# WORKSHOP: Technical training on how to set Targets for the Global Covenant

**The European Commission's science and knowledge service**

Joint Research Centre

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# Development of scenarios for CO2 emissions

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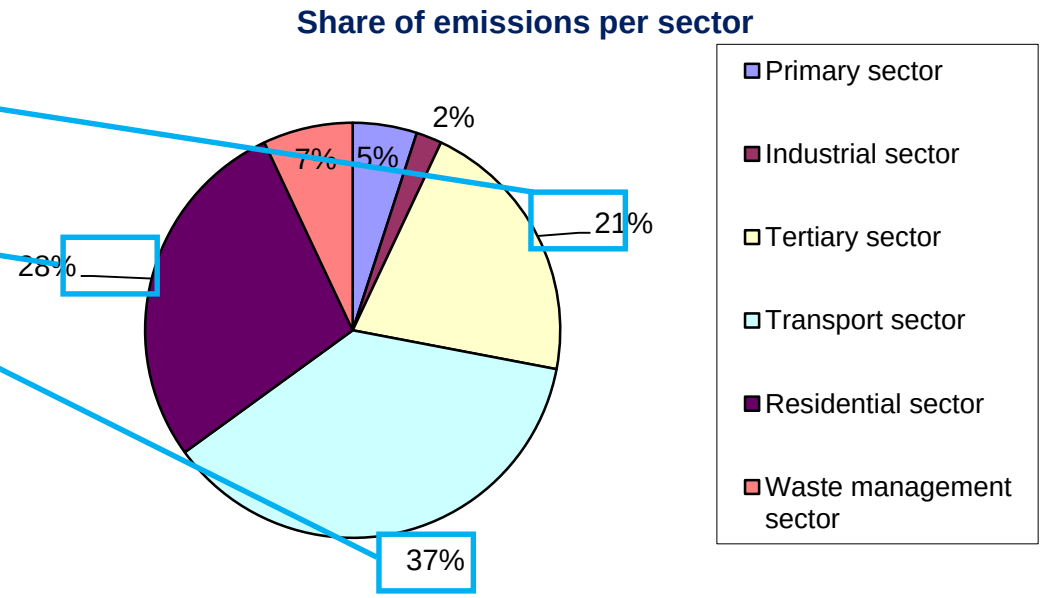
European Commission

# CoM Emission Inventory: Main principles

***BEI*** quantifies the amount of $CO_2$ emitted due to final energy consumption in given activity sectors on the municipality's territory within a calendar year and it helps to select the appropriate actions.

**Three sectors represent 86% of the emissions of the city**



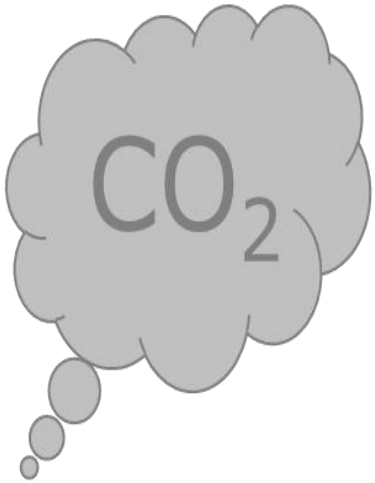

**Example: Castelldefelds (Spain)**

# CoM Emission Inventory: Main principles

- Emission Inventories as a **tool** to support the deployment and monitoring of local energy and climate policies;
- **Bottom-up approach** in activity data collection;
- **Simplicity and flexibility:** the approach can be adapted to the specific situation of local authorities (city size, level of expertise, political mandate, etc.);
- Main focus on **$CO_2$** emissions associated with local **energy consumption;**
- **Four key sectors** to be accounted for in the BEI and targeted by SE(C)AP measures:
  - Municipal buildings & public lighting
  - Residential buildings
  - Tertiary buildings
  - Transport

# Bottom-Up *versus* Top-Down approach

- Ideally a full **Bottom-Up** approach should be followed
- **Top-Down** approaches might not give an accurate picture of the municipality




**Will the Monitoring Emission Inventories capture the results of local actions?**





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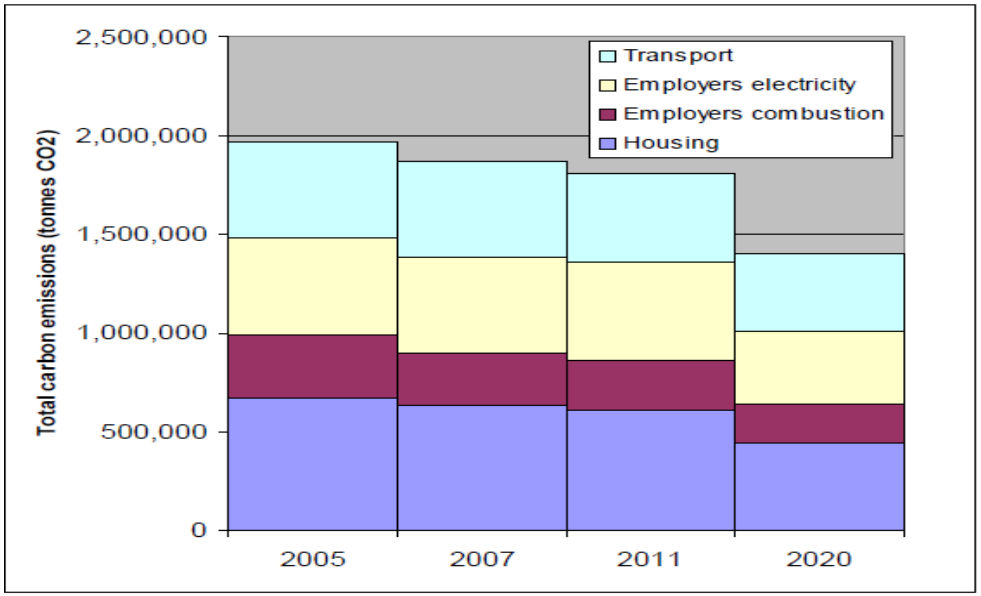
The BEI shows where the local authority is at the beginning of the planning process, and the successive monitoring inventories will show the progress towards the objective.

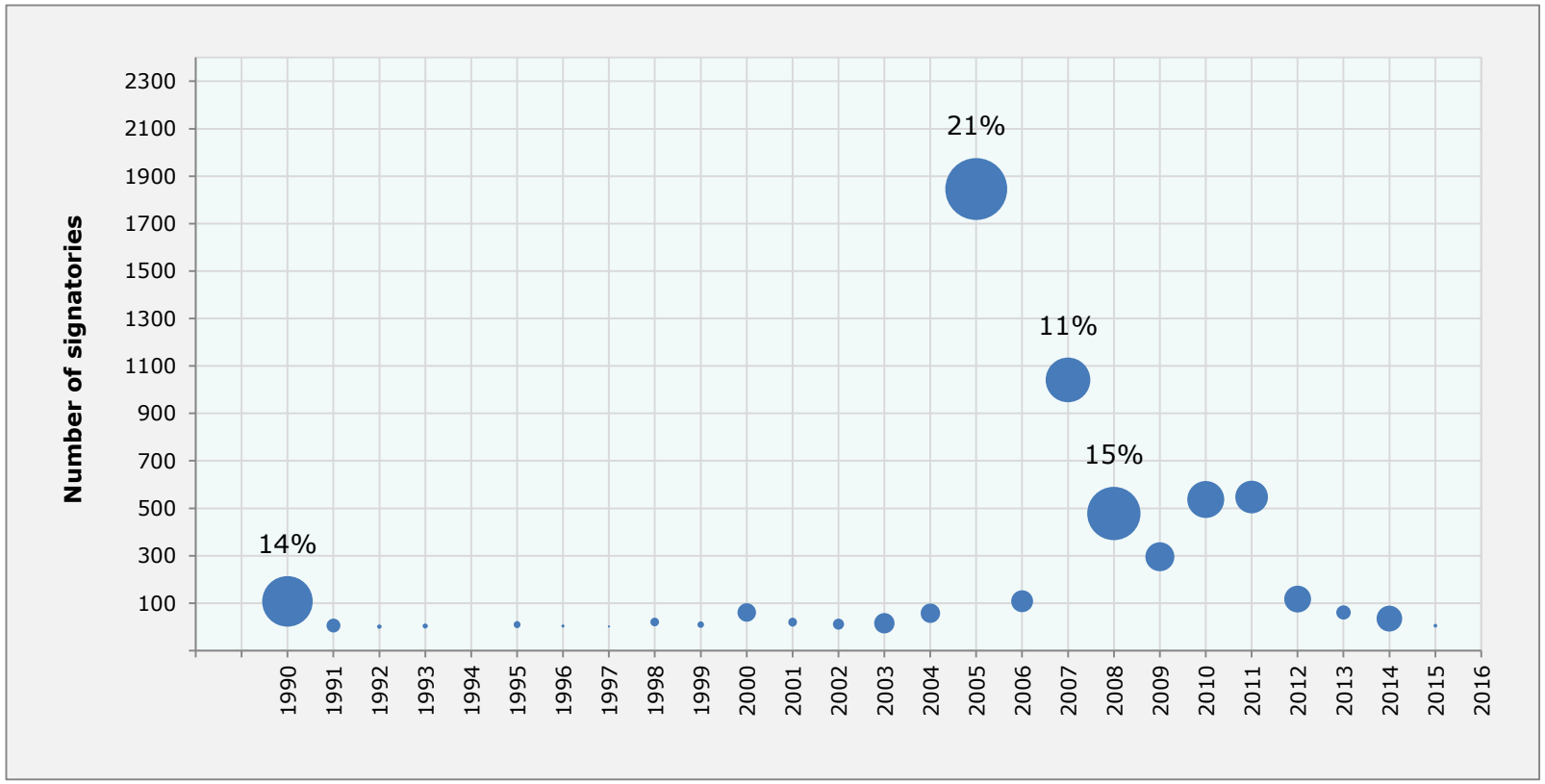



**Example: Sunderland, UK**

# The base year

- The base year is the reference year for setting the objective.
- The Covenant's goal is to contribute to the EU commitment to reduce GHG emissions at least by 20% by 2020 and by at least 40% by 2030 compared to 1990.
- The recommended baseline year is 1990.
- If data availability is insufficient, then a subsequent year must be chosen.

# The base year




***Data from CoM BEI dataset (N=5,403, 97% from EU28) at 4th of September 2016, Kona A. et al., 2016***
***The population covered in the corresponding SEAPs is represented in relative terms by the size of the bubble.***

# The base year

For the **regional extensi**ons of the Covenant beyond EU borders, the local economic situation was taken into account when recommending the base year.

For example for CoM East - originally covering countries from Eastern Europe and Central Asia - the recommendation is to use a more recent year which is representative of the current economic situation.

# Definition of the boundary of the inventory

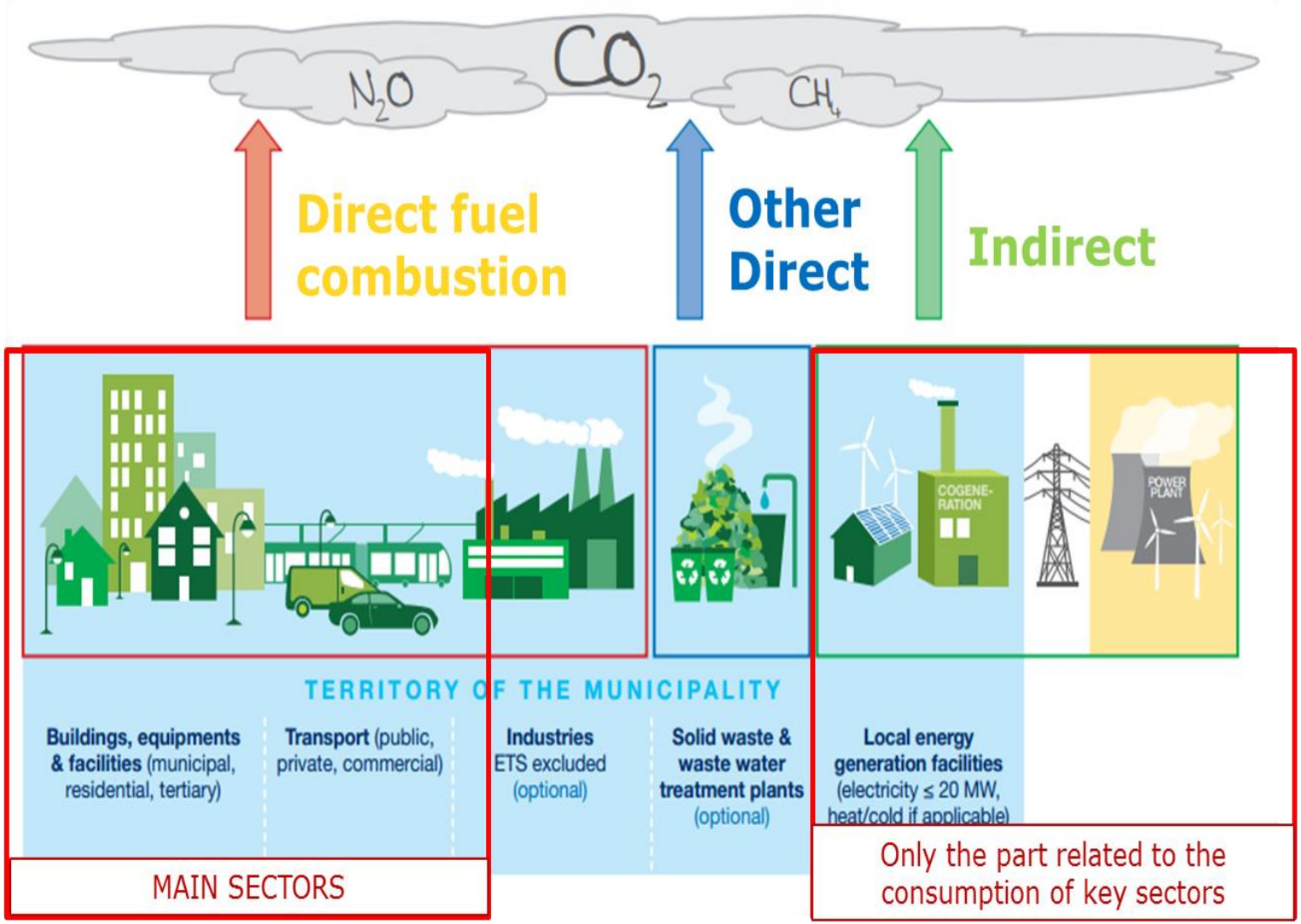
It is set by the administrative boundaries of the local authority signatory of the Covenant.

*The majority of CoM signatories are municipalities, but there are also higher administrative units (e.g. provinces, regions, counties). In Global  Regions of the world we could talk about National approaches (China)*

**It coincides with the territory where the final energy is consumed and the one tackled by the SECAP measures.**

*The signatory might choose not to tackle through any measures, sectors which are otherwise included in the inventory (not recommended).*
*Nevertheless the target applies to all emissions included in BEI.*

# Targeted emissions

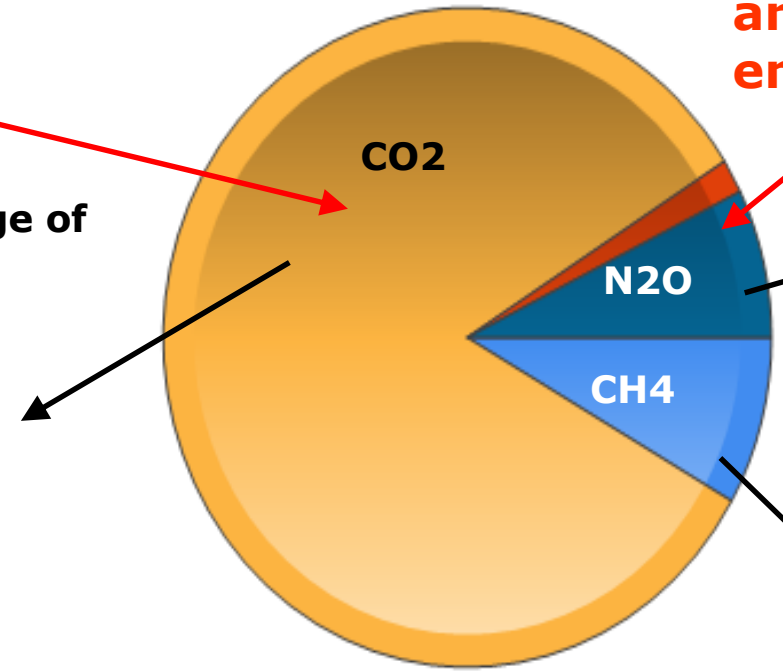



Not exhaustive inventory

# Greenhouse Gases (GHG) reporting

**Inclusion (in $CO_2$ eq) recommended if actions are planed in related emitting sectors**

**Mandatory**




**Combustion & usage of fossil fuels**

**Agriculture (77%)**
**Industry (8%)**

**Agriculture (49%)**

**Waste (31%)**

***Share of greenhouse gases EU27 – (EEA, 2009)***

**Fugitive emissions (15%)**



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# Steps in emission calculation

**1.) Identifying the emission sources and collect activity data:**

- Final energy consumption:
  - in buildings, equipment/facilities and industries
  - in transport
- Local generation of grid distributed energy (electricity, heat, cold)

*Considered indirectly, via emission factors, if included in SECAP*

- Other emission sources (not related to energy consumption) (e.g. waste …)

*Only emissions reported, no activity data required*

**2.) Choosing the emission factors**

**3.) Calculating the GHG Emissions**

# Key concepts and calculation rules

**Activity Data** * **Emission factors** = **Emissions**

| Activity Data | Emission factors | Emissions |
|---|---|---|
| electricity consumed in municipal buildings [$MWh_{electricity}$] | amount of $CO_2$ emitted per MWh electricity [$tCO_2/MWh_{electricity}$] | total amount of $CO_2$ emitted from electricity [$tCO_2$] |
| ↓ | ↓ | |
| **Find the proper data related to your local authority** | **Most emission factors can be found in the Guidebook and in technical literature** | |

# Key concepts and calculation rules

## Activity data (AD)

AD quantifies the human activity occurring in the territory of the local authority.

Examples of activity data are:

- oil used for heating in residential buildings [$MWh_{fuel}$]
- electricity consumed in municipal buildings [$MWh_{electricity}$]
- heat consumed by residential buildings [$MWh_{heat}$]

It is strongly recommended to use **data relevant for the local territory**! If the inventory is built with national averages, the subsequent inventories will not show the effect of the actions implemented at local level!

# Key concepts and calculation rules

## Emission factors (EFs)

EFs are coefficients which quantify the emission per unit of activity. The emissions are estimated by multiplying the EF with the corresponding activity data.

Examples of EFs are:

- amount of $CO_2$ emitted per MWh of oil consumed [$tCO_2/MWh_{fuel}$]
- amount of $CO_2$ emitted per MWh electricity [$tCO_2/MWh_{electricity}$]
- amount of $CO_2$ emitted per MWh heat consumed [$tCO_2/MWh_{heat}$]

# GHGs and Emission factors

If GHG other that $CO_2$ are included in the BEI, then it is necessary to convert the amount of $CH_4$ or $N_2O$ into $CO_2$ equivalents multiplying by Global Warming Potential coefficients:

| TABLE 3. CONVERSION OF $CH_4$ AND $N_2O$ TO $CO_2$-EQUIVALENT UNITS | |
|---|---|
| MASS OF GHG AS T COMPOUND | MASS OF GHG AS T $CO_2$-EQUIVALENT |
| 1 t $CO_2$ | 1 t $CO_2$-eq |
| 1 t $CH_4$ | 21 t $CO_2$-eq |
| 1 t $N_2O$ | 310 t $CO_2$-eq |

***IPCC, Second Assessment Report***

# GHGs and Emission factors

## Choice of emission factors

- **Standard emission factors, according to IPCC guidelines (Intergovernmental Panel on Climate Change) approach:**
  Based on the Carbon content of fuels.

  Advantages:
  - ✓ Simple;
  - ✓ In line with international reporting (UNFCC, Kyoto protocol…).

- **LCA (Life Cycle Analysis) emission factors:**
  Includes embodied emissions that occur upstream (e.g. emissions required to extract, transform, transport the fuel up to the city).

  Advantages:
  - ✓ Gives a better view of the global impact of the activities occurring in the territory

# GHGs and Emission factors

| TABLE 4. STANDARD $CO_2$ EMISSION FACTORS (FROM IPCC, 2006) AND $CO_2$-EQUIVALENT LCA EMISSION FACTORS (FROM ELCD) FOR MOST COMMON FUEL TYPES | | |
|---|---|---|
| TYPE | STANDARD EMISSION FACTOR [t $CO_2$/MWh] | LCA EMISSION FACTOR [t $CO_2$-eq/MWh] |
| Motor Gasoline | 0.249 | 0.299 |
| Gas oil, diesel | 0.267 | 0.305 |
| Residual Fuel Oil | 0.279 | 0.310 |
| Anthracite | 0.354 | 0.393 |
| Other Bituminous Coal | 0.341 | 0.380 |
| Sub-Bituminous Coal | 0.346 | 0.385 |
| Lignite | 0.364 | 0.375 |
| Natural Gas | 0.202 | 0.237 |
| Municipal Wastes (non-biomass fraction) | 0.330 | 0.330 |
| Wood [a] | 0 – 0.403 | 0.002 [b] – 0.405 |

**(CoM West Guidebook: table 4, p. 62)**

# CoM activity sectors

GLOBAL COVENANT of MAYORS for CLIMATE & ENERGY

**Buildings, equipment/ facilities**

- Municipal
- Tertiary (commercial & non-municipal services)
- Residential

**Urban transport** (municipal, public, private)

**STRONGLY RECOMMENDED**

= the CoM EU key sectors

Local production of grid distributed energy:

- Electricity
- Heat/Cold

**RECOMMENDED IF IN SEAP**

Other energy related sectors:

- Industries not involved in the EU ETS*
- Agriculture, Forestry, Fisheries (only energy consumption)
- Other road transportation (e.g. highways)

Non energy related sectors:

- Wastewater and/or solid waste treatment (non energy related)

* *European Union Emissions Trading System (EU ETS)*

***Focus on sectors that can be directly influenced by local policies***

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# CoM activity sectors

Industries involved in the EU ETS

**NOT RECOMMENDED**

**Aviation, Shipping, Agriculture**

**(non energy related: enteric fermentation, fertilizer application, etc…)**

# Emission Factors for fuels and renewable heat

In general, biomass/biofuels are a form of **renewable energy**, the use of which does not have an impact on the $CO_2$ concentration in the atmosphere. However, this is the case only if biomass/biofuels are produced in a sustainable manner.

In the absence of national regulations regarding the sustainability of biomass/biofuels, the local authority might use the criteria set in the Directive 2009/28/EC on the promotion of the use of energy from renewable sources.
Only biomass/biofuels that meet these criteria should be considered as renewable in the context of the CoM.

# Emission Factors for electricity

In order to calculate the $CO_2$ emissions to be attributed to electricity consumption it is recommended to use the national emission factor or the European one (NEEFE) [$tCO_2/MWh$].

**What if there is some *local electricity production* AND the local authority wants to take action in this field?**

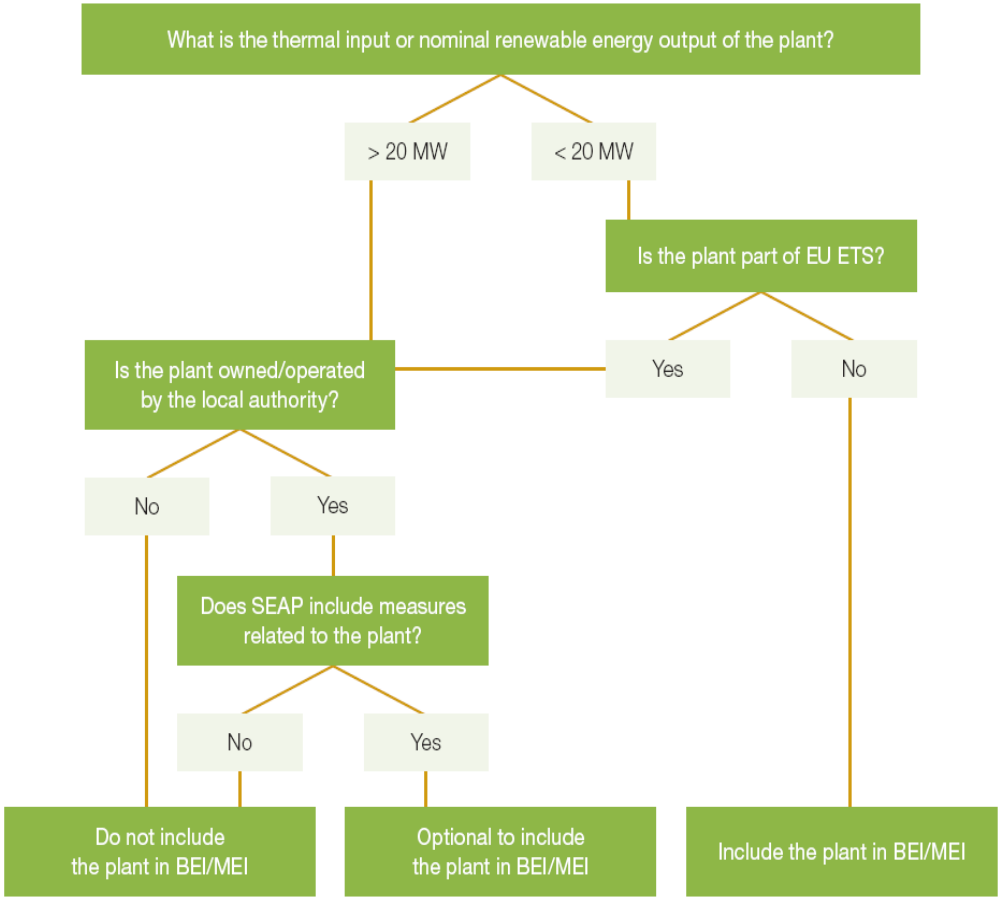
**The municipality can correct the national emission factor with the local production of electricity by calculating the local emission factor for electricity consumption (EFE)**

# Steps in calculating the Local Emission Factor for electricity

## 1.)Deciding which local electricity production units should be included in the inventory according to the following decision tree:

**Large (> 20 MW) Plants that are not operated by the local authority are not considered to be «local»**

**CoM West Guidebook, p. 64**



# Steps in calculating the Local Emission Factor for electricity

## 2.) Calculating the Local Emission Factor for electricity:

$$EFE = \frac{[(TCE - LPE - GEP) * NEEFE] + CO_2LPE + CO_2GEP}{TCE}$$

**EFE = Local Emission Factor for Electricity**

**TCE = Total Consumption of Electricity**

**LPE = Local Production of Electricity**

**GEP = Green Electricity Purchased by the local administration**

**NEEFE = National (or European) Emission Factor for Electricity**

# Steps in calculating the Local Emission Factor for electricity

## EFs for heat

**…if there is some heat sold / distributed as a commodity to end users? (e.g. district heating)**

A local emission factor for heat (EFH) has to be calculated

$$EFH = \frac{CO_2LPH + CO_2IH - CO_2EH}{LHC}$$

LPH = local heat production
IH = imported heat
EH = exported heat
LHC = local heat consumption

CoM West Guidebook: p.67

# DATA COLLECTION CHALLENGES

- Energy consumption of buildings, vehicles, lighting systems and other facilities operated by **municipality** is usually adequately registered

- Energy consumption data in **residential & commercial** sector are of a poor quality

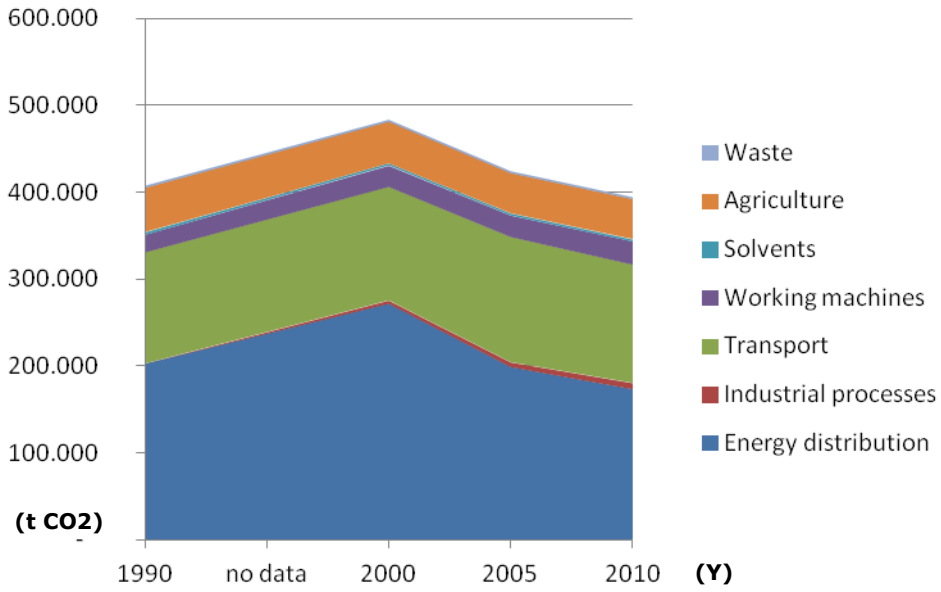
- Data on **Local Heat and Electricity Production** may be hard to find when plants are privately operated

- **Transport** sector estimations of emissions are based on statistics and very often outdated assumptions

# DATA COLLECTION CHALLENGES

## Structure of national/regional statistical data

### 1. Activity sectors




**Sweden**

### 2. CoM sectors

- **Municipal Buildings, equipment/ facilities**
- **Tertiary Buildings, equipment/ facilities**
- **Residential Buildings, equipment/ facilitie**
- **Public lighting**
- **Industries (non ETS)**
- **Municipal Fleet**
- **Public transport**
- **Private and Commercial transport**

**CoM**



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# DATA COLLECTION CHALLENGES

- Data reporting remains a **major challenge** for signatories and the level of details in the templates shows a certain country dependence
- For templates with a good level of details:
  - Electricity consumption and its split by Covenant sub-sectors are generally reported
  - When relevant, data on Natural Gas consumption are indicated, even though the split by Covenant sub-sectors can be more challenging
- Split by Covenant sub-sectors may be a challenge
- Energy consumption data in Private/Commercial Transport are usually challenging


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# DATA COLLECTION CHALLENGES

## We want to look at energy-related emissions 'cities' are 'fully accountable' for...

### 1. Energy-related ...some sectors are not the focus of the CoM!

- Food and consumer goods;
- Deforestation;
- Fugitive emissions...

Is the methodology and data allowing to evaluate emissions over time available?

### 2. Full accountability... e.g. how do we deal with electricity?

- The majority of the electricity consumed in municipalities is generally produced elsewhere;
- $CO_2$ emissions are accounted for using regional or national EFs which **should be kept constant** throughout the years;
- In case of local electricity production a **Local Emission Factor** should be calculated.

**...and with sectors LAs cannot influence** (Aviation, heavy industry)?

⇨ Generally to **be excluded**

# DATA COLLECTION CHALLENGES

## Focussing on the TRANSPORT sector

### Municipal and public transport

### Private and commercial transport

- Traffic Monitoring Systems
- Fuel sales within the territory

→ *Corrections and data analysis are needed:*

- *Interurban transportation;*
- *Vehicles registered in the territory;*
- *Tourism?*

# Data collection: tips from CoM

**1.MeShaRtility project, f**unded under "Intelligent Energy Europe Programme" addressed the specific challenges in data collection for the Covenant signatories.The project measure and share utilities data from Covenant of Mayors signatories. Duration: April 2012- April 2015, target region: EU in general, specifically addressing 12 countries: Bulgaria, Croatia, Cyprus, Estonia, Germany, Italy, Latvia, Malta, Poland, Romania, Slovenia, Spain, http://www.meshartility.eu/en/

Summary report can be downloaded from: http://www.meshartility.eu/images/documents/pl/ICLEI_meshartility_report_EN_210x297_Screen_2.pdf

# Data collection: tips from CoM

**2.Data4Action project ,** also co-funded "Intelligent Energy Europe Programme " and addressing the specific challenges in data collection for the Covenant signatories, aims to foster win-win energy data exchange collaboration models between public authorities and energy data providers moving from bilateral data exchange cooperation agreements to regional «one-stop shop» data centres (« Observatories»).

Duration: March 2014- February 2017, target area: EU28, http://data4action.eu

3.**Data Access Guidebook for Sustainable Energy Actions Plans**, 2016
*The report can be downloaded from:*
http://www.fedarene.org/wp-content/uploads/2017/01/576-Data-Access-Guidebook-rx15.pdf

# National initiative

Centralized data collection at national level are facilitating data collection at local level

- Netherlands and Denmark have developed tools which provide energy and climate data per activity sector, broken down at least at municipal level.
  - *Climate Monitor, Netherlands, since 2009, www.klimaatmonitor.databank.nl*
  - *Municipal Carbon Inventory Tool, Denmark, since 2008, http://www.ens.dk/undergrund*

- Cyprus Energy Agency has developed a tool which provides the local authorities with all the energy consumption information required in order to establish their CO2 inventory.

  - *http://www.cea.org.cy/app/CEA_energy.html*

# Regional initiative

**Covenant territorial coordinators** play a key role in helping small and medium size local authorities to collect the data

- Energy data base of the province of Limburg:

The province of Limburg with partners established a data base containing the results of Baseline Emission Inventory, Renewable energy scan, Sustainable building scan and a Set of climate indicators prepared for each of the Limburg (44) municipalities. This was done to encourage municipalities to sign the Covenant of Mayors and draft up a SEAP (Sustainable Energy Action Plan). By doing this, the province of Limburg wants to reach their goal, set in 2008: becoming climate neutral in 2020”

# Summary

- Good quality and reliable data is important
- The availability and sources of energy data are country/region dependent
- Energy consumption data has to be relevant to the particular situation of the municipality (national averages may not reflect in the subsequent monitoring inventories the effect of the actions implemented at local level)
- Difficult to assess the consumption of energy vectors that are not distributed via a grid (heating oil, biomass …). Surveys are often required to complement this data.
- Importance of utilities /energy suppliers / grid operators: they own the primary data

# Summary

- Territorial coordinators (e.g. supporting structures) and other National/ regional authorities can play a key role in collecting data and making it available to local authorities

- Aggregated data may not be enough: need data for each energy vector, for community, for each category of customer (households, public sector, industry, services)

- Data related to transport and mobility: difficult to be estimated

- So, the data collection process requires time and resources.

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# Summary

**BUT**

don't lose the focus

**BEI as a tool for better climate planning!!**

# Stay in touch

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