SEVENTH ASSESSMENT CYCLE

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UN environment programme

The IPCC Inventory Software

A Tool to Support the Enhanced Transparency Framework Implementation under the Paris Agreement

IPCC TFI TSU

UNFCCC SBs 5 June 2024

Transparency is critical to fighting Global Warming

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Article 4

COMMITMENTS

1. All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:

(a) Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties;

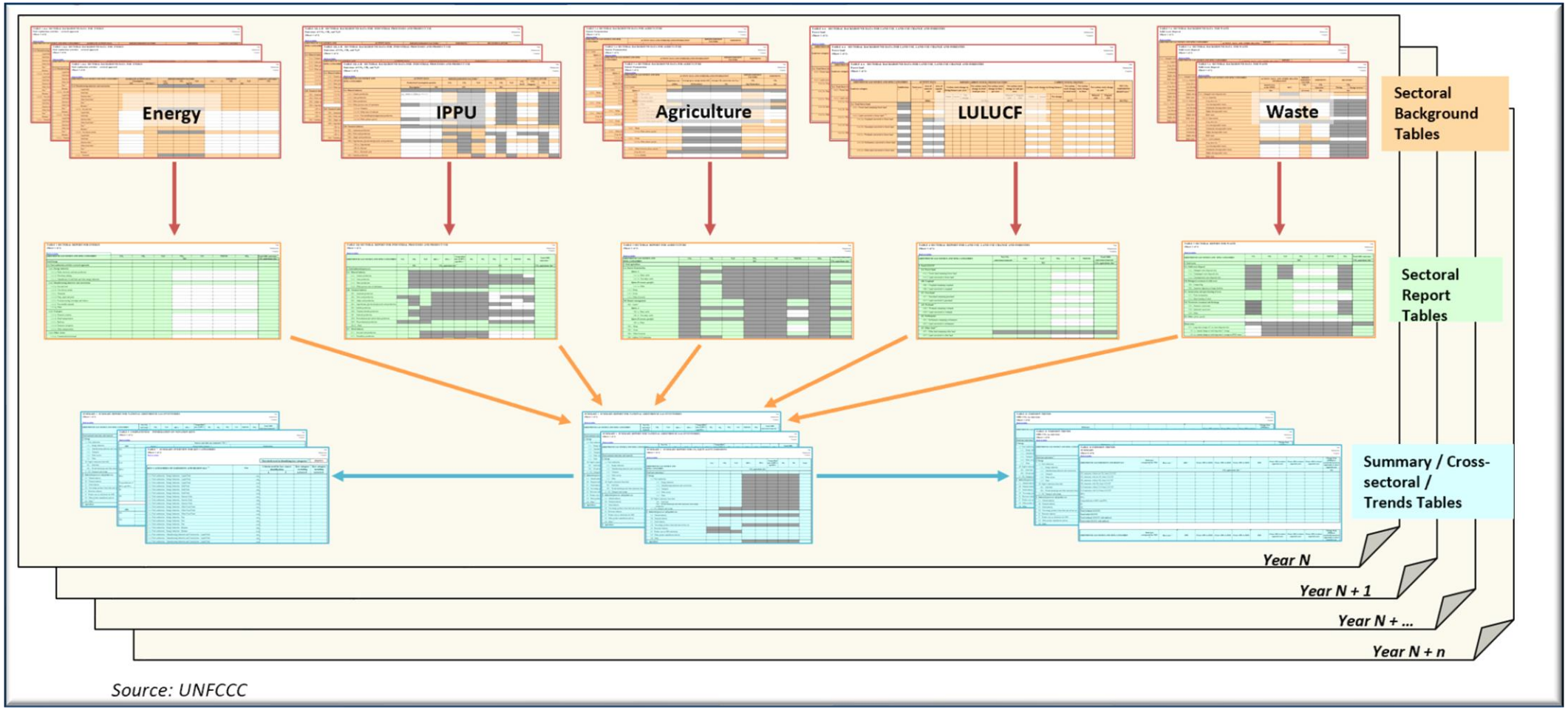
UNITED NATIONS
1992

IPCC supporting Transparency since its onset

IPCC's original authors (1991-1995) set out to produce:

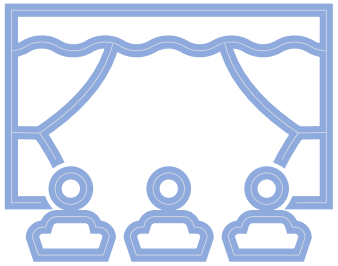
- ✓ **Methodological guidance to prepare National GHG Inventories**
- ✓ **Software to facilitate use of those Guidelines**

Transparency take a lot of efforts

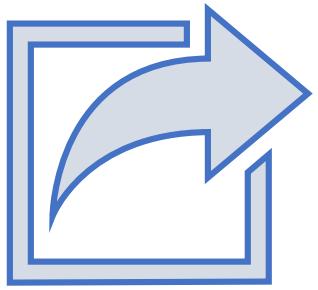


IPCC Inventory Software: Event Outline

Evolution and Features of the *Software*



Demonstration, including Interoperability with the UNFCCC ETF Reporting Tool



Moving Forward

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Evolution and Features of the IPCC Inventory Software for NGHGI

The IPCC Inventory Software

Complete

All IPCC methods *(all Tiers)* **and all IPCC approaches**

All IPCC default data

AR 5

Automatically implements AR5 GWP100 values
(and allows any other user-specific metric to be applied)

Cross-cutting elements
Uncertainty Analysis - Key Category Analysis

All sectors and categories of the National GHG Inventory

The IPCC Inventory Software

Easy to Use

Prepare an inventory using IPCC default methods with minimal efforts

All IPCC defaults at your fingertips

Avoids methodological and calculation errors

Data Managers facilitate data entry

(Fuels, Solid Waste, F-gases, Livestock, Land Representation, Land Use)

Have NGHGI estimates ready for Paris Agreement reporting

The IPCC Inventory Software

Fundamental for National GHG Inventory Preparation

Adaptable to national circumstances

- Allows subnational level of reporting
- Use multiple tiers across inventory, even within a category
- Apply your own country-specific values wherever available

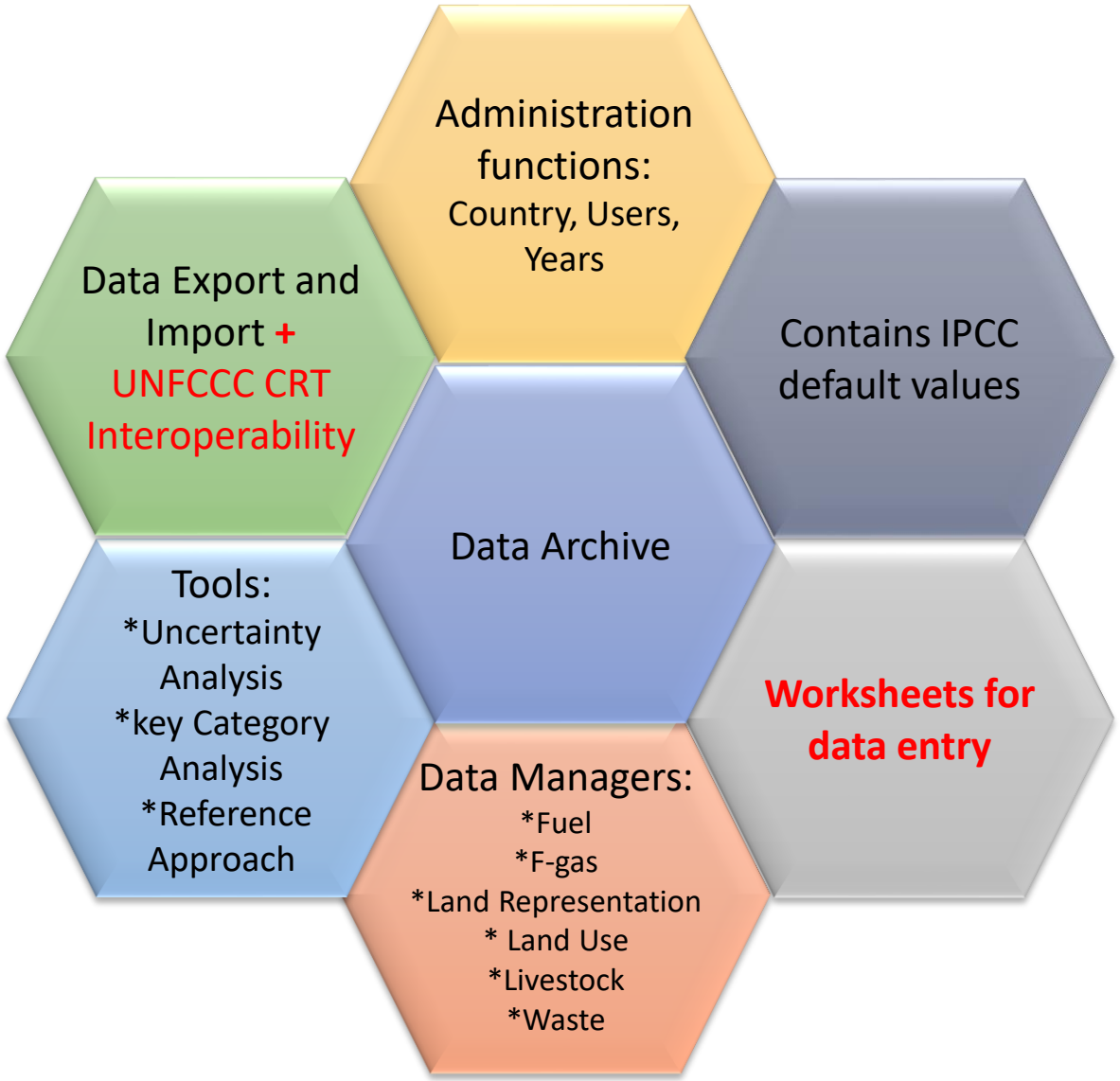
Organizing framework for data collection among national entities

Multiple experts in your country can work on different categories/ sectors simultaneously

Establishes a single archive, in-country, to help you build for the future

Confidence that your inventory is consistent with the *2006 IPCC Guidelines* & UNFCCC requirements

Architecture



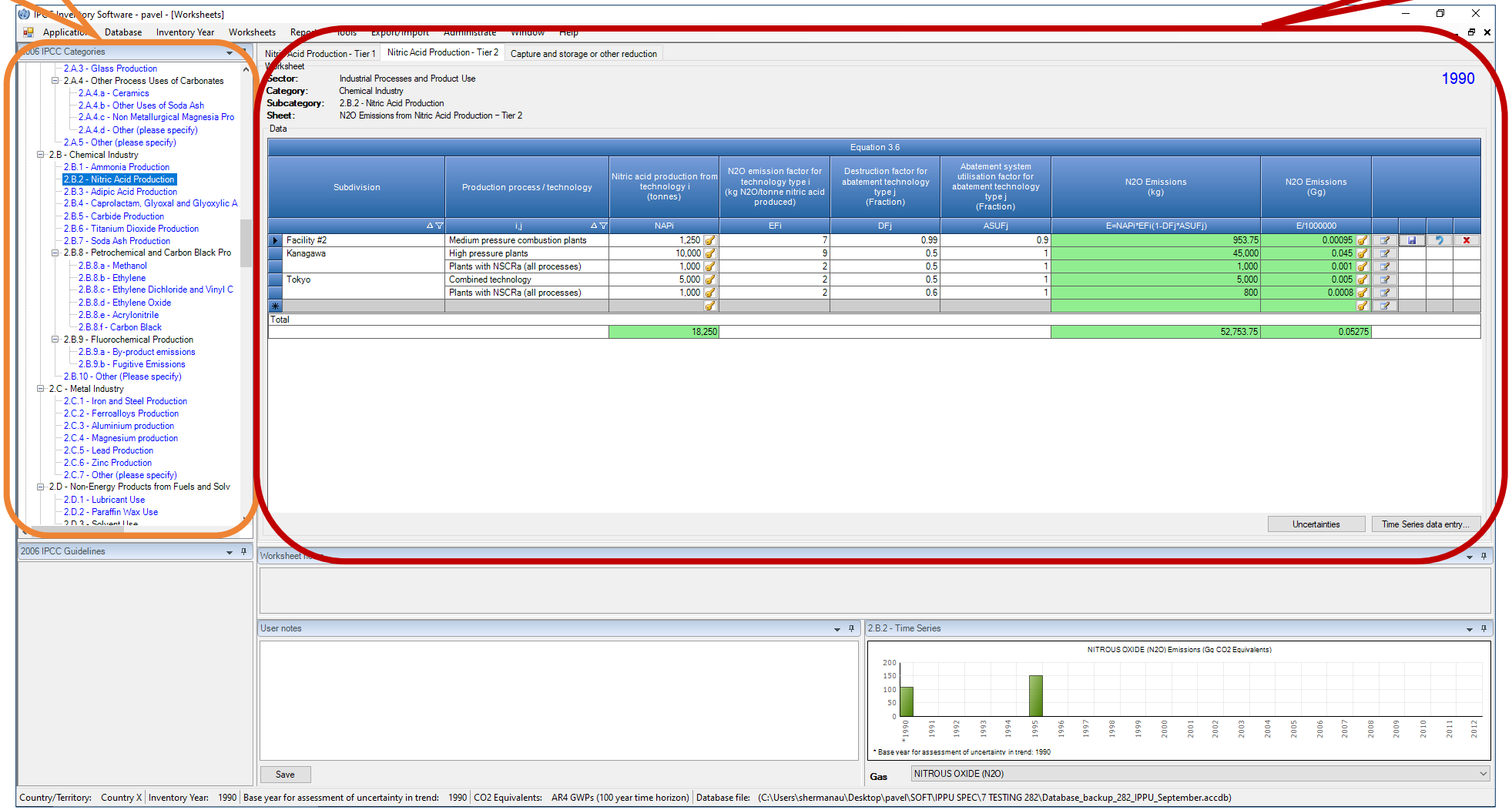
- MSAccess (ACE OLEDB 12) for WindowsOS
- ACCDB file, *backup function*
- Microsoft .NET Framework 4.6.2
- Password protected

NEVER FORGET PASSWORD!

Example of a Worksheet

Categories

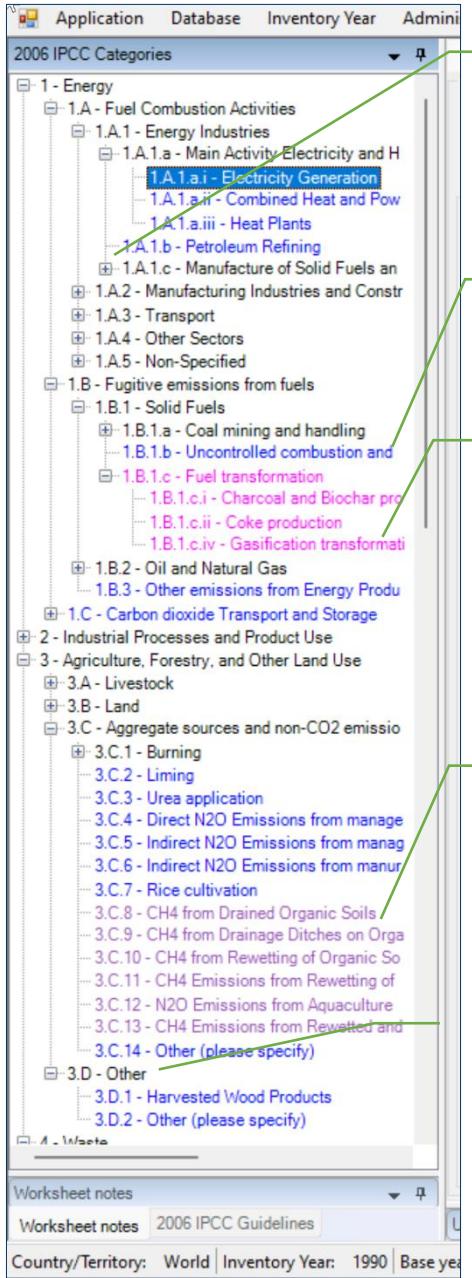
Data Entry & Calculation



2006 IPCC Categories Navigation Window (tree)

The worksheets relevant to the selected IPCC Category will be displayed in the main working area on the right.

Worksheets are available for all IPCC categories that are highlighted in blue, magenta and lilac.



Press ⊞ to open a subcategory

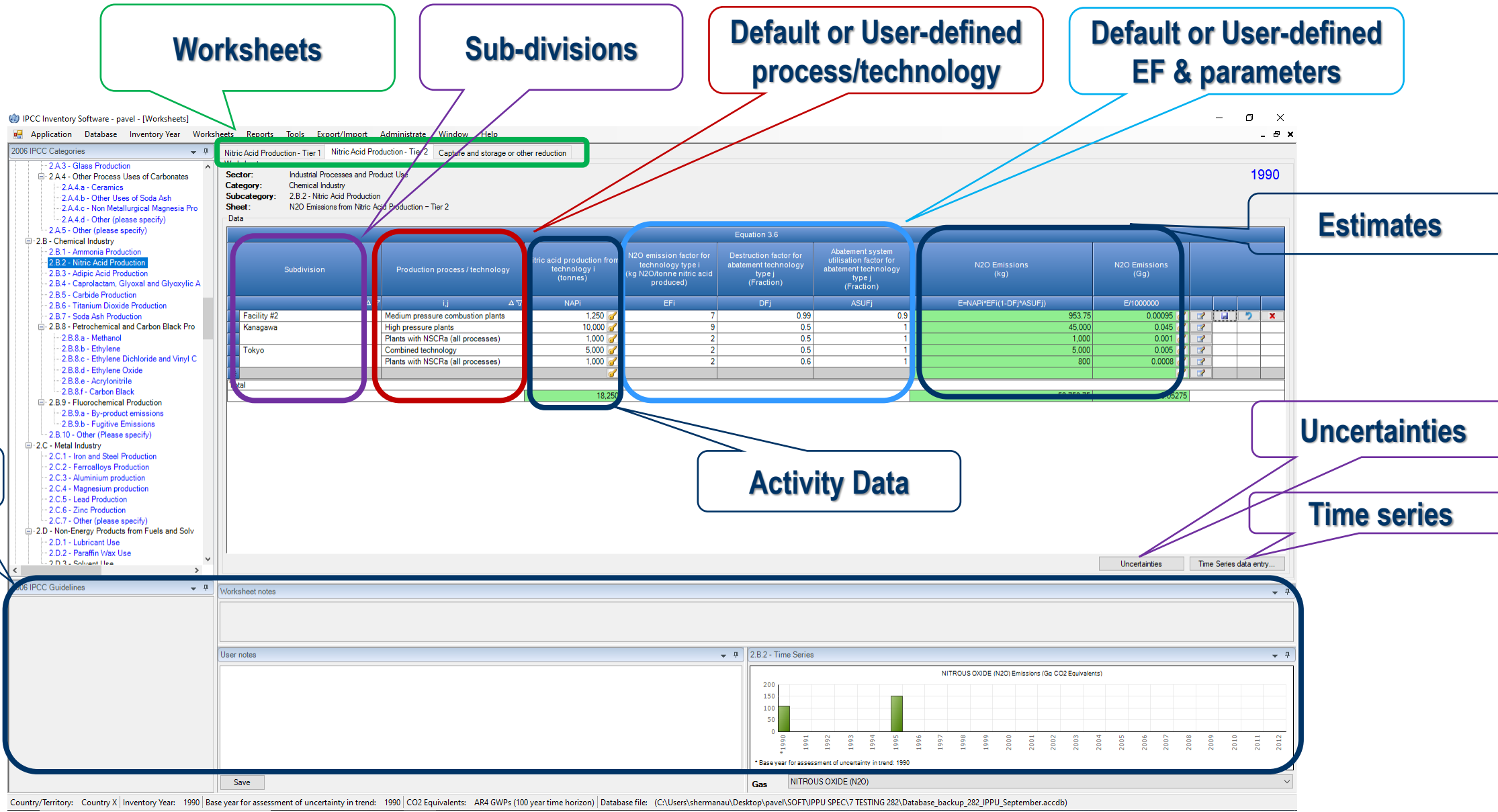
Blue highlighted categories are from the 2006 IPCC Guidelines

Magenta highlighted categories are from the 2019 Refinement

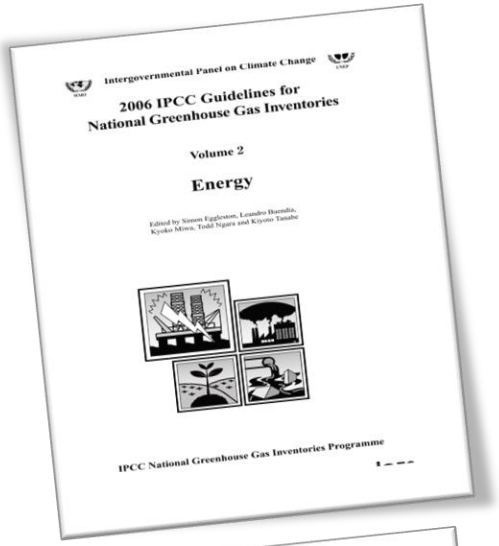
Lilac highlighted categories are from the Wetlands Supplement

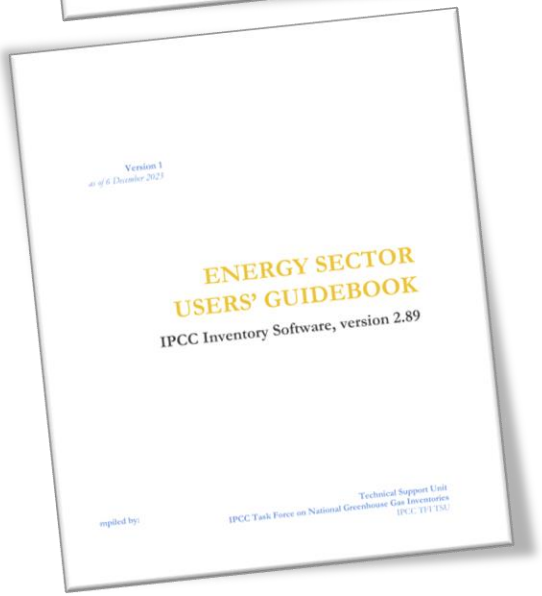
Clicking on the **Black** "Sector/ Sub-sector" level shows the CO_2e time series graph of the "Sector/ Sub-sector".

Example of a Worksheet



Available resources





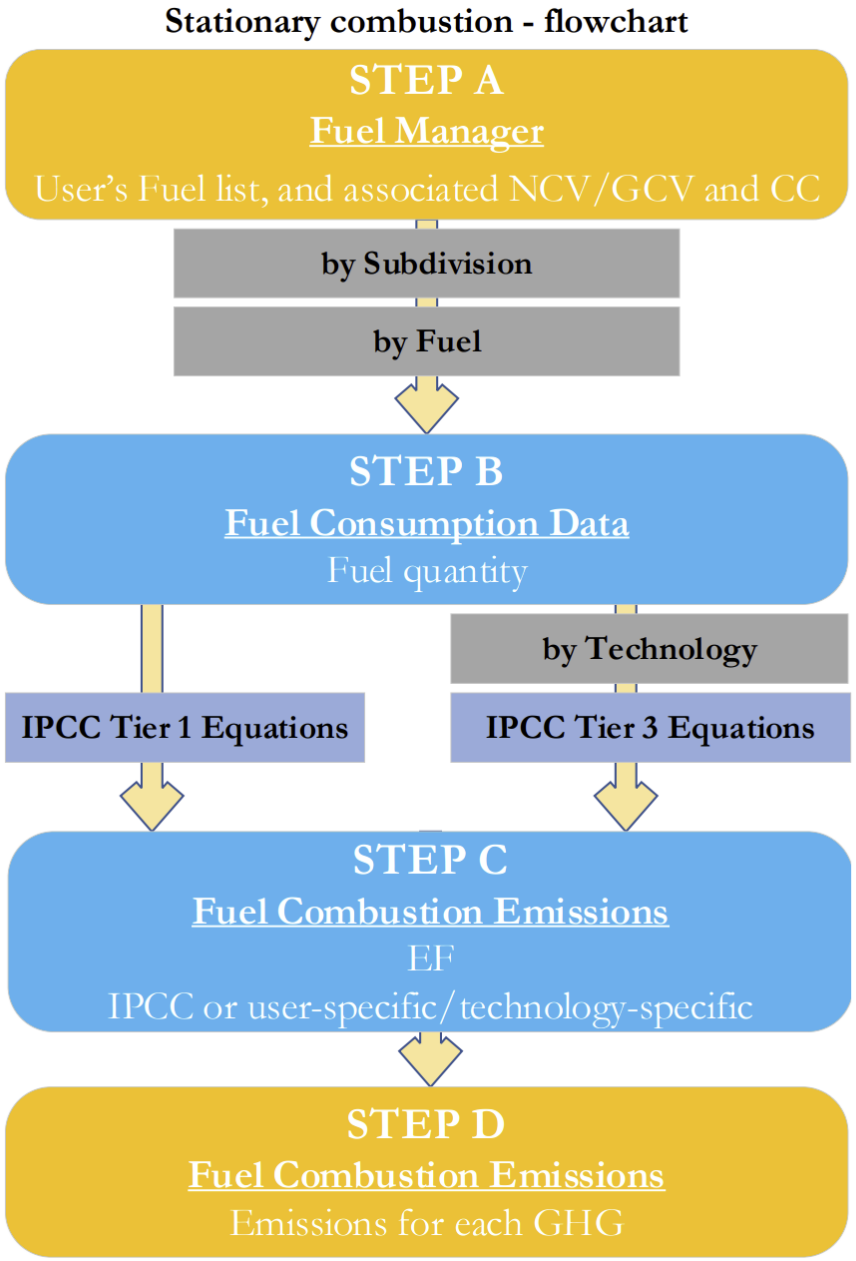
Available at: *https://www.ipcc-nggip.iges.or.jp/software/index.html*

- ✓ **The 2006 IPCC Guidelines for National GHG Inventories**
  - ➢ **The *Software* is a tremendous tool to prepare a GHG inventory**, *although does not replace knowledge of the 2006 IPCC Guidelines.*

- ✓ **The *Software* Users' Guidebooks**
  - ➢ Integrated guides for the IPCC Guidelines & the *Software :*
    - ➢ Guides currently available for
      - General Software User Manual
      - Energy Sector
      - Livestock Categories 3.A.
      - Land Representation
      - UNFCCC Interoperability – CRT Export Quick Start Guide
    - ➢ Other sector-based Guidebooks under development

- ✓ **IPCC TFI TSU Support** @ *ipcc-software@iges.or.jp*

Guidebook



The Sector Guidebook is the place to start…

For each category, the Guidebook includes, *inter alia,* the following information:

- The relevant equations from the 2006 IPCC Guidelines
- A description of the relevant worksheets. For category 1.A.1.a.i this includes **Fuel Manager, Fuel Consumption Data** and **Fuel Consumption Emissions**
- A **User's Work Flowchart**
  - **Step A: Fuel Manager**
  - **Step B: Fuel Consumption Data**
  - **Step C: Fuel Combustion Emissions - EFs**
  - **Step D: Fuel Combustion Emissions - Results**
- Step-by-step guidance to input **activity data** and **emission factor** information
- **Results**

IPCC Inventory Software & Paris Agreement Reporting

International reporting requirements

- ✓ Countries to submit a Biennial Transparency Report (BTR), including the NGHGI and its CRTs (Common Reporting Tables).
- ✓ Reporting must follow the Modalities, Procedures and Guidelines (MPGs) (decision 18/CMA.1), and so be based on the *2006 IPCC Guidelines*

IPCC Inventory Software as a Tool

- ✓ Decision 5/CMA.3 mandates the UNFCCC secretariat to develop reporting tools, including for CRTs.
- ✓ Decision 5/CMA.3 requests the UNFCCC secretariat to facilitate interoperability with the IPCC Inventory Software and invites the IPCC to cooperate

IPCC Inventory Software & Paris Agreement Reporting

IPCC Inventory Software

1. Prepare GHG Inventory in IPCC Software

- ✓ Estimate GHG emissions consistent with IPCC Guidelines
- ✓ Reduce errors
- ✓ Supports national institutional arrangements

2. Review Visualized CRTs

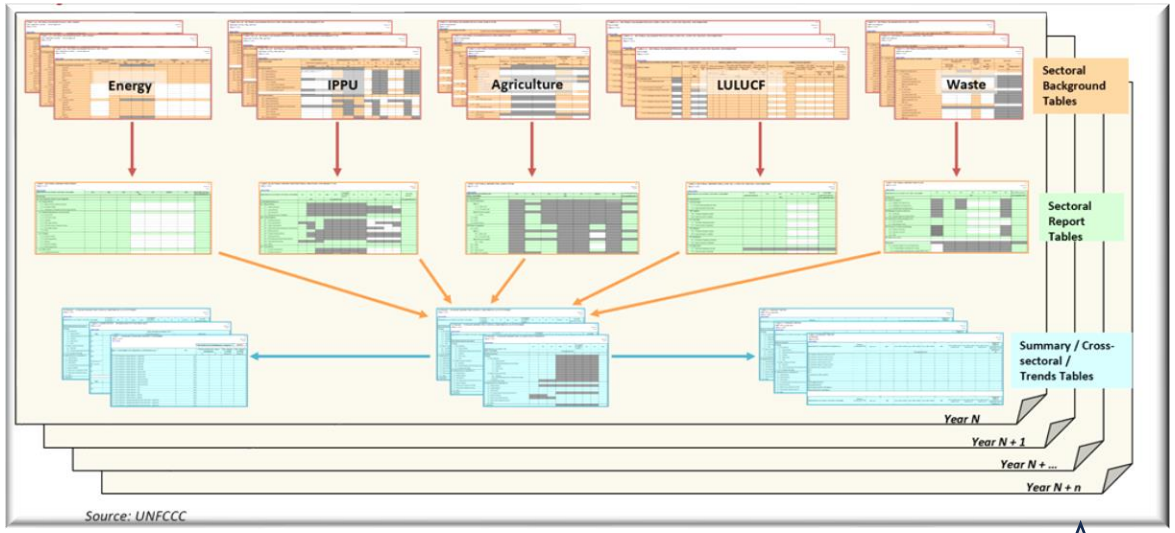
- ✓ Review results; if necessary, go back to calculation worksheets
- ✓ Finalize notation keys for reporting
- ✓ Incorporate information needed for reporting in the CRT, including flexibility, as applicable.

3. Produce JSON file

- ✓ Save file on your computer

4. Upload file to UNFCCC ETF Reporting Tool

UNFCCC ETF Reporting Tool



Complete, Easy to Use, Fundamental

IPCC Inventory Software used to complete 60 tables of the CRT for each year of the time series!

IPCC Inventory Software in the ETF

- ✓ Estimates a **complete NGHGI** consistent with IPCC *Good Practice* and UNFCCC requirements in the format of UNFCCC CRTs
- ✓ Allows to compile explanatory information for CRT **Table 9**
- ✓ Allows to compile explanatory information for **flexibility**
- ✓ Allows to compile explanatory information on method and EF for CRT **Summary 3**
- ✓ Allows to compile all **official comments** for CRT
- ✓ Allows to compile **documentation boxes** and **additional information**
- ✓ Allows to designate information as **confidential**

All these at once, with a single Tool only

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Live Demonstration

A Deeper Dive…entering Energy Sector data in the *Software*

Using national data or readily available international data sets

Terajoules

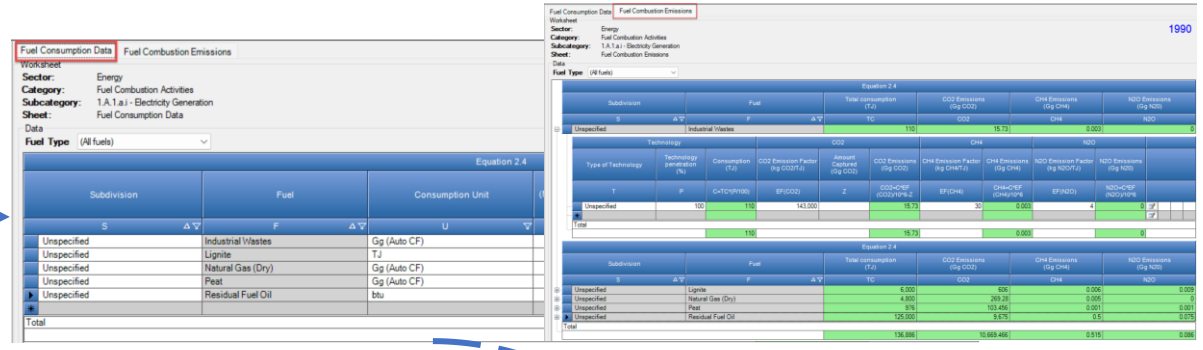
	Primary coal and peat	Coal and peat products	Primary Oil	Oil Products	Natural Gas	Biofuels and waste	Nuclear	Electricity	Heat	Total energy	of which: renewables
2021											
Primary production	..	..	336779	..	102398	174939	..	27515	..	641631	202454
Imports	..	..	3105	183656	17765	..	..	157	..	204684	..
Exports	..	..	-334870	-3999	..	-50	..	-6242	..	-345162	-50
International marine bunkers	..	..	..	-296	..	..	..	..	..	-296	..
International aviation bunkers	..	..	..	-8429	..	..	..	..	..	-8429	..
Stock changes	..	..	1198	8587	..	..	..	..	..	9785	..
Total energy supply	..	..	6213	179518	120163	174889	..	21430	..	502212	202404
Statistical difference	..	..	-12330	-638	10969	0	..	0	..	-2000	27515
Transfers	..	..	..	..	..	..	..	..	..	..	..
Transformation	..	..	-16321	13075	-103422	-47580	..	51868	..	-102381	-47580
Electricity plants	..	..	-2172	-3288	-103422	..	..	51868	..	-57014	..
CHP plants	..	..	..	..	..	..	..	..	..	..	..
Heat plants	..	..	..	..	..	..	..	..	..	..	..
Coke ovens	..	..	..	..	..	..	..	..	..	..	..
Briquetting plants	..	..	..	..	..	..	..	..	..	..	..
Liquefaction plants	..	..	..	..	..	..	..	..	..	..	..
Gas works	..	..	..	..	..	..	..	..	..	..	..
Blast furnaces	..	..	..	..	..	..	..	..	..	..	..
NGL plants & gas blending	..	..	-4118	4408	..	..	..	..	..	289	..
Oil refineries	..	..	-10031	[illegible]	..	..	..	..	..	[illegible]	..
Other transformation	..	..	..	..	..	..	..	..	..	..	..
Energy industries own use	..	..	-997	..	..	..	..	..	..	..	..
Losses	..	..	-1225	..	..	..	..	..	..	..	..
Final consumption	..	..	..	..	..	..	..	..	..	..	..
Final energy consumption	..	..	..	..	..	..	..	..	..	..	..
Manufacturing, const., mining	..	..	..	..	..	..	..	..	..	..	..
Iron and steel	..	..	..	..	..	..	..	..	..	..	..
Chemical and petrochemical	..	..	..	..	..	..	..	..	..	..	..
Non-ferrous metals	..	..	..	..	..	..	..	..	..	..	..
Non-metallic minerals	..	..	..	..	..	..	..	..	..	..	..
Transport equipment	..	..	..	..	..	..	..	..	..	..	..
Machinery	..	..	..	..	..	..	..	..	..	..	..
Mining and quarrying	..	..	..	..	..	..	..	..	..	..	..
Food and tobacco	..	..	..	..	..	..	..	..	..	..	..
Paper, pulp and printing	..	..	..	..	..	..	..	..	..	..	..
Wood and wood products	..	..	..	..	..	..	..	..	..	..	..
Textile and leather	..	..	..	..	..	..	..	..	..	..	..
Construction	..	..	..	..	..	..	..	..	..	..	..
Industries n.e.s	..	..	..	..	..	..	..	..	..	..	..
Transport	..	..	..	..	..	..	..	..	..	..	..
Road	..	..	..	..	..	..	..	..	..	..	..
Rail	..	..	..	..	..	..	..	..	..	..	..
Domestic aviation	..	..	..	..	..	..	..	..	..	..	..
Domestic navigation	..	..	..	..	..	..	..	..	..	..	..
Pipeline transport	..	..	..	..	..	..	..	..	..	..	..
Transport, n.e.s	..	..	..	..	..	..	..	..	..	..	..
Other	..	..	..	..	..	..	..	..	..	..	..
Agriculture, forestry, fishing	..	..	..	..	..	..	..	..	..	..	..
Commerce, public services	..	..	..	..	..	..	..	..	..	..	..
Households	..	..	..	..	..	..	..	..	..	..	..
Other consumers	..	..	..	..	..	..	..	..	..	..	..
Non-energy use	..	..	..	..	..	..	..	..	..	..	..

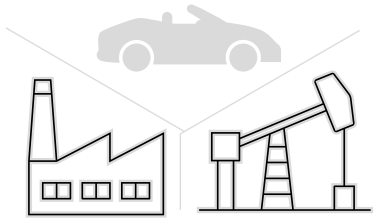
Terajoules

	All Coal	All Oil	Natural Gas	Primary biofuels / Waste	Charcoal	Electricity	Total energy	of which: renewables
2021								
Primary production	..	..	..	*7153	..	23	*7175	*7175
Imports	..	*10915	..	0	50	..	*10965	50
Exports	..	*-87	..	0	-29	..	*-116	-29
International marine bunkers	..	..	..	..	..	..	..	..
International aviation bunkers	..	*-838	..	..	..	..	*-838	..
Stock changes	..	..	..	..	..	..	..	..
Total energy supply	..	*9990	..	*7153	21	23	*17186	*7196
Statistical Difference	..	*-40	..	0	0	0	*-40	*23
Transfers	..	..	..	..	..	..	..	..
Transformation	..	*-5586	..	*-4014	2161	1837	*-5603	*-1854
Electricity plants	..	*-5586	..	..	..	1837	*-3749	..
Charcoal plants	..	..	..	*-4014	2161	..	*-1854	*-1854
Other transformation	..	0	..	0	..	..	0	0
Energy industries own use	..	..	..	..	..	-275	-275	..
Losses	..	..	..	..	..	*-367	*-367	..
Final consumption	..	*4445	..	*3138	*2181	*1217	*10982	*5320
Final energy consumption	..	*4445	..	*3138	*2181	*1217	*10982	*5320
Manufacturing, const., mining	..	*1879	..	..	..	*234	*2113	..
Transport	..	*1085	..	..	..	..	*1085	..
Road	..	*1085	..	..	..	..	*1085	..
Domestic aviation	..	..	..	..	..	..	..	..
Domestic navigation	..	..	..	..	..	..	..	..
Other transport	..	..	..	..	..	..	..	..
Other	..	*1481	..	*3138	*2181	*983	*7784	*5320
Agriculture, forestry, fishing	..	..	..	..	..	..	..	..
Commerce and public services	..	..	..	..	..	..	..	..
Households	..	..	..	*3138	*2181	..	*5320	*5320
Other consumers	..	*1481	..	..	..	*983	*2464	..
Non-energy use	..	..	..	..	..	..	..	..

Source: 2021 Energy Balances (https://unstats.un.org/unsd/energystats/pubs/balance/)

…and filling in relevant data for each category in the two worksheets below

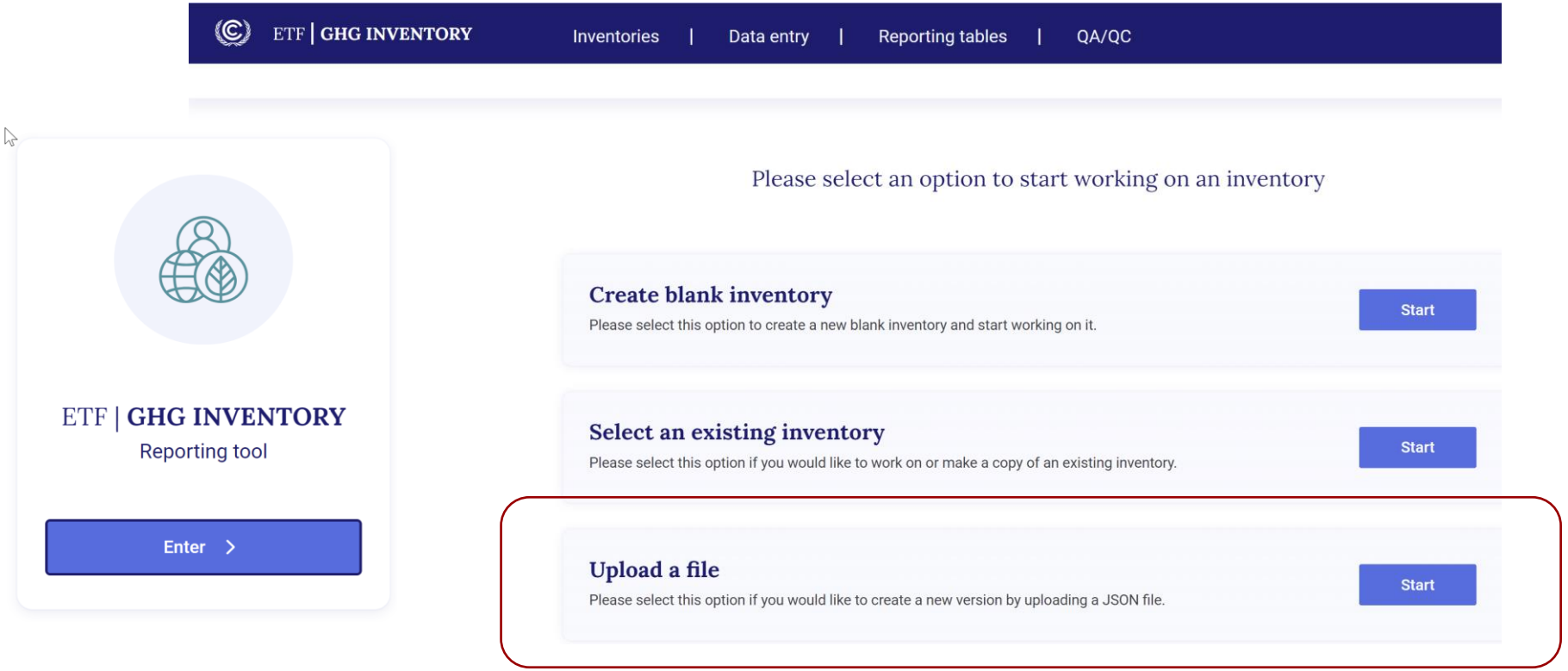




…for most countries captures majority of emissions:

- *fuel combustion responsible for ~70% of total emissions, excl. LULUCF*
- *Same worksheets allow countries to report Tier 2/3 methods for stationary combustion (~55% of total national emissions, excl LULUCF)*

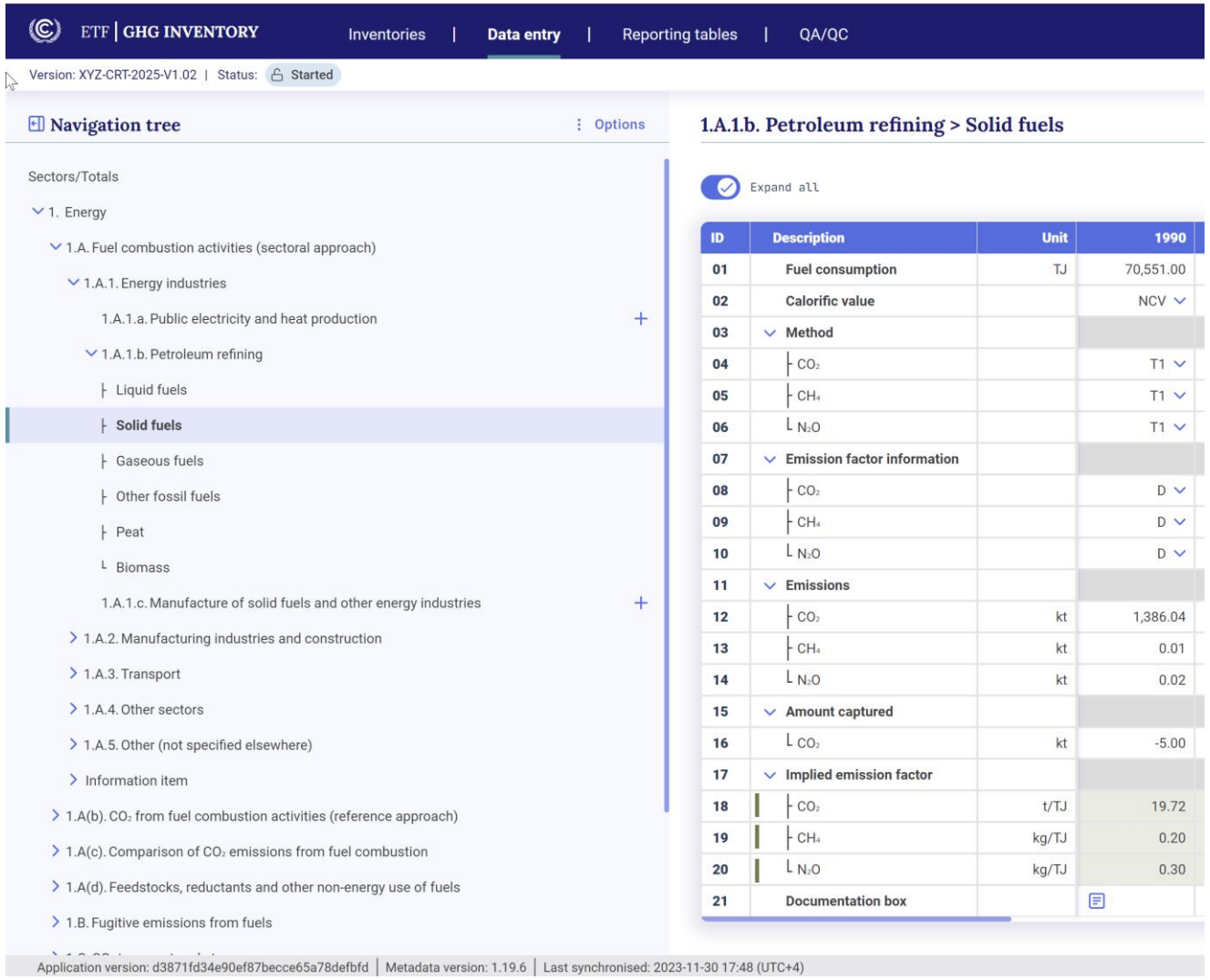
Import IPCC JSON file into ETF Reporting Tool



1. Select 'Upload a file"
2. Drag and drop or upload JSON file from previous step
3. You will be prompted to enter version settings:
   -Submission year
   -For developing countries, if you are applying flexibilities for time series/latest year
   -Sector-specific selections

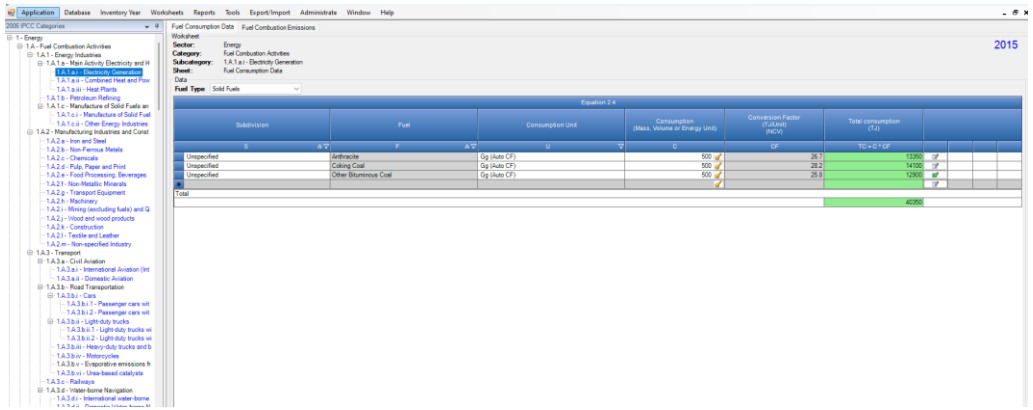
Note: Screenshots subject to change in final version.

Quality Control Data Entry



- Use of the IPCC JSON file is a means of data input into the ETF Reporting Tool. Users can check all data input grids and reporting tables in the ETF Reporting Tool.
- Users should quality control their imported IPCC data prior to submission.
- Note: The implied emission factors will be calculated here; they were not shown in the IPCC Inventory Software

Submit GHG Inventory to UNFCCC ….and start preparing for next submission



Remember: The ETF Reporting tool is the official tool TO BE USED for submission of data to the UNFCCC to meet reporting obligations under the Paris Agreement.

And…with the inventory you have created in the IPCC Inventory Software, you are well prepared to build on it for your next BTR GHG inventory submission.

Thus… helping build a sustainable GHG inventory system.

Some final thoughts on this example

You can now estimate GHG emissions/removals for all categories, using any method available in the 2006 IPCC Guidelines.

The exact set of worksheets presented in this example are used to estimate GHG emissions from many categories in the energy sector.

The broad approach (using the worksheets and the Guidebooks) is applicable across the *Software.*

The Energy Guidebook, as well as Guidebooks for data managers in the AFOLU sector and Interoperability, are available. Guidebook for waste will be ready by June followed by IPPU.

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Moving Forward

Ongoing work

- **Paris Agreement requirements**
  - Interoperability with UNFCCC reporting tool for Common Reporting Tables (*Decision 5/CMA.3*), Testing

- **Other**
  - Testing
  - Export/Import functionality: time series, individual subdivisions for categories
  - Uncertainty Analysis
  - Guidebooks
  - Other supporting material, as
    - ✓ step-by-step exercises on implementation of IPCC default methodologies
    - ✓ Land representation tools (add-on, excel-based datasheet)

Download & Use

https://www.ipcc-nggip.iges.or.jp/software/index.html

- Version 2.91 of the IPCC Inventory Software comes with two alternative installation packages: **32 bit *vs* 64bit.**
- Please support by using it and reporting any findings to: ipcc-software@iges.or.jp

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Slides Supporting Demonstration

Step A: Set-up Fuel Manager

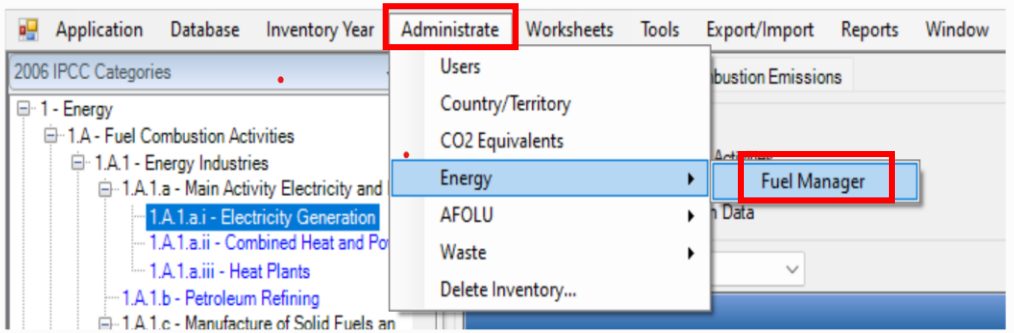
The **Fuel Manager** contains the following for each fuel:
-- name, carbon content and calorific value.

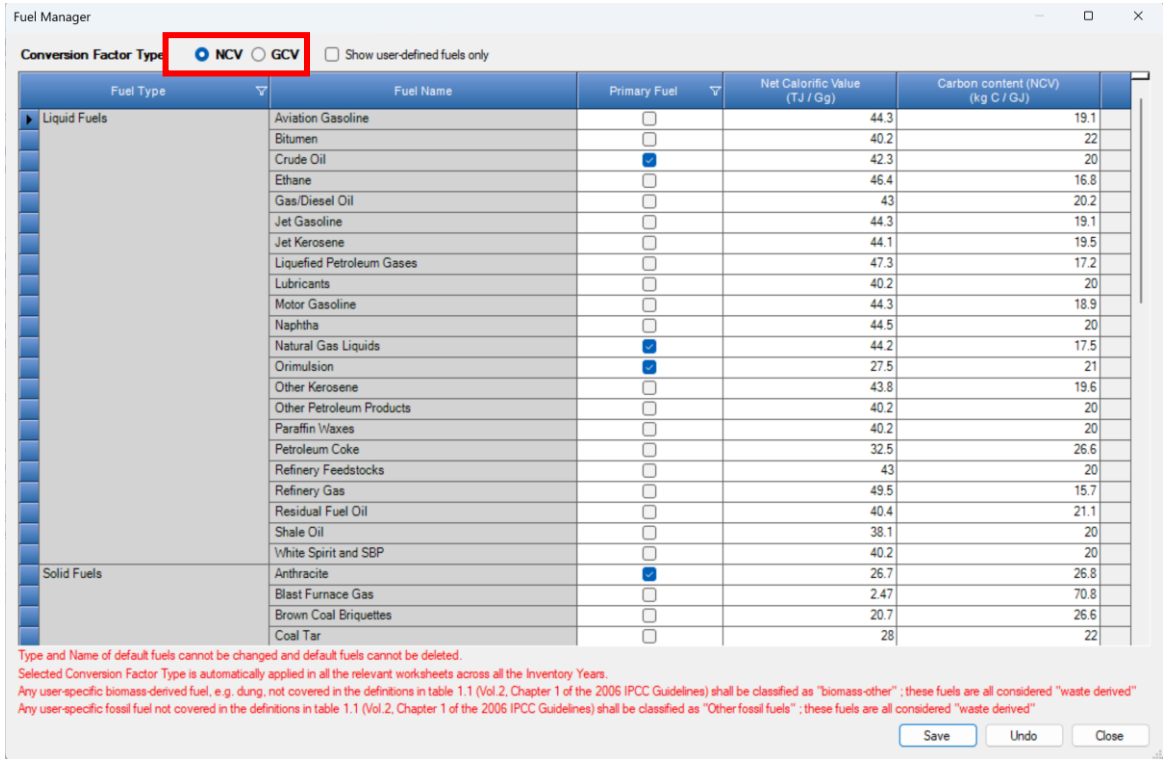
- Access **Fuel Manager** from main menu or any category level worksheet before you start a GHG Inventory, can modify **Fuel Manager** later.

  If you change parameters, data in worksheets automatically linked from the **Fuel Manager** are updated.

- Select **NCV (Net Calorific Value)** or **GCV (Gross Calorific Value)** as the Conversion Factor Type.

  Note that:
  - For each IPCC default fuel, when NCV is selected, the Calorific Value and Carbon Content are pre-filled with IPCC default values, may overwrite with user-specific values.
  - For GCV, no IPCC default values are available, requires data to be entered by the user.





Fuel Type	Fuel Name	Primary Fuel	Net Calorific Value (TJ / Gg)	Carbon content (NCV) (kg C / GJ)
Liquid Fuels	Aviation Gasoline	☐	44.3	19.1
	Bitumen	☐	40.2	22
	Crude Oil	☑	42.3	20
	Ethane	☐	46.4	16.8
	Gas/Diesel Oil	☐	43	20.2
	Jet Gasoline	☐	44.3	19.1
	Jet Kerosene	☐	44.1	19.5
	Liquefied Petroleum Gases	☐	47.3	17.2
	Lubricants	☐	40.2	20
	Motor Gasoline	☐	44.3	18.9
	Naphtha	☐	44.5	20
	Natural Gas Liquids	☑	44.2	17.5
	Orimulsion	☑	27.5	21
	Other Kerosene	☐	43.8	19.6
	Other Petroleum Products	☐	40.2	20
	Paraffin Waxes	☐	40.2	20
	Petroleum Coke	☐	32.5	26.6
	Refinery Feedstocks	☐	43	20
	Refinery Gas	☐	49.5	15.7
	Residual Fuel Oil	☐	40.4	21.1
	Shale Oil	☐	38.1	20
	White Spirit and SBP	☐	40.2	20
Solid Fuels	Anthracite	☑	26.7	26.8
	Blast Furnace Gas	☐	2.47	70.8
	Brown Coal Briquettes	☐	20.7	26.6
	Coal Tar	☐	28	22

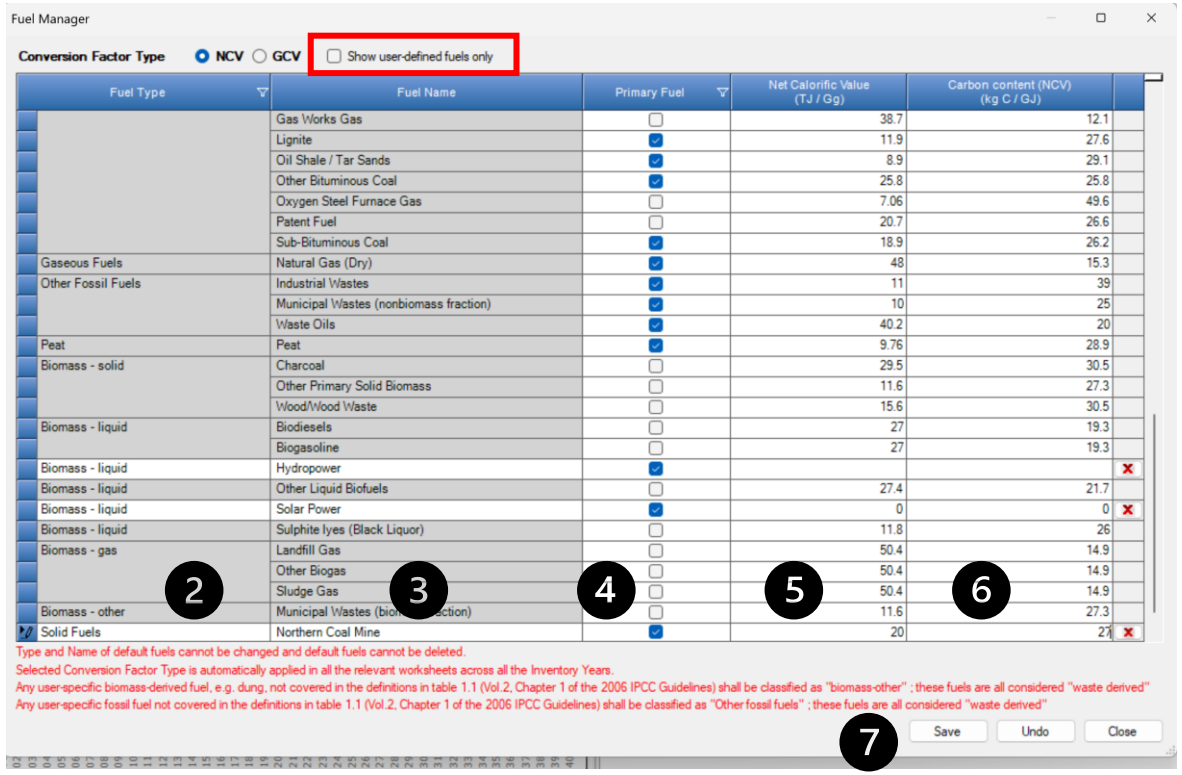
Step A: Set-up Fuel Manager

For each new (user-specific) fuel entry the following steps apply:

1. Click on the **asterisk** in the bottom-most row to add the user-specific fuel.
2. Select **fuel type** from the drop-down menu.
3. Enter specific **fuel name**.
4. Indicate (checkbox) if a **primary fuel** or not.
5. Enter its **calorific value** in TJ/Gg, (either NCV or GCV according to the selection made for entire Fuel Manager).
6. Enter **carbon content** in kg C/GJ.
7. **Save**

[To single out user-defined fuels only, the corresponding box on the window's top border shall be marked].

Example: New fuel type: Northern Coal Mine, primary fuel, NCV=20 and CC=27



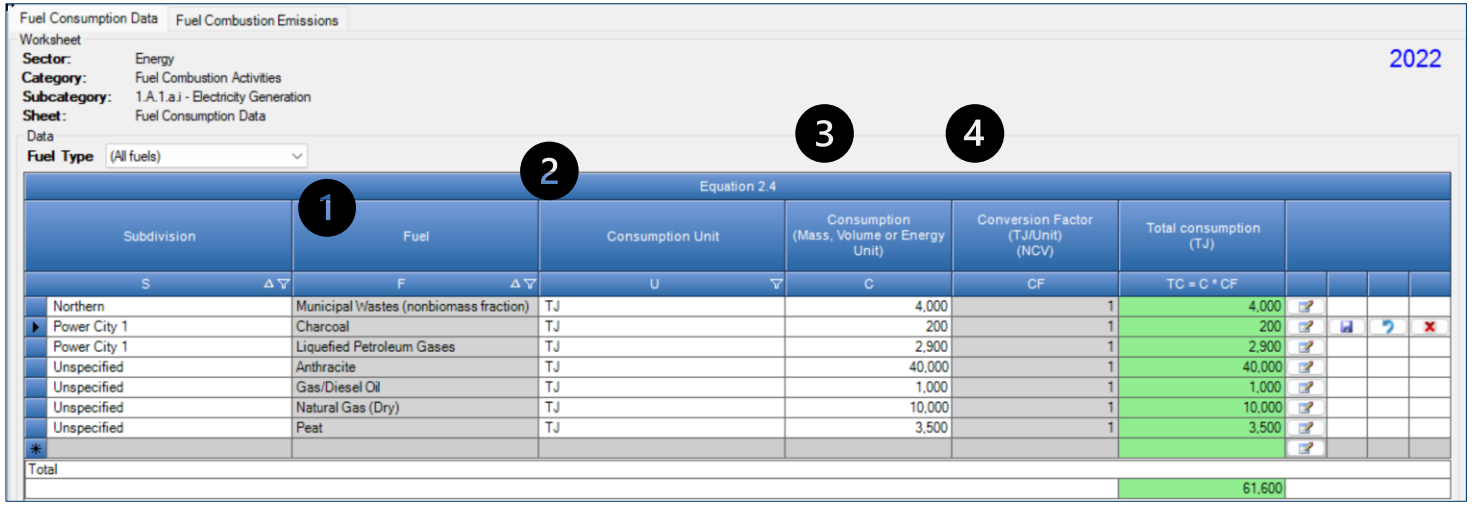
Step B: Fuel Consumption Data

Then, compile worksheet **Fuel Consumption Data** either with a single row of data for the entire category or with subnational aggregations.

Then, for each subdivision in Column |S| data are entered row by row as follows:

1. Column |F|: select each fuel used from the drop-down menu (one row for each fuel)
(N*ote that fuels shown in the dropdown are those listed in the Fuel Manager. User can filter fuels shown in the "Fuel Type" bar at the top)*

2. Column |U|: enter unit of fuel consumption data (e.g. Gg, TJ, m^3). To enter a user-specific unit (e.g. m3) select *Gg (Manual CF)* from the dropdown menu and overwrite *Gg* with the user-specific unit.



3. Column |C|: enter corresponding amount of fuel consumed.

4. Column |CF|: enter conversion factor to convert the consumption unit to an energy unit (TJ). *Note that where Gg of fuel are entered, the NCV/GCV is automatically sourced from the Fuel Manager; while if the consumption unit is TJ the Software compiles the conversion factor with the value 1. Where other units are applied (e.g. m^3) the user shall enter the relevant conversion factor here.*

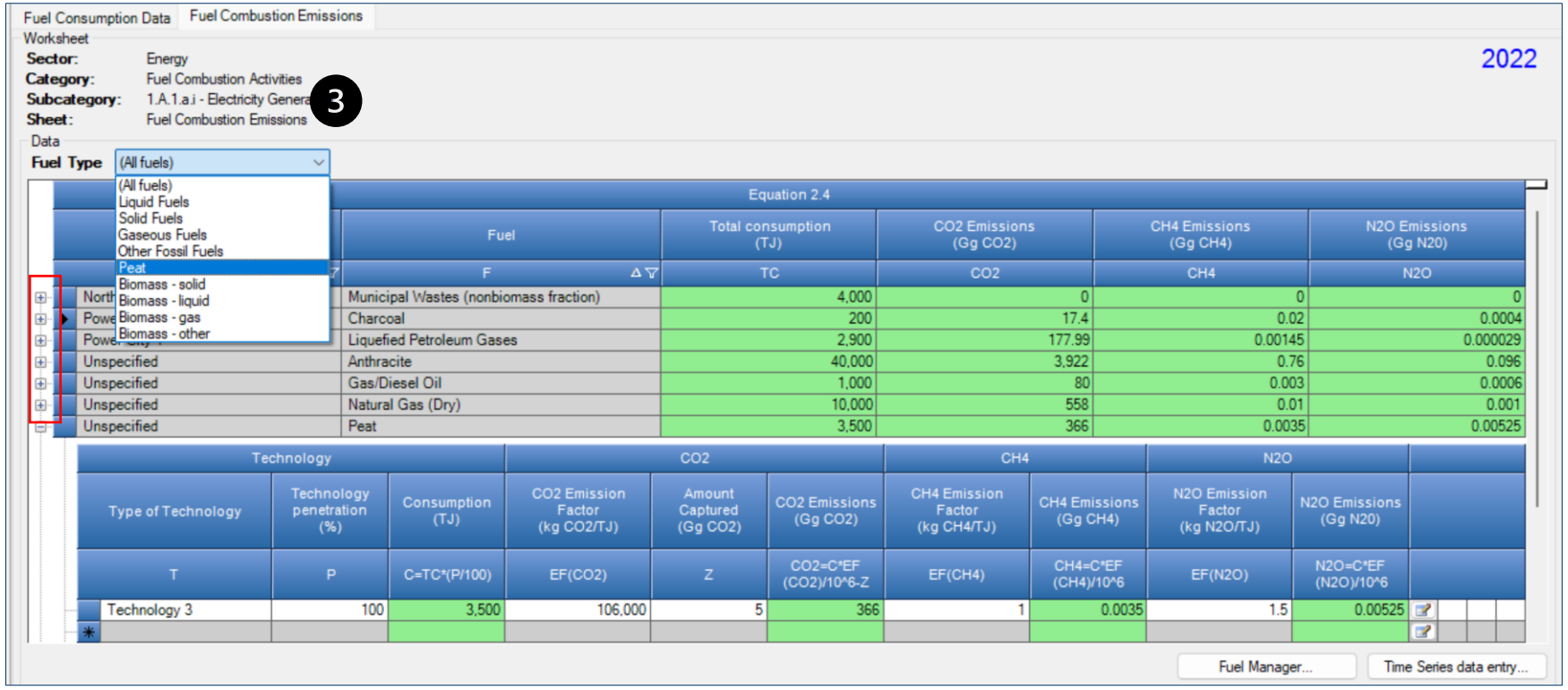
Step C: Fuel Consumption Emissions

Then, the **Fuel Combustion Emissions** worksheet is pre-filled by the *Software* with rows corresponding to the number of subdivision/fuel combinations entered in worksheet **Fuel Consumption Data**.

1. For each row, users click the symbol "⊞" on the left of the row to open a drop-down table where EF values are to be compiled.

2. Drop-down table can be filled: either with a single row of data, this is the case for IPCC default method; or with several rows, one row for each technology type, this is the case for IPCC Tier 3 method.

3. Again the "Fuel Type" bar available to enter data for each fuel one by one.



Step C: Fuel Consumption Emissions - EFs

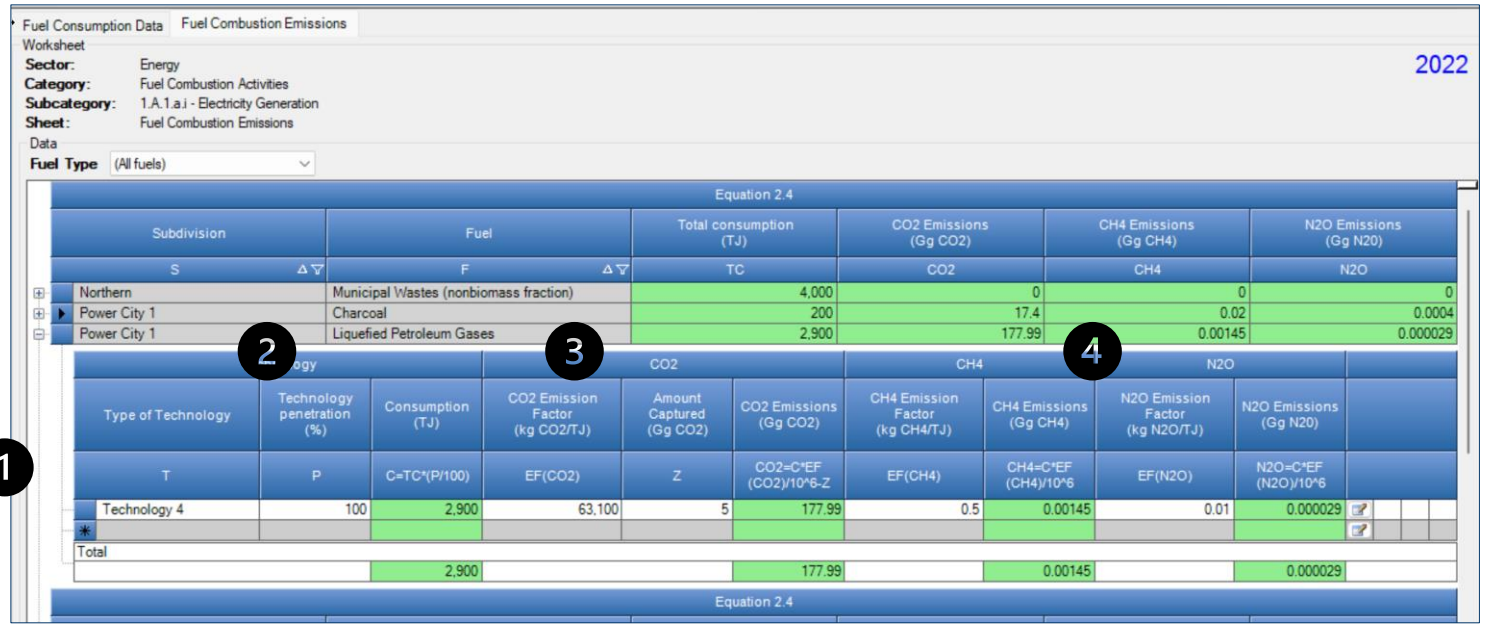
Compile each row as follows:

1. **Column |T|:** enter technology type. Where the IPCC default method is applied, the notation "unspecified" is selected.

2. **Column |P|:** enter technology penetration rate (%) associated with each technology type. The technology penetration rate apportions the total fuel consumed in the subdivision among technology types. Where the IPCC default method is applied, the value *100* is automatically entered by the *Software*. (*For each fuel in each subdivision, summing up technology penetration rates shall = 100%)*

3. **Column |EF(CO_2)|:** select from the drop-down menu the IPCC default value or, for user-specific fuels entered in the **Fuel Manager**, the value calculated by the *Software* as the carbon content multiplied by 44/12; otherwise enter the technology-type-specific value, in kg of CO_2 per TJ.

4. **Column |EF(CH_4)|** and **Column |EF(N_2O)|:** select from the drop-down menu the IPCC default value or enter the technology- type-specific value, in kg of CH_4 per TJ or kg of N_2O per TJ, respectively.



Step D: Fuel Combustion Emissions- Results

1. **To estimate the total CO_2 emitted into the atmosphere**, the amount of CO_2 **captured instead of emitted** into the atmosphere is to be entered in Gg CO_2 **in Column |Z|** of worksheet **Fuel Combustion Emissions.**

2. Then, for each GHG, emissions from each source are calculated by the *Software*, in mass unit (Gg). Total emissions from each source of stationary combustion is the sum of all emissions from combustion of all fuels listed in all subdivisions.

Fuel Consumption Data | Fuel Combustion Emissions

Worksheet
Sector: Energy
Category: Fuel Combustion Activities
Subcategory: 1.A.1.a.i - Electricity Generation
Sheet: Fuel Combustion Emissions

2022

Data
Fuel Type (All fuels)

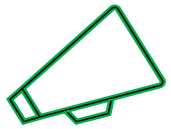
Equation 2.4

Subdivision	Fuel	Total consumption (TJ)	CO2 Emissions (Gg CO2)	CH4 Emissions (Gg CH4)	N2O Emissions (Gg N20)
S	F	TC	CO2	CH4	N2O
Northern	Municipal Wastes (nonbiomass fraction)	4,000	383.48	0.132	0.0176

Technology			CO2			CH4		N2O	
Type of Technology	Technology penetration (%)	Consumption (TJ)	CO2 Emission Factor (kg CO2/TJ)	Amount Captured (Gg CO2)	CO2 Emissions (Gg CO2)	CH4 Emission Factor (kg CH4/TJ)	CH4 Emissions (Gg CH4)	N2O Emission Factor (kg N2O/TJ)	N2O Emissions (Gg N20)
T	P	C=TC*(P/100)	EF(CO2)	Z	CO2=C*EF (CO2)/10^6-Z	EF(CH4)	CH4=C*EF (CH4)/10^6	EF(N2O)	N2O=C*EF (N2O)/10^6
Technology 1	60	2,400	91,700	10	210.08	30	0.072	4	0.0096
Technology 2	50	2,000	91,700	10	173.4	30	0.06	4	0.008
Total		4,400			383.48		0.132		0.0176

1

2



Do you notice the error in the image?

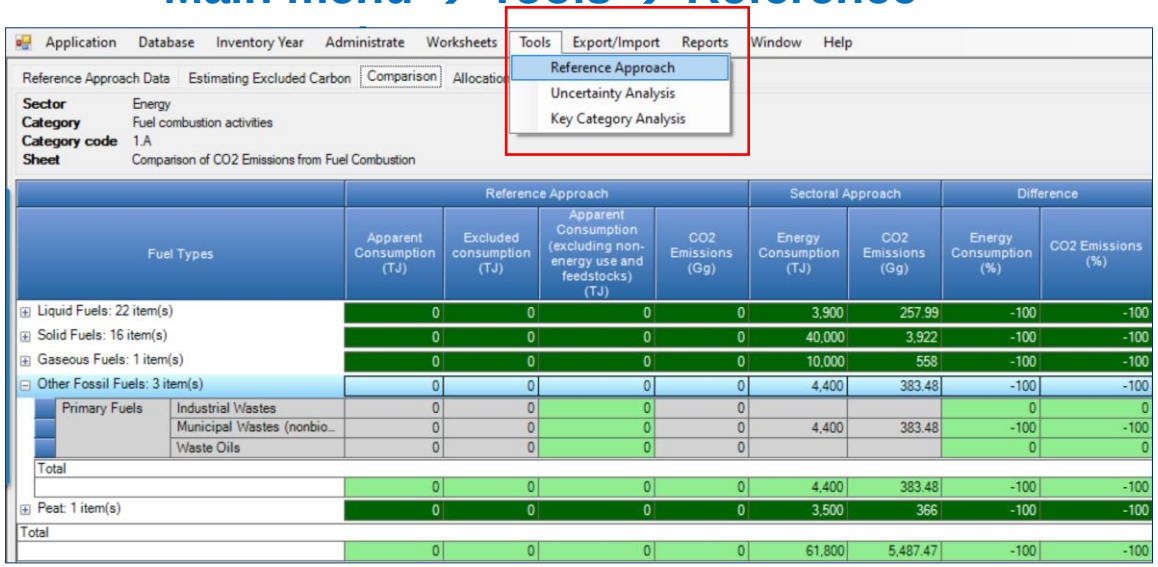
The *Software* has alerted you that the technology penetration rates are greater than 100%.

Comparing Sectoral and Reference Approaches

- You have just estimated GHG emissions from electricity generation – this estimation methodology is based on sectoral consumption, and part of the **Sectoral Approach.**

- **The Reference Approach** is designed to calculate CO_2 emissions from fuel combustion, starting from high-level energy supply data. This approach does not distinguish between different source categories within the energy sector and only estimates total emissions from source category 1.A Fuel Combustion.

Main menu → Tools → Reference

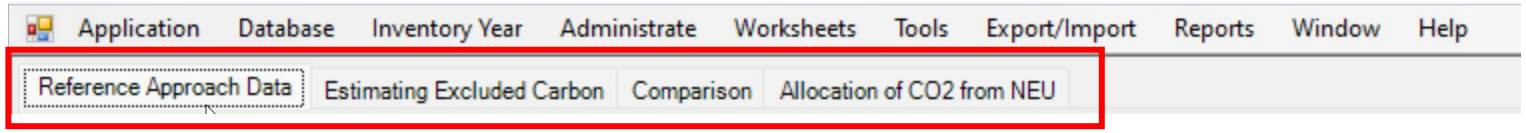


Fuel Types		Reference Approach: Apparent Consumption (TJ)	Excluded consumption (TJ)	Apparent Consumption (excluding non-energy use and feedstocks) (TJ)	CO2 Emissions (Gg)	Sectoral Approach: Energy Consumption (TJ)	CO2 Emissions (Gg)	Difference: Energy Consumption (%)	CO2 Emissions (%)
Liquid Fuels: 22 item(s)		0	0	0	0	3,900	257.99	-100	-100
Solid Fuels: 16 item(s)		0	0	0	0	40,000	3,922	-100	-100
Gaseous Fuels: 1 item(s)		0	0	0	0	10,000	558	-100	-100
Other Fossil Fuels: 3 item(s)		0	0	0	0	4,400	383.48	-100	-100
Primary Fuels	Industrial Wastes	0	0	0	0			0	0
	Municipal Wastes (nonbio...	0	0	0	0	4,400	383.48	-100	-100
	Waste Oils	0	0	0	0			0	0
Total		0	0	0	0	4,400	383.48	-100	-100
Peat: 1 item(s)		0	0	0	0	3,500	366	-100	-100
Total		0	0	0	0	61,800	5,487.47	-100	-100

- The *Software* can calculate the Reference Approach and make a comparison between emissions estimated using the Reference and Sectoral Approaches.

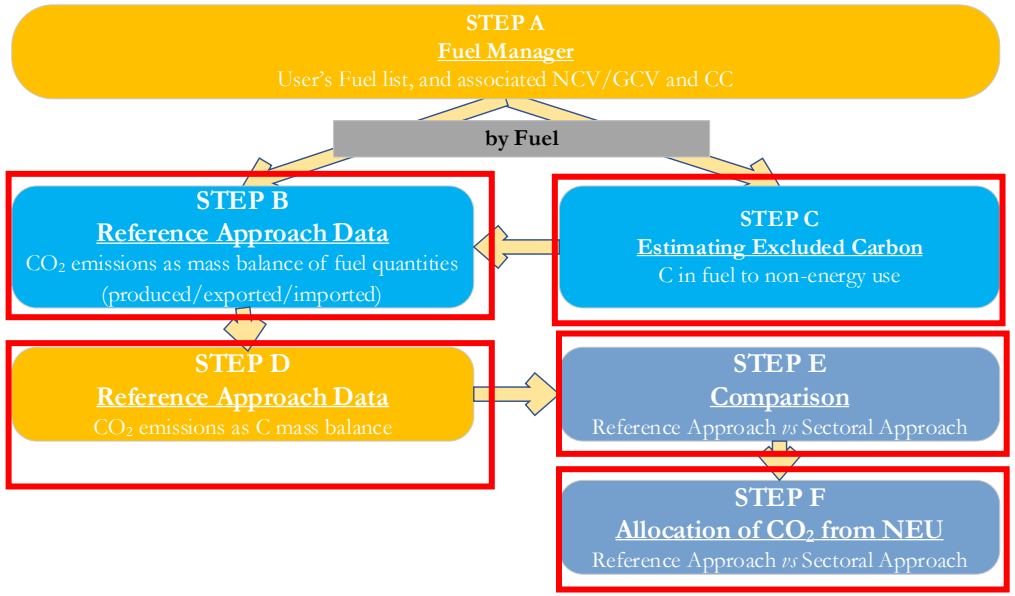
- In the **Comparison tab** of the Reference Approach menu, the energy consumption and emissions from the data entered for electricity generation (under Sectoral Approach).

Comparing Sectoral and Reference Approaches



The *Software* calculates CO_2 emissions from fuel combustion categories for the top-down reference approach using the following worksheets:

- **Fuel Manager**: information on *carbon content* and *calorific value*
- **Reference Approach Data**: for each fuel type calculates apparent consumption; uses data *calorific value* and *carbon content* (filled in automatically from the **Fuel Manager**), the excluded carbon, and the fraction oxidized. From this information the worksheet calculates actual CO_2 emissions.
- **Estimating Excluded Carbon**: contains for specific fuels the amount of the total estimated quantity of carbon which does not lead to fuel combustion emissions, calculates the amount of carbon that shall be excluded from the emissions.
- **Comparison**: Compares summary information on total estimated AD and CO_2 emissions from the Reference and Sectoral approaches.
- **Allocation of CO_2 from NEU** summarizes the total CO_2 excluded from the reference approach, by fuel. This worksheet allows for reporting the CO_2 emissions from NEU reported elsewhere in the NGHGI, identifying in which category they are reported.



Step B. Reference Approach Data

We have already explored the Fuel Manager, so here we start with Step B. Reference Approach Data.
For each fuel, enter the following information:

1. **Column |Unit|:** select or enter manually the measurement unit used (e.g. Gg, TJ, m^3). (*see "+" sign to expand to the full fuel list)*

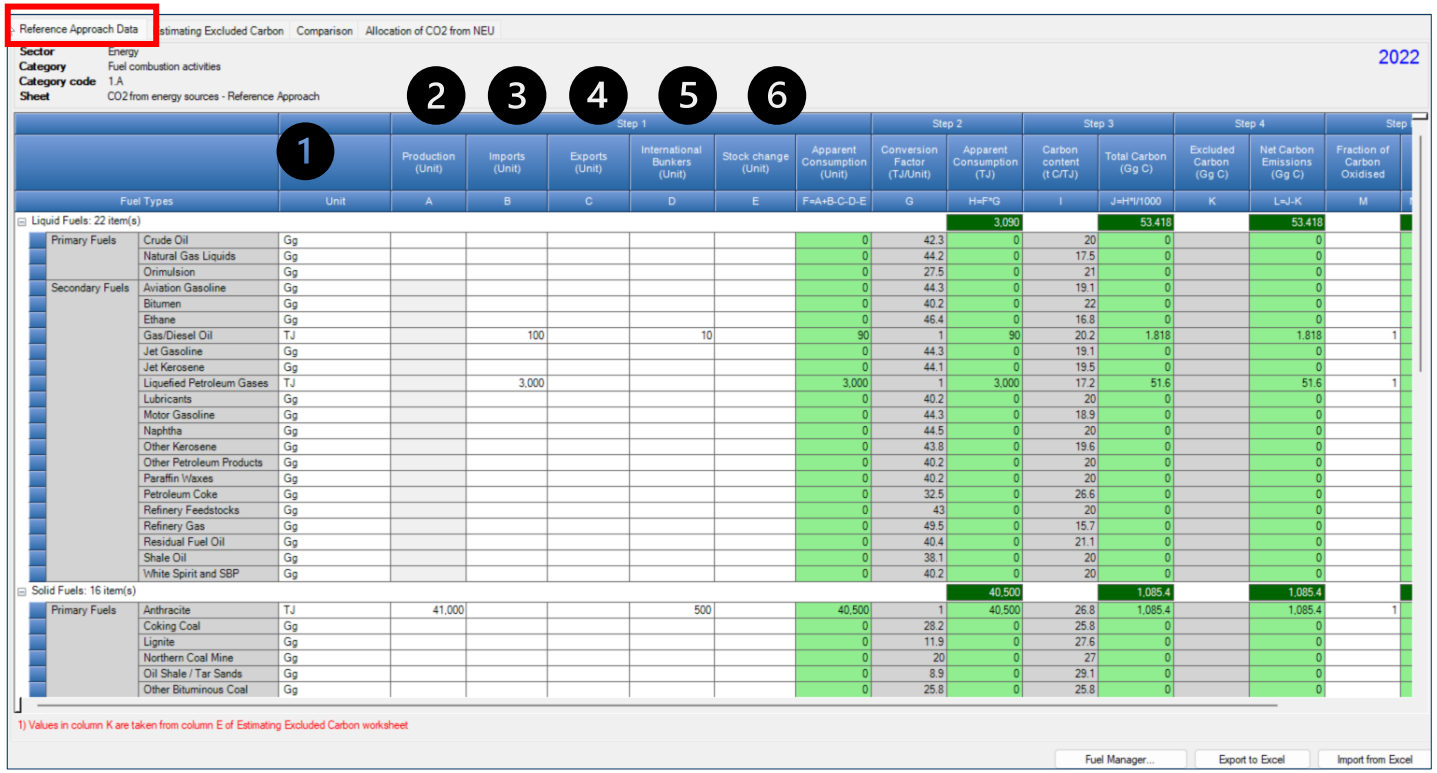
2. **Column |A|:** input the amount of production of the fuel (primary fuels only)

3. **Column |B|:** input the amount of imported fuel

4. **Column |C|:** input the amount of exported fuel

5. **Column |D|:** input the amount of fuel used for international bunkers, if applicable

6. **Column |E|:** input the amount of stock change.
Note that an increase in stocks is a positive stock change which withdraws supply from consumption. A stock reduction is a negative stock change which, when subtracted in the equation, causes an increase in apparent consumption



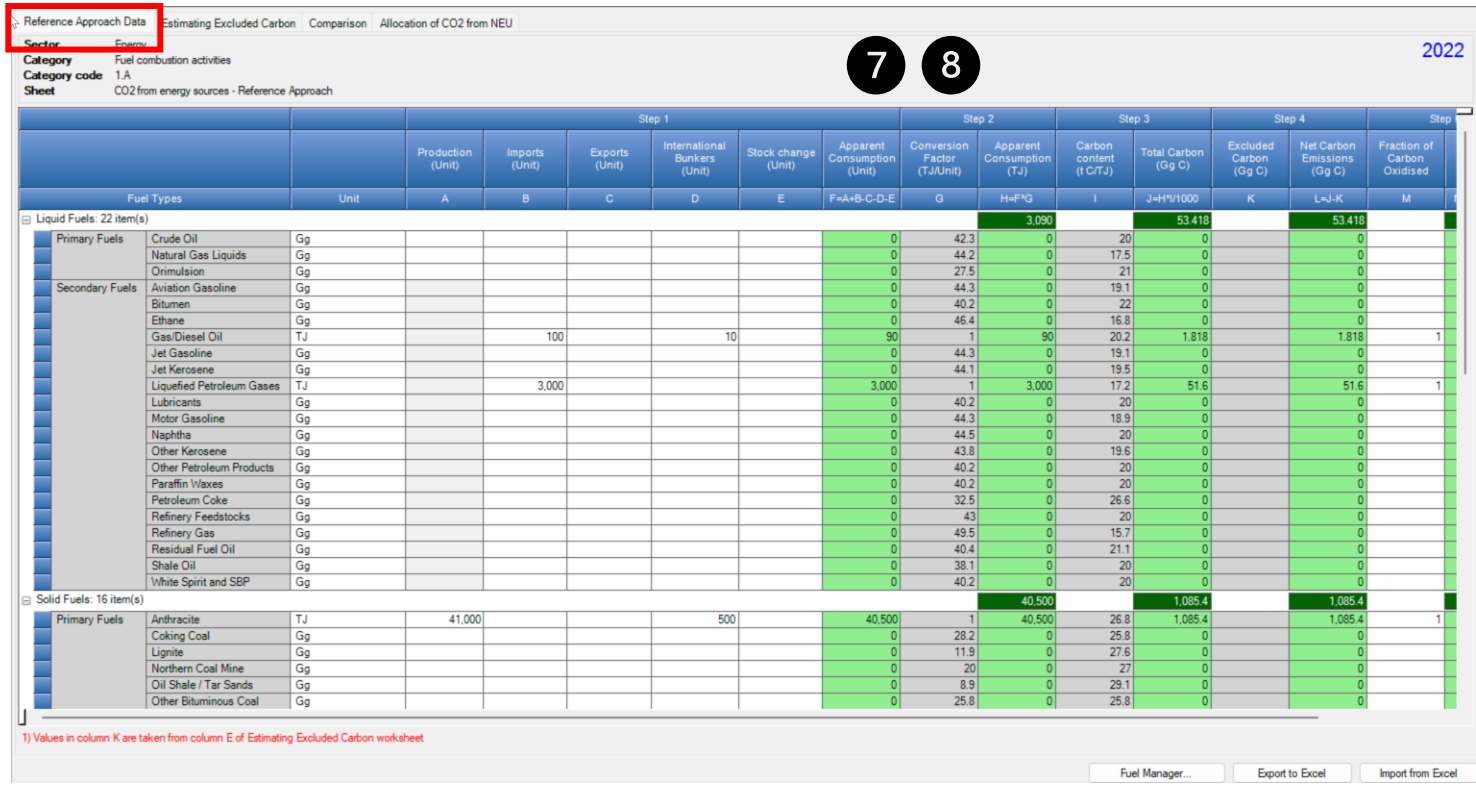
Step B. Reference Approach Data

For each fuel, enter the following information *(continued)*:

7. **Column |F|:** the *Software* estimates the amount of apparent consumption of the fuel.

8. **Column |G|:** conversion factor in (TJ/Unit) is filled automatically from the Fuel Manager.

Note that where Gg of fuel are converted to TJ, the NCV/GCV is sourced from the Fuel Manager and compiled by the Software as a conversion factor; while if the consumption unit is TJ, the Software compiles the conversion factor cell with the value 1. Where other units are applied (e.g. m^3) the user shall enter relevant conversion unit here.



Step C. Estimating Excluded Carbon

For each fuel in the Column |Fuel Types|, enter the following information:

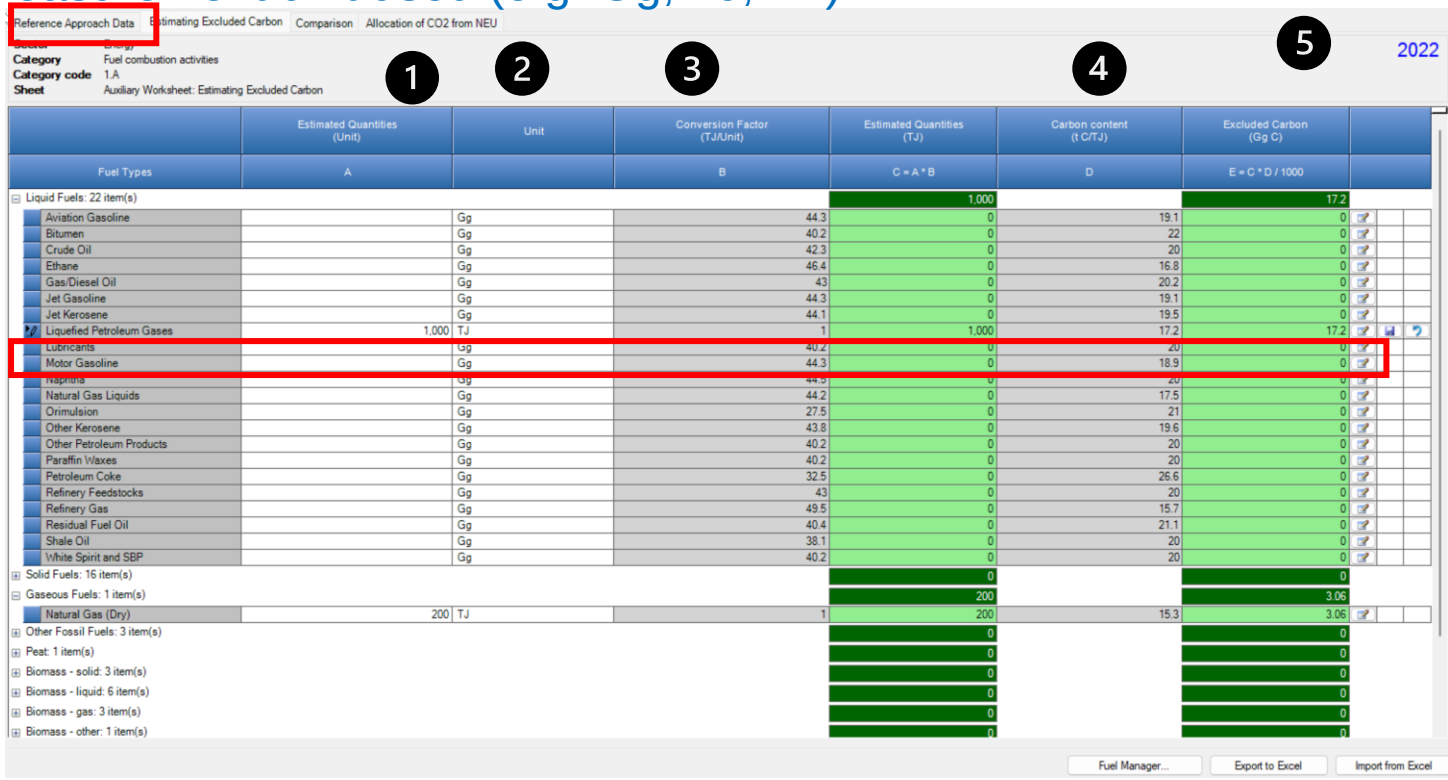
1. **Column |A|**: enter the estimated quantity of the fuel not used for combustion purposes (e.g. natural gas used as a feedstock for ammonia production, or coking coal used in the iron and steel industry).

2. **Column |Unit|:** select or enter manually the measurement unit used (e.g. Gg, TJ, m^3).

3. **Column |B|:** conversion factor in TJ/Unit is filled automatically from the Fuel Manager.

4. **Column |D|:** carbon content is filled automatically from the Fuel Manager in t C/TJ.

5. Excluded carbon in **Column |E|** is then automatically included in **Column |K|** of the **Reference Approach Data** tab.



Step D. Reference Approach Data Tab

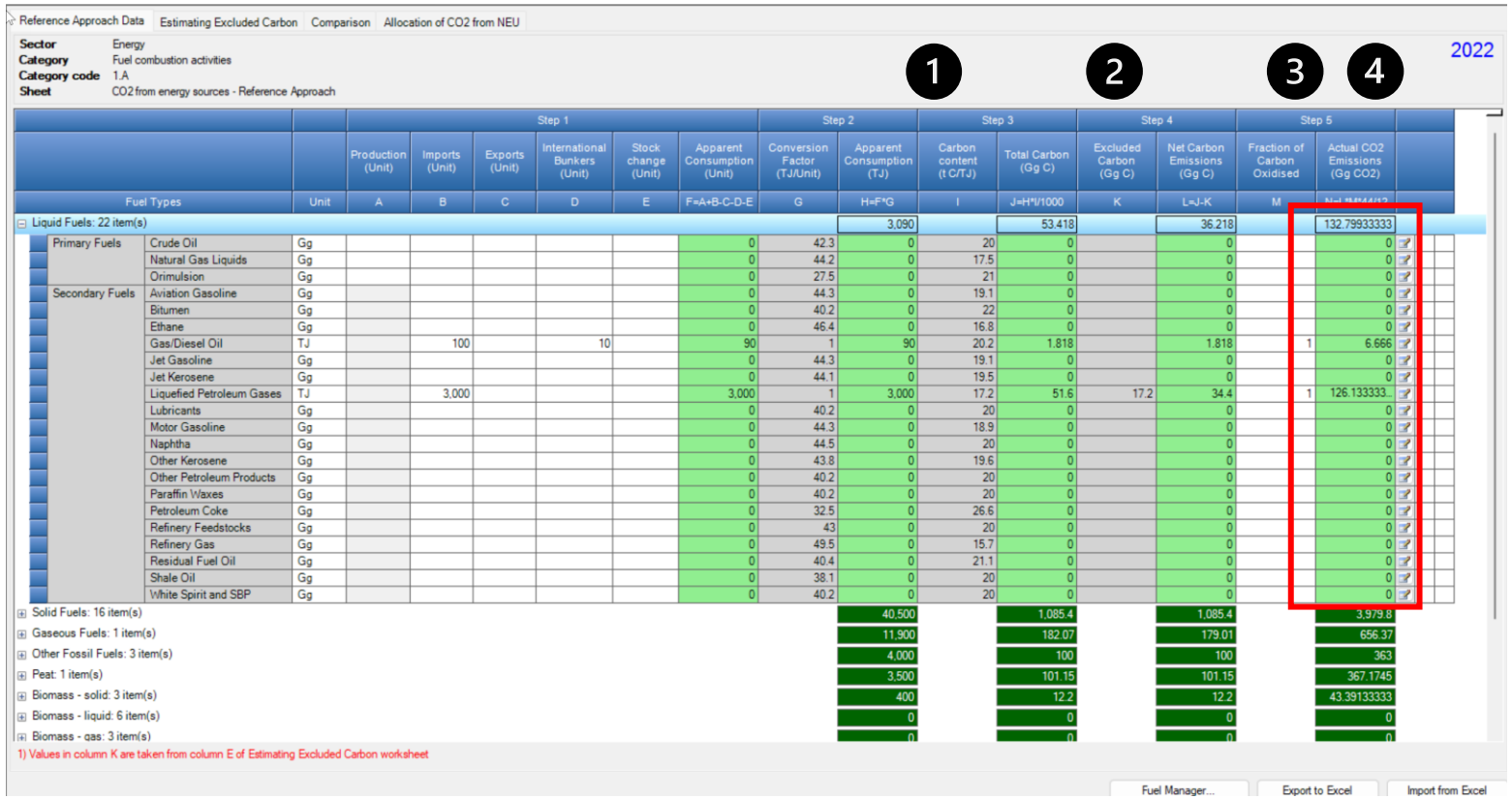
Input of EFs for the Reference Approach requires the following steps:

1. **Column |I|:** carbon content is filled automatically from the Fuel Manager in t C/TJ.

2. Excluded carbon in **Column |K|** is taken automatically from the **Excluded Carbon** worksheet

3. **Column |M|:** enter fraction of oxidized carbon.
Note if no information on this factor is available, the value "1" shall be entered to proceed with calculations

4. *Software* estimate CO_2 emissions following the Reference Approach



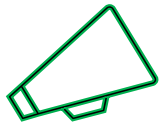
Recall: gray shading means that data contained in that cell are automatically pooled from somewhere else.

Step E. Comparison

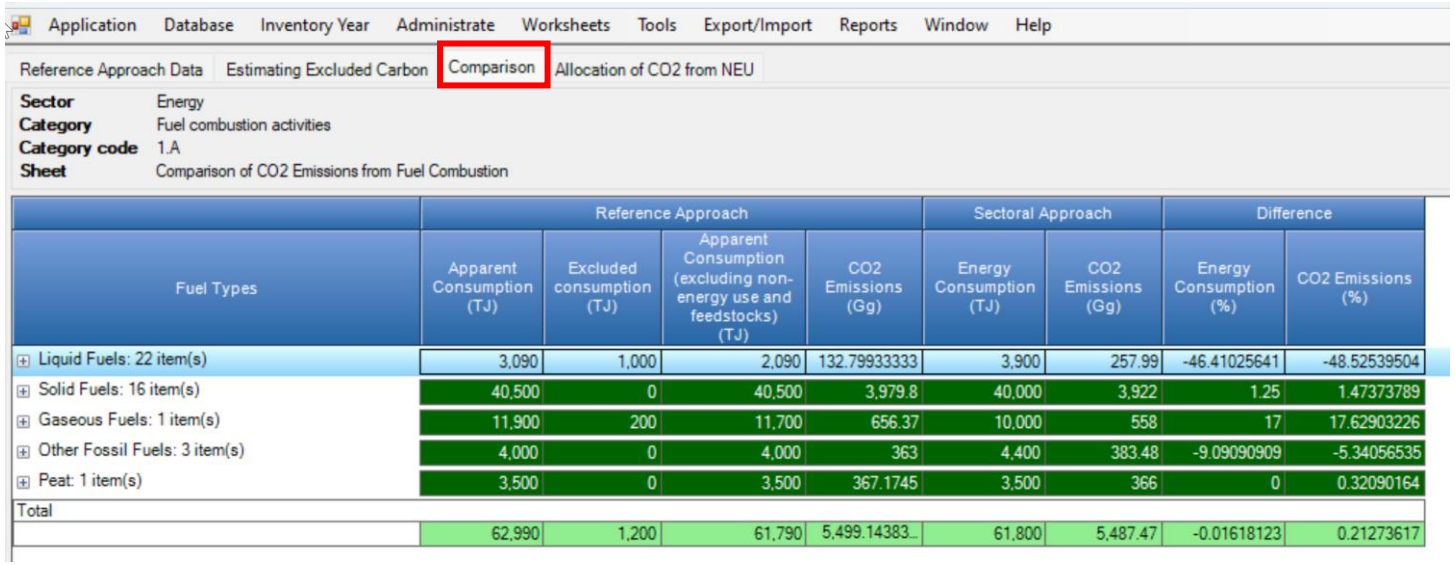
The *Software* provides results of CO_2 estimations under the Reference and Sectoral approaches and performs a comparison between the two approaches by each fuel, fuel type and total for the NGHGI
For each fuel, enter following information:

- Worksheet **Comparison** presents the results for the **Reference Approach**, as well as main AD (apparent consumption). This worksheet also summarizes the main AD and CO_2 emissions calculated under the **Sectoral Approach**, by fuel type. In the Columns **|Difference|**, the *Software* provides the comparative difference between the Reference and Sectoral approaches in terms of energy consumption and CO_2 emissions.

- The 2006 IPCC Guidelines, Section 6.8, provide possible reasons for a gap between the two approaches, (expected to be less than 5%). For higher percent differences, reporting programs typically require users to provide a clear explanation and justification.



In this example, which reason might you provide for the sectoral approach being greater than the reference approach for liquid fuels?



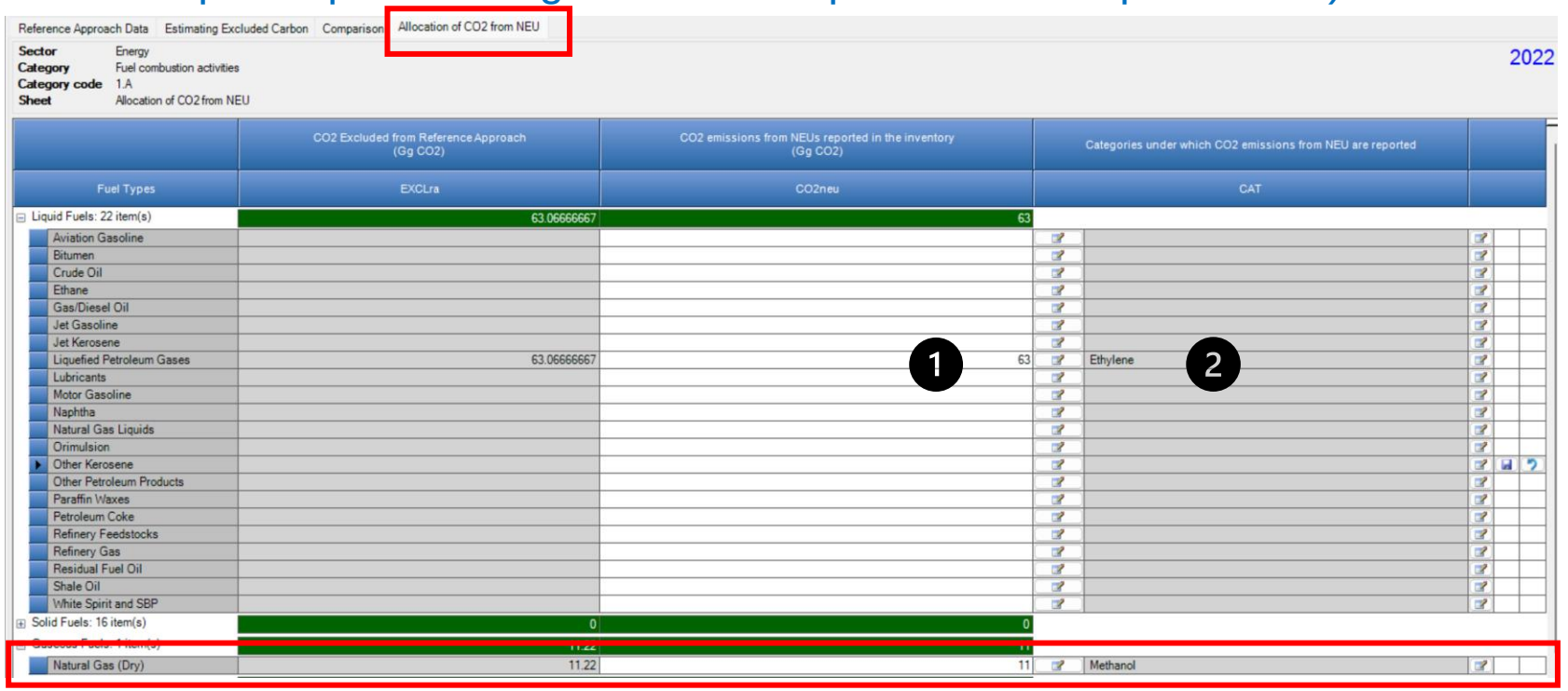
Fuel Types	Reference Approach				Sectoral Approach		Difference	
	Apparent Consumption (TJ)	Excluded consumption (TJ)	Apparent Consumption (excluding non-energy use and feedstocks) (TJ)	CO2 Emissions (Gg)	Energy Consumption (TJ)	CO2 Emissions (Gg)	Energy Consumption (%)	CO2 Emissions (%)
⊞ Liquid Fuels: 22 item(s)	3,090	1,000	2,090	132.79933333	3,900	257.99	-46.41025641	-48.52539504
⊞ Solid Fuels: 16 item(s)	40,500	0	40,500	3,979.8	40,000	3,922	1.25	1.47373789
⊞ Gaseous Fuels: 1 item(s)	11,900	200	11,700	656.37	10,000	558	17	17.62903226
⊞ Other Fossil Fuels: 3 item(s)	4,000	0	4,000	363	4,400	383.48	-9.09090909	-5.34056535
⊞ Peat: 1 item(s)	3,500	0	3,500	367.1745	3,500	366	0	0.32090164
Total								
	62,990	1,200	61,790	5,499.14383...	61,800	5,487.47	-0.01618123	0.21273617

Step F. Allocation of CO_2 from NEU

For each relevant fuel in Column |Fuel Types| that is used for NEU and for which CO_2 emissions from the use of that fuel are reported elsewhere, enter the following information:

1. Column |CO2neu|: enter the quantity of CO_2 emissions from NEU that is reported elsewhere in the NGHGI, in $GgCO_2$ (e.g. CO2 emissions from the liquified petroleum gases used in petrochemical production).

2. Column |CAT|: for each relevant fuel, click on the editing box in the left-hand side of the column and select one or more categories of the inventory where these CO_2 emissions are reported.



Allocation of CO_2 from Non-energy use

In the **Comparison slide**, the apparent consumption in the Reference approach was **higher than** energy consumption in the Sectoral Approach for gaseous fuels.

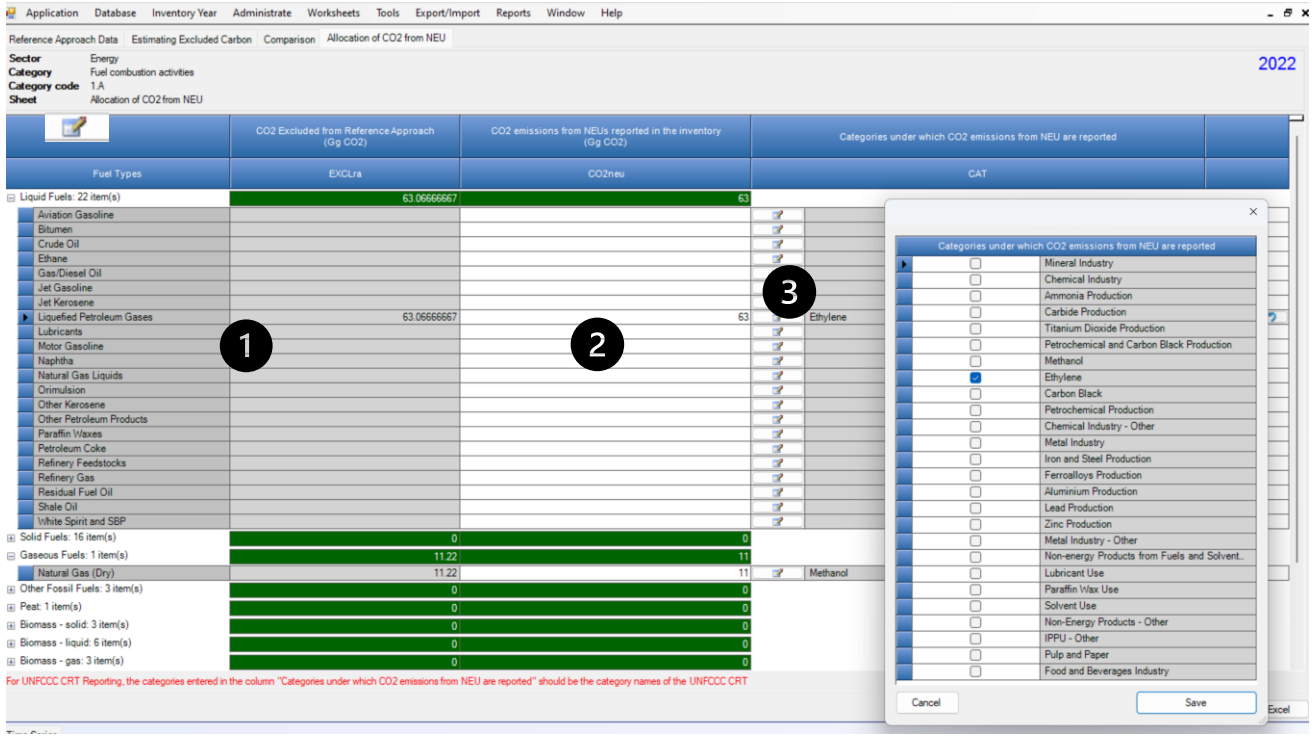
- One possible reason, could be that there is double counting of the natural gas used for combustion in the energy sector, and that used as a feedstock for the petrochemical industry (and thus reported in the IPPU sector). Recall, in the Estimating Excluded Carbon worksheet, we estimated 1,000 TJ were excluded?

- In this tab "Allocation of CO_2 from Non-energy use" you can indicate where this LPG was used.

1. CO_2 is automatically populated from "**Estimating Excluded carbon**"

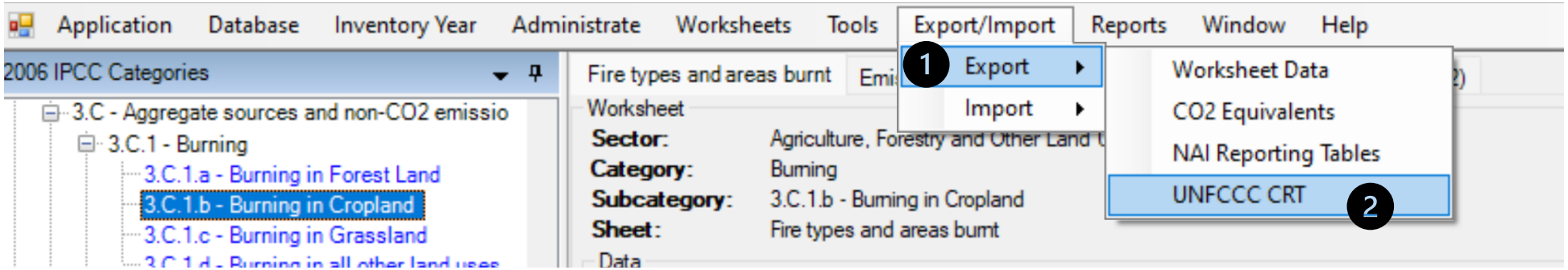
2. **Enter the CO_2 emissions reported elsewhere**

3. **To select the category(ies)** where reported select and check appropriate category(ies) in the dropdown. This information will be used the UNFCCC ETF Reporting Tool

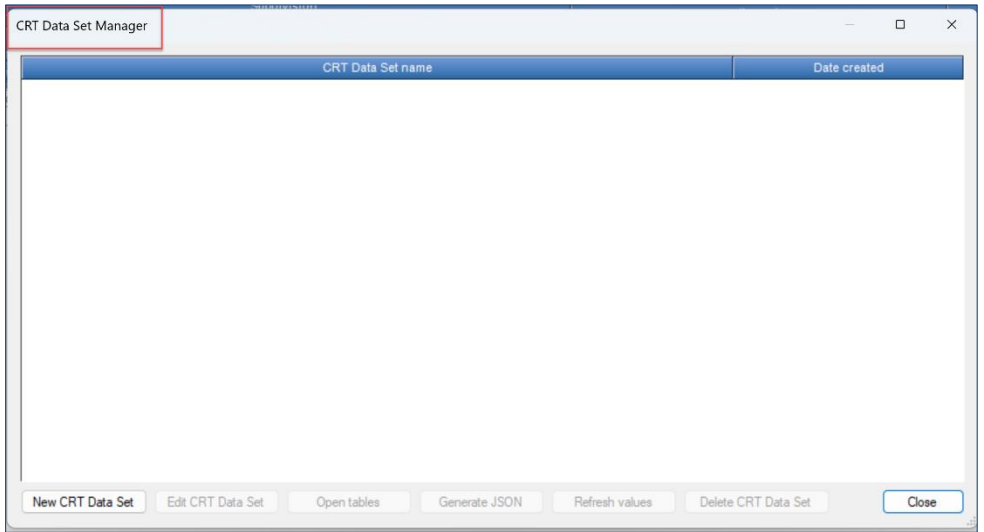


Access CRT Interface in Software

1. **Navigate to** Main Menu and select **"Export/Import"**
2. **Select** "Export" and "UNFCCC CRT"

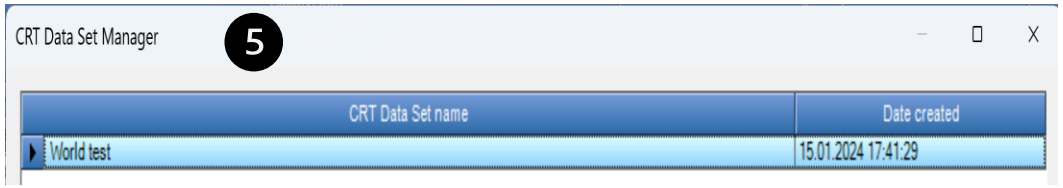


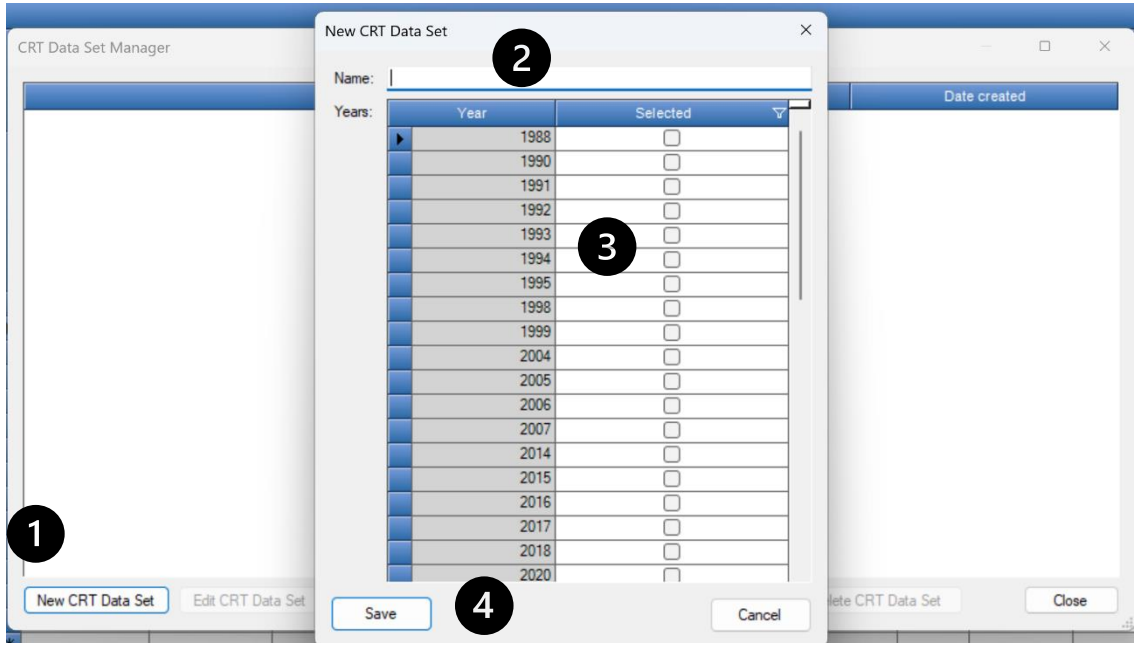
- This opens the **CRT Data Set Manager** interface



Create New CRT Data Set

1. **Select New CRT Data Set:** This action button opens a screen where properties of the new CRT Data Set are specified, managed and exported to JSON independently.
2. **Name –** Enter name of new CRT Data Set
3. **Years –** Select years to include in your data set
4. **Save –** Select Save
5. A new data set is created





NOTES:

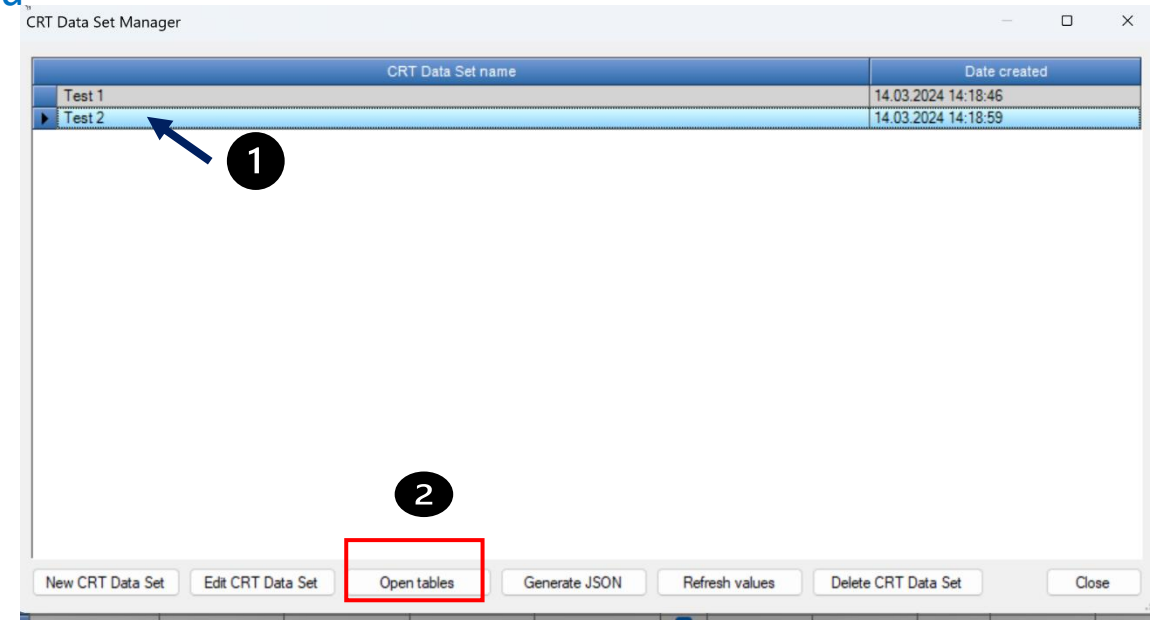
- The list of years for selection will include only those years that you have created in the *Software*
- You may save in the JSON a subset of years you have in your CRT data set

Open CRTs

- **Open Tables** is an interface that visualizes the CRT and allows you to review, manage and finalize the data for the CRT across sectors and years for your selected CRT Data Set

  1. Highlight the **CRT Data Set** you want to review

  2. Select Open Tables



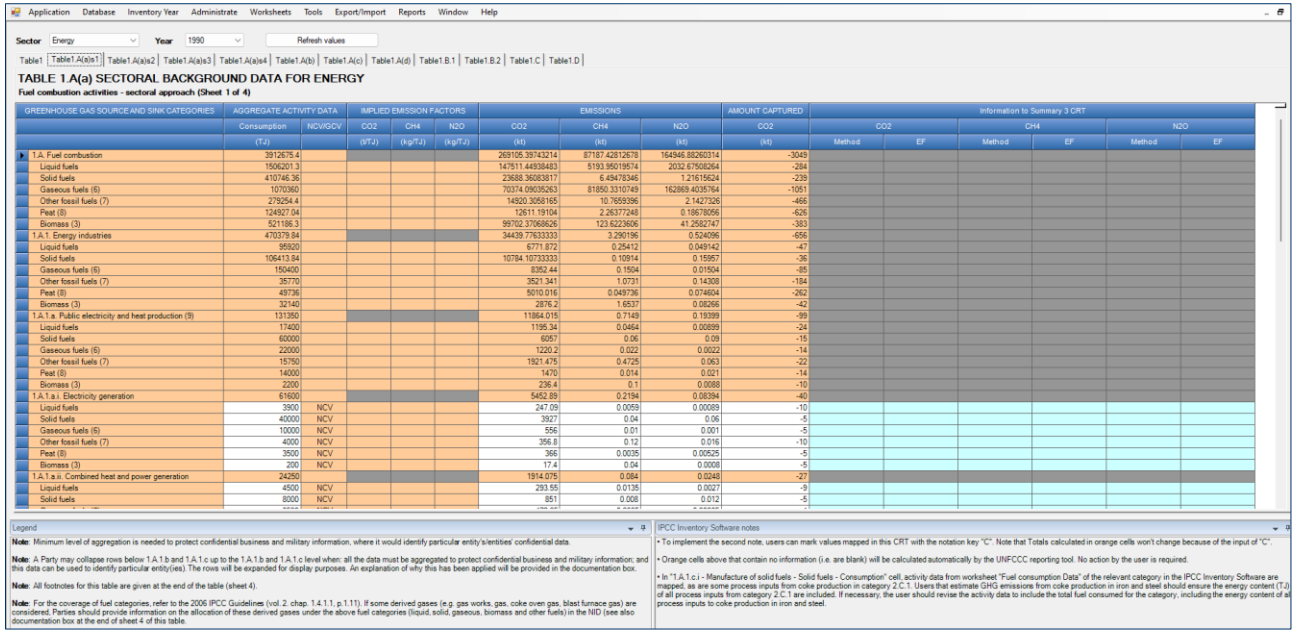
- This action button opens a screen containing CRT for the currently selected CRT Data Set.

- This screen will open in a mode that allows you to switch between the visualized CRT and other *Software* screens (e.g. Worksheets). Only one visualized CRT for one CRT Data Set can be open at a time.

Recall, to access this screen navigate to the **Main Menu** and select **Export/Import / Export** / **UNFCCC CRT**

Open CRTs - Functionalities

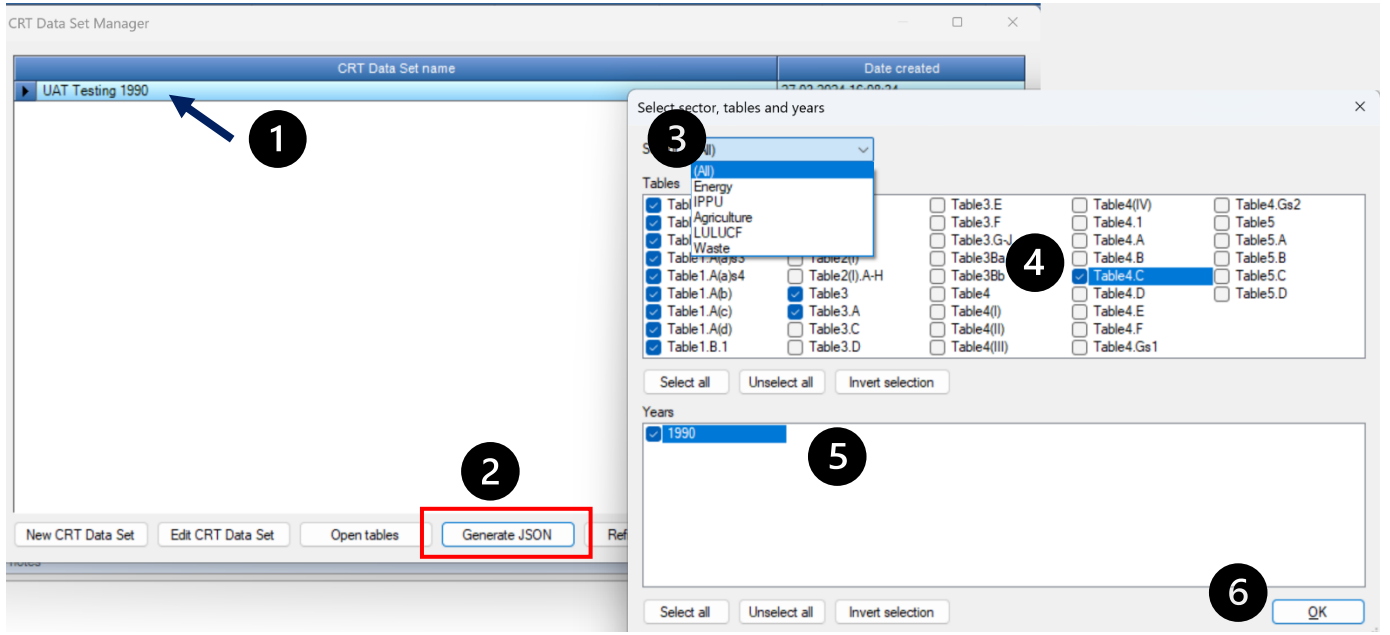
- In Open Tables, you can separately visualize each table for each sector and each year and provide additional information that will be needed for your submission in the UNFCCC ETF Reporting Tool.
- In the visualized CRT, you may:
  - **Review** your data, including data aggregations
  - **Change notation keys**
  - **Provide explanations** for **use of the notation keys "IE"** (included elsewhere) and **"NE"** (not estimated) for CRT table 9
  - Provide information on the **method and EFs used**, for Summary 3 of the CRT
  - Designate information as confidential (notation key "C")
  - Draft **"Official" comments**
  - Provide information for **documentation boxes**
  - Review **CRT footnotes**
  - Review **IPCC Inventory Software Notes**



Generate JSON

- Selecting this button allows you to generate a JSON file for export and subsequent upload to the UNFCCC ETF Reporting Tool.
- All tables of the CRT that belong to the selected CRT Data Set and settings selected below, will be serialized into the JSON file for selected years.

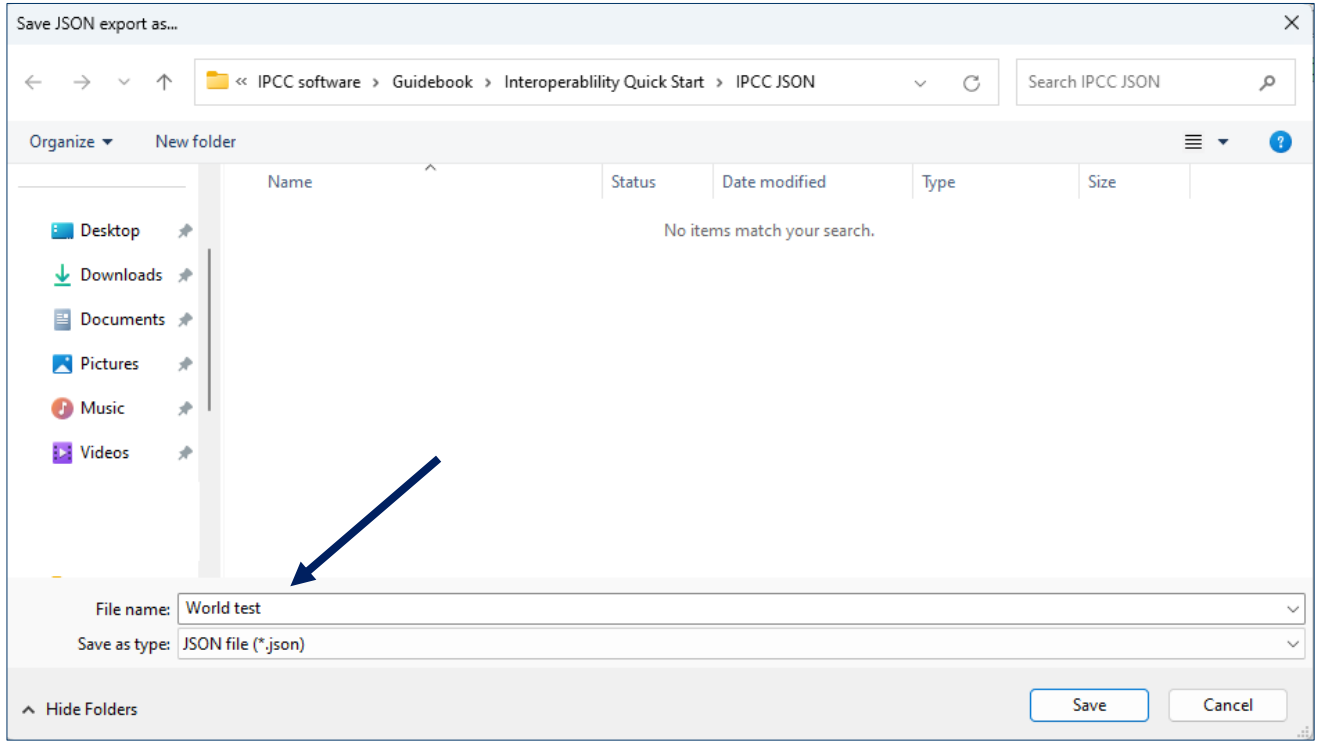
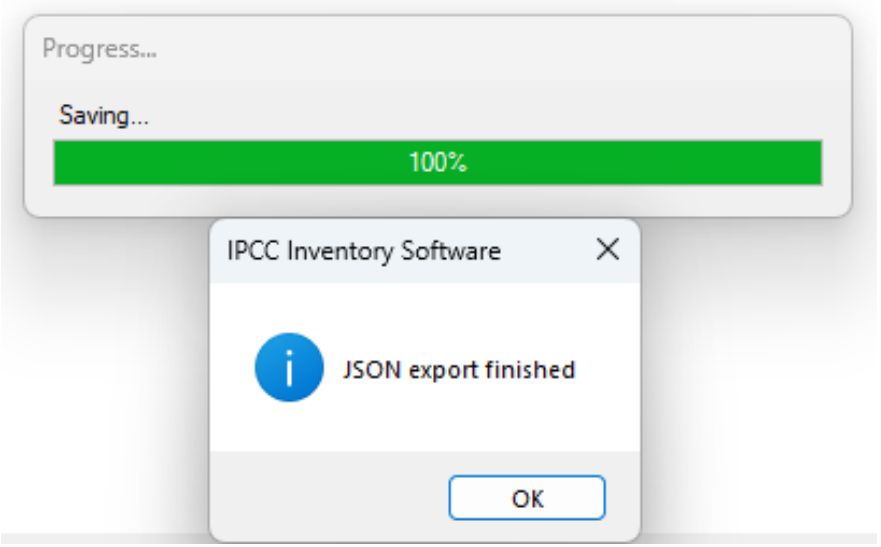
1. **Highlight** the **CRT Data Set** for which you want to generate a JSON file.
2. **Select Generate JSON**
3. **Select Sector(s)** you would like to include in the JSON file. You may include one, multiple, or all sectors
4. **Select specific table(s) of the CRT** you would like to include in the JSON file.
5. **Select** the **Year(s)** you want to include in the JSON file. You may, but do not have to, include all years that are in your CRT Data Set.
6. **Select "OK"**



Notes:

Recall, to access this screen navigate to the **Main Menu** and select **Export/Import / Export / UNFCCC CRT**

- At the time of drafting, the F gas tables of the IPPU sector are not yet available for export in JSON format.

Generate JSON

Save the JSON file to your computer. This is the file you can then upload to the ETF Reporting Tool