February 12, 2025

Demo for Biofuels in R&D GREET®

3:00-4:00 p.m. CT

Instructors

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Argonne National Laboratory Subject Matter Experts

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Main Outputs for SI-ICE LDVs and CIDI-ICE LDVs

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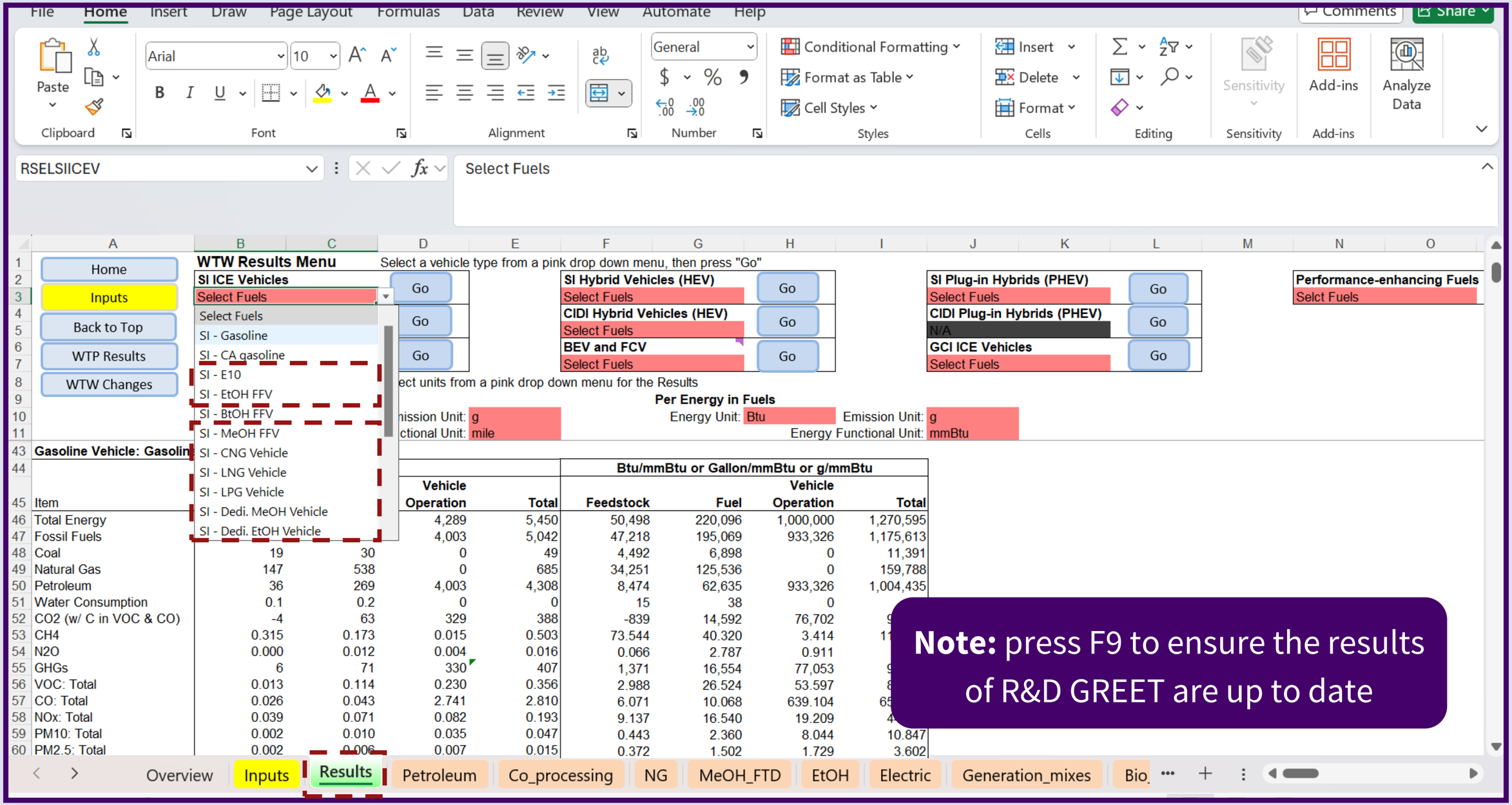

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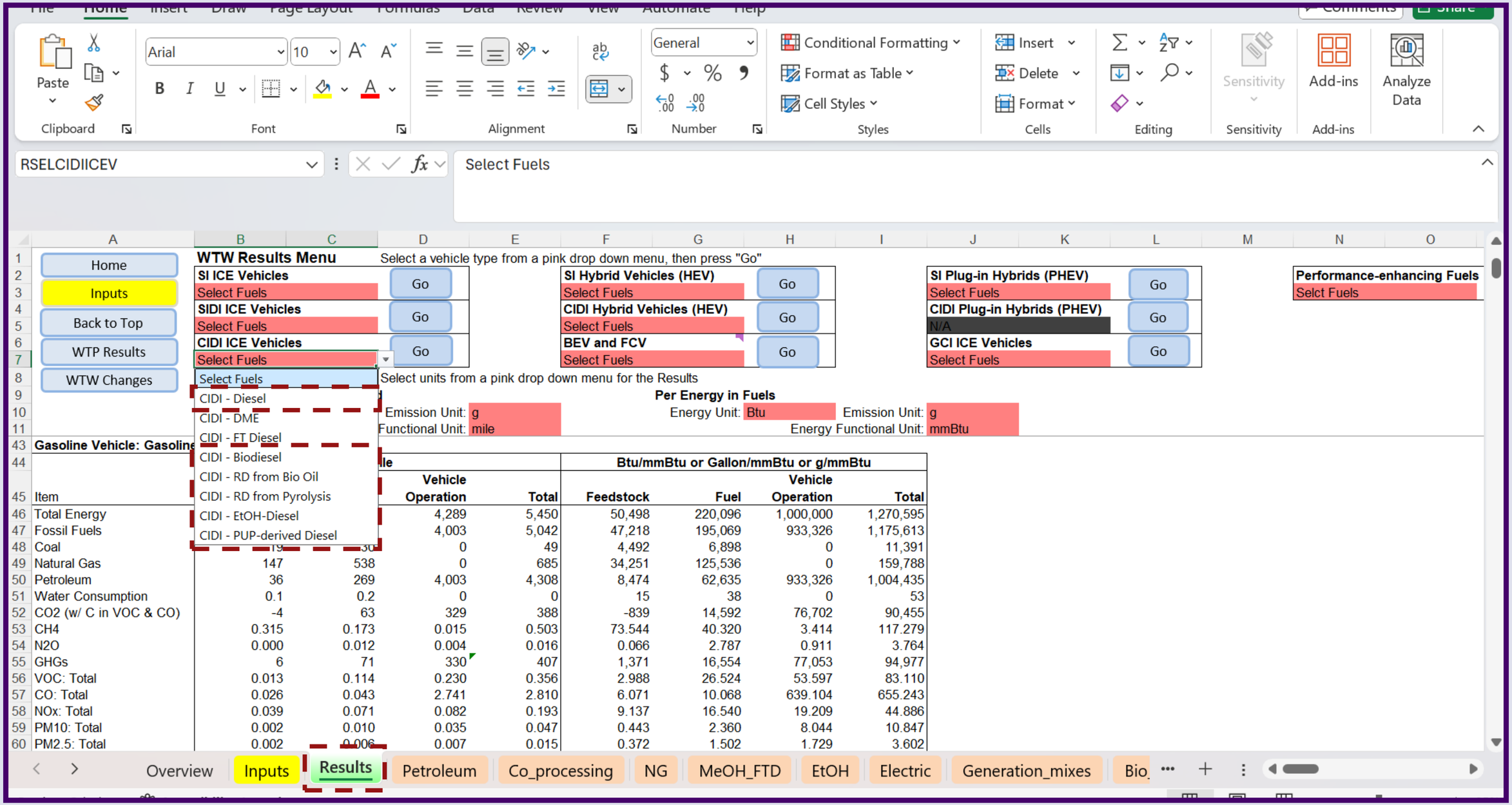

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Ethanol Overview

Find the General Settings to Alter an Ethanol Pathway

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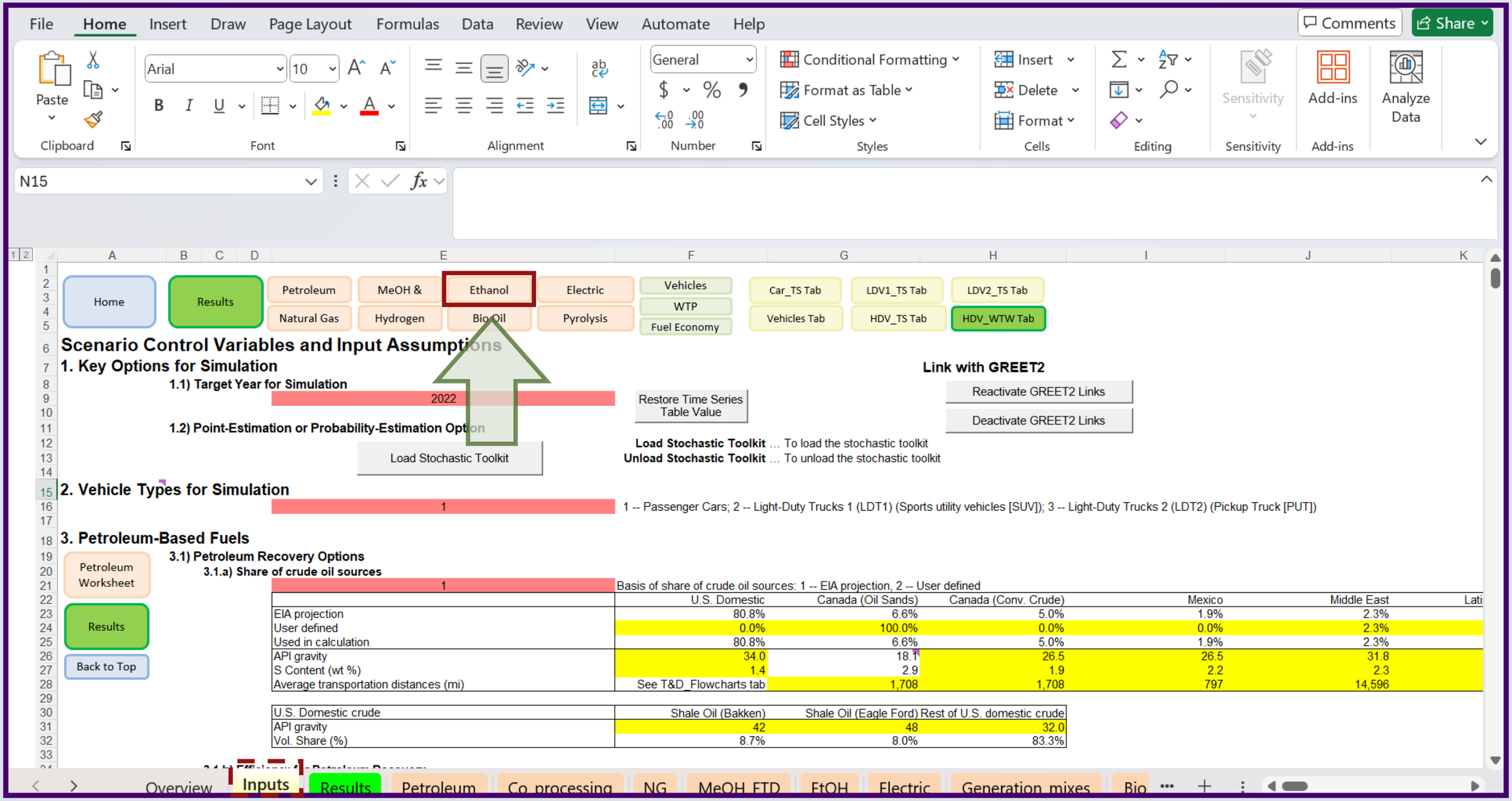

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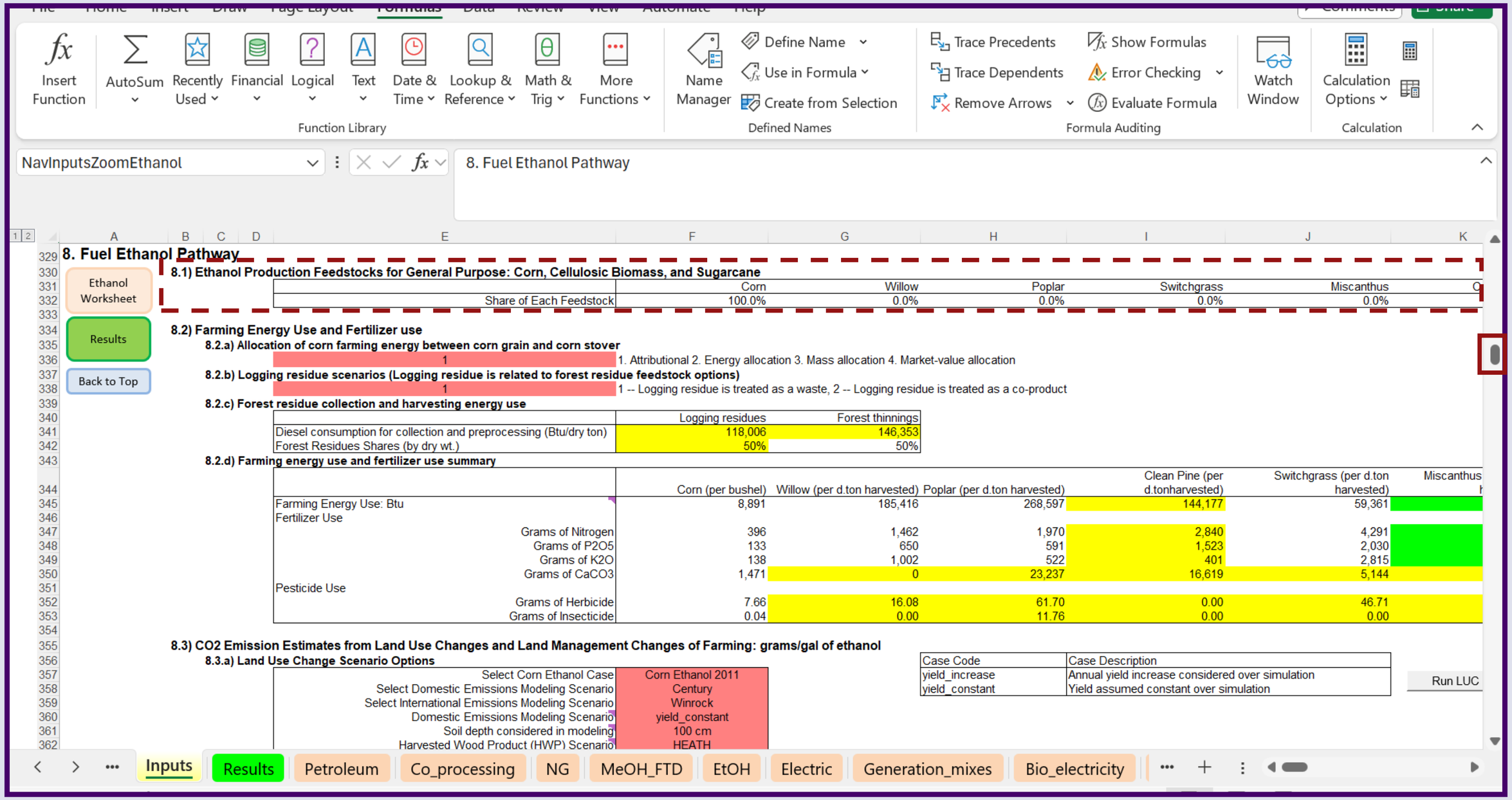

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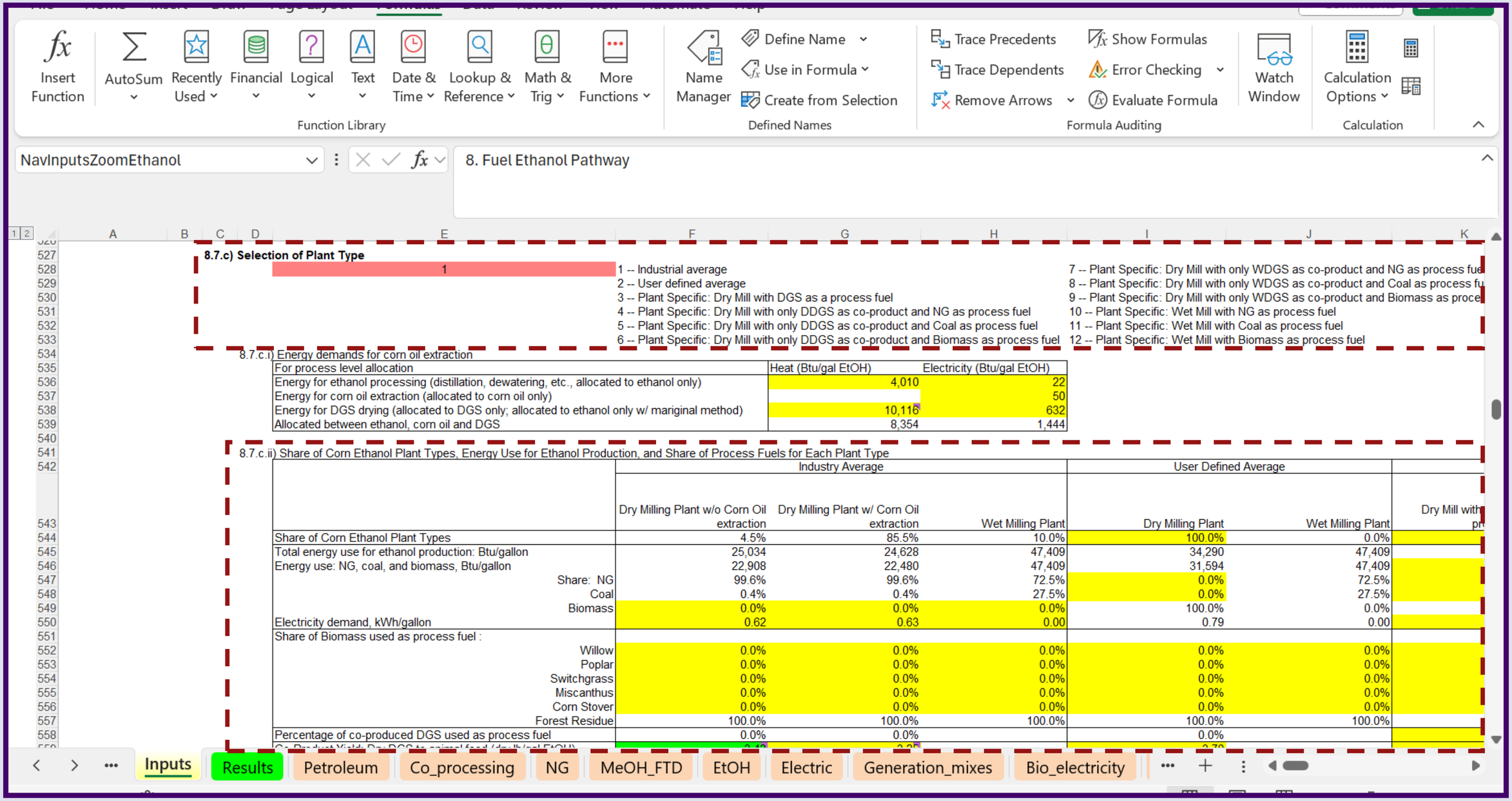

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Name Manager | Define Name | Use in Formula | Create from Selection | Defined Names
Trace Precedents | Trace Dependents | Remove Arrows | Show Formulas | Error Checking | Evaluate Formula | Formula Auditing
Watch Window
Calculation Options | Calculation

NavInputsZoomEthanol

8. Fuel Ethanol Pathway

8.7.c) Selection of Plant Type

1

1 -- Industrial average
2 -- User defined average
3 -- Plant Specific: Dry Mill with DGS as a process fuel
4 -- Plant Specific: Dry Mill with only DDGS as co-product and NG as process fuel
5 -- Plant Specific: Dry Mill with only DDGS as co-product and Coal as process fuel
6 -- Plant Specific: Dry Mill with only DDGS as co-product and Biomass as process fuel
7 -- Plant Specific: Dry Mill with only WDGS as co-product and NG as process fue
8 -- Plant Specific: Dry Mill with only WDGS as co-product and Coal as process fu
9 -- Plant Specific: Dry Mill with only WDGS as co-product and Biomass as proce
10 -- Plant Specific: Wet Mill with NG as process fuel
11 -- Plant Specific: Wet Mill with Coal as process fuel
12 -- Plant Specific: Wet Mill with Biomass as process fuel

8.7.c.i) Energy demands for corn oil extraction

For process level allocation	Heat (Btu/gal EtOH)	Electricity (Btu/gal EtOH)
Energy for ethanol processing (distillation, dewatering, etc., allocated to ethanol only)	4,010	22
Energy for corn oil extraction (allocated to corn oil only)		50
Energy for DGS drying (allocated to DGS only; allocated to ethanol only w/ mariginal method)	10,116	632
Allocated between ethanol, corn oil and DGS	8,354	1,444

8.7.c.ii) Share of Corn Ethanol Plant Types, Energy Use for Ethanol Production, and Share of Process Fuels for Each Plant Type

	Industry Average			User Defined Average		
	Dry Milling Plant w/o Corn Oil extraction	Dry Milling Plant w/ Corn Oil extraction	Wet Milling Plant	Dry Milling Plant	Wet Milling Plant	Dry Mill with pr
Share of Corn Ethanol Plant Types	4.5%	85.5%	10.0%	100.0%	0.0%	
Total energy use for ethanol production: Btu/gallon	25,034	24,628	47,409	34,290	47,409	
Energy use: NG, coal, and biomass, Btu/gallon	22,908	22,480	47,409	31,594	47,409	
Share: NG	99.6%	99.6%	72.5%	0.0%	72.5%	
Coal	0.4%	0.4%	27.5%	0.0%	27.5%	
Biomass	0.0%	0.0%	0.0%	100.0%	0.0%	
Electricity demand, kWh/gallon	0.62	0.63	0.00	0.79	0.00	
Share of Biomass used as process fuel :						
Willow	0.0%	0.0%	0.0%	0.0%	0.0%	
Poplar	0.0%	0.0%	0.0%	0.0%	0.0%	
Switchgrass	0.0%	0.0%	0.0%	0.0%	0.0%	
Miscanthus	0.0%	0.0%	0.0%	0.0%	0.0%	
Corn Stover	0.0%	0.0%	0.0%	0.0%	0.0%	
Forest Residue	100.0%	100.0%	100.0%	100.0%	100.0%	
Percentage of co-produced DGS used as process fuel	0.0%	0.0%		0.0%		

Inputs | Results | Petroleum | Co_processing | NG | MeOH_FTD | EtOH | Electric | Generation_mixes | Bio_electricity

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Further Explore Ethanol Scenarios

Ethanol tabs

Primary

Ethanol

Some Secondary

Ag_Inputs

RNG

NG

Inputs

Results

Fuel_Prod_TS

Fuel_Specs

Electricity

Car_TS

Vehicles

EF

T&D

T&D Flowcharts

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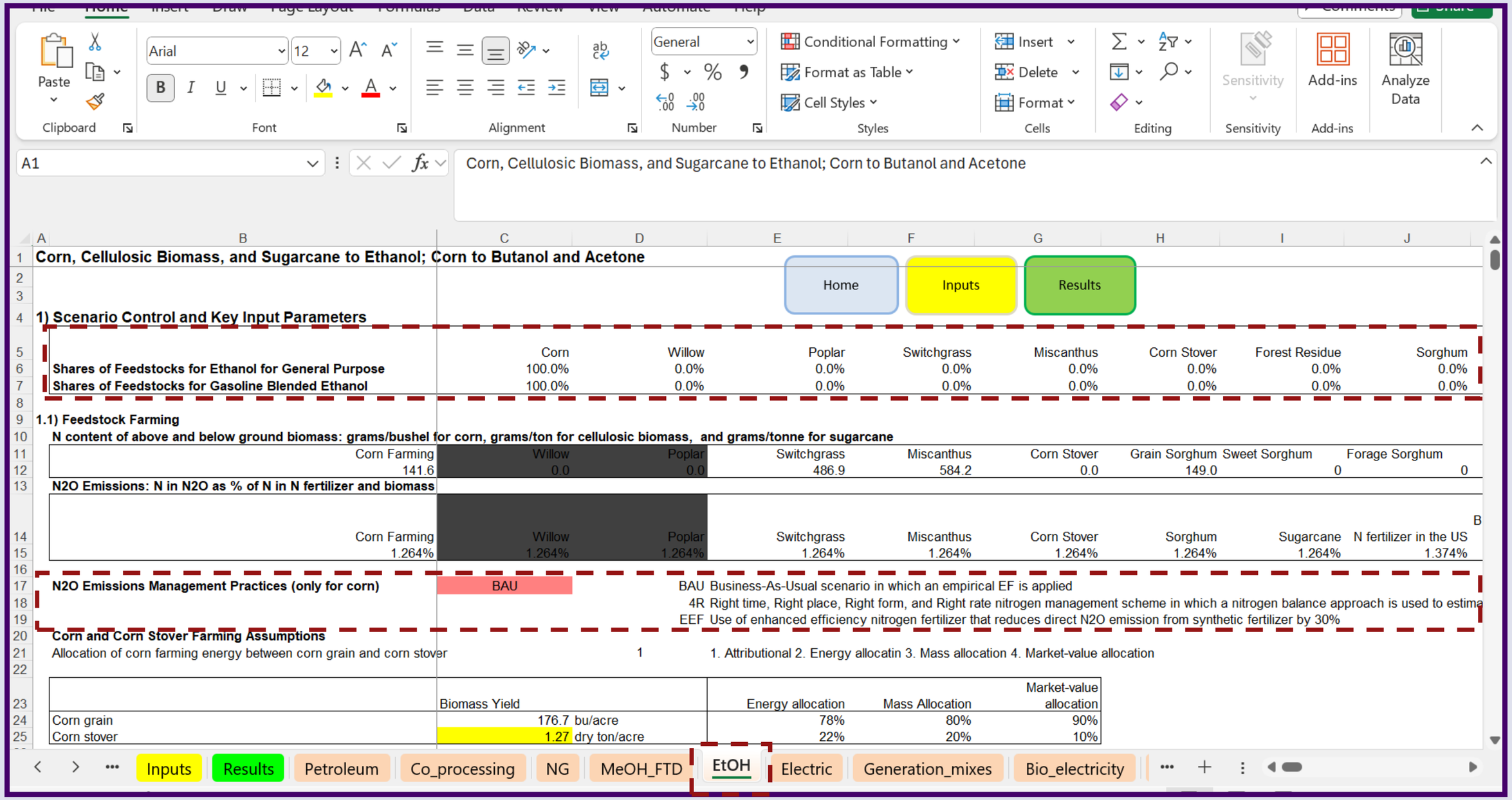

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Biodiesel and Renewable Diesel Overview

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General Settings to Alter a Biodiesel or Renewable Diesel Pathway

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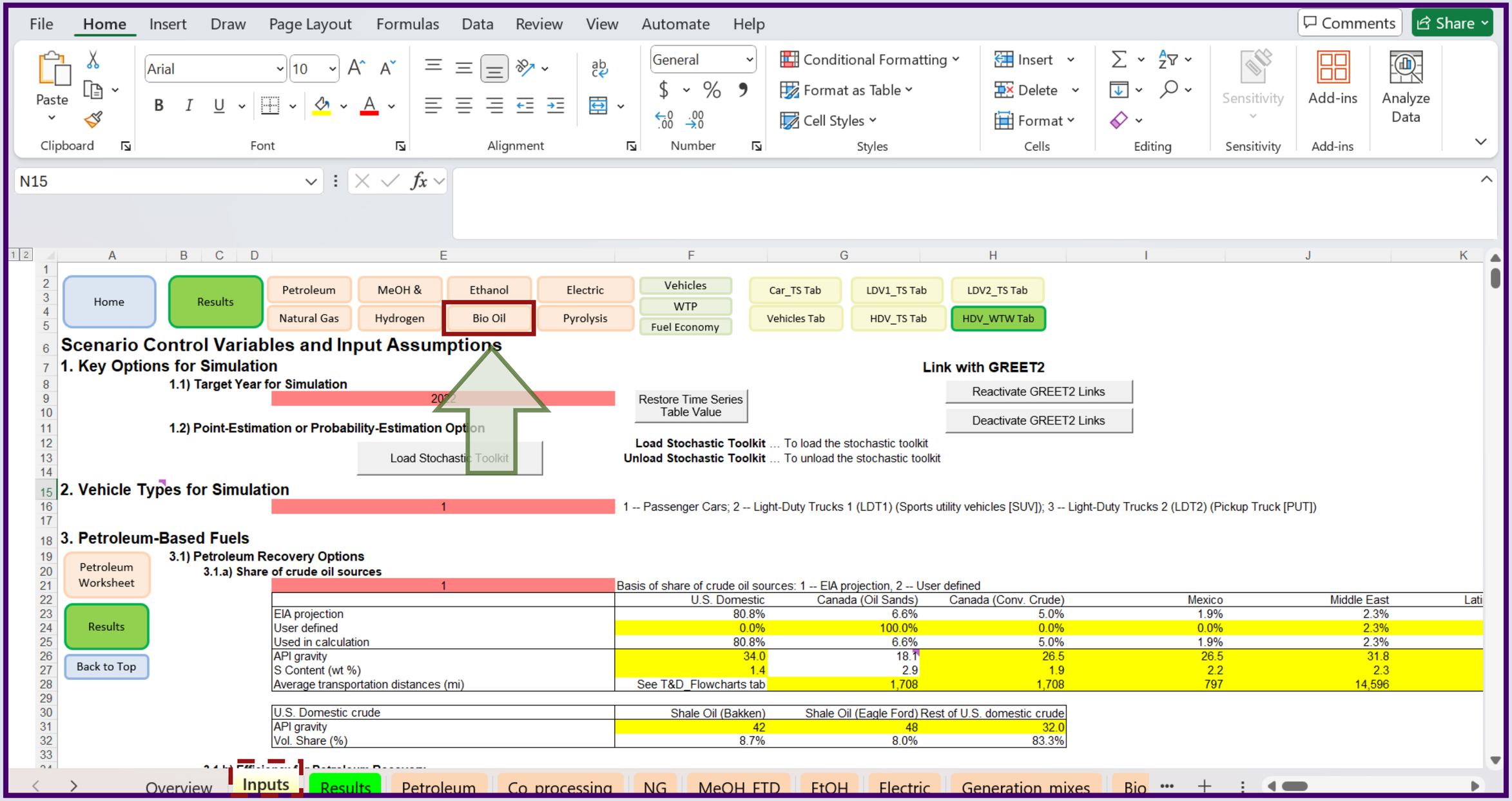

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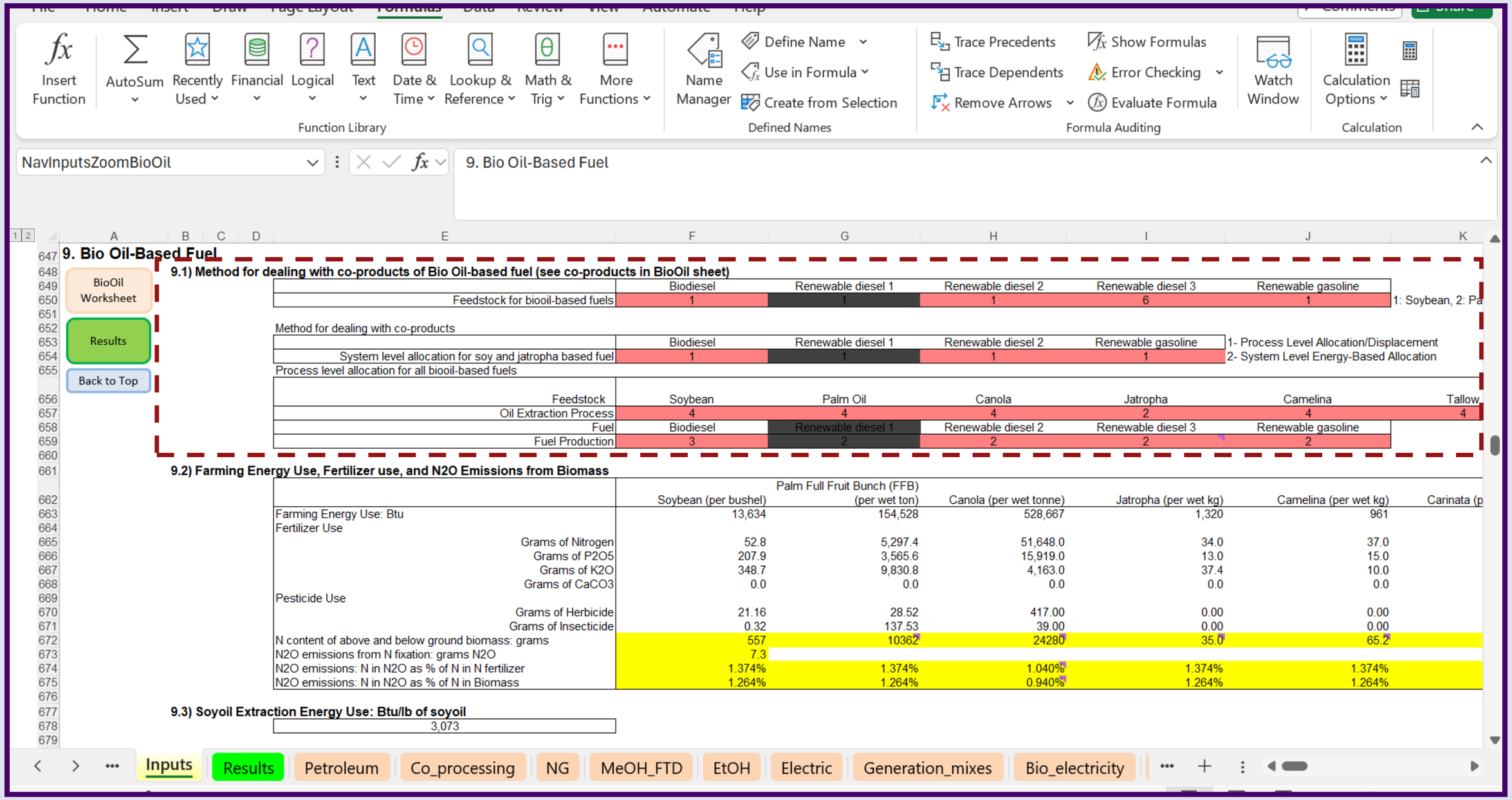

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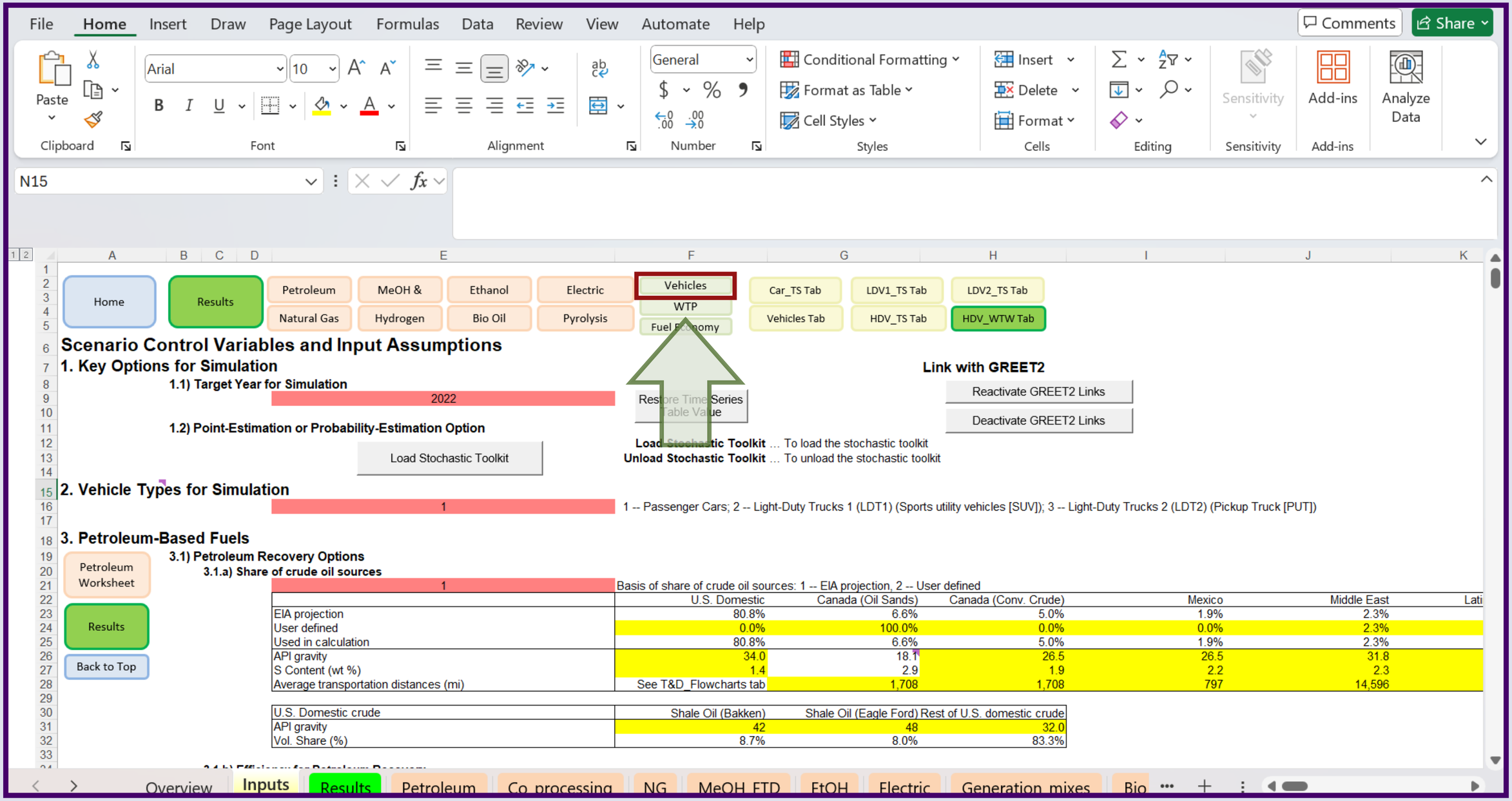

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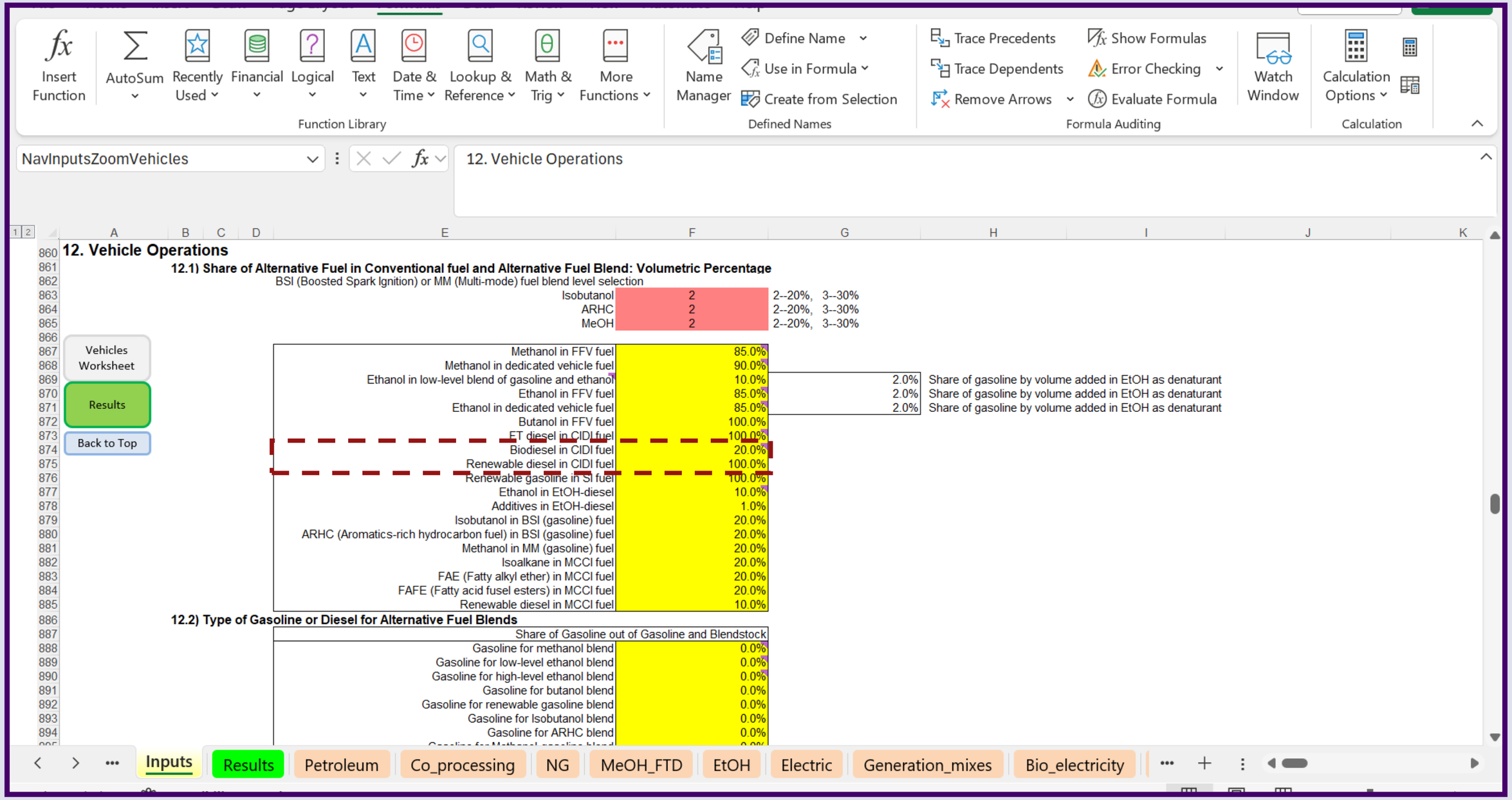

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Further Explore Biodiesel and Renewable Diesel Scenarios

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Biodiesel and renewable diesel tabs

Primary

BioOil

Some Secondary

RNG

NG

Ag_Inputs

Inputs

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Fuel_Prod_TS

Fuel_Specs

Electricity

Car_TS

Vehicles

EF

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T&D Flowcharts

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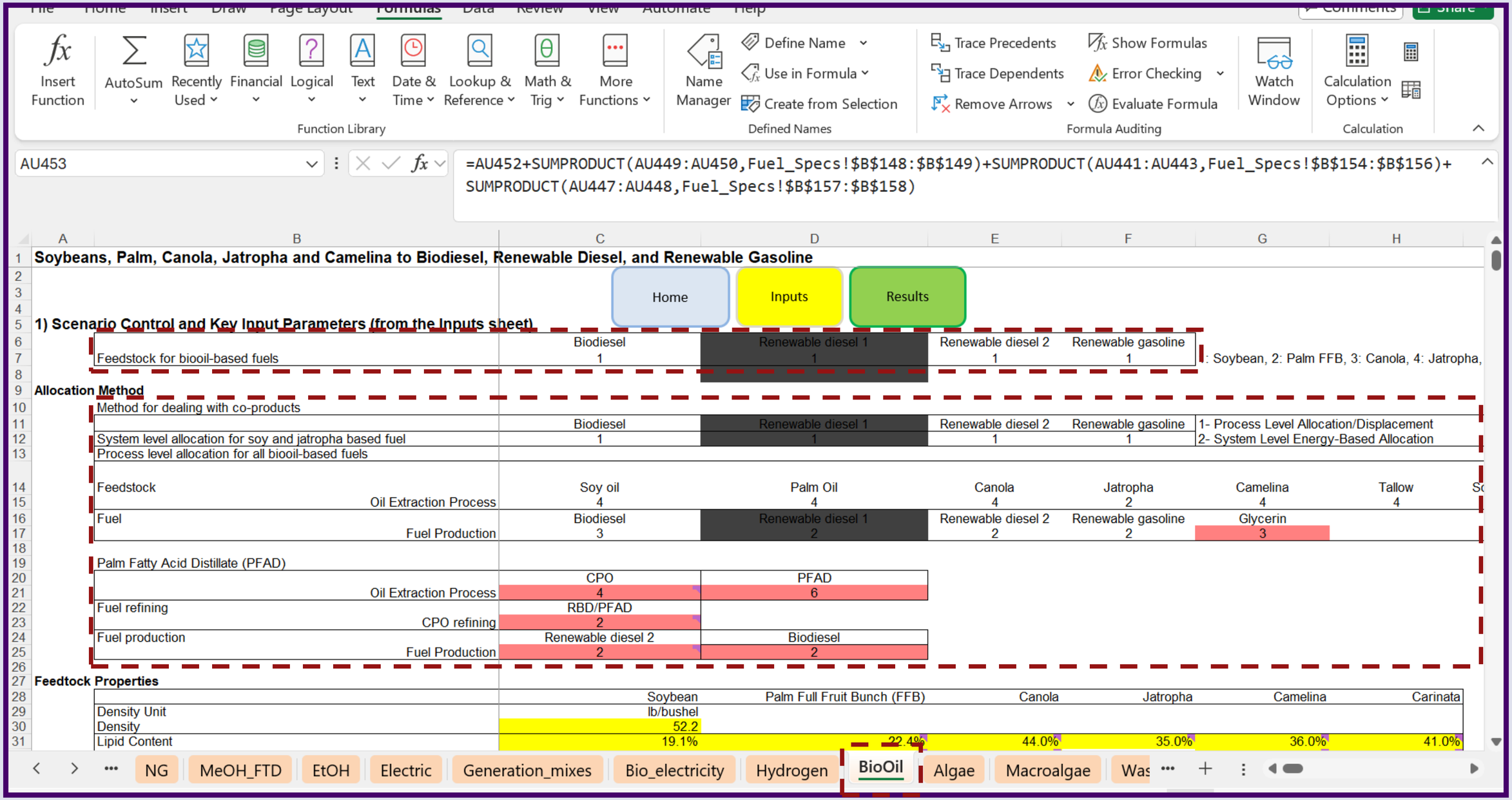

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Renewable Natural Gas Overview

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General Settings to Alter a Renewable Natural Gas Pathway

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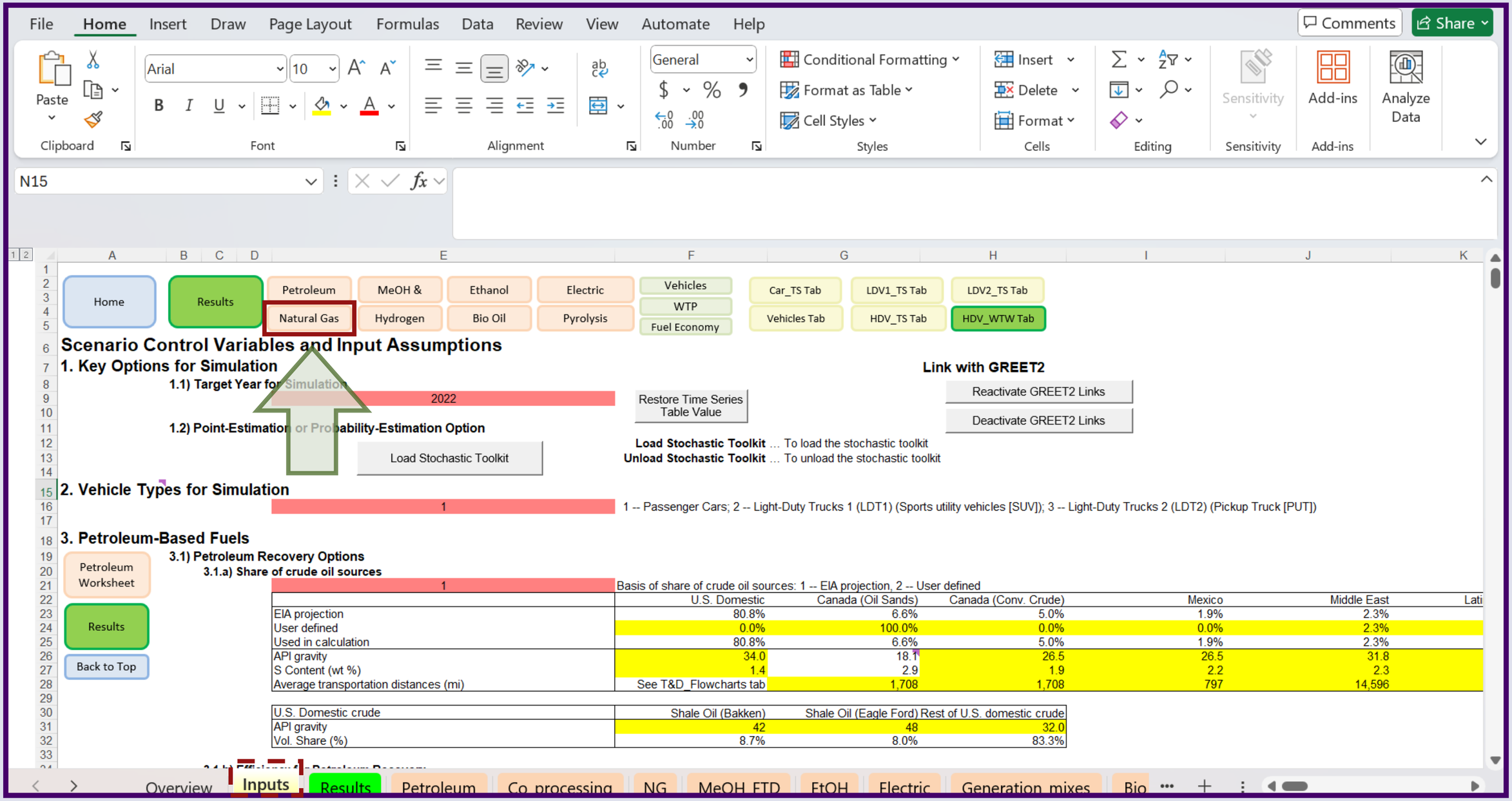

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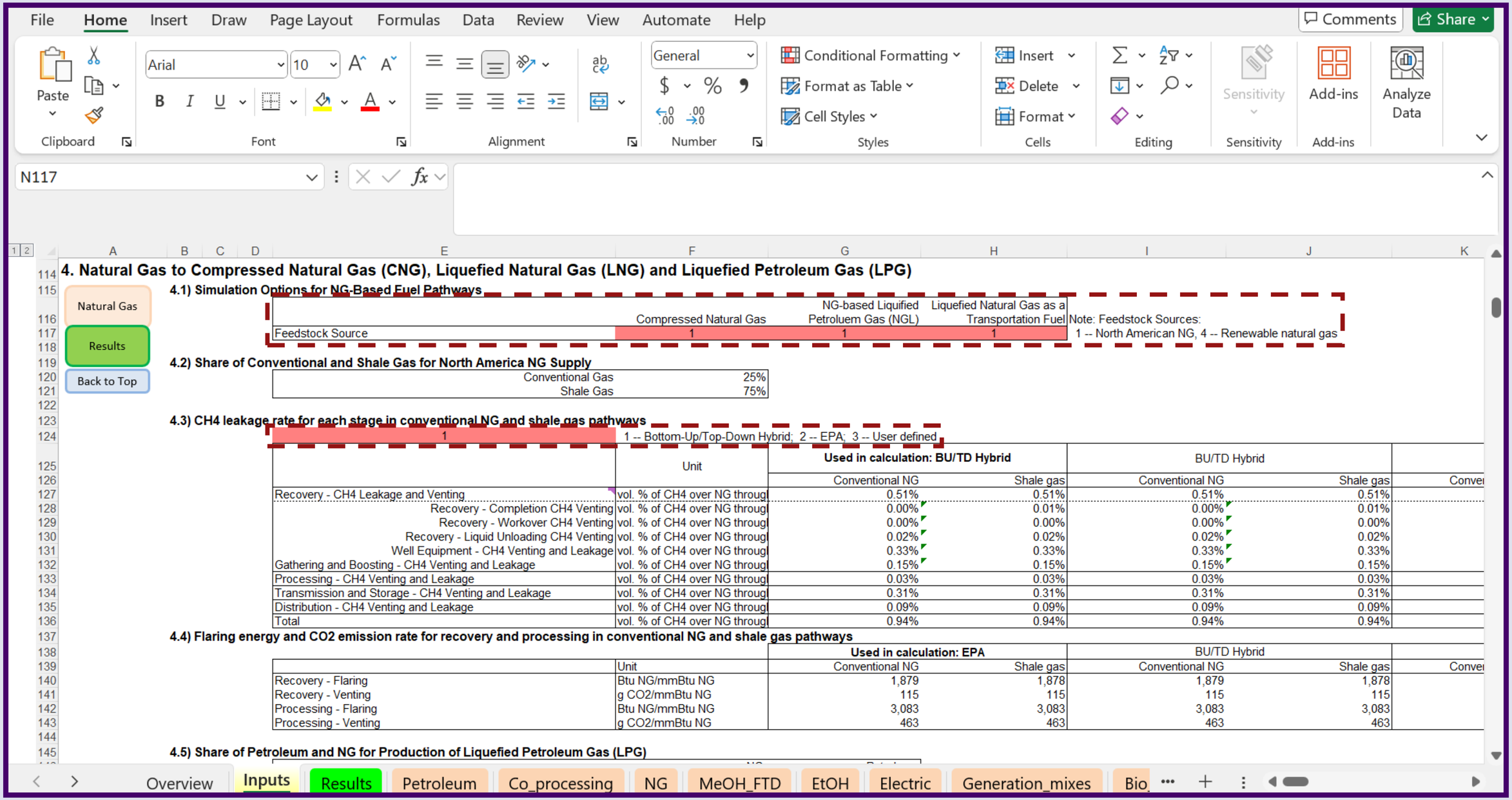

4. Natural Gas to Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LPG)

Natural Gas | Results | Back to Top

4.1) Simulation Options for NG-Based Fuel Pathways

	Compressed Natural Gas	NG-based Liquified Petroluem Gas (NGL)	Liquefied Natural Gas as a Transportation Fuel
Feedstock Source	1	1	1

Note: Feedstock Sources: 1 -- North American NG, 4 -- Renewable natural gas

4.2) Share of Conventional and Shale Gas for North America NG Supply

Conventional Gas	25%
Shale Gas	75%

4.3) CH4 leakage rate for each stage in conventional NG and shale gas pathways

1 (1 -- Bottom-Up/Top-Down Hybrid; 2 -- EPA; 3 -- User defined)

	Unit	Used in calculation: BU/TD Hybrid		BU/TD Hybrid		
		Conventional NG	Shale gas	Conventional NG	Shale gas	Conver
Recovery - CH4 Leakage and Venting	vol. % of CH4 over NG throug	0.51%	0.51%	0.51%	0.51%	
Recovery - Completion CH4 Venting	vol. % of CH4 over NG throug	0.00%	0.01%	0.00%	0.01%	
Recovery - Workover CH4 Venting	vol. % of CH4 over NG throug	0.00%	0.00%	0.00%	0.00%	
Recovery - Liquid Unloading CH4 Venting	vol. % of CH4 over NG throug	0.02%	0.02%	0.02%	0.02%	
Well Equipment - CH4 Venting and Leakage	vol. % of CH4 over NG throug	0.33%	0.33%	0.33%	0.33%	
Gathering and Boosting - CH4 Venting and Leakage	vol. % of CH4 over NG throug	0.15%	0.15%	0.15%	0.15%	
Processing - CH4 Venting and Leakage	vol. % of CH4 over NG throug	0.03%	0.03%	0.03%	0.03%	
Transmission and Storage - CH4 Venting and Leakage	vol. % of CH4 over NG throug	0.31%	0.31%	0.31%	0.31%	
Distribution - CH4 Venting and Leakage	vol. % of CH4 over NG throug	0.09%	0.09%	0.09%	0.09%	
Total	vol. % of CH4 over NG throug	0.94%	0.94%	0.94%	0.94%	

4.4) Flaring energy and CO2 emission rate for recovery and processing in conventional NG and shale gas pathways

	Unit	Used in calculation: EPA		BU/TD Hybrid		
		Conventional NG	Shale gas	Conventional NG	Shale gas	Conver
Recovery - Flaring	Btu NG/mmBtu NG	1,879	1,878	1,879	1,878	
Recovery - Venting	g CO2/mmBtu NG	115	115	115	115	
Processing - Flaring	Btu NG/mmBtu NG	3,083	3,083	3,083	3,083	
Processing - Venting	g CO2/mmBtu NG	463	463	463	463	

4.5) Share of Petroleum and NG for Production of Liquefied Petroleum Gas (LPG)

Overview | Inputs | Results | Petroleum | Co_processing | NG | MeOH_FTD | EtOH | Electric | Generation_mixes | Bio

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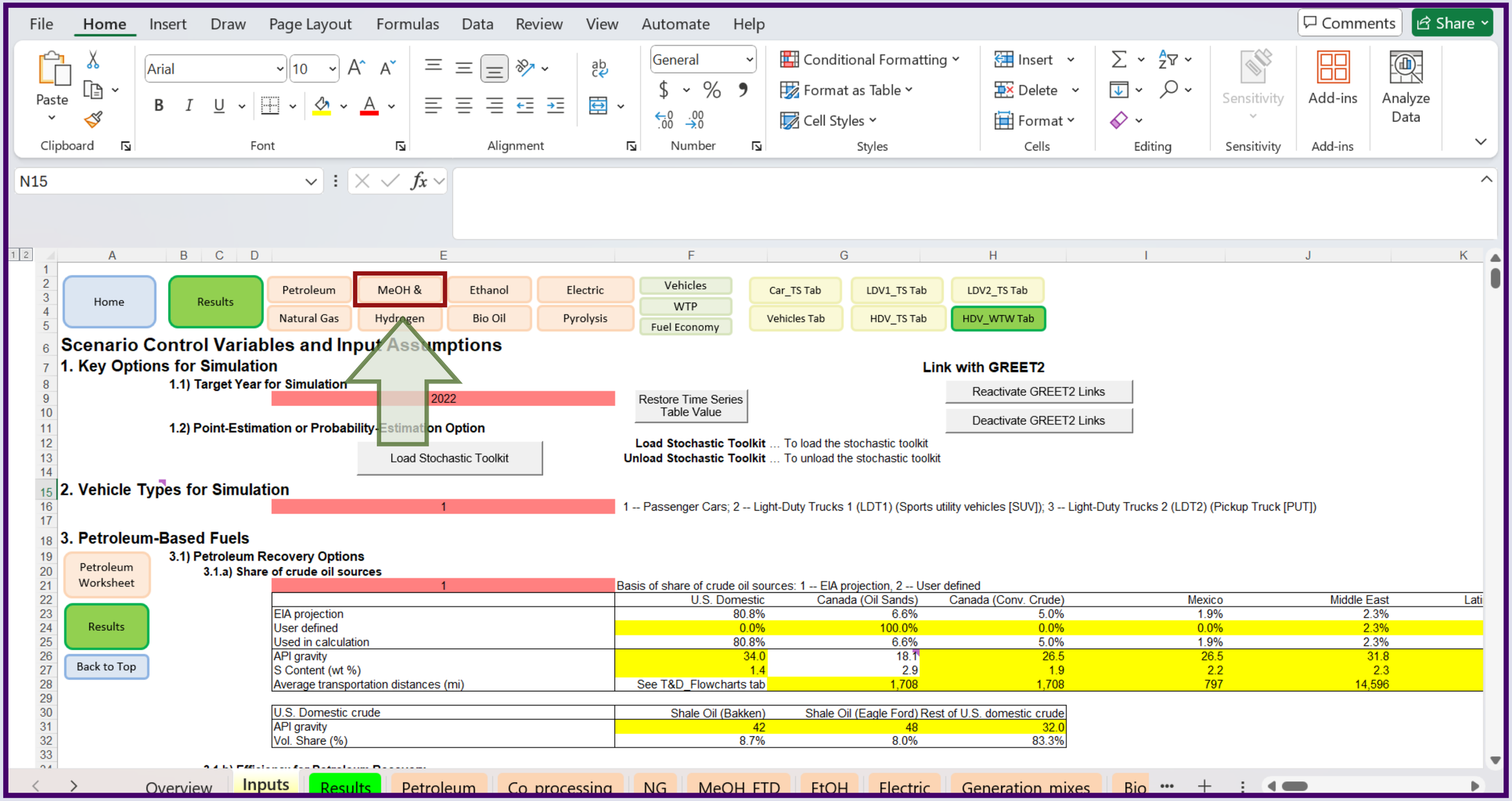

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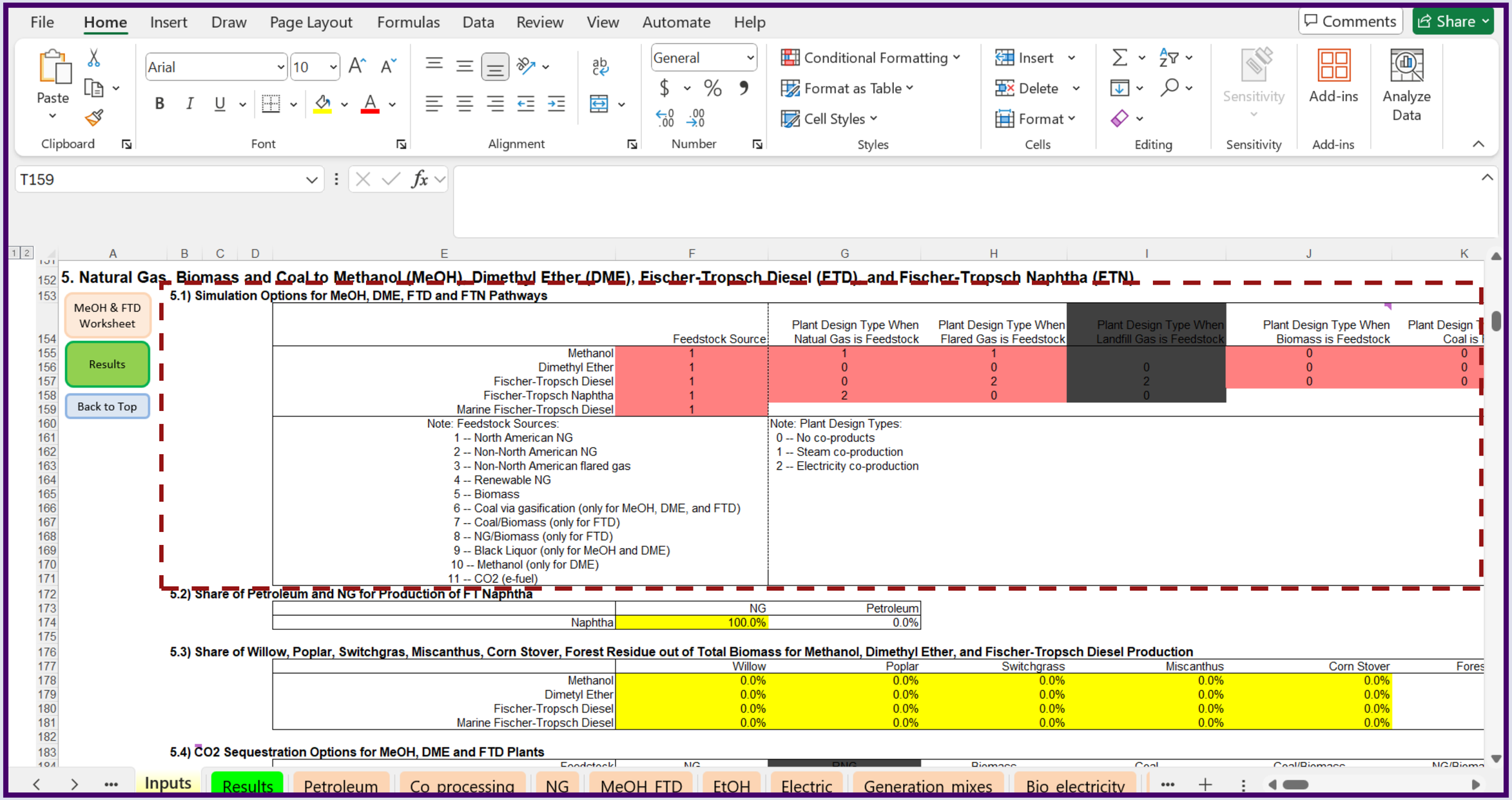

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Further Explore Renewable Natural Gas Scenarios

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Renewable natural gas fuels tabs

Primary

Waste

RNG

Some Secondary

NG

BioOil

MeOH_FTD

EtOH

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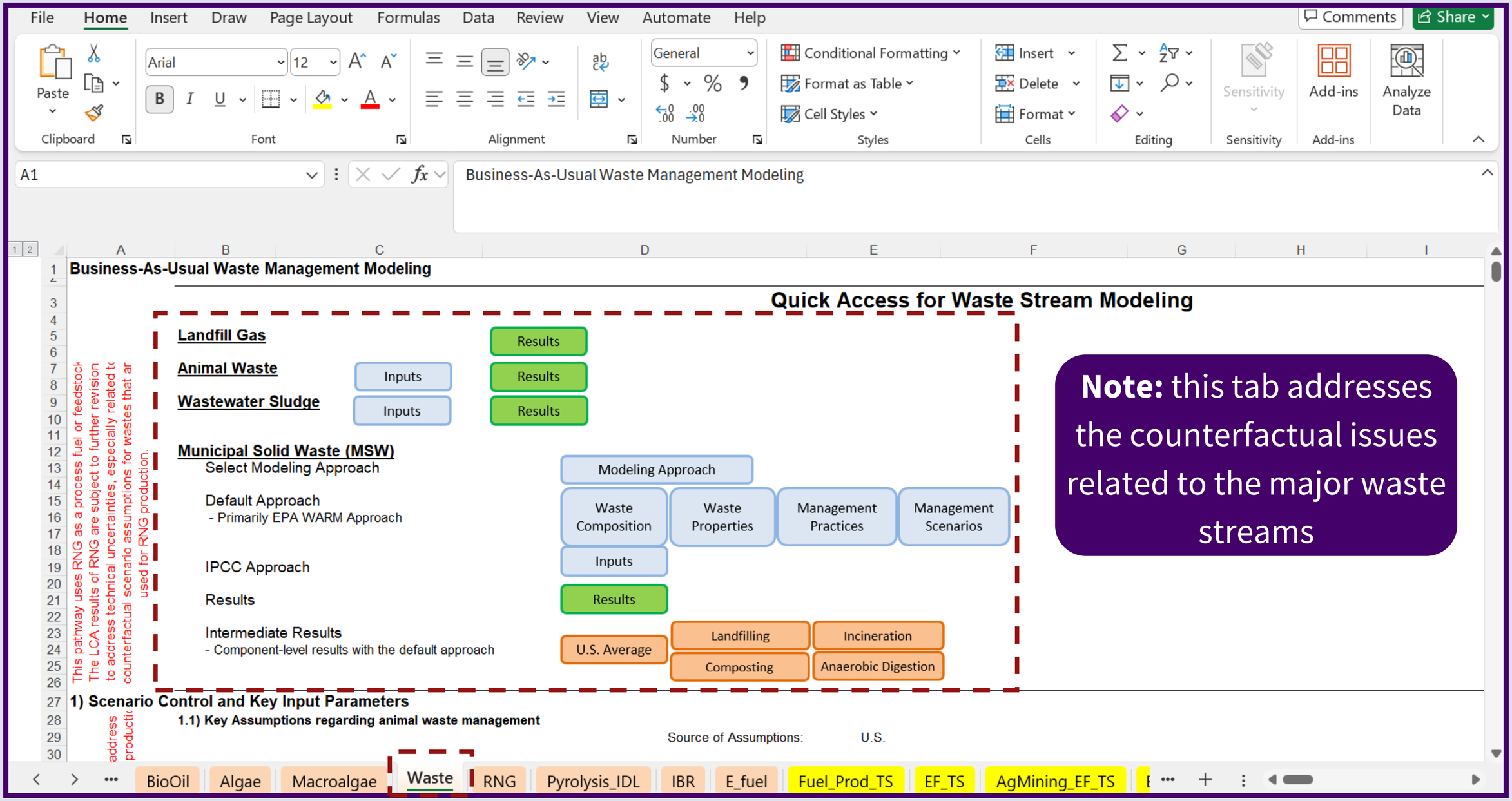

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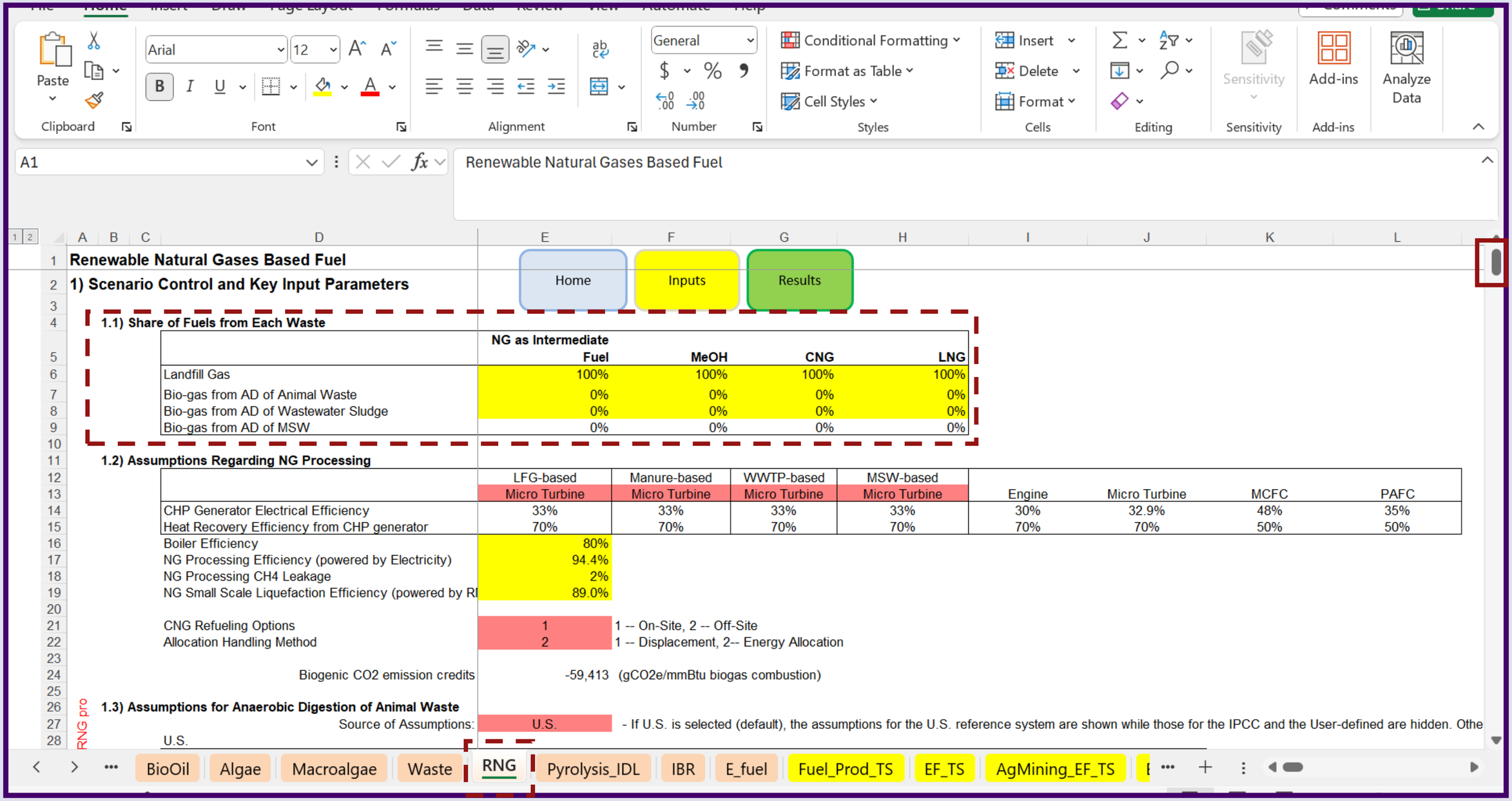

Renewable Natural Gases Based Fuel

1) Scenario Control and Key Input Parameters

Home | Inputs | Results

1.1) Share of Fuels from Each Waste

	NG as Intermediate Fuel	MeOH	CNG	LNG
Landfill Gas	100%	100%	100%	100%
Bio-gas from AD of Animal Waste	0%	0%	0%	0%
Bio-gas from AD of Wastewater Sludge	0%	0%	0%	0%
Bio-gas from AD of MSW	0%	0%	0%	0%

1.2) Assumptions Regarding NG Processing

	LFG-based Micro Turbine	Manure-based Micro Turbine	WWTP-based Micro Turbine	MSW-based Micro Turbine	Engine	Micro Turbine	MCFC	PAFC
CHP Generator Electrical Efficiency	33%	33%	33%	33%	30%	32.9%	48%	35%
Heat Recovery Efficiency from CHP generator	70%	70%	70%	70%	70%	70%	50%	50%

Boiler Efficiency	80%	
NG Processing Efficiency (powered by Electricity)	94.4%	
NG Processing CH4 Leakage	2%	
NG Small Scale Liquefaction Efficiency (powered by RI	89.0%	
CNG Refueling Options	1	1 -- On-Site, 2 -- Off-Site
Allocation Handling Method	2	1 -- Displacement, 2-- Energy Allocation
Biogenic CO2 emission credits	-59,413	(gCO2e/mmBtu biogas combustion)

1.3) Assumptions for Anaerobic Digestion of Animal Waste

Source of Assumptions: U.S. - If U.S. is selected (default), the assumptions for the U.S. reference system are shown while those for the IPCC and the User-defined are hidden. Othe

U.S.

RNG pro

BioOil | Algae | Macroalgae | Waste | RNG | Pyrolysis_IDL | IBR | E_fuel | Fuel_Prod_TS | EF_TS | AgMining_EF_TS

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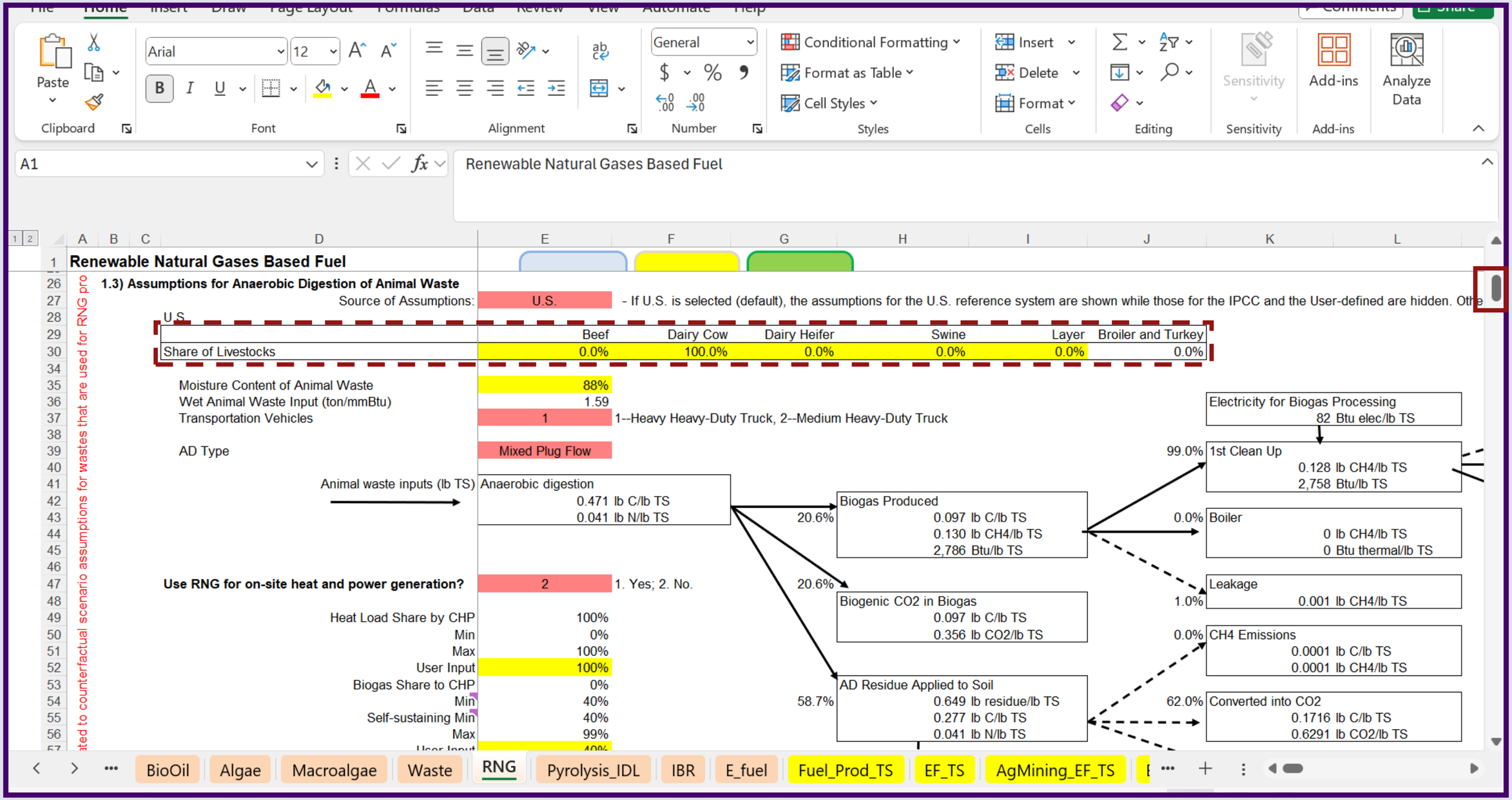

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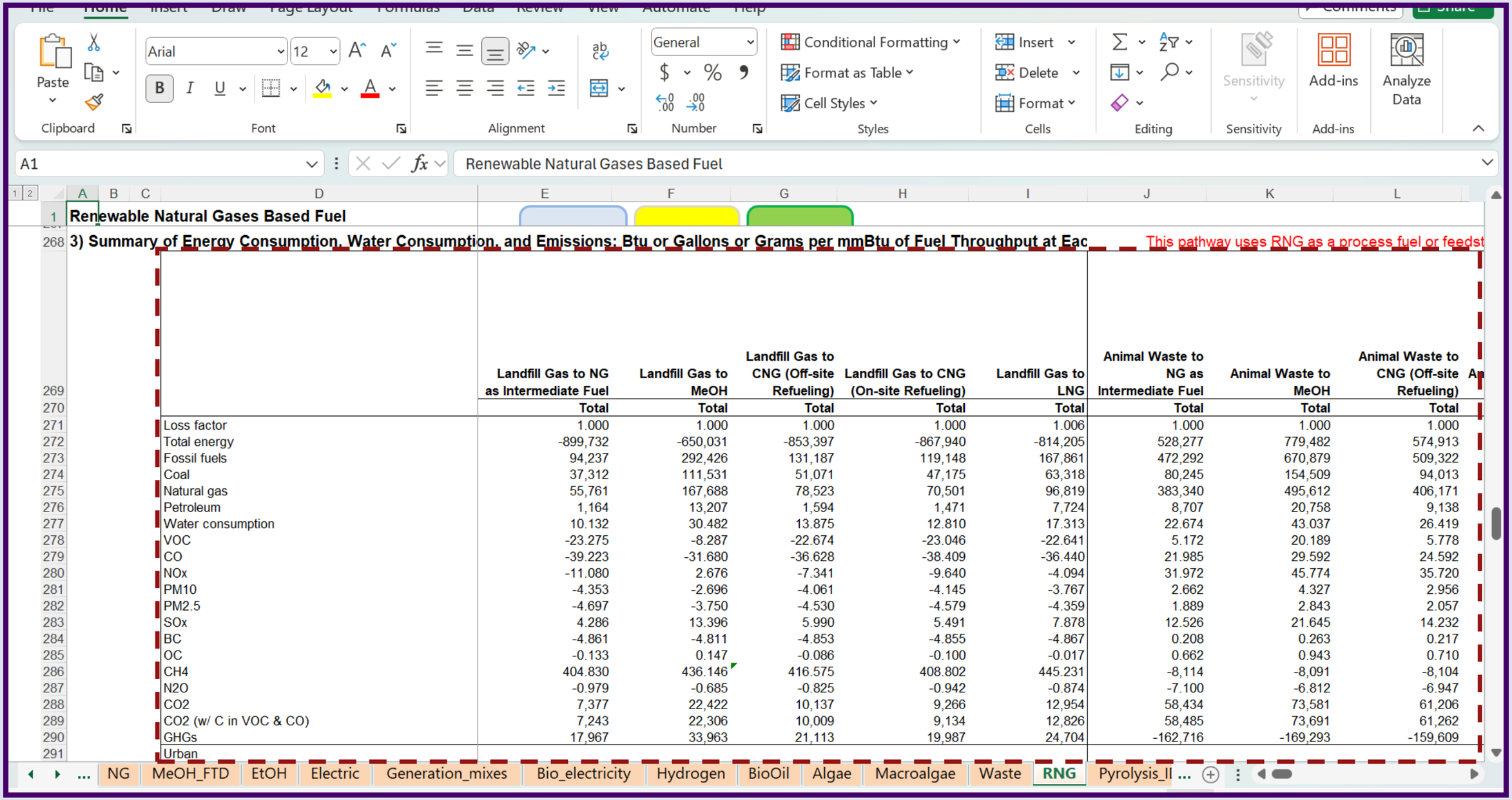

Renewable Natural Gases Based Fuel

3) Summary of Energy Consumption, Water Consumption, and Emissions: Btu or Gallons or Grams per mmBtu of Fuel Throughput at Eac

This pathway uses RNG as a process fuel or feedst

	Landfill Gas to NG as Intermediate Fuel	Landfill Gas to MeOH	Landfill Gas to CNG (Off-site Refueling)	Landfill Gas to CNG (On-site Refueling)	Landfill Gas to LNG	Animal Waste to NG as Intermediate Fuel	Animal Waste to MeOH	Animal Waste to CNG (Off-site Refueling)	An
	Total	Total	Total	Total	Total	Total	Total	Total	
Loss factor	1.000	1.000	1.000	1.000	1.006	1.000	1.000	1.000	
Total energy	-899,732	-650,031	-853,397	-867,940	-814,205	528,277	779,482	574,913	
Fossil fuels	94,237	292,426	131,187	119,148	167,861	472,292	670,879	509,322	
Coal	37,312	111,531	51,071	47,175	63,318	80,245	154,509	94,013	
Natural gas	55,761	167,688	78,523	70,501	96,819	383,340	495,612	406,171	
Petroleum	1,164	13,207	1,594	1,471	7,724	8,707	20,758	9,138	
Water consumption	10.132	30.482	13.875	12.810	17.313	22.674	43.037	26.419	
VOC	-23.275	-8.287	-22.674	-23.046	-22.641	5.172	20.189	5.778	
CO	-39.223	-31.680	-36.628	-38.409	-36.440	21.985	29.592	24.592	
NOx	-11.080	2.676	-7.341	-9.640	-4.094	31.972	45.774	35.720	
PM10	-4.353	-2.696	-4.061	-4.145	-3.767	2.662	4.327	2.956	
PM2.5	-4.697	-3.750	-4.530	-4.579	-4.359	1.889	2.843	2.057	
SOx	4.286	13.396	5.990	5.491	7.878	12.526	21.645	14.232	
BC	-4.861	-4.811	-4.853	-4.855	-4.867	0.208	0.263	0.217	
OC	-0.133	0.147	-0.086	-0.100	-0.017	0.662	0.943	0.710	
CH4	404.830	436.146	416.575	408.802	445.231	-8,114	-8,091	-8,104	
N2O	-0.979	-0.685	-0.825	-0.942	-0.874	-7.100	-6.812	-6.947	
CO2	7,377	22,422	10,137	9,266	12,954	58,434	73,581	61,206	
CO2 (w/ C in VOC & CO)	7,243	22,306	10,009	9,134	12,826	58,485	73,691	61,262	
GHGs	17,967	33,963	21,113	19,987	24,704	-162,716	-169,293	-159,609	
Urban									

NG | MeOH_FTD | EtOH | Electric | Generation_mixes | Bio_electricity | Hydrogen | BioOil | Algae | Macroalgae | Waste | RNG | Pyrolysis_II

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Ethanol Scenarios

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Ethanol

Oxygenate

- Added to gasoline to promote gasoline burning cleanly
- When the additive accounts for **less than 12%** of the fuel
- Burned in low-level ethanol “blend” vehicles: SI-ICE and SIDI-ICE vehicles

Blend

- Used for biofuel purposes
- When the additive accounts for **more than 12%**
- Burned in a flex fuel vehicle (FFV) or a dedicated ethanol vehicle
- An increasing octane number of the fuel produces better knock resistance and may allow for better engine efficiency

100% Ethanol

Model a Dedicated Ethanol (EtOH) Spark-Ignition Internal Combustion Engine (SI-ICE) Light-Duty Car Fueled by 100% Ethanol

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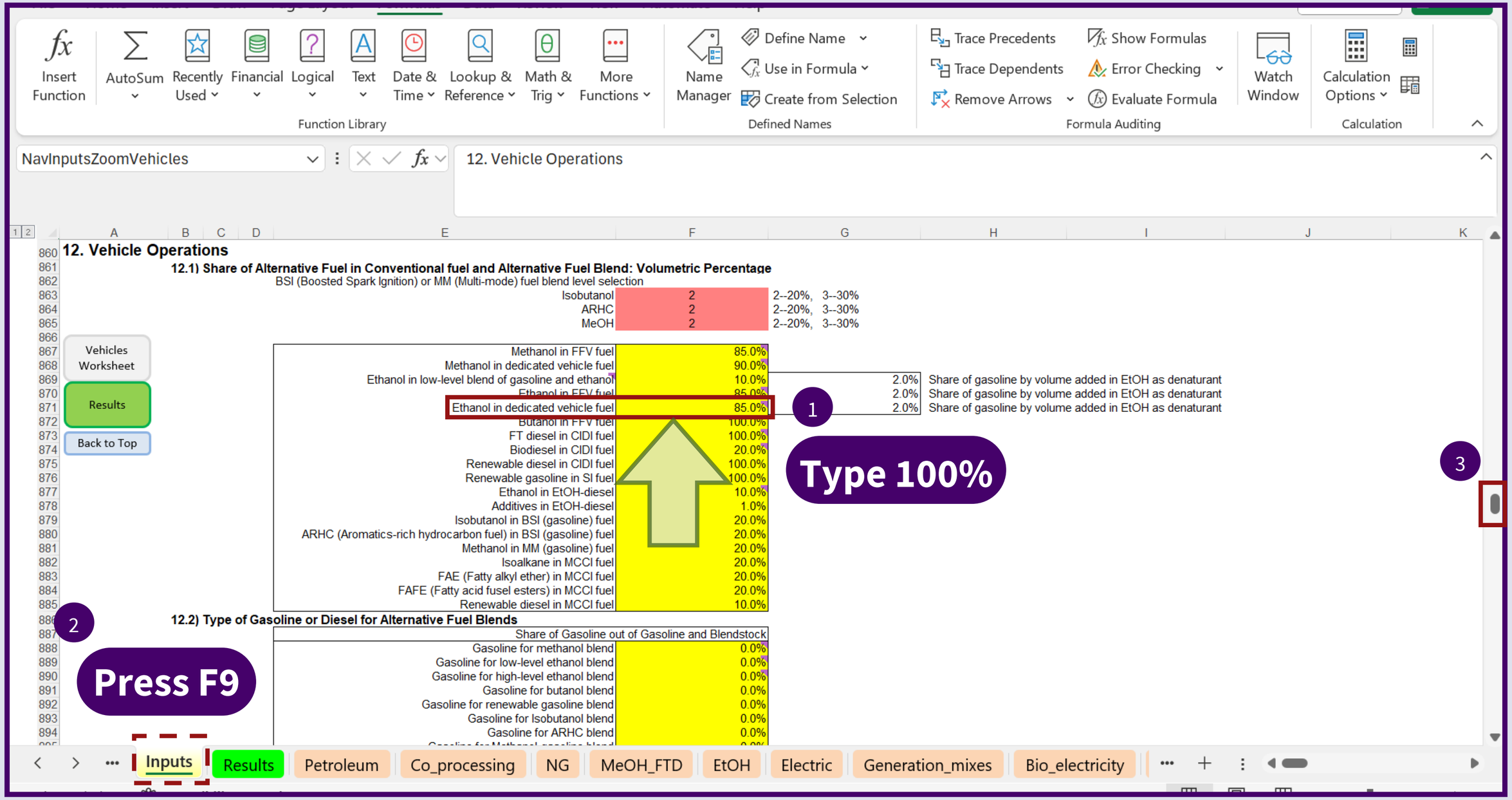

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Default Agricultural Feedstock in Ethanol as a Blend

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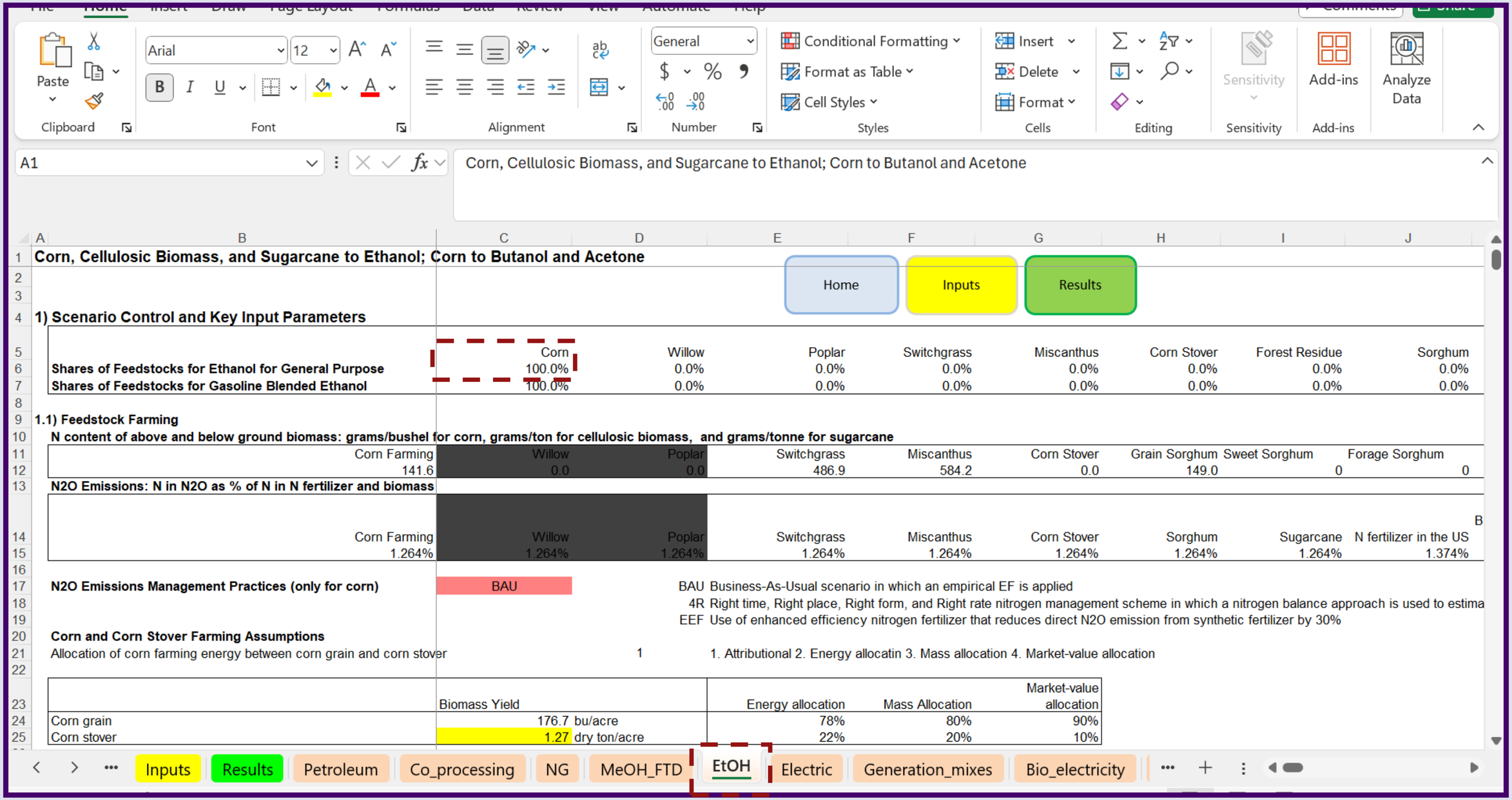

Corn, Cellulosic Biomass, and Sugarcane to Ethanol; Corn to Butanol and Acetone

Home | Inputs | Results

1) Scenario Control and Key Input Parameters

	Corn	Willow	Poplar	Switchgrass	Miscanthus	Corn Stover	Forest Residue	Sorghum
Shares of Feedstocks for Ethanol for General Purpose	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shares of Feedstocks for Gasoline Blended Ethanol	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

1.1) Feedstock Farming

N content of above and below ground biomass: grams/bushel for corn, grams/ton for cellulosic biomass, and grams/tonne for sugarcane

Corn Farming	Willow	Poplar	Switchgrass	Miscanthus	Corn Stover	Grain Sorghum	Sweet Sorghum	Forage Sorghum
141.6	0.0	0.0	486.9	584.2	0.0	149.0	0	0

N2O Emissions: N in N2O as % of N in N fertilizer and biomass

Corn Farming	Willow	Poplar	Switchgrass	Miscanthus	Corn Stover	Sorghum	Sugarcane	B N fertilizer in the US
1.264%	1.264%	1.264%	1.264%	1.264%	1.264%	1.264%	1.264%	1.374%

N2O Emissions Management Practices (only for corn) BAU

BAU Business-As-Usual scenario in which an empirical EF is applied
4R Right time, Right place, Right form, and Right rate nitrogen management scheme in which a nitrogen balance approach is used to estima
EEF Use of enhanced efficiency nitrogen fertilizer that reduces direct N2O emission from synthetic fertilizer by 30%

Corn and Corn Stover Farming Assumptions

Allocation of corn farming energy between corn grain and corn stover: 1 (1. Attributional 2. Energy allocatin 3. Mass allocation 4. Market-value allocation)

	Biomass Yield	Energy allocation	Mass Allocation	Market-value allocation
Corn grain	176.7 bu/acre	78%	80%	90%
Corn stover	1.27 dry ton/acre	22%	20%	10%

Inputs | Results | Petroleum | Co_processing | NG | MeOH_FTD | EtOH | Electric | Generation_mixes | Bio_electricity

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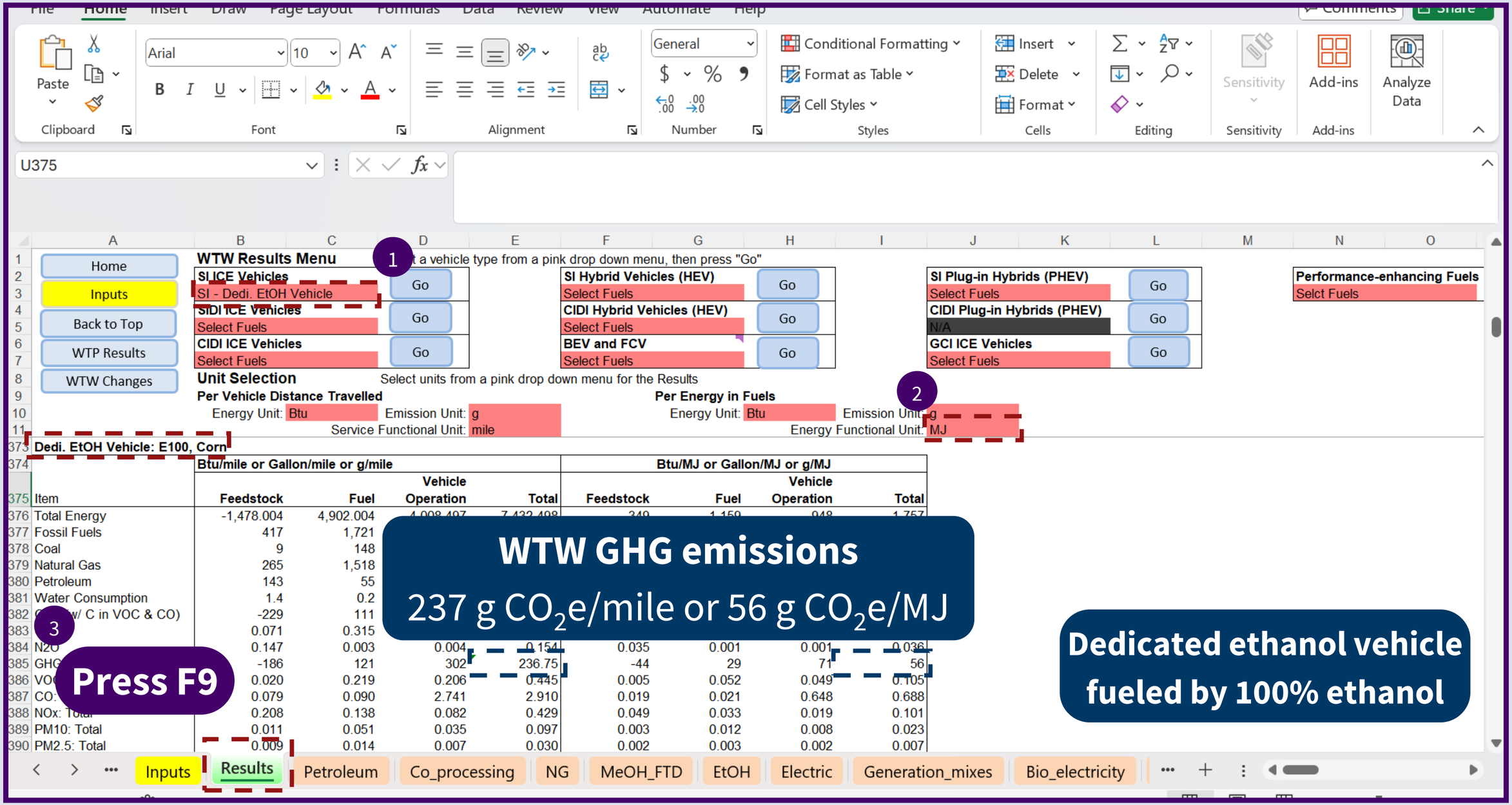
Well-to-Wheel (WTW) GHG Emissions



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E80 in an FFV

Model a Flex Fuel Spark-Ignition Internal Combustion Engine Vehicle (SI-ICE FFV) Light-Duty Car Fueled by E80

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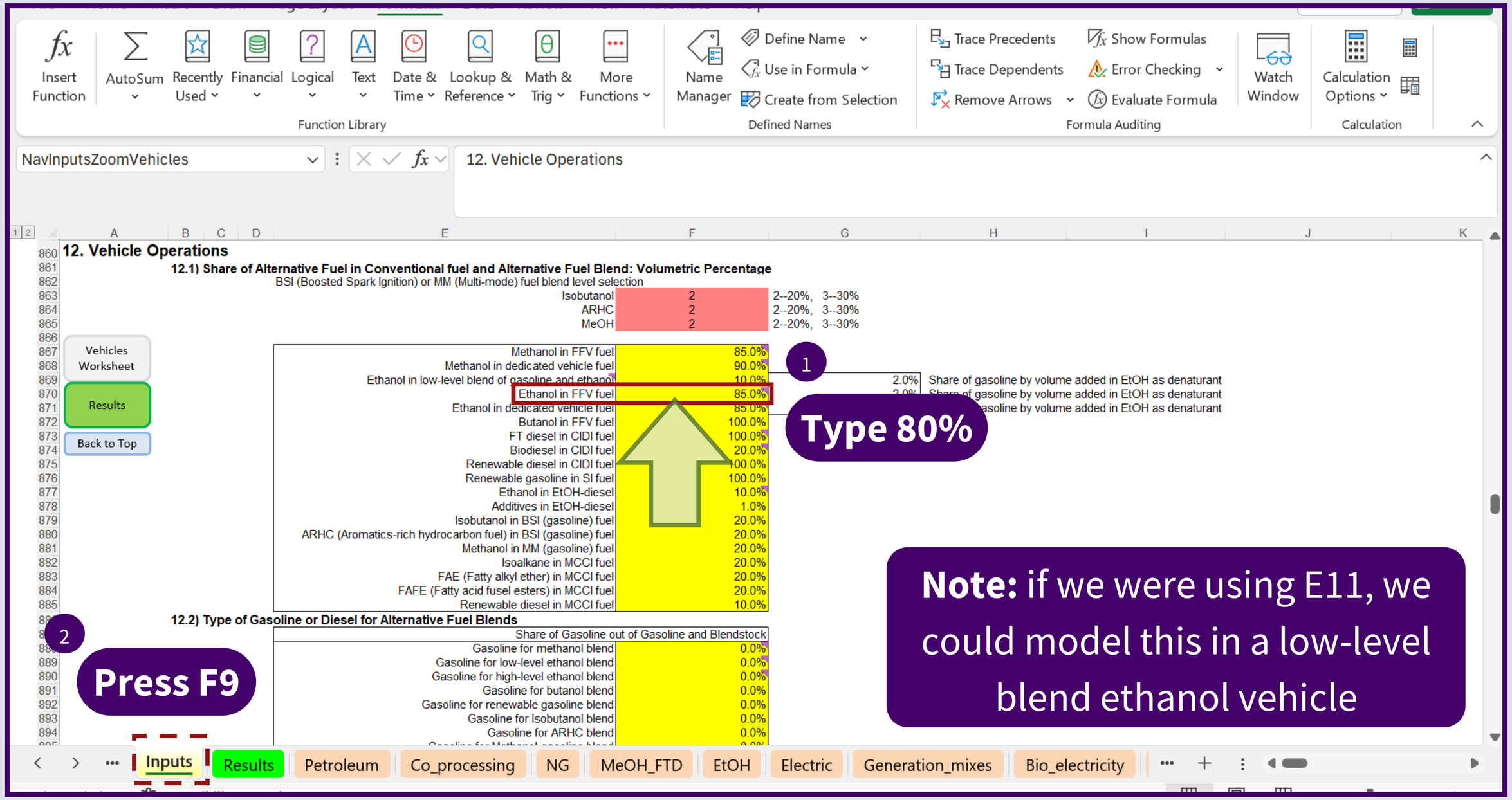

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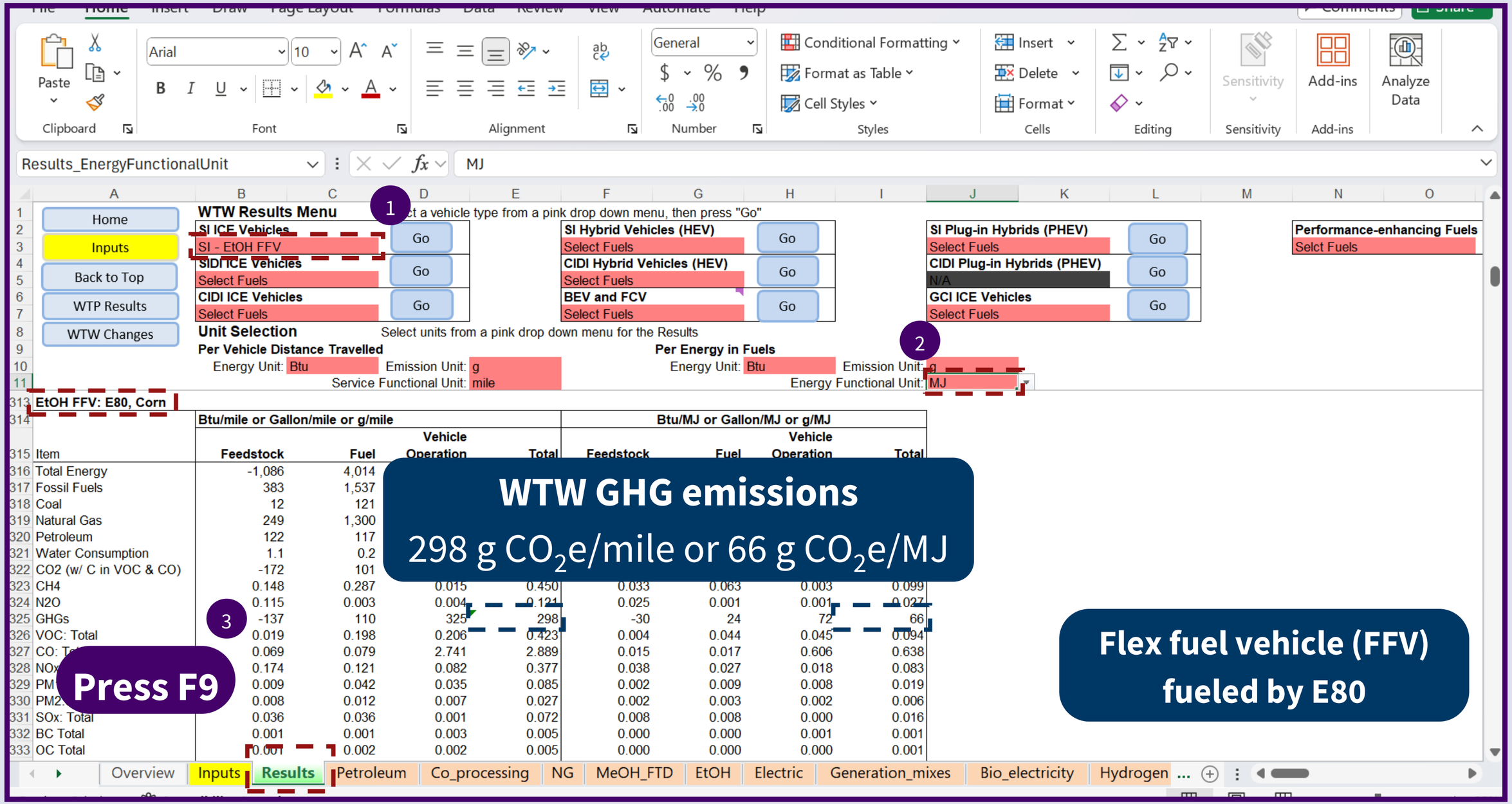
Well-to-Wheel (WTW) GHG Emissions



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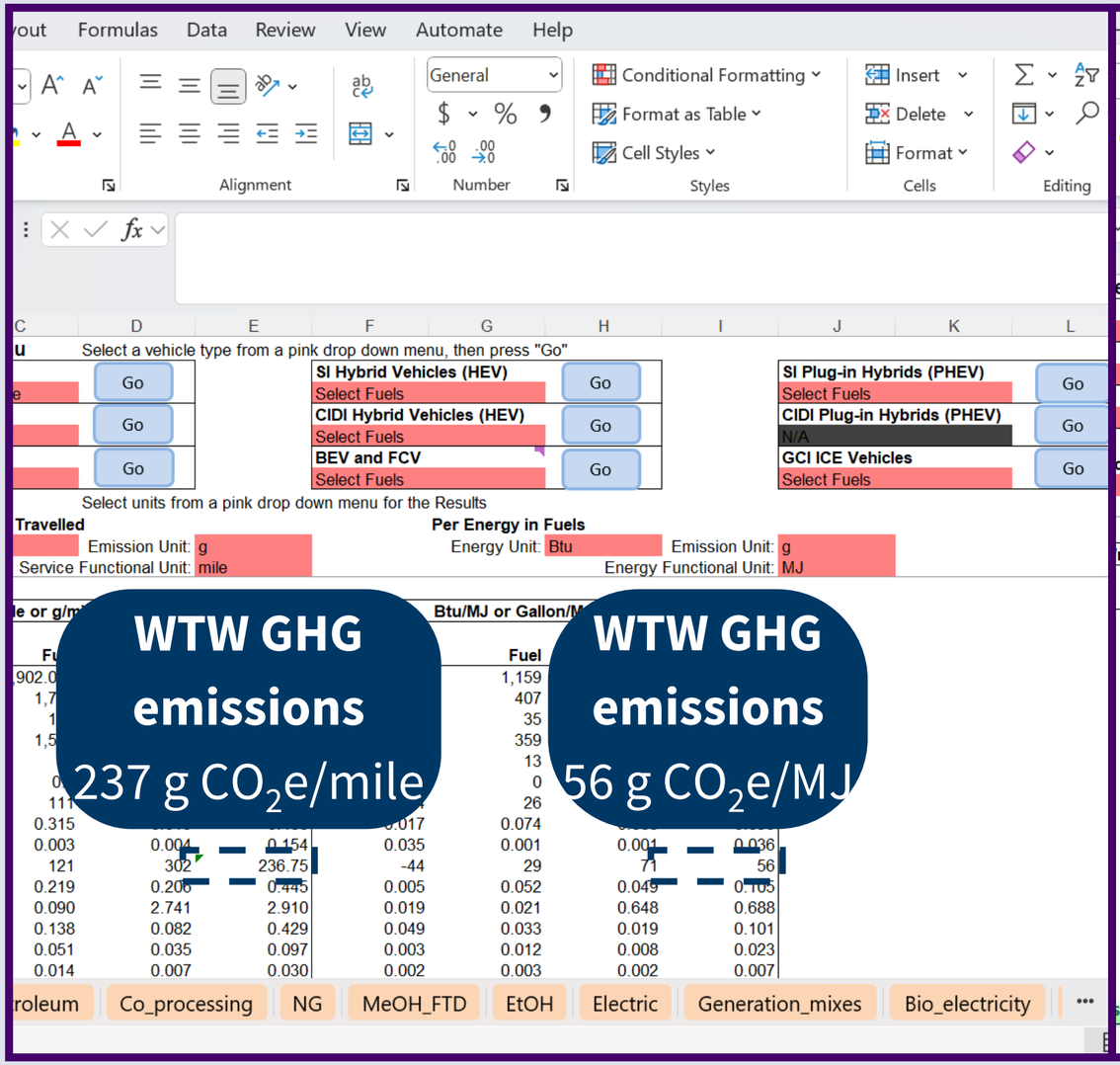
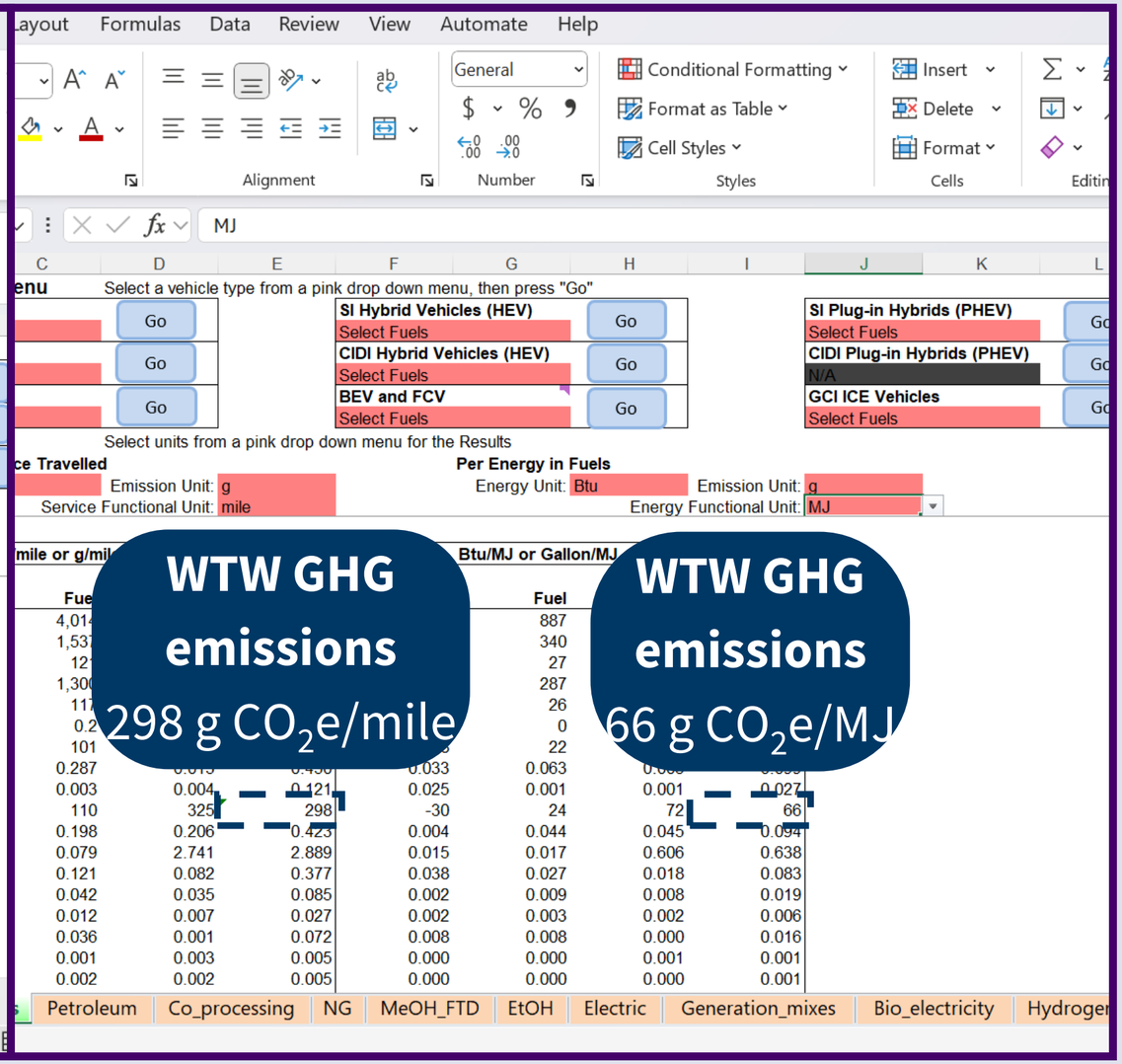
Dedicated EtOH vehicle fueled by 100% ethanol

Flex fuel vehicle fueled by E80





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Biodiesel and Renewable Diesel Scenarios

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Conventional Diesel

Model a Compression-Ignition Direct-Injection Internal Combustion Engine (CIDI-ICE) Light-Duty Car Fueled by Conventional Diesel

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CIDI-ICE vehicle

CIDI-ICE

Compression-ignition direct-injection internal combustion engine

1. Air is fed into the engine’s intake
2. The compression of the air produces heat
3. This heat burns the fuel

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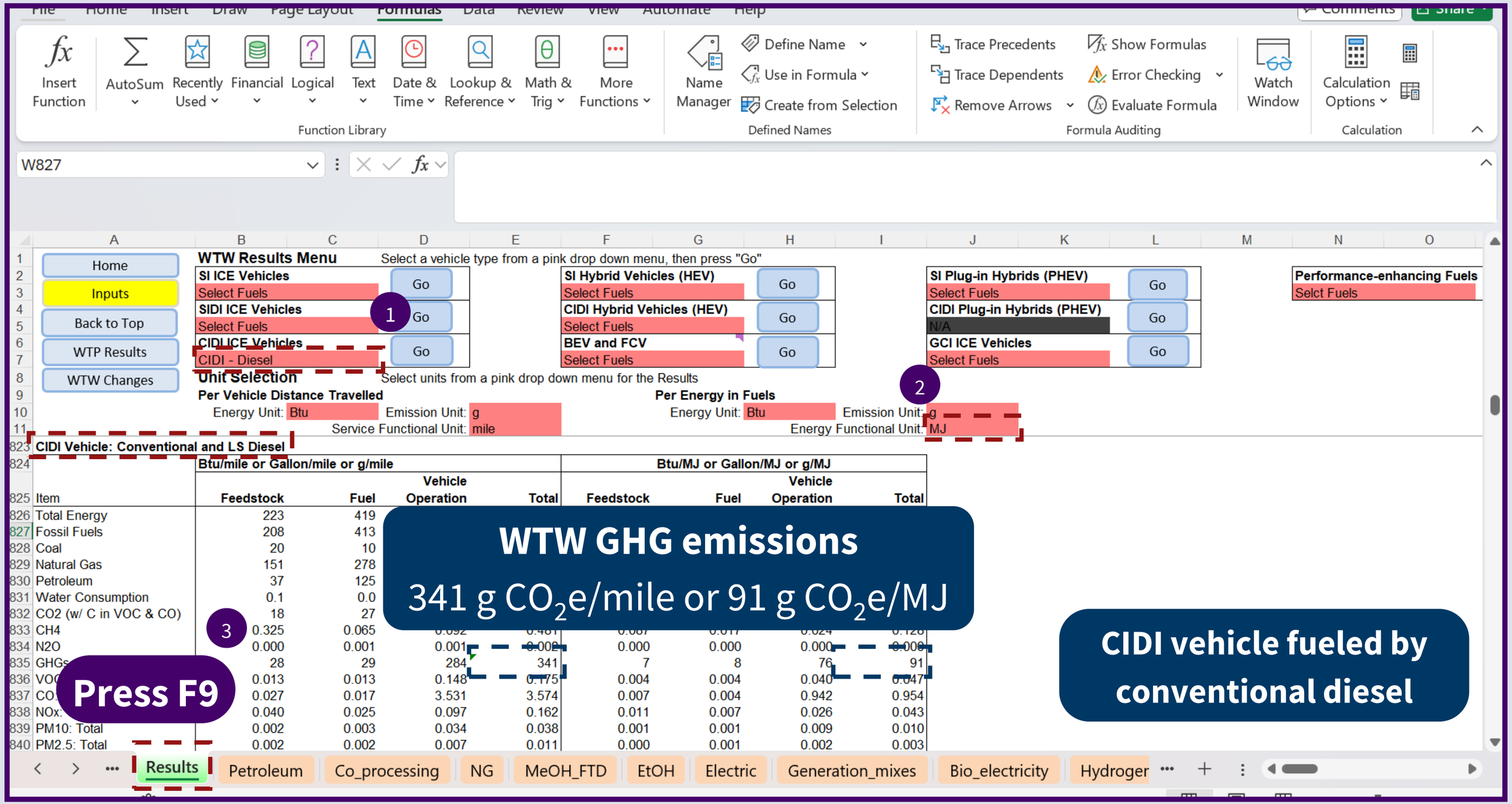
Well-to-Wheel (WTW) GHG Emissions



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Soybean Biodiesel

Model a Compression-Ignition Direct-Injection Internal Combustion Engine (CIDI-ICE) Light-Duty Car Fueled by Biodiesel Produced by Soybeans

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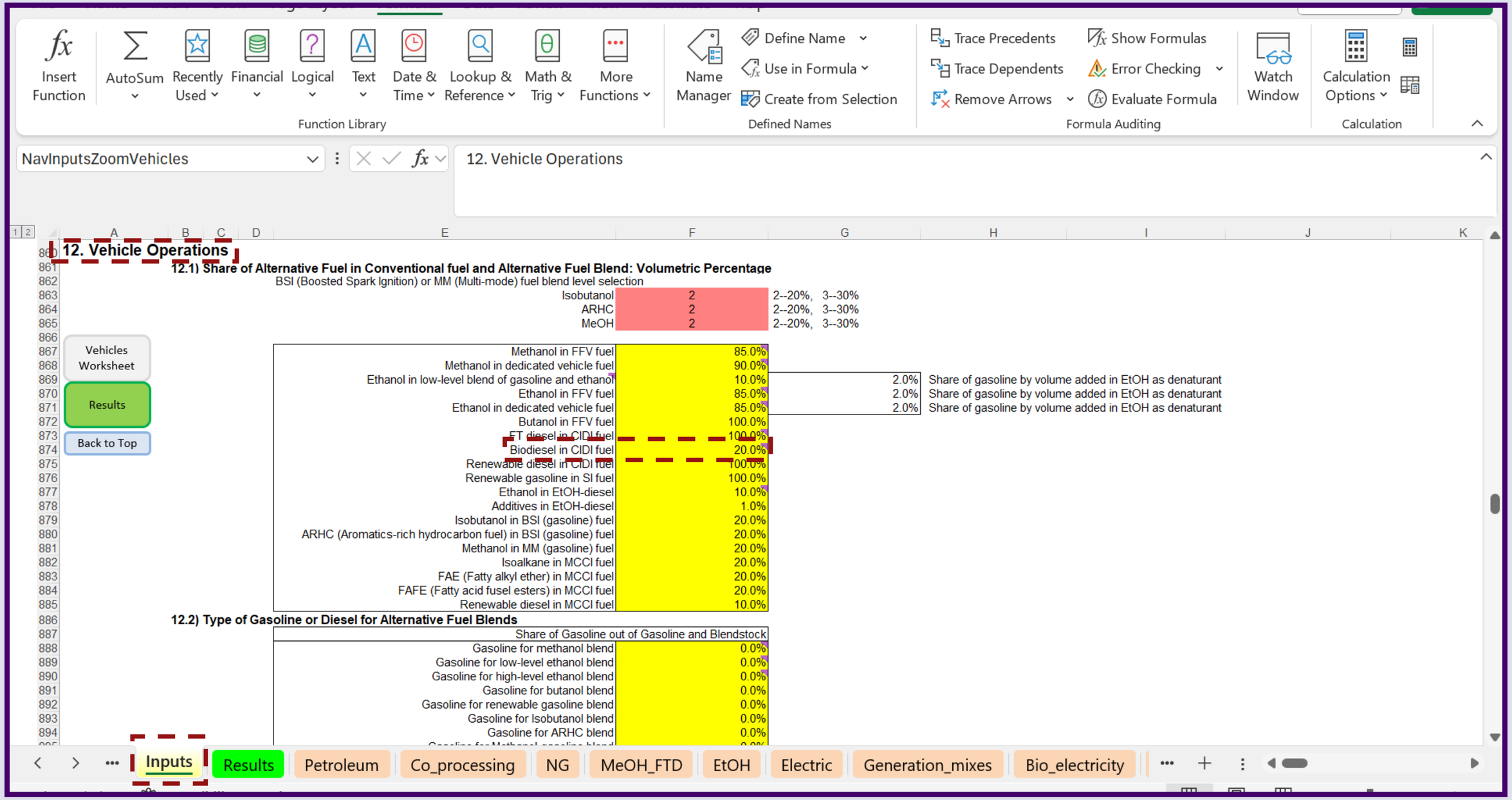
Default Content (%) of Biodiesel Used in CIDI Fuel



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Default Agricultural Feedstock for Biodiesel

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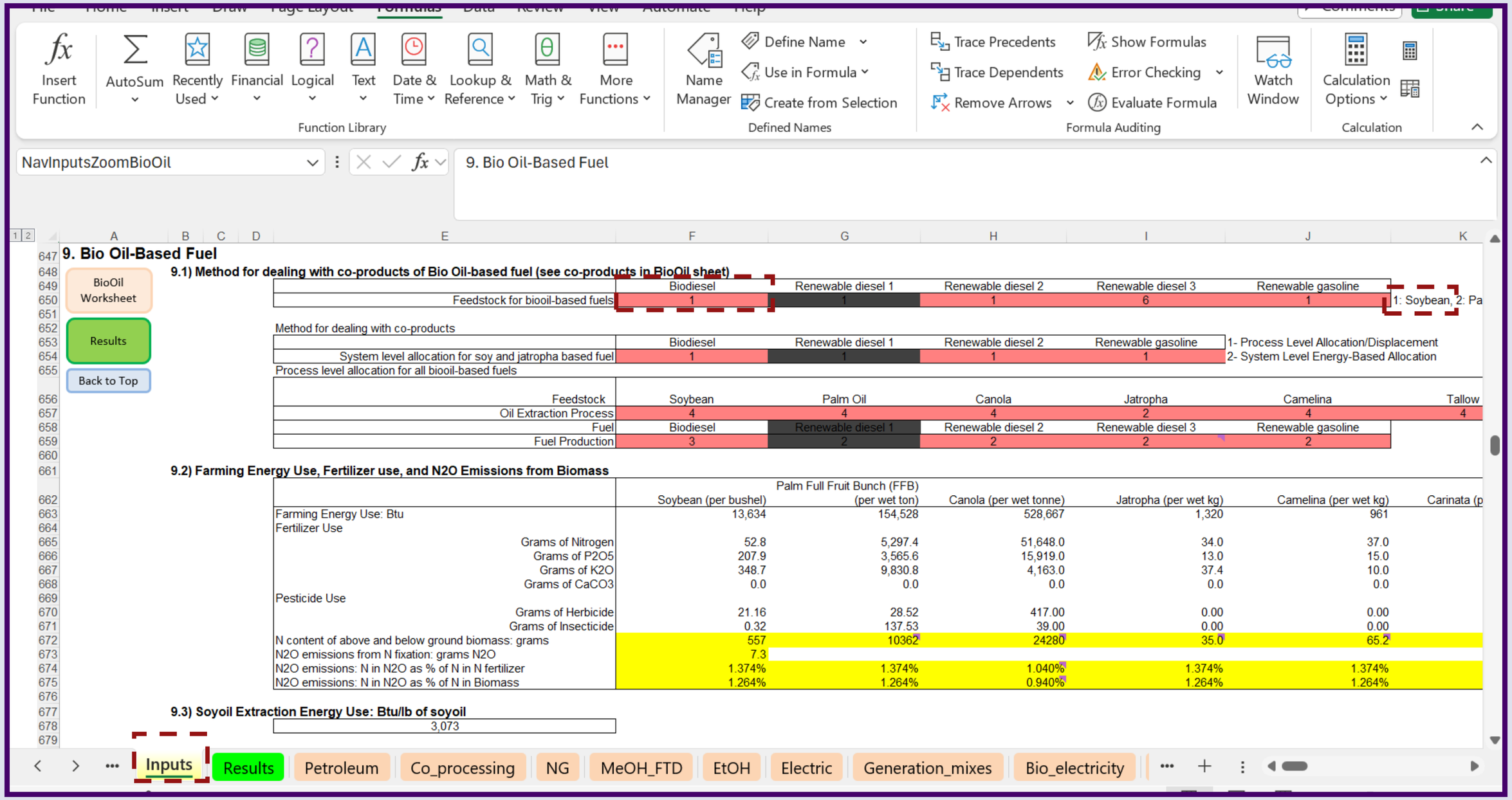

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Default GHG Emissions from Domestic and International Induced Land Use Changes

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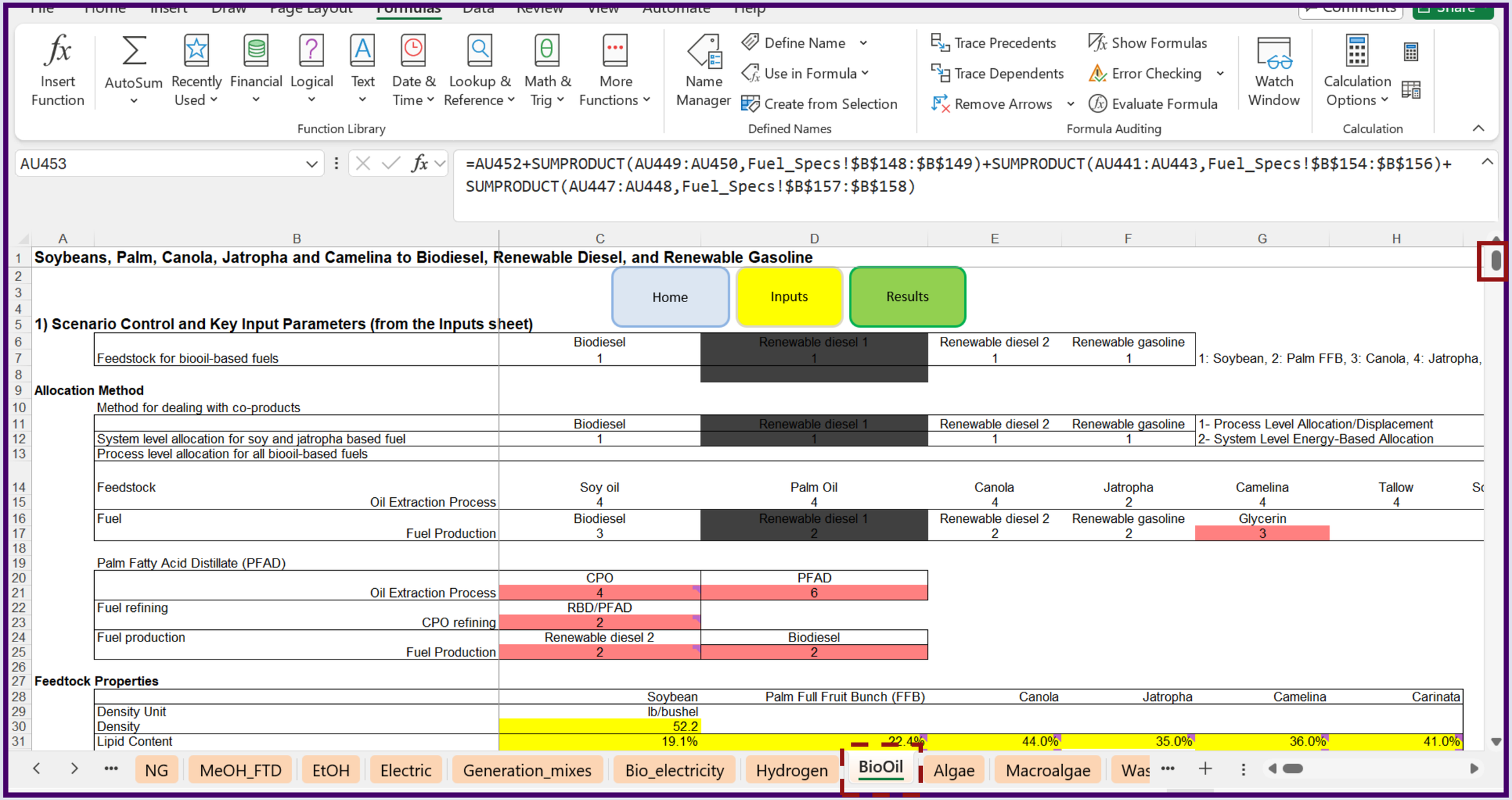

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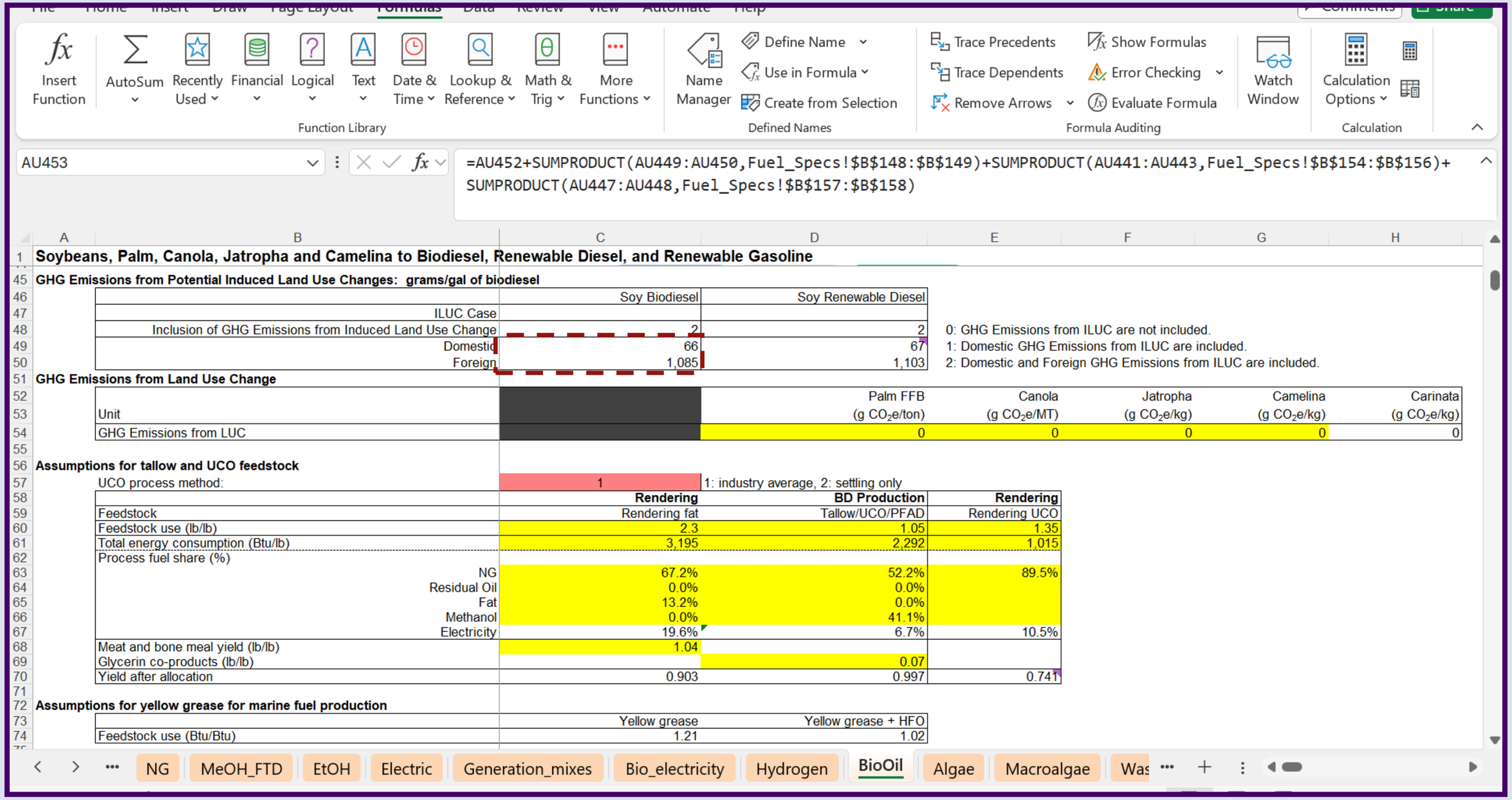

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Name Manager | Define Name | Use in Formula | Create from Selection | Defined Names
Trace Precedents | Trace Dependents | Remove Arrows | Show Formulas | Error Checking | Evaluate Formula | Formula Auditing
Watch Window
Calculation Options | Calculation

AU453

=AU452+SUMPRODUCT(AU449:AU450,Fuel_Specs!$B$148:$B$149)+SUMPRODUCT(AU441:AU443,Fuel_Specs!$B$154:$B$156)+
SUMPRODUCT(AU447:AU448,Fuel_Specs!$B$157:$B$158)

Soybeans, Palm, Canola, Jatropha and Camelina to Biodiesel, Renewable Diesel, and Renewable Gasoline

GHG Emissions from Potential Induced Land Use Changes: grams/gal of biodiesel

	Soy Biodiesel	Soy Renewable Diesel
ILUC Case		
Inclusion of GHG Emissions from Induced Land Use Change	2	2
Domestic	66	67
Foreign	1,085	1,103

0: GHG Emissions from ILUC are not included.
1: Domestic GHG Emissions from ILUC are included.
2: Domestic and Foreign GHG Emissions from ILUC are included.

GHG Emissions from Land Use Change

Unit		Palm FFB (g CO_2e/ton)	Canola (g CO_2e/MT)	Jatropha (g CO_2e/kg)	Camelina (g CO_2e/kg)	Carinata (g CO_2e/kg)
GHG Emissions from LUC		0	0	0	0	0

Assumptions for tallow and UCO feedstock

UCO process method: 1 (1: industry average, 2: settling only)

	Rendering	**BD Production**	**Rendering**
Feedstock	Rendering fat	Tallow/UCO/PFAD	Rendering UCO
Feedstock use (lb/lb)	2.3	1.05	1.35
Total energy consumption (Btu/lb)	3,195	2,292	1,015
Process fuel share (%)			
NG	67.2%	52.2%	89.5%
Residual Oil	0.0%	0.0%	
Fat	13.2%	0.0%	
Methanol	0.0%	41.1%	
Electricity	19.6%	6.7%	10.5%
Meat and bone meal yield (lb/lb)	1.04		
Glycerin co-products (lb/lb)		0.07	
Yield after allocation	0.903	0.997	0.741

Assumptions for yellow grease for marine fuel production

	Yellow grease	Yellow grease + HFO
Feedstock use (Btu/Btu)	1.21	1.02

NG | MeOH_FTD | EtOH | Electric | Generation_mixes | Bio_electricity | Hydrogen | BioOil | Algae | Macroalgae | Was

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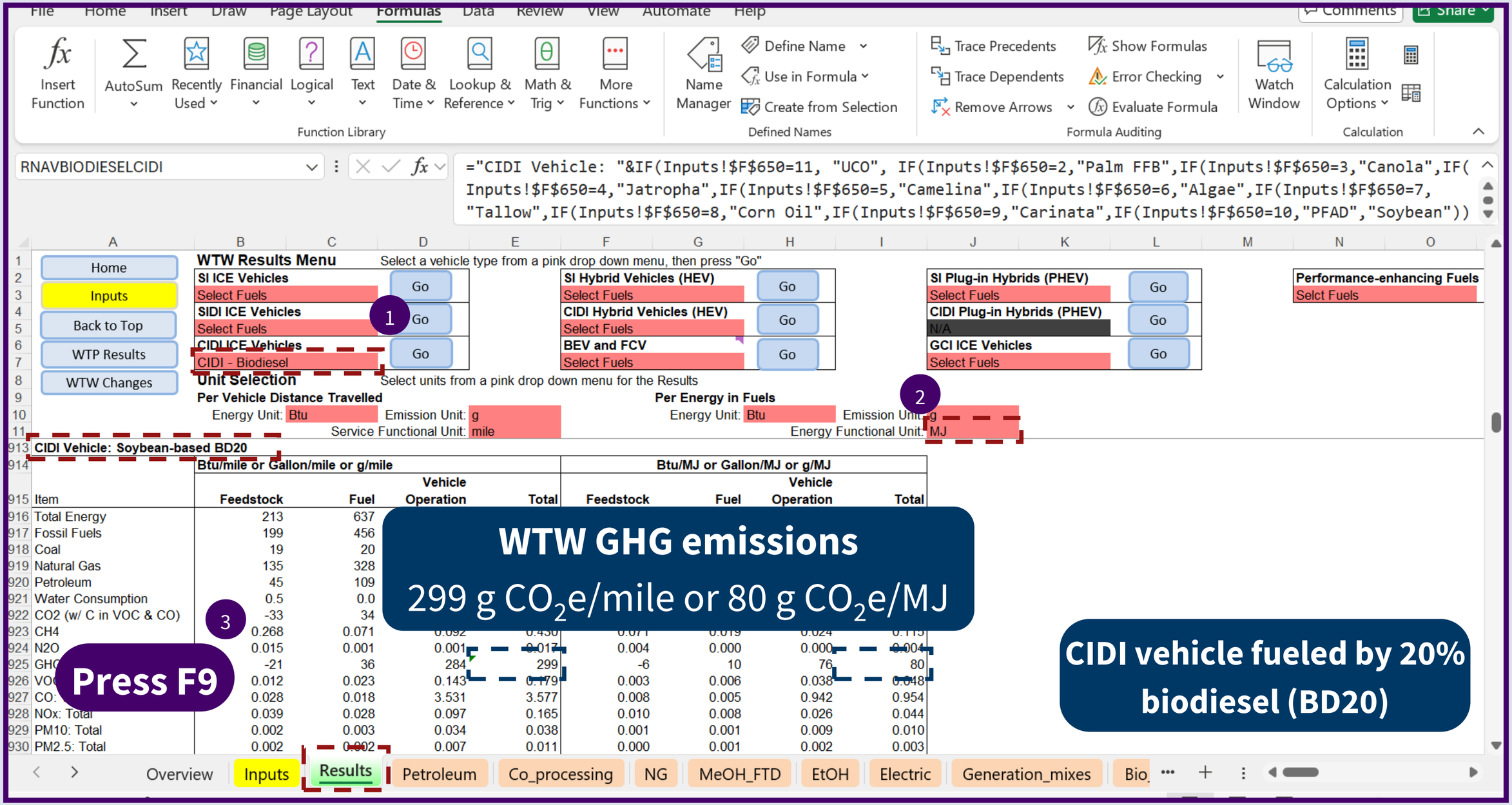
Well-to-Wheel (WTW) GHG Emissions



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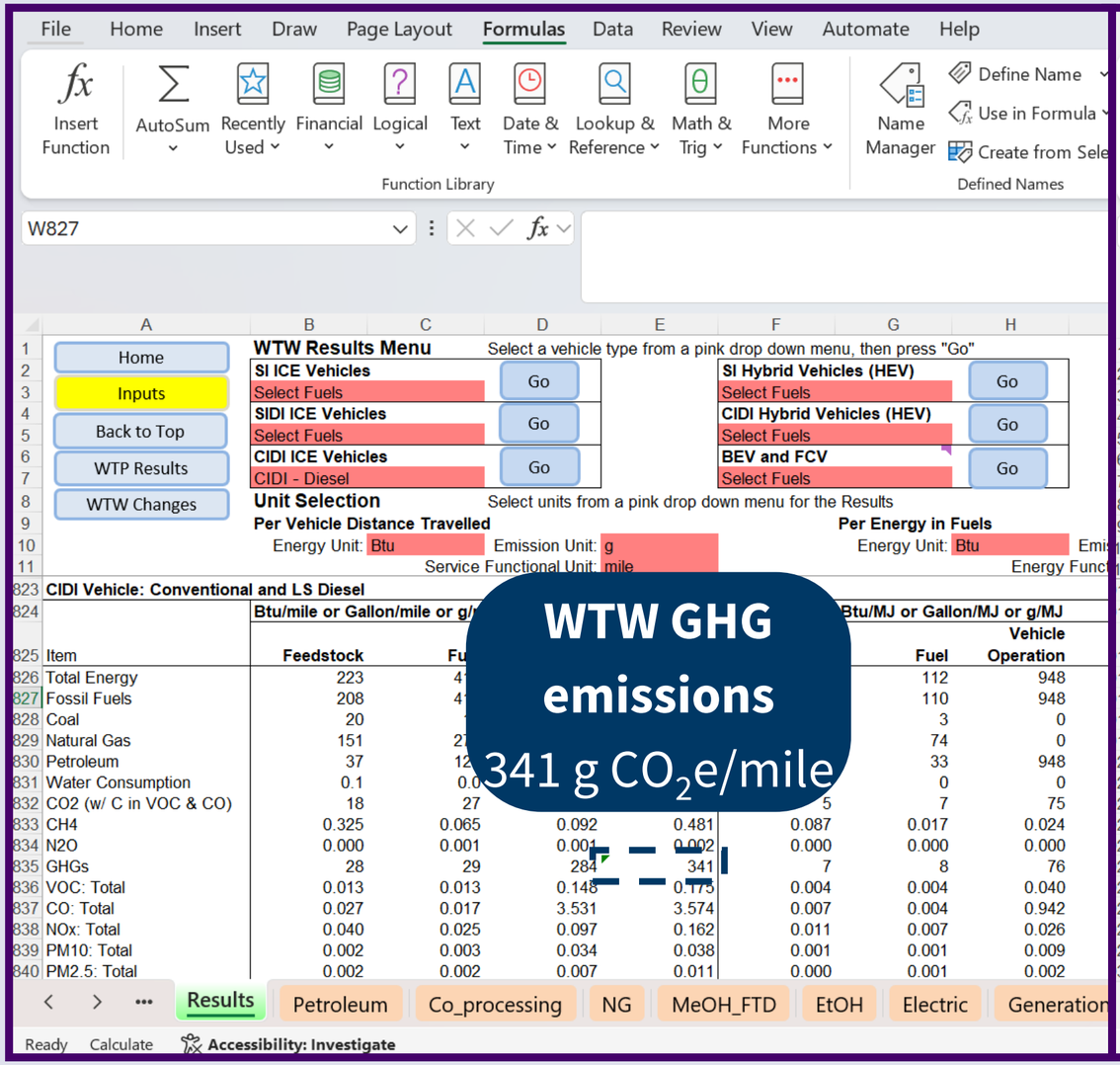
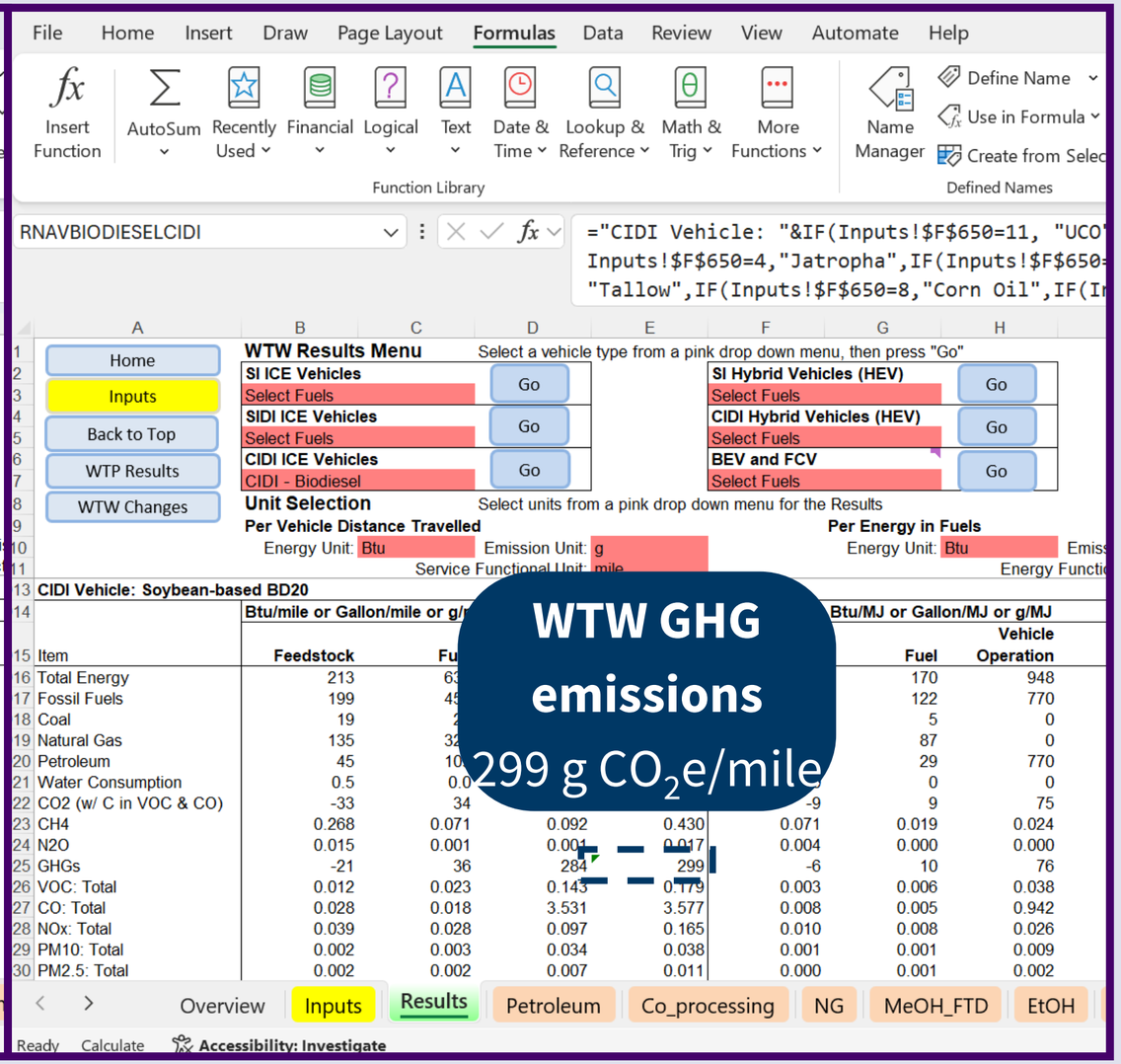
CIDI fueled by conventional diesel



CIDI fueled by soybean biodiesel (BD20)



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Soybean Renewable Diesel

Model a Compression-Ignition Direct-Injection Internal Combustion Engine (CIDI-ICE) Light-Duty Car Fueled by Renewable Diesel Produced by Soybeans

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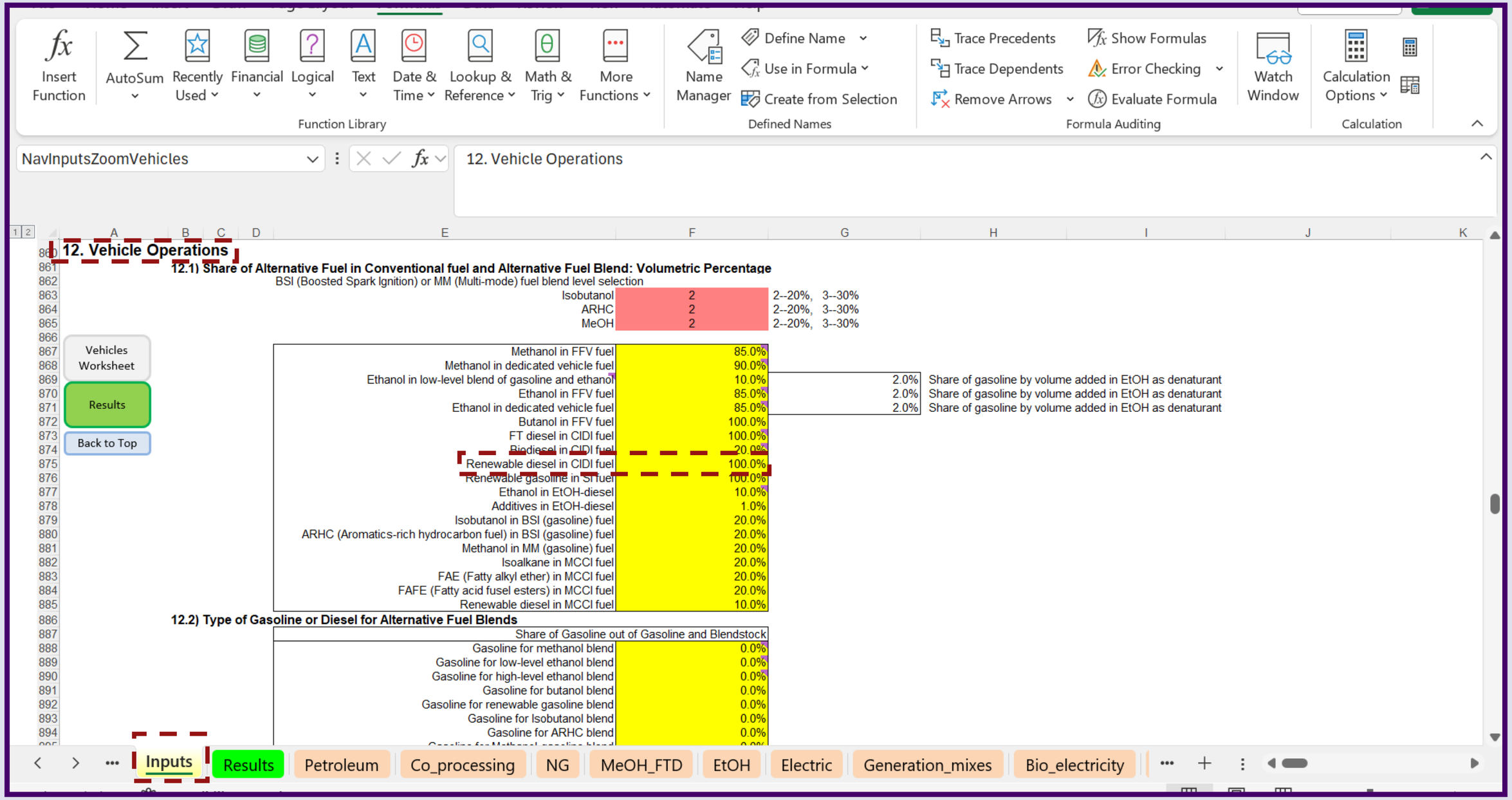
Default Content (%) of Renewable Diesel Used in CIDI Fuel



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Default Agricultural Feedstock for Renewable Diesel

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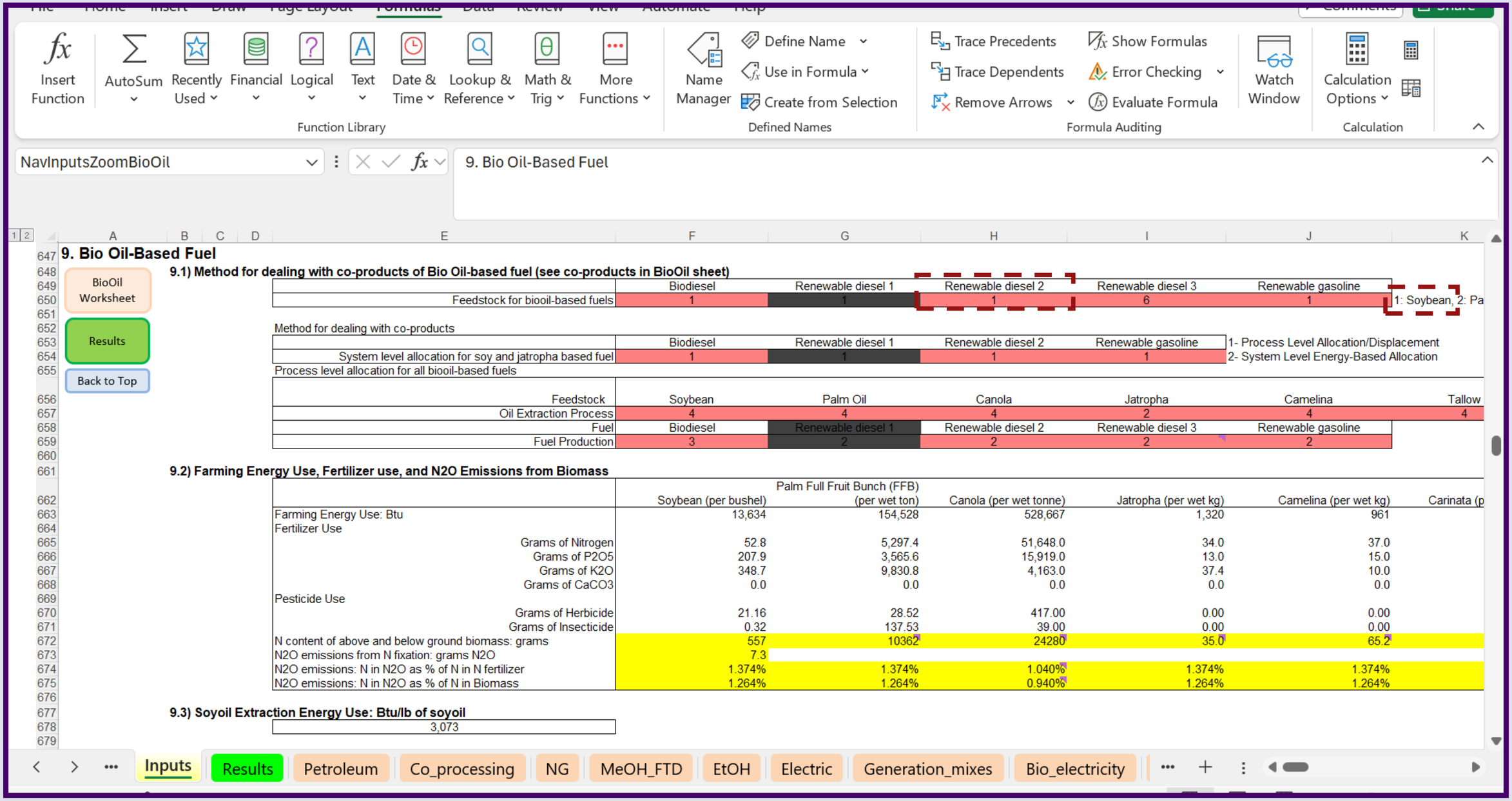
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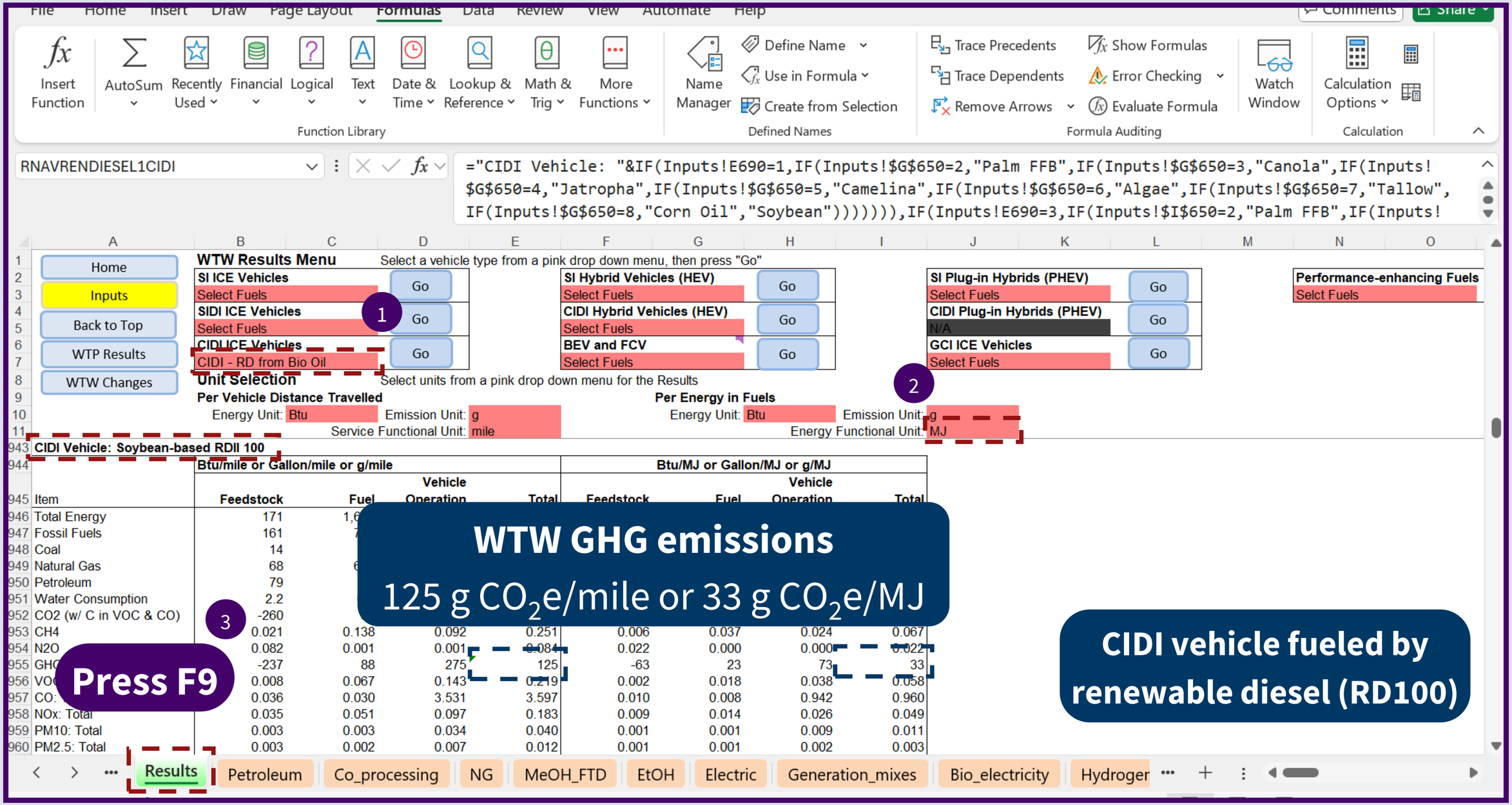
Date & Time
Lookup & Reference
Math & Trig
More Functions
Function Library
Name Manager
Define Name
Use in Formula
Create from Selection
Defined Names
Trace Precedents
Trace Dependents
Remove Arrows
Show Formulas
Error Checking
Evaluate Formula
Formula Auditing
Watch Window
Calculation Options
Calculation
NavInputsZoomBioOil
9. Bio Oil-Based Fuel
BioOil Worksheet
Results
Back to Top
9. Bio Oil-Based Fuel
9.1) Method for dealing with co-products of Bio Oil-based fuel (see co-products in BioOil sheet)
Biodiesel | Renewable diesel 1 | Renewable diesel 2 | Renewable diesel 3 | Renewable gasoline
Feedstock for biooil-based fuels: 1 | 1 | 1 | 6 | 1
1: Soybean, 2: Pa
Method for dealing with co-products
Biodiesel | Renewable diesel 1 | Renewable diesel 2 | Renewable gasoline
System level allocation for soy and jatropha based fuel: 1 | 1 | 1 | 1
1- Process Level Allocation/Displacement
2- System Level Energy-Based Allocation
Process level allocation for all biooil-based fuels
Feedstock: Soybean | Palm Oil | Canola | Jatropha | Camelina | Tallow
Oil Extraction Process: 4 | 4 | 4 | 2 | 4 | 4
Fuel: Biodiesel | Renewable diesel 1 | Renewable diesel 2 | Renewable diesel 3 | Renewable gasoline
Fuel Production: 3 | 2 | 2 | 2 | 2
9.2) Farming Energy Use, Fertilizer use, and N2O Emissions from Biomass
Soybean (per bushel) | Palm Full Fruit Bunch (FFB) (per wet ton) | Canola (per wet tonne) | Jatropha (per wet kg) | Camelina (per wet kg) | Carinata (p
Farming Energy Use: Btu: 13,634 | 154,528 | 528,667 | 1,320 | 961
Fertilizer Use
Grams of Nitrogen: 52.8 | 5,297.4 | 51,648.0 | 34.0 | 37.0
Grams of P2O5: 207.9 | 3,565.6 | 15,919.0 | 13.0 | 15.0
Grams of K2O: 348.7 | 9,830.8 | 4,163.0 | 37.4 | 10.0
Grams of CaCO3: 0.0 | 0.0 | 0.0 | 0.0 | 0.0
Pesticide Use
Grams of Herbicide: 21.16 | 28.52 | 417.00 | 0.00 | 0.00
Grams of Insecticide: 0.32 | 137.53 | 39.00 | 0.00 | 0.00
N content of above and below ground biomass: grams: 557 | 10362 | 24280 | 35.0 | 65.2
N2O emissions from N fixation: grams N2O: 7.3
N2O emissions: N in N2O as % of N in N fertilizer: 1.374% | 1.374% | 1.040% | 1.374% | 1.374%
N2O emissions: N in N2O as % of N in Biomass: 1.264% | 1.264% | 0.940% | 1.264% | 1.264%
9.3) Soyoil Extraction Energy Use: Btu/lb of soyoil
3,073
Inputs
Results
Petroleum
Co_processing
NG
MeOH_FTD
EtOH
Electric
Generation_mixes
Bio_electricity

Well-to-Wheel (WTW) GHG Emissions



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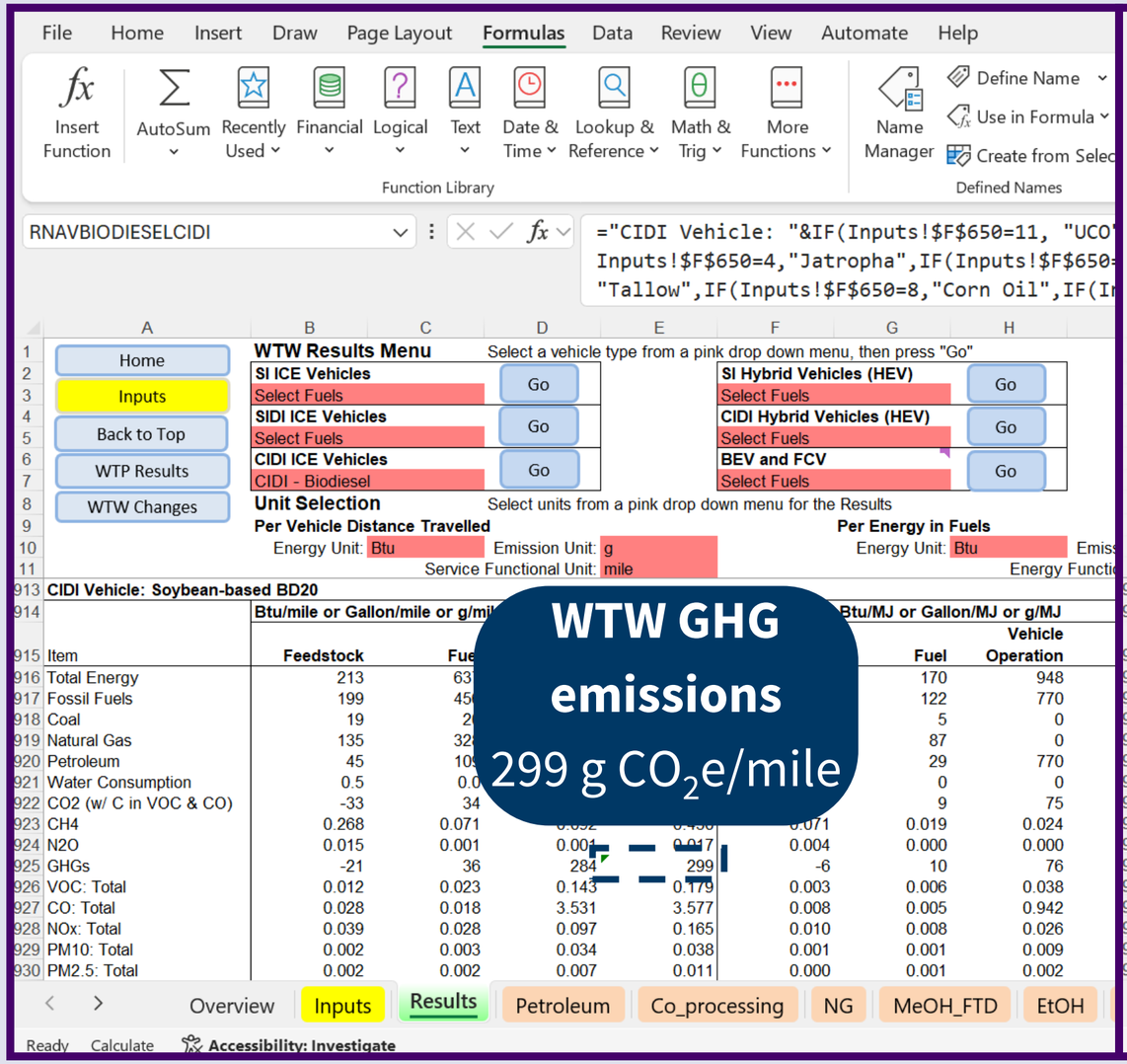
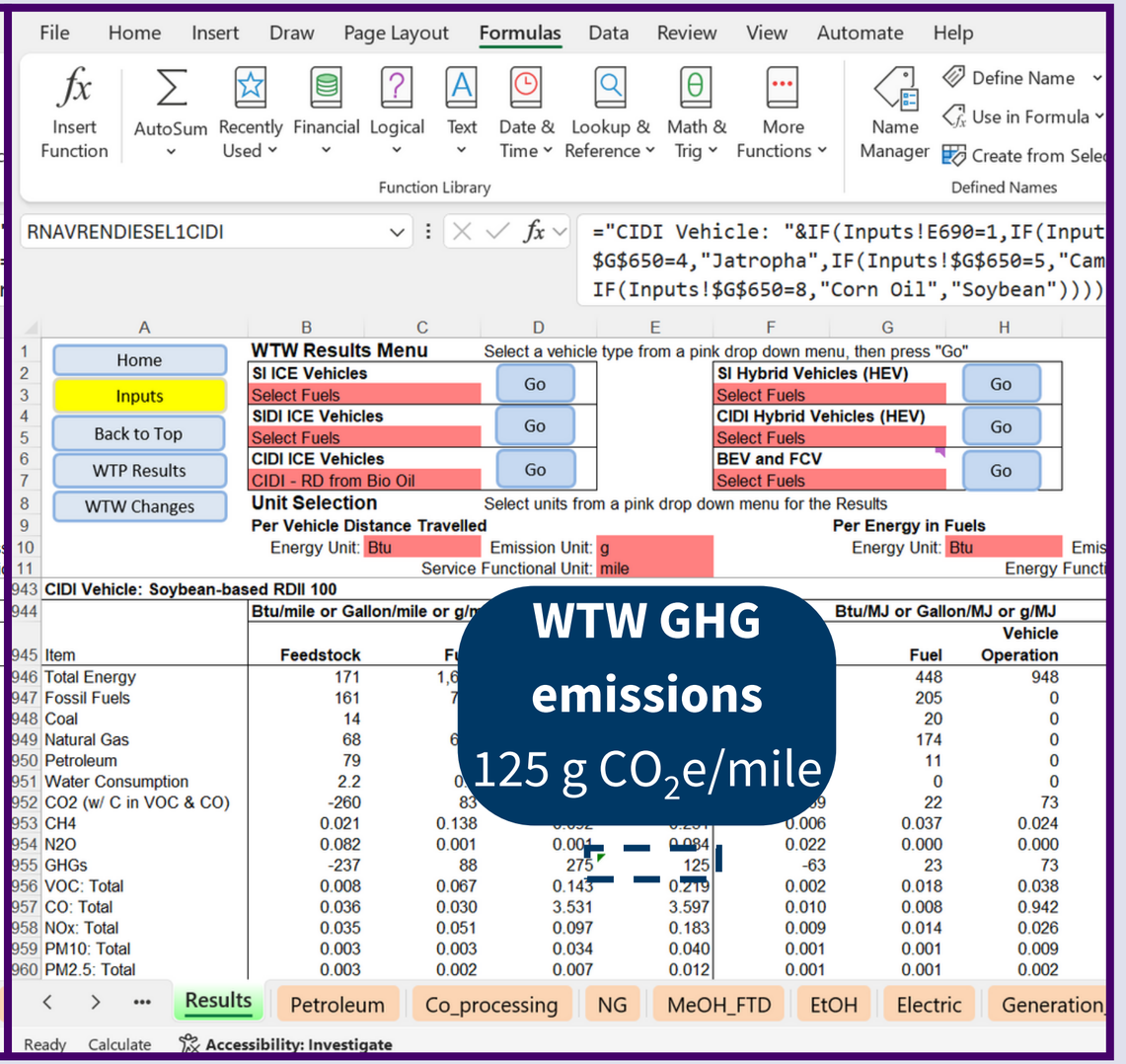
CIDI fueled by soybean biodiesel (BD20)



WTW GHG emissions

299 g CO_2e/mile

CIDI fueled by soybean renewable diesel (RD100)



WTW GHG emissions

125 g CO_2e/mile

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Compare biodiesel and renewable diesel

Renewable diesel can be used in 100% blends - “drop-in” or a complete replacement of conventional diesel

Biodiesel (BD20) still contains 80% conventional fossil diesel, which explains the higher emissions produced from biodiesel

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Soybean 35% Biodiesel

Model a Compression-Ignition Direct-Injection Internal Combustion Engine (CIDI-ICE) Light-Duty Car Fueled by 35% Biodiesel Produced by Soybeans

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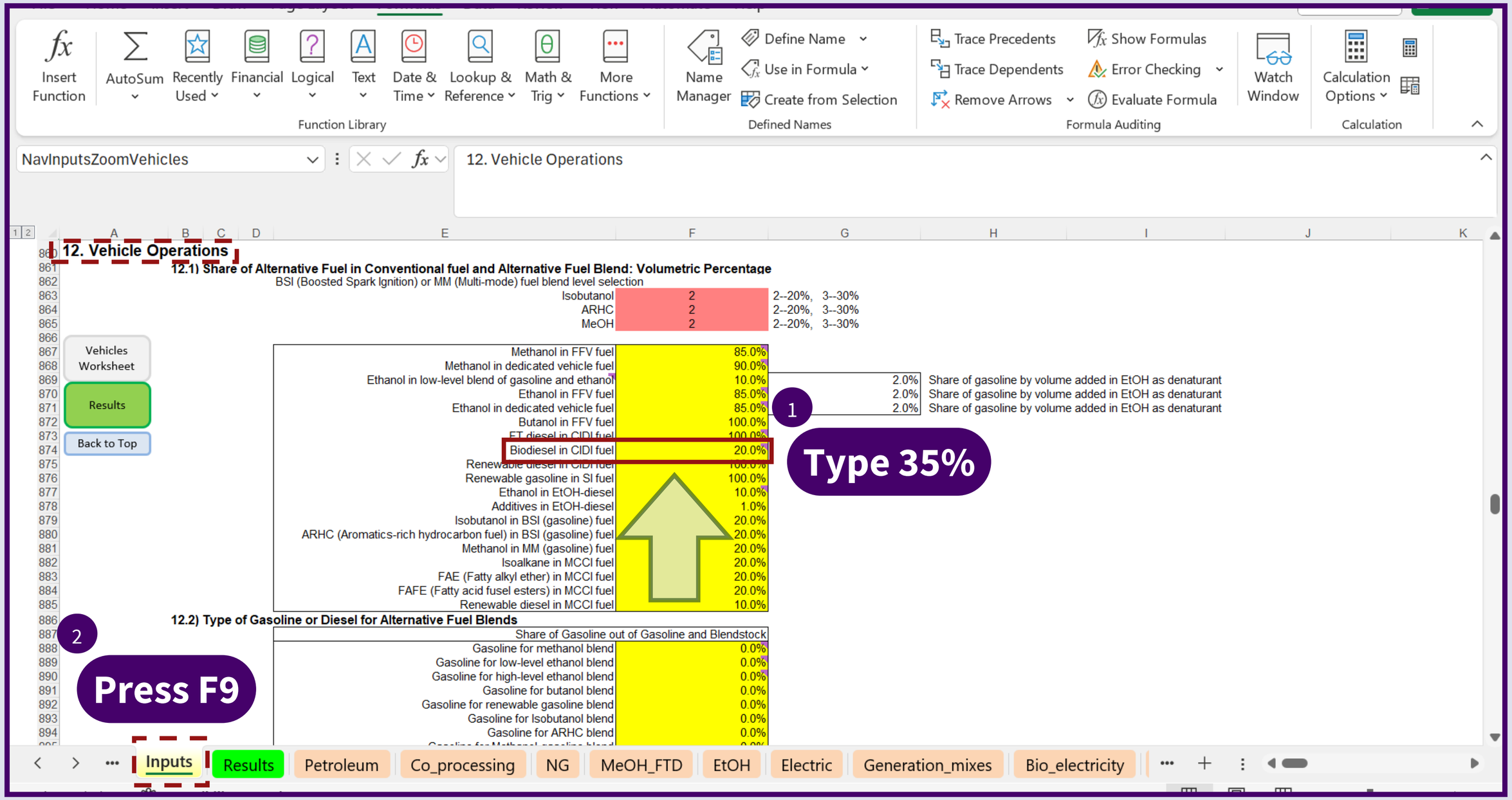

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Default Energy Content of Soy Oil

Default energy content of soy oil

Estimates the soy oil conversion efficiency to BD/RD by energy

Accounts for total energy consumption in some cases

Estimates the energy-based allocation factor between soy oil and soybean meal during the soybean crushing and oil extraction step

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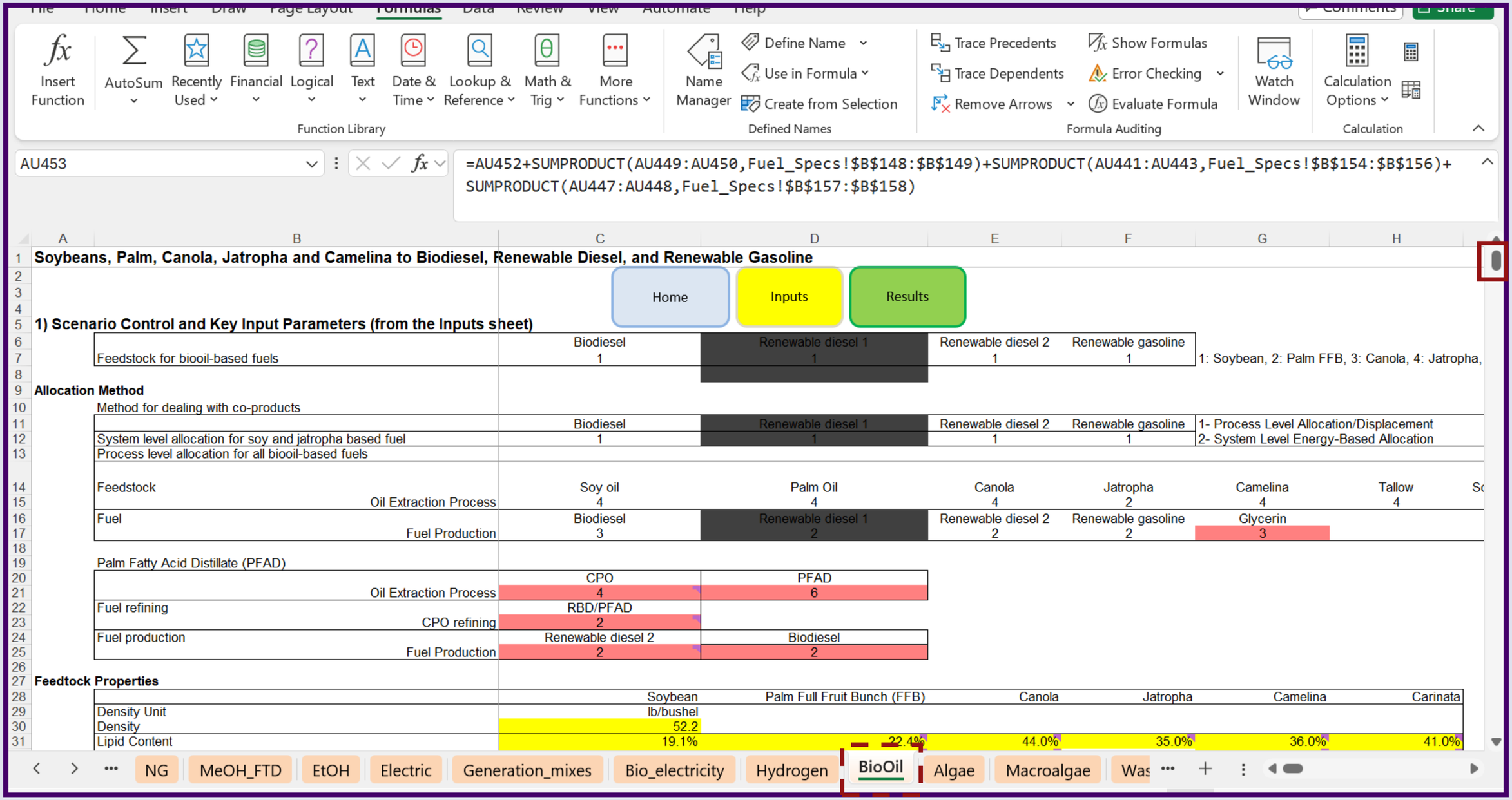

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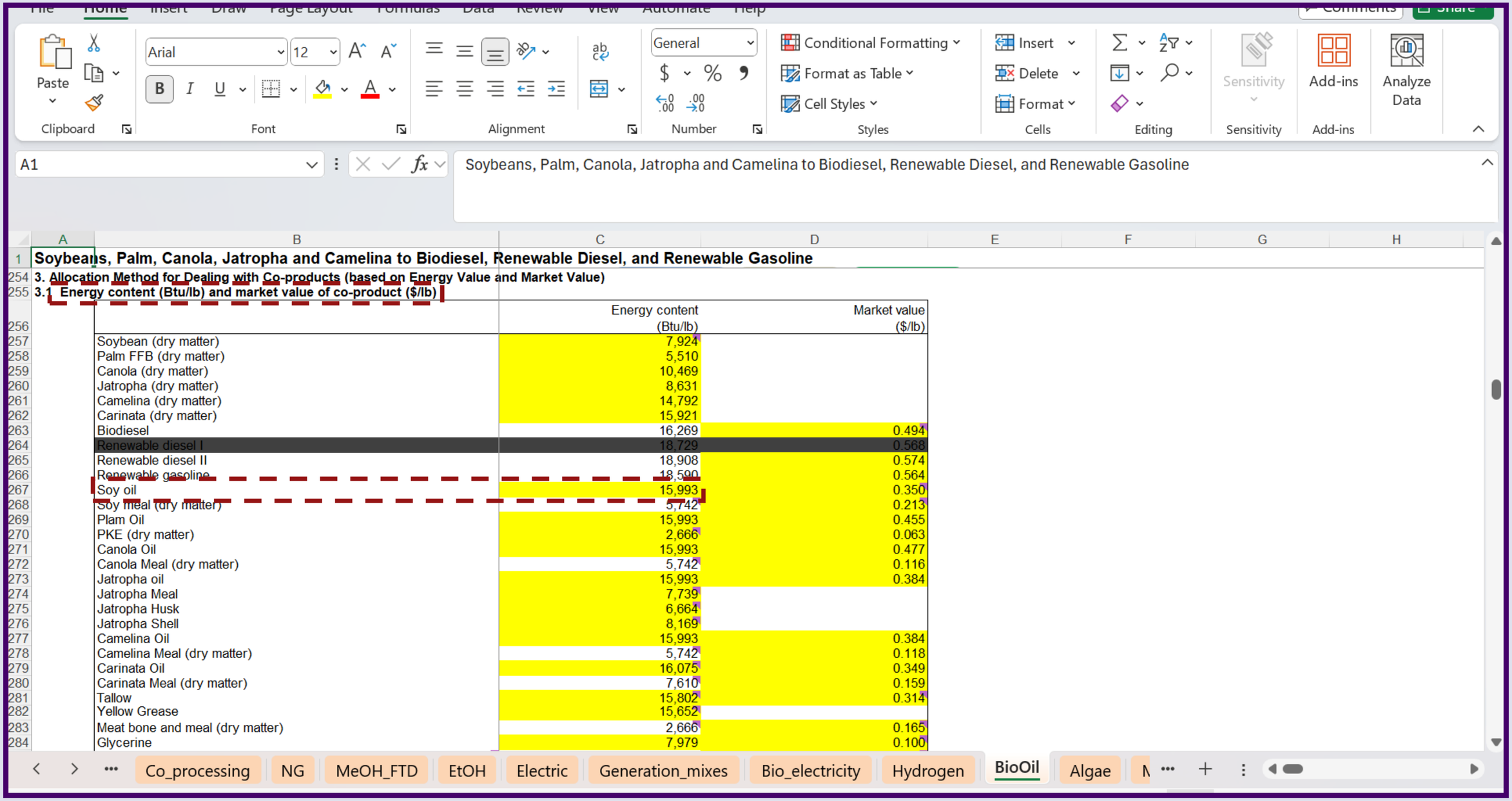


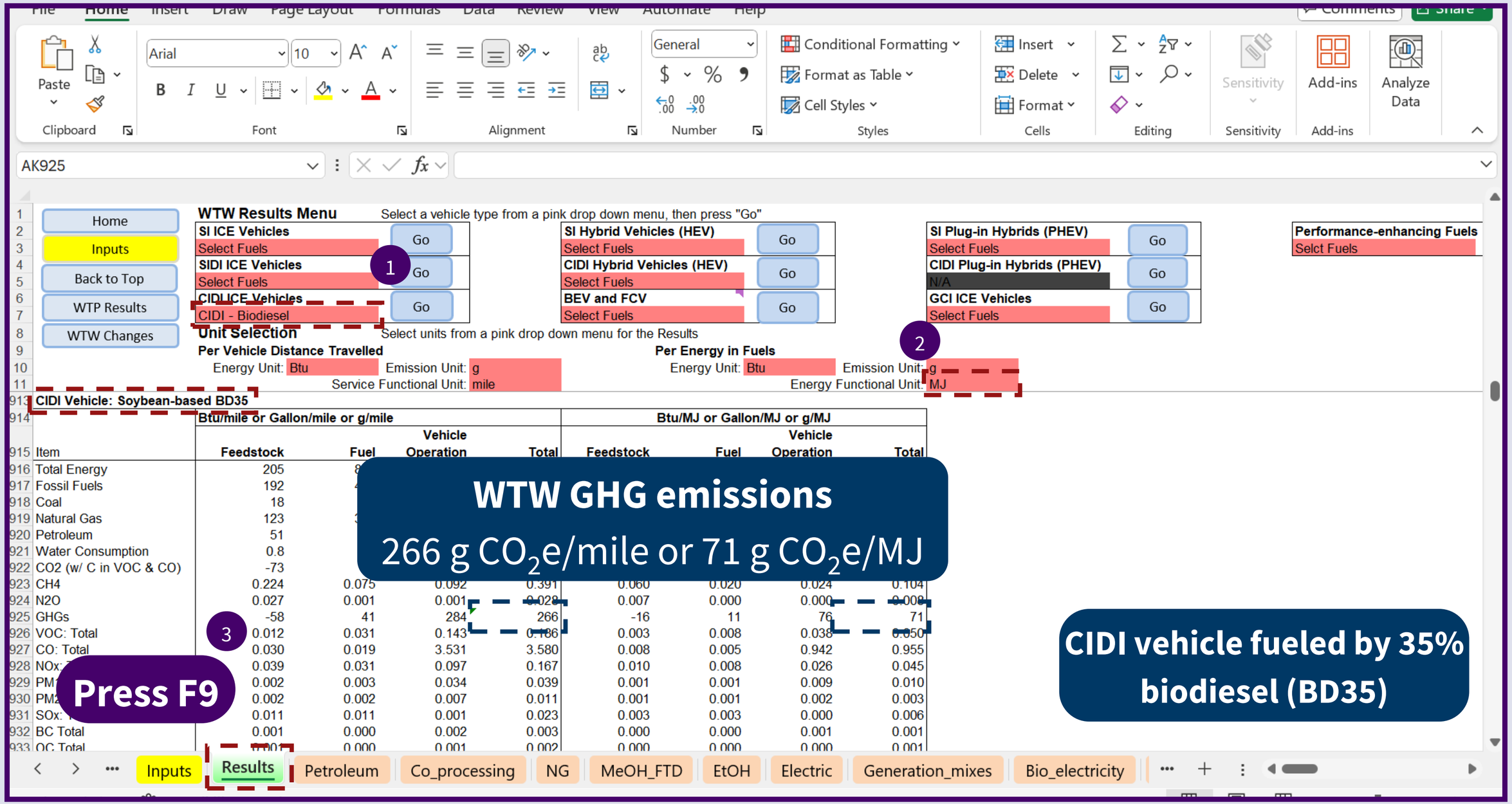
Soybeans, Palm, Canola, Jatropha and Camelina to Biodiesel, Renewable Diesel, and Renewable Gasoline

3. Allocation Method for Dealing with Co-products (based on Energy Value and Market Value)

3.1 Energy content (Btu/lb) and market value of co-product ($/lb)

	Energy content (Btu/lb)	Market value ($/lb)
Soybean (dry matter)	7,924	
Palm FFB (dry matter)	5,510	
Canola (dry matter)	10,469	
Jatropha (dry matter)	8,631	
Camelina (dry matter)	14,792	
Carinata (dry matter)	15,921	
Biodiesel	16,269	0.494
Renewable diesel I	18,729	0.568
Renewable diesel II	18,908	0.574
Renewable gasoline	18,590	0.564
Soy oil	15,993	0.350
Soy meal (dry matter)	5,742	0.213
Plam Oil	15,993	0.455
PKE (dry matter)	2,666	0.063
Canola Oil	15,993	0.477
Canola Meal (dry matter)	5,742	0.116
Jatropha oil	15,993	0.384
Jatropha Meal	7,739	
Jatropha Husk	6,664	
Jatropha Shell	8,169	
Camelina Oil	15,993	0.384
Camelina Meal (dry matter)	5,742	0.118
Carinata Oil	16,075	0.349
Carinata Meal (dry matter)	7,610	0.159
Tallow	15,802	0.314
Yellow Grease	15,652	
Meat bone and meal (dry matter)	2,666	0.165
Glycerine	7,979	0.100

Well-to-Wheel (WTW) GHG Emissions



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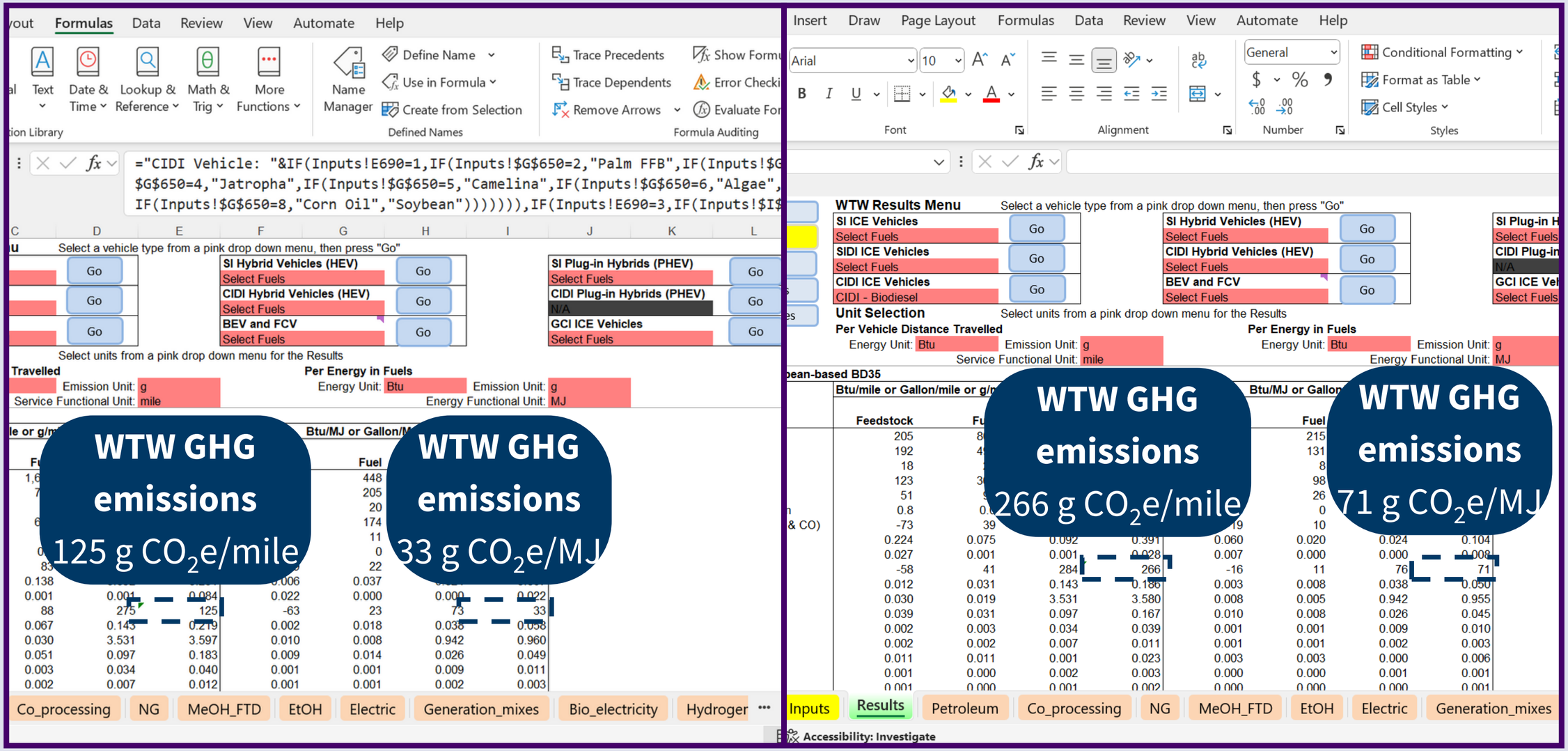
CIDI fueled by soybean renewable diesel

CIDI fueled by 35% soybean biodiesel (BD35)



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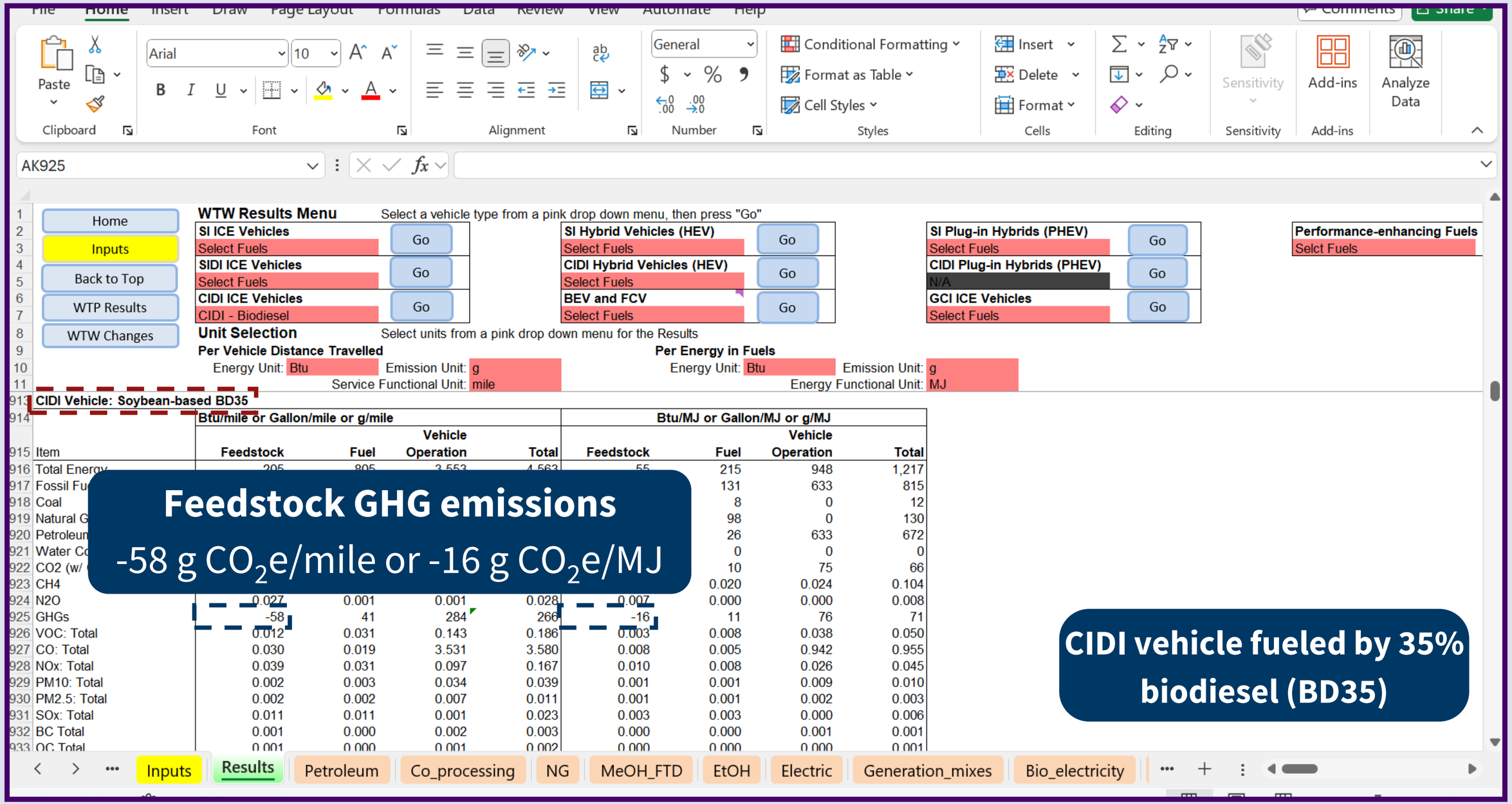
Challenge: Which Stage of the Vehicle Cycle Accounts for Biogenic CO_2 Credits?



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Biogenic credits and emissions

The “Feedstock" stage accounts for the biogenic carbon uptake credit provided due to biomass feedstock production

Biogenic CO_2 emissions are included in the "Vehicle Operation"

The net effect of biogenic CO_2 emissions and the biogenic carbon uptake credit is small

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Renewable Natural Gas Scenarios

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RNG from Landfill Gas

Model a Refuse Truck Fueled by Liquified Natural Gas Produced from RNG from Landfill Gas

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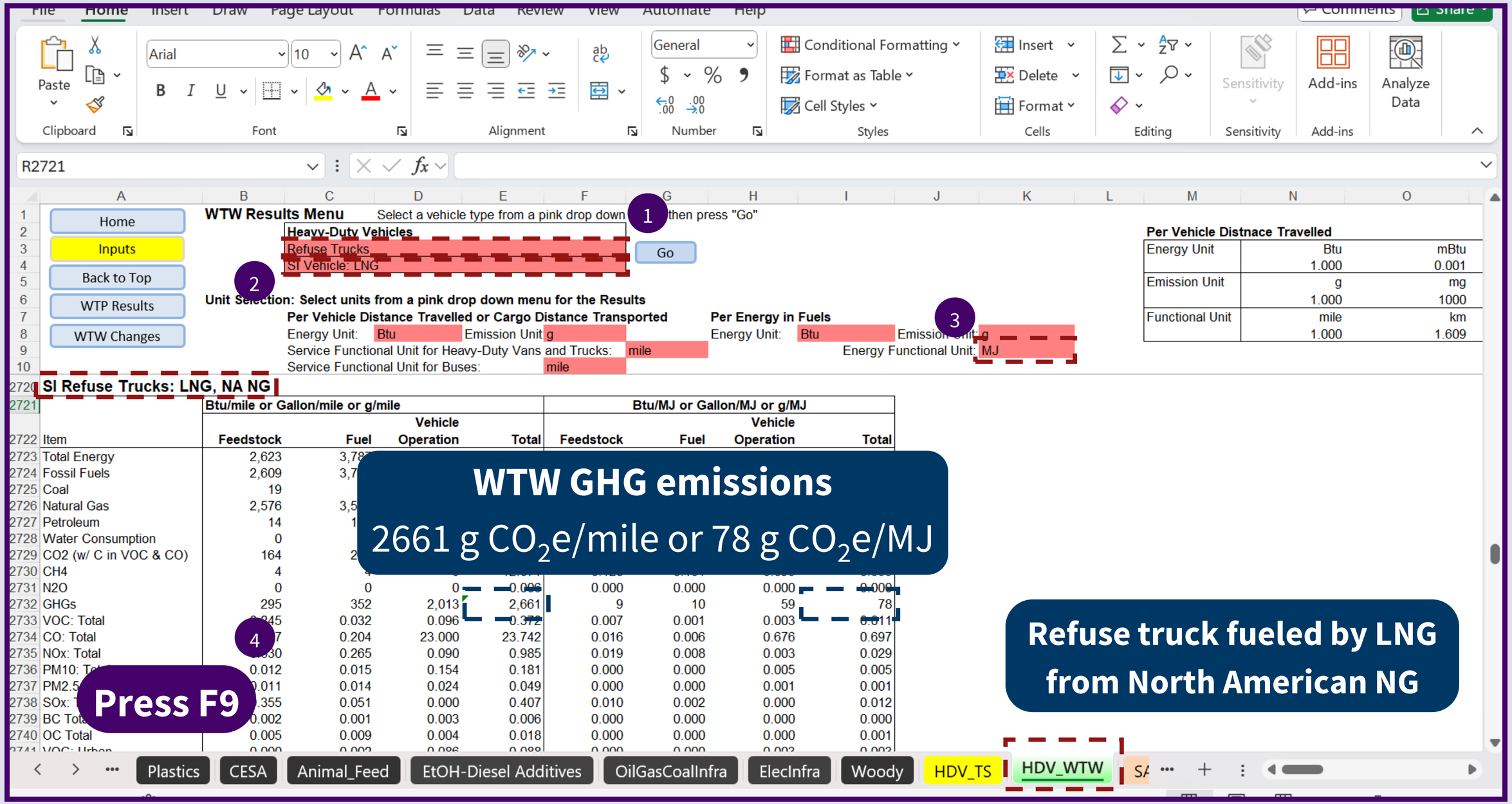

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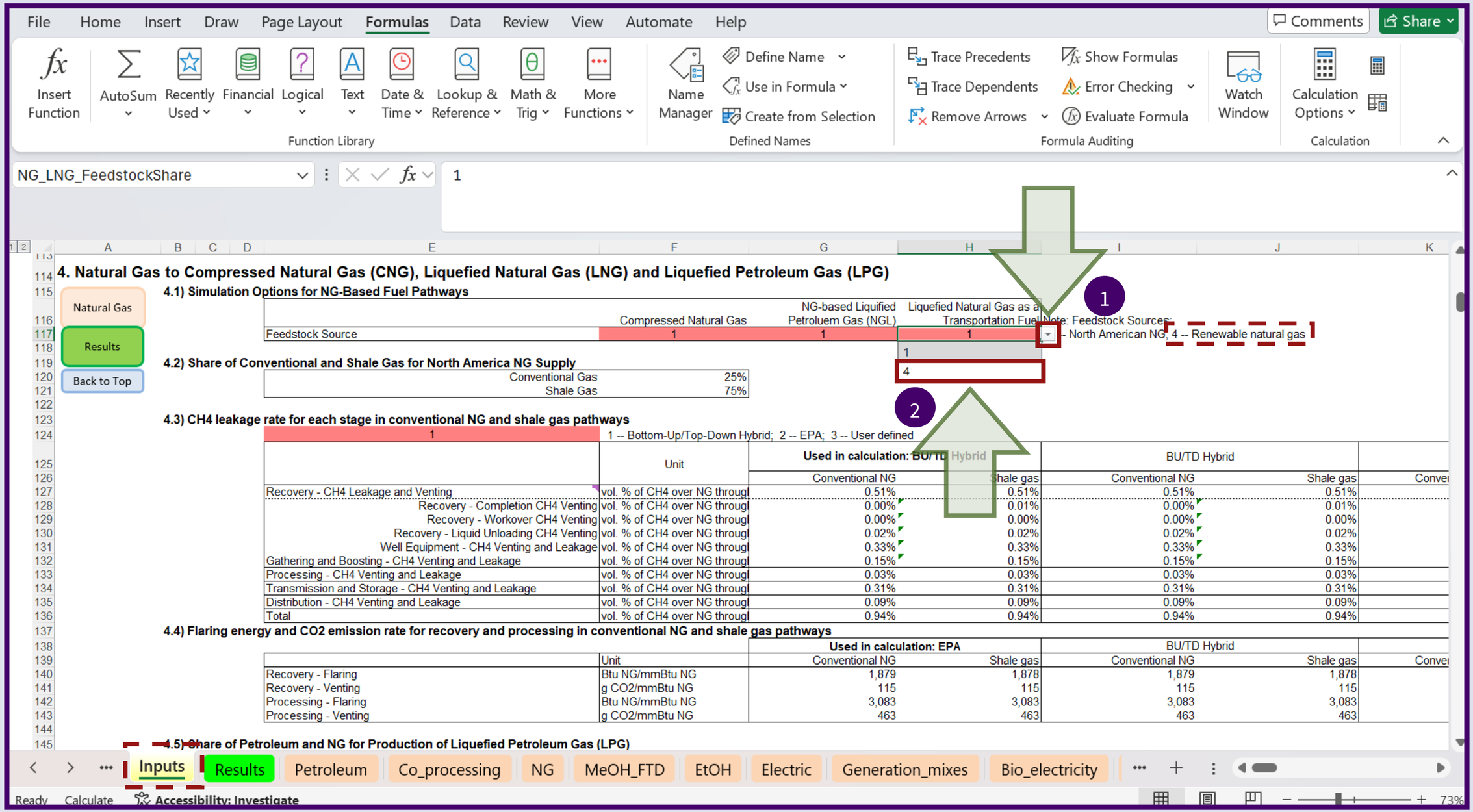

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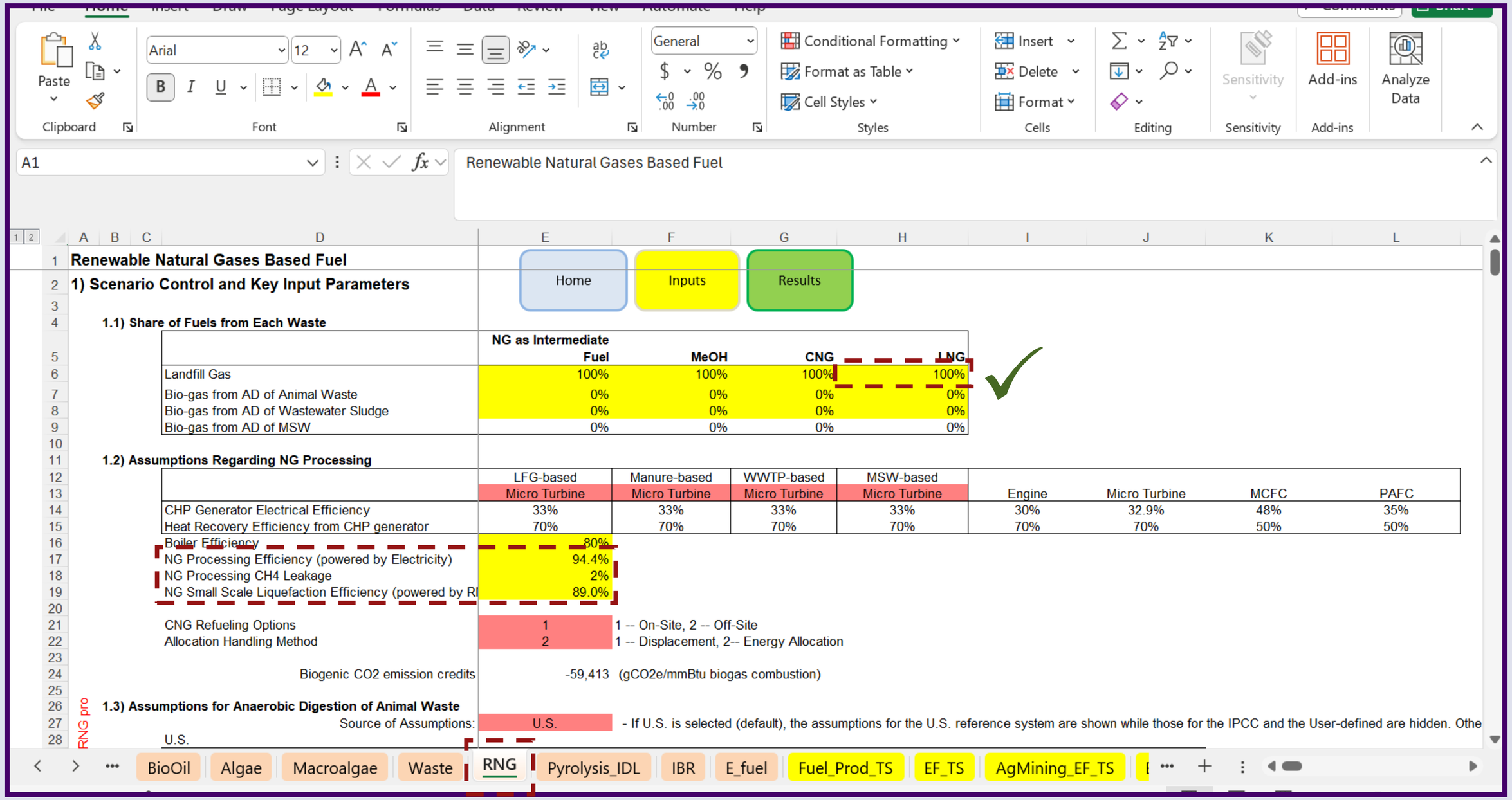

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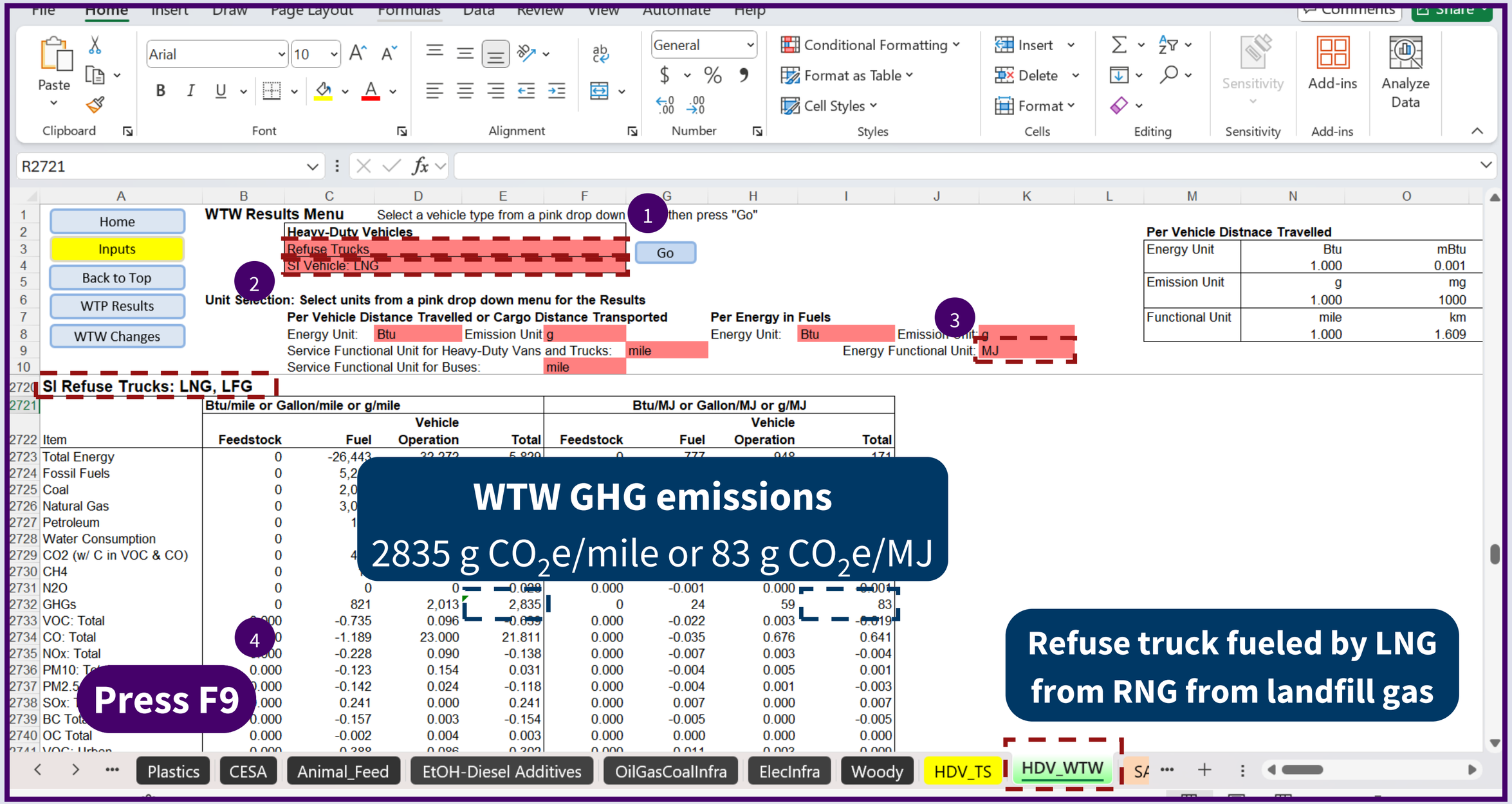
Well-to-Wheel (WTW) GHG Emissions



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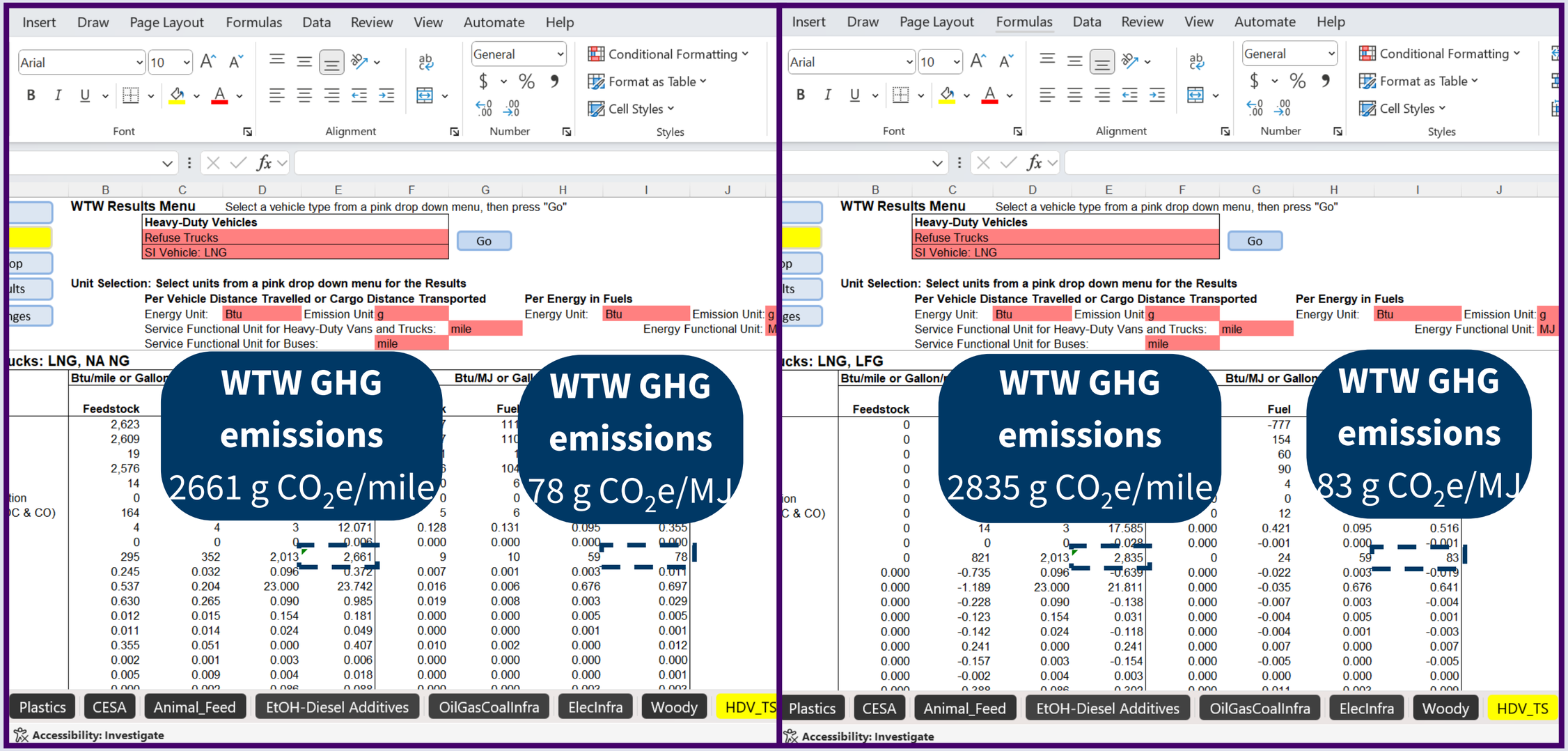
Refuse truck fueled by LNG from North American NG

Refuse truck fueled by LNG from RNG produced from landfill gas



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RNG from AD

Model a Refuse Truck Fueled by Liquified Natural Gas Produced from RNG from Anaerobic Digestion (AD) from Animal Manure

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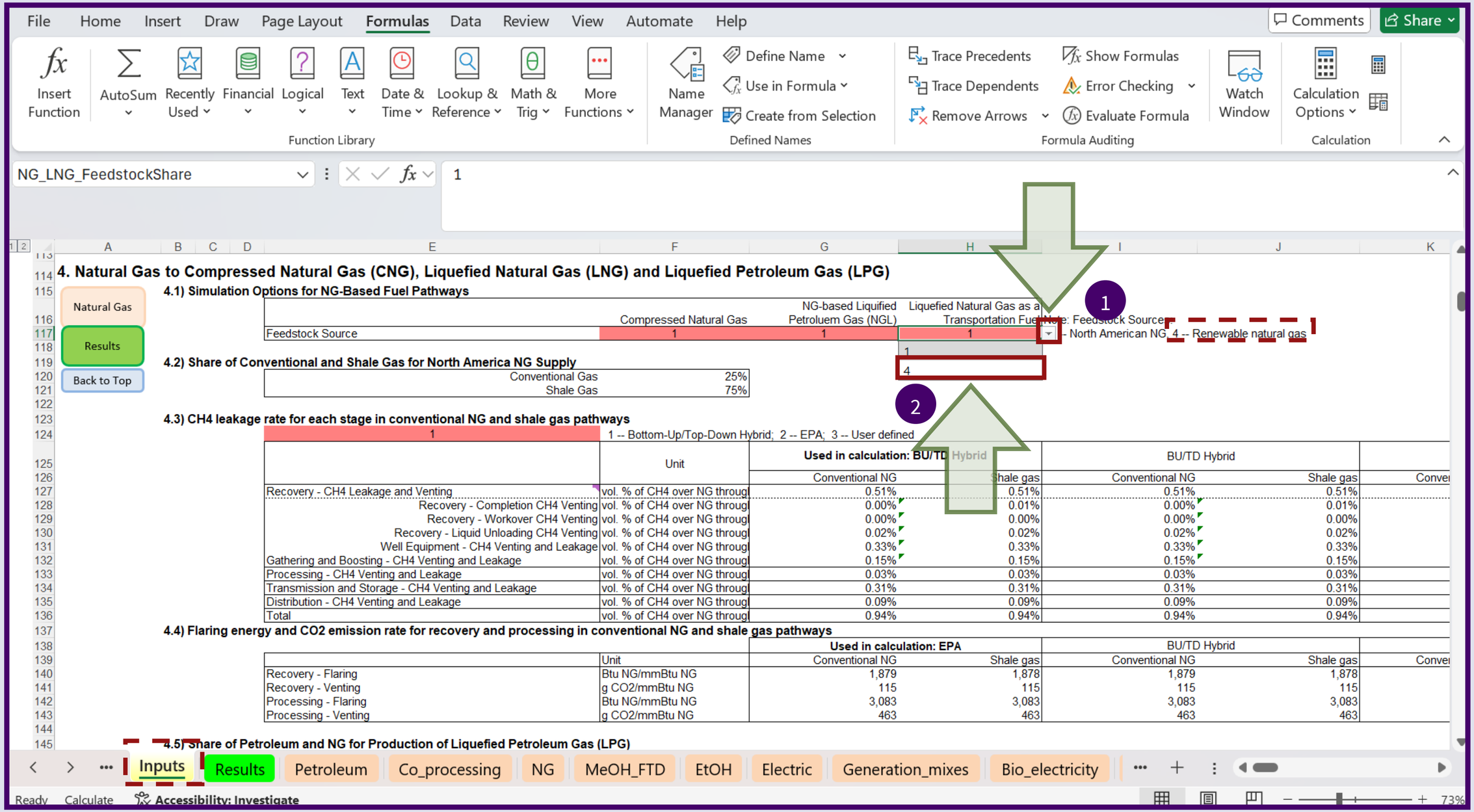

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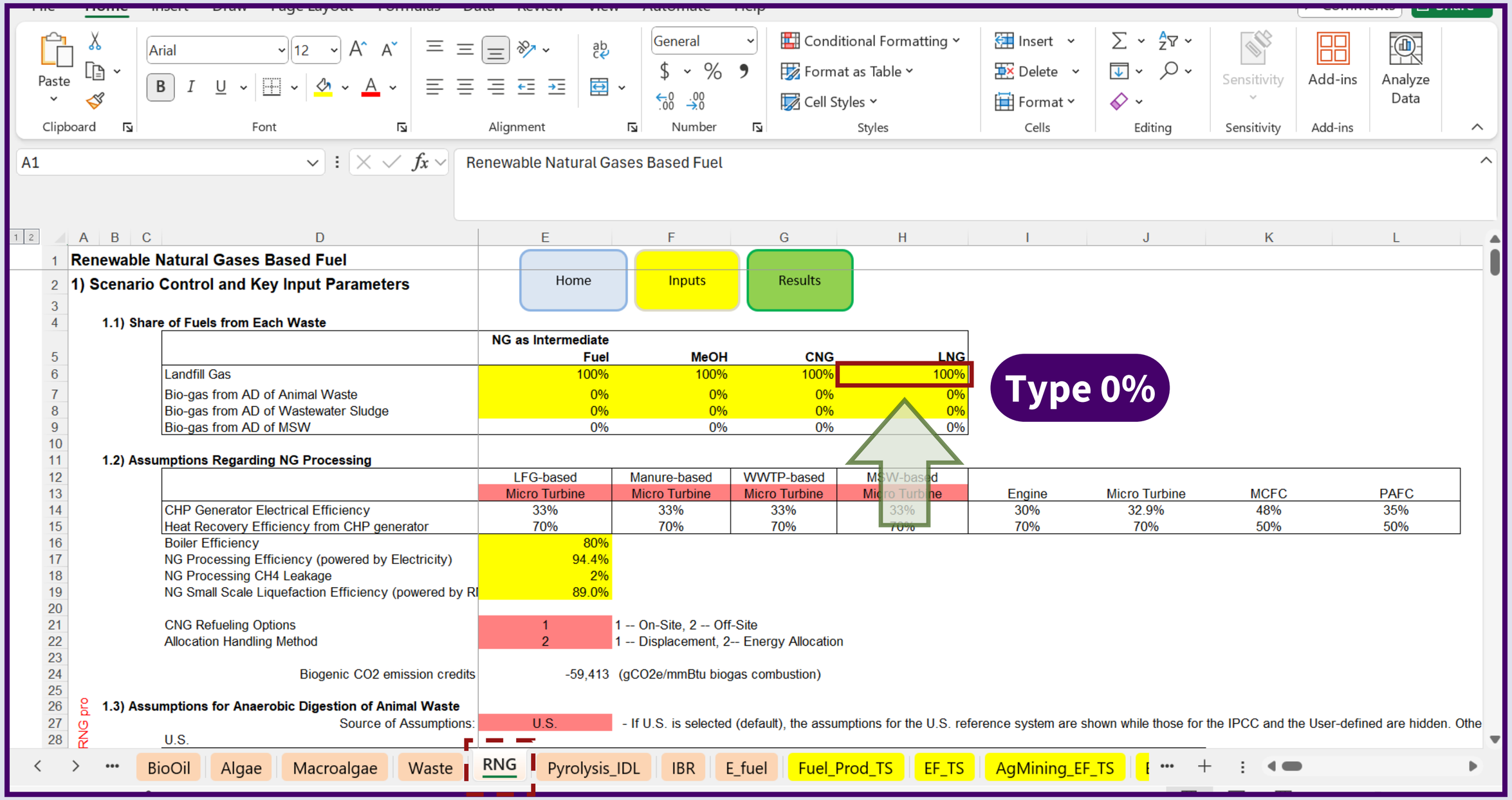

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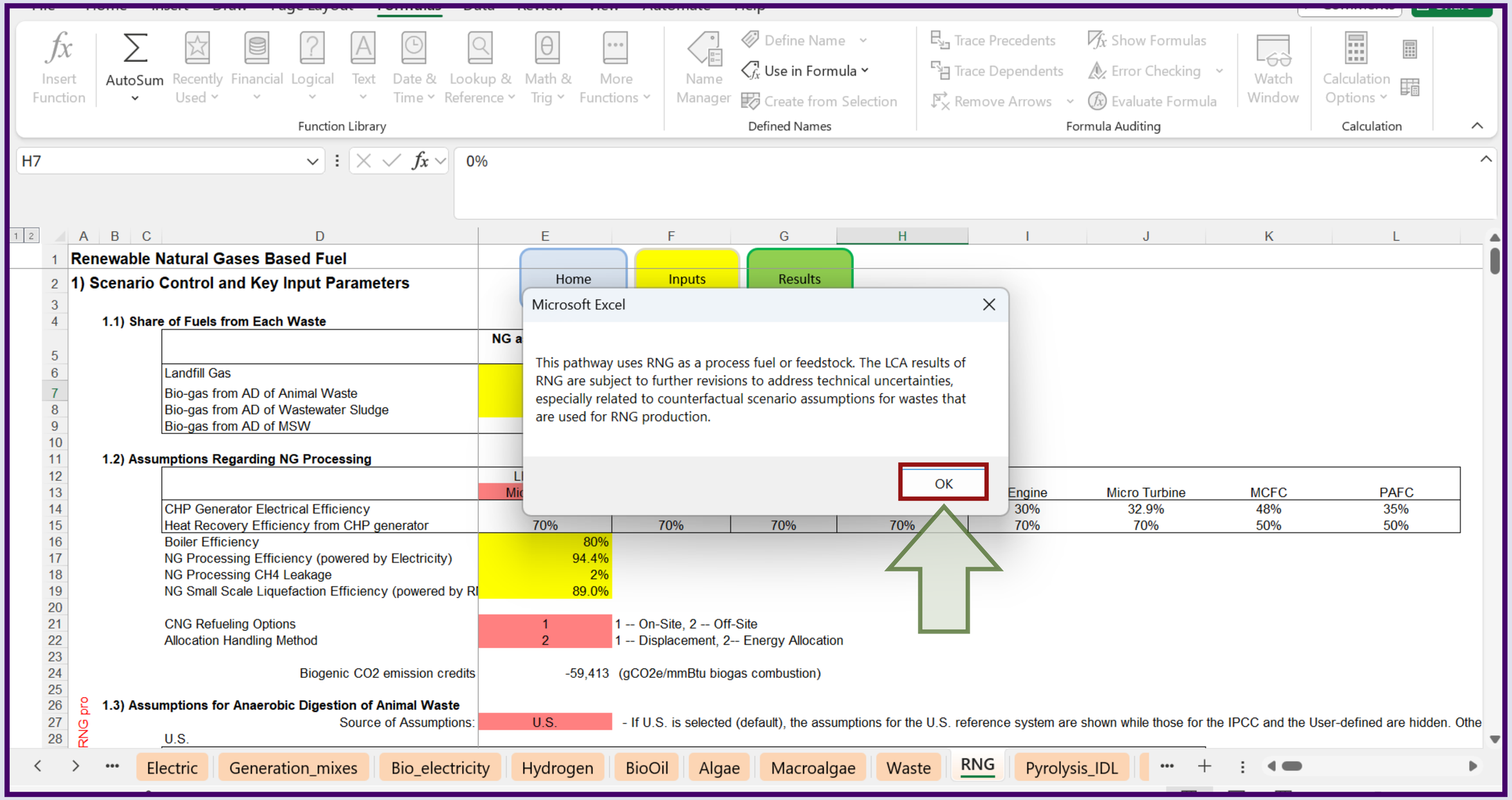
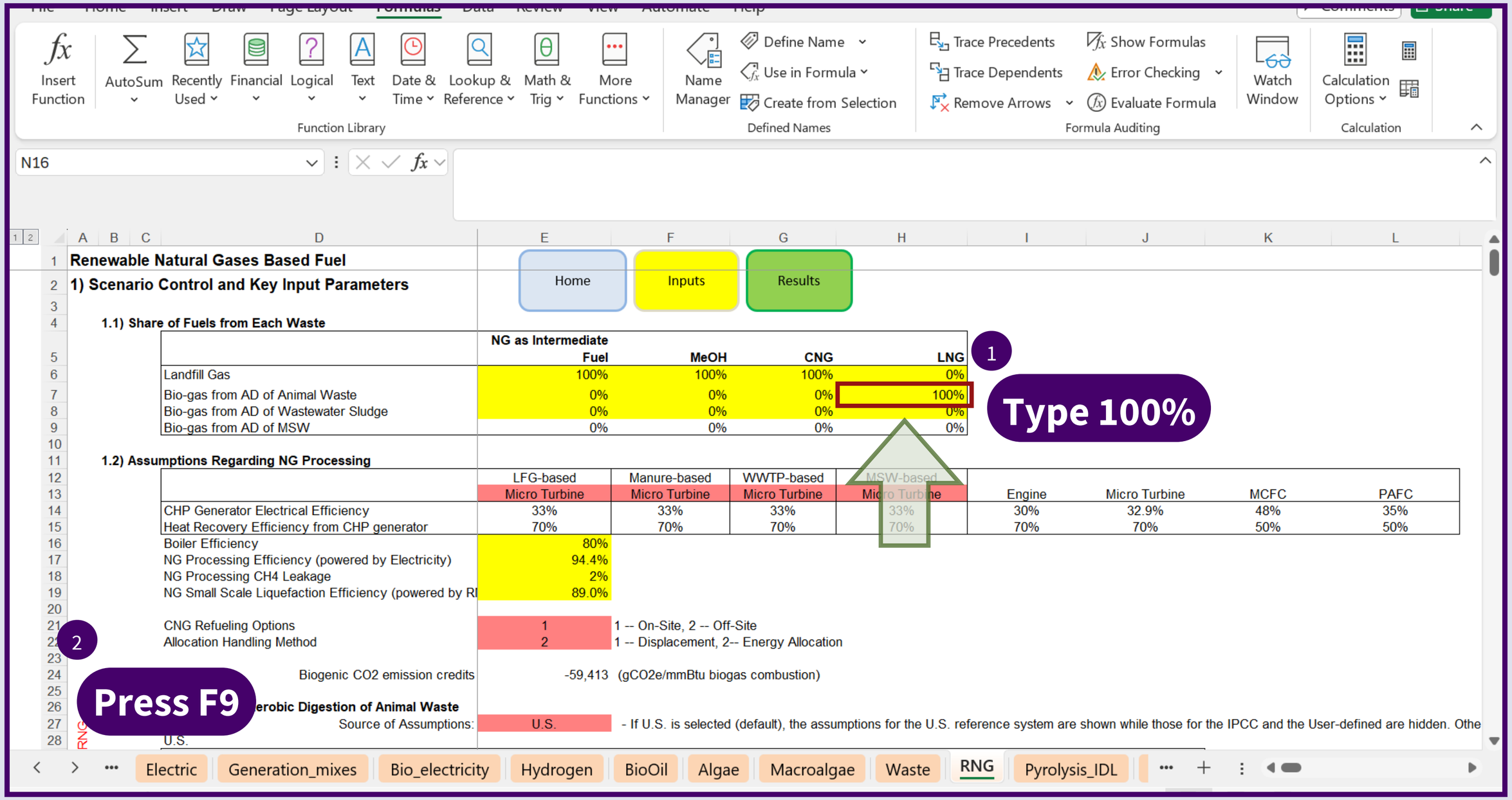

Insert Function
AutoSum
Recently Used
Financial
Logical
Text
Date & Time
Lookup & Reference
Math & Trig
More Functions
Function Library
Name Manager
Define Name
Use in Formula
Create from Selection
Defined Names
Trace Precedents
Trace Dependents
Remove Arrows
Show Formulas
Error Checking
Evaluate Formula
Formula Auditing
Watch Window
Calculation Options
Calculation
H7
0%
Renewable Natural Gases Based Fuel
1) Scenario Control and Key Input Parameters
Home
Inputs
Results
1.1) Share of Fuels from Each Waste
Landfill Gas
Bio-gas from AD of Animal Waste
Bio-gas from AD of Wastewater Sludge
Bio-gas from AD of MSW
1.2) Assumptions Regarding NG Processing
Engine
Micro Turbine
MCFC
PAFC
CHP Generator Electrical Efficiency
30%
32.9%
48%
35%
Heat Recovery Efficiency from CHP generator
70%
70%
70%
70%
70%
70%
50%
50%
Boiler Efficiency
80%
NG Processing Efficiency (powered by Electricity)
94.4%
NG Processing CH4 Leakage
2%
NG Small Scale Liquefaction Efficiency (powered by RI
89.0%
CNG Refueling Options
1
1 -- On-Site, 2 -- Off-Site
Allocation Handling Method
2
1 -- Displacement, 2-- Energy Allocation
Biogenic CO2 emission credits
-59,413
(gCO2e/mmBtu biogas combustion)
1.3) Assumptions for Anaerobic Digestion of Animal Waste
Source of Assumptions:
U.S.
- If U.S. is selected (default), the assumptions for the U.S. reference system are shown while those for the IPCC and the User-defined are hidden. Othe
U.S.
RNG pro
Microsoft Excel
This pathway uses RNG as a process fuel or feedstock. The LCA results of RNG are subject to further revisions to address technical uncertainties, especially related to counterfactual scenario assumptions for wastes that are used for RNG production.
OK
Electric
Generation_mixes
Bio_electricity
Hydrogen
BioOil
Algae
Macroalgae
Waste
RNG
Pyrolysis_IDL



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Default Livestock Producing the Animal Waste in Anaerobic Digestion

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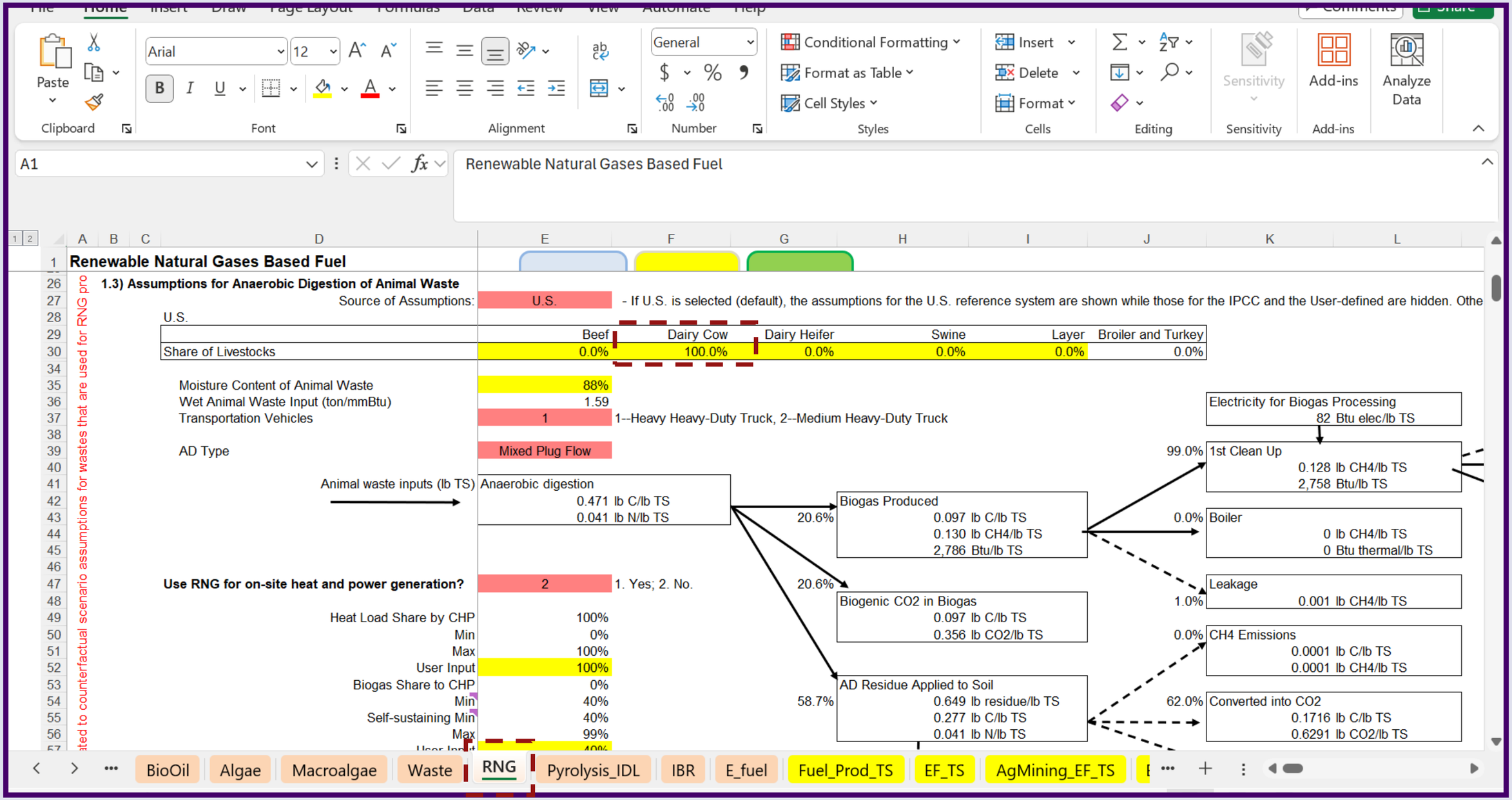

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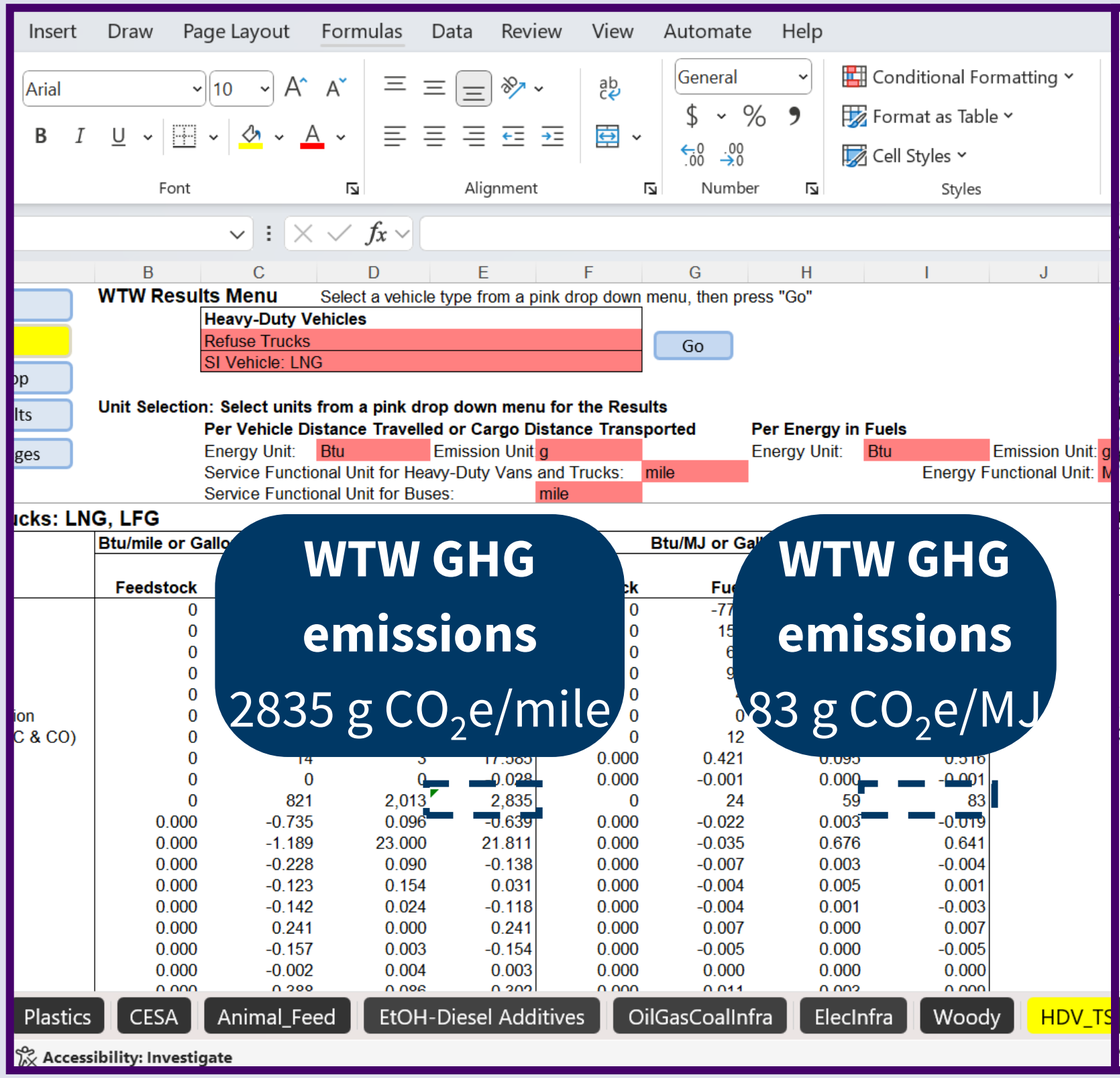
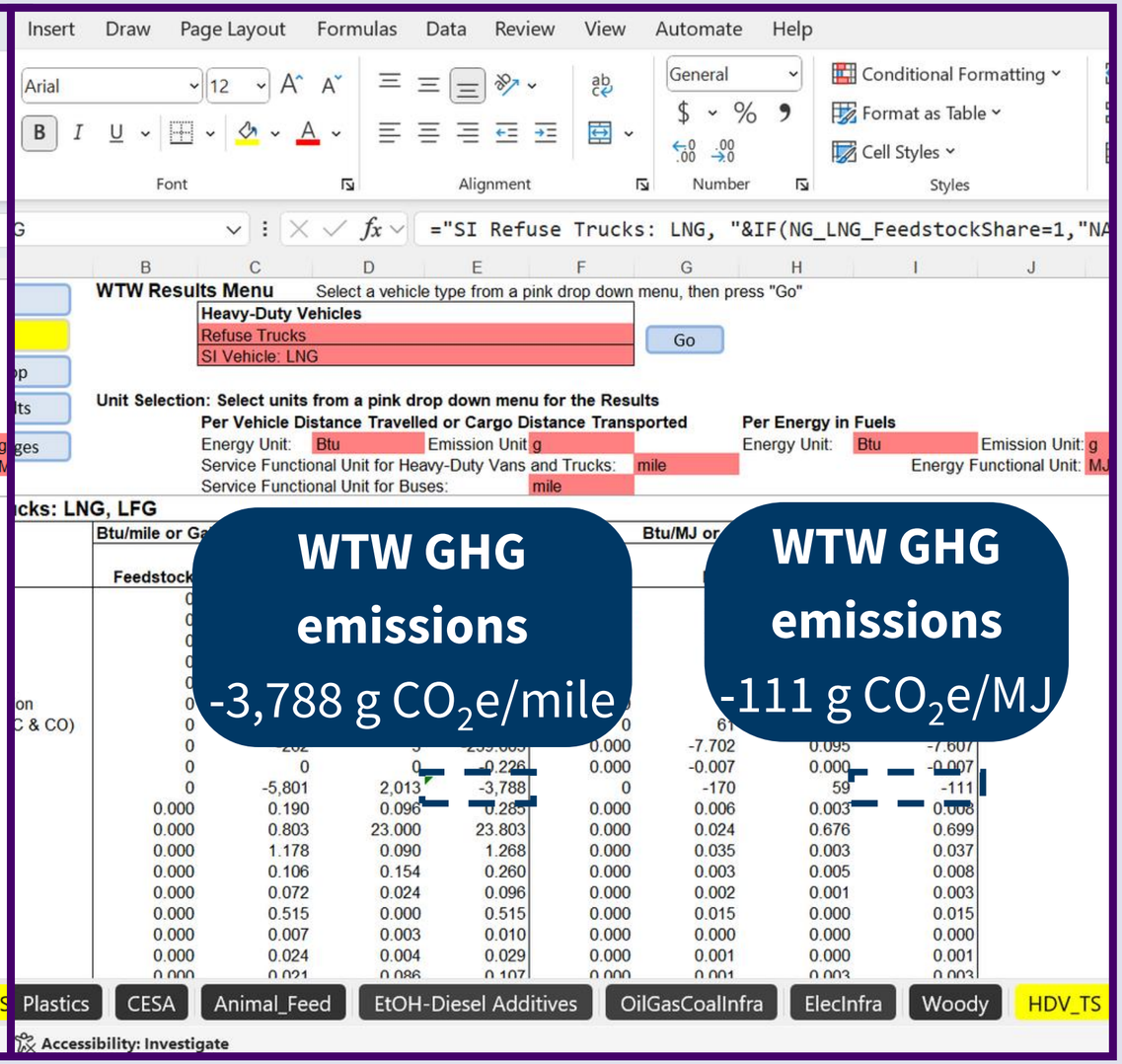
Well-to-Wheel (WTW) GHG Emissions

Refuse truck fueled by LNG from RNG produced from landfill gas

Refuse truck fueled by LNG from RNG produced from AD from animal manure





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Compare RNG from landfill gas and RNG from AD

In GREET, animal manure-based RNG has deeply negative GHG emissions

Assumption in GREET

Typical manure management practices are replaced with AD facilities with RNG upgrading

These manure management practices emit a lot of fugitive methane, so, by ending these practices one receives a significant GHG emissions (negative) credit

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THANK YOU

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