CommitClimate CO_2 Simulator

SECTOR: BUILDINGS

interreg-baltic.eu/project/commit-climate

Interreg Baltic Sea Region
Co-funded by the European Union
ENERGY TRANSITION CommitClimate

Goal of the presentation

- What is included in the sector, which sub-sectors
- Calculation rationale
- Technical assumptions
- What can the user change? What cannot the user change? Linkages with other sectors
- List of policy measures
- Policy measures working principle

Buildings Sector

- The sector includes emissions from consumption of energy consumption in buildings, equipment and facilities
- Includes energy consumption for heating & cooling, lighting and appliances, cooking
- Sub-sector breakdown:
  - Municipal buildings
  - Residential buildings
  - Public infrastructure
    - Public lighting
    - Municipal water supply & wastewater treatment
  - Other
    - Commercial and Tertiary sector
    - Industry and Construction
    - Agriculture and Forestry
    - Other

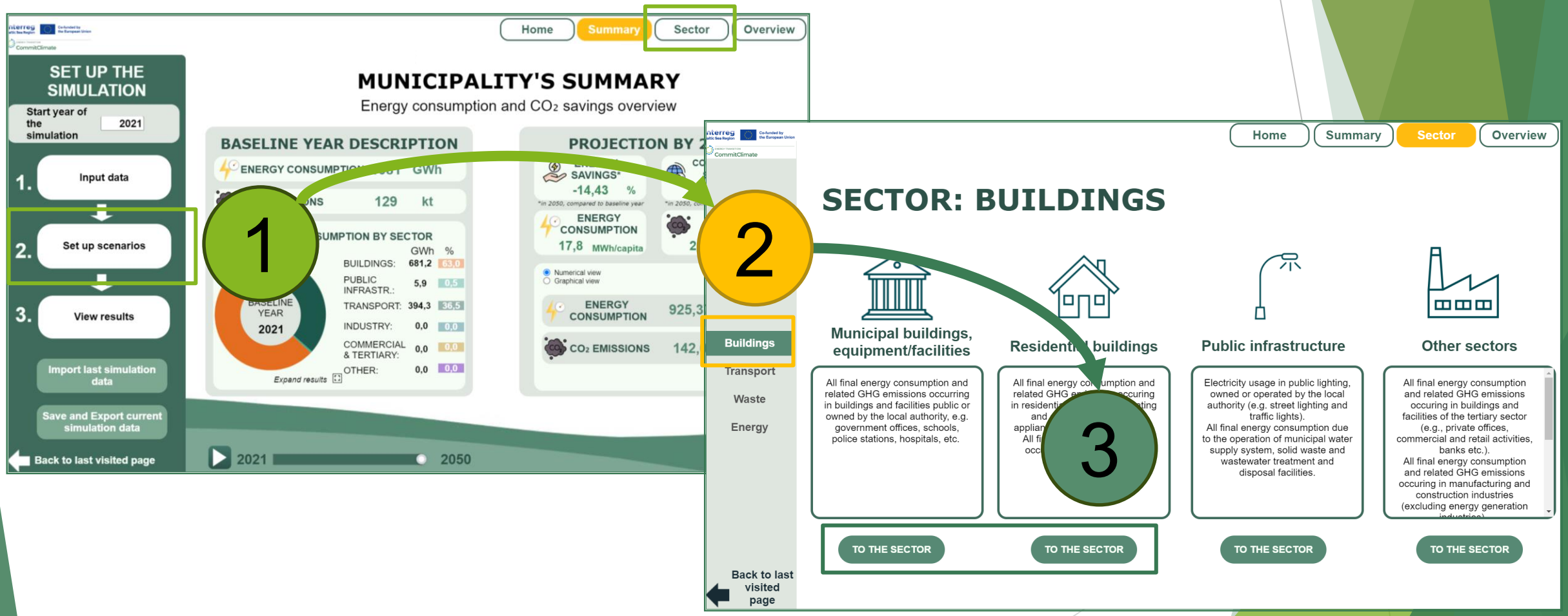
Policy application caution!

- *NB! Please note that emissions are also influenced by developments in the energy sector. As a result, changes in emissions may occur in the policy scenario even if no policies are applied within this sector.*

Adjustments to these outcomes can be made by modifying policies in the local energy production sector.

Approach to calculating emissions in municipal and residential buildings

Navigation to energy consumption in buildings



Approach to calculating emissions from energy consumption in buildings I

- The calculation of emissions is based on three variables:
  - Building area (m^2)
  - Specific energy consumption (kWh/ m^2 /year)
  - Emission factor (tons CO_2 /MWh)

$$E = area \times SC \times EF$$

where

E	*- CO2 emissions (tonnes/year)*
Area	*- area (m^2)*
SC	*- specific conumption (kWh/ m^2 /year)*
EF	*- emission factors (tonnes CO_2 /MWh)/1000*

Approach to calculating emissions from energy consumption in buildings II

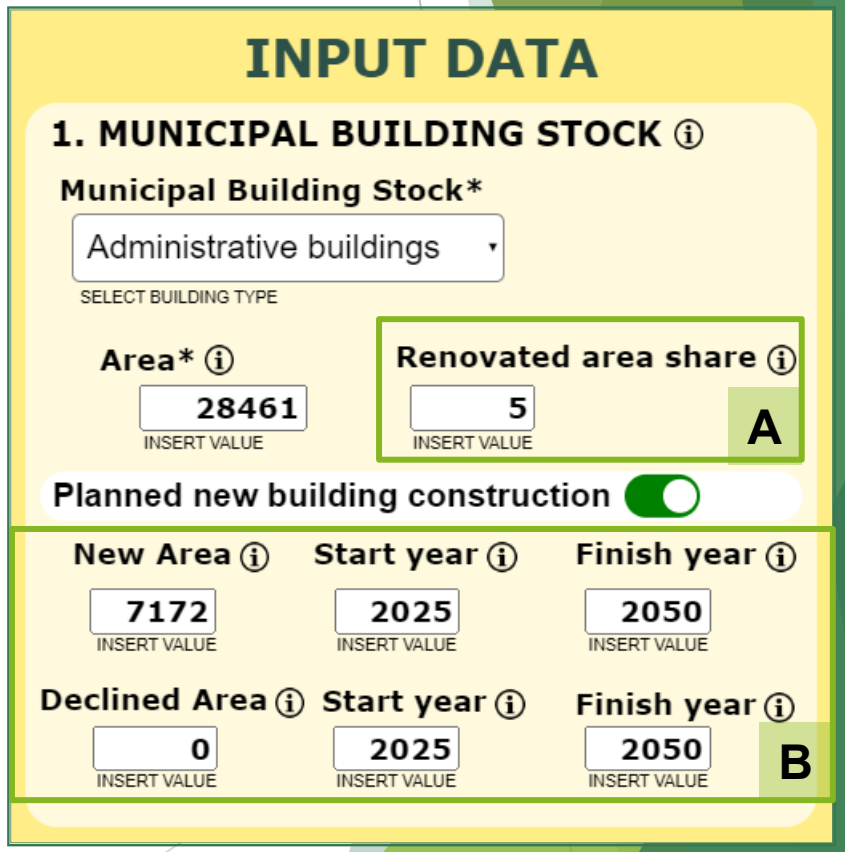
1. Area of the building group (I)

- The area of the building group is a mandatory input. The simulator will not generate results if the total area of the buildings is equal to 0 m^2 (in some groups the area of the buildings may be 0)
- The total area of the building group must be specified in square meters
- The building groups available for municipal buildings are:
  - Schools
  - Kindergartens
  - Administrative buildings
  - Sports facilities
  - Hospitals
  - Cultural facilities
  - Other
- The building groups available for residential buildings are:
  - Single family detached
  - Single family attached
  - Large multi-family
  - Other

Approach to calculating emissions from energy consumption in buildings III

1. Area of the building group (I)

- If it is known that the municipality plans to build new buildings or demolish existing buildings, this can be indicated by specifying the planned construction/demolition area and time frame in the input data section (B). The simulator will add/remove this building area to the buildings of the specific group linearly over the specified time and will take it into account in the calculation of the emissions of the baseline scenario. In the calculations, specific energy consumption values in accordance with building codes are applied to new buildings.
- If the proportion of renovated buildings is known, it is possible to specify it for each building group in the input data section (A). Renovated buildings are understood as those in which further improvement will not result in energy consumption savings. Renovated buildings will not be included in the energy consumption reduction potential.



Approach to calculating emissions from energy consumption in buildings IV

2. Specific energy consumption (I)

- There are three types of energy consumption in buildings:
  - Electricity consumption (kWh/m^2/year)
  - Heat energy consumption (kWh/m^2/year)
  - Cooking gas consumption (m^3/year)
- It should be noted that electricity consumption refers to electricity consumption for lighting and equipment. If a building uses electric heating, electricity consumption in this case should be included in heat energy consumption.
- By default, the Simulator uses the assumption of the average specific electricity and heat energy consumption in the country. The user has the option to change the assumed values in the Technical Assumptions section.
- Existing buildings and New buildings (applicable if an assumption has been made about the construction of new buildings) may have different specific energy consumption. The user has the option to change the assumed values in the Technical Assumptions section.

Technical assumptions for calculating energy consumption in buildings I

- The user has the option to change the technical assumptions underlying the energy consumption calculations. These include:
  - (1) Average specific energy consumption (can be changed for different building groups, can be changed for existing and new buildings)
  - (2) Heat supply—centralized or individual (can be changed between existing and new buildings)
  - (3) Individual heating data:
    - Fuel mix in individual heating
    - Average heat losses
    - Boiler efficiency
  - (4) Current RES electricity generation
- Technical assumptions regarding emission factors for different fuels and energy types can be viewed and changed in the Simulator section “Energy”.

NB! If the user does not make any changes to the technical parameters, built-in default values are used for calculations. Default values most often reflect national averages or are based on expert assumptions.

Technical assumptions for calculating energy consumption in buildings II

- *(1A) Average specific energy consumption*

Heat energy consumption in municipal and residential sector buildings, considering the proportion of renovated buildings (existing buildings).

User input data on the proportion of renovated buildings in each building group (%), **B**

*Enter in the Input data section

Specific heat energy consumption in unrenovated buildings (E=A/C)

*Calculated

User data or default technical assumptions about the average specific electricity and heat consumption in each building group (kWh/ m^2 /year), **A**

*Enter information in the Technical assumptions section for “Municipal buildings” in ”Residential buildings”

Specific heat energy consumption in renovated buildings (F=(1-D/100)*E)

*Calculated

Average heat savings due to renovation (40%), **D**

*Assumption

Proportion of unrenovated buildings in each building group in percentage (100 – **B**)

*Calculated

C=(1-D/100)*B + (1-D/100)

Technical assumptions for calculating energy consumption in buildings III

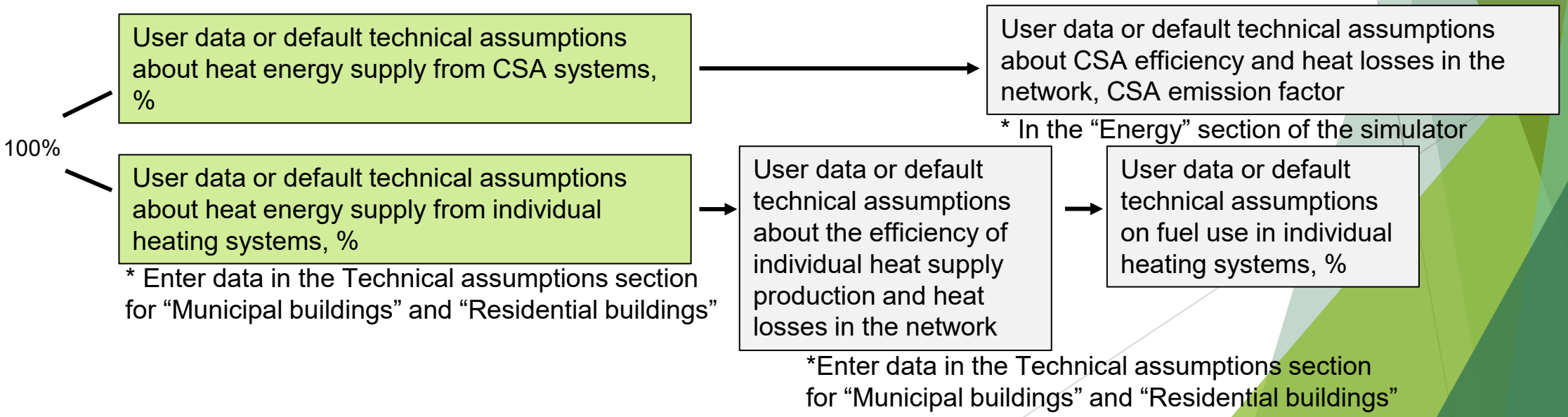
- *(1B) Average specific energy consumption*

Electricity and cooking gas consumption in municipal and residential buildings

- The user has the option to change the technical assumptions regarding the average specific electricity consumption in municipal and residential buildings, expressed in kWh/m^2 /year of electricity
- The average specific electricity consumption can be changed depending on: building group (schools, kindergartens, administration buildings, etc.) and building type (existing buildings or new buildings)
- The user indicates the cooking gas consumption, if applicable (default value is 0). The applied unit is m^3 /year

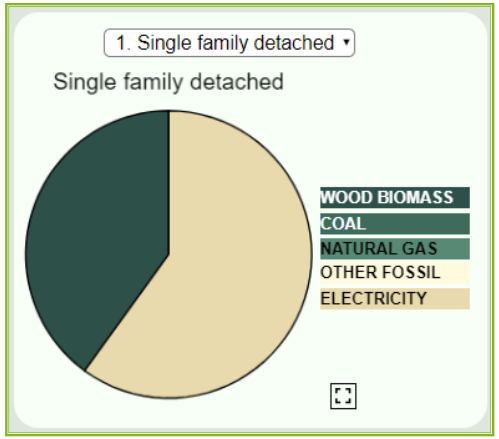
Technical assumptions for calculating energy consumption in buildings IV

- *(2) Heat supply in municipal and residential buildings by type*
- Heat supply in buildings is considered in two ways:
  - Centralized
  - Decentralized (individual heating)
- The user must specify the percentage for both types of heat supply

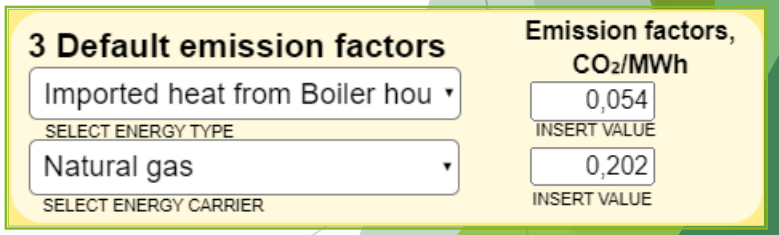


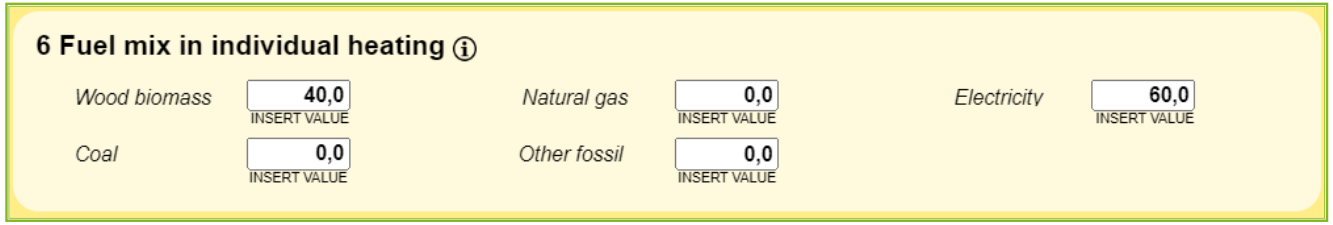
Technical assumptions for calculating energy consumption in buildings V

- *(3) Individual heating data*
- To accurately assess emissions from individual heating in municipal and residential buildings, the percentage distribution of fuel usage must be indicated. The most common forms of fuel in individual heating are available:
  - Wood biomass
  - Coal
  - Natural gas
  - Other fossil
  - Electricity



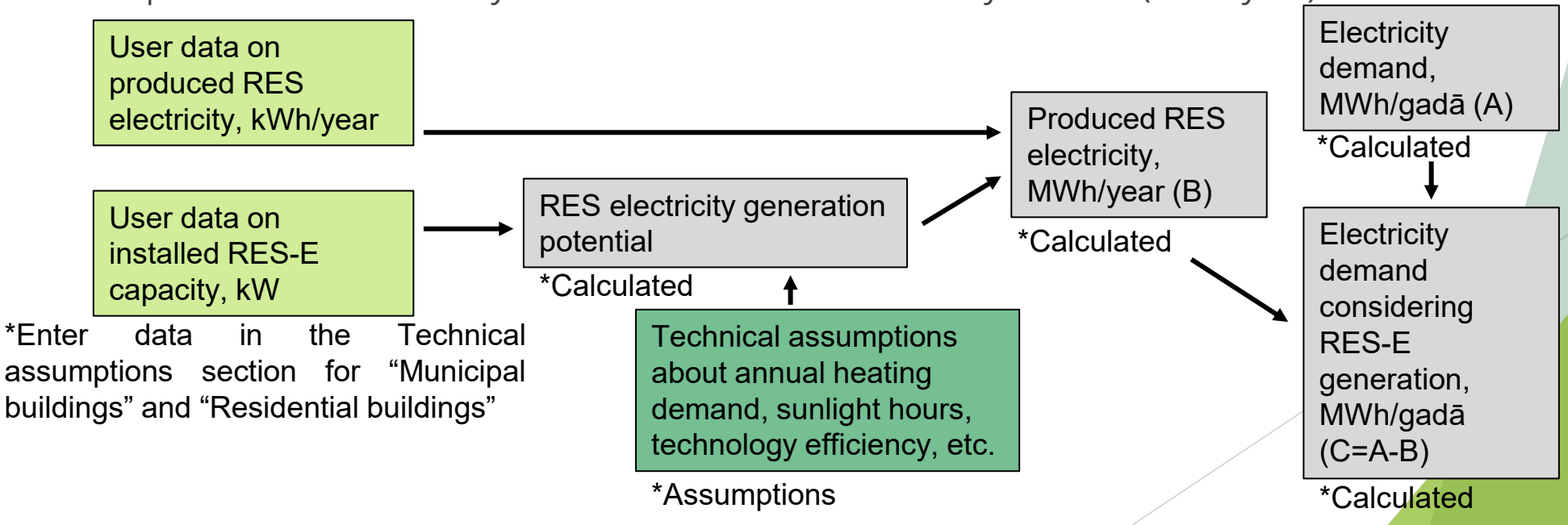
The CO_2 emission factors used for each fuel type can be viewed and changed in the Simulator section “Energy” -> “Change technical assumptions”





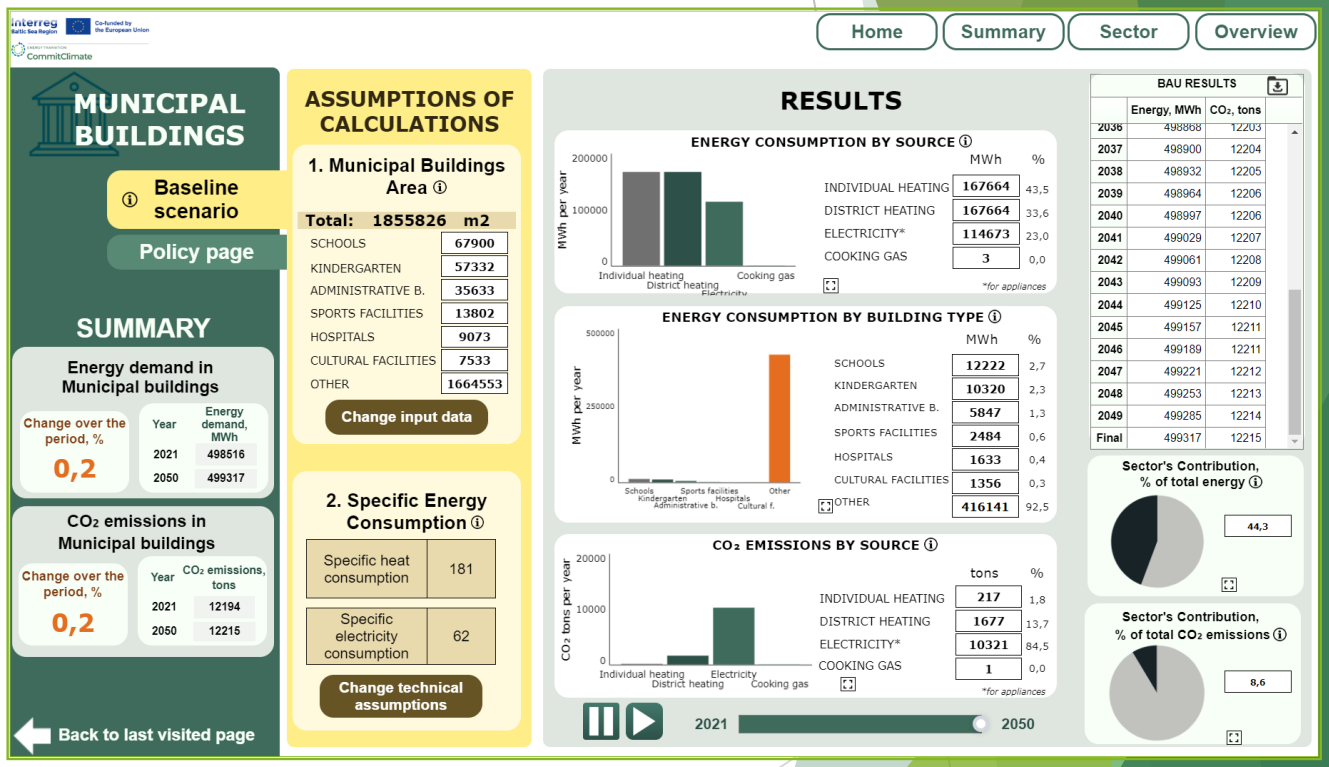
Technical assumptions for calculating energy consumption in buildings VI

- *(4) Current RES electricity generation*
- If the municipality is already using RES electricity sources (both in municipal buildings and in the residential sector), this can be considered in the calculation of the baseline scenario.
- The user must specify the installed electricity generation capacity (kW) or the amount of electricity produced (kWh/year)
- The produced RES electricity is subtracted from the electricity demand (MWh/year)



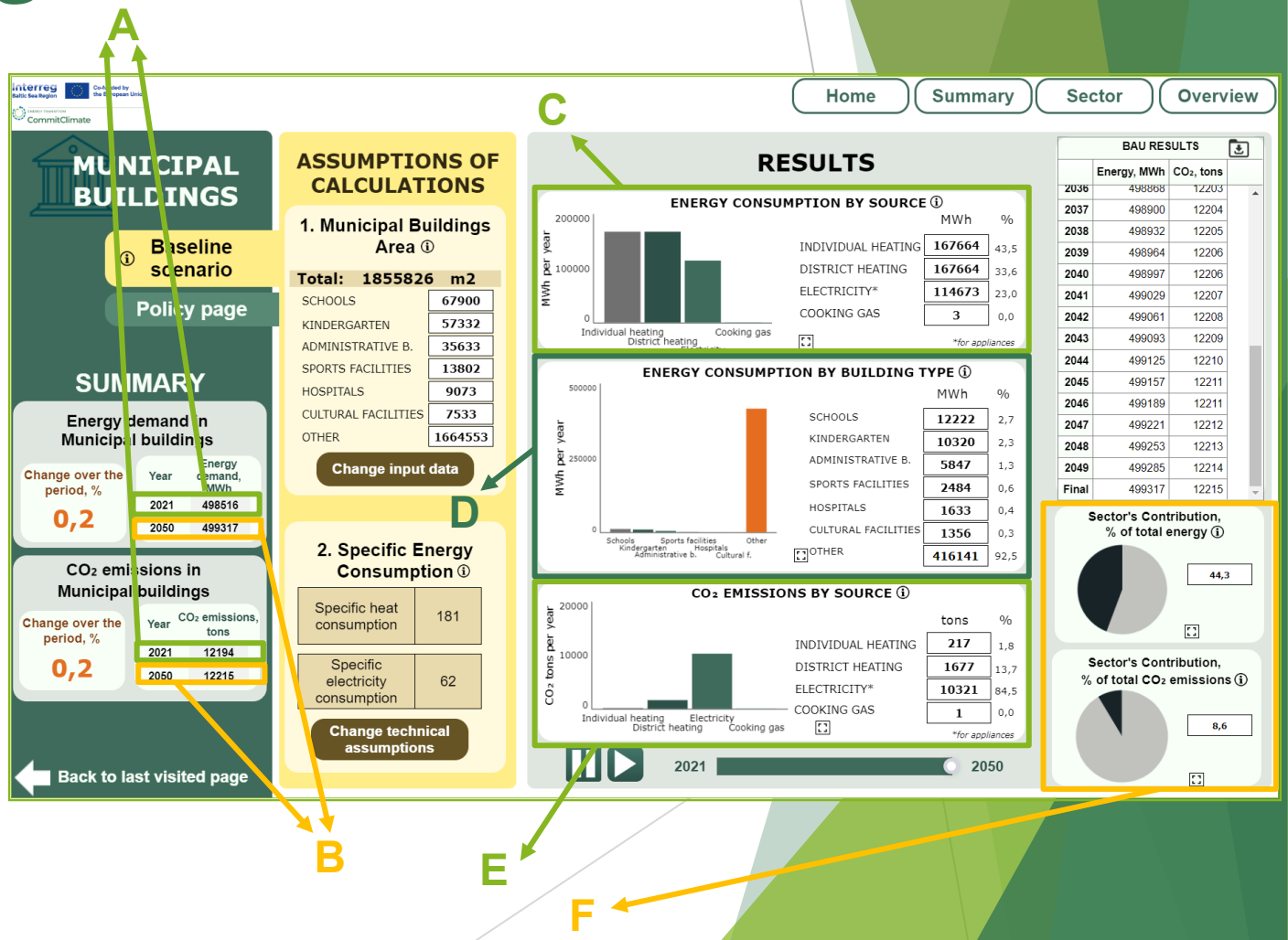
Baseline scenario for energy consumption in buildings I

- After the user has input data for the building sector and specified technical assumptions (optional), the Simulator can calculate the energy consumption and associated CO_2 emissions of the building sector in the baseline scenario.
- The baseline scenario describes the continuation of the current situation (in the base year) considering changes in the building stock (if applicable)
- The baseline scenario is visible in the first view after opening the sector page.



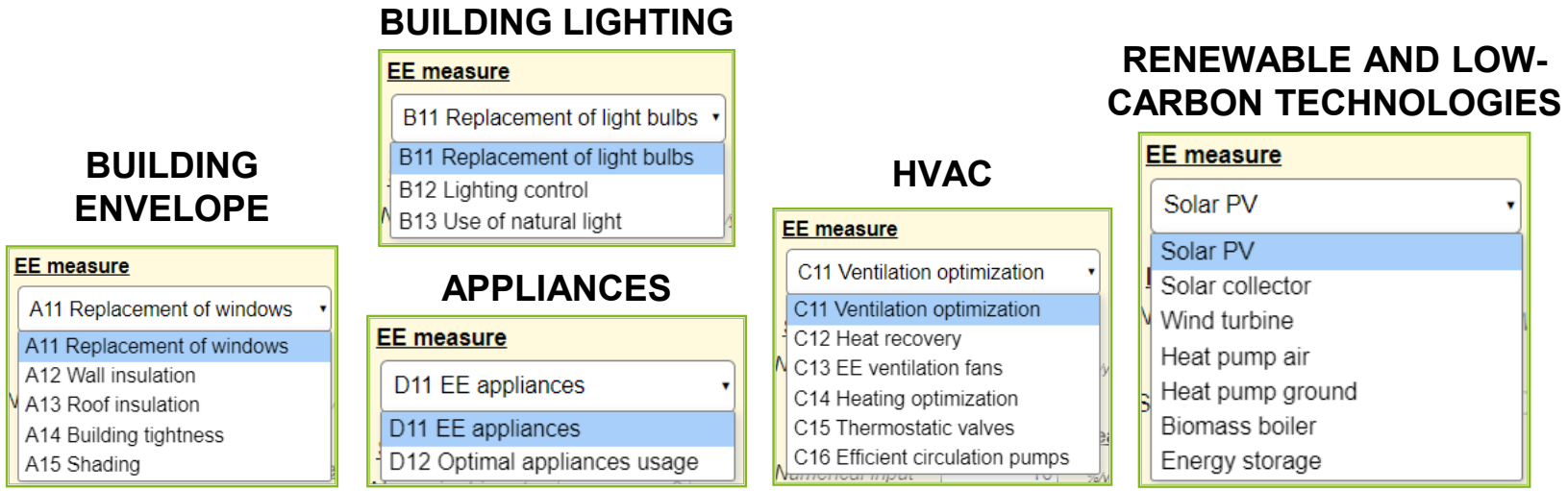
Baseline scenario for energy consumption in buildings II

- The baseline scenario is visible in the first view after opening the sector page
- In the baseline scenario, it is possible to view the results for:
  - Energy demand and GHG emissions in the Baseline year (A)
  - Energy demand and GHG emissions in 2050 (B)
  - Energy consumption breakdown by energy type (C)
  - Energy consumption breakdown by building type (D)
  - GHG emission breakdown by energy type (E)
  - Sector's contribution of total energy consumption and GHG emissions in the municipality (F)



Policy measures in the buildings sector

- The user can analyze the impact of various policy measures on energy consumption and CO_2 emissions in the buildings sector. The most detailed analysis is available in the municipal buildings sector.



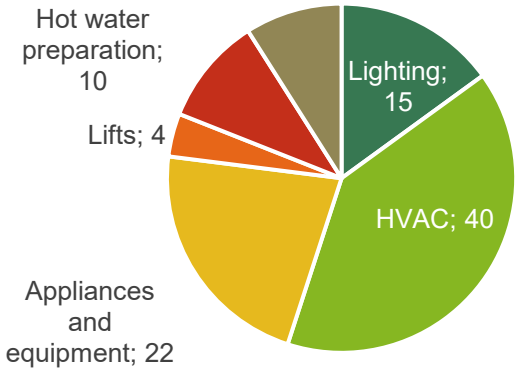
- An aggregated approach to assessing energy efficiency measures in the residential building sector
  - Renovation of building stock
  - Electricity saving measures
  - Renewable and low-carbon technologies

Technical assumptions for calculating energy consumption savings in buildings I

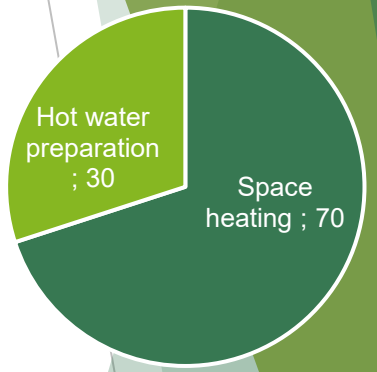
1. Municipal buildings

- An assumption* has been made about the distribution of electricity and heat consumption in municipal buildings.
- An assumption* has been made about the typical maximum achievable energy consumption savings in percentage for each measure:

Electricity consumption in municipal buildings, %



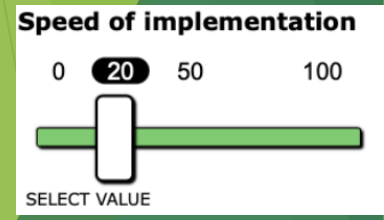
Heat consumption in municipal buildings, %



Policy code	A11	A12	A13	A14	A14	B11	B12	B13	C11	C12	C13	C14	C15	C16	D11	D12
% savings	15	40	10	5	5	80	5	5	10	10	10	10	10	10	20	10

**These assumptions can be adjusted by the user but its optional*

- The user-specified "Speed of implementation" (%/year) of the measure determines how quickly energy savings will be achieved.



Technical assumptions for calculating energy consumption savings in buildings II

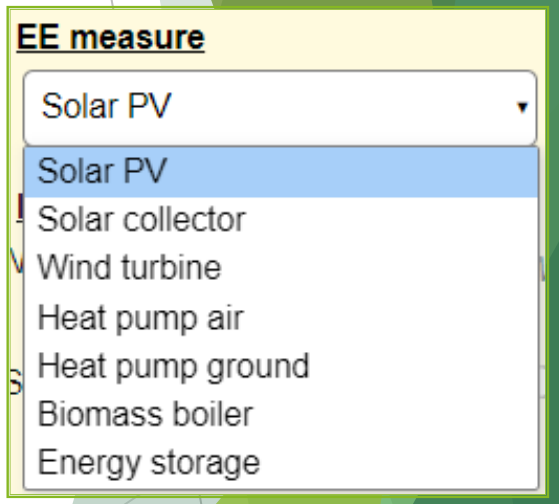
2. Residential buildings

- The speed of the building renovation policy (%/year) determines the speed at which the stock of unrenovated buildings (CO_2) is transferred to the stock of renovated buildings in each of the building groups:
  - Single-family houses
  - Multi-apartment houses
  - Other houses
- A typical reduction in heat energy consumption is assumed for renovated buildings – 40% (the value can be changed in the technical assumptions section of the Residential buildings policy)
- The speed of the electricity consumption reduction policy (%/year) determines the speed at which the potential for reducing electricity consumption or the typical reduction is achieved (the default value is 30%, but the user can change it in the technical assumptions section of the Residential buildings policy)

Technical assumptions for implementing renewable and low-carbon technologies policies in buildings

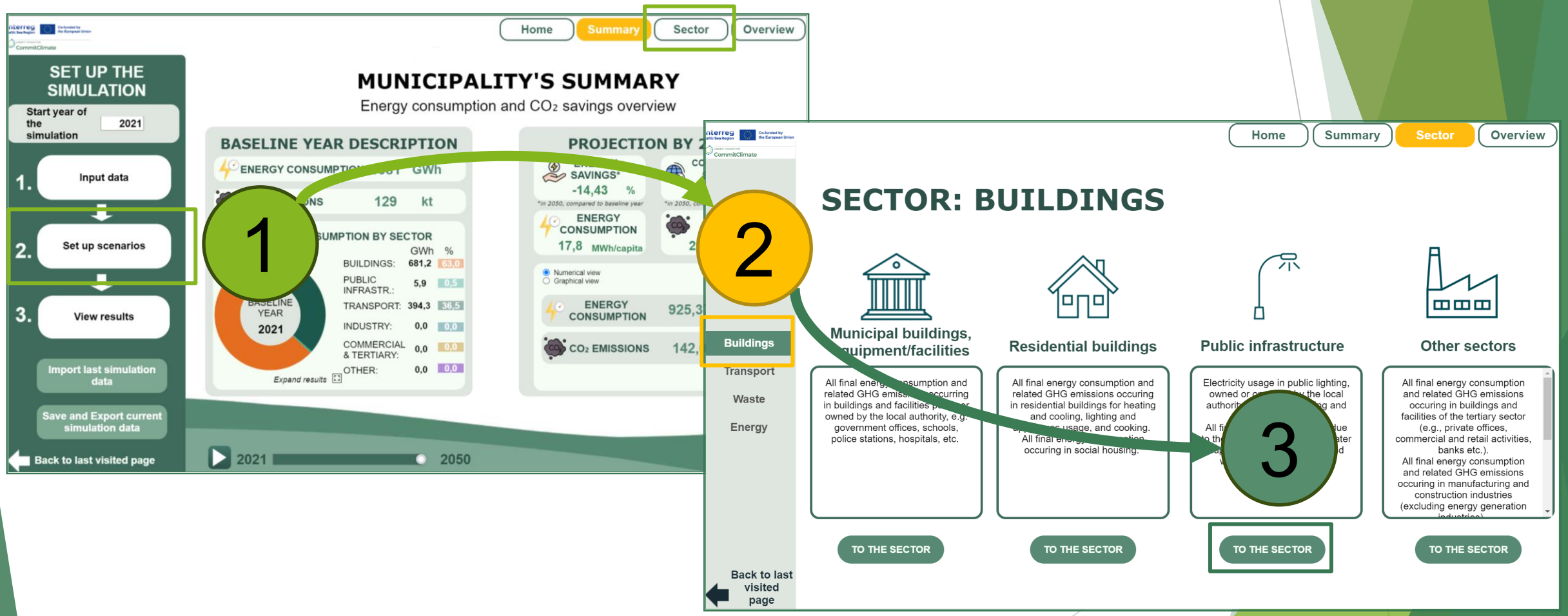
- One of the proposed measures is the wider use of renewable and low-carbon technologies in municipal and residential buildings
- The user has the opportunity to select a technology from the given list, indicate the desired achievable installed capacity (kW) and the year of achieving the goal
- Based on technical assumptions such as annual heating demand, sunlight hours, technology efficiency, etc., the Simulator calculates the RES energy production potential.
  - These values can be adjusted by selecting «specify calculation parameters». This step is optional and only required if more detailed customization is needed.
- It is assumed that RES energy replaces:
  - Heat pumps and solar collectors -> replaces individual heat demand
  - Biomass boiler -> adds biomass use to individual heat supply
  - RES electricity generation, energy storage -> reduces electricity demand
  - Increase in electricity consumption due to installation of heat pumps -> increase in electricity demand

RENEWABLE AND LOW-CARBON TECHNOLOGIES



Approach to calculating emissions in the public infrastructure sector

Navigation to the public infrastructure sector



Approach to calculating emissions in public infrastructure I

- The basis for the emission calculation is:
  - Electricity consumption (MWh/year)
    - Public lighting
    - Drinking water preparation facilities
    - Wastewater treatment facilities
  - Electricity emission factors (t CO_2/MWh)

$$E = EC_{lighting} \times EC_{drinking\ water} \times EC_{wastewater} \times EF$$

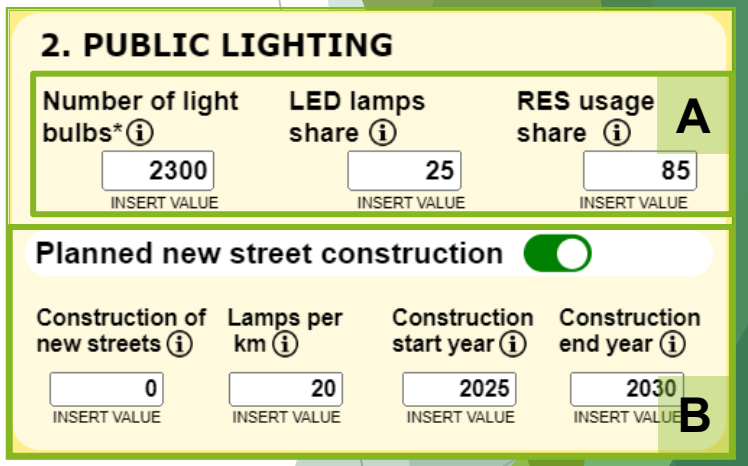
where

E	*- CO2 emissions (tonnes/year)*
$EC_{lighting}$	*- Electricity consumption public lighting (MWh/year)*
$EC_{drinking\ water}$	*- Electricity consumption drinking water preparation (MWh/year)*
$EC_{wastewater}$	*- Electricity consumption wastewater treatment (MWh/year)*
EF	*- emission factors (tonnes CO2/MWh)*

Approach to calculating emissions in public infrastructure II

1. Public lighting

- If the public lighting sector is included in the CO_2 emission baseline calculation, the number of existing lighting bulbs (required information) must be specified in the Simulator input data (A). If the number of bulbs is specified as 0 (default value), the sector will not be included in the emission baseline calculation
- Additional information to be specified to specify the calculation is: share of LED bulbs from total bulbs (%) and RES electricity use (% of LED bulbs)
  - The Simulator uses assumptions about the input power of conventional and LED bulbs (W) and the number of lighting hours per year (h/year) to calculate electricity consumption for public lighting
  - Assumption values can be changed in the Technical assumptions section of the Public infrastructure sector
- If the municipality plans to build new streets, thereby increasing the number of lighting bulbs, this can be specified in the Input data (B). This information will be taken into account in the baseline scenario calculation



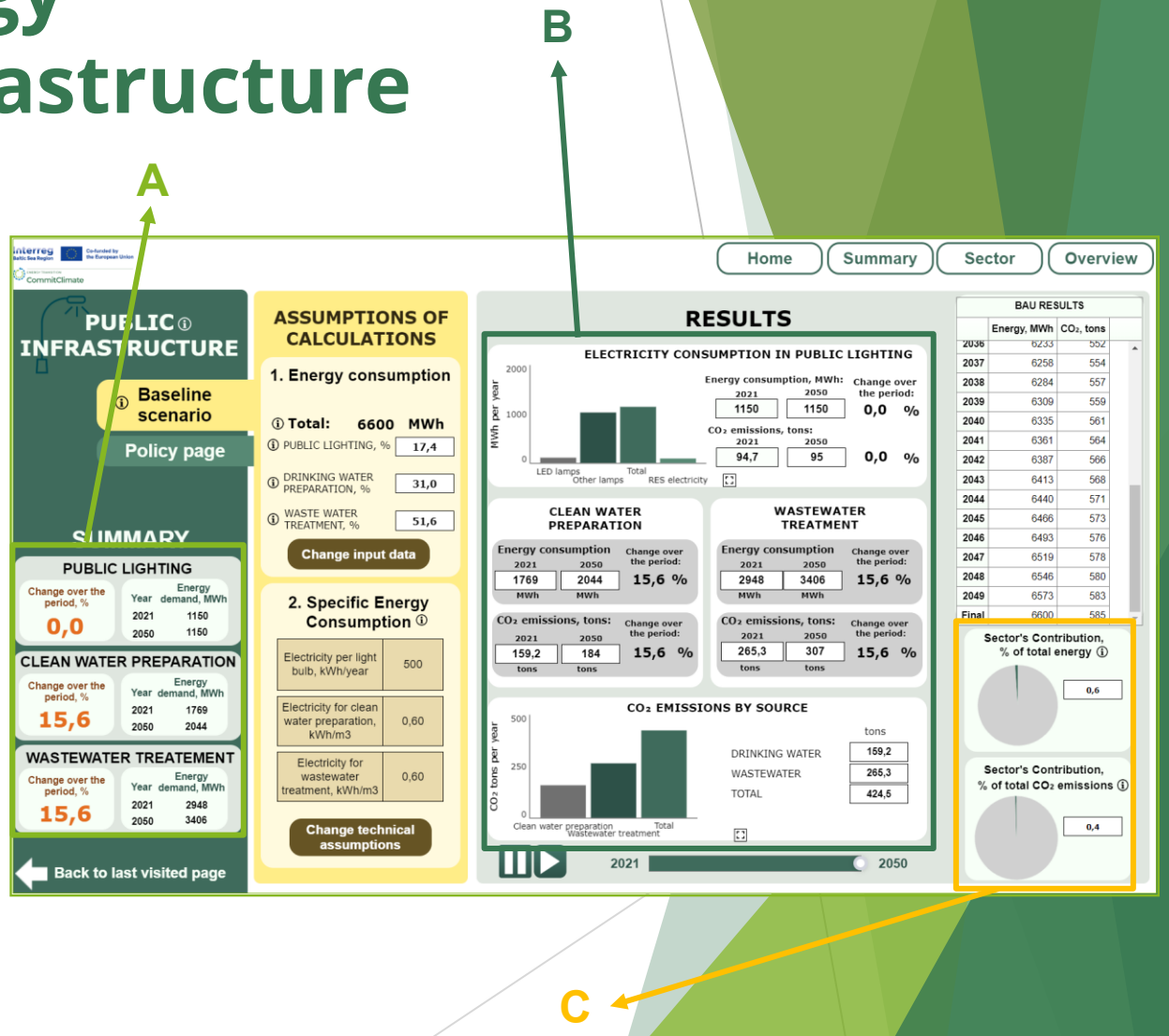
Approach to calculating emissions in public infrastructure IIi

2. Drinking water preparation facilities, Wastewater treatment facilities

- Water management-related electricity consumption is automatically included in the baseline calculation based on the input data on the population.
- The simulator uses technical assumptions about the average specific clean water consumption per capita (m^3 per day) and wastewater generation (m^3 per day), as well as unit electricity consumption per m^3 of clean water and wastewater.
- The technical assumptions can be changed by the user in the Public infrastructure sector technical assumptions section
- If it is possible to predict changes in water consumption or management-related electricity consumption (increase or decrease), this can be taken into account in the baseline scenario calculation by indicating it in the technical assumptions

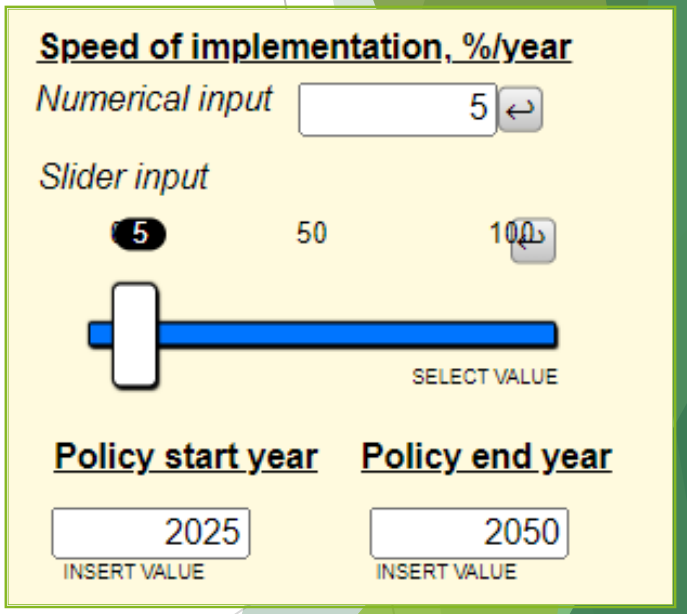
Baseline scenario for energy consumption in public infrastructure

- After the user has input data on the population and number of light bulbs and specified technical assumptions (optional), the Simulator can calculate the public sector energy consumption and related CO_2 emissions in the baseline scenario.
- The baseline scenario describes the continuation of the current situation (in the base year), but taking into account changes in the number of light bulbs, population and technical indicators (if applicable)
- The baseline scenario is visible in the first view after opening the sector page (Fig.)
- In the baseline scenario, it is possible to view the results for:
  - Energy demand and GHG emissions in the Baseline year and 2050 by each sub-sector (A)
  - Total and specific electricity demand and emissions in Public infrastructure sector, breakdown by subsectors (B)
  - Sector's contribution of total energy consumption and GHG emissions in the municipality (C)



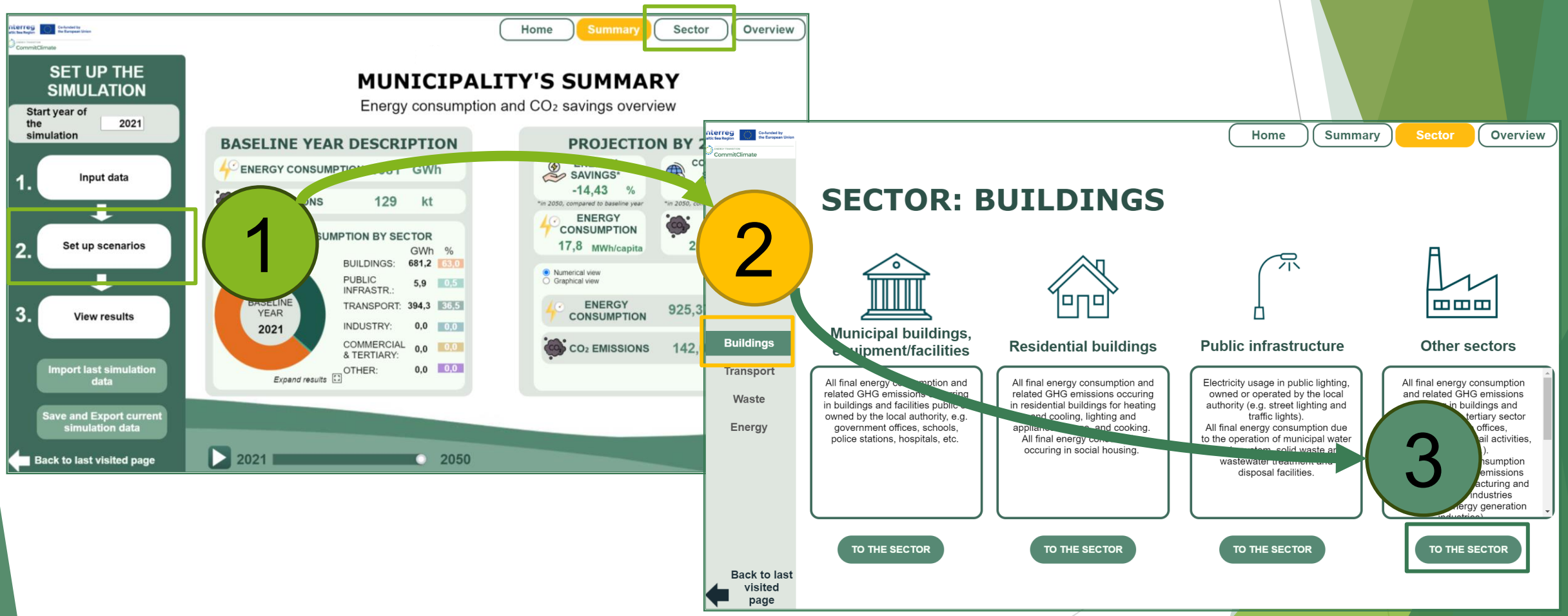
Policy measures in the public infrastructure sector

- The user has the opportunity to analyze the impact of various policy measures on electricity consumption and CO_2 emissions in the public infrastructure sector
  - Replacement of inefficient light bulbs in public lighting
  - RES usage in public lighting
  - Energy efficiency improvement in clean water preparation and wastewater treatment
  - Decrease in clean water consumption and wastewater generation
- The user-specified “Speed of implementation” (%/year) of the measure determines how quickly the energy consumption savings will be achieved
- The user-specified “Year of measure start” of the measure determines when the implementation of the measure that results in the energy consumption reduction will start.



Approach to calculating emissions in “Other sectors”

Navigation to other sectors



Approach to calculating emissions in Other sectors I

- The inclusion of this sector in the calculation of the emission baseline is not mandatory
- The basis for the emission calculation is aggregated data on energy consumption (MWh/year) in the following sectors:
  - Commercial and Tertiary
  - Industry and Construction
  - Agriculture and Forestry
  - Other
- The calculation is based on user-specified information on the consumption of different fuel types and the corresponding emission factors

$$E = EC_{lighting} \times EF$$

where

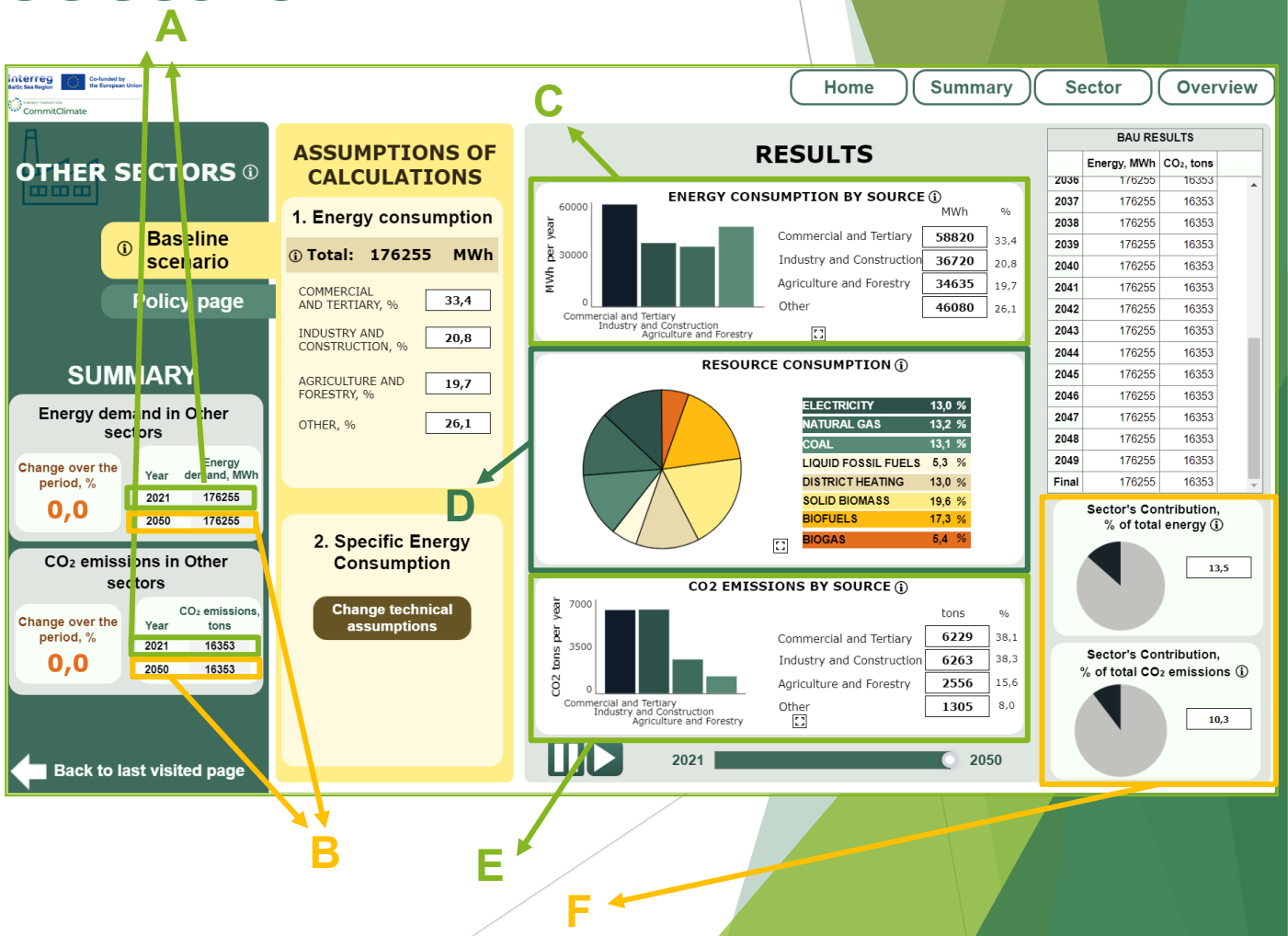
E	*- CO2 emissions (tonnes/year)*
$EC_{lighting}$	*- Electricity consumption (MWh/year)*
EF	*- emission factors (tonnes CO2/MWh)*

Approach to calculating emissions in Other sectors II

- The user specifies energy consumption information in the Other sectors section "Technical assumptions", entering statistical data on energy consumption in each sub-sector
- The types of fuels offered include:
  - Electricity
  - Natural gas
  - Coal
  - Liquid fossil fuels
  - District heating
  - Solid biomass
  - Biofuels
  - Biogas
- If there are known prerequisites that energy consumption tends to increase or decrease, it is possible to indicate here the rate at which energy consumption changes in each of the sub-sectors in the base scenario.
  - By selecting the button “Use RES to cover the projected energy demand increase”, an additional input field appears, allowing the user to define what share of the increased energy demand will be covered by renewable energy sources (RES). This share is then assigned an emission factor of 0 tCO_2/MWh. If this option is not selected, the increase in energy demand is distributed according to the initial fuel mix defined in the baseline assumptions, and the corresponding emission factors are applied accordingly.
- If in Other sectors RES electricity is produced, this can be indicated in the technical assumptions. The amount of RES electricity is subtracted from the total electricity demand.

Baseline scenario for energy consumption in Other sectors

- After the user has entered data on energy consumption by fuel type in Other sectors (optional) in the technical assumptions section, the Simulator can calculate the energy consumption and associated CO_2 emissions of Other sectors in the baseline scenario.
- The baseline scenario describes the continuation of the current situation (in the base year)
- The baseline scenario is visible in the first view after opening the sector page (Fig.)
- In the baseline scenario, it is possible to view the results for:
  - Energy demand and GHG emissions in the Baseline year (A)
  - Energy demand and GHG emissions in 2050 (B)
  - Energy consumption breakdown by sub-sector (C)
  - Energy consumption breakdown by energy carrier (D)
  - GHG emission breakdown by sub-sector (E)
  - Sector's contribution of total energy consumption and GHG emissions in the municipality (F)



Policy measures in Other sectors

- The user can analyze the impact of policy measures on electricity consumption and CO_2 emissions in Other sectors
- Since the sector is viewed with aggregated data, the analysis of possible policy measures is also done in an aggregated manner. The user indicates:
  - the rate (%/year) at which energy efficiency measures are implemented in each of the sub-sectors, allowing for energy consumption savings to be achieved
  - the year from which annual energy consumption savings will be achieved
- In addition, one of the proposed measures is the wider use of renewable and low-carbon technologies. The user can select a technology from the given list, indicate the desired achievable installed capacity (kW) and the year of achieving the goal. Based on such technical assumptions as annual heating demand, sunlight hours, technology efficiency, etc., the Simulator calculates the RES energy production potential.

CommitClimate CO_2 Simulator

SECTOR: BUILDINGS

To view information on the emission calculation approach in other sectors, go to the sections “Transport”, “Waste”, “Energy”

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