MITICA

MITIGATION-INVENTORY TOOL FOR INTEGRATED CLIMATE ACTION

MITICA Regional Workshops

United Nations
Framework Convention on
Climate Change

23/04/2024
SANDER AKKERMANS

Wrap up Day 1 – MITICA Training

MITICA is a tool allowing for:

- Developing **GHG emissions projections** based on historic emissions and relevant proxies (WoM).
- Estimating the **impact of mitigation policies and measures (PAMs)** based on a list of PAMs based on international practices and aligned with the IPCC methodology.
- Developing different **mitigation scenarios (WeM and WaM)** considering the implementation of different PAMs.

MITICA was developed as:

- An **innovative tool** combining several **statistical and machine-learning techniques** to optimise the modelling of the projections.
- A **desktop application** including a **guidance manual** to facilitate its use
- A **key tool supporting countries in fulfilling their reporting requirements under the UNFCCC**.

Wrap up Day 1 – MITICA Training

Are there any remaining questions?

From Theory to Practice

In this session, we will answer the following questions:

- What **data** do I need to have and in what format to use MITICA?
- How can I **project GHG emissions inventories** with MITICA?
- How do I **choose mitigation PAMs** and how to interpret their effect?
- How do I **create different mitigation scenarios** (WoM, WeM, WaM)?
- How to **export results data**?

Day 2 - MITICA Training

Agenda for today

Time (CET)	Topic
9:00 – 9:30	**Projecting GHG emissions in MITICA**, using national GHG inventories as a basis. Real examples on data processing and uploading in MITICA for calculating the Without Measures Scenario
9:30 – 09:45	**Validating GHG projections** by IPCC category in the Without Measures scenario – Description of the criteria and review of validation examples.
9:45 – 09:55	**Questions and Answers.**
09:55 – 10:40	**Analysis of Policies and Measures (PAMs)** by IPCC sector. Assessment of alternatives and design of mitigation scenarios.
10:40 – 10:50	**Using the Dashboard** to visualise projected GHG emission scenarios and PAMs. Examples of data exporting.
10:50 – 11:00	**Questions and Answers.**

1. The Country of MITICA

Firstly, to develop the GHG projections, we need as the basis the GHG inventory of a country.

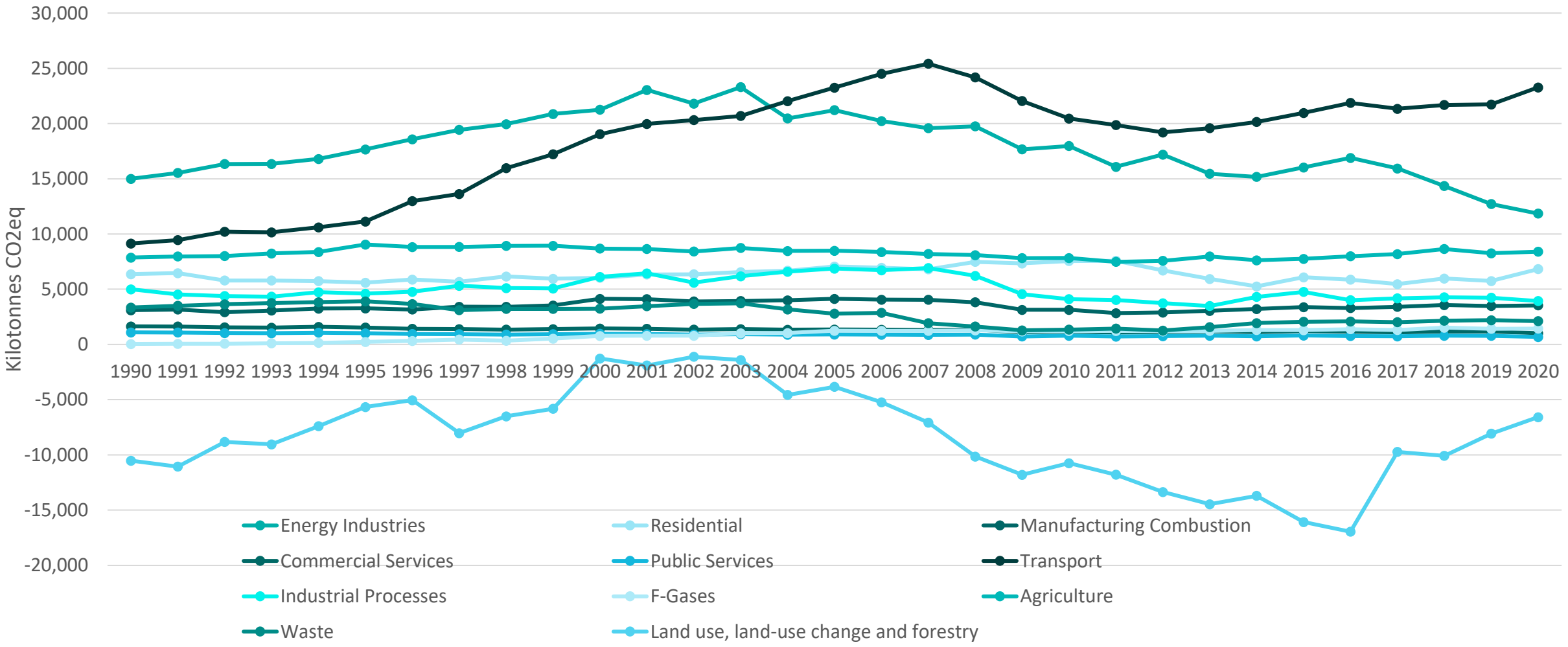
This country is “MITICA”, a fictitious developing country with the following characteristics:

- **Land area**: 120.000 km2
- **Population** of about 9,7 million (2024) –> Relatively low population density
- **National GDP** at 96 billion USD (2024) –> Middle income country

- **Energy sector:** Reliance on fossil fuels for electricity production and heating, but recent shifts to renewables, some oil and gas exploration and processing as well as fuel production.
- **Industry:** Relatively strong manufacturing sector and substantial cement production.
- **Transport:** Heavy reliance on road transport with insignificant electrification, substantial domestic aviation and railway use due to large distances between population centres.
- **Agriculture:** Substantial cattle farming and agricultural production.
- **Forests and Land and land-use:** Large stretches of forest and grassland cover but substantial use for agriculture and settlements.
- **Waste:** Average waste production, with improving waste management capacities.

1. GHG Inventory MITICA

The natural circumstances and economic structure of MITICA are associated with the following GHG emissions profiles by sector between 1990-2020.



Flow of Activities in MITICA

Step 0: Support and User Manual

Step 1: Uploading the required data

Step 1.1. Choosing the forecasting year

Step 2: Projecting the Without Measures Scenario (WoM)

Step 3: Validating the WoM Scenario

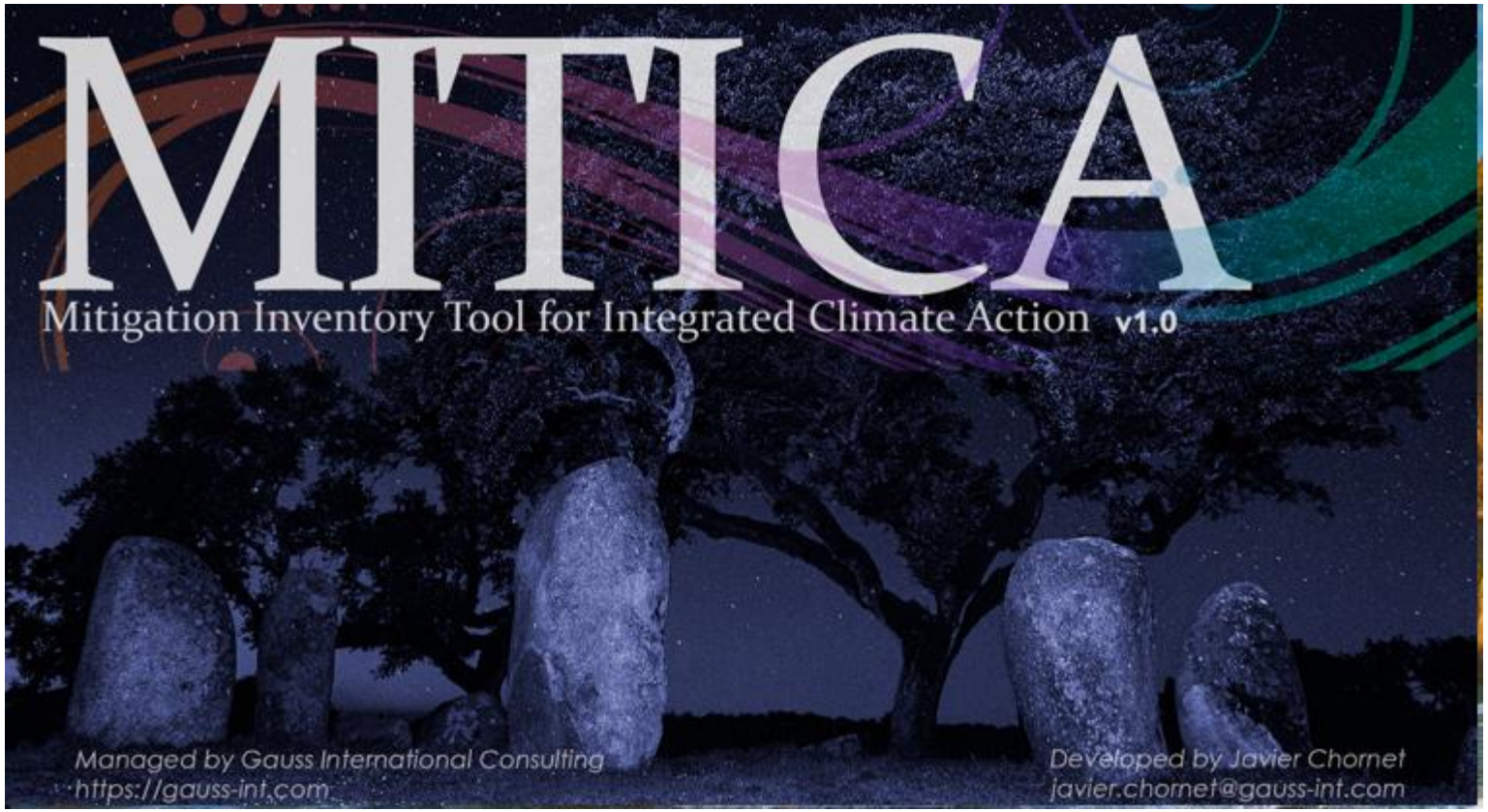
Step 4: Include and assess the impact of mitigation Policies and Measures (PAMs)

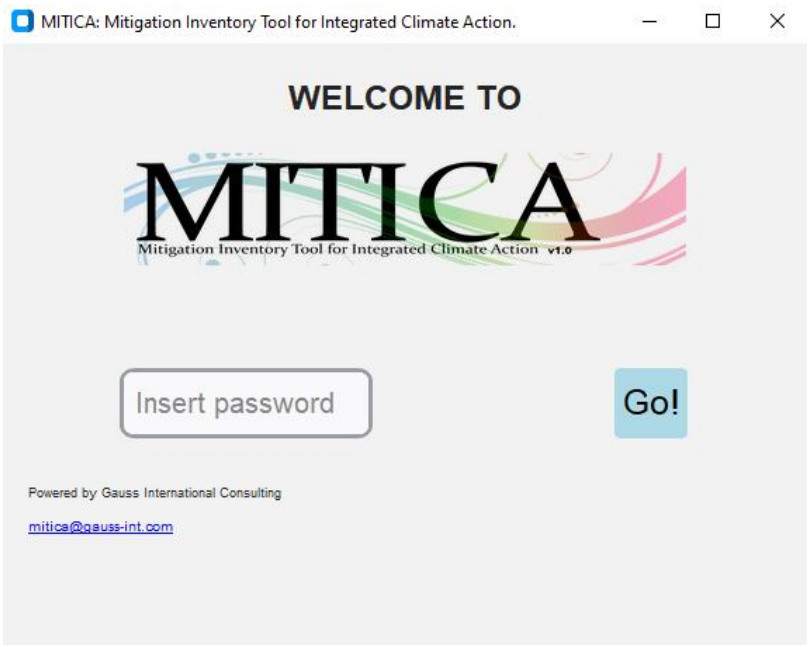
Step 5. Designing the With Existing Measures (WeM) and With Additional Measures Scenarios (WaM)

Step 6: Summarize the results

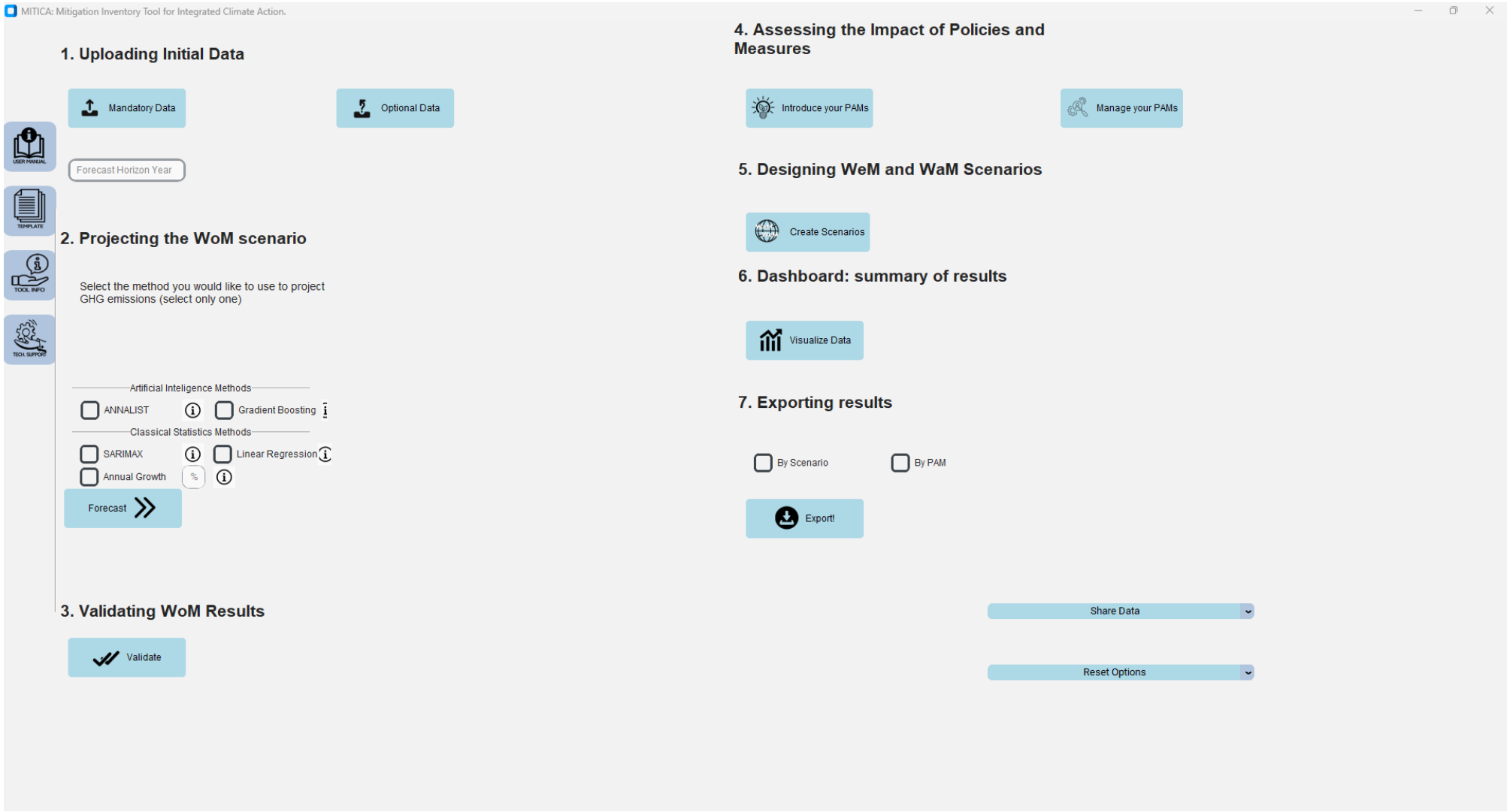
Step 7: Export the results

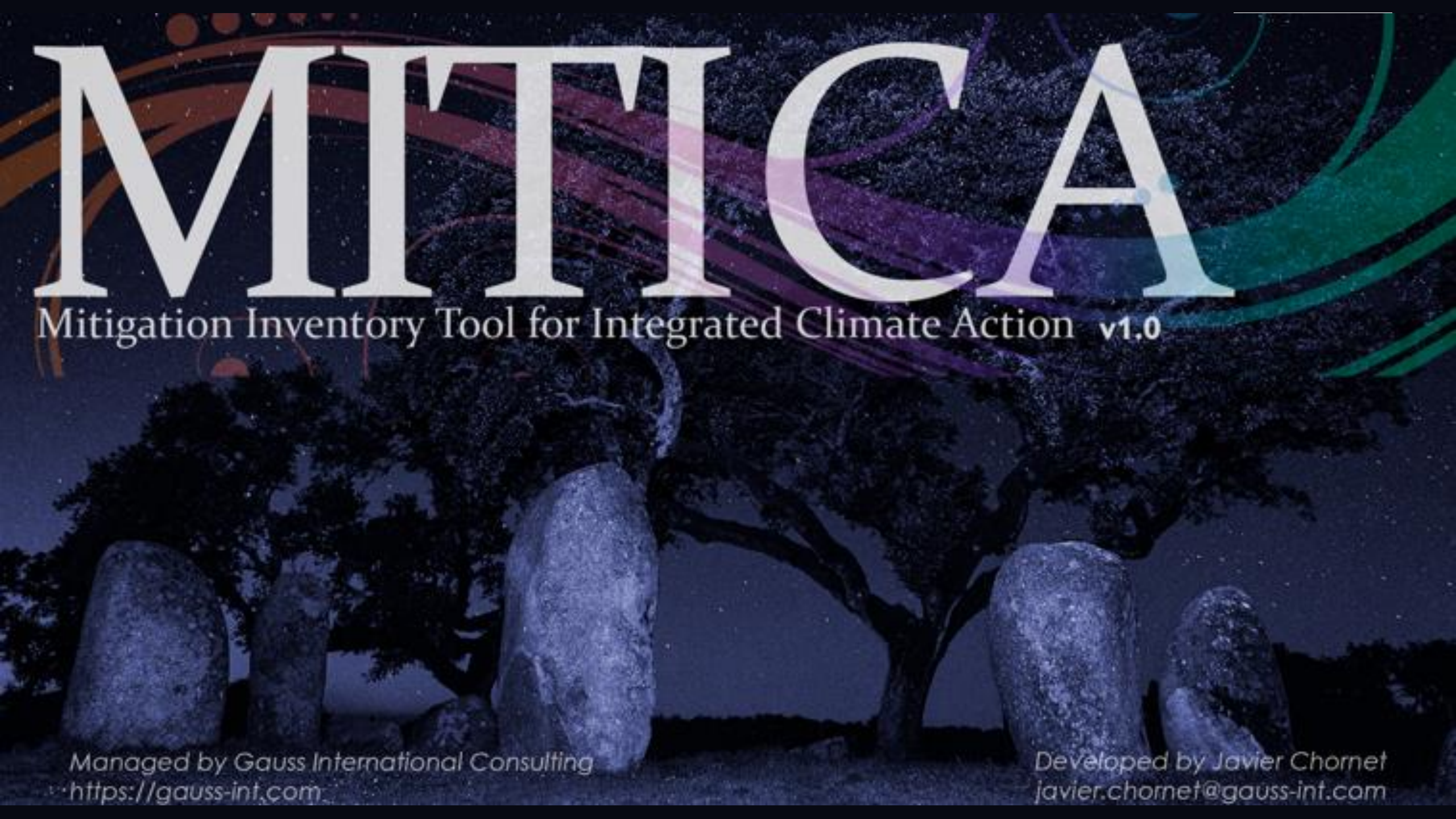
Flow of Activities in MITICA





Flow of Activities in MITICA




MITICA
Mitigation Inventory Tool for Integrated Climate Action v1.0
Managed by Gauss International Consulting
https://gauss-int.com
Developed by Javier Chornet
javier.chornet@gauss-int.com

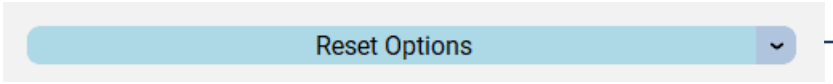
Step 0: Support and User Manual

Extensive User Manual with explanations of general steps and of each PAM including default values

Download of the Excel format for the GHG Inventory

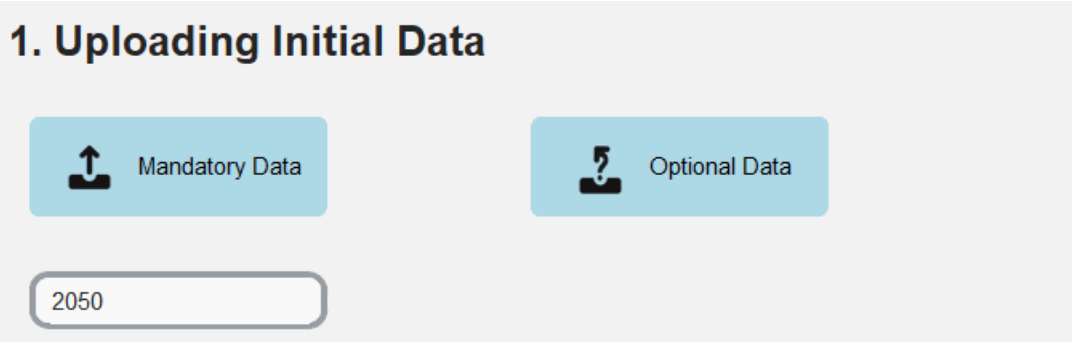
Basic info on MITICA indicating the version and the hosts of the tool

Email link to Gauss to request support



Allows for resetting the whole session or only certain steps in case that is required

Step 1: Uploading the required data



In order to run MITICA, we need to upload mandatory data and can further include optional data.

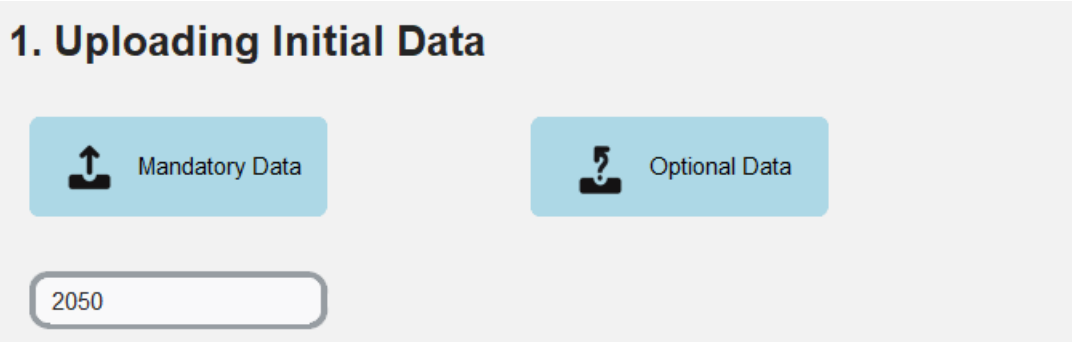
Mandatory data:

- GHG Inventory covering the period 1990 – 2020
- Proxy 1: GDP data 1990 – last forecasting year (2050)
- Proxy 2: Population 1990 – last forecasting year (2050)

Optional data:

- Numerous sectoral proxies ordered by IPCC sector and type
- Data on these additional optional proxies is similarly required from 1990 – last forecasting year

Step 1.1: Choosing the Forecasting Year



To forecast the GHG inventory, we need to **set the year until which we want to project GHG emissions**.

→ If we choose 2050, MITICA then considers the GHG emissions trends of the uploaded inventory time series 1990 to 2020 as well as the trends and projections for GDP and population + any other proxy to project the GHG emissions until the target year 2050.

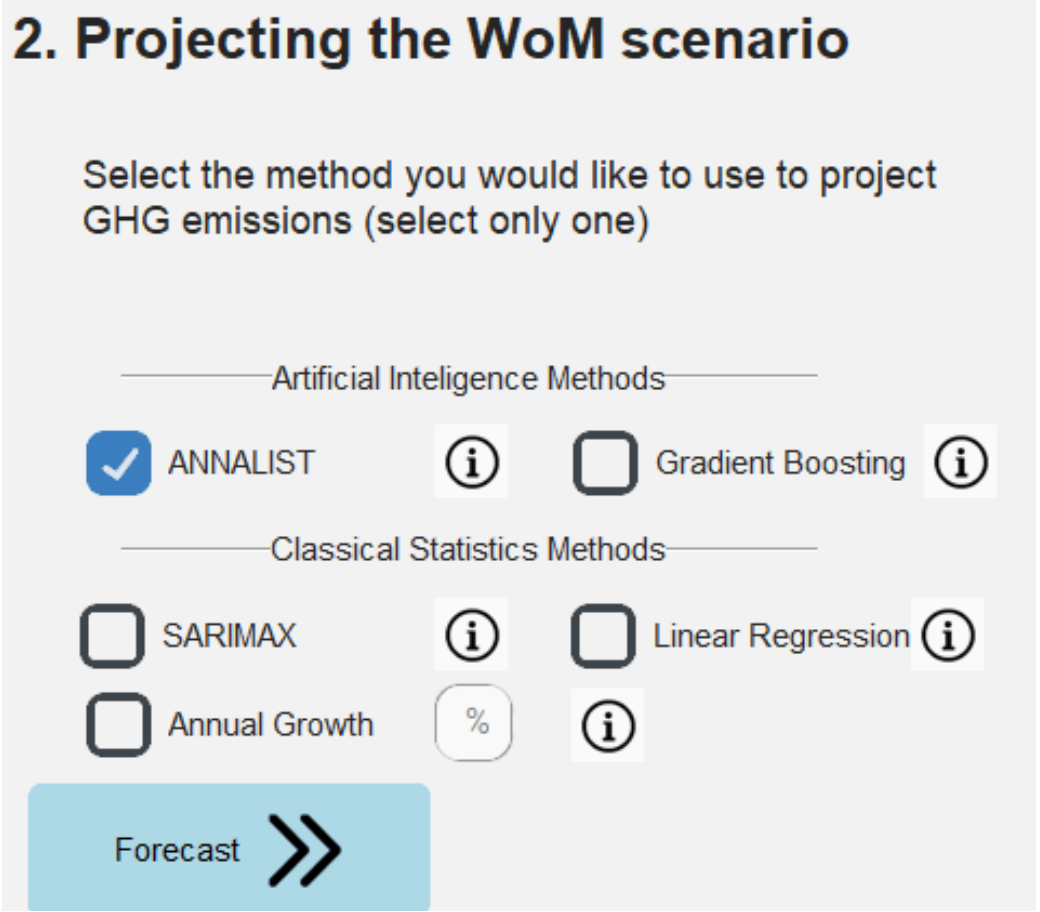
Step 2: Projecting the Without Measures Scenario (WoM)

In this step MITICA **projects the Without Measures (WoM) scenario** based on the proxies and the GHG inventory uploaded.

→ In this scenario, no policies and measures implemented or planned are considered.

To project, MITICA requires us to **choose a statistical method** to develop the WoM scenario.

→ ANNALIST is the recommended option because it combines several machine learning techniques with classical approaches to define a best-fit model by source/sink category.

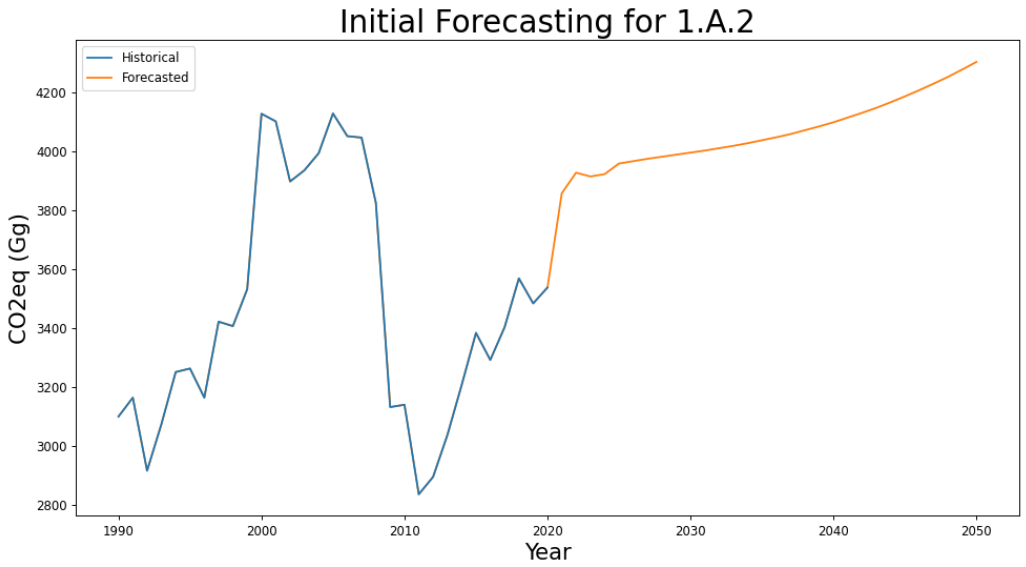


Step 3: Validating GHG Projections by IPCC Category in the WoM

The third step requires us to **validate the projection for each of the IPCC GHG emissions categories**.

This step is crucial, because it allows us to adjust the projections based on certain considerations and preferences. For instance:

- We know that the chemical industry in our country is planned to cease operation in 2035, but MITICA does not know this and projects the emissions based on historic emissions and proxies
  → Need to consider this limitation as emissions will go toward 0
- We know there is a target to reach 0 emissions in a sector, but MITICA does not know this
  → Need to set the target in the tool, it will then project it accordingly.



Are there any questions?

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.1 Select the PAMs

- **More than 60 PAMs are defined in MITICA**. Users need to specify the magnitude and certain parameters to obtain GHG emission reduction results.
- **PAMs are chosen by sector and subsector** in strict alignment with the IPCC categories.
- The PAMs have been identified through **extensive international research** on common mitigation actions implemented by countries.
- They are **predetermined in MITICA** and are **to be customized based on the PAMs introduced**.
  - Customizing means to determine the magnitude of the PAM (e.g., how much solar PV is to be installed, how many cars to be electrified). Default parameters are provided by the tool to facilitate calculation.
- The PAMs manual provides instructions and explanations for each PAM to facilitate the introduction of PAMs in MITICA.

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.1 Select the PAMs

As a first step, we need to decide on which PAMs to introduce.

- Based on the key categories and mitigation targets of your country and considering the national context such as technological possibilities and boundaries, economic factors and prioritized sectors, the key PAMs should be selected.

Note, MITICA allows for largely unrestricted **testing and customization of PAMs**. As such, you can use the tool for several (interlinked) purposes:

- Estimating the **mitigation impact** of the most relevant PAMs to report in the BTR.
- Defining the **unconditional and conditional PAMs** in line with the targets of the NDC.
- Developing the different **mitigation scenarios** (WeM and WaM) – more in step 5.
- Assessing the **effectiveness and compare different PAMs** to refine policy decisions and NDC update processes.

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.1 Select the PAMs

- Further, when choosing the most effective PAMs to be implemented in a country, it is essential to **consider the key emissions categories** identified in the GHG inventory.
- **Key categories** are those categories which together represent 95% of all GHG emissions in the inventory.
- The **PAMs manager** helps to maintain the overview of the PAMs the user introduces.
- Moreover, MITICA indicates whether the user has chosen a key category or not to guide the prioritisation of PAMs.

Key Categories of the GHG Inventory	
1A3b	Road transportation
1A1a	Public electricity and heat production
1A4b	Residential
3A1	Enteric fermentation
1A2	Manufacturing
2A	Mineral Industry
3D	Agricultural Soils
2F	F-gases
5A	Solid Waste

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

Selected PAMs	Categories	Policies and Measures
	1A1a Public electricity and heat production	Use of Renewables for power production (solar)
	1A2 Manufacturing industries and construction	Fuel switch coal to natural gas in industry
	1A3b Road Transport	Fuel switch from fossil diesel to biodiesel
	2A Mineral Industry	Replacement of clinker in cement production
	3A Enteric Fermentation	Improved feeding practices for cattle
	4A Forest Land	Afforestation via converted land
	5A Solid Waste	Reduction of waste production per capita

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A1a Public electricity and heat production	Use of Renewables for power production (solar)

To estimate the PAM, choose the correct PAM in MITICA by:

1. Choose the sector → Energy
2. Choose the subsector → Power Sector
3. Choose the correct PAM → use of renewables for production via installed
    - The other option would be via electricity produced, but we have in this example data on capacity installed

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A1a Public electricity and heat production	Use of Renewables for power production (solar)

How does this PAM mitigate GHG emissions?

- ***The solar PV capacity replaces the need to use the capacity of thermal plants for electricity production***

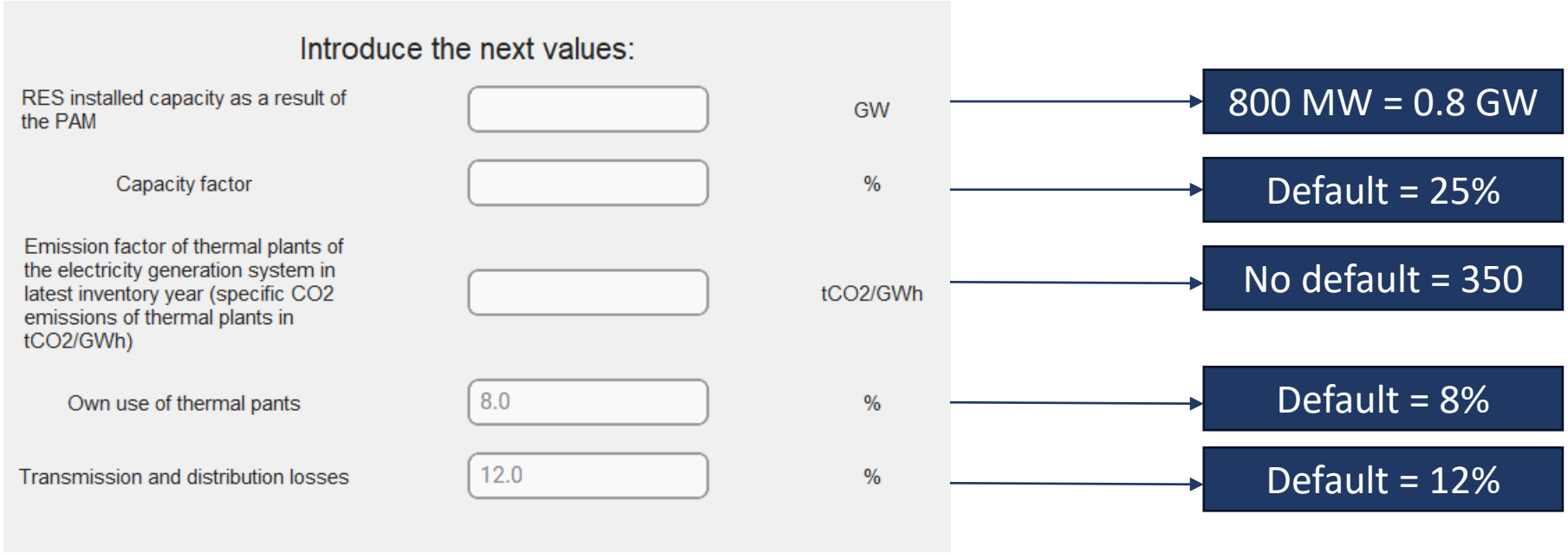
Data needed for estimation:

1. How much capacity is to be installed in GW? – decision to be made
2. What is the capacity factor of the solar PV plant? – national statistics or default
3. Emission factor of thermal plants producing electricity? – national data likely in energy balance
4. Own electricity use of thermal plants? - national statistics or default
5. Transmission and distribution losses in the national grid? – national statistics or default

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A1a Public electricity and heat production	Use of Renewables for power production (solar)



Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A1a Public electricity and heat production	Use of Renewables for power production (solar)

Introduce the next values:

RES installed capacity as a result of the PAM	0.8	GW
Capacity factor	25	%
Emission factor of thermal plants of the electricity generation system in latest inventory year (specific CO2 emissions of thermal plants in tCO2/GWh)	350	tCO2/GWh
Own use of thermal pants	8	%
Transmission and distribution losses	12	%

The Annual Mitigation Potential is 766.5 ktCO2

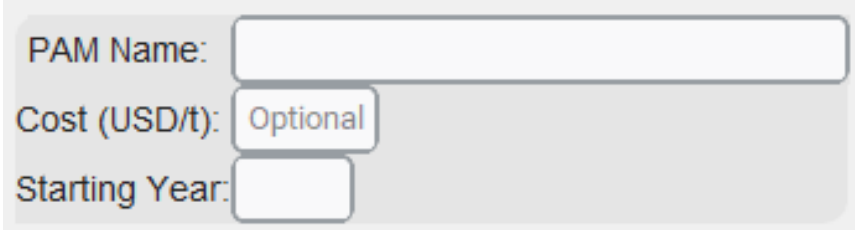
MITICA converts the mitigation potential automatically in ktCO2 eq., thus PAMs targeting other gases such as CH4 or N2O.

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

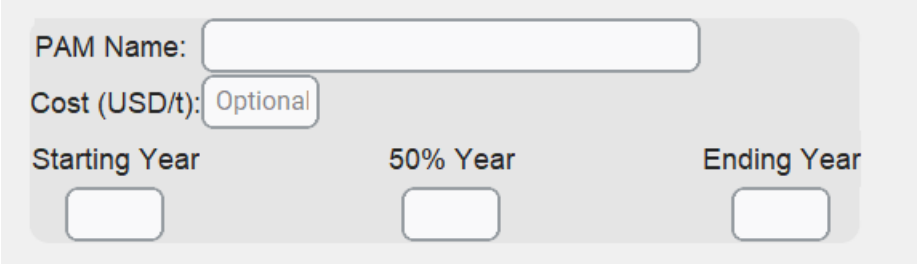
Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A1a Public electricity and heat production	Use of Renewables for power production (solar)

In the next step, we are asked to determine whether the PAM unfolds a **constant or a variable impact** and the choose the corresponding years.



Constant: Once implemented, the PAM mitigates the same amount of GHG emissions from year x until 2050.

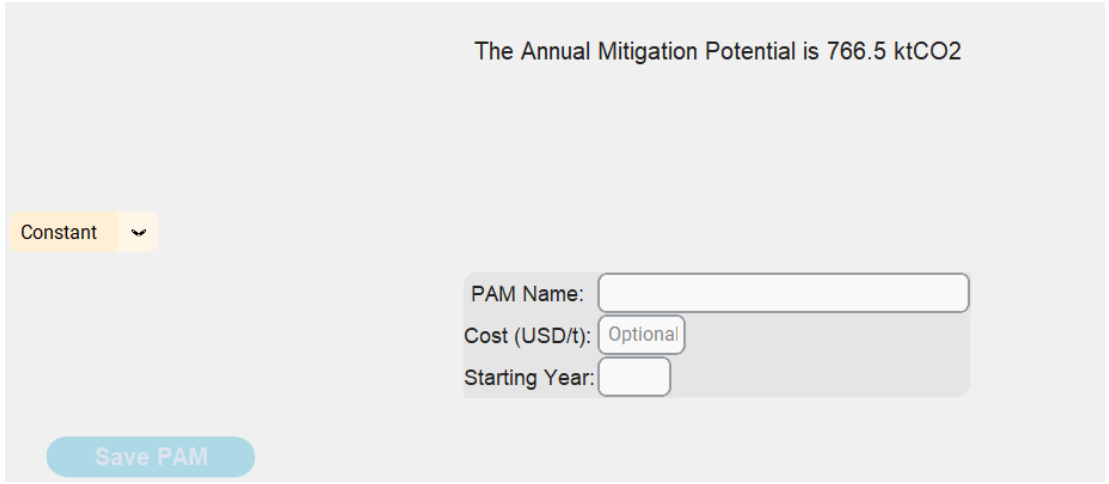


Variable: The PAM is implemented to varying degrees (in %) over a specific period thus mitigating varying amounts of GHG emissions.

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A1a Public electricity and heat production	Use of Renewables for power production (solar)



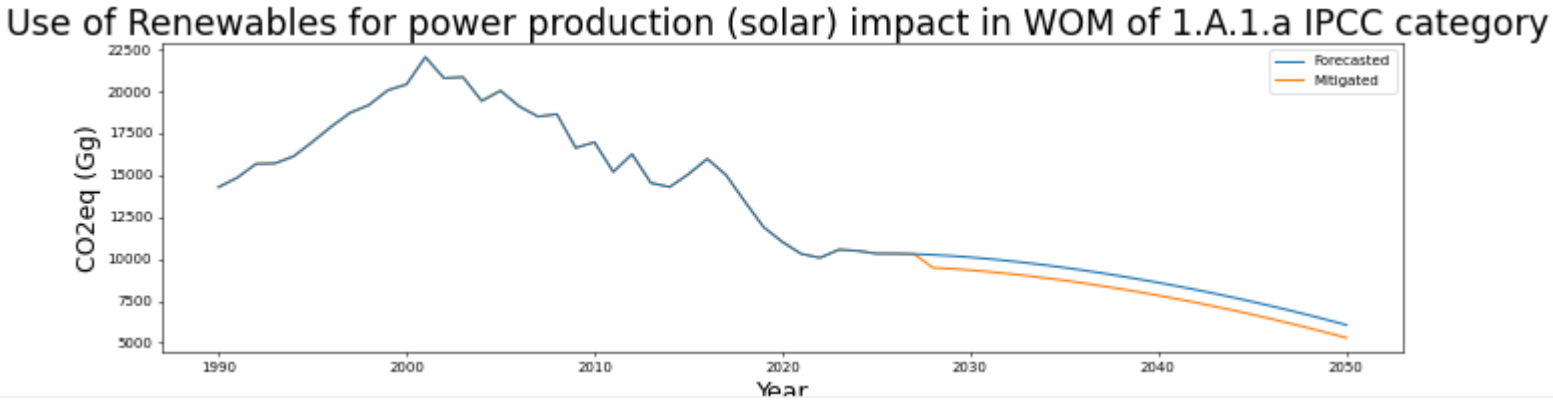
After choosing the type impact (**constant** or variable), we are asked to define:

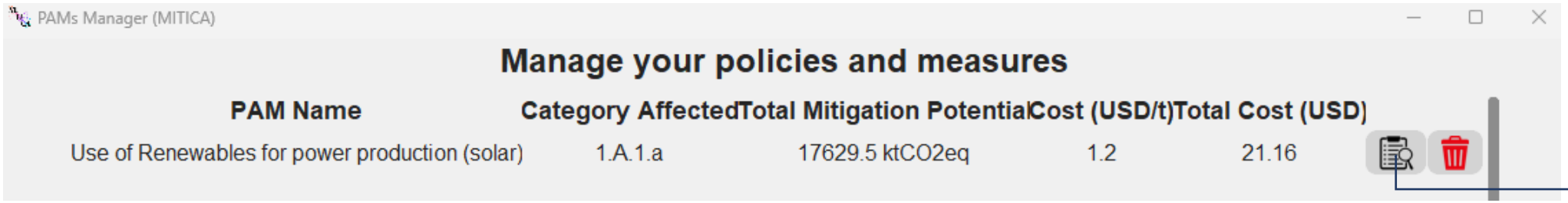
- The name of the PAM → **Use of Renewables for power production (solar)**
- The costs for implementation in USD/t CO2 (if known) → **1.2**
- The starting years or in case of variable impact, the year in which 50% is implemented as well as the ending year after which no more.
  - Constant → **2028**

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A1a Public electricity and heat production	Use of Renewables for power production (solar)





Saves the input variables of the PAM

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

Selected PAMs	Categories	Policies and Measures
	1A1a Public electricity and heat production	Use of Renewables for power production (solar)
	1A2 Manufacturing industries and construction	Fuel switch coal to natural gas in industry
	1A3b Road Transport	Fuel switch from fossil diesel to biodiesel
	2A Mineral Industry	Replacement of clinker in cement production
	3A Enteric Fermentation	Improved feeding practices for cattle
	4A Forest Land	Afforestation via converted land
	5A Solid Waste	Reduction of waste production per capita

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A2 Manufacturing industries and construction	Fuel switch from coal to natural gas in industry

Introduce the next values:

Annual coal use	8000	TJ
CO2 EF of coal	94.6	tCO2/TJ
CO2 EF of NG	56.1	tCO2/TJ

PAM Name: Fuel switch from coal to natural gas in indu

Cost (USD/t): 3.2

Starting Year	50% Year	Ending Year
2030	2035	2042

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
1A3b Road Transport	Fuel switch from fossil diesel to biodiesel

Introduce the next values:

Annual biodiesel use	550	kt
NCV of biodiesel	44	TJ/kt
CO2 EF of biodiesel	4	tCO2/TJ
CO2 EF of diesel	74.1	tCO2/TJ

PAM Name: Fuel switch from fossil diesel to biodiesel

Cost (USD/t): 1.5

Starting Year	50% Year	Ending Year
2022	2026	2035

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
2A Mineral Industry	Replacement of clinker in cement production

Introduce the next values:

Cement production	2000000	tons
Share in clinker (reference)	70	%
Share in clinker (reduction option)	50	%
EF of clinker production	0.52	tonnes CO2 / tonn clinker

PAM Name: Replacement of clinker in cement product

Cost (USD/t): 1.4

Starting Year	50% Year	Ending Year
2024	2029	2048

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
3A Enteric Fermentation	Improved feeding practices for dairy cattle

Introduce the next values:

CH4 emissions from enteric fermentation	500	ktCH4
Percentage of livestock that improved feeding practices are applied	50	%
Technical reduction potential enteric methane emissions	6	%
Efficiency of the application of the measure	100	%

PAM Name: Improve feeding practices for dairy cattle

Cost (USD/t): 0.6

Starting Year	50% Year	Ending Year
2030	2032	2034

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
4A Forest Land	Afforestation via converted land

Introduce the next values:

CO2 Emissions from Category 'Land Converted to Forest Land'	1800	ktCO2/year
Area of 'Land Converted to Forest Land'	2500	ha
Afforested land	1500	ha

PAM Name: Afforestation via converted land

Cost (USD/t): -2.5

Starting Year	50% Year	Ending Year
2027	2037	2045

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.2 Introduce the PAMs

IPCC (key) categories	Policies and Measures
5A Solid Waste	Reduction of waste production per capita

Introduce the next values:

Waste per capita generation rate	0.26	kg/cap/yr
Reduced waste per capita generation rate due to the effect of awareness campaigns and other policies (e.g. taxes, etc)	0.18	kg/cap/yr

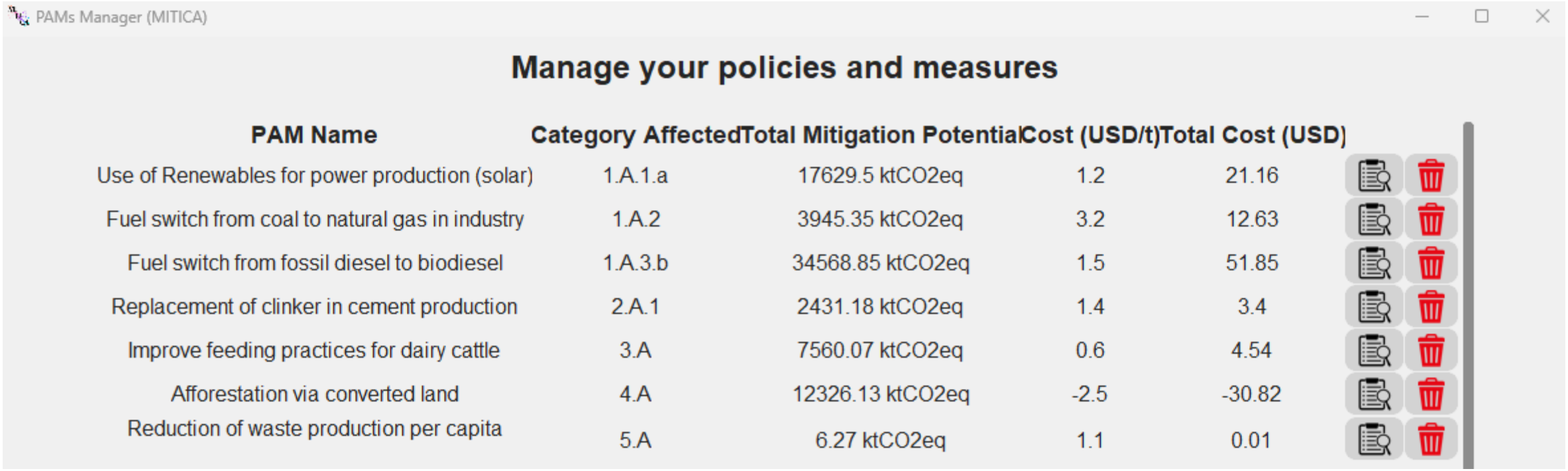
PAM Name: Reduction of waste production per capita

Cost (USD/t): 1.1

Starting Year	50% Year	Ending Year
2025	2037	2050

Step 4: Analysis of Policies and Measures (PAMs) by IPCC Sector

Step 4.3 Review the PAMs



PAM Name	Category Affected	Total Mitigation Potential	Cost (USD/t)	Total Cost (USD)
Use of Renewables for power production (solar)	1.A.1.a	17629.5 ktCO2eq	1.2	21.16
Fuel switch from coal to natural gas in industry	1.A.2	3945.35 ktCO2eq	3.2	12.63
Fuel switch from fossil diesel to biodiesel	1.A.3.b	34568.85 ktCO2eq	1.5	51.85
Replacement of clinker in cement production	2.A.1	2431.18 ktCO2eq	1.4	3.4
Improve feeding practices for dairy cattle	3.A	7560.07 ktCO2eq	0.6	4.54
Afforestation via converted land	4.A	12326.13 ktCO2eq	-2.5	-30.82
Reduction of waste production per capita	5.A	6.27 ktCO2eq	1.1	0.01

- Which PAMs do you think are the most effective in reducing GHG emissions?
- Which PAMs are cost more cost-effective?

Step 5: Design the WeM and WaM Scenarios

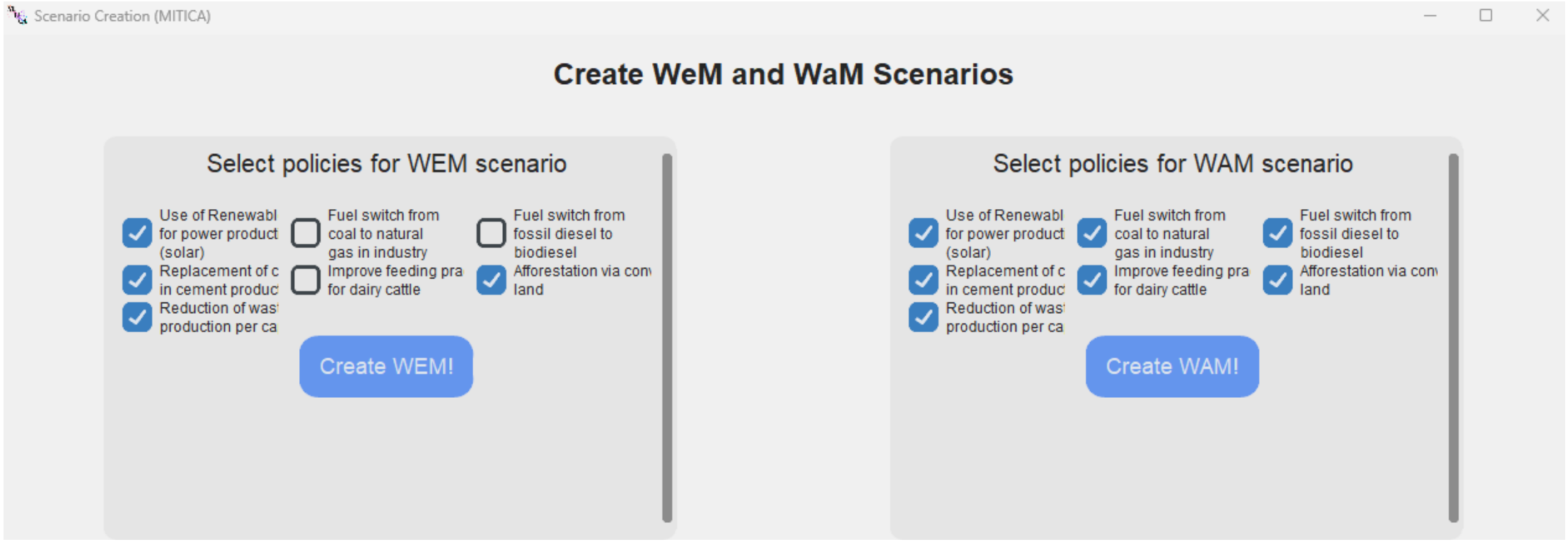
In this step, we need to determine which of the PAMs we introduced are part of the ***´With Existing Measures Scenario´*** **(WeM)** and which are part of the ***´With Additional Measures Scenario´*** **(WaM).**

Here, your expertise as a national modeller comes in, because you are aware of your country´s NDC mitigation targets and likely know which measures are considered conditional and unconditional upon receiving international support.

Therefore, to construct the WeM and WaM, you should ask yourselves the following questions:

- *Which of the PAMs are considered already under implementation?*
- *Which of the PAMs are considered in my country´s mitigation targets, are they part of the conditional or unconditional component of the targets?*
- *And linked to that:*
- *Which of the PAMs do not require international support?*
- *Which of the PAMs do require international support?*

Step 5: Design the WeM and WaM Scenarios



Step 6: Summary of Results

Results can be visualized under different options:

Choose to either show the **mitigation scenarios** or the **cost of mitigation (MACC)**. Based on this choice, the following options are available for visualization.

Mitigation scenarios

a. Choose to show results either by category or PAM.

b. Choose the sector or all sectors to be visualized.

Cost of mitigation

a. Show results by category or by scenario.

b. Depending on a. choose either the sector or the scenario.

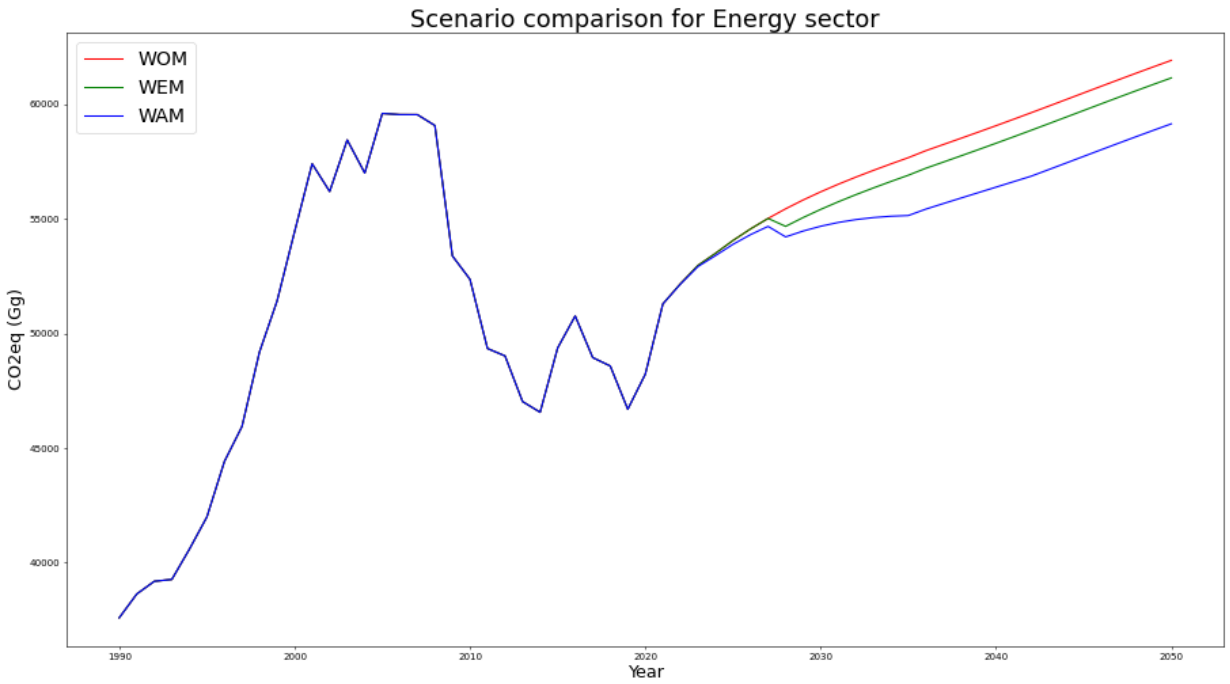
Step 6: Summary of Results

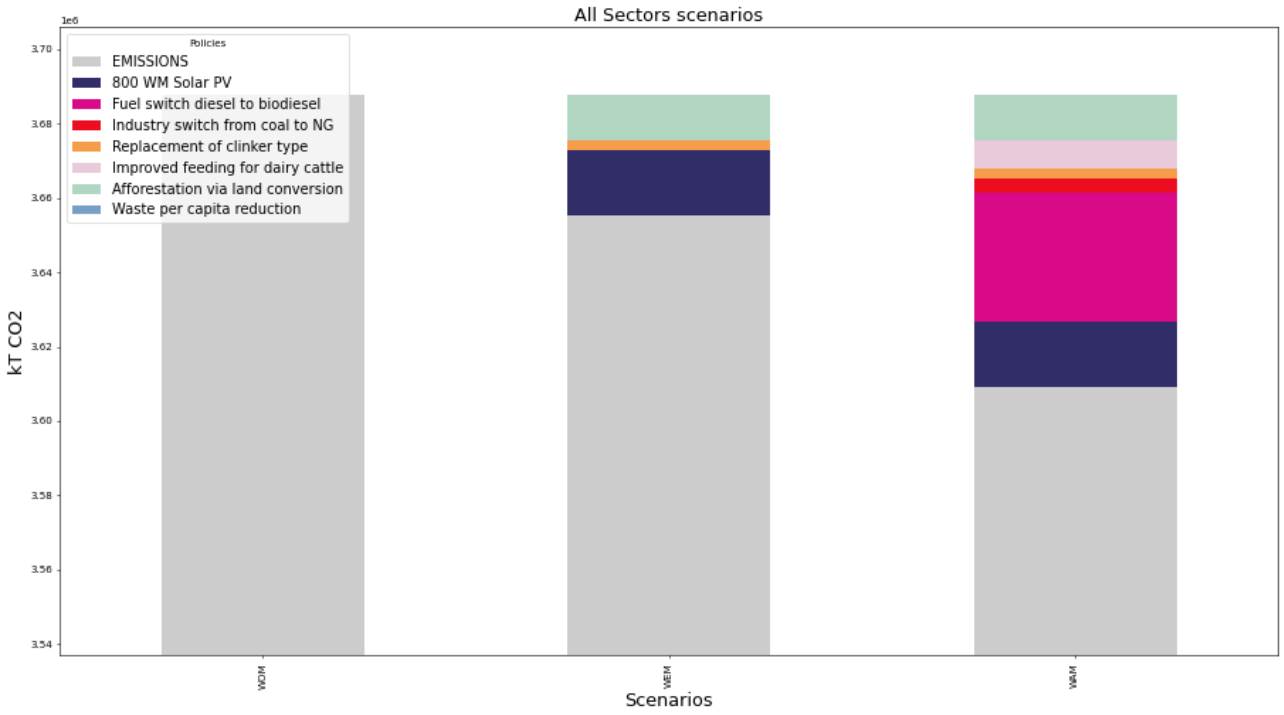
Mitigation scenarios

a. Show results by **category.**
b. Show results for the **energy sector.**

Mitigation scenarios

a. Show results by **PAM.**
b. Show results for the **all sectors**.





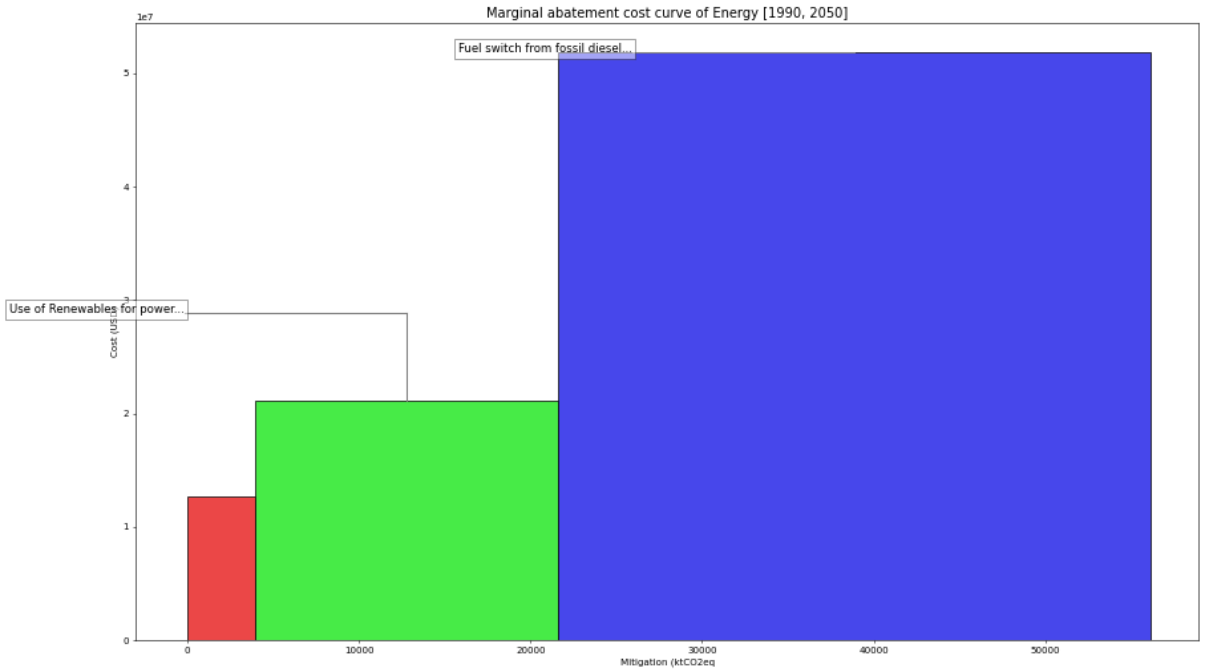
Step 6: Summary of Results

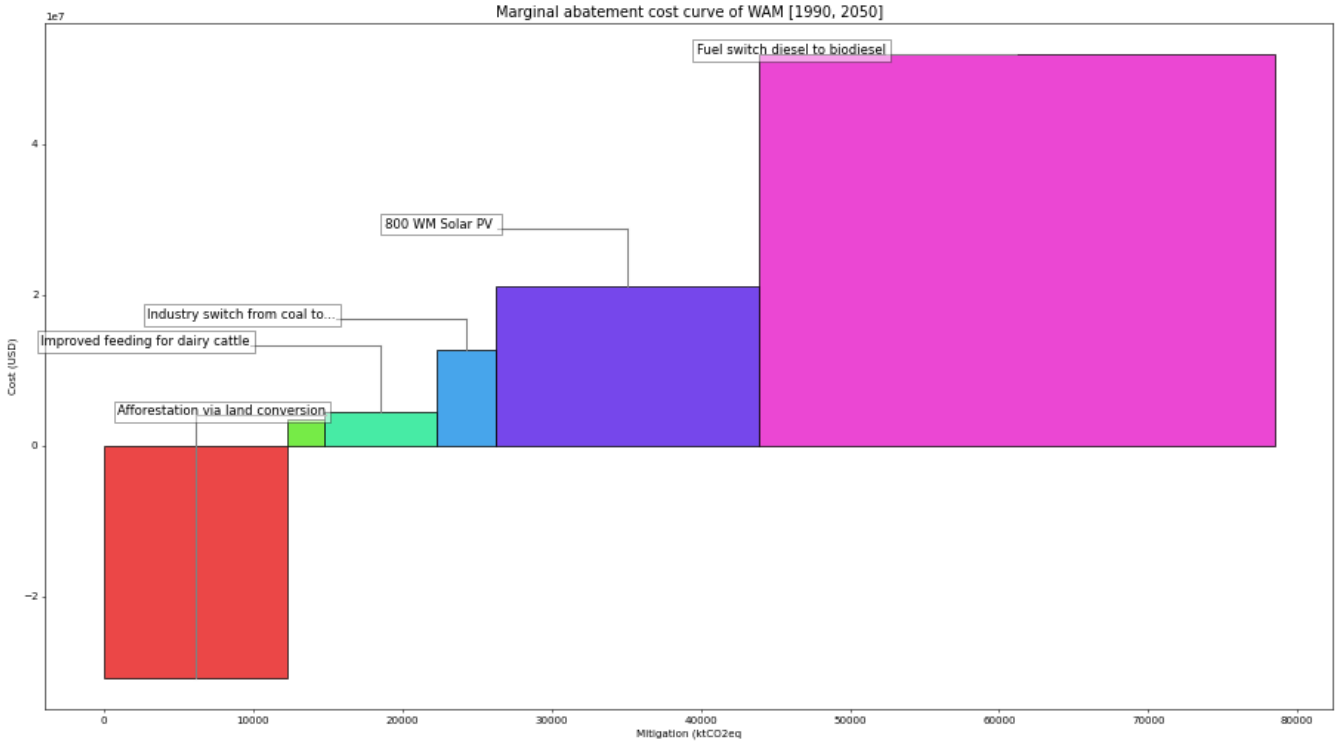
Cost of mitigation

- Show results by **category.**
- Show results for **energy sector.**

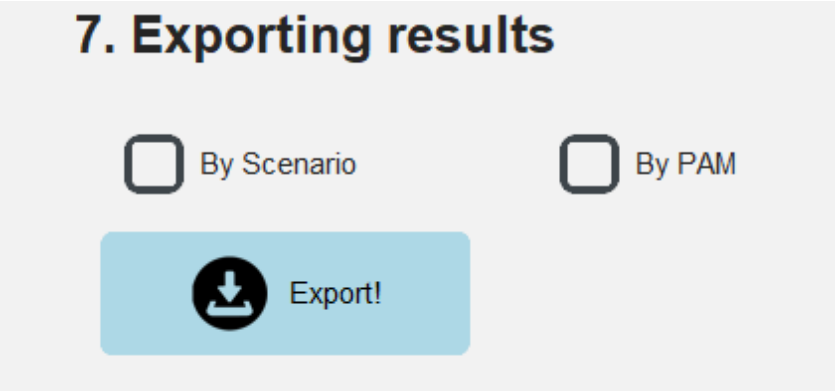
Cost of mitigation

- Show results by **scenario.**
- Show results for **WaM.**





Step 7: Exporting Results



The **export button directly downloads Excel files**.

- **By Scenario**: Excel file with different worksheets by WoM, WeM and WaM showing emissions by category and by year.
- **By PAM**: Excel file with different worksheets by PAM as linked to the IPCC sector it impacts showing the reduction by year.

The **Export ZIP button** allows users to **collaborate** in MITICA by creating zip files with the progress or results data which can then be shared with colleagues.

This helps for instance to add PAMs by expert.

How to do this?

1. Export the results data as a zip file-
2. Colleagues then load the zip files into their MITICA application using the same button.

→ Note, when loading in the zip file the new data erases all previous steps.

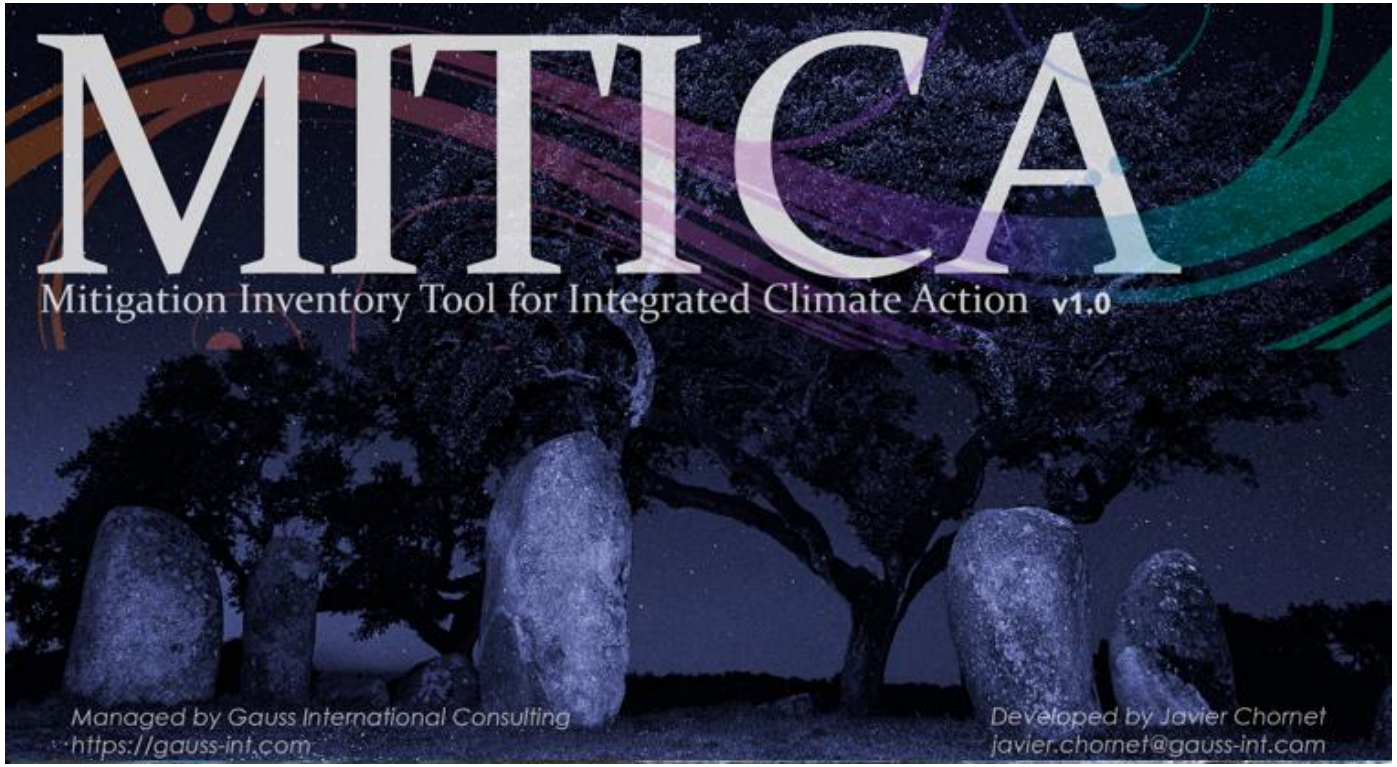
→ Therefore, it is important as a user to always save the results on the PC to ensure work progress can be retrieved at all times.

Questions and Answers

Are there any questions?

Obtaining and using MITICA

- MITICA will be **made available by the Secretariat to UNFCCC focal points upon request**.
- MITICA will also be **available to researchers**.
- MITICA **will not** be shared for commercial purposes.
- Further information: https://gauss-int.com/MITICA



Thank you!

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