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Covenant of Mayors for Climate & Energy Eastern Partnership

Covenant of Mayors for Climate & Energy – Eastern Partnership

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2 PART

Introduction to Municipal Energy Management Cycle: key definitions, commitment, structure, baseline situation, setting targets, action plan, implementation, monitoring and verification, evaluation of achievements and benefits

Municipal Energy Management System

KEY SECTORS:

- public buildings
- street lightening
- public transport

DATA SOURCES:

- energy consumption: meters, invoices, contracts,…
- energy audits,
- building stock inventory and streetlights cadastre

Municipal Energy Management System

Implementing energy management systems can strengthen a municipality's ability to systematically identify and implement energy efficiency improvements in infrastructure such as buildings, public lights, and water treatment plants. The current energy crisis, rising electricity costs and the need to transition to a low carbon economy, necessitate municipalities to improve their energy management systems and reduce their energy usage.

Source: giz.de

Municipal Energy Management System

Energy efficiency is the first fuel municipalities should consider in their energy transition. **Adopting energy management principles** will enable a systematic **development of bankable energy efficiency projects that will reduce energy usage and related costs**.

Improved energy management in municipalities will help improve service delivery and mitigate the impact of load shedding. Municipalities should also lead by example and encourage their consumers to follow suit and contribute to a more effective service delivery.

Source: giz.de

Systematic acquisition of energy data

- Establishing of Municipal Energy Management System
- Creating Building stock inventory
- Preliminary analysis on energy consumption
- Energy audits
- Action plan and implementation
- Monitoring, Verifying, Reporting

Provide base for energy planning, create sustainable energy action plans, prioritizing buildings, planning budget, implementation of actions, follow-up on actions and monitoring

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Buildings – macro sector

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Activity sectors and data to be included in the CoM inventories - "Building" macro-sector

Activity sector	Description
Municipal buildings, equipment/facilities	All final energy consumption and related GHG emissions occurring in buildings and facilities public or owned by the local authority shall be reported in this activity sector, e.g. **government offices, schools, police stations, hospitals, etc.** All final energy consumption due to the operation (e.g. electricity for pumping, natural gas for heating, etc.) of **municipal water supply system, solid waste and wastewater treatment and disposal facilities** are also included here.
Tertiary buildings, equipment/facilities	All final energy consumption and related GHG emissions occurring in buildings and facilities of the tertiary sector (services) shall be reported in this activity sector, e.g. offices of **private companies, banks, commercial and retail activities, private schools, hospitals, etc.** All final energy consumption due to operation (e.g. electricity for pumping, natural gas for heating, etc.) of **private water supply system, solid waste and wastewater treatment and disposal facilities** shall be reported in this activity sector.
Residential buildings	All final energy consumption and related GHG emissions occurring in buildings that are primarily used as residential buildings for **cooking, heating & cooling, lighting and appliances** usage shall be reported in this activity sector. All final energy consumption occurring in **social housing** shall be reported in this sector.

Buildings – macro sector

Collecting information from every individual energy consumer within the local territory is not always possible or practical. Therefore, a variety of approaches are likely to be needed to develop an estimate of energy consumption.
Several options are available, and often a combination of them is necessary to have an overall picture of the energy consumption within the local territory.

- Energy consumption (electricity, heat, cold, water)
- Working processes
- Number of users
- Construction of buildings
- Devices operational regime

Building stock inventory

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At the start of an energy management in a municipality – independent of the size of the public body – it is essential to collect concrete information about the buildings owned and used by the municipality (suggestion: include buildings with conditioned **area >250 m²**)

Building inventory is a baseline for the next steps, like setting up an EMIS, and later on, planning long-term renovation strategies with selection of priority buildings and benchmark assessments.

The building inventory should include:

- Building: official name of the building
- Address of the building
- Category - building use including possible specific features in the use
- Occupancy – is the municipality the owner or is the building leased / rented?
- Status in context of refurbishment (already refurbished, in plan for next years, etc.)
- **Year of construction and refurbishment(s)**
- **Surface area in m2**
- Conditioned surface area in m2
- Heating system
- Main energy source for heat – energy carrier
- **Annual energy consumption for heat, electricity and water**

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Building stock inventory- example

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BASIC DATA:	PRE-REFURBISHMENT DATA:	DOCUMENTATION AND COSTS:	POST-REFURBISHMENT DATA:
• Official name of the building. • Adress and municipality of the building • Owner – state, municipality etc. • Type/Purpose – school, administrative building, residential building • Status of refurbishment – already refurbished, in plan for next two years, in process, etc..	**• Year of construction** **• Area in m2** **• Conditioned area in m2** **• Heating system** **• Main energy source for heat** **• Connection to district heating network** **• Energy number (kWh/m2/p.a)** **• Use of heat (in kWh/p.a)** **• Use of electricity (in kWh/p.a)** **• Other / Comments**	**• Energy Certificate** **• Detailed energy audit** **• Building permit** **• Estimated energy savings for heat in kWh/p.a.** **• Estimated electricity savings in kWh/p.a.** **• Estimated investment costs in EUR** **• Main area of refurbishment (Building fixtures, building envelope, heating system, indoor lighting)** **• Foreseen year of refurbishment**	**• Total cost of refurbishment in EUR** **• Financing scheme (ESCO, own sources, subsides, bonds, etc.)** **• Subsidies (yes/no, % of whole investment)** **• Own participation (% of whole investment)** **• Simplified payback period for investment (years)** **• Use of heat (in Kwh/p.a)** **• Use of electricity (in Kwh/p.a)** **• Actual energy savings of Heat (kWh/p.a.)** **• Actual electricity savings (kWh/p.a.)**

Preliminary analiysis

- A questionnaire form
- Get a rough overview of many buildings in a short time (walkthrough, unlike energy audits)
- On-site visit is necessary
- To form an overview over possible measures to increase the energy-efficiency of the buildings (with a rough idea of the time-frame needed)
- To be able to prioritize buildings for elaboration of long-term renovation strategy

Building: Rathaus			
year of construction:	1887		
building type:	administration building, town hall		
energy carrier for heat:	natural gas		
type of heat supply:	☐ single stoves ☐ constant temp. boiler	☐ low temp. boiler	☒ condensing boiler ☐ heat pump ☐ CHP ☐ district heating
age:	☐ > 20 years	☒ 10 – 20 years	☒ < 10 years
heating system:	radiators		
heating circuit pumps:	☐ unregulated multi-level	☒ with electr. control > 2009	☐ high-efficient pumps
insulation of heating pipes :	☐ none with voids	☐ sufficient	☒ good
control and regulation system:	☐ faulty broken ☐ hard to operate	☐ ok, but no documentation (available)	☒ central control ☐ single room control ☐ building control system
heating times adapted to building use	☐ no	☐ unknown	☒ yes
heating curve adapted to the standard of the building:	☐ no	☐ unknown	☒ yes
hydraulic balanced system:	☐ no	☐ unknown	☒ yes
ventilation:	windows		
domestic hot water:	☐ none ☐ decentral	☒ central	☒ circulation
exterior walls:	masonry ~30 – 50cm		
	☒ without insulation		☐ with insulation
windows:	☒ single glazing	☒ twin pane glazing	☐ heat protection glas ☐ triple glazing
top floor ceiling / roof:	☒ without insulation		☒ with insulation
cellar ceiling:	☒ without insulation		☐ with insulation
lighting system:	☐ filament lamps	☒ energy saving lamps	☒ fluorescent lamps ☐ LED
responsible person:	☐ no	☒ yes	☐ expert, energy manager
energy monitoring:	☐ no	☒ yes	☐ monthly
energy passport issued:	☒ no		☐ yes
potential for low- and no-cost measures:	☐ high potential	☒ fair	☐ low potential

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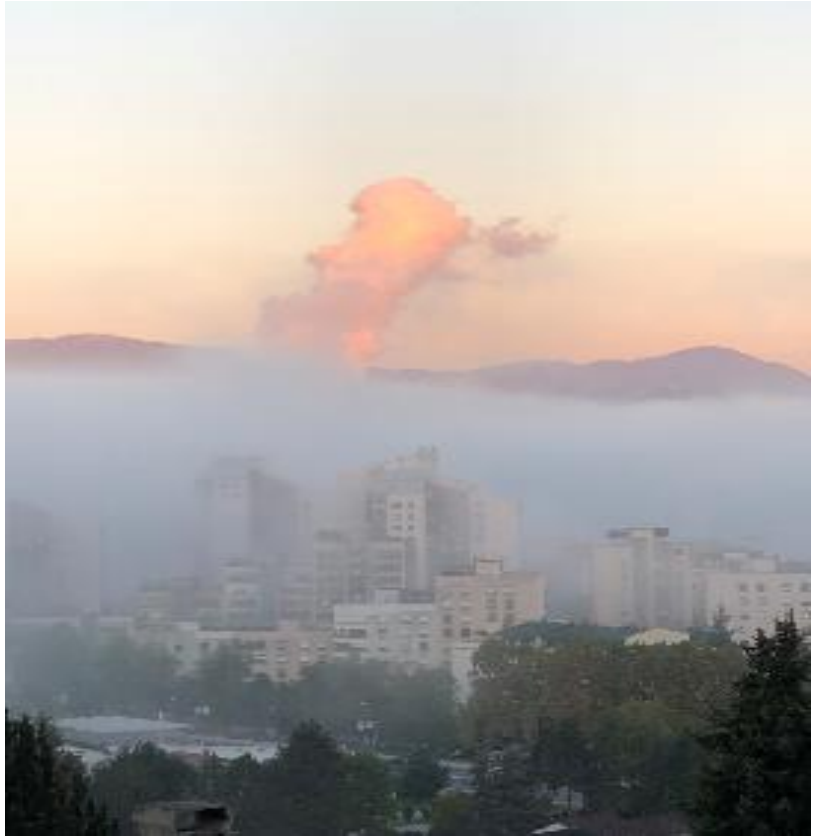
Municipal buildings and equipment/facilities

The local authority should be able to collect accurate and comprehensive final energy consumption data related to its **own buildings and facilities – street lighting.**
Some local authorities already have a full energy accounting system in place.

If not….

Municipal buildings and equipment/facilities

- Identify all buildings and equipment/facilities owned/managed by the Local Authority;
- Identify all energy delivery points (electricity, natural gas, heat from heating district network, fueloil tanks…);
- Identify the person/department receiving the invoices and energy data;
- Organise a centralised collection of these documents/data;
- Select an appropriate system to store and manage the data (could be a simple spread sheet or a more elaborate software, available commercially);
- Make sure the data are collected and introduced in the system at least every year. Telemeasurement is possible and can ease the process of data collection.



Data collection - Energy audits

- The energy efficiency directive of the European Union defines an energy audit as: "a **systematic procedure with the purpose of obtaining adequate knowledge of the energy consumption profile of a building or group of buildings, an industrial or commercial operation or installation or a private or public service**, identifying and quantifying cost-effective energy saving opportunities, and reporting the findings"

Design tool →

- public administration can acquire technical specifications for project design

Assessment tool →

- based on which the public administration can take an informed decision on the implementation of energy efficiency measures in a building

Data collection - Energy audits

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START

Preliminary contacts

Agree with the Municipality on the aim, degree of accuracy and purpose of the energy audit

Start-up meeting

Energy auditor agrees on the organization of the work. Time schedule, involvement of building user, access, existing information

Data collection

Data collection means to collect building information. Data availability and reliability is key to a qualitative energy audit

Analysis

Calculation and proposals for different sets of energy efficiency improvement measures compared to the established baseline

Report

The findings of an energy audit shall then be structured and reported. The content of the energy audit report shall satisfy its purpose

Final meeting

The most exciting parts is to showcase the findings and results; with the idea that the municipality will turn them into a practice

END

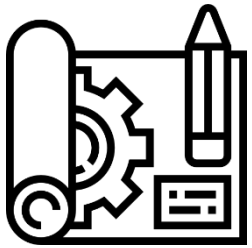
Field work

Building inspection is a very important step in energy auditing. Based on the scope of the energy audit, the energy auditor will go through all building elements and engineering systems understanding the current energy efficient level and physical conditions

Data collection - Energy audits

Gather relevant information about the building

- **engineering drawings** like (ground plots, cross sections)
- **detailed plans** (if available) for information about the constructions and parts of the buildings that cannot be inspected, (e.g. flat roof constructions under sealing)
- **energy consumption of at least the last 3 years** for heat and electric energy;
- **the surface area** (especially the conditioned area can be determined via the engineering drawings)
- typical **number of inhabitants** and operation schedule (hours of use)
- **typical heating and cooling schedule;**
- previous energy audits;
- reports from pervious analysis of the efficiency of the boilers and of the air-conditioning installation,
- information about last renovation steps taken.



Data collection - Energy audits

Gather relevant information about the energy consumption

Gather data from building owner (finance and management departments of municipalities), such as:

ENERGY BILLS, that provide information about:

- annual energy consumption
- energy prices, fees, tariffs and costs
- specific CO_2-emissions of the energy carrier [kg CO_2/MWh]

ENERGY MONITORING, provides information about:

- the energy consumption in a higher resolution: annual, monthly, weekly, daily, real-time
- trends..

Energy audit – Proposal of measures

Single measures to improve the energy efficiency can be proposed (depending on national context)

For the building envelope typical measures are:

- insulation of walls
- installation of new windows
- insulation of the roof, additional insulation for platform roofs

For the technical infrastructure, typical measures are:

- installation of new boilers, connection to district heating
- mechanical ventilation with heat recovery
- refurbishment of the light-system

For the description of the single measure, the following structure is proposed:

- description of the actual state and construction
- review / appraisal: U-value, what is the problem, need for improvement
- proposed measure
- savings: energy and CO_2-emissions (net savings and %)

For the quality of the proposed measures, a target should be defined (minimal requirements defined by legislation, passive house standard etc.)

Energy audit – Proposal of measures

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Calculation of packages of measures

- The goal is to reach a certain energetic level for the building.
- A target should be set (possible targets are minimal requirements defined by legislation, new-building-standard or passive house standard).
- For the decision, which single measure or which pack of measures should be applied to the building, a calculation of the financial indicators is necessary:
- Estimation of the investment costs for the proposed measures;
- Calculation of cost savings;
- Payback period

For the description of the packages of measures, the following structure is proposed:

- list of measures, which measures are combined and why
- results of the calculation with comparison of the target-values
  - primary energy demand
  - End energy demand
  - U-values
  - Specific energy consumption
- Estimation / calculation of the investment costs with differentiation of costs for energetic improvement and costs that are necessary anyway
- Advice what must be taken into consideration if the measures are implemented e.g. disassembling of evacuation staircases, derogation of ledges or cornices and sills
- Calculation of profitability
- Indication of subsidies

Energy audit – example of energy audit report (mandatoery content)

ENERGY AUDIT REPORT

1. Introduction

2. Building general information

3. Executive Summary table

4. Legal and normative references

5. Overview of sources of information

6. Description of the building

- 6.1 Description of the actual state of the building fabrics
- 6.2 Description of the actual state of the engineering systems
- 6.3 Description of specific anomalies detected during building inspection

7. Building renovation

- 7.1 Description of the proposed energy efficiency measure
- 7.2 Estimated energy savings
- 7.3 Economic analysis of the proposed renovation package

8. Integration of Renewable energy sources (if requested)

9. Conclusion and recommendations

Annexes

Municipal Energy Management System data processing

Digitalization: Systematic acquisition of energy data (supply and consumption)

Energy data are collected in regular time intervals in need to be visualized. Most of it can be done by software – energy bookkeeping. Accurate and correct data collection is a baseline for all the later processing and calculations of EE and RES implementation – energy audits, bills collection,….

Moja stavba 1
Ulica 1
2000 Maribor

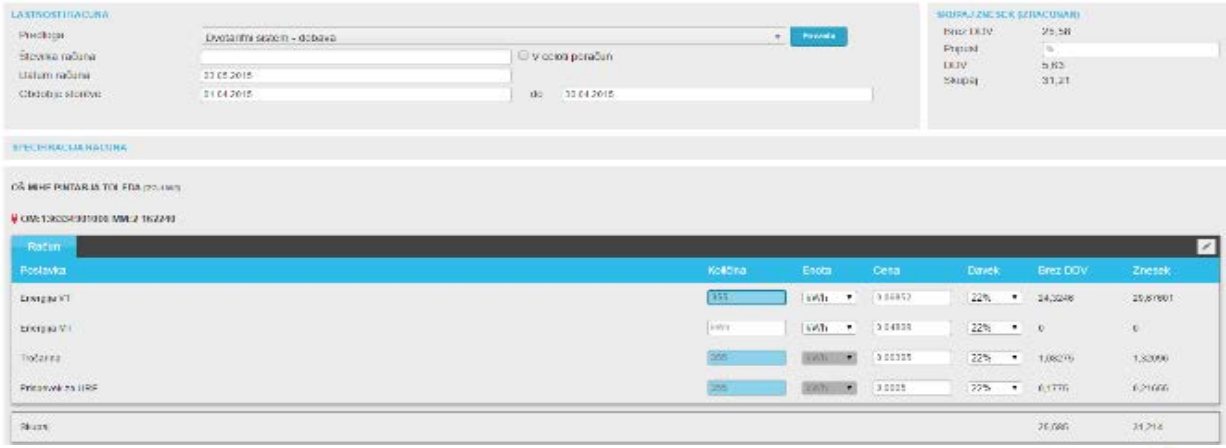
Obdobje:
2010 - 2012

ID: PO001
Mesečna poraba po vrsti storitve

Vrsta storitve: Elektrika + toplota

	Poraba v kWh			Stopnja rasti v %		Pov. letna stopnja rasti v %
	2010	2011	2012	2010/2011	2011/2012	2010 - 2012
januar	2.153	26.566	4.475	1.134,20	-83,20	44,19
februar	1.842	40.442	30.872	2.095,60	-23,70	309,39
marec	1.817	5.249	2.084	188,90	-60,30	7,1
april	1.449	4.816	1.591	232,30	-67,00	4,77
maj	1.412	4.677	1.563	231,20	-66,60	5,2
junij	1.428	40.548	1.225	2.739,30	-97,00	-7,38
julij	345	3.445	248	898,90	-92,80	-15,21
avgust	418	3.465	61	729,40	-97,70	-55,97
september	3.461	4.552	1.467	31,50	-67,80	-34,89
oktober	45.770	5.002	1.990	-89,10	-60,20	-79,15
november	2.048	29.371	2.205	1.334,30	-92,50	3,77
december	2.132	5.221	41.137	144,90	687,90	339,27
skupaj	64.274	173.355	88.938	169,71	-48,70	17,63

Data processing



- **All relevant data from the invoices**
- **E-invoice**

Municipal Energy Management System data processing

Processing and analyzing energy data

Analysis of your energy data reveals opportunities for improvement in your building – reports, templates, calculations,….

Moja stavba 1
Ulica 1
2000 Maribor

Obdobje:
jan 2013 - sep 2013

ID: RA002
Seznam računov po stroškovnih mestih

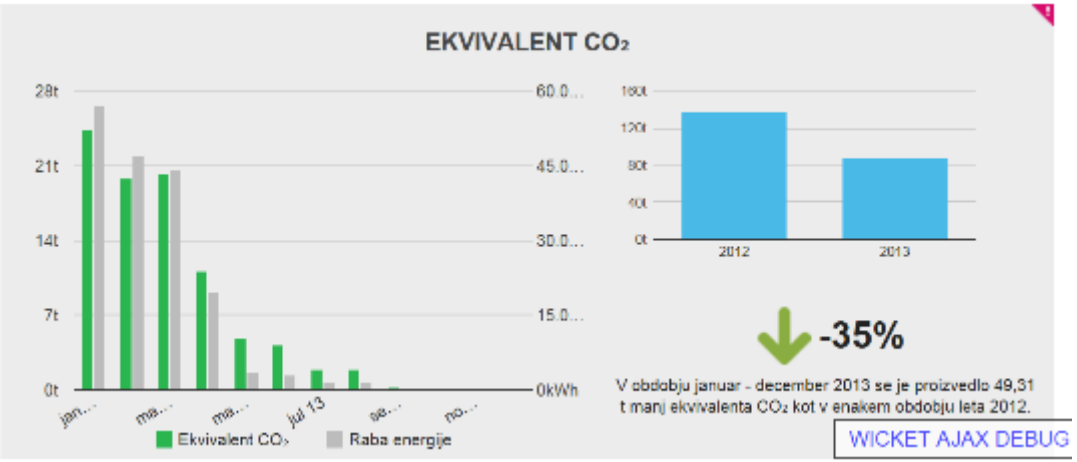
Stroškovno mesto: EE-02 (ELEKTRIČNA ENERGIJA)

Izvajalec storitve	Št. MM	Št. OM	Št. računa	Datum	Obdobje (začetek)	Obdobje (Konec)	Št. dni	Rač. mesec	Znesek	status	Vrsta pogodbene storitve
Elektro Celje Energija	4-014092	110020076 364/22761 0	0078136	04.04.2013	01.03.2013	31.03.2013	31	2013-03	196,02	Račun	Celovita storitev
Elektro Celje Energija	4-014092	110020076 364/22761 0	0105309	08.05.2013	01.04.2013	30.04.2013	30	2013-04	154,14	Račun	Celovita storitev
Elektro Celje Energija	4-014092	110020076 364/22761 0	0129831	04.06.2013	01.05.2013	31.05.2013	31	2013-05	166,38	Račun	Celovita storitev
Elektro Celje Energija	4-014092	110020076 364/22761 0	0147487	02.07.2013	01.06.2013	30.06.2013	30	2013-06	148,25	Račun	Celovita storitev
/					01.07.2013	31.07.2013	31	2013-07	0	Manjka račun	/

Municipal Energy Management System data processing

Identifying and implementing the EE and RES measures based on previus phase

List of measures of EE and RES to improve energy situation in building. Priority should be made according to the technical and economical justification and available founds – action plans, procurement, execution on filed,….

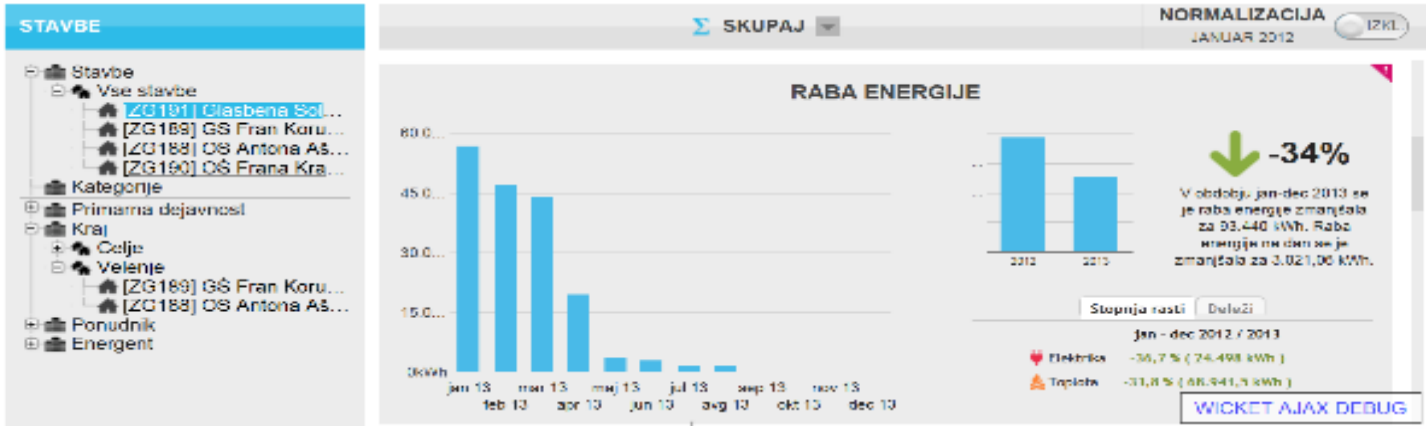


Energy Management System phases

Monitoring and evaluating

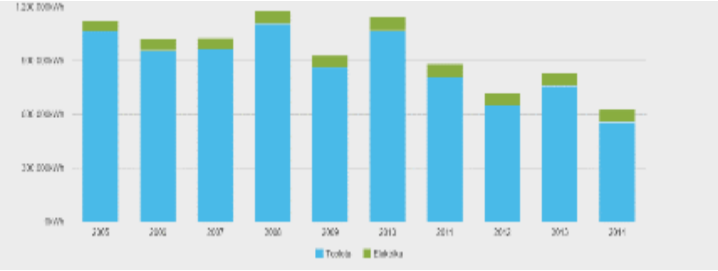
Each measure should be monitored and evaluated.

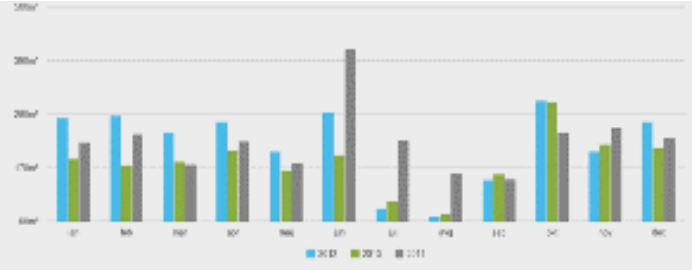
Quality, precise and detailed evaluation of the success of each measure is the basline for the continuation of energy-efficient action – annual, monthly, weekly or even daily reports, presentation to decision makers,….

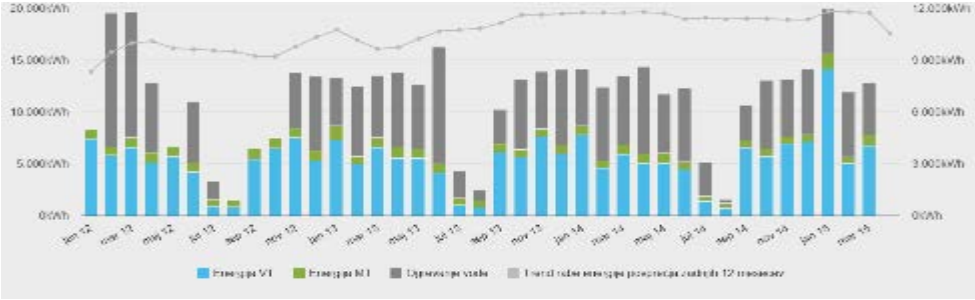


Energy Analyses

- Annual consumption– assessment of savings as baseline for the investment
- Monthly comparison– defining the errors + energy consumption monitoring

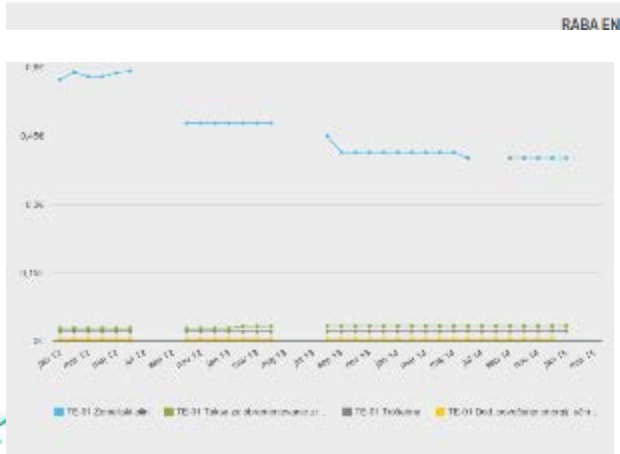




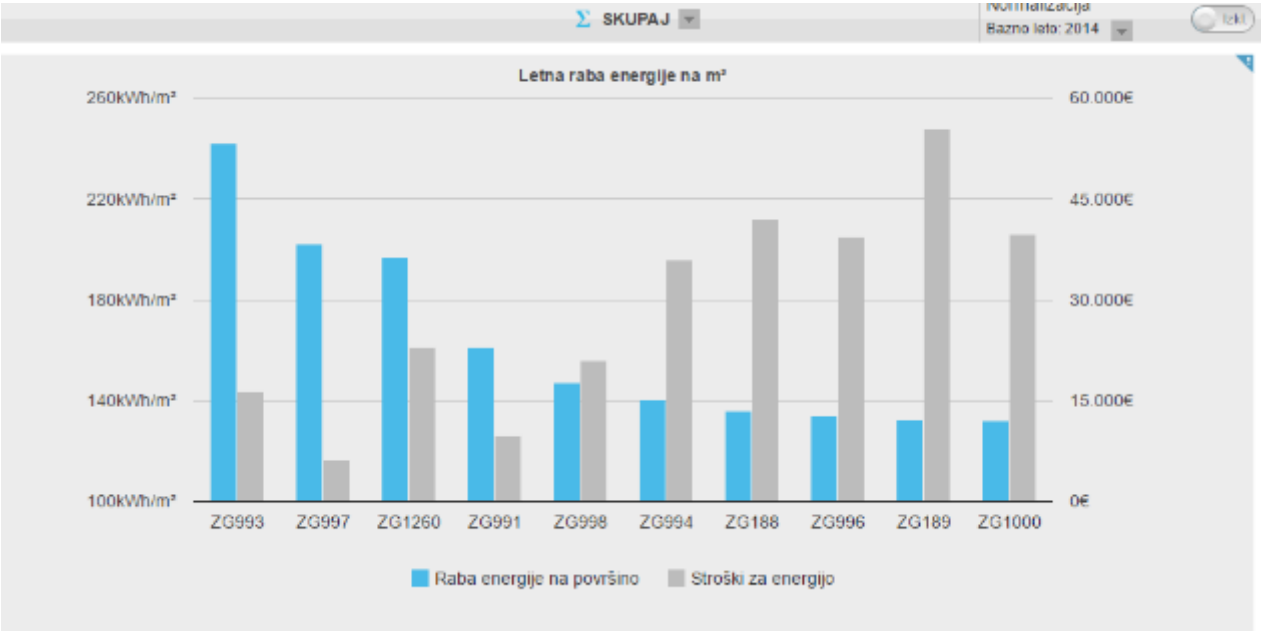


Cost Analyses

- Annual and Monthly comparison of costs – simply shown
- Prices of energy + taxes, fees, excise duties and other



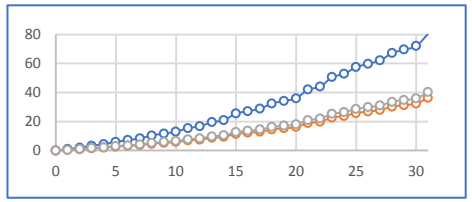
Energy Performance Number



Energy Performance Number (in kWh/m^2/a) – Benchmarking of buildings with similar processes

Verification/Recommisioning/Optimization /Fine tuning

Monitoring



Operation, optimization

Installation

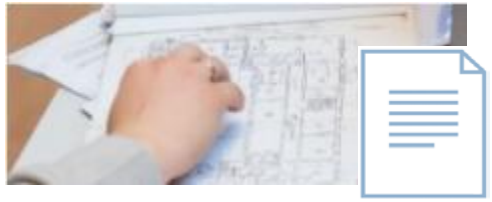
Monitoring → Motivation → Planning → Financing → Installation → Operation → Monitoring

MUNICIPALITY

Energy efficiency improvement actions

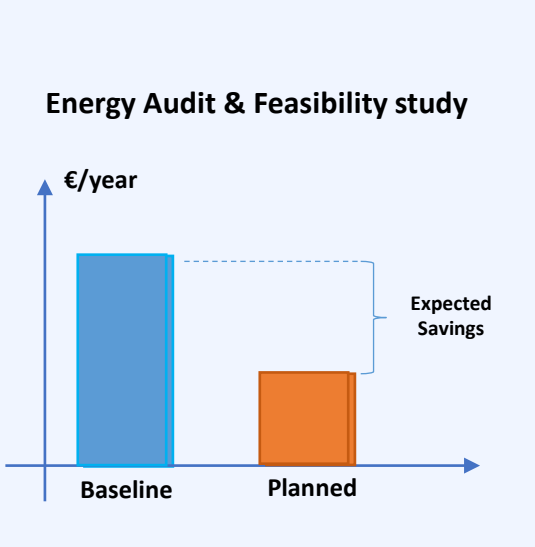
Motivation, information advice

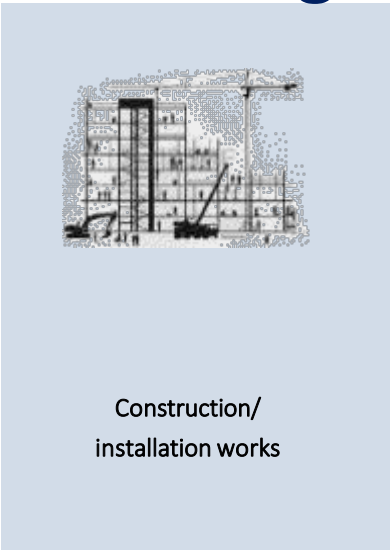
Planning and development

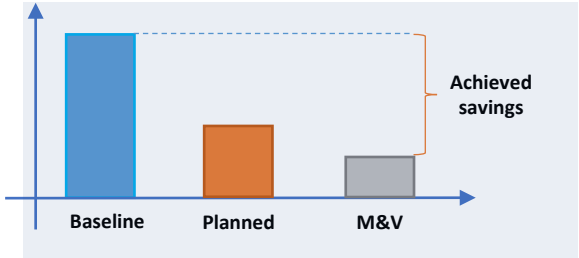


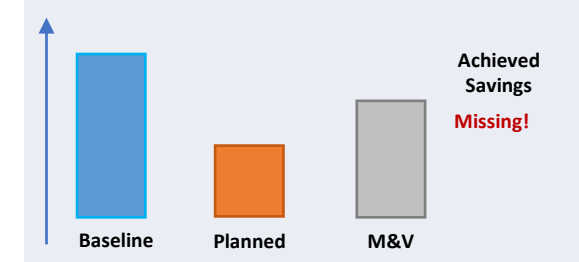
Financing

Verification/Recommisioning/Optimization /Fine tuning









Verification/Recommisioning/Optimization/ Fine tuning

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What and where did it go wrong?

Poorly managed procurement process

- Lack of sufficient technical specification
- Service, goods and works do not meet expectations/requirements

Irregular financial calculation

- miscalculated financial and economical parameters

Inappropriate goals set

- Too high/too low energy savings
- Underestimated investment costs

Poorly performed energy audit

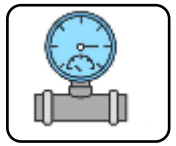
- Not meeting minimum requirement
- Wrong input data, calculation, etc.

Inappropriate system`s regulation

- Thermostat, valves, settings, etc.

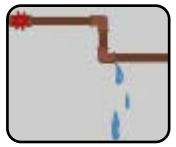
Inappropriate human behaviour in buildings

- miscalculated financial and economical parameters



Inappropriate measuring of the results

- lack of suitable monitoring and verification to check achieved results



Inappropriate energy system, equipment, solution, wrong installation

- over or under sized design
- wrong installation, implementation

Verification/Recommisioning/Optimization /Fine tuning

Recommissioning is a **systematic approach** focusing on inspection of existing energy systems in buildings, the processes of its operations and maintaining. In order to achieve the desired building performance, it is necessary to develop and define **procedures** and corrective **measures** to improve current situation.

Measures → **Implemented systematically**

Procedures → **Monitoring, Measurement and verification**

Verification/Recommisioning/Optimization /Fine tuning

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START

Asses building site

Understanding the current situation. Review documentation, like energy audits, financial analyses, project design, tender, settings

Measurement & verification plan

A measurement and verification plan is an essential element for developing and analysing implemented energy efficiency measures and/or spot fine-tuning opportunities of a building or facility

Prioritise improvements

A list of potential improvements for the building is the results of the detailed analysis and assessment of the building, the collection of monitoring data and testing facilities and system.

Implementation

The implementation of recommissioning improvement measures
Most of the time will require a separate contract because is difficult to predict the results for the recommissioning process.

END

MEETINGS: during the process you need to periodically meet with the municipality: kick off meeting, progress meetings and final meeting are necessary.

Testing and energy monitoring

Monitoring is a key activity for recommissioning and fine-tuning.
Depending on the level needed:

- Energy accounting/bookkeeping
- Installation of temporary monitoring system
- Advance monitoring systems

Verification/Recommisioning/Optimization /Fine tuning

Kindergarten – example

- Heated area – 1566 m^2
- Heat energy consumption **before** renovation – 206 kWh/m^2 year
- Estimated heat energy consumption **after** renovation – 99 kWh/m^2 year
- Real measured heat energy consumption **after** renovation – 180,1 kWh/m^2 year

During inspection

Around 50% of windows were open at outdoor air temperature of 1-3 ^{o}C

During inspection

Regulation OFF?!

Key Definition – **Baseline Emission Inventory**

BEI: Baseline Emission Inventory

Definition:

A Baseline Emission Inventory (BEI) is a quantification of the amount of CO_2 emitted due to energy consumption in a specified territory within a given period of time. Development of the BEI constitutes an obligatory stage of SEAP/SECAP preparation.

Goal:

Identification of principal sources of CO_2 emissions and their respective reduction potentials.

Advantages:

- closer monitoring and better understanding of the various factors that influence the CO_2 emissions;
- regular input to policy-making, allowing quicker reactions;
- the specific expertise necessary for inventories can be maintained and consolidated.

Introduction – WHAT IS BEI

BEI reflects many factors, as energy consumption and CO_2 emissions are dependent on:

- economic structure
- level of economic activity
- number of inhabitants
- population density
- characteristics of the building stock
- usage and level of development of the various transport modes
- citizens' behaviour
- climate, etc.

BEI should reflect LOCAL SITUATION!
Assessments and estimations based on national or regional means will not reflect the real situation locally

BEI - Recommendations

1 **As far as possible, internationally agreed standards shall be followed.** E.g. use emission factors that are in line with Intergovernmental Panel on Climate Change (IPCC) or European Reference Life Cycle Database (ELCD)

2 **Methodological approaches and sources of the data used in the estimations should not change for several years** for the sake of monitoring the progress in emission reduction.

3 **The BEI should reflect local situation** – it should be based on local data on energy consumption/production and other information necessary to prepare the inventory. Assessments and estimations based on national or regional means will not reflect the real situation.

BEI - Recommendations

1 **The BEI should include at least the sectors where the local authorities intend to take measures** aimed at achievement of their emission reduction goals, that is the sectors that constitute important sources of CO2 emission

2 **The BEI should contain reliable information** or at least common-sense vision of reality (that is, if possible, most objectively reflect the current situation).

3 **The process of input data collection, the sources of data and calculation methodology for the BEI should be duly documented** (at least the necessary data should be preserved in the local authority's documents).

Networks and methodologies

Existing networks that give recommendations on the elaboration of BEI:

- **Covenant of Mayors** (CoM) Provides methodology: Guidebook „How to develop a Sustainable Energy and Climate Action Plan (SECAP) – Part 2 – Baseline Emission Inventory“
- **Climate Alliance** Developed guidelines, methodologies and tools for different regions during the years. They developed online calculation tools, such as Climate Protection Planner (Germany) and ECORegion (Germany, Luxemburg, Switzerland, Italy, Austria), and guidelines such as „Klimaschutz in Kommunen – Praxisleitfaden“
- **Greenhouse Gas Protocol** Provides methodology in „Global Protocol for Community-Scale Greenhouse Gas Emission Inventories - An Accounting and Reporting Standard for Cities“
- **European Investment Bank** (EIB) Provides methodology: „EIB Project Carbon Footprint Methodology – Methodologies for the Assesment of Project GHG Emissions and Emission Variations
- **ICLEI** Provides methodology „Local Government Operations Protocol - For the quantification and reporting of greenhouse gas emissions inventories“

Calculation tools

Worldwide many calculation tools on the elaboration of BEI exist:

- The tools typically use comparable emission factors and recommend comparable activity data sources.
- Most of the tools are excel sheets and some of them are web based.
- Most of the tools are available in English (and some of them only in national language).
- Some tools that can be used freely and some others need license.

The main differences are related to the necessary inputs, the analysis level and the output presentation. Differences can be found in:

- the treatment of indirect emissions from electricity produced outside the municipality.
- the manner in which emissions from combined heat and power production (CHP) are allocated between heat and electricity.
- regard to which sectors and compounds are included and how the boundaries and scopes are set for the inventories.

Calculation tools for elaboration of BEI

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Covenant of Mayors for Climate & Energy Eastern Partnership

Online tools:

1. **„Climate protection planner“ (**Germany)
2. **„Ecospeed“** (Germany, Switzerland, Austria, Italy, Luxemburg)
3. **„Bilan Carbone“** (France)
4. etc.

Advantages of using an online tool:

- More complex calculation algorithms can be included
- Estimation processes can be included in case of low data quality or missing data
- Basic statistical data can be included, e.g. inhabitants, CO_2-emission factors, transportation data
- Central update of databases is possible
- BEIs elaborated with the same tool or methodology are comparable
- Graphical and tabular data visualization can be included as well as automatic report generation
- Support by tool provider possible

Calculation tools for elaboration of BEI

The basic criteria that define a good calculation tool are:

- **Simple structure, concise, web based in a simple form**
- **Flexible** (easy to update or add new subcategories by the user)
- **Applicable in several communities** despite their diversity and characteristics
- **Easy access, easily understandable** by the user
- Bottom-up approach and check with regional or national figures or indicators **(combination of bottom-up and top-down approach)**
- Inputs can by detailed if possible or approximately based on estimations in case of missing data

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How to develop BEI

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1. Set boundaries and define clear scope
2. Define baseline year
3. Choose accounting approach
4. Choose GHGs to be included
5. Choose emission factors
6. Identify key target sectors

How to develop BEI

1 SET BOUNDARIES AND DEFINE CLEAR SCOPE

Territory

Suggestion: Base emission inventory on administrative boundaries – **NUTS(6)** - (Nomenclature of territorial units for statistics)

Type of GHG emissions that can be included (Covenant of Mayors)

1. **Direct emissions:** physically occur from sources in the administrative territory (mostly C02)
2. **Indirect emissions:** energy consumption (electricity, heating, cooling) consumed but not produced by the local territory
3. **Non-energy related direct emissions that occur in the territory:** C02, but also CH4 and N2O

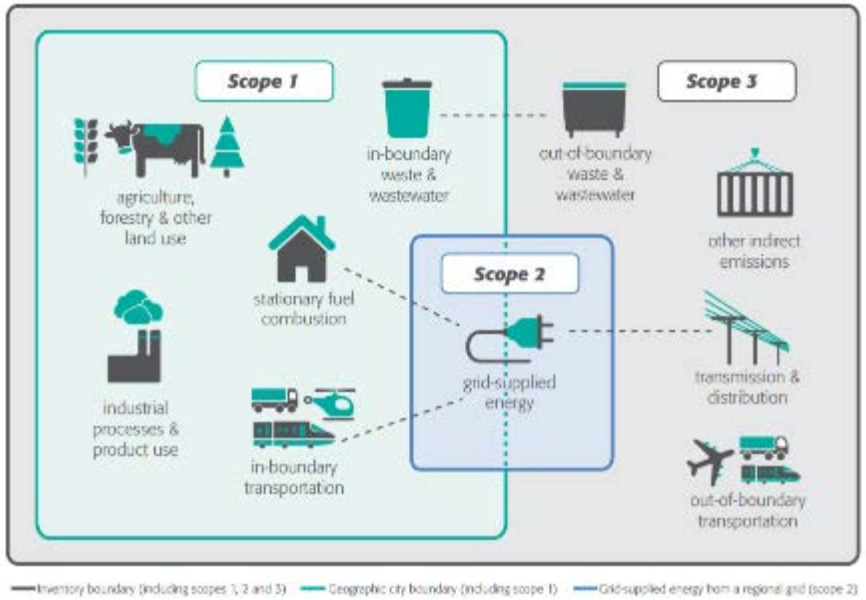
!! At least **scope 1 and 2 emissions** should be included in the carbon footprint, as these are most significant emissions associated with the territory.

How to develop BEI

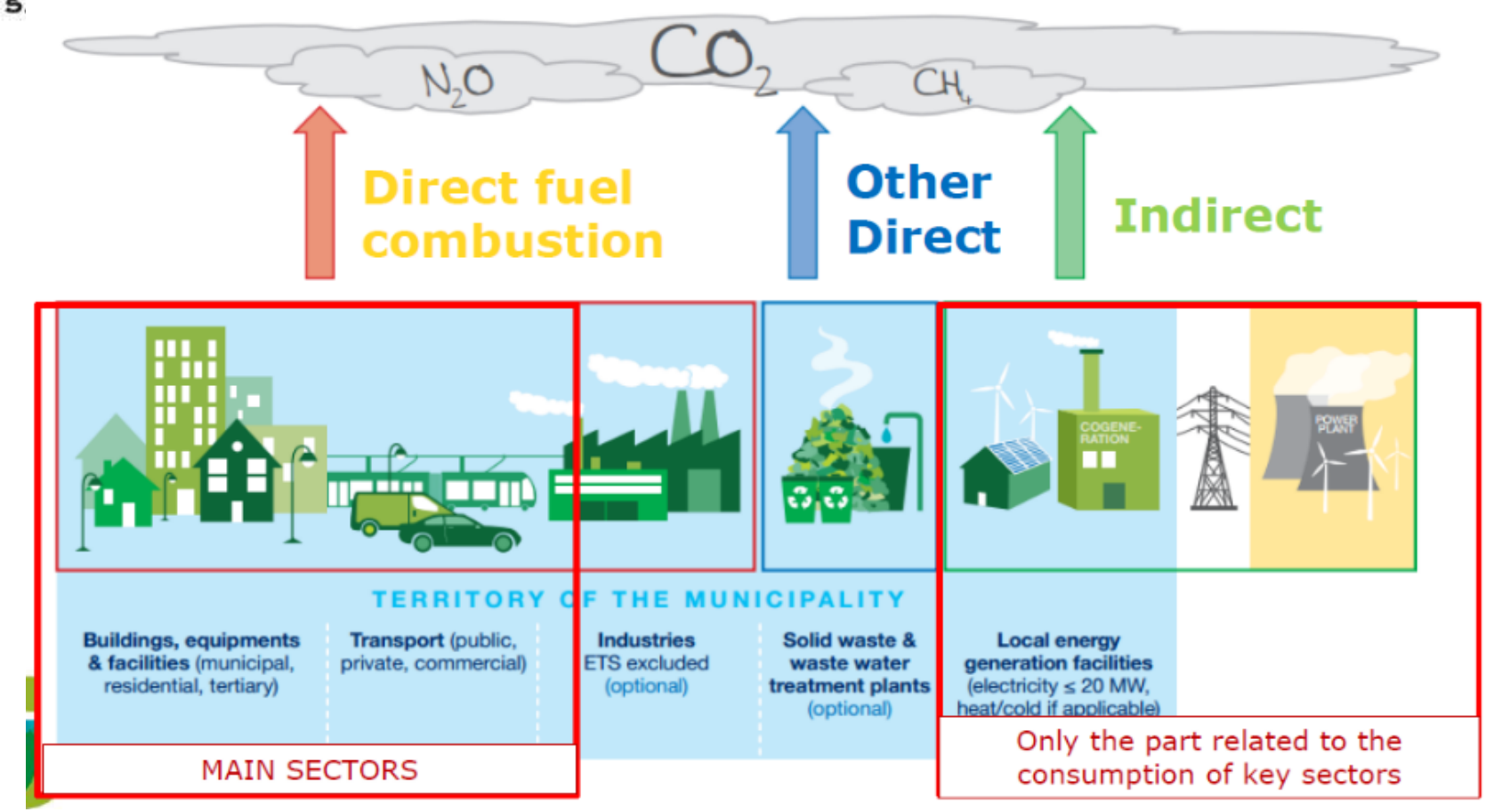
1: SET BOUNDARIES AND DEFINE CLEAR SCOPE

Greenhouse Gas Protocol methodology suggest the following:

Scope	Definition
Scope 1	GHG emissions from sources located within the city boundary.
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary.
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary.



How to develop BEI



How to develop BEI

2: BASELINE YEAR

- EU recommendation: **year 1990**

- However, you are free to choose the year for which you can get the most comprehensive and reliable data, **which should be the closest subsequent year, but not later than 2005?**
- In an exceptional case that a Signatory is unable to gather reliable data for any of the years between 1990 and 2005, it may use a later baseline year than 2005. Such a choice should be transparently justified in the SECAP.
- **Always keep the same baseline year**, even if targets change.

How to develop BEI

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3: ACCOUNTING APPROACH

Activity-based approach

- Emissions that occur due to energy consumption within the local territory, either **directly** (fuel combustion) or **indirectly** (consumption of electricity and heat/cold).
- The GHG emissions are directly estimated from the carbon content of the fuel.
- Approach used for the national reporting in the frame of UNFCCC and it is compatible with the EU binding legislation on climate and energy.
- Mostly CO2 emissions - emissions of CH4 and N2O are of secondary importance.

Life Cycle Assessment (LCA) approach

- Emissions from the whole supply chain (e.g. from the energy extraction to production, transport, use and recycling) and not only from the final combustion
- Offering more accurate picture of the emissions related to both energy production and use.
- **Internationally standardised approach**, supported by international iniciatives (UNEP, SETAC) and consistent with internationally agreed standards (UNFCCC, ISO).
- It is particularly suitable for assessing potential trade-offs between different types of environmental impacts associated with specific policy and management decisions.

How to develop BEI

4: GREENHOUSE GASSES TO BE INCLUDED

- Three main GHGs are cosidered to be CO2, CH4 and N2O.

- Inclusion of CH4 and N2O depends on whether measures to reduce also these greenhouse gases are planned in the local action plans, and on the approach chosen.

Activity-based:

- If only energy-related activity sectors are included in the BEI, it is sufficient to report only CO2 emissions.
- Other greenhouse gases can also be included in the BEI (from combustion, from waste and water management etc) if the activity-based approach is chosen.

In this case, the emission reporting should use unit "tonnes CO2 equivalent".

LCA:

- In the case of the LCA approach **other greenhouse gases** may play an important role.
- In this case emission reporting unit **"tonnes CO2 equivalent"** should be used.
- If the local authority uses a methodology/tool that does not include any other GHGs than CO2, then the inventory will be based on CO2 only, so the unit wil be „tonnes CO2"
- Use Global Warming Potential (GWP) values to convert CO2 to CO2-equivalents

How to develop BEI

5: EMISSION FACTORS

Choice of emission factors:

- **Activity-based/territorial approach offers option to use standard/default emission factors, according to IPCC guidelines (Intergovernmental Panel on Climate Change)**

Based on the Carbon content of fuels.

Advantages:

- Simple
- Easily accessible
- In line with international reporting (UNFCC, Kyoto protocol…).

- **LCA (Life Cycle Analysis) approach requires LCA emission factors (CoM, ELCD, GHG Protocol…)**

Include 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

How to develop BEI

6: IDENTIFY KEY TARGET SECTORS

WHAT TO INCLUDE:

- Emission inventories shall focus on energy-related sectors (e.g. municipal buildings and infrastructure, street lighting, public and private transport, services) for which local authorities have greater influence, even though the scope could be enlarged to other sectors in which they take specific actions (e.g. waste management, agriculture).

WHAT NOT TO INCLUDE (based on CoM):

- Emissions in sectors over which local authority has no control should be excluded:
- Large scale power plants >20 MW capacity
- Aviation and Shipping (except local ferries)
- Nuclear energy
- AFOLU Carbon Capture and Storage (CCS) technologies
- Emission credits purchased or sold on the carbon market
- All fugitive emissions from the supply chain
- Process emissions from industrial plants
- Other source included under the Industrial Processes and Product Use (IPPU) sector

Monitornig of BEI

Use the same tool

- Use the same tool you used for baseline emission inventory (web based, excel…)

Keep it consistent!

- Do not change methodology, data sets, approach, sectors

Recommendation: monitor on yearly basis

- Monitoring on yearly basis provides better understanding of the various factors that influence the CO2 emissions, allowing quicker reactions. Also specific expertise necessary for inventories can be maintained and consolidated.
- Interval can be chosen individualy – such as 2 or 4 years.

Recalculations

All emissions over time should be estimated consistently - as far as possible, the time series should be calculated using the same methods, data sources and boundary definitions in all years. However, there are a few occasions when recalculation of BEI is necessary to ensure that the reported trends in emissions reflect real changes in the emissions, instead of other factors:

1. Changes in inventory boundary:

Changes or adjustments in a city's administrative boundary, or changes in inclusion or exclusion of activities within the city boundary. But no emissions recalculations are needed for activities that either did not exist in the base year, or reflect a natural increase or decrease in city activities (known as "organic growth").

2. Changes in calculation methodology or improvements in data accuracy:

A city may report the same sources of GHG emissions as in previous years, but measure or calculate them differently (new information on local emission factors, correction of heat consumption for outside temperature etc.)

3. Industry delocalization
4. Adding or removing optional activity sectors
5. Discovery of significant errors
6. Methodological changes (not recommended, only if needed).

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Thank you!

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ENERGYCITIES Climate Alliance KOMMUNAL KREDIT PUBLIC CONSULTING EMY AEER Interakcia EEC-DDO UNION OF COMMUNITIES OF ARMENIA NOBLETMEDIA