other sector.

<i>Energy carrier</i>	Energy	Unit
<i>Heat/cold</i>		MWh





**SECAP template**

# SECAP template

## Baseline Emission Inventory

1) Inventory year

[drop-down]

2) Number of inhabitants in the inventory year

3) Emission factors

☐

IPCC

☐

LCA (Life Cycle Assessment)

4) Emission reporting unit

☐

tonnes CO<sub>2</sub>

☐

tonnes CO<sub>2</sub> equivalent

# SECAP template - Final Energy Consumption



Sector	FINAL ENERGY CONSUMPTION [MWh]															
	Electricity	Heat/cold	Fossil fuels								Renewable energies					Total
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
Municipal buildings, equipment/facilities																0
Tertiary (non municipal) buildings, equipment/facilities																0
Residential buildings																0
Public lighting																0
Industry	Non-ETS															0
	ETS (not recommended)															0
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRANSPORT																
Municipal fleet																0
Public transport																0
Private and commercial transport																0
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER																
Agriculture, Forestry, Fisheries																0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



# SECAP template - Energy Supply

## B1. Municipal purchases of certified green electricity

Municipal purchases of certified green electricity	Renewable electricity purchased [MWh]	CO <sub>2</sub> / CO <sub>2</sub> eq. Emission factor [t/MWh]
<u>Certified green electricity purchased</u>		

## B2. Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]	Emission factor [t/MWh produced]	CO <sub>2</sub> / CO <sub>2</sub> eq. emissions [t]
Wind			0
Hydroelectric			0
Photovoltaics			0
Geothermal			0
<b>TOTAL</b>	<b>0</b>		<b>0</b>

## B3. Local/distributed electricity production

Local electricity production plants (ETS and large-scale plants > 20 MW not recommended)	Electricity produced [MWh]		Energy carrier input [MWh]										CO <sub>2</sub> / CO <sub>2</sub> eq. emissions [t]	
			Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	Other		
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal						Fossil sources	Renewable sources
Combined Heat and Power														
Other														
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0

## B4. Local heat/cold production

Local heat/cold production plants	Heat/cold produced [MWh]		Energy carrier input [MWh]										CO <sub>2</sub> / CO <sub>2</sub> eq. emissions [t]	
			Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	Other		
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal						Fossil sources	Renewable sources
Combined Heat and Power														
District heating (heat-only)														
Other														
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0

# SECAP template - CO2 emissions



Electricity		Heat/cold	Fossil fuels								Renewable energies				
<u>National</u>	<u>Local</u>		Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil	Biofuel	Plant oil	Other biomass	Solar thermal	Geothermal

Non-energy related sectors	CO <sub>2</sub> eq. emissions [t]
<u>Waste management</u>	
<u>Waste water management</u>	
<u>Other non-energy related</u>	



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# SECAP template - Emission inventory

Sector		CO <sub>2</sub> emissions [t] / CO <sub>2</sub> eq. emissions [t]															
		Electricity	Heat/cold	Fossil fuels								Renewable energies					Total
				Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel	Plant oil	Other biomass	Solar thermal	Geothermal	
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																	
Municipal buildings, equipment/facilities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tertiary (non municipal) buildings, equipment/facilities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential buildings		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public lighting		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry	Non-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRANSPORT																	
Municipal fleet		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public transport		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Private and commercial transport		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER																	
Agriculture, Forestry, Fisheries		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER NON-ENERGY RELATED																	
Waste management																	0
Waste water management																	0
Other non-energy related																	0
TOTAL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



***Thank you for your attention.....***