

Global Common Carbon Metric approach

Joint UN Environment - UNFCCC Workshop
Mitigation in the building sector

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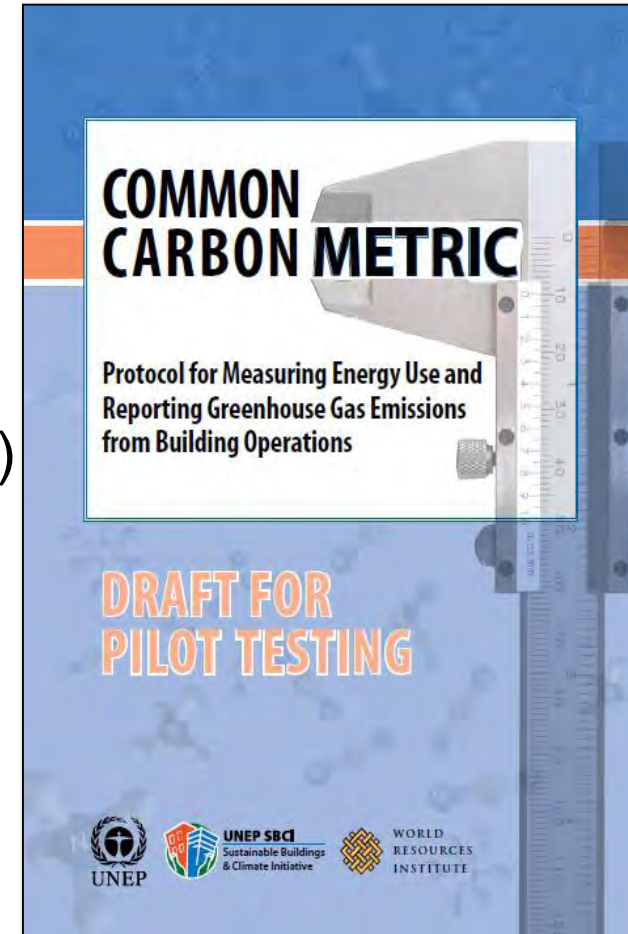
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Outline of the presentation

- Overview of CCM approach
- CCM 1.0 pilot 1
- CCM 1.0 pilot 2
- CCM 2.0
- Insights from testing of CCM 2.0

The Common Carbon Metric (CCM)

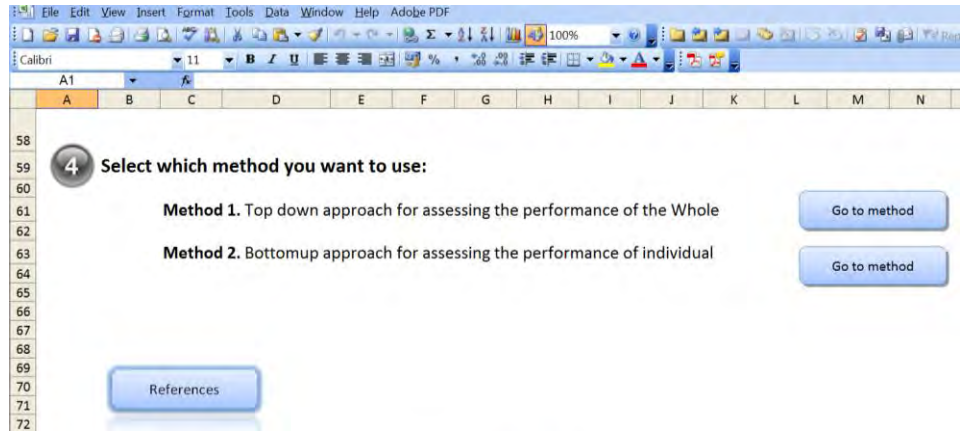
- Measuring Energy Use & Reporting GHG Emissions from Building Operations
- CCM protocol and Excel based tool
- Developed by UNEP: SBCI
- Meets the requirements that reporting is measurable, reportable and verifiable (MRV)
- Phase 1 pilot: 2010-2011
- Phase 2 pilot: 2011-2012
- Energy: **kWh/m²/yr**
kWh/occupant/yr
- Emissions (equivalent (e)): **kgCO₂e/m²/yr**
kgCO₂e/occupant/yr



CCM methodology

- **Top-down approach:** Performance of the *whole* (regional, city or national level) is characterized at a coarse level using *estimated* data on fuel and electricity consumption.

- **Bottom-up approach:** Performance of individual case-study buildings is characterized at a fine level using *measured* data on fuel and electricity consumption.
 - Ideally sample size will be statistically valid, enabling verification of the *whole*.



Top-down approach: data requirements

- **Area of the Whole** (m²).
- **Total occupancy** of the whole (number of occupants, or number of residents where information on occupancy is limited).
- Information on the **percentage** of the Whole's **occupants** and **building area** attributable to different categories of building stocks (%).
 - At a minimum for : residential and non-residential buildings.
- Information on the **total amount of electricity** consumed by the Whole and on the amounts of **different types of fuels** used
- Information on the percentage of the **Whole's electricity and fuel use** that is **attributable to different categories of building stocks** (%).
- **Custom emission factors** may optionally be provided in place of the **default emission factors for electricity and fuel use**.

Bottom-up approach: data requirements

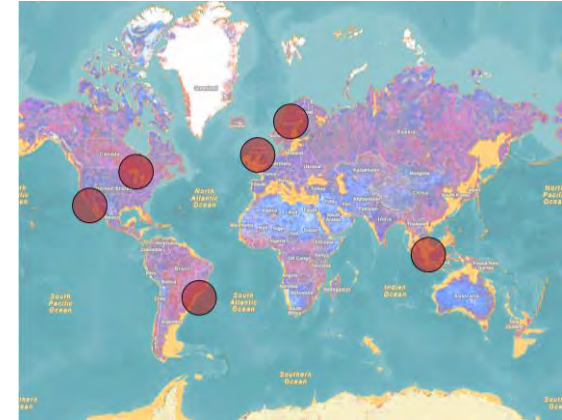
- **Descriptive information**, including **building name**, **building category**, year of construction and year of last major retrofit, and address.
- **Occupancy** (number of occupants) and **area** (m²).
- Data on the **total amount** of purchased and **metered electricity** (in kWh).
- Data on the **total amount of *different* fuels** consumed (various measurement units).
- Custom emission factors may optionally be provided in place of the default emission factors for electricity and fuel use.
- Users may optionally report the **amount of purchased green power** or the **amount of renewable energy that has been generated on-site** and **returned to the grid**.

CCM Phase I Pilot: key outcomes

- Performance metrics computed for a total of:
 - 49 individual buildings (total area: 1.48 km²)
 - 5 larger stocks (or Wholes) (total area: 176.60 km²)
- Submissions spanned multiple climate regions in Australia, Asia, Europe, India, N. America, and Africa.
- **Consensus-based definitions added about *building area*, *building occupancy*.**

CCM Phase II Pilot: Technical enhancements in CCM

- Performance metrics being computed for:
 - >150 individual buildings (total area: 7.4 km²)
 - 7 larger stocks (or Wholes) (total area: 177 km²)
- Expanded list of **residential** and **non-residential building** types based on UNFCCC's building categorizations.
- Normalize building performance by degree day.
- Input fuel consumption data by month through the top-down and bottom-up approaches.
- Input information on multiple fuels for the same building.
- Record amount of purchased green power or amount of renewable energy generated on-site and returned to the grid.



- kWh / m² / year
- kgCO₂e / m² / year
- kWh / occupant / year
- kg CO₂e / occupant / year
- kWh / m² / year / DD
- kWh / occupant/ year / DD

Application of CCM



ISO standard

- CCM has informed the development of an ISO standard on carbon metric of buildings (ISO/TC59/SC17).

Nationally Appropriate Mitigation Actions (NAMAs)

- NAMAs refer to any action that reduces emissions in developing countries and is prepared under the umbrella of a national governmental initiative.
- To facilitate NAMAs, a globally consistent MRV methodology is essential to measure and track energy use and energy reductions from buildings.
- **CCM is able to support the establishment of baselines from the sector or sub-sector** (residential, commercial, etc.), thus allowing measurement over time of increased efficiency and GHG reductions from a particular building stock. (UNEP DTIE project -NAMAs for the Building Sector in Asia)

CCM 2.0 – Web-based version

<http://ccmbuildings.net/>



ABOUT

The Common Carbon Metric 2.0 (CCM2.0) is a tool for measuring building energy related greenhouse gas (GHG) emissions and energy savings potential of the stock of new and existing buildings in an investment portfolio, municipality, region or country.

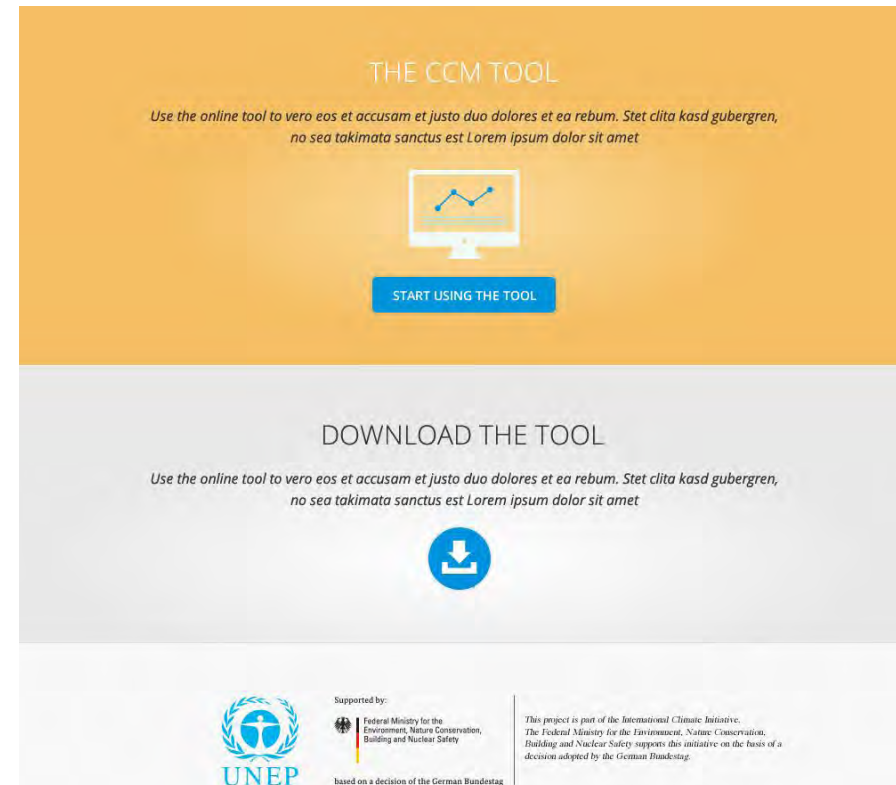
CCM2.0 generates an energy demand and GHG emissions base-line and enables the development of energy saving and GHG mitigation scenarios that can be used to support applications for climate finance for mitigation actions in the buildings sector under UNFCCC mechanisms such as the Nationally Appropriate Mitigation Actions (NAMA) and the Green Climate Fund (GCF).

The tool is based on a calculation methodology that conforms to 'measurable, reportable and verifiable (MRV)' data standards.

You can use the tool directly on-line and also choose to share your assessments with others through an open-linked database. You can also download a version that can be further customized to your specific requirements.

CCM 2.0 – Web-based version

- Online tool for measuring building energy related greenhouse gas (GHG) emissions and energy savings potential of the stock of new and existing buildings in an investment portfolio, municipality, region or country.
- Generates an energy demand and GHG emissions base-line and
- Enables the development of energy saving and GHG mitigation scenarios
- Used to support applications for climate finance for mitigation actions in the buildings sector under UNFCCC mechanisms such as NAMAs and the Green Climate Fund (GCF.)



CCM 2.0 – Web-based version



- Tool is based on a calculation methodology that conforms to ‘measurable, reportable and verifiable (MRV)’ data standards. It supports:
- Measurement of energy use and related GHG emissions from buildings & serves as the basis for assessing the potential for certain mitigation actions
- Covers five end-uses: space heating, space cooling, water heating, lighting and appliances.
- Reporting on the country’s/city’s GHG emissions and appropriate mitigation actions
- Verification of the compliance with mitigation commitments by enabling updating of energy use and emissions data over time.

Top-down assessment

Would you like to conduct baseline or future-lines assessment?

- Baseline
- Futureline

Name of your Assessment

Top-down test case 3

Description

Top-down test case 3

Please, select the approach you would like to use for your assessment

- Top-down
- Bottom-up
- Hybrid

Specify the year of your baseline

2010

Please, indicate the level you would like to make the assessment for

- Region
- Country
- City
- District
- Portfolio of individual buildings

Please, select the building types you have data for

- Total for residential
 - Single-family
 - Multifamily
 - Other residential
- Total for non-residential
 - Offices
 - Hotels
 - Mercantile & services
 - Food service
 - Education
 - Public assembly
 - Health care
 - Institutional lodging
 - Other non-residential

Top-down assessment

2.1

Please, provide the data for total floor area in the country of your interest in m² and indicate whether it is measured or estimated

2.2

2.3

2.4

| Floor area | Unit | Data type  | Total value | Source of data |
|----------------------|----------------|---|-------------|----------------|
| Total building stock | m ² | Measured  | 200687 | P1 |

2.5

2.6

2.7

2.8

← PREVIOUS QUESTION

NEXT QUESTION →

2.1

Is it possible to break down total floor area by different building types (residential vs non-residential)

2.2

Yes 

2.3

2.4

2.5

← PREVIOUS QUESTION

NEXT QUESTION →

Top-down assessment

2.1

2.2

2.3

2.4

2.5

2.6

2.7

Would you like to provide data on floor area for each building type in absolute numbers (i.e. in m²) or as a percentage of the total floor area of the building sector (i.e. in %)?

As percentage of the total floor area of the building sector ▾

← PREVIOUS QUESTION

NEXT QUESTION →

2.1

2.2

2.3

2.4

2.5

2.6

2.7

2.8

Please, provide data on the floor area in each building type in the portfolio of your interest in %

| Floor area by building type | Unit | Data type ⓘ | Existing | New | Retrofit | Source of data |
|-----------------------------|------|-------------|----------|-----|----------|----------------|
| Mercantile & services | % | Third par ▾ | 60.7 | 0 | 0 | P1 |
| Education | % | Third par ▾ | 39.3 | 0 | 0 | P1 |

← PREVIOUS QUESTION

NEXT QUESTION →

Top-down assessment

2.1

2.2

2.3

2.4


2.5

2.6

2.7

2.8

Please, provide the data for total occupancy in the portfolio of your interest and indicate whether it is measured or estimated

| Occupancy | Unit | Data type  | Total value | Source of data |
|--|---------------------|---|-------------|----------------|
| Total occupancy in the building sector | Number of occupants | Estimated  | 64000 | User |

← PREVIOUS QUESTION

NEXT QUESTION →

2.1

2.2

2.3

2.4

2.5

2.6

2.7

Is it possible to break down total occupancy by different building types (residential vs non-residential and their sub-categories)?

✔ Successfully saved the assessment.

Yes 

← PREVIOUS QUESTION

NEXT QUESTION →

Top-down assessment

2.1

2.2

2.3

2.4

2.5

2.6

2.7

Would you like to provide data on occupancy for each building type in absolute numbers (i.e. in number of occupants) or as a percentage of the total occupancy in the building sector (i.e. in %)?

✔ Successfully saved the assessment.

As percentage of the total ▼

← PREVIOUS QUESTION

NEXT QUESTION →

2.1

2.2

2.3

2.4

2.5

2.6

2.7

2.8

Please provide the occupancy of each building type as a % of the total occupancy of the building stock in your portfolio of interest

| Occupancy by building type | Unit | Data type ⓘ | Value | Source of data |
|----------------------------|------|-------------|-------|----------------|
| Mercantile & services | % | Estimatec ▼ | 60.7 | User |
| Education | % | Estimatec ▼ | 39.3 | User |

Top-down assessment



3.1

Please, provide data for the total electricity use in the portfolio of your interest in KWh

3.2

3.3

3.4

| Electricity use | Unit | Data type  | Total value | Source of data |
|----------------------|------|---|-------------|----------------|
| Total building stock | kWh | Estimated  | 30221248.8 | P1 |

← PREVIOUS QUESTION

NEXT QUESTION →

3.1

3.2

3.3

3.4

Is it possible to break down total electricity use by different building types (residential vs non-residential)?

Yes 

Top-down assessment

3.1

3.2

3.3

3.4

Would you like to provide data on electricity use for each building type in absolute numbers (i.e. in KWh) or as a percentage of the total electricity use in the building sector (i.e. in %)?

As percentage of the total electricity use in the building sector ▾

← PREVIOUS QUESTION

NEXT QUESTION →

3.1

3.2

3.3

3.4



Please, provide data on the share of each building type in the total electricity use of the portfolio of your interest in %

| Share in the total electricity use | Unit | Data type ⓘ | Existing | New | Retrofit | Source of data |
|------------------------------------|------|-------------|----------|-----|----------|----------------|
| Mercantile & services | % | Third par ▾ | 78.4 | 0 | 0 | P1 |
| Education | % | Third par ▾ | 21.6 | 0 | 0 | P1 |

Top-down assessment

4.1

Please, provide data for the total fuel (including oil, gas, coal, biomass, etc.) use in the portfolio of your interest in KWh

| Fuel use | Unit | Data type  | Total value | Source of data |
|----------------------|------|---|-------------|----------------|
| Total building stock | kWh | Measured  | 17215494.72 | P1 |


← PREVIOUS QUESTION

NEXT QUESTION →

4.1

Is it possible to break down total fuel use by different building types (residential vs non-residential)?

4.2

Yes 

4.3

4.4

Top-down assessment

4.1

4.2

4.3

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4.7

Would you like to provide data on fuel use for each building type in absolute numbers (i.e. in kWh) or as a percentage of the total fuel use in the building sector (i.e. in %)?

✔ Successfully saved the assessment.

In absolute numbers

← PREVIOUS QUESTION

NEXT QUESTION →

4.1

4.2

4.3

4.4

4.5

4.6

Please, provide data on the fuel use in each building type in the portfolio of your interest

| Fuel use | Unit | Data type ⓘ | Existing | New | Retrofit | Source of data |
|-----------------------|------|-------------|-------------|-----|----------|----------------|
| Mercantile & services | kWh | Measurer ▼ | 6042327.828 | 0 | 0 | P1 |
| Education | kWh | Measurer ▼ | 11173166.89 | 0 | 0 | P1 |

Top-down assessment

4.1

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4.4

4.5

Is it possible to provide data on fuel use by different fuels?

Yes ▼

← PREVIOUS QUESTION

NEXT QUESTION →

4.1

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4.7

4.8

4.9

4.10

Please, specify, which of the following energy fuel types used in buildings in the portfolio of your interest

| Fuel type | Used? |
|--|-------------------------------------|
| Non-biomass renewables | <input type="checkbox"/> |
| Fossil fuels - Oil | <input type="checkbox"/> |
| Fossil fuels - Natural gas | <input checked="" type="checkbox"/> |
| Fossil fuels - Liquefied Petroleum Gases (LPG) | <input type="checkbox"/> |
| Fossil fuels - Coal | <input type="checkbox"/> |
| Biomass fuels - Wood or wood waste | <input checked="" type="checkbox"/> |
| Biomass fuels - Charcoal | <input type="checkbox"/> |
| Biomass fuels - Liquid biofuels | <input type="checkbox"/> |
| Biomass fuels - Biogas | <input type="checkbox"/> |

Top-down assessment

4.1

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4.7

Would you like to provide data on fuel use for each fuel type in absolute numbers (i.e. in KWh) or as a percentage of the total fuel use (i.e. in %)?

✔ Successfully saved the assessment.

As percentage of the total fuel use ▼

← PREVIOUS QUESTION

NEXT QUESTION →

4.1

4.2

4.3

4.4

4.5

4.6

4.7

4.8

Please, provide data on the fuel use for each fuel in each building type in the portfolio of your interest in %

| Building type | Unit | Data type ⓘ | Natural gas | Wood or wood waste | Source of data |
|-----------------------|------|-------------|-------------|--------------------|----------------|
| Mercantile & services | % | Measurer ▼ | 36.4 | 0 | P1 |
| Education | % | Measurer ▼ | 63.6 | 100 | P1 |

← PREVIOUS QUESTION

NEXT QUESTION →

Top-down assessment

4.1

4.2

4.3

4.4

4.5

4.6

4.7

4.8

4.9

4.10

Please, provide data on the emission factors for different energy carriers in the portfolio of your interest

| Energy carrier | Unit | Data type ⓘ | Value | Source of data |
|--|---------------|-------------|---------|----------------|
| Electricity | kg CO2/Kwh | Based on ▼ | 0.41205 | Gov.uk Greer |
| Fossil fuels - Natural gas | kg CO2/Kwh | Based on ▼ | 0.184 | Gov.uk Greer |
| Biomass fuels - Wood or wood waste | kg CO2/Kwh | Based on ▼ | 0.01307 | Gov.uk Greer |

Top-down assessment

RESULTS

Top-down test case 3 ↓ Top-down Baseline 2010 Portfolio of individual buildings

table view visual view

^ Floor area & Occupancy

Floor area for each building type in the base year (m²)

| Building types | 2010 |
|-----------------------|-----------|
| Mercantile & services | 121817.01 |
| Education | 78869.99 |

Occupancy for each building type in the base year (occupants)

| Building types | 2010 |
|-----------------------|-------|
| Mercantile & services | 38848 |
| Education | 25152 |

^ Electricity use

Electricity use for each building type in the base year (kWh)

| Building types | 2010 |
|-----------------------|-------------|
| Mercantile & services | 23693459.06 |
| Education | 6527789.74 |

Electricity use per m² by building type in the base year (kWh/m²)

| Building types | 2010 |
|-----------------------|--------|
| Mercantile & services | 194.50 |
| Education | 82.77 |

Electricity use per occupant by building type in the base year (kWh/occupant)

| Building types | 2010 |
|-----------------------|--------|
| Mercantile & services | 609.90 |
| Education | 259.53 |

Top-down assessment

^ Fuel use

Fuel use for each building type in the base year (kWh/m²)

| Building types | 2010 |
|-----------------------|-------------|
| Mercantile & services | 6042327.83 |
| Education | 11173166.90 |

Fuel use per m² by building type in the base year (kWh/m²)

| Building types | 2010 |
|-----------------------|--------|
| Mercantile & services | 49.60 |
| Education | 141.67 |

Fuel use per occupant by building type in the base year (kWh/occupant)

| Building types | 2010 |
|-----------------------|--------|
| Mercantile & services | 155.54 |
| Education | 444.23 |

^ GHG emissions

GHG emissions for each building type in the base year (kgCO₂e)

| Building types | 2010 |
|-----------------------|-------------|
| Mercantile & services | 10167580.75 |
| Education | 4143337.74 |

GHG emissions per m² for each building type in the base year (kgCO₂e/m²)

| Building types | 2010 |
|-----------------------|-------|
| Mercantile & services | 83.47 |
| Education | 52.53 |

GHG emissions per occupant for each building type in the base year (kgCO₂e/m²)



| Building types | 2010 |
|-----------------------|--------|
| Mercantile & services | 261.73 |
| Education | 164.73 |

Bottom-up assessment

1.1

Baseinfo questions

Would you like to conduct baseline or future-lines assessment?

-  Baseline
-  Futureline


Name of your Assessment

Bottom-up test case 3

Description

Bottom-up test case 3

Please, select the approach you would like to use for your assessment

-  Top-down 
-  Bottom-up 
-  Hybrid 

Bottom-up assessment

2.1

2.2

Please, provide details on the project, for which you would like to perform the assessment

| Project background | Value |
|--------------------|------------|
| Aim | Evaluation |
| Geographical scope | Regional |
| Climate zone(s) | Cfb |

← PREVIOUS QUESTION

NEXT QUESTION →

2.1

2.2

Please, provide data for each building in the project according to the data requirements indicated in the table

| No. | Building ID / name | Urban or rural area | Building type | Building vintage | Data type | Annual fuel use (kWh) | Annual electricity use (kWh) | Floorarea (m2) | Occupancy (person) | Source of data |
|-----|--------------------|---------------------|---------------|------------------|-----------|-----------------------|------------------------------|----------------|--------------------|----------------|
| 1 | B1 | Urban | Non-resic | Existing | Measured | 3194837 | 15157861 | 46222.5 | 0 | P1 |
| 2 | B2 | Urban | Non-resic | Existing | Measured | 1620797 | 2201976.6 | 45558 | 0 | P1 |
| 3 | S1 | Urban | Non-resic | Existing | Measured | 2316427 | 1148625 | 13574 | 0 | P1 |
| 4 | S2 | Urban | Non-resic | Existing | Measured | 1286074 | 1089882 | 9986 | 0 | P1 |

Bottom-up assessment

3.1

Is it possible to provide data on electricity use for different end-uses?

3.2

3.3

✔ Successfully saved the assessment.

Yes ▼

3.1

Would you like to provide data on electricity use for different end-uses in absolute numbers (i.e. in kWh) or as a share of the total electricity use in each building?

3.2

3.3

✔ Successfully saved the assessment.

As a share of the total electricity use in each building ▼

Bottom-up assessment

3.1

3.2

3.3

Please, provide data on the share of different end-uses in the total electricity use of each building (if the end-use is not applicable for the building, please, put zero)

⚠ Warning, editing an already finished question may result in data loss in follow-up questions.

| Building ID / name | Unit | Data type | Space cooling | Space heating | Hot water | Lighting | Appliances | Source data |
|--------------------|------|-----------|---------------|---------------|-----------|----------|------------|-------------|
| R1 | % | Estimate | 40 | 0 | 0 | 30 | 30 | test |
| R2 | % | Estimate | 30 | 0 | 0 | 40 | 30 | test |
| S1 | % | Estimate | 20 | 0 | 0 | 50 | 30 | test |
| S2 | % | Estimate | 10 | 0 | 0 | 60 | 30 | test |

4.1

4.2

4.3

4.4

4.5

Is it possible to provide data on fuel use for different end-uses?

✔ Successfully saved the assessment.

Yes

Bottom-up assessment

- 4.1
- 4.2
- 4.3
- 4.4
- 4.5
- 4.6
- 4.7

Would you like to provide data on fuel use for different end-uses in absolute numbers (i.e. in kWh) or as a share of the total fuel use in each building?

✔ Successfully saved the assessment.

As a share of the total fuel use in each building ▼

← PREVIOUS QUESTION

NEXT QUESTION →

- 4.1
- 4.2
- 4.3
- 4.4
- 4.5
- 4.6
- 4.7

Please, provide data on the share of different end-uses in the total electricity use of each building (if the end-use is not applicable for the building, please, put zero)

| Building ID / name | Unit | Data type | Space cooling | Space heating | Hot water | Lighting | Appliances | Source data |
|--------------------|------|-----------|---------------|---------------|-----------|----------|------------|-------------|
| R1 | % | Estimate | 0 | 90 | 10 | 0 | 0 | test |
| R2 | % | Estimate | 0 | 90 | 10 | 0 | 0 | test |
| S1 | % | Estimate | 0 | 80 | 20 | 0 | 0 | test |
| S2 | % | Estimate | 0 | 80 | 20 | 0 | 0 | test |

Bottom-up assessment

- 4.1
- 4.2
- 4.3
- 4.4

Is it possible to provide data on fuel use by different fuels?

Yes

← PREVIOUS QUESTION

NEXT QUESTION →

- 4.1
- 4.2
- 4.3
- 4.4
- 4.5
- 4.6
- 4.7

Please, provide data on shares of different fuels in the total fuel use.

Successfully saved the assessment.

| Building ID / name | End Use | Unit | Data type | Non-biomass renewables | Oil | Natural gas | LPG | Coal | Wood or wood waste | Char... |
|--------------------|---------------|------|-----------|------------------------|-----|-------------|-----|------|--------------------|---------|
| R1 | Space heating | % | Estimate | 0 | 0 | 90 | 0 | 0 | 0 | 0 |
| R1 | Hot water | % | Estimate | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| R2 | Space heating | % | Estimate | 0 | 0 | 00 | 0 | 0 | 0 | 0 |
| R2 | Hot water | % | Estimate | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| S1 | Space heating | % | Estimate | 0 | 0 | 20 | 0 | 0 | 00 | 0 |
| S1 | Hot water | % | Estimate | 0 | 0 | 10 | 0 | 0 | 10 | 0 |
| S2 | Space heating | % | Estimate | 0 | 0 | 20 | 0 | 0 | 60 | 0 |
| S2 | Hot water | % | Estimate | 0 | 0 | 10 | 0 | 0 | 10 | 0 |

CCM 2.0 – Testing summary

- CCM 2.0 was tested using top-down and bottom-up datasets from previous pilot studies of CCM 1.0.
- Overall the web-based CCM 2.0 is clear and easy to follow.
- Progress bar is helpful and the ability to move forward and backward throughout the tool is beneficial.
- Based on the experience of the reviewer, the estimated time for data entry in the tool was found to be:
 - **Top down:** 5-7 minutes for 2 buildings types
 - **Bottom up:** 7-9 minutes for 2 buildings
 - **Hybrid:** 10-12 minutes for two building types

CCM 2.0 – Recommendations from testing

- Provision to enter monthly energy data would be useful.
- To encourage use of CCM 2.0, it is helpful to say upfront the time expected to complete assessments.
- Given the challenges of data security and privacy, it should be clarified where data are being hosted in CCM 2.0.
- Desirable to integrate some kind of 'feedback mechanism' to communicate to the user how much data input is complete while the user is inputting data.
- Given the growing recognition of performance gap between modelled (predicted) and measured energy performance of buildings, CCM could show how much data has been input in terms of both modelled and measured data.

Thank you!