

January 24, 2025

# Introducing and Demonstrating R&D GREET<sup>®</sup>.Net

2:00-3:00 p.m. CT

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## **Argonne National Laboratory Subject Matter Experts**

*Zifeng Lu*



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# Introducing R&D GREET .Net



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# .Net platform development

**Adaptable** to include a broad range of applications

**Expandable** to include new pathways and expanded boundaries

**Transparent** to enhance usability and maintain credibility



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# Limitations of the R&D GREET Excel platform



## R&D GREET Excel Can Be

1. Difficult to **find** a specific process, pathway, mix, or vehicle
2. **Time-consuming** to build a new process, pathway, or mix
3. Easy to make **mistakes** due to the flexibility of the Excel platform
4. Difficult to **track** the functional unit and unit conversions at each step
5. Hard to update your own file when a new version of the R&D GREET Excel is released



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# Benefits of the R&D GREET .Net platform

Provides an **easy-to-use**, fully graphical, and interactive interface

Allows users to **quickly** develop each element in the model and perform LCA calculations

Applies the **same LCA** method as the R&D GREET Excel platform with a **faster algorithm** for model calculations

Derives **consistent results** with the Excel platform



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# How to Download R&D GREET .Net



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# Downloading R&D GREET .Net

1. Go to Argonne's GREET Website: [greet.anl.gov](http://greet.anl.gov)
2. Select **R&D GREET .Net** on the left side of the screen
3. Click on the most recent greet.application file under  
**Download the new R&D GREET .Net Software**
4. Follow the instructions on the following installation interface
5. Enter your information to register and **submit**



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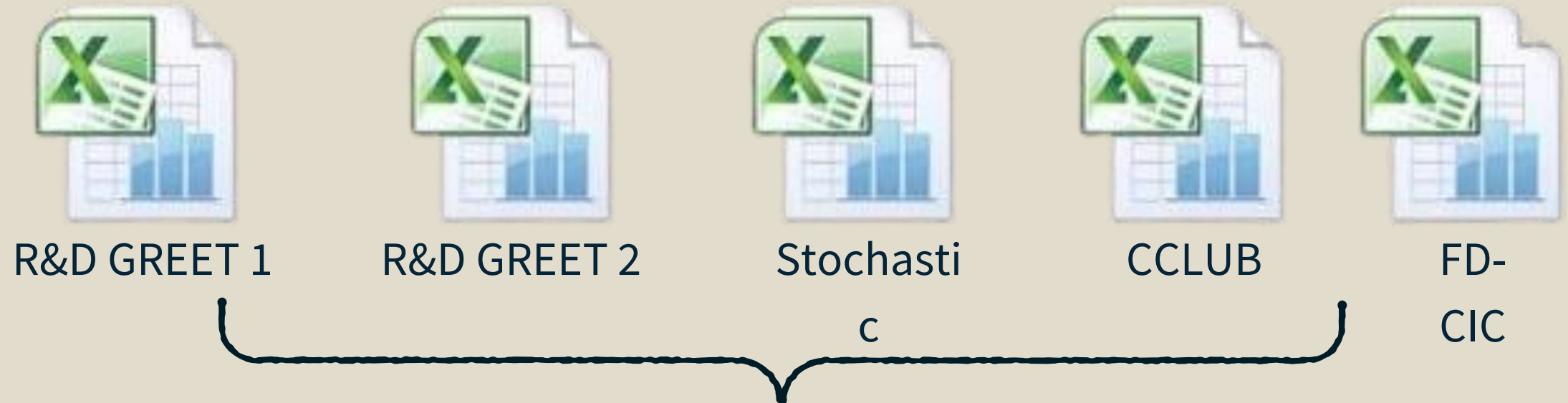
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# R&D GREET .Net model design

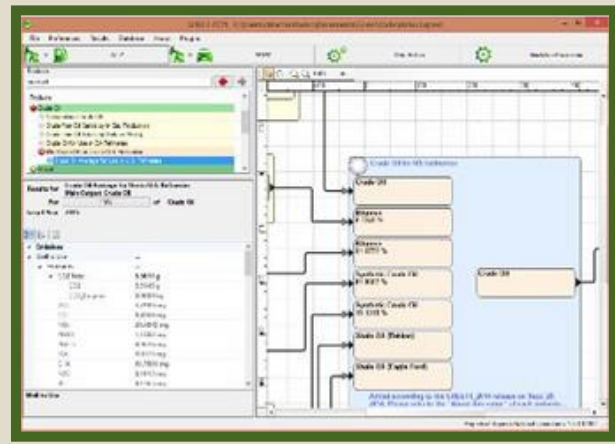
**R&D GREET.Net integrates all databases in Excel models**



Local .greet file only stores data sets



**R&D GREET.Net**



Local GREET application only implements GREET methodology

**GREET Data Server**

**Regular Updates**

**R&D GREET.Net separates datasets and methodology**

**GREET Software Server**

**Regular Updates**

# Terminology



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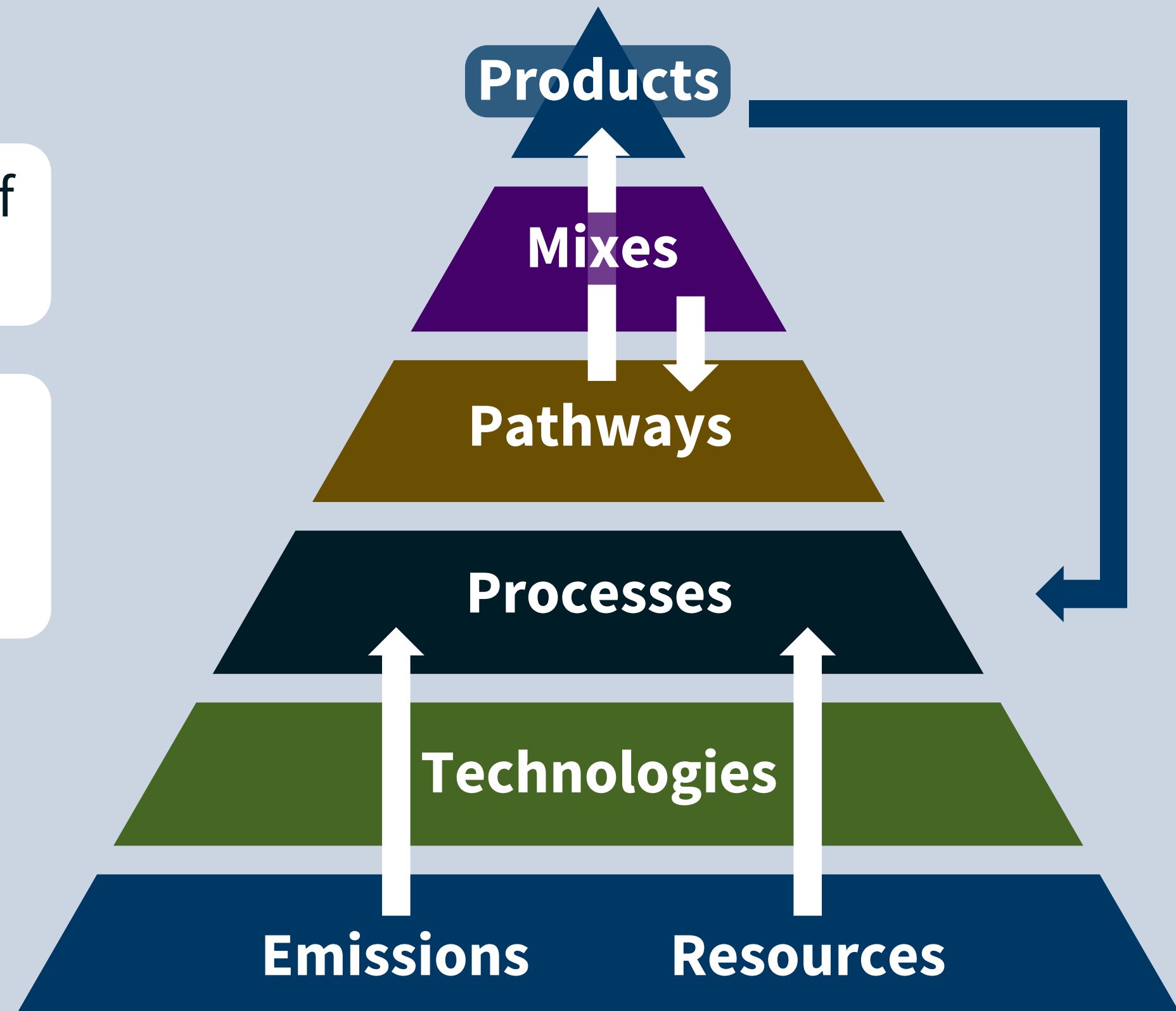


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# R&D GREET .Net concepts hierarchy

Technologies are defined on top of the emissions and resources

Processes are the basic building blocks for pathways and pathway mixes



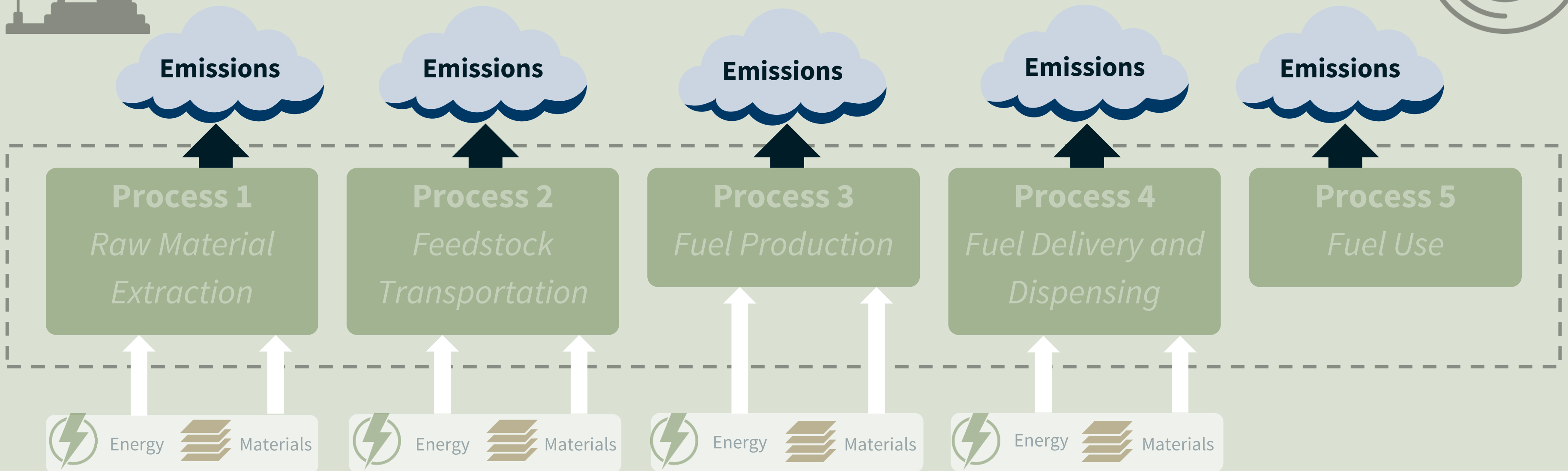
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# Terminology: *emissions*

**Emissions:** greenhouse gas emissions (GHG) and air pollutant emissions



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# Terminology: *resources*

**Resources:** inputs and outputs

Examples: *fuels, materials, energy, products, items, and more*



Emissions

Emissions

Emissions

Emissions

Emissions

**Process 1**

*Raw Material  
Extraction*

**Process 2**

*Feedstock  
Transportation*

**Process 3**

*Fuel Production*

**Process 4**

*Fuel Delivery and  
Dispensing*

**Process 5**

*Fuel Use*



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# Terminology: *technologies*

**Technologies:** equipment that consume resources  
(e.g., fuel) and produces emissions  
Examples: *boiler, engine, and turbine*



Emissions

Emissions

Emissions

Emissions

Emissions

Process 1

Raw Material  
Extraction



Process 2

Fuel  
Transportation



Process 3

Fuel  
Combustion



Process 4

Fuel  
Delivery and  
Dispensing



Process 5

Fuel Use



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# Terminology: *processes*

**Processes:** basic building blocks for pathways and pathway mixes that define inputs, outputs, and their relationship in a step



Emissions

Emissions

Emissions

Emissions

Emissions

**Process 1**

*Raw Material  
Extraction*

**Process 2**

*Feedstock  
Transportation*

**Process 3**

*Fuel Production*

**Process 4**

*Fuel Delivery and  
Dispensing*

**Process 5**

*Fuel Use*



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# Terminology: *pathways*

**Pathways:** a series of processes involved in product production



Emissions

Emissions

Emissions

Emissions

Emissions

**Process 1**

*Raw Material  
Extraction*

**Process 2**

*Feedstock  
Transportation*

**Process 3**

*Fuel Production*

**Process 4**

*Fuel Delivery and  
Dispensing*

**Process 5**

*Fuel Use*



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# Terminology: *pathway mixes*

## Pathway 1

Conventional Crude Recovery

Conventional Crude Oil  
Transportation

Crude Oil Storage

## Pathway 2

Shale Oil Recovery

Shale Oil Transportation

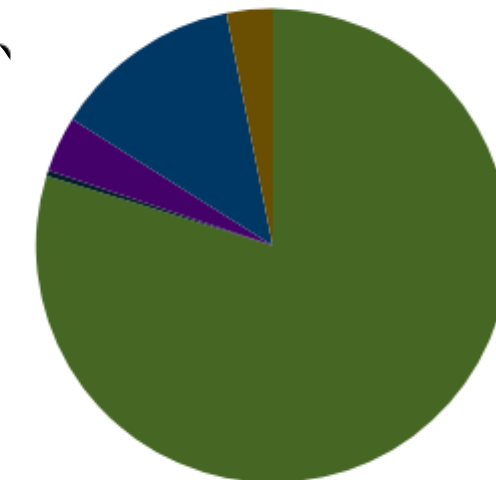
Shale Oil Storage

**Pathway Mixes:** a proportional combination of multiple pathways which produce a *consistent product*

Energy, mass, or volume shares can be defined to reflect the contributions of individual pathways

## Crude Oil Pathway Mix

Pathway 2  
12.9%



Pathway 1  
79.8%



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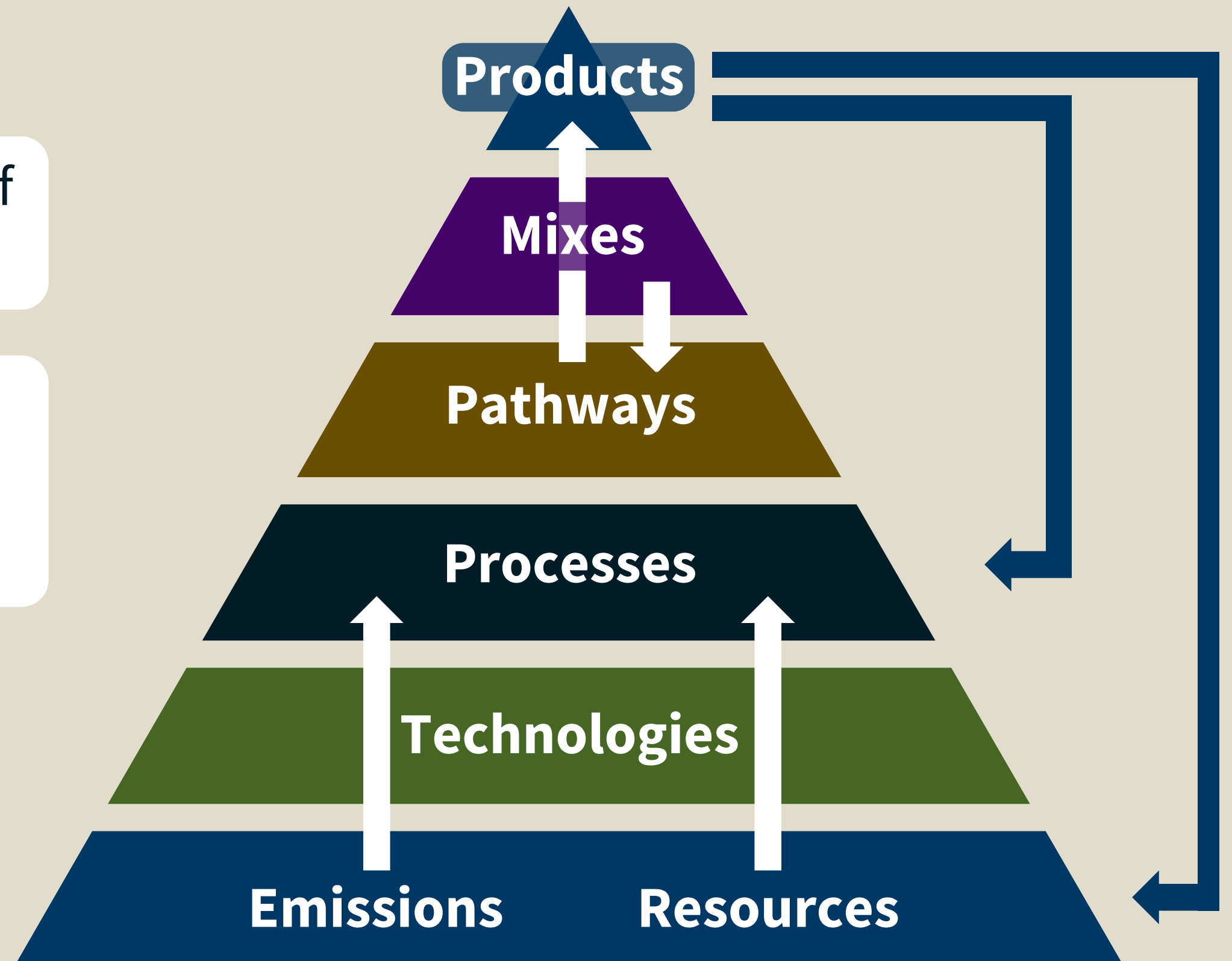
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# R&D GREET .Net concepts hierarchy

Technologies are defined on top of the emissions and resources

Processes are the basic building blocks for pathways and pathway mixes



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# General Navigation



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# Main panes in R&D GREET .Net

The screenshot shows the R&D GREET .Net software interface. The main window is titled "GREET® 2022 C:\Users\zlu\Documents\Greet\Data\default.greet". The interface includes a menu bar (File, Preferences, Results, Database, About, Plugins) and a toolbar with icons for WTP Results, WTW and C2G Results, Data Editors, Simulation Parameters, and Mapping. The main workspace is divided into several panes:

- WTP Results**: A purple callout box pointing to the "WTP Results" button in the toolbar.
- WTW and C2G Results**: A purple callout box pointing to the "WTW and C2G Results" button in the toolbar.
- Data Editors**: A blue callout box pointing to the "Data Editors" button in the toolbar.
- Simulation Parameters**: A blue callout box pointing to the "Simulation Parameters" button in the toolbar.
- Mapping**: A green callout box pointing to the "Mapping" button in the toolbar.
- Scenario Pane**: A green callout box pointing to the right side of the interface.

The interface also features a "Products" list on the left, a "Results for" section with a "Target Year" of 2022, and a "Ready" status bar at the bottom indicating "Project has been modified" and "Recalculation Needed".



[Visit the GREET Model Tutorial Videos for R&D GREET .Net walkthroughs](#)

- [R&D GREET.Net](#)



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# R&D GREET .Net main menu options

The screenshot shows the R&D GREET .Net software interface. The main window displays a list of products on the left, including 1,3-Propanediol, 1,4-Butanediol, 2% Hydrogen in Nitrogen, 3% Sulfuric Acid, 3% Yttria-Stabilized Zirconia, 8% Yttria-Stabilized Zirconia, Acetone, Acetylene, Acrylic Acid, Acrylonitrile, and AD Residue. The target year is set to 2022. The status bar at the bottom indicates "Ready", "Project has been modified", and "Recalculation Needed".

Two callout boxes highlight menu options:

- Results** menu:
  - Calculate (F9)
  - Monitoring Results (F10)
  - Export to XML (F12)
- File** menu:
  - New
  - Open a project
  - Save (Ctrl+S)
  - Save As (F12)
  - Exit

Three callout boxes provide instructions:

- Enable calculation or Press F9 or Select "Recalculation Needed"
- Create a blank .greet file
- Open an existing .greet file (project)
- "Save" or "Save As" the project

- [R&D GREET.Net](#)



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# “WTP Results” pane: *Zone 1*

**Zone 1 Products Tree**

Search the interested products

Expand the node and select a pathway or mix to review

Ready **Project has been modified** Property of Argonne National Laboratory

- [R&D GREET.Net](http://R&D.GREET.Net)



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# “WTP Results” pane: Zone 2

The screenshot displays the GREET 2022 software interface. The main window is titled "GREET® 2022" and shows the "WTP Results" pane. The interface includes a menu bar (File, Preferences, Results, Database, About, Plugins) and a toolbar with icons for WTP Results, WTW and C2G Results, Data Editors, Simulation Parameters, and Mapping. The "Products" list on the left includes items like 1,3-Propanediol, 1,4-Butanediol, 2% Hydrogen in Nitrogen, 3% Sulfonic Acid, 3% Yttria-Stabilized Zirconia, 8% Yttria-Stabilized Zirconia, Acetone, Acetylene, Acrylic Acid, Acrylonitrile, and AD Residue. The "Results for" section shows "Conventional Diesel from Crude Oil for US Refineries" with a "Main Output: Conventional Diesel" and a "Target Year 2022". The "Emissions" table is expanded to show "Well to Use" results:

| Emissions    |            |
|--------------|------------|
| Well to Use  |            |
| CO2 Total    | 13.1822 kg |
| CO2          | 13.2032 kg |
| CO2_Biogenic | -0.0210 kg |
| VOC          | 7.4975 g   |
| CO           | 12.4235 g  |
| NOx          | 19.0726 g  |
| PM10         | 1.3608 g   |
| PM2.5        | 1.1439 g   |
| SOx          | 5.2153 g   |
| CH4          | 0.1117 kg  |
| N2O          | 0.2441 g   |
| BC           | 0.1730 g   |
| POC          | 0.3111 g   |
| Groups       |            |
| GHG-100      | 16.6210 kg |
| GHG-20       | 22.5086 kg |

The "Flow properties" section shows "Well to Use". A central visualization area displays "Zone 2" with a green arrow pointing to it from a text box that reads: "Well-to-use results associated with the selected pathway or mix". The status bar at the bottom indicates "Ready Project has been modified" and "Property of Argonne National Laboratory".

- [R&D GREET.Net](http://R&D.GREET.Net)

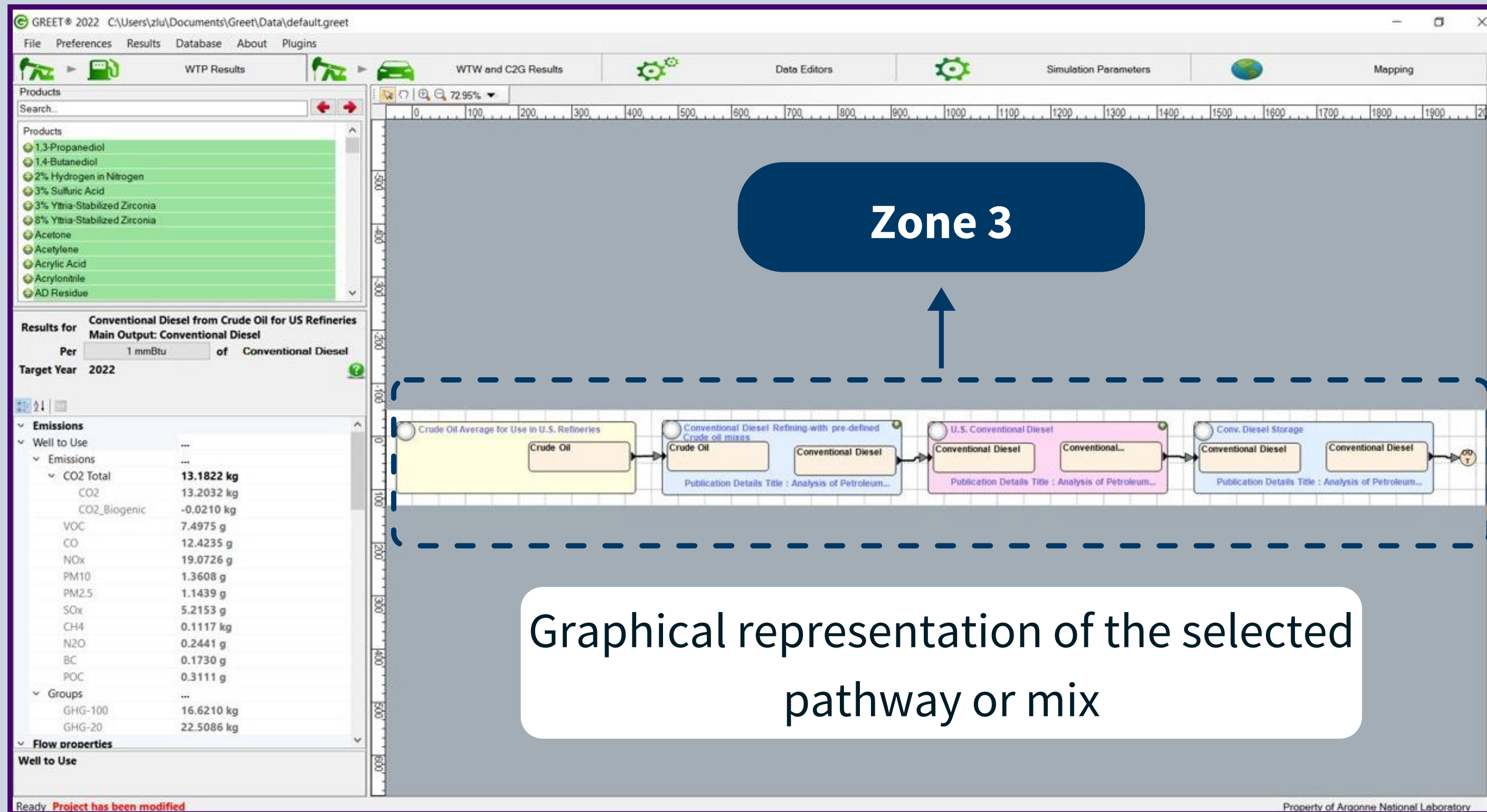


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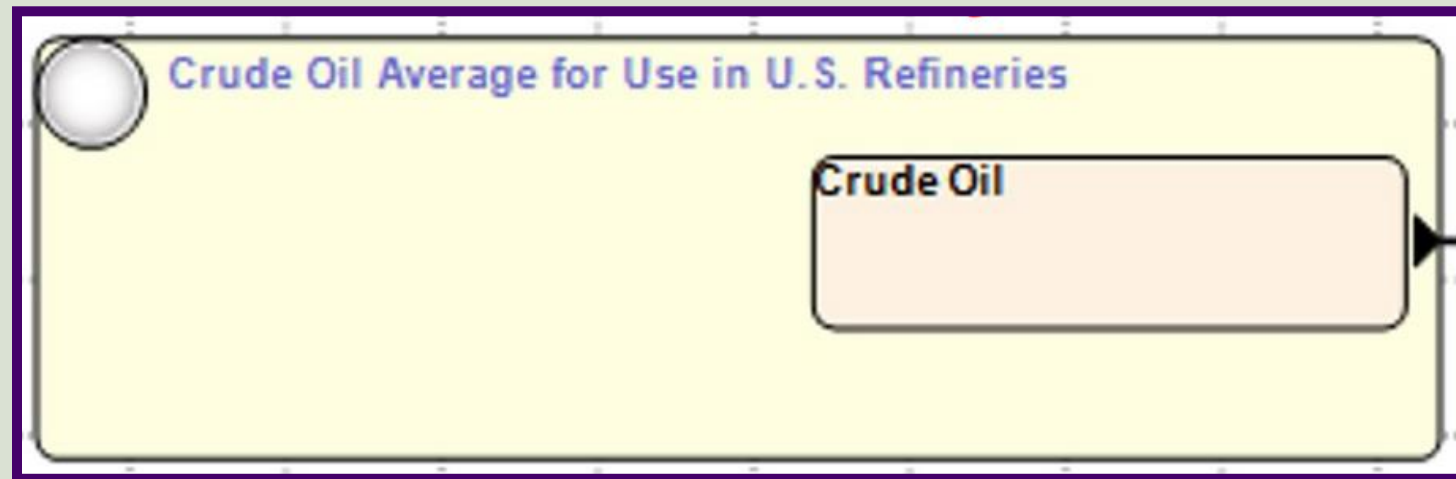
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# “WTP Results” pane: Zone 3

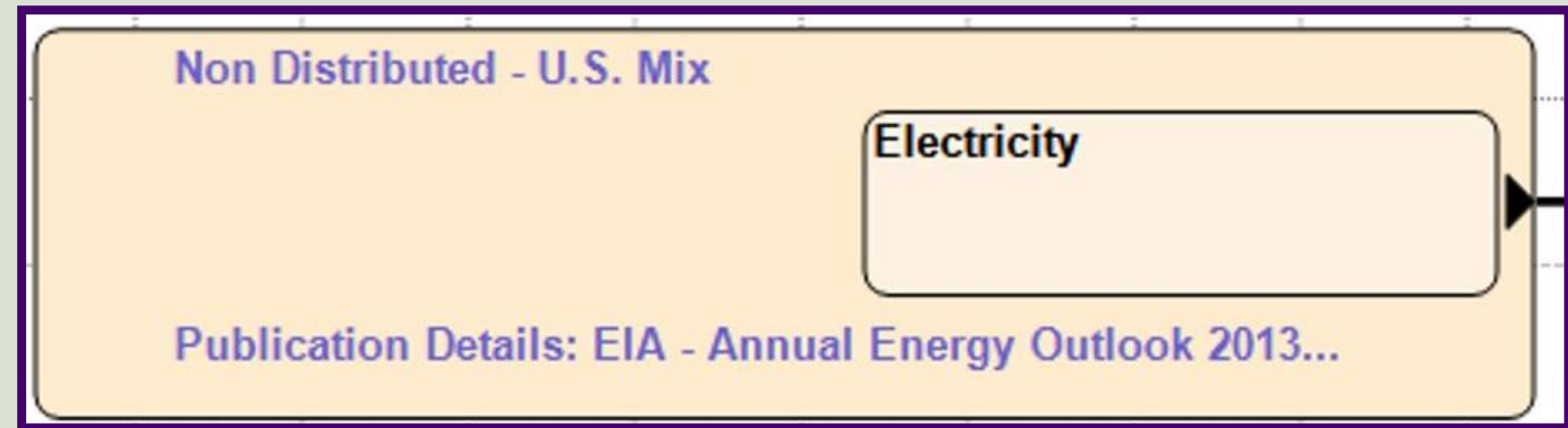


# Color codes of the graphical representations

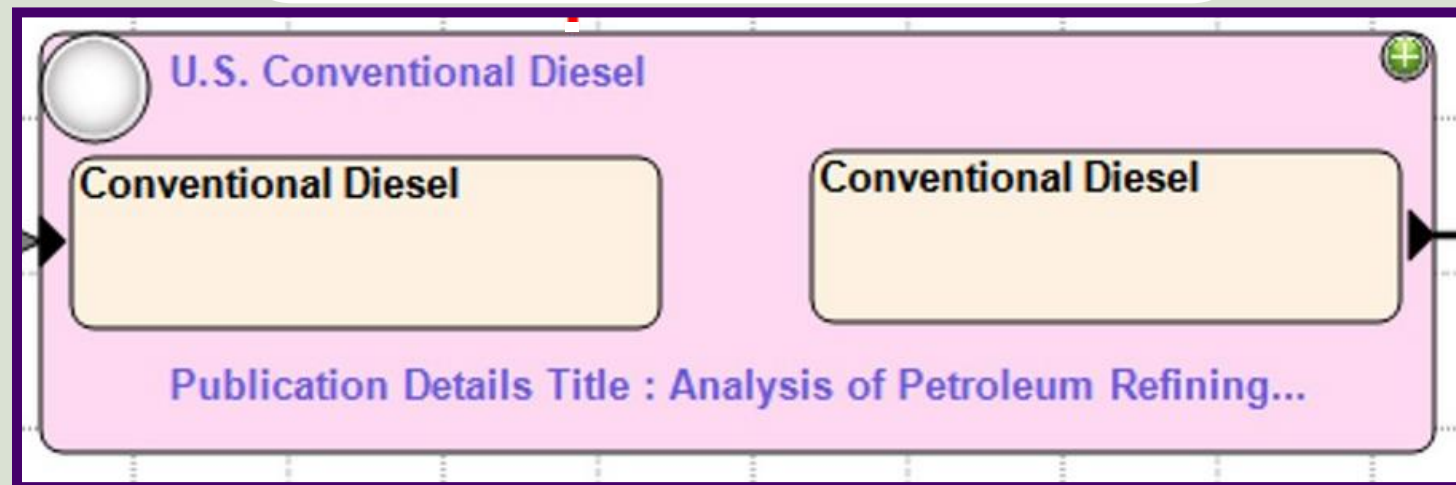
Feed pathway



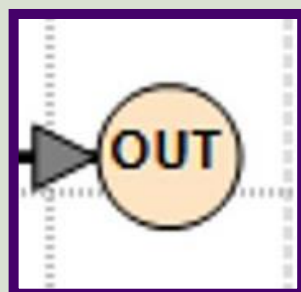
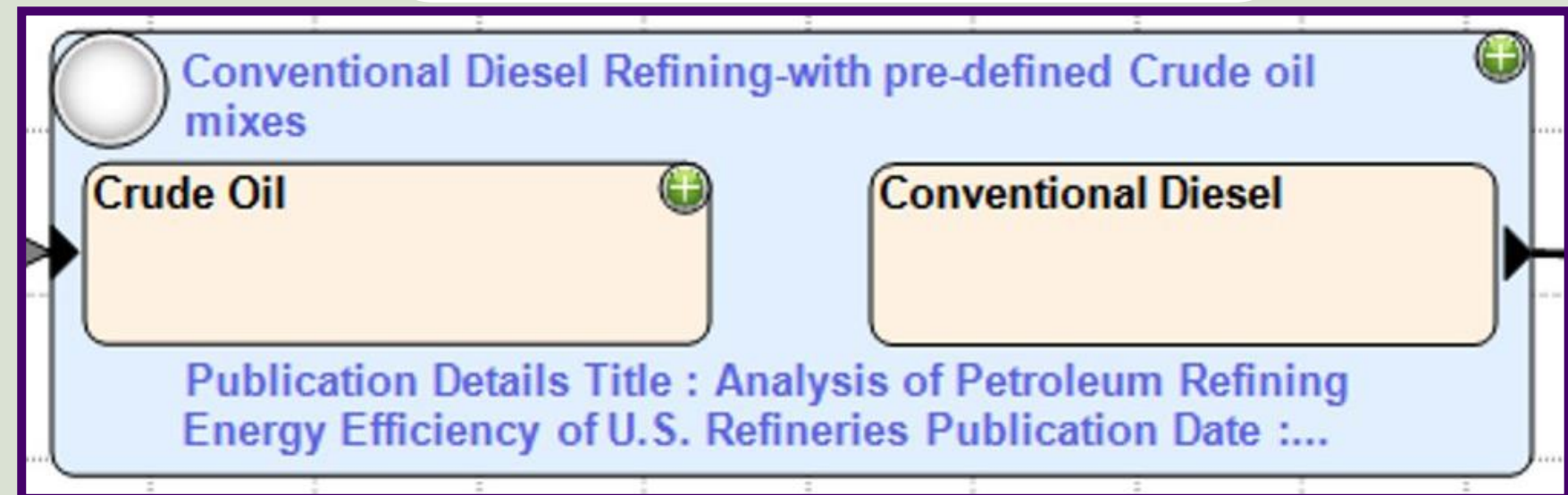
Feed mix



Transportation process



Stationary process



Main product of the pathway

- [R&D GREET.Net](http://R&D.GREET.Net)



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# R&D GREET .Net resources



## YouTube Channel

[https://www.youtube.com/watch?v=BrqRhJ3qRml&list=PLLT1SPoEVQqxWRoFTABWU\\_ibyLSpS18pO](https://www.youtube.com/watch?v=BrqRhJ3qRml&list=PLLT1SPoEVQqxWRoFTABWU_ibyLSpS18pO)

## Online Documents

<https://greet.es.anl.gov/index.php?content=greetdotnet>

## Software Documents

GREET-Model.pdf - mathematical methods

GREET-Manual.pdf - how to use the model



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# Demo for R&D GREET .Net



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# H<sub>2</sub> Production

Create a New Steam Methane Reforming (SMR)  
Hydrogen Production Pathway with Real-World  
Data



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# Real-world data: *inputs*

**Data Below is from a Refinery SMR unit  
(unit: per day)**

## **Inputs**

Feedstock - Natural Gas - 5.204 million normal cubic feet

Utility - Electricity - 15,600 kWh

Utility - Steam - 1,958 mmBtu

## **Upstream Assumptions**

North American NG from shale and conventional gas as  
stationary fuel

U.S. electricity grid mix

Steam from a small boiler using North American NG



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# Real-world data: *outputs*

**Data Below is from a Refinery SMR unit  
(unit: per day)**

## **Outputs**

Main Product - Hydrogen - 49.2 ton

Co-product - Steam - 634 mmBtu

Emissions - all carbon in input NG is released as CO<sub>2</sub>

## **Co-product Handling Method**

Displace steam produced from hydrogen central plants  
using North American NG



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# Steps in R&D GREET .Net



1. Create a new resource "H<sub>2</sub> Demo"
2. Create a **new technology** "CO<sub>2</sub> from SMR Demo" to handle CO<sub>2</sub> emissions
3. Create a **new stationary process** "H<sub>2</sub> Production from SMR Demo"
4. Create a **new pathway** "H<sub>2</sub> Production Pathway from SMR Demo"
5. Press F9 to **run the simulation**
6. **Explore** the pathway results in the "WTP Results" pane

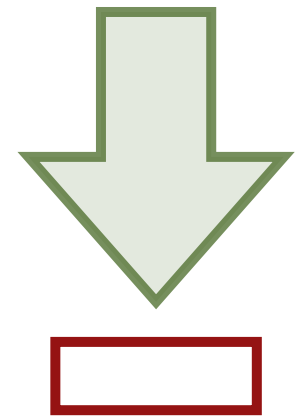


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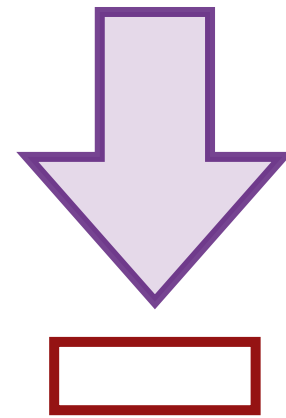
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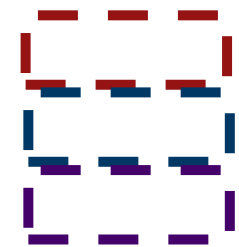
# Demo session symbol key



Select



Right click



Look here

1

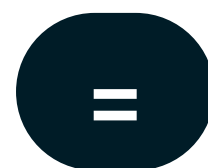
Step 1



Scroll

Note:

Instructions  
or notes



Equation

Type

Type the  
following text  
into a cell

Words

Simulation  
results label



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# Create a New Resource

## “H<sub>2</sub> Demo”



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WTP Results | WTW and C2G Results | **Data Editors** | Simulation Parameters | Mapping

Products

Search...

Products

- 1,3-Propanediol
- 1,4-Butanediol
- 2% Hydrogen in Nitrogen
- 3% Sulfuric Acid
- 3% Yttria-Stabilized Zirconia
- 8% Yttria-Stabilized Zirconia
- Acetone

Results for Select an item from above list

# Welcome to GREET® 2023

## What's new?

The major updates in this version:

- See [Summary of Expansions, Updates, and Results in GREET® 2023 \(.pdf\)](#)
- Or [GREET Website](#) for details
- Bug fixes to make GREET.Net more reliable

## Getting started

The user documentation should be a great help, but in order to get started quickly, you should have a look at these guides:

- [Using the WTP explorer](#) to navigate through products
- [Well to Wheels analysis](#) for vehicles
- [Data Editors](#) to enter or modify data
- [Simulation Parameters](#) for fine tuning

GREET Tutorial videos are also available and constitute a solid base to start with the software. The video play list is available on [YouTube](#)

## Documentation

The most recent User Manual of GREET.Net can be found through: "About" → "User Manuals" from the Menu Bar. Documentation and help is also available from the GREET website. You can consult the following pages to get information:

- [User Guide and Model](#)
- [Publications page](#)
- [API for developers](#)

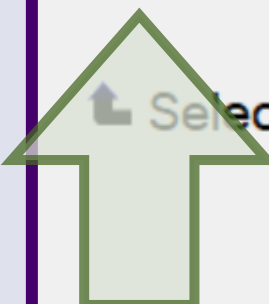
## Support

Support is available by:

- Contacting the GREET team at [greet@es.anl.gov](mailto:greet@es.anl.gov) and ask about GREET.Net or the assumptions used.
- Our [contact page](#) to talk directly with the development team

**Open R&D GREET .Net**

To start with the WTP explorer, expand one of the products in the list on the top left, then select a pathway or a mix.



Select A Parameter To Modify

General Statistics

|                                    |        |
|------------------------------------|--------|
| Number of pathways                 | 1871   |
| Number of processes                | 2788   |
| Number of stationary processes     | 2344   |
| Number of transportation processes | 444    |
| Number of modes                    | 23     |
| Number of gases                    | 28     |
| Number of resources                | 903    |
| Number of technologies             | 315    |
| Number of parameters               | 110336 |
| Number of mixes                    | 173    |
| Number of vehicles                 | 262    |

Most recent modifications

| Description                                                                    | Modified At     |
|--------------------------------------------------------------------------------|-----------------|
| Process - Wet Mill - Corn for PLA                                              | 12/11/2023 9:31 |
| Mix - Non Distributed - U.S. Central and Southern Plains Mix                   | 12/8/2023 12:49 |
| Process - Grain sorghum farming                                                | 12/8/2023 11:58 |
| Process - Ethanol-To-Jet: Standalone from Corn                                 | 12/8/2023 11:02 |
| Process - Dry Mill Ethanol Production w/ Corn Starch & Fiber Ethanol           | 12/8/2023 10:44 |
| Process - Ethanol Production (Associated with Corn Stover Ethanol)             | 12/8/2023 10:19 |
| Process - Ethanol Production (Associated with Corn Ethanol)                    | 12/8/2023 10:11 |
| Process - Sugar-To-Jet: Catalytic Conversion with H2 from Biomass Gasification | 12/8/2023 9:34  |
| Process - Sugar-To-Jet: Catalytic Conversion with In-Situ H2                   | 12/8/2023 9:33  |
| Process - Sugar-To-Jet: Catalytic Conversion with Purchased H2                 | 12/8/2023 9:32  |
| Process - Sugar-To-Jet: Biological Conversion                                  | 12/8/2023 9:30  |

Exclude parameters from list

- Add Resource
- Modify Resource
- Import from CSV

Parameter To Modify



General Statistics

|                                    |        |
|------------------------------------|--------|
| Number of pathways                 | 1871   |
| Number of processes                | 2788   |
| Number of stationary processes     | 2344   |
| Number of transportation processes | 444    |
| Number of modes                    | 23     |
| Number of gases                    | 28     |
| Number of resources                | 903    |
| Number of technologies             | 315    |
| Number of parameters               | 110336 |
| Number of mixes                    | 173    |
| Number of vehicles                 | 262    |

Most recent modifications

| Description                                                                    | Modified At      |
|--------------------------------------------------------------------------------|------------------|
| Process - Wet Mill - Corn for PLA                                              | 12/11/2023 9:31  |
| Mix - Non Distributed - U.S. Central and Southern Plains Mix                   | 12/8/2023 12:49  |
| Process - Grain sorghum farming                                                | 12/8/2023 11:58  |
| Process - Ethanol-To-Jet: Standalone from Corn                                 | 12/8/2023 11:02  |
| Process - Dry Mill Ethanol Production w/ Corn Starch & Fiber Ethanol           | 12/8/2023 10:44  |
| Process - Ethanol Production (Associated with Corn Stover Ethanol)             | 12/8/2023 10:19  |
| Process - Ethanol Production (Associated with Corn Ethanol)                    | 12/8/2023 10:11  |
| Process - Sugar-To-Jet: Catalytic Conversion with H2 from Biomass Gasification | 12/8/2023 9:34 / |
| Process - Sugar-To-Jet: Catalytic Conversion with In-Situ H2                   | 12/8/2023 9:33 / |
| Process - Sugar-To-Jet: Catalytic Conversion with Purchased H2                 | 12/8/2023 9:32 / |
| Process - Sugar-To-Jet: Biological Conversion                                  | 12/8/2023 9:30 / |

Exclude parameters from list

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Resource Parameters

State: liquid

Name: New Resource 376933632

Alternative Names

Families

Primary Resource  Can be a primary resource (Natural resource)

Density\*  Sulfur Ratio\*

Low Heating Value\*  Carbon Ratio\*

High Heating Value\*  Market Value\*

Notes

\* At Standard Conditions

Compatible Resources:

Add

**Resource Name:  $H_2$  Demo**  
**State: Gaseous**  
**Density:  $2.55 \text{ g/ft}^3$**   
**LHV:  $290 \text{ Btu/ft}^3$**   
**Sulfur and Carbon Ratio: 0%**  
**Market Value:  $\$1/\text{kg}$**

Edit pathway mixes | [Where is this resource used?](#) | [Edit evaporation properties](#)

Add as New



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Resource Parameters

State:

Name:

Alternative Names:

Families:

Primary Resource:  Can be a primary resource (Natural resource)

Density\*:  Sulfur Ratio\*:

Low Heating Value\*:  Carbon Ratio\*:

High Heating Value\*:  Market Value\*:

Notes:

\* At Standard Conditions

Compatible Resources:

**Fill in the inputs on the left as shown**



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | **Technologies** | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Resource Parameters

State: **2** gaseous

Name: H2 Demo

Alternative Names

Families

Primary Resource  Can be a primary resource (Natural resource)

Density\* 2.5500 g/ft<sup>3</sup> Sulfur Ratio\* 0 %

Low Heating Value\* 290 Btu/ft<sup>3</sup> Carbon Ratio\* 0 %

High Heating Value\*  Market Value\* 1 \$/kg

Notes add your notes

\* At Standard Conditions

Compatible Resources:

Add

GREET

Added as a new resource: H2 Demo.

**1** OK

Edit pathway mixes | [Where is this resource used?](#) | [Edit evaporation properties](#)

Add as New



**Create a New Technology  
“CO<sub>2</sub> from SMR Demo”  
to Handle CO<sub>2</sub> Emissions**



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**ENERGY**

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | **Technologies** | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Resource Parameters: Add Technology, Modify Technology, Import from CSV

State: \_\_\_\_\_

Name: \_\_\_\_\_

Alternative Names: \_\_\_\_\_

Families: \_\_\_\_\_

Primary Resource:  Can be a primary resource (Natural resource)

Density\* 2.5500 g/ft<sup>3</sup> | Sulfur Ratio\* 0 %

Low Heating Value\* 290 Btu/ft<sup>3</sup> | Carbon Ratio\* 0 %

High Heating Value\* \_\_\_\_\_ | Market Value\* 1 \$/kg

Notes: add your notes

\* At Standard Conditions

Compatible Resources: \_\_\_\_\_

Add

Edit pathway mixes | [Where is this resource used?](#) | [Edit evaporation properties](#)

Add as New | Apply



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Resource Parameters  
State: gaseous  
Name: H2 Demo  
Alternative Names  
Families  
Primary Resource  Can be a primary resource (Natural resource)  
Density\* 2.5500 g/ft<sup>3</sup>  
Low Heating Value\* 290 Btu/ft<sup>3</sup>  
High Heating Value\*  
Notes add your notes  
\* At Standard Conditions

Compatible Resources:

Please select the resource to be used by this new t...  
Name: Natural Gas

| Name                                           | State   |
|------------------------------------------------|---------|
| Compressed Natural Gas                         | gaseous |
| Life-cycle natural gas consumption of malei... | gaseous |
| Liquefied Natural Gas                          | liquid  |
| Liquefied Renewable Natural Gas                | liquid  |
| Natural Gas                                    | gaseous |
| Natural Gas Liquids                            | liquid  |
| Renewable Natural Gas                          | gaseous |
| Synthetic Natural Gas                          | gaseous |

1

2

**Search "Natural Gas"**

**Double click**

Edit pathway mixes | [Where is this resource used?](#) | [Edit evaporation properties](#)

Add as New | Apply

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

No years to Display. To add a year click

**1** Add year

**2** Type 0

**3** Ok

Name: New Technology 376934862

Notes: [Empty text area]

Resource: Natural Gas

[Processes using this technology](#) | Add as New

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Add year | Any Year

1

- VOC
- BC\_TBW
- CH4\_Biogenic
- CO
- NOx
- PM10
- PM2.5
- SOx
- GHG
- CO2
- POC\_TBW
- N2O
- NO2
- SO2
- BC
- PM10\_TBW
- PM2.5\_TBW
- VOC\_evap
- H2
- CO2\_C
- HFC-134a
- POC
- CO2\_Biogenic
- CO2\_LandUseChange
- CO2\_Fertilizer
- CF4
- SF6
- C2F6

2

Name: New Technology 376934862

Notes:

Resource: Natural Gas

[Processes using this technology](#) Add as New

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

|     | Any Year |                                    |
|-----|----------|------------------------------------|
| CO2 | 0 kg/J   | Switch to calculated value         |
| NOx | 0 kg/J   | Switch to user value               |
| CH4 | 0 kg/J   | Edit For                           |
|     |          | Change Unit                        |
|     |          | About this value                   |
|     |          | Delete emissions for the whole row |
|     |          | Add distribution                   |

**Right click**

1

2

Name: New Technology 376934862

Notes:

Resource: Natural Gas

[Processes using this technology](#)

Add as New

**Assumption:** *all carbon in natural gas is released as CO<sub>2</sub>*

|              |              |
|--------------|--------------|
| Add year     | Any Year     |
| CO2          | 56.3124 ug/J |
| NOx          | 0 kg/J       |
| CH4          | 0 kg/J       |
|              |              |
| Add Emission |              |

GREET

Added as a new Technology: CO2 from SMR Demo.

OK

**Fill in the name and notes as shown below**

Name: CO2 from SMR Demo

Notes: add your notes

Resource: Natural Gas

Add as New

# Create a New Stationary Process

## “H<sub>2</sub> Production from SMR Demo”



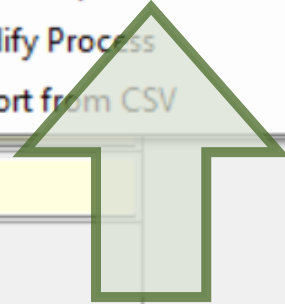
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**ENERGY**

|              |        |
|--------------|--------|
| Add year     |        |
| CO2          | 56.312 |
| NOx          | 0 kg/J |
| CH4          | 0 kg/J |
|              |        |
| Add Emission |        |

- Add Stationary Process
- Add Transportation Process
- Modify Process
- Import from CSV



Name: CO2 from SMR Demo

Notes: add your notes



Resource: Natural Gas

[Processes using this technology](#)

Add as New

Apply

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Demo

Other Resources

Construction and demoli... | H2 Demo

2 Search "Demo"

3 Drag H<sub>2</sub> Demo to main outputs

1

Inputs below

Drag and Drop Main Output below

Drag and Drop other Outputs Below

Name: New Stationary Process 376935924

Urban Share: 0%

Notes

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#) | Add as New

Resources | Technologies | Special Items



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

natural gas

**2** Search "Natural Gas"

**3** Drag Natural Gas to inputs

Drop Inputs below

Drag and Drop Main Output below

H2 Demo

Quantity: 49.2000 ton

Losses

Drag and Drop other Outputs Below

**1** Type 49.2 ton

Name: New Stationary Process 376936378

Urban Share: 0 %

Notes

Let GREET estimate carbon relations

[View Carbon Relations](#) | [Where is this process used?](#) | [Add as New](#)



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

natural gas

**Frequently Used Resources**

- Natural Gas
- Renewable Natural Gas
- Natural Gas Liquids

**Other Resources**

- Compressed Natural Gas
- Life-cycle natural gas co...
- Liquefied Natural Gas
- Liquefied Renewab...
- Synthetic Natural Gas

**Drag and Drop Inputs below**

**1**

**Natural Gas**

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA NG from Sha

**Type 5.2e6 ft<sup>3</sup>**

**Drag and Drop Main Output below**

H2 Demo

Quantity: 49.2000 ton

Losses

**Drag and Drop other Outputs Below**

Urban Share: 0 %

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#) | Add as New



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Path

# Search "Electricity"

1

2

## Drag Electricity to inputs

electricity

Frequently Used Resources

Electricity

Drag and Drop Inputs below

Natural Gas

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA NG from Sha

Drag and Drop Main Output below

H2 Demo

Quantity: 49.2000 ton

Losses

Drag and Drop other Outputs Below

Name: New Stationary Process 376936378

Urban Share: 0%

Notes

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#) | Add as New

Resources | Technologies | Special Items

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Path

Search "Steam"

3

1

2

4

Drag Steam to inputs

Type 15600 kWh

steam

Other Resources

Steam

Natural Gas

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA NG from Sha

Electricity

Quantity: 15600 kWh

Source: Single Pathway

Pathway: Pathway: Distributed - U.S. Mix

H2 Demo

Name: New Stationary Process 376936378

Notes

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#) | Add as New

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

steam

Other Resources

Steam

**Drag and Drop Inputs below**

**Natural Gas**

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA NG from Sha

**Electricity**

Quantity: 15600 kWh

Source: Single Pathway

Pathway: Pathway: Distributed - U.S.

**Steam**

Quantity: 1958 mmBtu

Source: Pathway Mix

Pathway Mix: Primary Resource, Pathway Mix, Output of a previous process, Single Pathway

**Drag and Drop Main Output below**

**H2 Demo**

Quantity: 49.2000 ton

Losses

Drag and Drop other Outputs Below

**Type 1958 mmBtu**

Name: New Stationary Process 376936378

Notes:

Urban Share: 0%

Let GREET estimate carbon relations

[View Carbon Relations](#) | [Where is this process used?](#) | [Add as New](#)

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

steam

Other Resources

Steam

2

**Drag Steam to other outputs**

Drag and Drop Inputs below

Natural Gas  
Quantity: 5200000 ft<sup>3</sup>  
Source: Single Pathway  
Pathway: Pathway: NA NG from Sha

Electricity  
Quantity: 15600 kWh  
Source: Single Pathway  
Pathway: Pathway: Distributed - U.S.

Steam  
Quantity: 1958 mmBtu  
Source: Single Pathway  
Pathway:

Drag and Drop Main Output below

H2 Demo  
Quantity: 49.2000 ton  
Losses

Drag and Drop other Outputs Below

Name: New St

Notes:

- Pathway: Steam Production via Small Boiler from North American Natural Gas
- Pathway: Steam Production via Small Boiler from North American Natural Gas w/ Urban Share
- Pathway: Stream produced from NNA Flared Gas at the CNG plant
- Pathway: Stream produced from NNA Flared Gas at the DME plant
- Pathway: Stream produced from NNA Flared Gas at the FT plant
- Pathway: Stream produced from NNA Flared Gas at the LNG plant
- Pathway: Stream produced from NNA Flared Gas at the MeOH plant

Urban Share: 0 %

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#) | Add as New

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

steam

Other Resources

Steam

**Drag and Drop Inputs below**

**Natural Gas**

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA NG from Sha

**Electricity**

Quantity: 15600 kWh

Source: Single Pathway

Pathway: Pathway: Distributed - U.S.

**Steam**

Quantity: 1958 mmBtu

Source: Single Pathway

Pathway: Pathway: Steam Productio

**Drag and Drop Main Output below**

**H2 Demo**

Quantity: 49.2000 ton

Losses

**Drag and Drop other Outputs Below**

**Steam**

Quantity: 634 mmBtu

Name: New Stationary Process 376936378

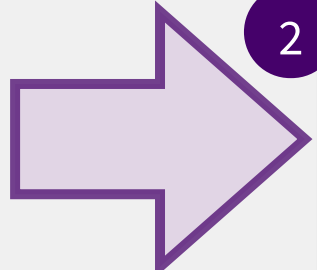
Notes:

Urban Share: 0%

Let GREET estimate carbon relations

[View Carbon Relations](#) | [Where is this process used?](#) | [Add as New](#)

**Right click**



2

1

**Type 634 mmBtu**

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

steam

Other Resources

- Steam

**Drag and Drop Inputs below**

**Natural Gas**

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA NG from Sha

**Electricity**

Quantity: 15600 kWh

Source: Single Pathway

Pathway: Pathway: Distributed - U.S.

**Steam**

Quantity: 1958 mmBtu

Source: Single Pathway

Pathway: Pathway: Steam Production

**Drag and Drop Main Output below**

**H2 Demo**

Quantity: 49.2000 ton

Losses

Drag and Drop other Outputs Below

**Steam**

Quantity

- Delete I/O
- About this Input
- Set as Input
- Set as Main Out
- Edit co-product method

Name: New Stationary Process 376936378

Notes:

Urban Share: 0%

Let GREET estimate carbon relations

[View Carbon Relations](#) | [Where is this process used?](#) | [Add as New](#)

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes

steam

Other Resources

Steam

Natural Gas  
Quantity: 5200000 ft<sup>3</sup>  
Source: Single Pathway  
Pathway: Pathway: N

Steam  
Quantity: 1958 mmBtu  
Source: Single Pathway  
Pathway: St

**Co-Products Editor**

H2 Demo  
Quantity: 49.2000 ton

Steam  
Quantity: 634 mmBtu

Treatment method for selected Co-Product  
 Displacement ✓ 1  
 Allocation

Displacement Resources  
 2

| Resource                                           | Source | Displacement Ratio |
|----------------------------------------------------|--------|--------------------|
| Solid Oxide Electrolyzer Cell Stack                |        |                    |
| Solid Oxide Electrolyzer Cell Stack - Waste Weight |        |                    |
| Solvent                                            |        |                    |
| sorbitol                                           |        |                    |
| Sorghum Bagasse Lignin                             |        |                    |
| Soy Oil                                            |        |                    |
| Soybean Meal                                       |        |                    |
| Soybean Protein Concentrate (62% Protein Content)  |        |                    |
| Soybeans                                           |        |                    |
| Spherical Natural Graphite                         |        |                    |
| Spherical Purified Natural Graphite                |        |                    |
| Spodumene concentrate                              |        |                    |
| Spruce/fir                                         |        |                    |
| Starch                                             |        |                    |
| <b>Steam</b>                                       |        |                    |
| Steel                                              |        |                    |
| Steel Scrap                                        |        |                    |
| Steer Axle Lubricant                               |        |                    |
| Styrene                                            |        |                    |
| Styrene-butadiene Rubber                           |        |                    |
| Succinic Acid                                      |        |                    |
| Sugar                                              |        |                    |
| Sugar Cane Bagasse                                 |        |                    |
| Sugar Cane Straw                                   |        |                    |
| Sugarcane                                          |        |                    |
| Sugars                                             |        |                    |
| Sulfur                                             |        |                    |
| Sulfuric Acid                                      |        |                    |
| Superphosphate                                     |        |                    |
| Sustainable Aviation Fuel (SAF)                    |        |                    |

Name: New Stationary Proc

Notes

Let GREET estimate carbon relations

[Where is this process used?](#)  3



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes

steam

Other Resources

Steam

Natural Gas

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA

Steam

Quantity: 1958 mmBtu

Source: Single Pathway

Pathway: Pathway: St

Name: New Stationary Proc

Notes

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#) | Add as New

Co-Products Editor

H2 Demo

Quantity: 49.2000 ton

Steam

Quantity: 634 mmBtu

Treatment method for selected Co-Product

Displacement

Allocation

Displacement Resources

Add Displaced Resource

| Resource | Source | Displacement |
|----------|--------|--------------|
| Steam    |        | 0%           |

Pathway Mix: Natural Gas and Still Gas

Pathway Mix: Natural Gas and Still Gas for On-Site Production

Pathway: Steam from Liquefied Natural Gas Boiler

Pathway: Steam from Liquefied Natural Gas Boiler for On-Site Production

Pathway: Steam from Natural Gas Boiler

Pathway: Steam from Natural Gas Boiler for On-Site Production

Pathway: Steam Production from Liquefied Petroleum Gas

**Pathway: Steam Production from NA NG at G.H2 Central Plant**

Pathway: Steam Production from NA NG at L.H2 Central Plant

Pathway: Steam Production from NG at DME/FTD plant

Pathway: Steam Production from NG for FT Fuel Plant - Nuclear

Pathway: Steam Production from NG for SNG Plant

Pathway: Steam Production via Small Boiler from North American Natural Gas

Pathway: Steam Production via Small Boiler from North American Natural Gas w/ Urban Share

Pathway: Stream produced from NNA Flared Gas at the CNG plant

Pathway: Stream produced from NNA Flared Gas at the DME plant

Pathway: Stream produced from NNA Flared Gas at the FT plant

Pathway: Stream produced from NNA Flared Gas at the LNG plant

Pathway: Stream produced from NNA Flared Gas at the MeOH plant

Apply



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes

steam

Other Resources

- Steam

**Co-Products Editor**

**H2 Demo**  
Quantity: 49.2000 ton

**Steam**  
Quantity: 634 mmBtu

Treatment method for selected Co-Product  
 Displacement  
 Allocation

Displacement Resources

Add Displaced Resource

| Resource | Source                        | Displacement Ratio |
|----------|-------------------------------|--------------------|
| Steam    | Pathway: Steam Production fro | 100 %              |

1

**Type 100%**

2

Apply

3 Resources

Technologies

Special Items

Name: New Stationary Proc

Notes:

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#) | Add as New



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways

demo

**1** Search "Demo"

**2** Drag CO<sub>2</sub> from SMR Demo to Natural Gas

**and Drop Inputs below**

- Natural Gas**  
Quantity: 5200000 ft<sup>3</sup>  
Source: Single Pathway  
Pathway: Pathway: NA NG from Sha
- Electricity**  
Quantity: 15600 kWh  
Source: Single Pathway  
Pathway: Pathway: Distributed - U.S.
- Steam**  
Quantity: 1958 mmBtu  
Source: Single Pathway  
Pathway: Pathway: Steam Production

**Drag and Drop Main Output below**

- H2 Demo**  
Quantity: 49.2000 ton  
Losses

**Drag and Drop other Outputs Below**

- Steam**  
Quantity: 634 mmBtu

Name: New Stationary Process 376936378

Urban Share: 0 %

Notes:

Let GREET estimate carbon relations

[View Carbon Relations](#) | [Where is this process used?](#) | [Add as New](#)

Resources | Technologies | Special Items

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | **Pathways** | Pathway Mix | Modes | Vehicles | Emission

demo

Natural Gas

CO2 from SMR Demo

3

**Drag and Drop Inputs below**

Natural Gas

Quantity: 5200000 ft<sup>3</sup>

Source: Single Pathway

Pathway: Pathway: NA NG from Sha

CO2 from SMR Demo 100 % ✓

Electricity

Quantity: 15600 k

Source: Single P

Pathway: Pathway

**Drag and Drop Main Output below**

H2 Demo

Quantity: 49.2000 ton

Losses

**Drag and Drop other Outputs Below**

Steam

Quantity: 634 mmBtu

**Fill in the name and notes as shown below**

Name: H2 Production from SMR Demo 1

Notes

Urban Share: 0 %

Let GREET estimate carbon relations

View Carbon Relations | [Where is this process used?](#)

2

Add as New

# Create a New Pathway

## “H<sub>2</sub> Production Pathway from SMR Demo”



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WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

demo

**Add Pathway**  
**Modify Pathway**

**Drag and Drop Inputs below**

**Natural Gas**  
 CO2 from SMR Demo  
 Quantity: 5200000 ft<sup>3</sup>  
 Source: Single Pathway  
 Pathway: NA NG from Sha

**CO2 from SMR Demo**  
 Quantity: 100 %

**Electricity**  
 Quantity: 15600 kWh  
 Source: Single Pathway  
 Pathway: Distributed - U.S.

**Steam**  
 Quantity: 1958 mmBtu  
 Source: Single Pathway  
 Pathway: Steam Production

**Drag and Drop Main Output below**

**H2 Demo**  
 Quantity: 49.2000 ton  
 Losses

**Drag and Drop other Outputs Below**

**Steam**  
 Quantity: 634 mmBtu

Name: H2 Production from SMR Demo  
 Urban Share: 0 %

Notes

Let GREET estimate carbon relations

[View Carbon Relations](#) | [Where is this process used?](#)

[Add as New](#) | [Apply](#)

Resources | Technologies | Special Items

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Compatible Processes

Name: demo

| Name                        | Type       |
|-----------------------------|------------|
| H2 Production from SMR D... | Stationary |

2

**Drag H2 Production from SMR Demo to pathway editor**

**Search "Demo"**

Pathways and Mixes

Search...

Products

- 1,3-Propanediol
- 1,4-Butanediol
- 2% Hydrogen in Nitrogen
- 3% Sulfuric Acid
- 3% Yttria-Stabilized Zirconia
- 8% Yttria-Stabilized Zirconia

Name: New Pathway 376938719

Notes

Add as New



WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Compatible Processes

| Name                        | Type           |
|-----------------------------|----------------|
| Mining of Platinum ( NA)    | Stationary     |
| Refining of Platinum (Ma... | Stationary     |
| Refining of Platinum (Ma... | Stationary     |
| Transportation spent cat... | Transportation |
| 1,3-Propanediol Producti... | Stationary     |
| 1,3-Propanediol Producti... | Stationary     |
| 1,3-Propanediol Producti... | Stationary     |
| 1,4-Butanediol Productio... | Stationary     |

Compatible pathway outputs

H2 Demo

**Drag H<sub>2</sub> Demo to pathway editor**

Pathways and Mixes

Search...

Products

- 1,3-Propanediol
- 1,4-Butanediol
- 2% Hydrogen in Nitrogen
- 3% Sulfuric Acid
- 3% Ytria-Stabilized Zirconia
- 8% Ytria-Stabilized Zirconia

Name: New Pathway 376938719

Notes:

Add as New

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Compatible Processes

| Name                        | Type           |
|-----------------------------|----------------|
| Mining of Platinum ( NA)    | Stationary     |
| Refining of Platinum (Ma... | Stationary     |
| Refining of Platinum (Ma... | Stationary     |
| Transportation spent cat... | Transportation |
| 1,3-Propanediol Producti... | Stationary     |
| 1,3-Propanediol Producti... | Stationary     |
| 1,3-Propanediol Producti... | Stationary     |
| 1,4-Butanediol Productio... | Stationary     |

Compatible pathway outputs

H2 Demo

Pathways and Mixes

Search...

Products

- 1,3-Propanediol
- 1,4-Butanediol
- 2% Hydrogen in Nitrogen
- 3% Sulfuric Acid
- 3% Ytria-Stabilized Zirconia
- 8% Ytria-Stabilized Zirconia

Name:

80%

H2 Production from SMR Demo

H2Demo

OUT

**Drag from the H<sub>2</sub> production process to the H<sub>2</sub> output**

Name:

Notes:

Add as New

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Resources | Technologies | Processes | Pathways | Pathway Mix | Modes | Vehicles | Emission

Compatible Processes

| Name                        | Type           |
|-----------------------------|----------------|
| Mining of Platinum (NA)     | Stationary     |
| Refining of Platinum (Ma... | Stationary     |
| Refining of Platinum (Ma... | Stationary     |
| Transportation spent cat... | Transportation |
| 1,3-Propanediol Producti... | Stationary     |
| 1,3-Propanediol Producti... | Stationary     |
| 1,3-Propanediol Producti... | Stationary     |
| 1,4-Butanediol Productio... | Stationary     |

Compatible pathway outputs

H2 Demo

Pathways and Mixes

Search...

Products

- 1,3-Propanediol
- 1,4-Butanediol
- 2% Hydrogen in Nitrogen
- 3% Sulfuric Acid
- 3% Ytria-Stabilized Zirconia
- 8% Ytria-Stabilized Zirconia

H2 Production from SMR Demo

H2 Demo

PUT

**Fill in the name and notes as shown below**

Name: H2 Production Pathway from SMR Demo

Notes:

Add as New

# Explore the Pathway Results in the “WTP Results” Pane



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WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products

demo

Products

Construction and demolition waste

H2 Demo

Results for Select an item from above list

1

2

3

Press F9

# to GREET® 2023

## What's new?

The major updates in this version:

- See [Summary of Expansions, Updates, and Results in GREET® 2023 \(.pdf\)](#)
- Or [GREET Website](#) for details
- Bug fixes to make GREET.Net more reliable

## Getting started

The user documentation should be a great help, but in order to get started quickly, you should have a look at these guides:

- [Using the WTP explorer](#) to navigate through products
- [Well to Wheels analysis](#) for vehicles
- [Data Editors](#) to enter or modify data
- [Simulation Parameters](#) for fine tuning

GREET Tutorial videos are also available and constitute a solid base to start with the software. The video play list is available on [YouTube](#)

## Documentation

The most recent User Manual of GREET.Net can be found through: "About" → "User Manuals" from the Menu Bar. Documentation and help is also available from the GREET website. You can consult the following pages to get information:

- [User Guide and Model](#)
- [Publications page](#)
- [API for developers](#)

## Support

Support is available by:

- Contacting the GREET team at [greet@es.anl.gov](mailto:greet@es.anl.gov) and ask about GREET.Net or the assumptions used.
- Our [contact page](#) to talk directly with the development team

To start with the WTP explorer, expand one of the products in the list on the top left, then select a pathway or a mix.



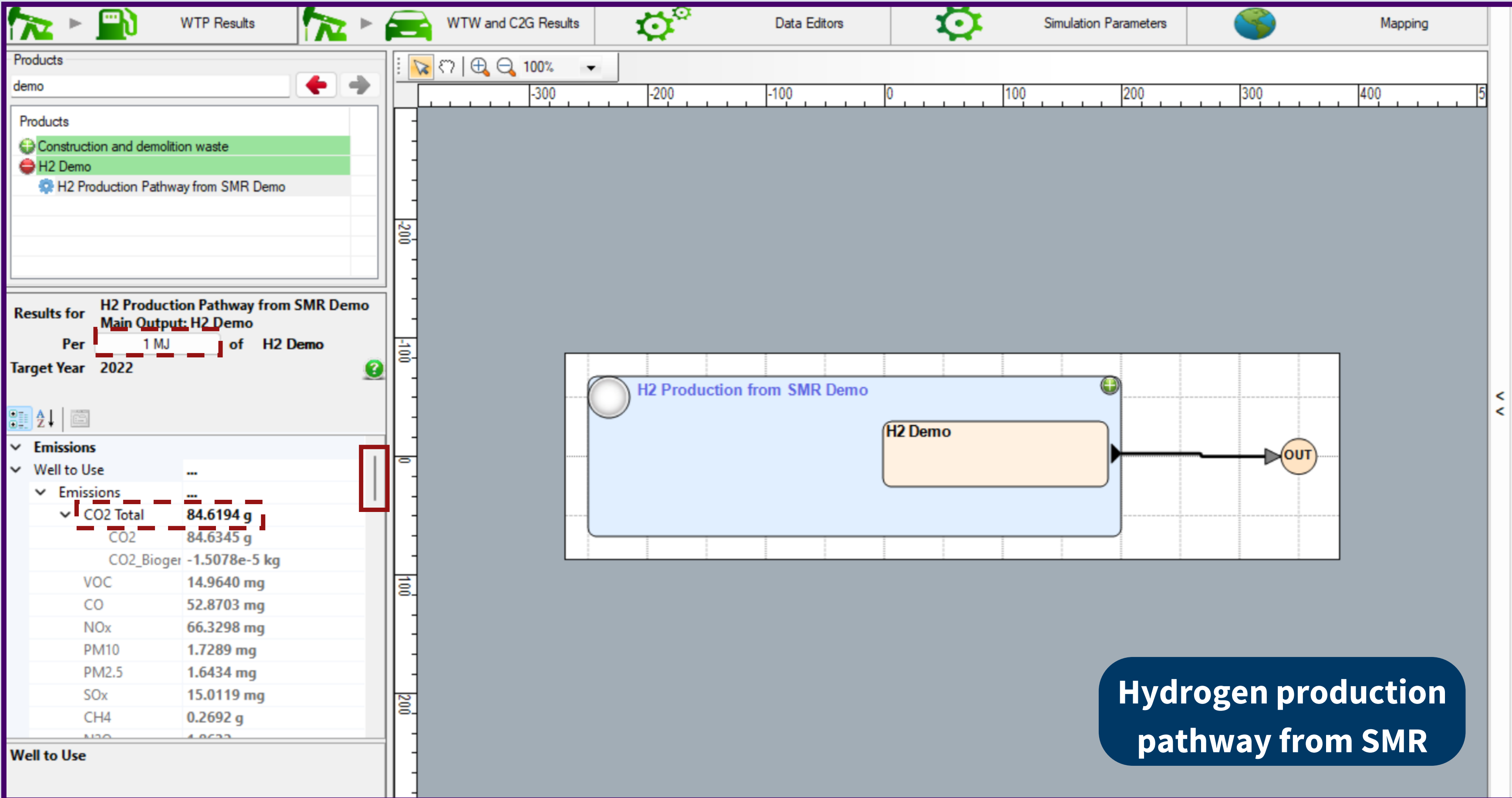
WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

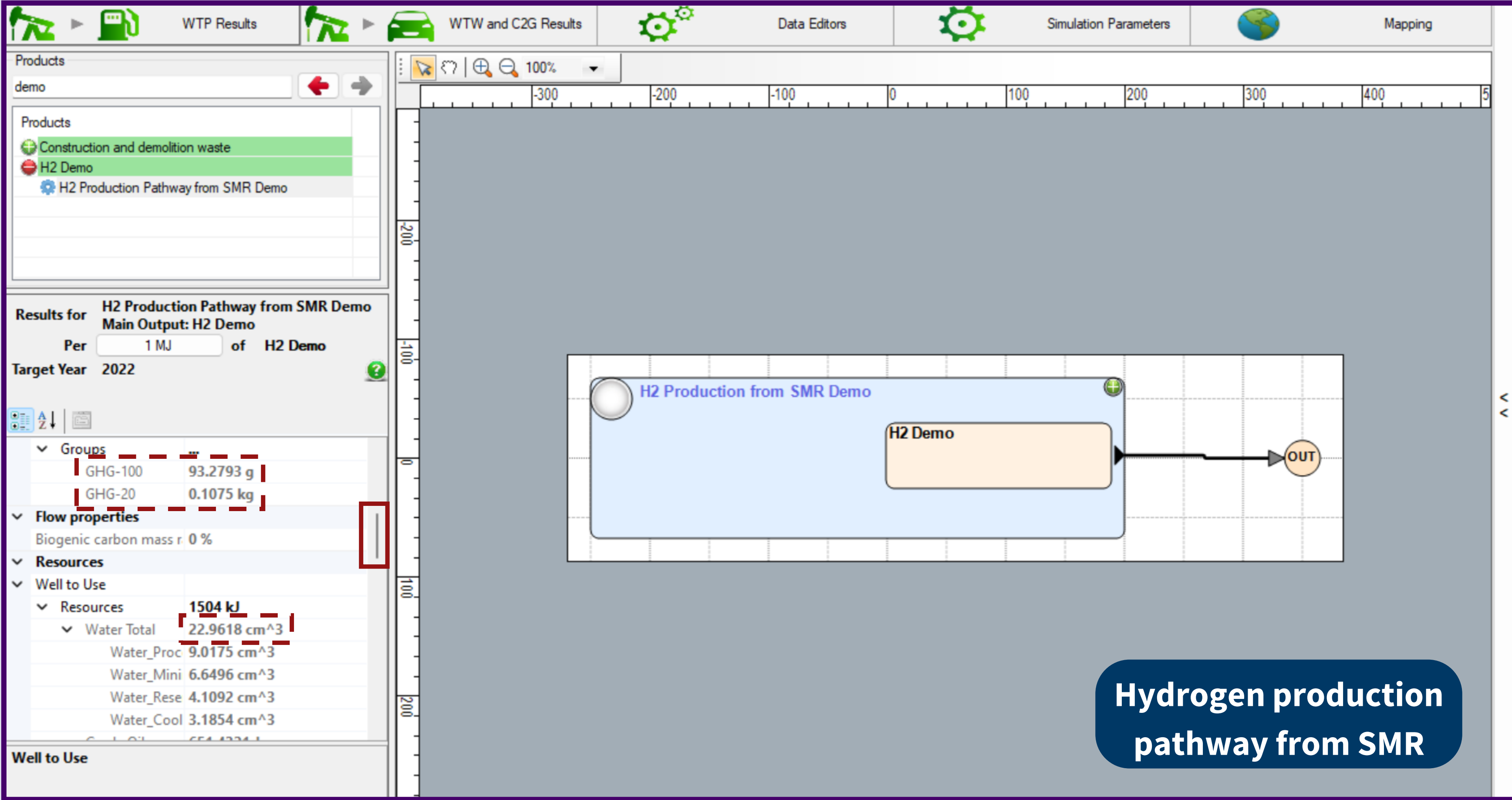
Products  
demo

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo**

Results for Select an item from above list

Target Year 2022





**Hydrogen production pathway from SMR**

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products: demo

Products List:

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo

Results for: H2 Production Pathway from SMR Demo  
Main Output: H2 Demo

Per 1 MJ of H2 Demo  
Target Year: 2022

|                 |                         |
|-----------------|-------------------------|
| Other Power (W) | 0.3818 J                |
| Groups          |                         |
| Fossil Fuel     | 1498 kJ                 |
| Natural Gas Fue | 1490 kJ                 |
| Coal Fuel       | 7825.6324 J             |
| Non Fossil Fuel | 5459.7664 J             |
| Renewable       | 2982.9974 J             |
| Nuclear         | 2476.7689 J             |
| Petroleum Fuel  | 819.0412 J              |
| Biomass         | 164.3846 J              |
| Water           | 22.9618 cm <sup>3</sup> |
| Urban Emissions |                         |
| Well to Use     | ...                     |

Well to Use

Diagram: H2 Production from SMR Demo

OUT

**Hydrogen production pathway from SMR**

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products: demo

Products:

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo

Results for **H2 Production Pathway from SMR Demo**  
**Main Output: H2 Demo**  
 Per  of **H2 Demo**  
 Target Year **2022**

Other Power (W 0.3818 J)

| Groups          |                         |
|-----------------|-------------------------|
| Fossil Fuel     | 1498 kJ                 |
| Natural Gas Fue | 1490 kJ                 |
| Coal Fuel       | 7825.6324 J             |
| Non Fossil Fuel | 5459.7664 J             |
| Renewable       | 2982.9974 J             |
| Nuclear         | 2476.7689 J             |
| Petroleum Fuel  | 819.0412 J              |
| Biomass         | 164.3846 J              |
| Water           | 22.9618 cm <sup>3</sup> |

Urban Emissions

Well to Use

Select Functional Unit

Use default preference  
 Use user preference

Unit Group: **energy** (dropdown menu open showing energy, energy, mass, volume, currency)

Unit: mmBtu | Amount: 1

Apply and Close

1 (points to 'Use user preference')

2 (points to 'mass' in dropdown menu)

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products: demo

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo

Results for **H2 Production Pathway from SMR Demo**  
 Main Output: H2 Demo  
 Per 1 MJ of H2 Demo  
 Target Year 2022

|                 |                         |
|-----------------|-------------------------|
| Other Power (W) | 0.3818 J                |
| Groups          |                         |
| Fossil Fuel     | 1498 kJ                 |
| Natural Gas Fue | 1490 kJ                 |
| Coal Fuel       | 7825.6324 J             |
| Non Fossil Fuel | 5459.7664 J             |
| Renewable       | 2982.9974 J             |
| Nuclear         | 2476.7689 J             |
| Petroleum Fuel  | 819.0412 J              |
| Biomass         | 164.3846 J              |
| Water           | 22.9618 cm <sup>3</sup> |
| Urban Emissions |                         |
| Well to Use     |                         |

Well to Use

Select Functional Unit

Use default preference  
 Use user preference

Unit Group: mass | Unit: lb | Amount: 1

Apply and Close

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products: demo

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo

Results for **H2 Production Pathway from SMR Demo**  
 Main Output: H2 Demo  
 Per  of H2 Demo  
 Target Year 2022

|                          |                         |
|--------------------------|-------------------------|
| Other Power (W 0.3818 J) |                         |
| Groups                   |                         |
| Fossil Fuel              | 1498 kJ                 |
| Natural Gas Fue          | 1490 kJ                 |
| Coal Fuel                | 7825.6324 J             |
| Non Fossil Fuel          | 5459.7664 J             |
| Renewable                | 2982.9974 J             |
| Nuclear                  | 2476.7689 J             |
| Petroleum Fuel           | 819.0412 J              |
| Biomass                  | 164.3846 J              |
| Water                    | 22.9618 cm <sup>3</sup> |

Urban Emissions  
Well to Use ...

Well to Use

Select Functional Unit

Use default preference  
 Use user preference

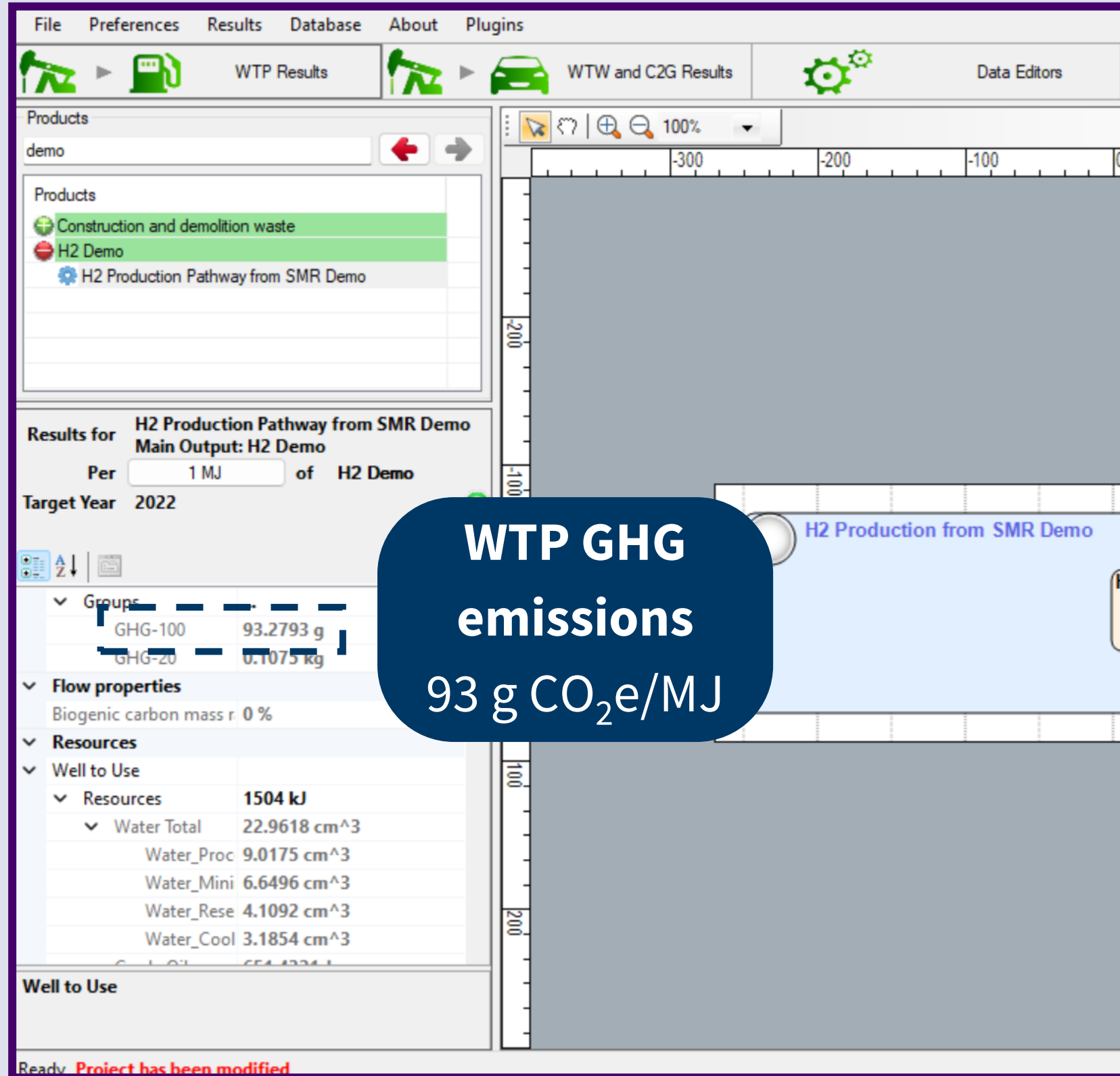
Unit Group: mass | Unit: lb | Amount:

1 Type 123

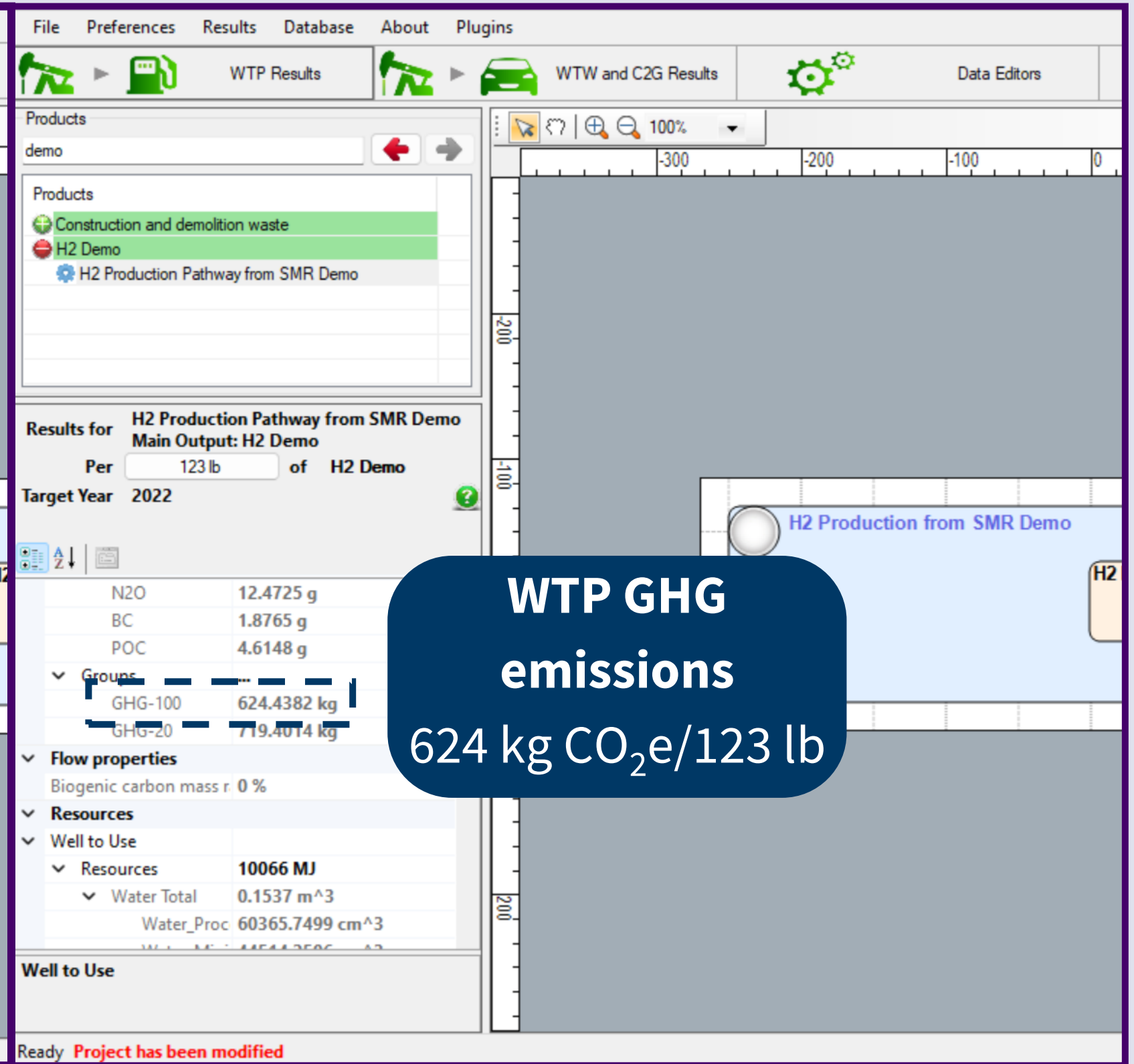
2

# Per 1 MJ of Hydrogen Demo

# Per 123 lb of Hydrogen Demo



**WTP GHG emissions**  
93 g CO<sub>2</sub>e/MJ



**WTP GHG emissions**  
624 kg CO<sub>2</sub>e/123 lb



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WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products: demo

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo

Results for **H2 Production Pathway from SMR Demo**  
 Main Output: H2 Demo  
 Per **123 lb** of H2 Demo  
 Target Year 2022

|         |             |
|---------|-------------|
| N2O     | 12.4725 g   |
| BC      | 1.8765 g    |
| POC     | 4.6148 g    |
| Groups  | ...         |
| GHG-100 | 624.4382 kg |
| GHG-20  | 719.4014 kg |

Flow properties: Biogenic carbon mass r. 0 %

Resources

Well to Use

- Resources: 10066 MJ
- Water Total: 0.1537 m<sup>3</sup>
- Water\_Proc: 60365.7499 cm<sup>3</sup>

Well to Use

```

graph LR
    A[H2 Production from SMR Demo] --> B[H2 Demo]
    B --> C((OUT))
  
```

WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products: demo

Products:

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo

Results for **H2 Production Pathway from SMR Demo**  
 Main Output: H2 Demo  
 Per 123 lb of H2 Demo  
 Target Year 2022

|         |             |
|---------|-------------|
| N2O     | 12.4725 g   |
| BC      | 1.8765 g    |
| POC     | 4.6148 g    |
| Groups  | ...         |
| GHG-100 | 624.4382 kg |
| GHG-20  | 719.4014 kg |

Flow properties: Biogenic carbon mass r. 0 %

Resources

Well to Use

- Resources: 10066 MJ
- Water Total: 0.1537 m<sup>3</sup>
- Water\_Proc: 60365.7499 cm<sup>3</sup>

Well to Use

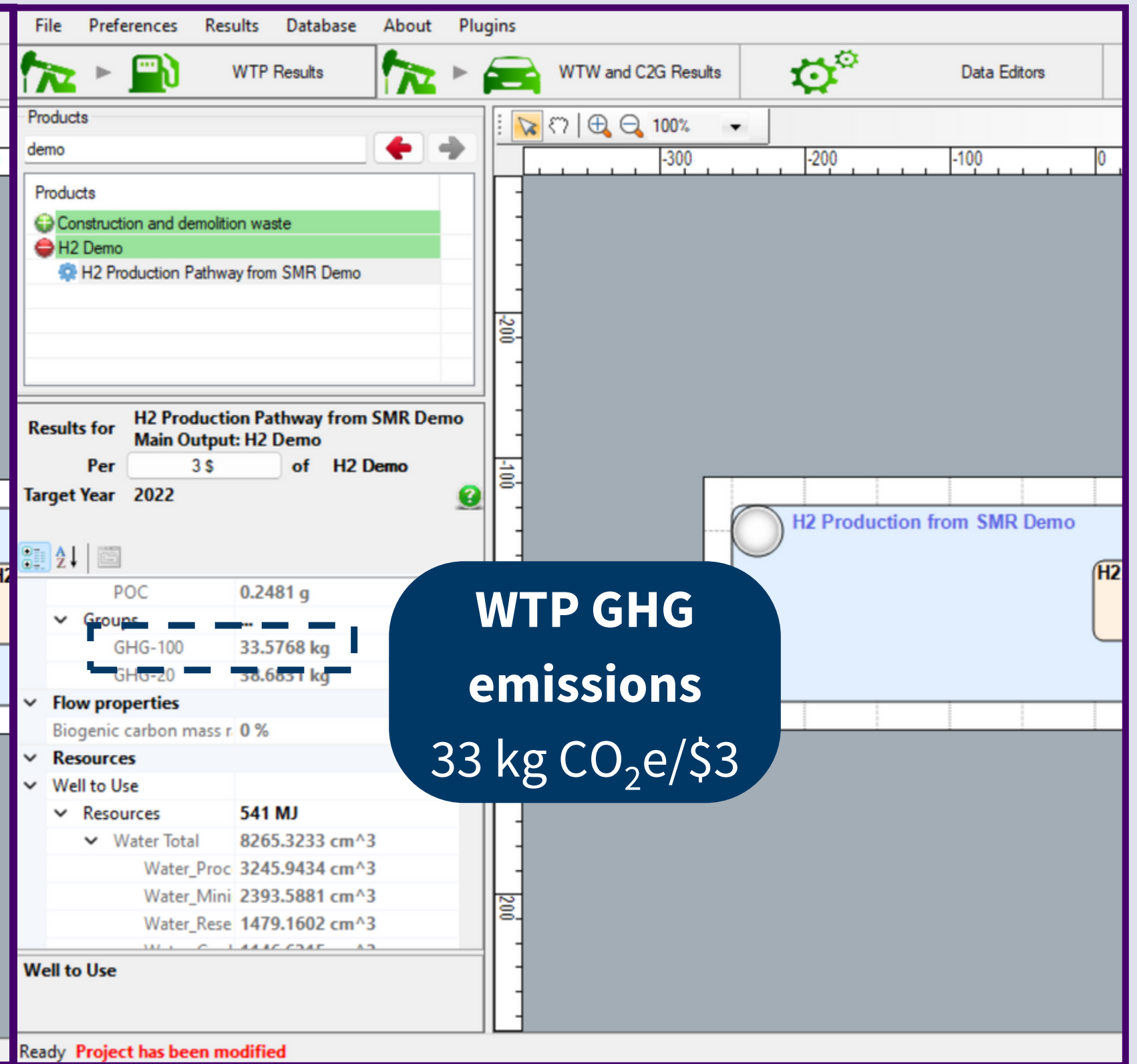
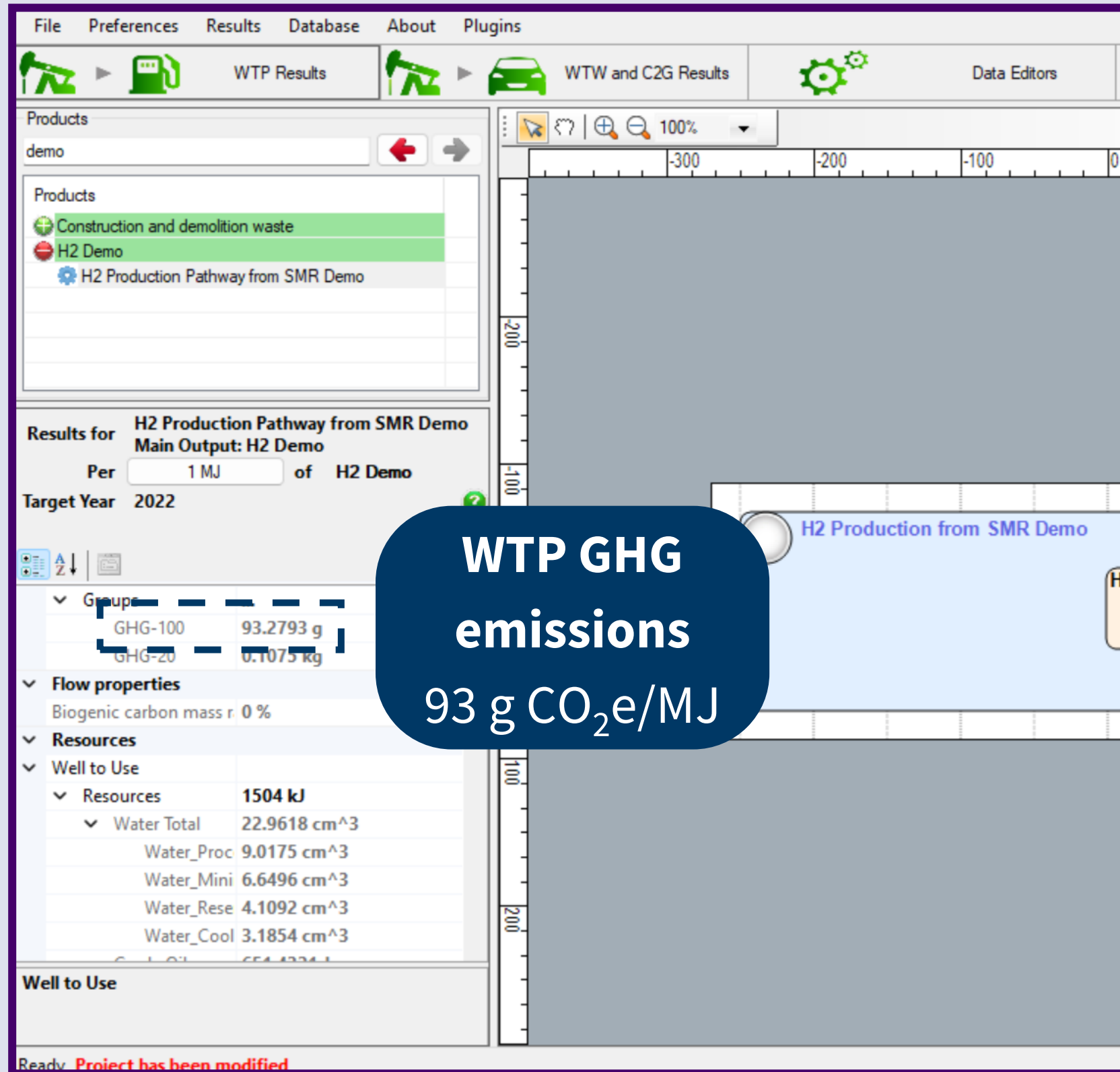
Select Function dialog box:

- Use default preference
- Use user preference
- Unit Group: currency
- Unit: \$
- Amount: 3
- Apply and Close

Fill in the unit as shown below

# Per 1 MJ of Hydrogen Demo

# Per \$3 of Hydrogen Demo



**WTP GHG emissions**  
93 g CO<sub>2</sub>e/MJ

**WTP GHG emissions**  
33 kg CO<sub>2</sub>e/\$3



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WTP Results | WTW and C2G Results | Data Editors | Simulation Parameters | Mapping

Products: demo

- Construction and demolition waste
- H2 Demo
- H2 Production Pathway from SMR Demo

Results for **H2 Production Pathway from SMR Demo**  
 Main Output: H2 Demo  
 Per 3 \$ of H2 Demo  
 Target Year 2022

|         |            |
|---------|------------|
| POC     | 0.2481 g   |
| Groups  | ...        |
| GHG-100 | 33.5768 kg |
| GHG-20  | 38.6831 kg |

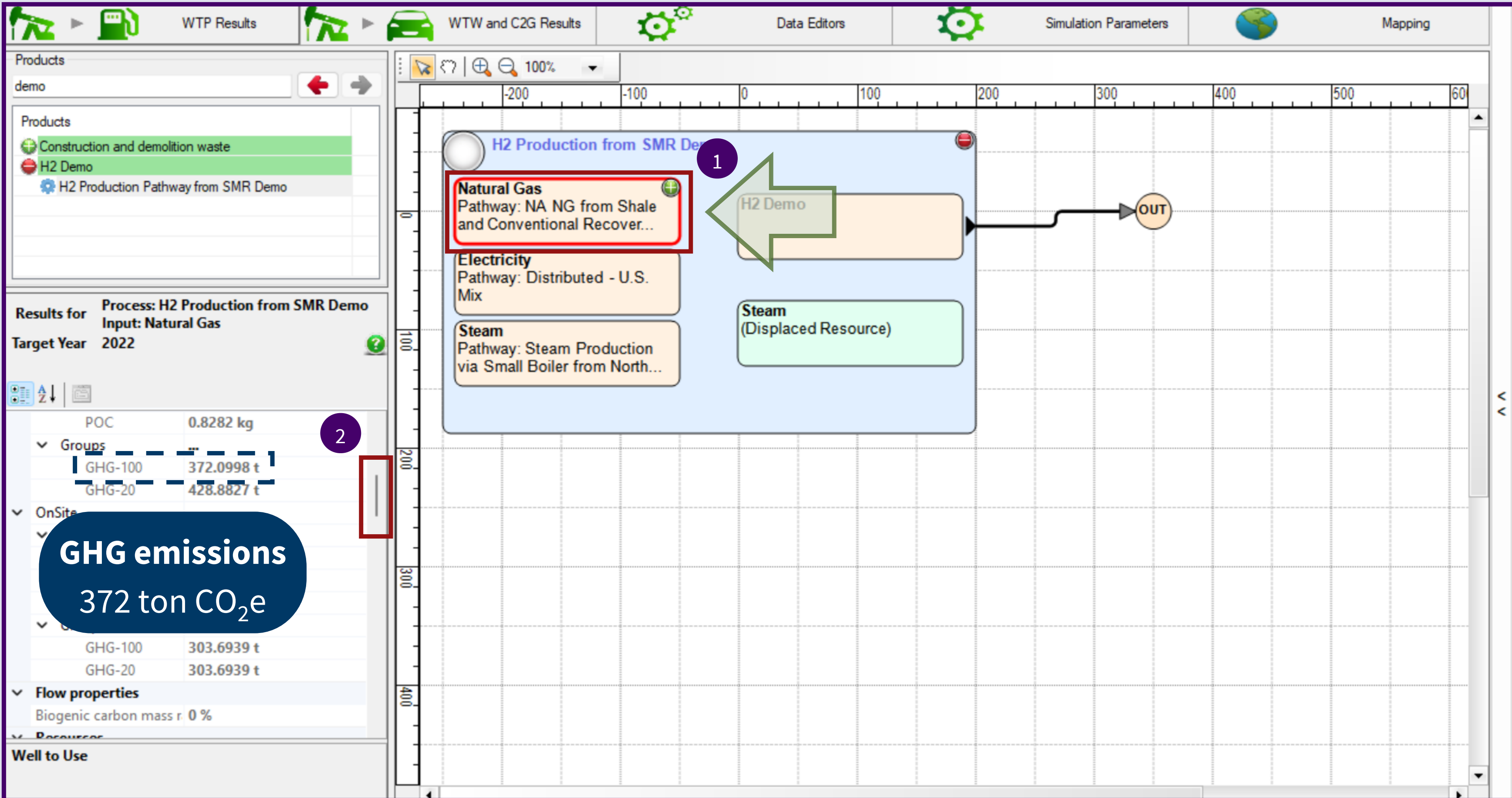
**Flow properties**  
Biogenic carbon mass r. 0 %

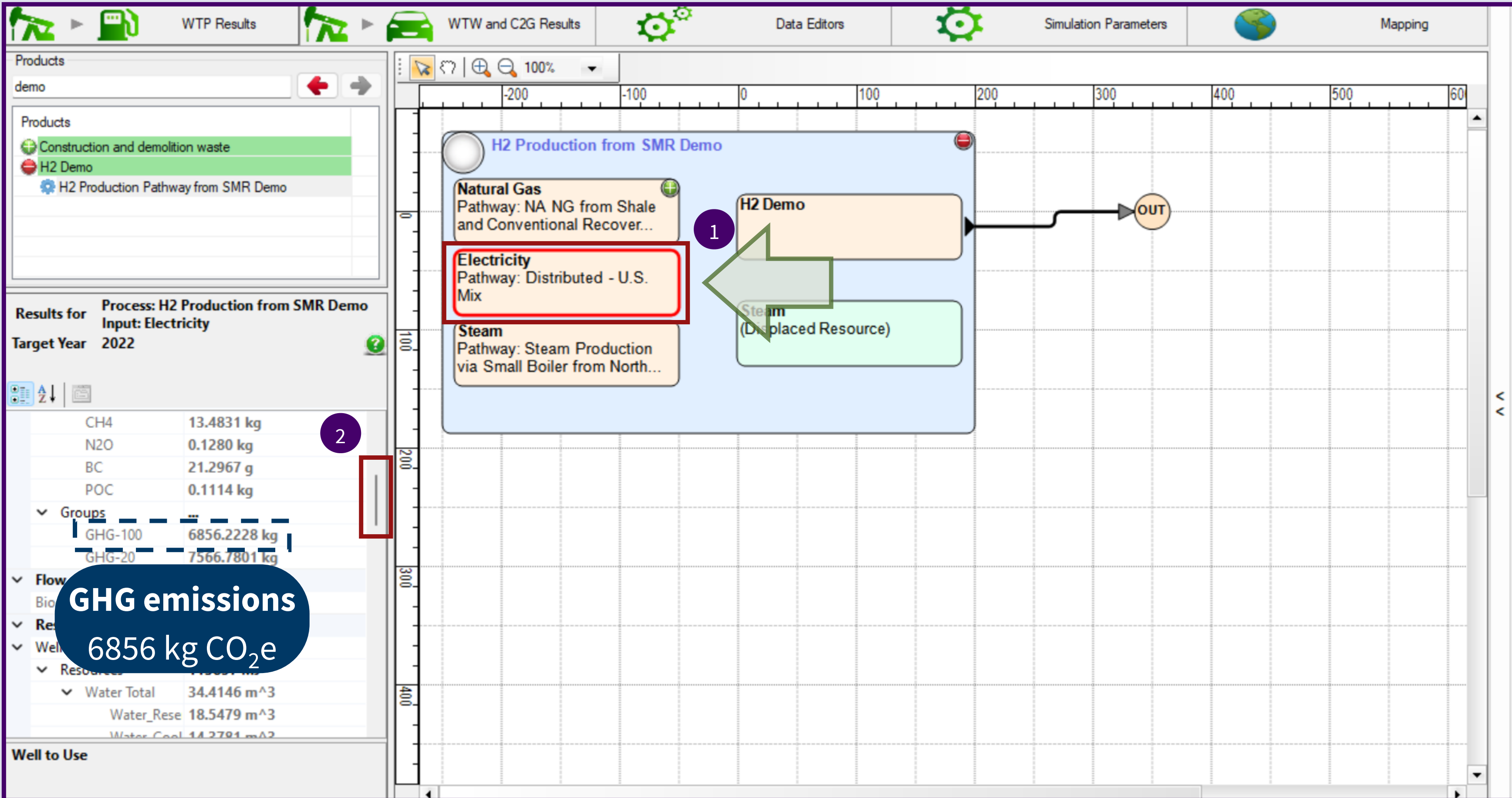
**Resources**

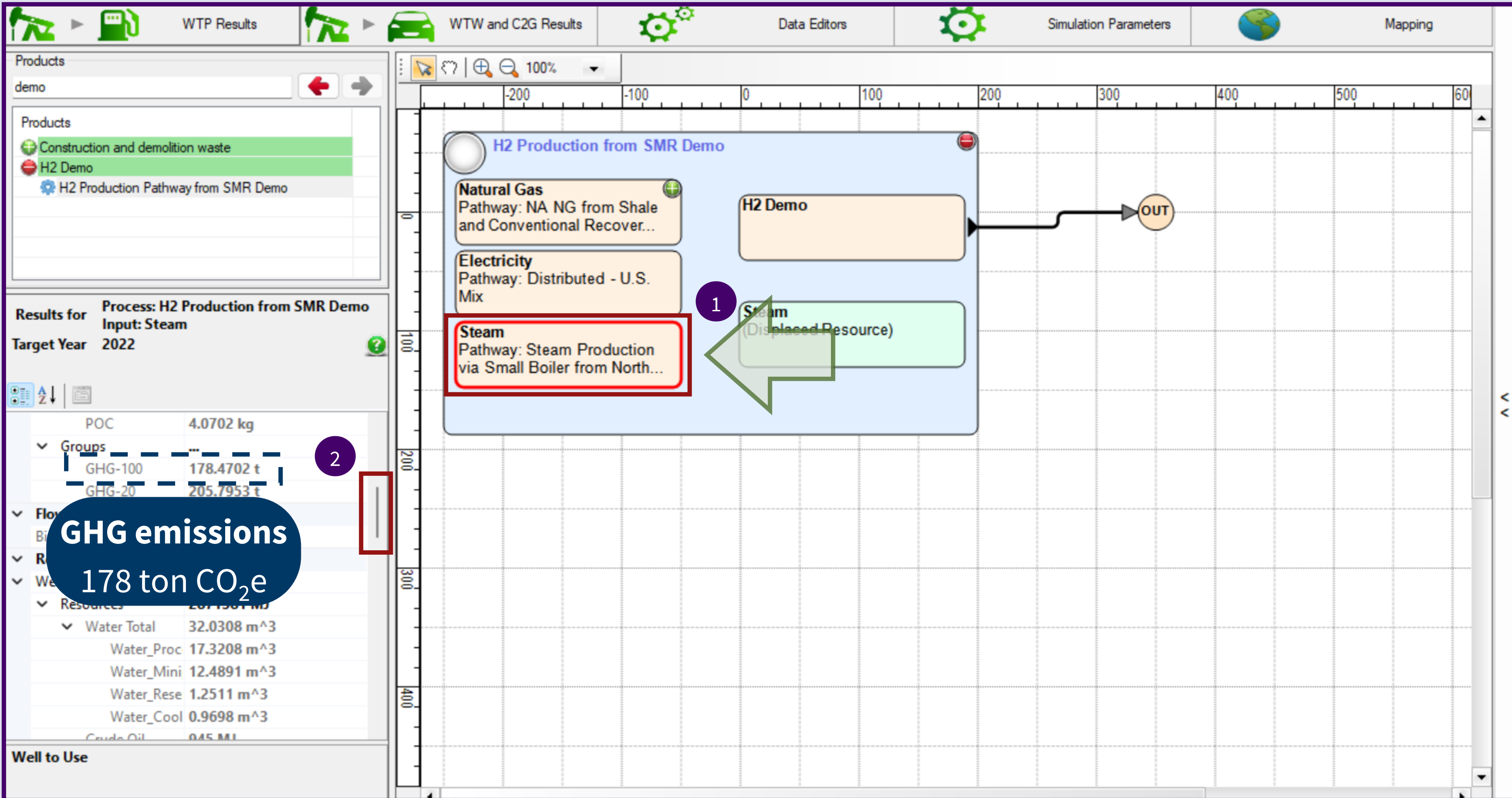
**Well to Use**

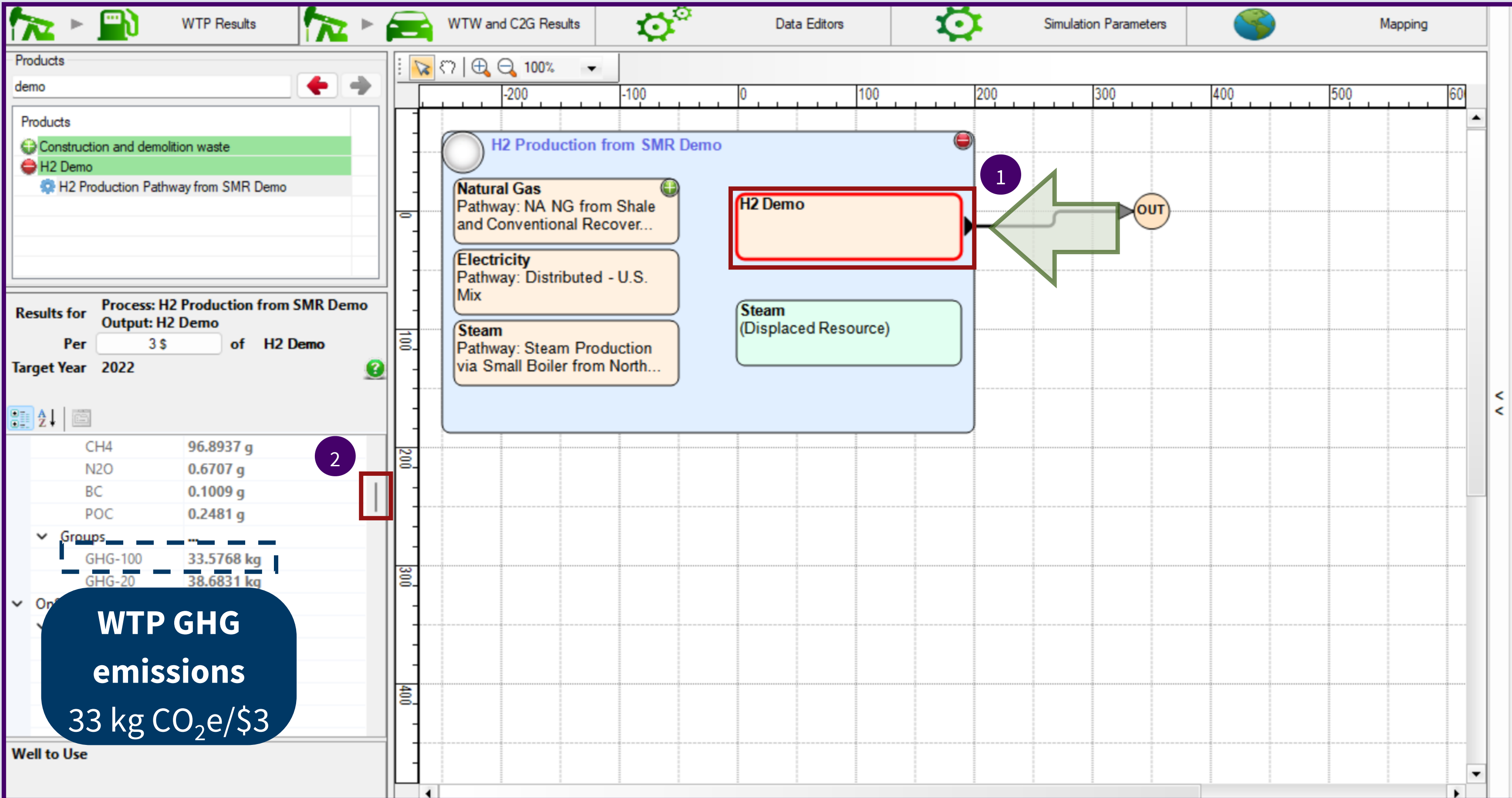
- Resources: 541 MJ
- Water Total: 8265.3233 cm<sup>3</sup>
- Water\_Proc: 3245.9434 cm<sup>3</sup>
- Water\_Mini: 2393.5881 cm<sup>3</sup>
- Water\_Rese: 1479.1602 cm<sup>3</sup>

Well to Use

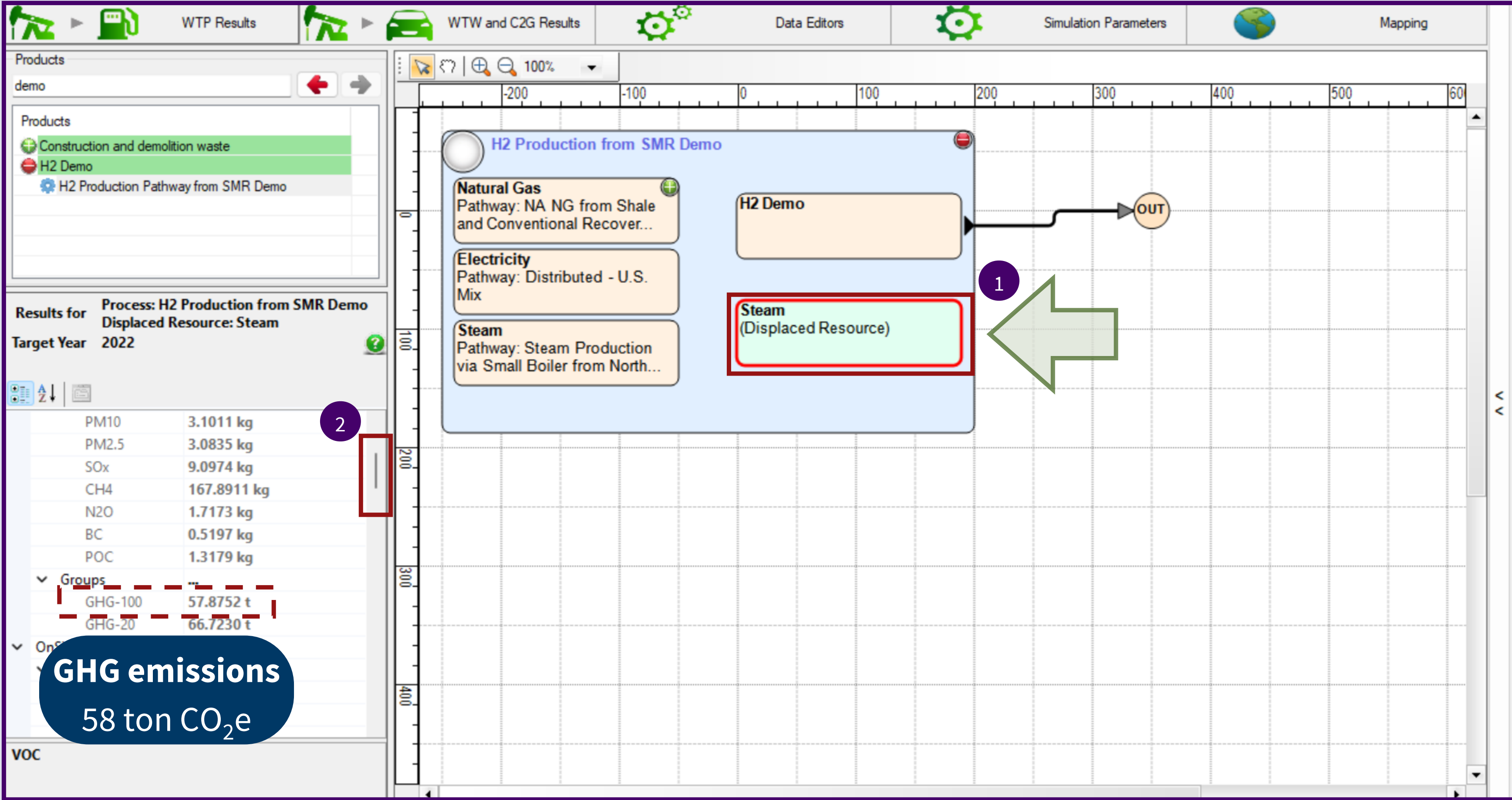


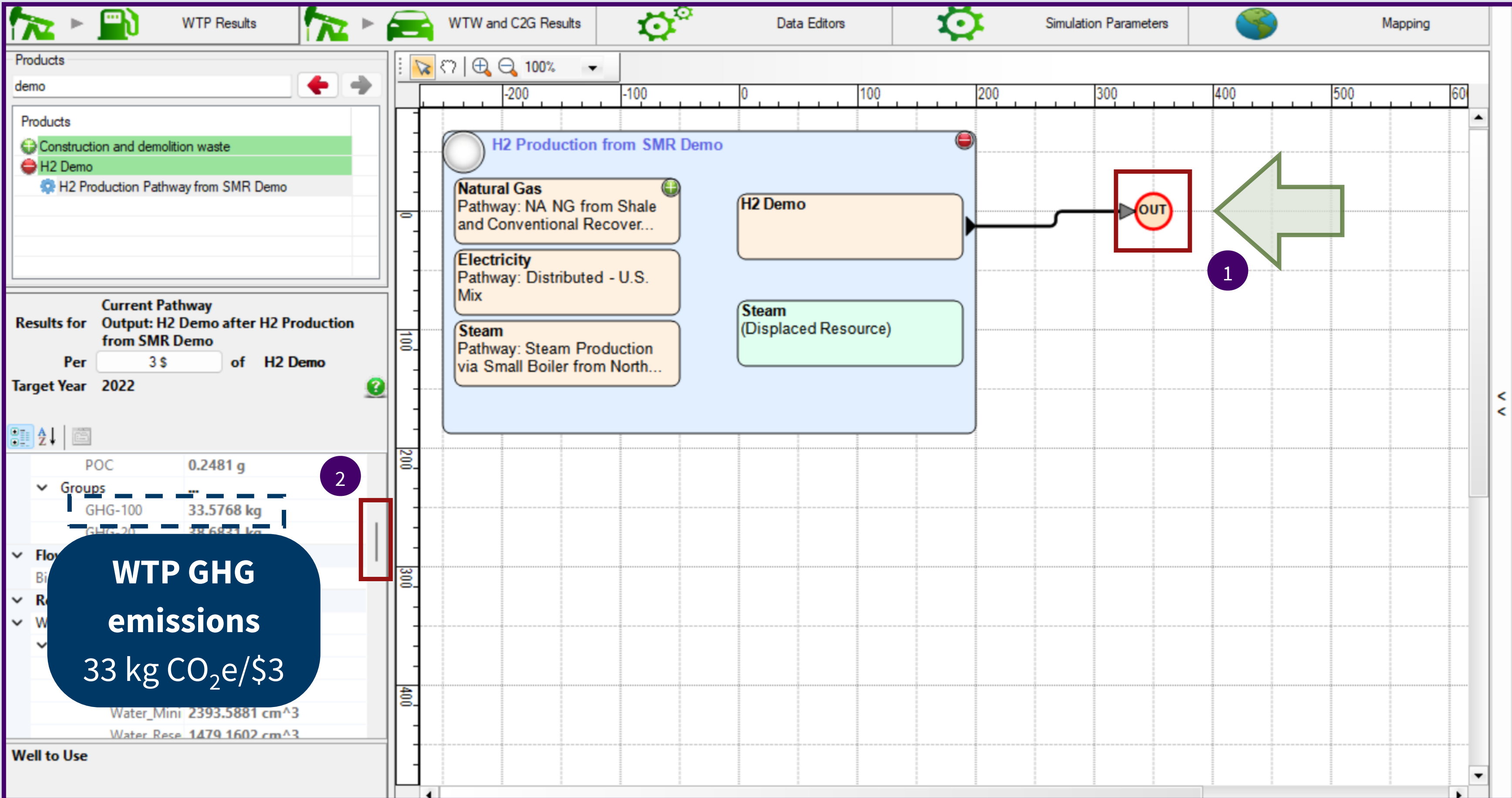






**WTP GHG emissions**  
33 kg CO<sub>2</sub>e/\$3





# Steps in R&D GREET .Net



## Zone 2

1. Modify a **resource**
2. Modify a **technology**
3. Modify a **stationary process**
4. Modify a **pathway**
5. Press F9 to **run the simulation**
6. **Explore** the pathway results in the “WTP Results” pane



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# THANK YOU



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