

ver. 1.0.0

# GCAM-EML User Guide

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# Installing GCAM-EML

GCAM-EML only runs on windows.

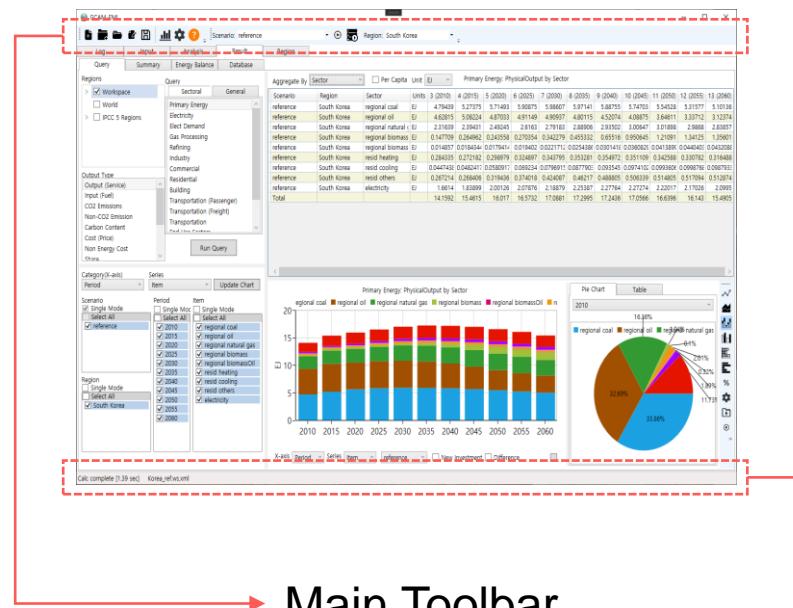
- ① Download xcam.zip from EML site
- ② Unzip zip file and then open the root “xcam” folder
- ③ Run XcamApp.exe
- ④ If you are asked to install .Net Core 3.1,  
go to the below link and install **.NET Core Desktop Runtime 3.1.8 x64**  
✓ <https://dotnet.microsoft.com/download/dotnet-core/3.1>

## **.NET Core Desktop Runtime 3.1.8**

The .NET Core Desktop Runtime enables you to run existing Windows desktop applications. **This release includes the .NET Core Runtime, you do not need to install it separately.**

OS	Installers	Binaries
Windows	<a href="#">x64</a>   <a href="#">x86</a>	

# Main Toolbar & Status bar



## Status bar

Ready

Initial state

Workspace loaded Korea\_ref.ws.xml

Workspace loaded

Running Korea\_test.ws.xml

Running scenario

Calc complete [1803 ms] Korea\_ref.ws.xml

Run complete

## Main Toolbar



1. New workspace
2. Open workspace
3. Open file
4. New workspace
5. Save workspace
6. View chart
7. Open option dialog
8. Open help file
9. Current scenario
10. Run the current scenario
11. Run all scenarios
12. Current region
13. Change unit

# Concept of Workspace and Scenario

```
<workspace name="test ws">
  <scenarios>
    <scenario name="reference">
      <file>primary/input_South_Korea_53.xml</file>
      <file>secondary/abc.xml</file>
    </scenario>
    <scenario name="sce1" based-on="reference">
      <file>secondary/sce1.xml</file>
    </scenario>
    <scenario name="sce2" based-on="sce1">
      <file>secondary/sce2.xml</file>
    </scenario>
  </scenarios>
  <chart-list />
</workspace>
```

Workspace contains all the information to run multiple scenarios.

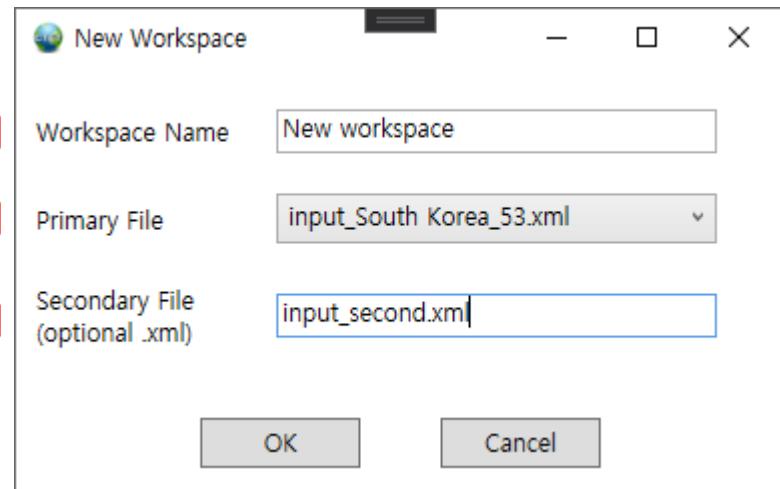
This workspace contains 3 scenarios

1. reference
2. sce1 based on reference
3. sce2 based on sce1

- Primary file is a main input file exported from GCAM input xml.
- Primary file remains intact.
- Secondary file contains data to update primary file.
- Scenario relationship is hierarchical. If scenario2 is based on scenario1, scenario2 includes all the changes in scenario1 plus changes in scenario2.



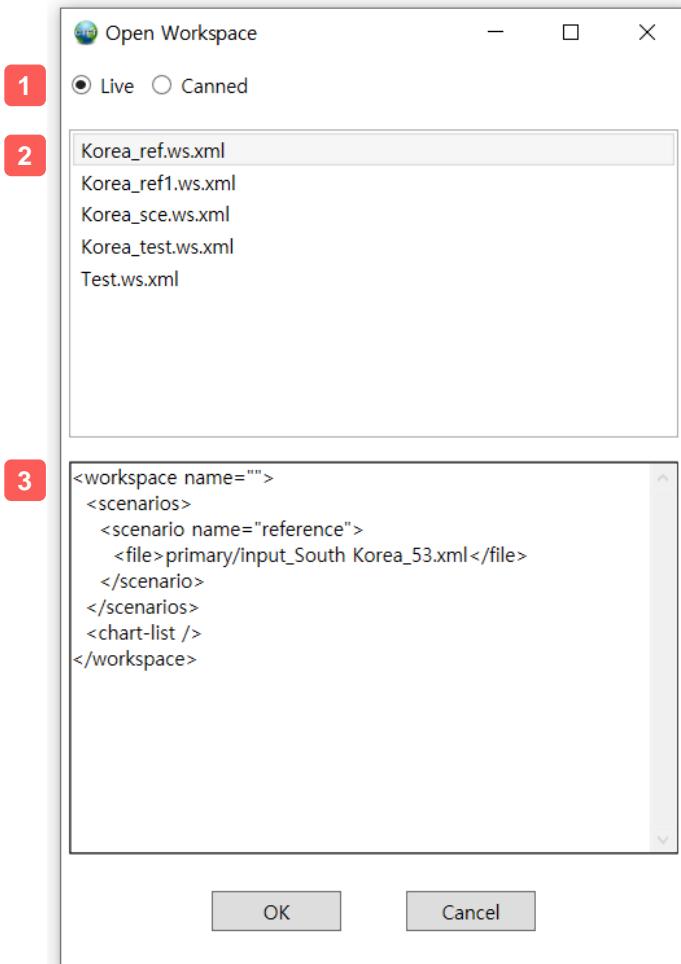
## New Workspace



1. Workspace name
2. Main input file for the reference scenario
3. Optional secondary xml used to modify reference scenario



# Open Workspace



## 1. Select live or canned

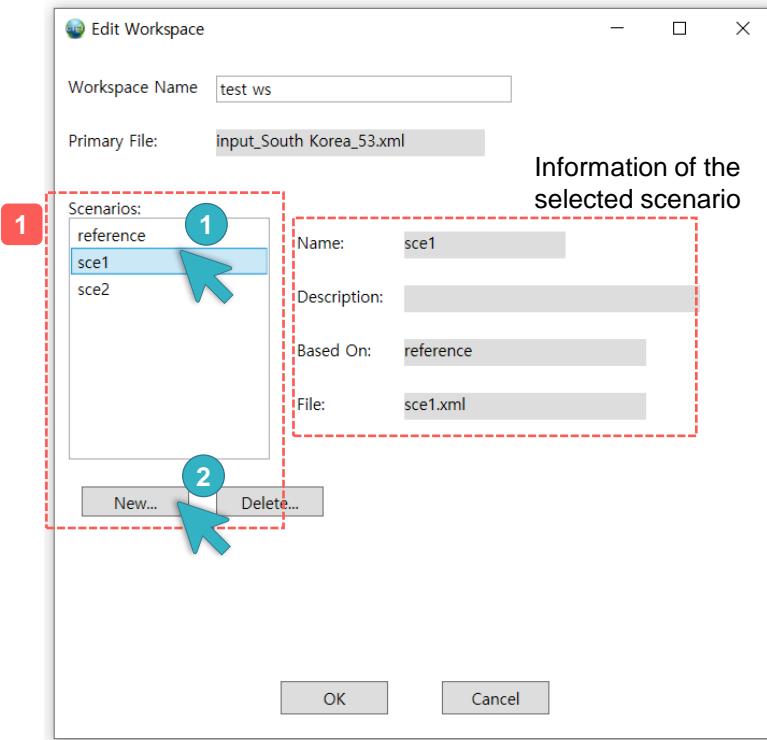
- Live: load input data and run, allows to update input data and scenarios.
- Canned: load output data and view

## 2. Workspace files in the folder

## 3. Display content of selected workspace

# Edit Workspace

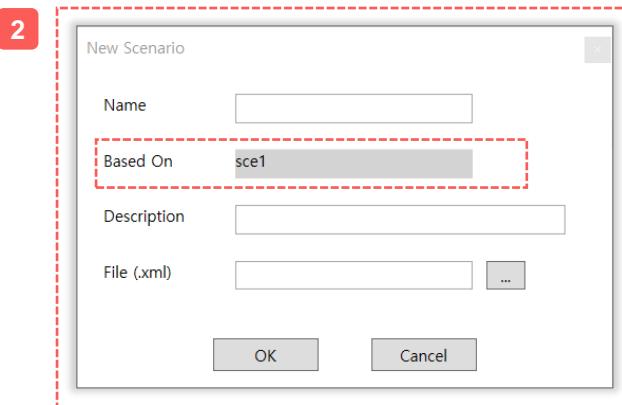
Create or delete scenario



1. Select a scenario and click New.

2. New Scenario dialog opens.

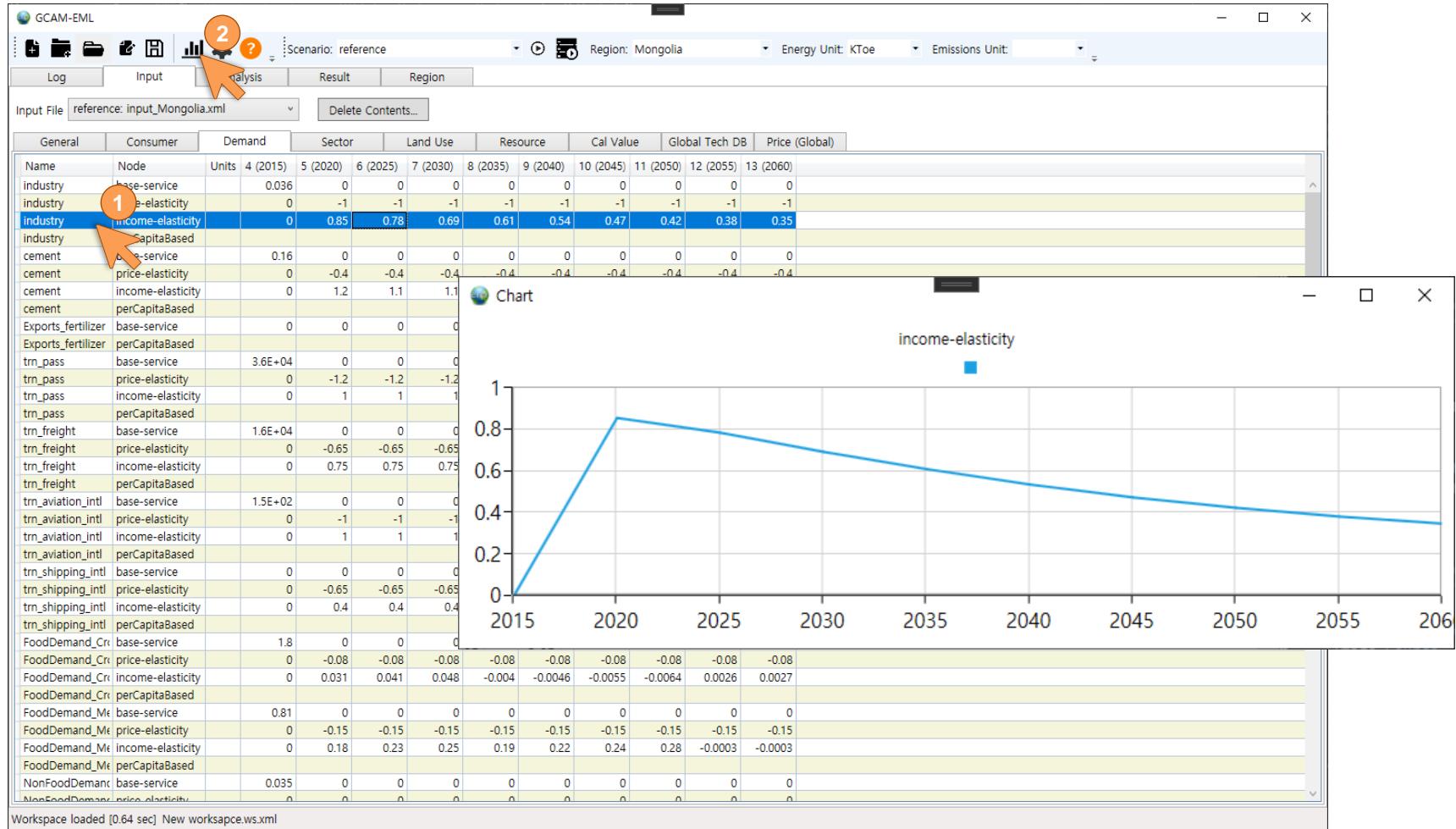
- New scenario is based on the selected scenario





## View Chart

Allows to view any tabular period data in a chart.





## Option Dialog

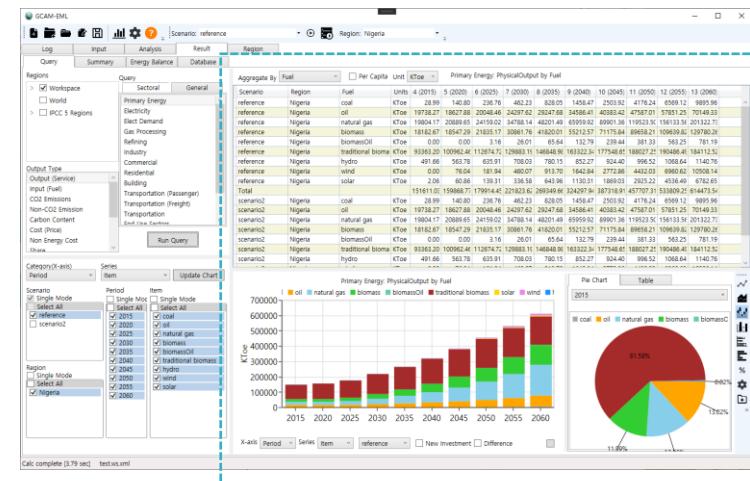
The screenshot shows two overlapping windows of a software application. The top window is titled 'Properties' and has tabs for 'General' and 'Fuel'. A red box labeled '1' highlights the 'Fuel' tab. Below it, a red box labeled '2' highlights the 'Fuel Options' section, which displays a list of fuel types with their corresponding color swatches. At the bottom of this list are buttons for moving items up and down, and a dropdown arrow.

Fuel Type	Color
coal	DarkGray
oil	Orange
refined liquids	Orange
natural gas	SkyBlue
gas	SkyBlue
biomass	LimeGreen
biomassOil	MediumAquamarine
ethanol	Maroon
traditional biomass	Brown
electricity	BurlyWood
nuclear	Magenta
solar	Gold
wind	Violet
hydro	DodgerBlue
geothermal	Peru
H2	DarkCyan

## 1. Set table format and unit

- Numeric format
    - G: General
    - F: Fixed-point

2. Set fuel colors and display order on the chart





# Help

Display this document

ver. 1.0.0

# GCAM-EML User Guide

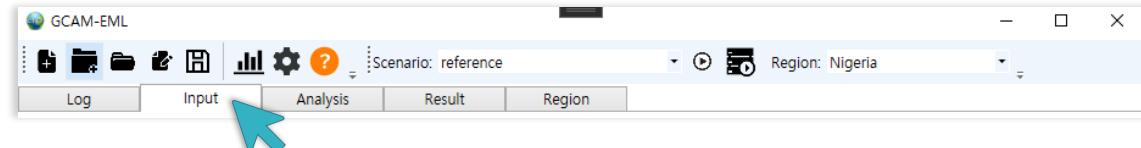
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Energy Modeling Lab., Ajou University

The diagram features a central white outline of the Earth. Surrounding the Earth are several white circles, each containing a different icon representing energy or the environment. These icons include a solar panel, a leaf, a lightning bolt with arrows between H<sub>2</sub> and O<sub>2</sub>, CO<sub>2</sub> with a downward arrow, and a power transmission tower. Lines connect these surrounding circles to the central Earth icon, illustrating the interconnected nature of global energy systems and environmental processes.

# Input tab



## View and analyze input data

A screenshot of the GCAM-EML software interface. On the left, there's a detailed view of the input XML file for Nigeria. On the right, the main workspace shows the input file structure with numbered callouts: 1. Input File (reference: input\_Nigeria.xml), 2. General, 3. Consumer, 4. Demand, 5. Sector, 6. Land Use, 7. Resource, 8. Cal Value, 9. Global Tech DB, and 10. Price (Global).

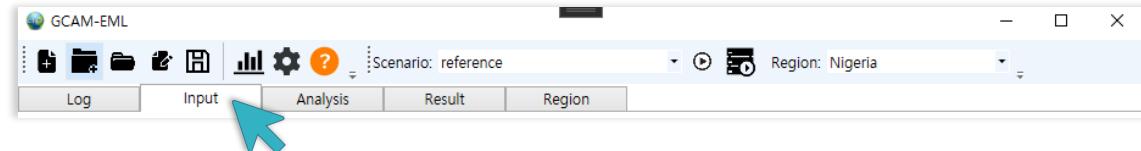
Input File reference: input\_Nigeria.xml

General   Consumer   Demand   Sector   Land Use   Resource   Cal Value   Global Tech DB   Price (Global)

1   2   3   4   5   6   7   8   9   10

1. Select input xml file
2. Socioeconomic parameters & CO2 coefficient
3. Building consumer
4. View base service, income & price elasticities, per capita based
5. View parameters for sector (share weight, interpolation rule, logit exponent....)
6. View parameters for land use (allocation, land carbon density, logit exponent ....)
7. View parameters for resource (resource curves, gdp or mac control....)
8. View all the calibrated values in the input data
9. Global technology database
10. Global price of good

## Input tab



Input File	reference: input_Nigeria.xml	<input type="button" value="1"/>						
General	Consumer	Demand	Sector	Land Use	Resource	Cal Value	Global Tech DB	Price (Global)

2

3

4

5

6

7

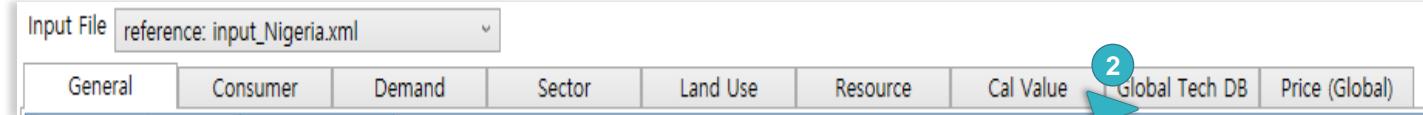
8

9

0

	2	Region: Nigeria									
Input	Output	Demand	Sector	Land use	Resource	Cal Value	Global Tech DB	Price (Global)			
Imports	779.0										
Name	units	4 (2011)	5 (2010)	4 (2009)	7 (2008)	8 (2007)	1 (2006)	10 (2005)	13 (2004)	14 (2003)	18 (2002)
Imports	kg	630	630	630	630	630	630	630	630	630	630
Imports	USD	630	630	630	630	630	630	630	630	630	630
Imports	CO2	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91
Imports	CO2t	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91
Primary Fuel CO2 Coefficient											
Name	Coef										
Imports	2										
regional biomass	22										
regional oil	23										
regional biogas	16.6										
regional coal	16.91										
regional corn for ethanol	27.3										
regional gas	16.91										
regional oil shale	27.3										
demanded coal	27.3										
demanded gas	16.91										
demanded natural gas	14.2										
demanded oil	14.2										
demanded pet	14.2										
petroleum	14.2										
unconventional oil	21.1										
regional oil shale	16.6										
regional oil	16.6										
refined liquids industrial	16.6										
refined liquids residential	16.6										
biomass	22										
biomass	22										

# Input tab: Cal Value



1

Readin value

Sector	SubSector	Technology	Fuel	Efficiency	Coefficient	Readin Input	Readin Outp	Input	Output
regional oil	crude oil	crude oil	crude oil	1		0.8264838	0.8264838	0.8264838	0.8264838
regional oil	unconventional oil	unconventional oil	traded unconventional	1		0	0	0	0
regional biomassOil	regional biomassOil	OilCrop	regional oilcrop	84	0	0	0	0	0
gas processing	natural gas	natural gas	regional natural gas	1		0.5750811	0.5750811	0.5750811	0.5750811
gas processing	biomass gasification	biomass gasification	regional biomass	1.343		0	0	0	0
gas processing	coal gasification	coal gasification	regional coal	1.326		0	0	0	0
refining	oil refining	oil refining	regional oil	1.0252895		0.806098	0.82648382	0.806098	0.806098
refining	biomass liquids	corn ethanol	elect_td_ind	0.026		0	0	0	0
refining	biomass liquids	biodiesel	regional biomassOil	1.0309		0	0	0	0
refining	coal to liquids	coal to liquids	regional coal	2.112		0	0	0	0
refining	gas to liquids	gas to liquids	regional natural gas	1.654		0.008372	0.013847288	0.008372	0.008372
electricity	coal	coal (conv pul)	regional coal	0.397		0	0	0	0
electricity	gas	gas (steam/CT)	wholesale gas	0.377		0.0794573925	0.21076231	0.0794573925	0.21076231
electricity	gas	gas (CC)	wholesale gas	0.565		0.0166518074	0.029472226	0.0166518074	0.029472226

Calculated  
value

2

Sector	Cal	Cal Output	Base Service(Rea
regional oil	0.826484	0.826484	
regional biomassOil	0	0	
gas processing	0.575081	0.575081	
refining	0.840331	0.814447	
electricity	0.240321	0.0961956	
elec_CSP	0	0	
elec_coal (conv pul)	0	0	
elec_gas (steam/CT)	0.210762	0.0794574	
elec_gas (CC)	0.0294724	0.0166519	
elec_refined liquids (steam	0	0	
elec_biomass (conv)	0	0	
elec_Gen_II_LWR	0	0	
elec_geothermal	0	0	

3

Needs validation

Flow / Product	coal	oil	natural gas	biomass	traditional bi	biomassOil	H2	ethanol	nuclear	wind	solar	hy
Total Primary Supply	0.00	0.83	0.59	4.67		0.00			0.00	0.00	0.00	
gas processing	0.00		-0.58	0.00								
refining	0.00	-0.83	-0.01			0.00			0.00	-0.00	-0.00	
electricity	0.00			0.00					0.00	-0.00	-0.00	
CHP												
trans & distr												
Total Transformation	0.00	-0.83	-0.55	0.66		0.00			0.00	-0.00	-0.00	
comm	0.00			0.12								
resid	0.00			4.01								
industry	0.00			0.54								
transportation	0.00											
Total Demand	0.00			4.67								
TPS + Transform - Demand	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

## 1. Details

- View all the calibrated values in the input data

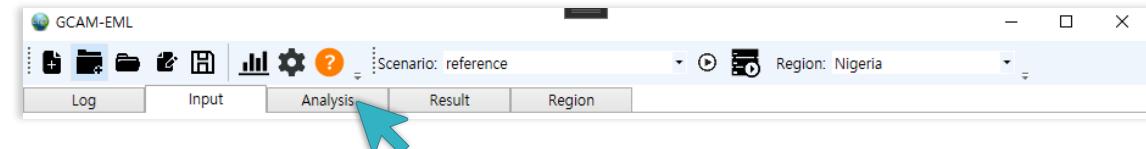
## 2. Summary

- Summarize calibrated values by collapsing values into sector level

## 3. Energy Balance

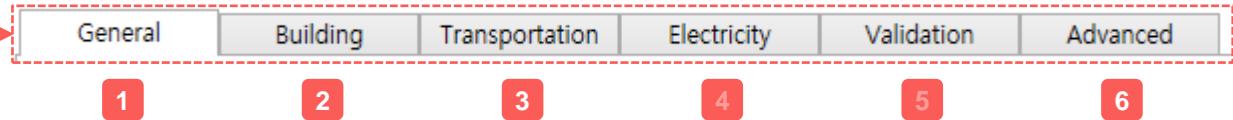
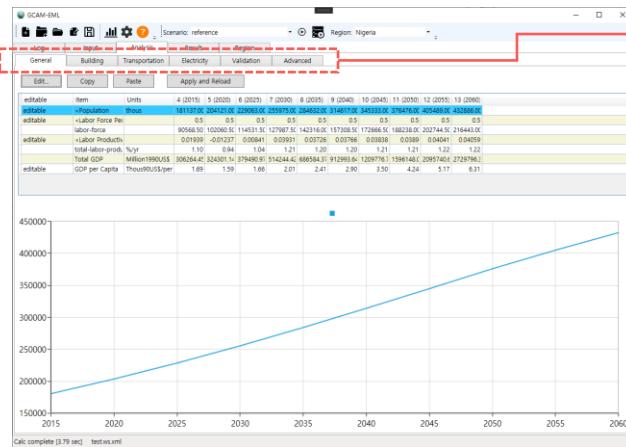
- Build energy balance table from input calibrated values

# Analysis tab



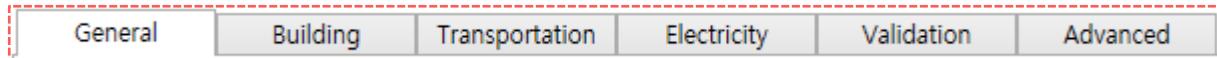
Analyze scenario runtime data

Provides tools to develop and analyze scenarios



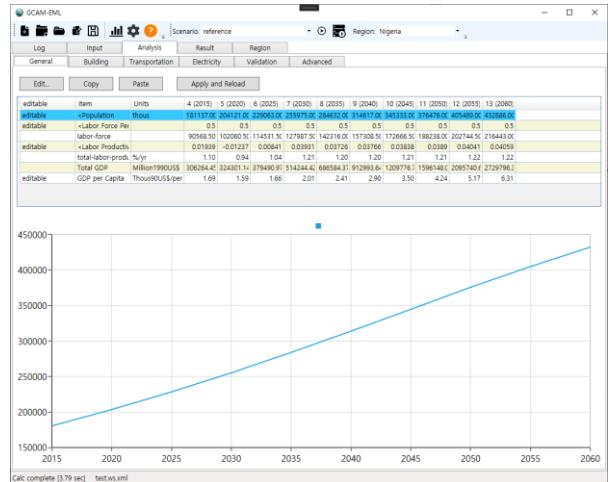
1. Allows to visualize and modify all the relevant data regarding socioeconomics
2. Allows to visualize and modify all the relevant data regarding building sector
3. Enables to easily visualize all the relevant data regarding transportation sector
4. Under construction
5. Under construction
6. Shows all the runtime values while running scenarios and provides useful data to develop and debug model and scenario.

# Analysis tab



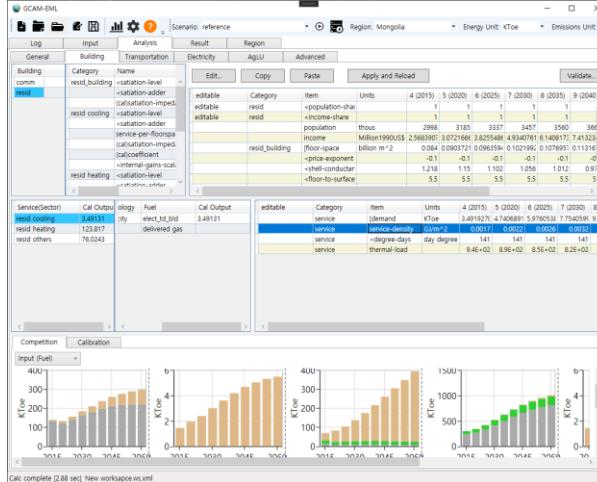
1

1



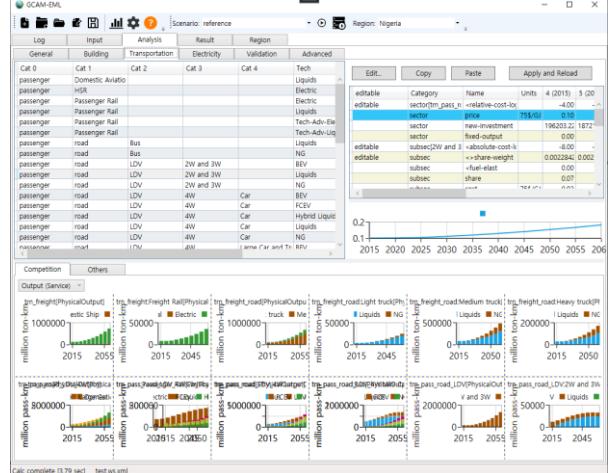
2

2

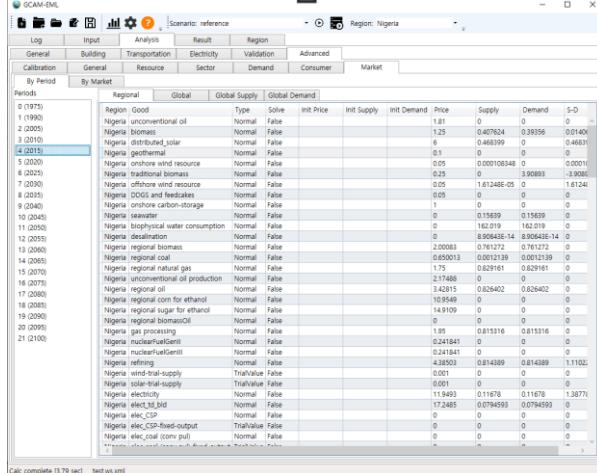


3

3



6



# Analysis tab: Edit scenario input data



2

General

Building

Transportation

Electricity

Validation

Advanced

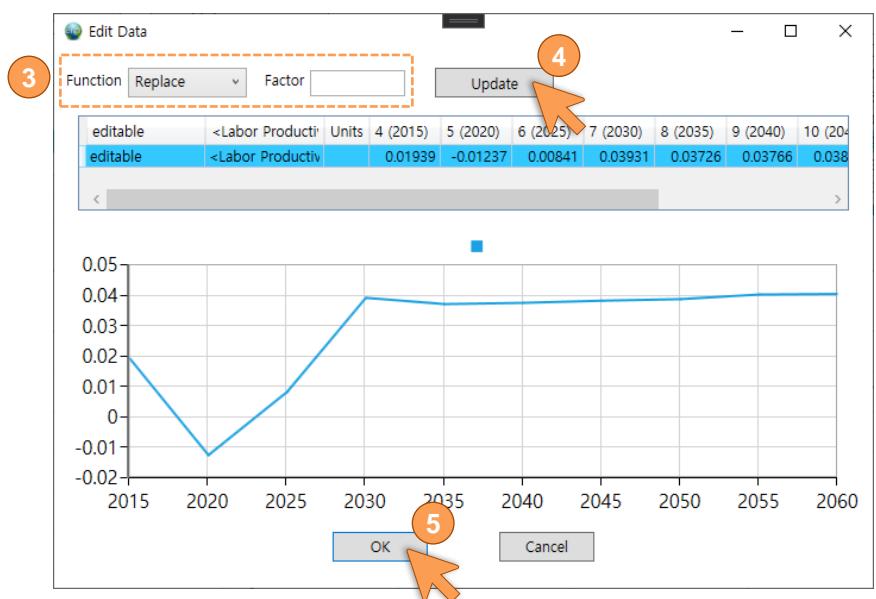
The screenshot shows the 'General' tab selected. At the top of the table, there is a row with 'Item' and 'Units' columns. The first row under 'Item' is highlighted with a yellow background and contains the text '<Population'. The 'Units' column for this row contains 'Thous'. The table has columns for years from 2015 to 2050. The first row under 'Item' is highlighted with a yellow background and contains the text '<Population'. The 'Units' column for this row contains 'Thous'. The table has columns for years from 2015 to 2050.

editable	Item	Units	4 (2015)	5 (2020)	6 (2025)	7 (2030)	8 (2035)	9 (2040)	10 (2045)	11 (2050)
editable	<Population	Thous	181137.00	204121.00	229063.00	255975.00	284632.00	314617.00	345333.00	376476.00
editable	<Labor Force Population		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	labor-force		90568.50	102060.50	114531.50	127987.50	142316.00	157308.50	172666.50	188238.00
editable	<Labor Productivity	%/yr	0.01939	-0.01237	0.00841	0.03931	0.03726	0.03766	0.03838	0.0389
	total-labor-prod	%/yr	1.10	0.94	1.04	1.21	1.20	1.20	1.21	1.21
	Total GDP	Million1990US\$	306264.45	324301.14	379490.97	514244.42	686584.37	912993.64	1209776.7	1596148.0
editable	GDP per Capita	Thous90US\$/per	1.69	1.59	1.66	2.01	2.41	2.90	3.50	4.24

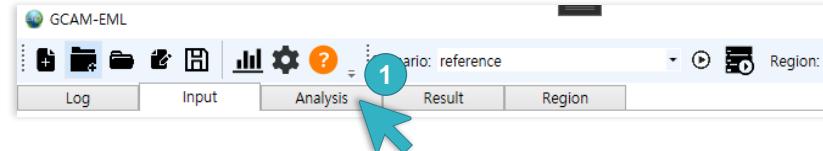
You can modify the row of which the first column is marked with editable as shown below.

1. Select an editable row you want to edit
2. Click Edit button opens Edit Data dialog
3. Type value into Factor text box and select function
4. Click Update, then modified values are represented in table and chart
5. Click OK button
6. After finishing editing, click Apply and Reload, which updates input xml file and reloads workspace.

You need to run the scenario again.



# Analysis tab: Edit scenario input data in collaboration with Excel



The screenshot shows a table of scenario input data. The table has columns for Item, Units, and years from 2015 to 2050. Row 1 (Population) is highlighted in yellow. Row 2 (Labor Force Productivity) is also highlighted in yellow. A row for 'total-labor-prod' is present. The table includes a header row with 'editable' status and a summary row for 'Total GDP'.

editable	Item	Units	4 (2015)	5 (2020)	6 (2025)	7 (2030)	8 (2035)	9 (2040)	10 (2045)	11 (2050)
editable	<Population	thous	181137.00	204121.00	229063.00	255975.00	284632.00	314617.00	345333.00	376476.00
editable	<Labor Force Per			0.5	0.5	0.5	0.5	0.5	0.5	0.5
	labor-force		90568.50	102060.50	114531.50	127987.50	142316.00	157308.50	172666.50	188238.00
editable	<Labor Productivit		0.01939	-0.01237	0.00841	0.03931	0.03726	0.03766	0.03838	0.0389
	total-labor-prod	/yr		1.10	0.94	1.04	1.21	1.20	1.20	1.21
	Total GDP	Million1990US\$	306264.45	324301.14	379490.97	514244.42	686584.37	912993.64	1209776.7	1596148.0
editable	GDP per Capita	Thous90US\$/per	1.69	1.59	1.66	2.01	2.41	2.90	3.50	4.24

Numbered callouts point to specific elements:

- 1: Points to the 'labor-productivity' row.
- 2: Points to the 'Copy' button in the toolbar.
- 3: Points to the 'Paste' button in the toolbar.
- 4: Points to the 'Apply and Reload' button in the toolbar.

1. Click on a row you want to edit
2. Click Copy button
  - Paste to Excel (or your favorite editor) and edit data as desired.
  - Copy modified data from Excel.
3. Click Paste button.
4. After finishing editing, click Apply and Reload, which updates input xml file and reloads workspace.

**You need to run the scenario again.**

## Analysis tab: Segregate resid into 'resid\_rural' and 'resid\_urban'

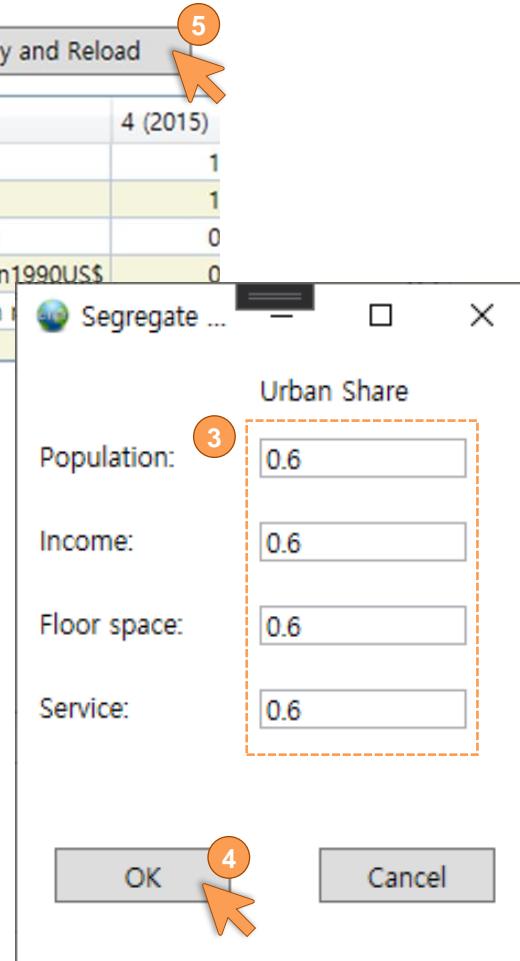


The screenshot shows the 'Segregate...' dialog box. On the left, there is a preview of the grid table from the previous screenshot. In the center, there are four buttons: Edit..., Copy, Paste, and Apply and Reload. The 'Apply and Reload' button is highlighted with a blue circle and a number '5'. On the right, there is a table with columns for editable, Category, Item, Units, and Value. The table includes rows for 'resid' (population-share), 'resid' (income-share), 'population' (thous), 'income' (Million 1990US\$), and 'resid\_building' (billion). The 'Segregate...' dialog box has a title bar and a close button.

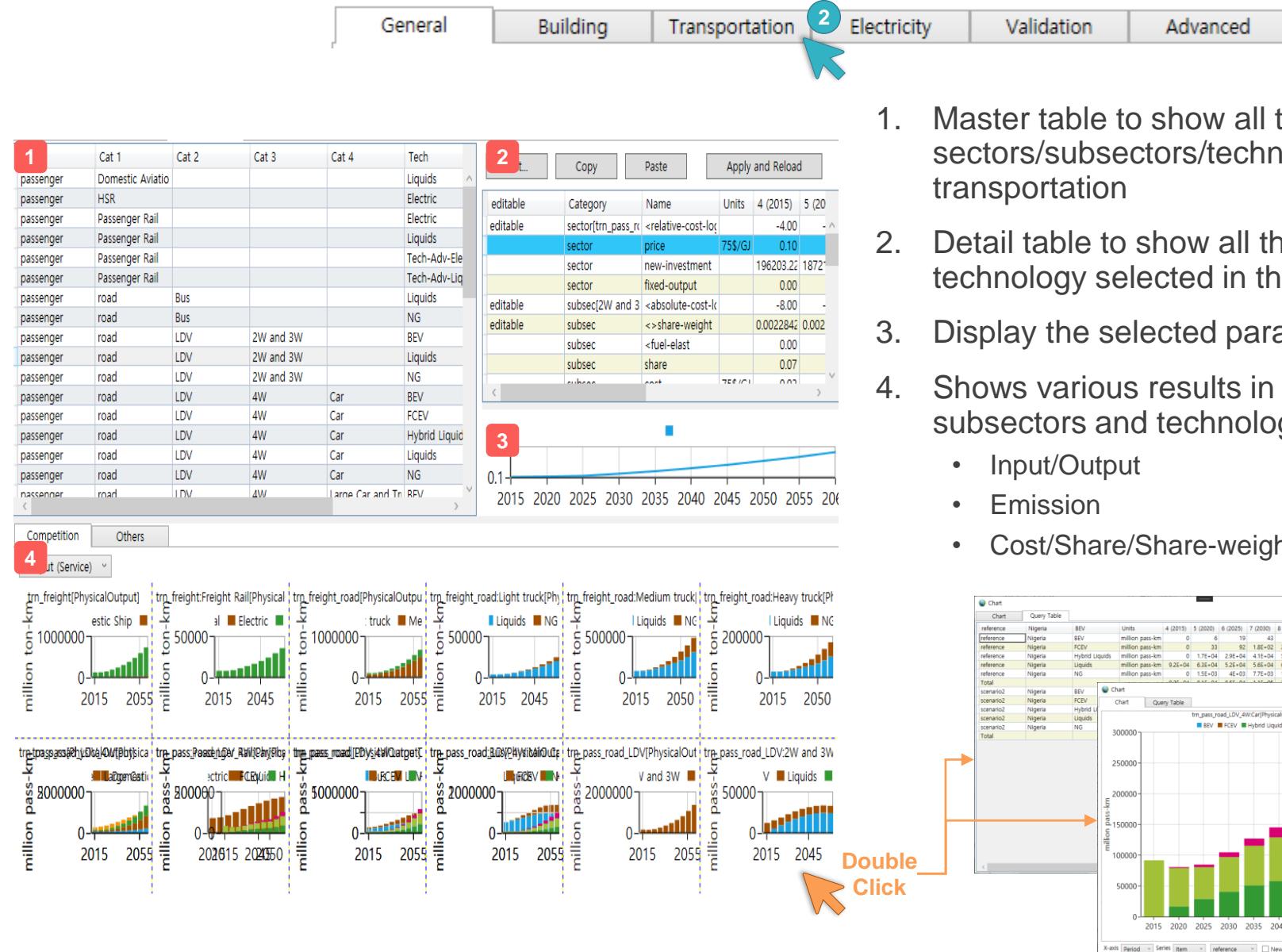
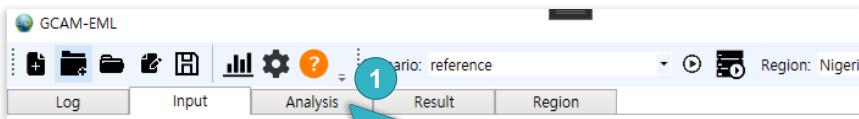
editable	Category	Item	Units	Value
editable	resid	<population-share		1
editable	resid	<income-share		1
		population	thous	0
		income	Million 1990US\$	0
	resid_building	[floor-space	billion	
		<price-exponent		

1. Right click on the Building grid.
2. Click Rural & Urban context menu, then segregate dialog pops up.
3. Enter desired urban shares.
4. Click OK.
5. Click Apply and Reload.

**This operation can be only applied to the reference scenario.**



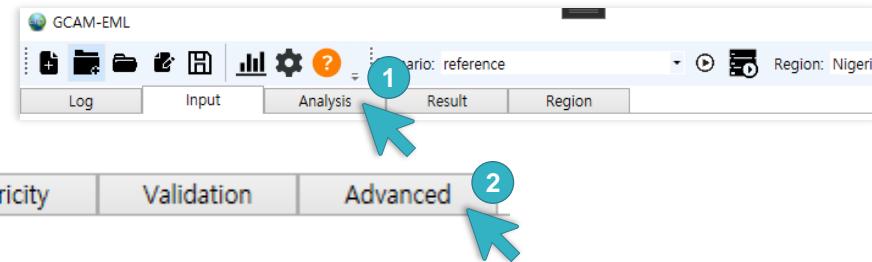
# Analysis tab: Transportation



1. Master table to show all the sectors/subsectors/technologies in transportation
2. Detail table to show all the parameters in the technology selected in the master table
3. Display the selected parameter in the chart
4. Shows various results in all the competing subsectors and technologies
  - Input/Output
  - Emission
  - Cost/Share/Share-weight



# Analysis tab: Advanced



Shows all the runtime values while running scenarios.

Provides useful data to develop and debug model and scenario.

1. Shows all the values related to the calibration process including share weight

2. Shows all parameters related to socioeconomic

3. Shows all parameters related to resource

4. Shows all parameters related to sector with a link diagram

5. Shows all parameters related to base service

6. Shows all parameters related to GCAM consumer

7. Shows all parameters of all market

# Analysis tab: Advanced

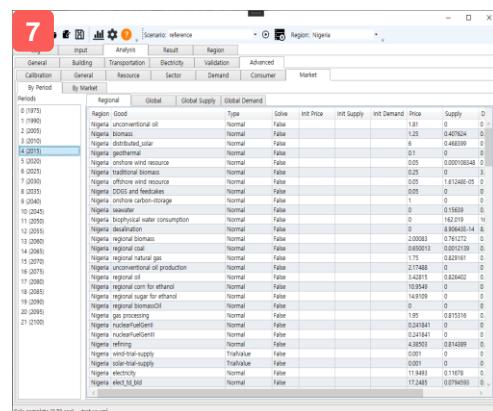
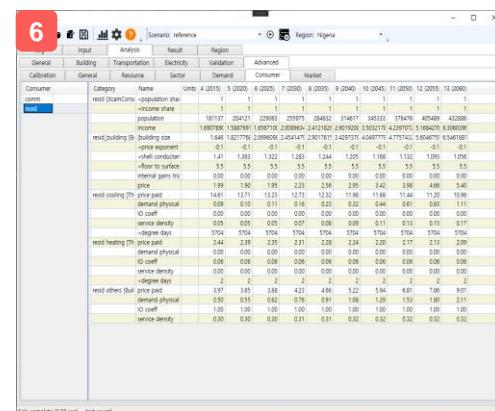
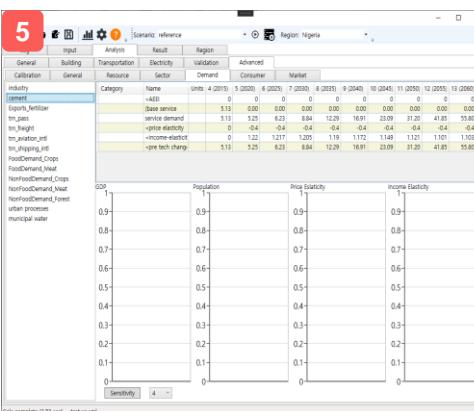


**1**

**2**

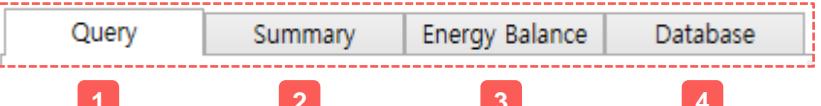
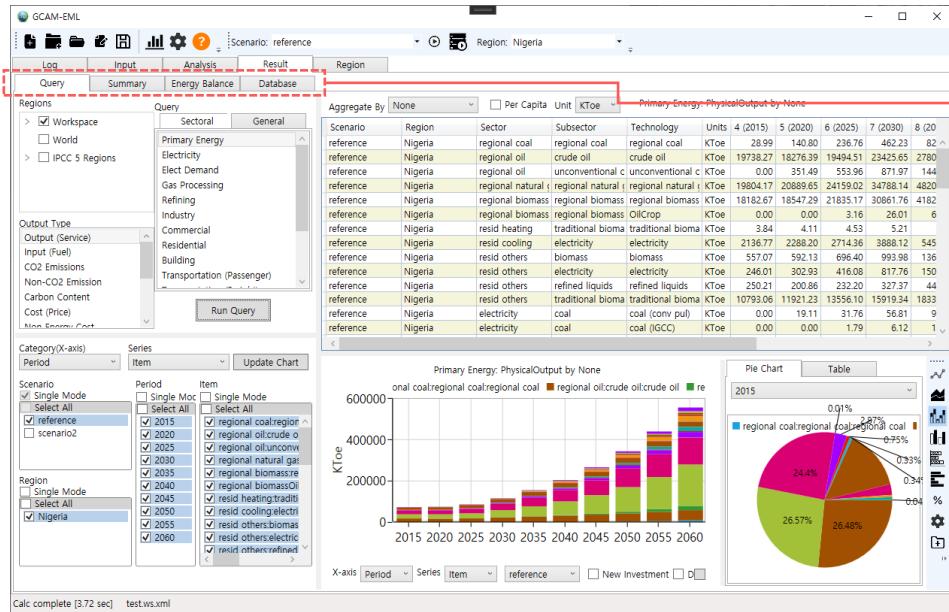
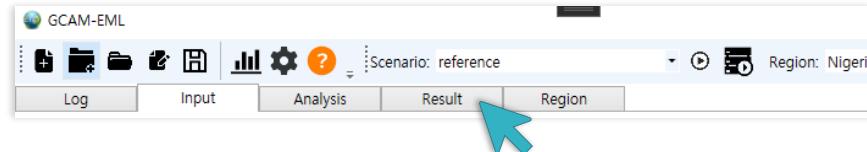
**3**

**4**



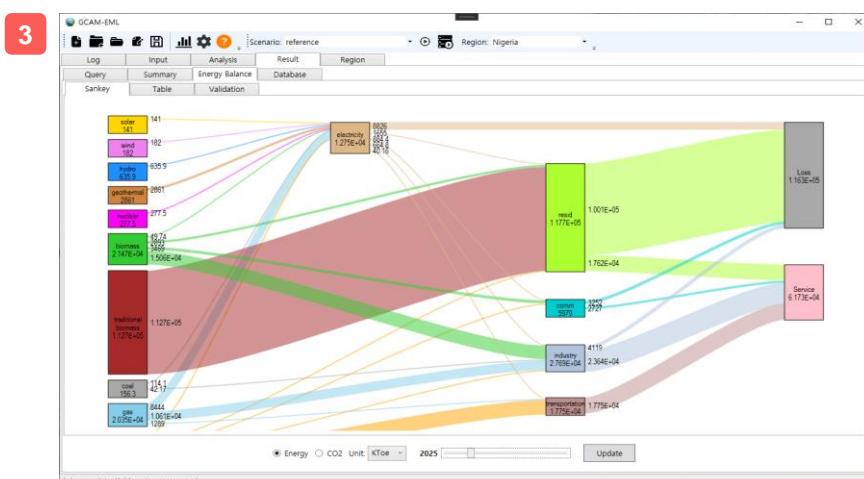
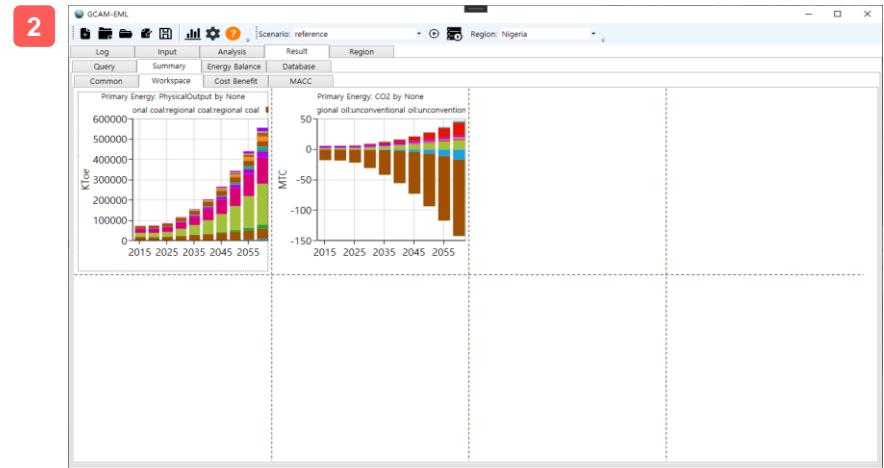
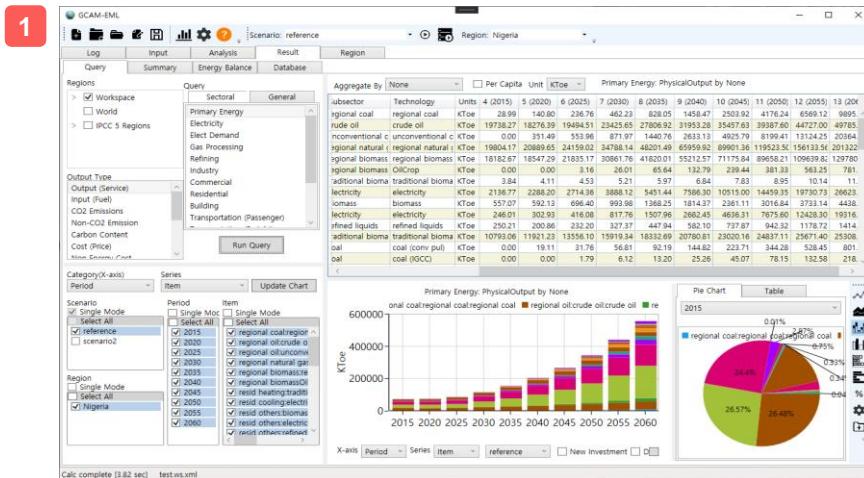
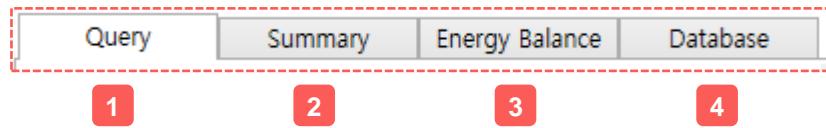
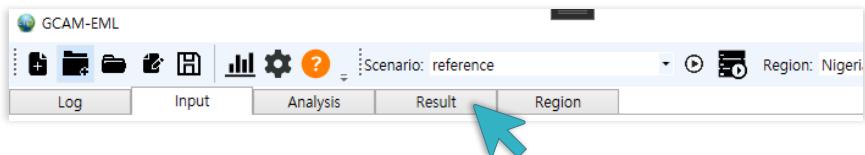
Calc complete (3.72 sec) test.ws.xml

# Result tab

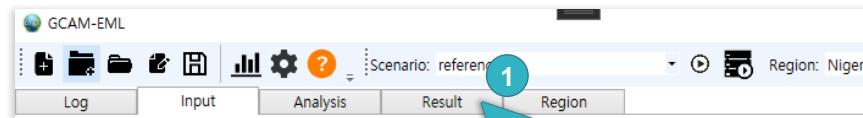


1. Query output data and display the result in the table and chart
2. Display charts as thumbnail grid which has been saved in the Query tab
3. Display energy/emission flow and energy balance table in IEA standard format
4. Display output database in master/detail table, allows to easily visualize massive xml data

## Result tab



# Result tab: Query

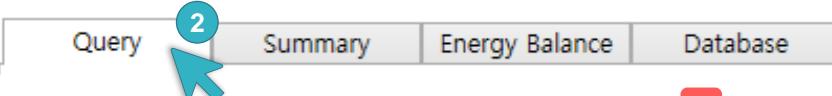


Regions  
1  
Workspace  
2  
IPCC 5 Regions

Output Type  
3  
CO2 Emissions  
4  
Non-CO2 Emission  
Carbon Content  
Cost (Price)  
Non-Energy Cost

Query  
4  
Sectoral General  
Primary Energy  
Electricity  
Elect Demand  
Gas Processing  
Refining  
Industry  
Commercial  
Residential  
Building  
Transportation (Passenger)

Run Query



- Procedure to query
1. Select Region(s)
  2. Select Output Type
  3. Select Query
  4. Click Run button

1  
2  
3  
4

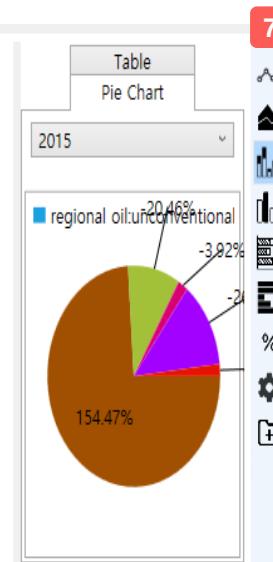
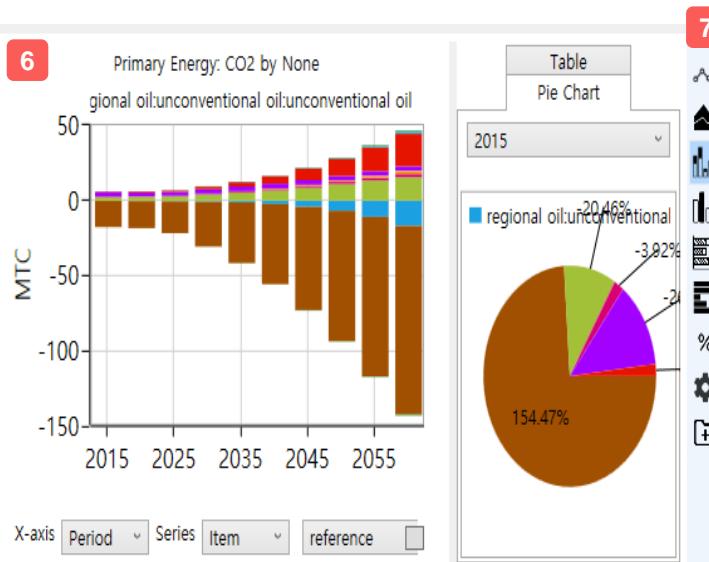
Aggregate By None  
Per Capita Unit KToe  
Primary Energy: CO2 by Nor

Source	Technology	Units	4 (2015)	5 (2020)	6 (2025)	7 (2030)	8 (2035)	9 (2040)
unconventional oil	unconventional oil	MTC	0.00	-0.29	-0.45	-0.72	-1.18	-1.65
regional biomass	regional biomass	MTC	-17.51	-17.86	-21.03	-29.72	-40.27	-50.00
regional biomass	OilCrop	MTC	0.00	0.00	-0.00	-0.02	-0.05	-0.08
iomass	biomass	MTC	2.32	2.41	2.79	3.90	5.28	7.00
refined liquids	refined liquids	MTC	0.44	0.35	0.40	0.55	0.74	0.90
coal	coal (conv pul)	MTC	0.00	0.05	0.09	0.15	0.24	0.30
coal	coal (IGCC)	MTC	0.00	0.00	0.00	0.02	0.03	0.05
gas	gas (steam/CT)	MTC	2.99	2.58	2.49	2.91	3.09	3.25
gas	gas (CC)	MTC	0.42	0.71	1.00	1.76	2.99	4.20
iomass	biomass (conv)	MTC	0.00	0.03	0.03	0.06	0.11	0.15
iomass	biomass (IGCC)	MTC	0.00	0.00	0.01	0.03	0.06	0.08
refined liquids	refined liquids (st)	MTC	0.00	0.00	0.00	0.00	0.00	0.00
refined liquids	refined liquids (C)	MTC	0.00	0.01	0.02	0.05	0.09	0.12

5  
Period  
Scenario  
Single Mode  
Select All  
reference  
scenario2  
Region  
Single Mode  
Select All  
Nigeria

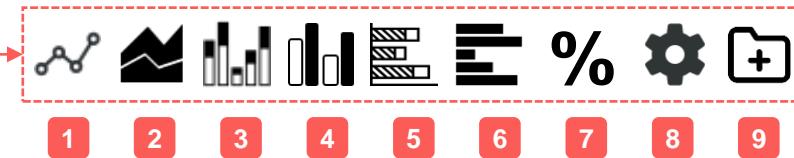
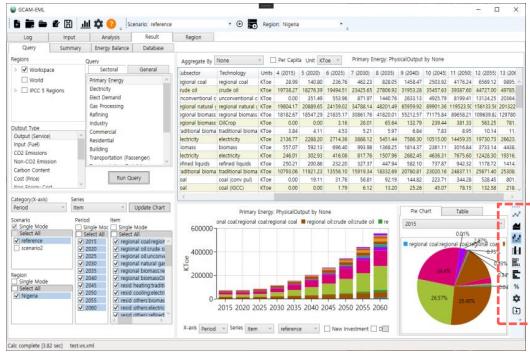
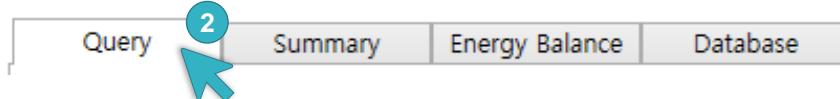
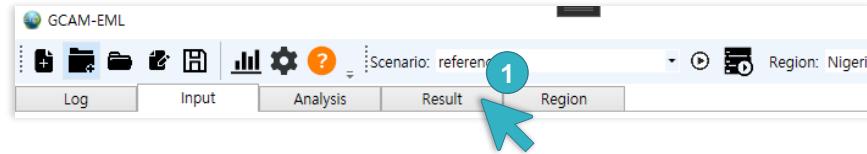
6  
Period  
Item  
Scenario  
Single Mode  
Select All  
reference  
scenario2  
Region  
Single Mode  
Select All  
Nigeria

선택적  
용안됨



1. Select Aggregate Type
2. Check Per Capita for per capita result
3. Select a desired unit
4. Query result table
5. Filter data for drawing chart
6. Display chart
7. Change chart type and chart property

# Result tab: Query



1. Line chart

2. Area cart

3. Stacked column bar chart

4. Side by side bar chart

5. Stacked bar chart

6. Horizontal side by side bar chart

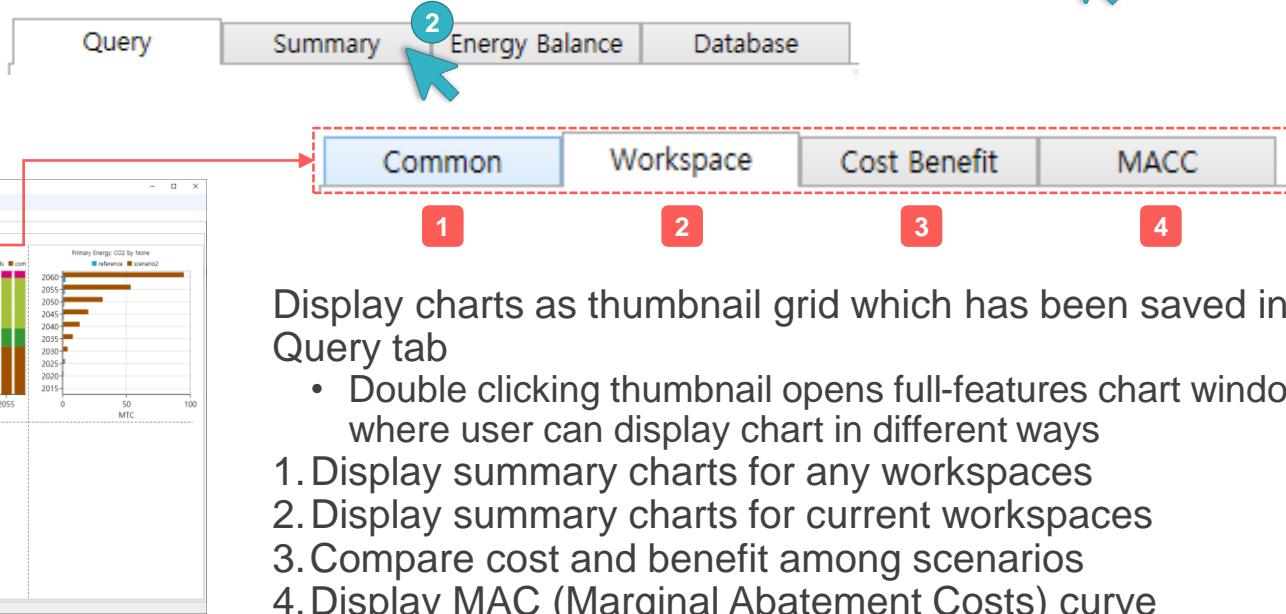
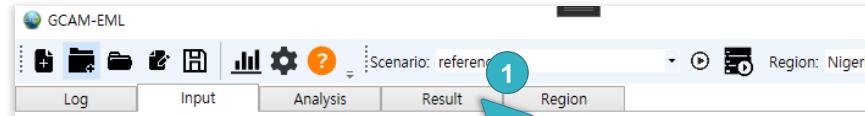
7. 100% toggle button

- On: 100% chart such as a 100% stacked bar or area chart

8. Chart option

9. Save chart as thumbnail which is displayed in Summary

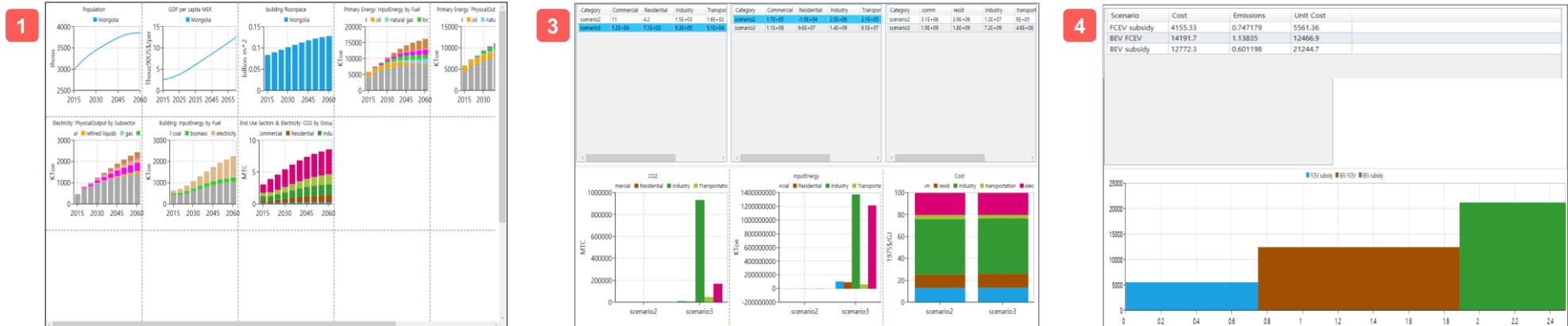
# Result tab: Summary



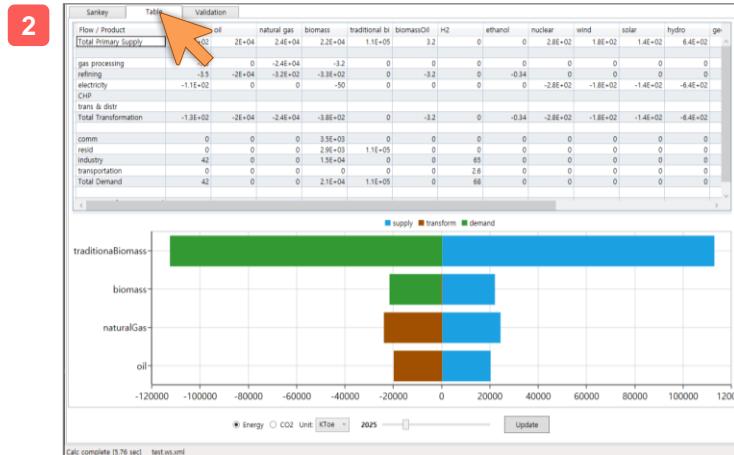
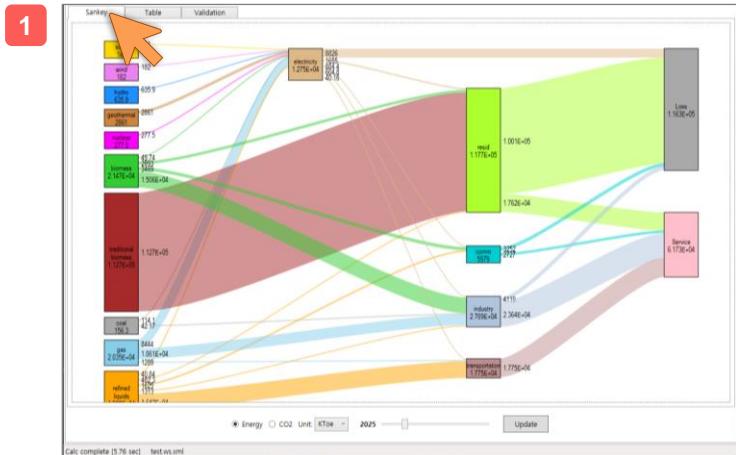
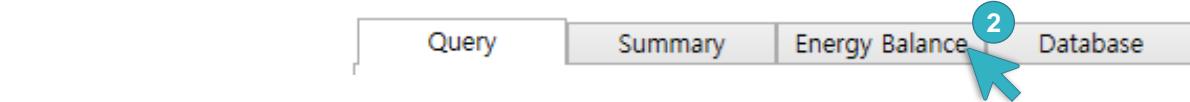
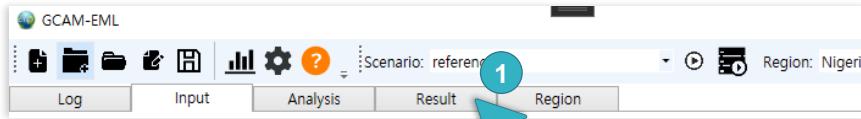
Display charts as thumbnail grid which has been saved in the Query tab

- Double clicking thumbnail opens full-features chart window where user can display chart in different ways

1. Display summary charts for any workspaces
2. Display summary charts for current workspaces
3. Compare cost and benefit among scenarios
4. Display MAC (Marginal Abatement Costs) curve



# Result tab: Energy Balance



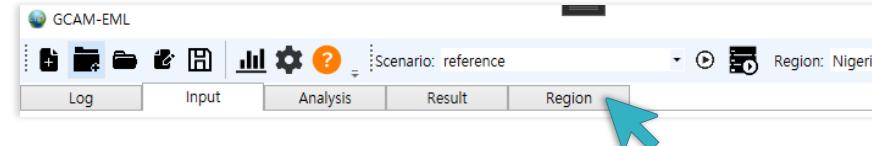
- Display energy/emission flow in the Sankey chart
- Display energy balance table in IEA standard format

Flow

Flow / Product	coal	oil	natural gas	biomass	traditio	biomassOil	H2	ethanol	nuclear	wind	solar	hydro	geother	electricity	refined liquic	gas	Total
Total Primary Supply	3.36166	4.97034	1.64545	0.229547	0	0.0180285	0	0	1.73898	0.00471666	0.0139707	0.0134388	0	0	0	0	1.6566
gas processing	0	0	-1.64545	-0.0102866	0	0	0	0	0	0	0	0	0	0	0	0	-0.6166
refining	0	-4.97034	0	0	0	-0.0180285	0	0	0	0	0	0	0	-0.0407914	4.55184	-0.001008	
electricity	-2.01955	0	0	-0.022518	0	0	0	0	-1.73898	-0.00471666	-0.0139707	-0.0134388	0	1.83899	-0.0920336	-0.7523	
CHP															0.0928584		
trans & distr															-0.15092		
Total Transformation	-2.01955	-4.97034	-1.64545	-0.0328046	0	-0.0180285	0	0	-1.73898	-0.00471666	-0.0139707	-0.0134388	0	1.74014	4.4598	0.899762	-3.35758
comm	0	0	0	0.0589617	0	0	0	0	0	0	0	0	0	0.547533	0.154978	0.157288	0.918762
resid	0.0274183	0	0	0.0112579	0	0	0	0	0	0	0	0	0	0.2294	0.128729	0.3427	0.739505
industry	1.3147	0	0	0.126523	0	0	0	0	0	0	0	0	0	0.996005	2.2366	0.351056	5.02488
transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00798658	1.93949	0.0487216	1.9962
Total Demand	1.34211	0	0	0.196742	0	0	0	0	0	0	0	0	0	1.78093	4.4598	0.899766	8.67935
TPS + Transform - Demand	-6.3E-06	0	0	-8.5E-08	0	0	0	0	0	0	0	0	0	-0.0407904	6.545E-06	-4.469E-06	-0.0407947

This row should be 0

# Region tab



Manage regions using interactive map

- World
- IPCC 5 Regions
- GCAM 32 Regions
- Custom

