USERGUIDE

Economic Impact Model for Electricity Supply

EIM-ES

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Introducing the EIM-ES

Ambition to Action

OVERVIEW

The Economic Impact Model for Electricity Supply (EIM-ES) is a spreadsheet-based economic model to estimate the domestic employment and wider economic impacts of investments in the electricity supply sector within a country. The model can be set up to include up to 35 technologies to provide an assessment of employment creation, investment and value added across sectors under different future pathways for the development of the electricity sector. The tool can therefore be used to compare the magnitude of economic impacts under a range of scenarios with different technology mixes.

INPUTS

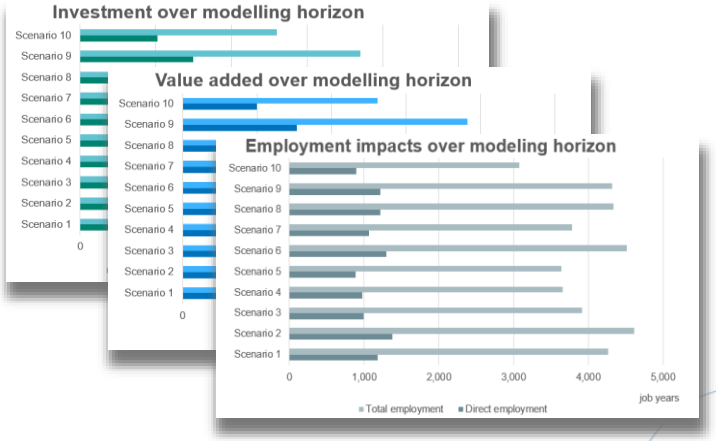
The analysis is based on:

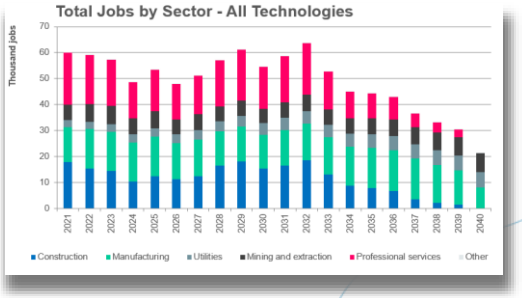
- Investment cost data that is disaggregated, where possible, into its component parts;
- Assumptions on the share of investments that stay within the country;
- Salaries across different sectors;
- Input Output tables, which represent the economic relationships between sectors; and
- Future pathways for electricity supply, including capacity and generation.

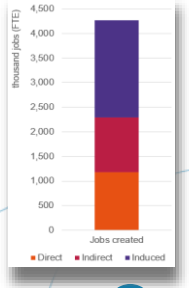
RESULTS

A wide-range of results – broken down by technology, economic sector and type of cost - are shown in tabular and chart form for each scenario as well as headline comparisons between up to ten scenarios. Direct economic impacts are estimated for each year of the analysis period; and the wider indirect and induced impacts are estimated in aggregate over the full period selected by the user.

This document provides a step-by-step guide to setting up and using the model.







Model overview

Purpose and features of the main sections of the model

INPUTS > >	Setup scenarios, define technologies, input costs, salaries and scenario pathway data (capacity, retirements, generation)
IO_INPUT > >	Includes the most up-to-date Input Output table available for the country
Scenario_Loop > >	Sheets used to run through scenarios processing calculations (automated process using VBA)
RESULTS > >	Displays detailed results for each scenario as well as a comparison of the headline scenario results
CALCULATIONS > >	Where the calculations are performed for each technology as well as aggregated indirect and induced economic impacts

IMPORTANT NOTE: Yellow cells throughout the file are input cells where the user needs to include either text or data. Non-yellow shaded cells typically denote where formulas are used to perform calculations or link to other cells.

Opening the Excel file

The file opens on the cover sheet with a notice about calculations: read, click OK and start set up

Ambition to Action

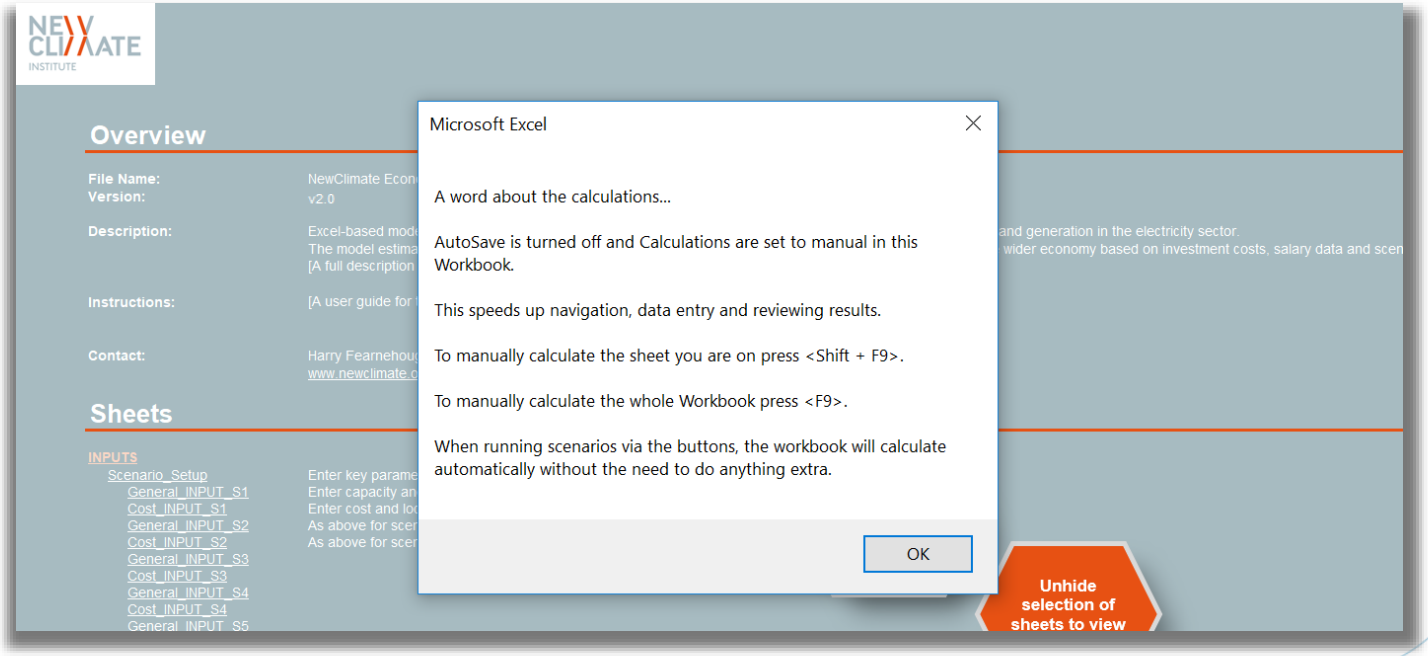
INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >



Setting up the scenarios and technologies

Setup scenarios, define technologies, input costs, salaries and scenario pathway data (capacity, retirements, generation)

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

Scenario_Setup

General INPUT_S1/2/3…

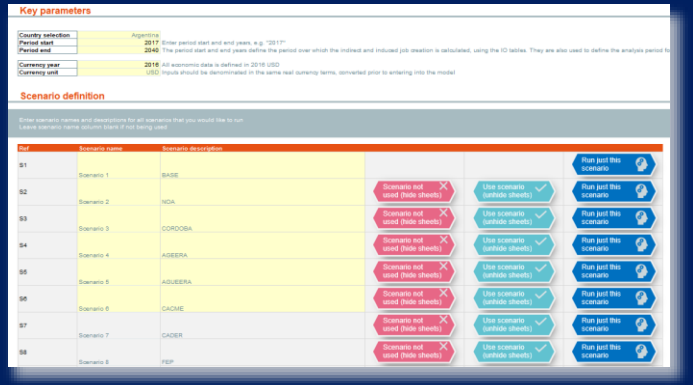
Cost INPUT_S1/2/3…

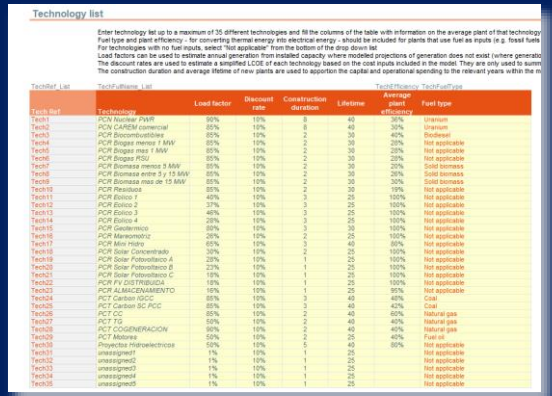
Fuel_Costs

Learning_Curves

DefaultComponent Summary

- Enter country and define analysis period under key parameters
- Investment data and salaries entered in the model need to be expressed in **real terms in the same currency**
- List scenario names and add brief description for reference
- Up to 35 technologies can be included (applies to all scenarios)
- Corresponding information required includes load factor, construction period, lifetime, plant efficiency and fuel type (where relevant)
- **Press F9 (calculate model) once the technology list is complete** to update the list across all sheets





Entering sectoral salaries and scenario pathway data

Setup scenarios, define technologies, input costs, salaries and scenario pathway data (capacity, retirements, generation)

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

Scenario_Setup

General INPUT_S1/2/3…

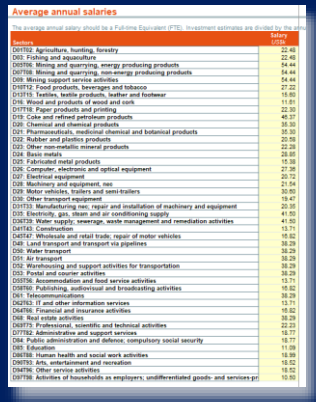
Cost INPUT_S1/2/3…

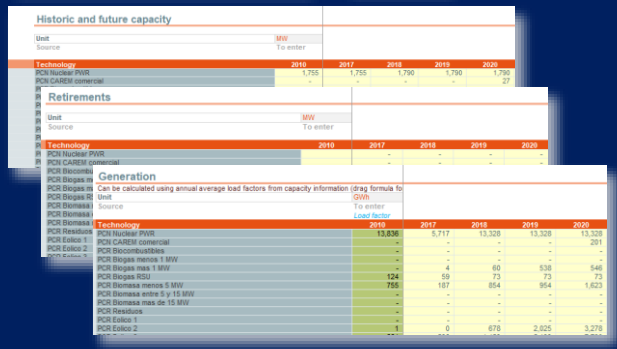
Fuel_Costs

Learning_Curves

DefaultComponent Summary

- Add **salaries** for all sectors included in IO tables
- Use buttons to automatically copy salary information to other General INPUT sheets if using the same for all scenarios
- Add **installed capacity** in each year of horizon and copy data for the last year (if pre 2050) to the end to avoid model interpreting as a fall in capacity
- Add **retirements as negative numbers** (important to ensure model calculates all added capacity)
- Add **electricity generation** if available (or drag turquoise shaded formula to use load factors)





Entering investment costs, local share and sectors

Setup scenarios, define technologies, input costs, salaries and scenario pathway data (capacity, retirements, generation)

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

Scenario_Setup

General INPUT_S1/2/3…

Cost INPUT_S1/2/3…

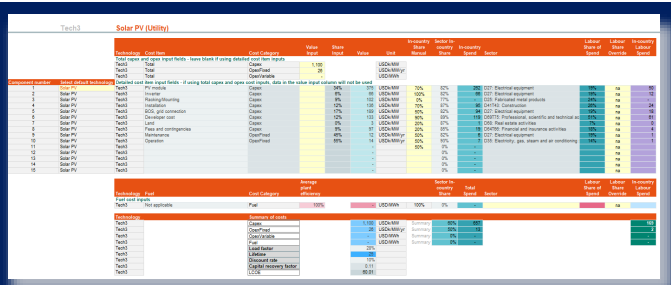
Fuel_Costs

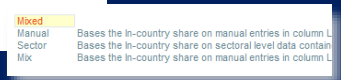
Learning_Curves

DefaultComponent Summary

For each technology…

- Enter **capex**, **fixed opex** and **variable opex** in top 3 rows
- To use default cost components select the **corresponding default technology from the drop down list and recalculate the worksheet (Shift + F9)**. This will automatically populate the cost item, cost category, share input and sector columns. These data can be manually overridden where better information exists (note capex, fixed opex and variable opex should each add to 100%)
- Enter **local share of investment** for each cost component, including fuel where relevant, or use sector level local shares from IO data (set in the box above the first technology)





Default technology

Investment

Local share

Sector

Tech3

Solar PV (Utility)

Component number	Select default technology
1	Solar PV
2	Solar PV
3	Solar PV
4	Solar PV
5	Solar PV
6	Solar PV
7	Solar PV
8	Solar PV
9	Solar PV
10	Solar PV
11	Solar PV
12	Solar PV
13	Solar PV
14	Solar PV
15	Solar PV

Technology	Cost Item	Cost Category	Value Input	Share Input	Value	Unit	In-country Share Manual	Sector In-country Share	In-country Spend	Sector	Labour Share of Spend	Labour Share Override	In-country Labour Spend
Total capex and opex input fields - leave blank if using detailed cost item inputs													
Tech3	Total	Capex	1,100			USDk/MW							
Tech3	Total	OpexFixed	26			USDk/MW/yr							
Tech3	Total	OpexVariable	-			USD/MWh							
Detailed cost item input fields - if using total capex and opex cost inputs, data in the value input column will not be used													
Tech3	PV module	Capex		34%	375	USDk/MW	70%	82%	262	D27: Electrical equipment	19%	na	50
Tech3	Inverter	Capex		6%	66	USDk/MW	100%	82%	66	D27: Electrical equipment	19%	na	12
Tech3	Racking/Mounting	Capex		9%	102	USDk/MW	0%	77%	-	D25: Fabricated metal products	24%	na	-
Tech3	Installation	Capex		12%	136	USDk/MW	70%	87%	95	D41T43: Construction	26%	na	24
Tech3	BOS, grid connection	Capex		17%	189	USDk/MW	50%	82%	94	D27: Electrical equipment	19%	na	18
Tech3	Developer cost	Capex		12%	133	USDk/MW	90%	89%	119	D69T75: Professional, scientific and technical ac	51%	na	61
Tech3	Land	Capex		0%	3	USDk/MW	20%	87%	1	D68: Real estate activities	7%	na	0
Tech3	Fees and contingencies	Capex		9%	97	USDk/MW	20%	85%	19	D64T66: Financial and insurance activities	18%	na	4
Tech3	Maintenance	OpexFixed		45%	12	USDk/MW/yr	50%	82%	6	D27: Electrical equipment	19%	na	1
Tech3	Operation	OpexFixed		55%	14	USDk/MW/yr	50%	93%	7	D35: Electricity, gas, steam and air conditioning	14%	na	1
Tech3					-		50%	0%	-			na	
Tech3					-			0%	-			na	
Tech3					-			0%	-			na	
Tech3					-			0%	-			na	
Tech3					-			0%	-			na	

Technology	Fuel	Cost Category	Average plant efficiency					Sector In-country Share	Total Spend	Sector	Labour Share of Spend	Labour Share Override	In-country Labour Spend
Fuel cost inputs													
Tech3	Not applicable	Fuel	100%		-	USD/MWh	100%	0%	-			na	

Technology	Summary of costs						
Tech3	Capex	1,100	USDk/MW	Summary	60%	657	169
Tech3	OpexFixed	26	USDk/MW/yr	Summary	50%	13	2
Tech3	OpexVariable	-	USD/MWh	Summary	0%	-	-
Tech3	Fuel	-	USD/MWh	Summary	0%	-	-
Tech3	Load factor	28%					
Tech3	Lifetime	25					
Tech3	Discount rate	10%					
Tech3	Capital recovery factor	0.11					
Tech3	LCOE	60.01					

Entering investment costs, local share and sectors

Setup scenarios, define technologies, input costs, salaries and scenario pathway data (capacity, retirements, generation)

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

Scenario_Setup

General INPUT_S1/2/3…

Cost INPUT_S1/2/3…

Fuel_Costs

Learning_Curves

DefaultComponent Summary

- Buttons at the top of the Cost_INPUT_S1 sheet can be used to copy the populated data for all technologies to all other scenarios, or individual scenarios automatically **if using the same cost and local share assumptions for all scenarios**

Adding fuel costs over time and learning curves

Setup scenarios, define technologies, input costs, salaries and scenario pathway data (capacity, retirements, generation)

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

Scenario_Setup

General INPUT_S1/2/3…

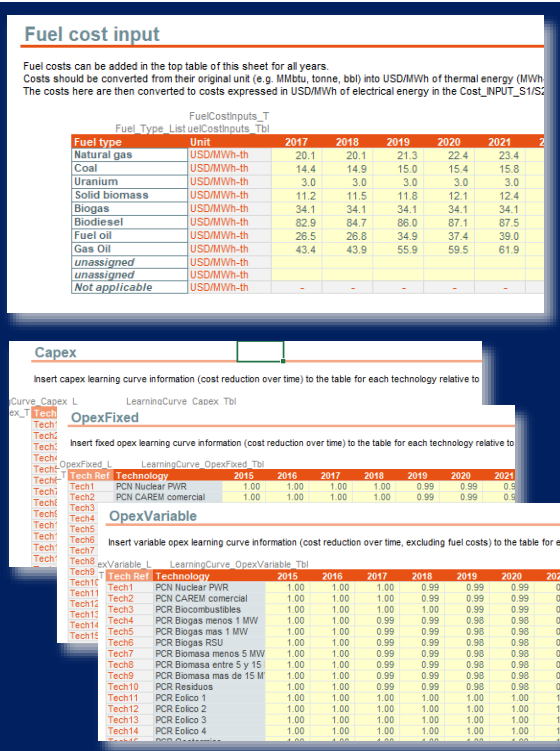
Cost INPUT_S1/2/3…

Fuel_Costs

Learning_Curves

DefaultComponent Summary

- Where available, **fuel cost projections** can be added for all relevant fuels
- All values need to be converted into USD/MWh-thermal prior to entering into the model
- **Technology cost (learning) curves** can be included for capex, fixed and variable opex as an index
- The year the main cost data is based on should be set to one and cost changes entered relative to this value, i.e. if the technology costs are from 2016 then that should be the base year where the index = 1



Fuel cost input

Fuel costs can be added in the top table of this sheet for all years.
Costs should be converted from their original unit (e.g. MMbtu, tonne, bbl) into USD/MWh of thermal energy (MWh
The costs here are then converted to costs expressed in USD/MWh of electrical energy in the Cost_INPUT_S1/S2

FuelCostInputs_T
Fuel_Type_List uelCostInputs_Tbl

Fuel type	Unit	2017	2018	2019	2020	2021
Natural gas	USD/MWh-th	20.1	20.1	21.3	22.4	23.4
Coal	USD/MWh-th	14.4	14.9	15.0	15.4	15.8
Uranium	USD/MWh-th	3.0	3.0	3.0	3.0	3.0
Solid biomass	USD/MWh-th	11.2	11.5	11.8	12.1	12.4
Biogas	USD/MWh-th	34.1	34.1	34.1	34.1	34.1
Biodiesel	USD/MWh-th	82.9	84.7	86.0	87.1	87.5
Fuel oil	USD/MWh-th	26.5	26.8	34.9	37.4	39.0
Gas Oil	USD/MWh-th	43.4	43.9	55.9	59.5	61.9
unassigned	USD/MWh-th					
unassigned	USD/MWh-th					
Not applicable	USD/MWh-th	-	-	-	-	-

Capex

Insert capex learning curve information (cost reduction over time) to the table for each technology relative to

LearningCurve_Capex_Tbl

OpexFixed

Insert fixed opex learning curve information (cost reduction over time) to the table for each technology relative to

LearningCurve_OpexFixed_Tbl

Tech Ref	Technology	2015	2016	2017	2018	2019	2020	2021
Tech1	PCN Nuclear PWR	1.00	1.00	1.00	1.00	0.99	0.99	0.9
Tech2	PCN CAREM comercial	1.00	1.00	1.00	1.00	0.99	0.99	0.9
Tech3								
Tech4								
Tech5								
Tech6								
Tech7								
Tech8								
Tech9								
Tech10								
Tech11								
Tech12								
Tech13								
Tech14								
Tech15								

OpexVariable

Insert variable opex learning curve information (cost reduction over time, excluding fuel costs) to the table for e

LearningCurve_OpexVariable_Tbl

Tech Ref	Technology	2015	2016	2017	2018	2019	2020	202
Tech1	PCN Nuclear PWR	1.00	1.00	1.00	0.99	0.99	0.99	0
Tech2	PCN CAREM comercial	1.00	1.00	1.00	0.99	0.99	0.99	0
Tech3	PCR Biocombustibles	1.00	1.00	1.00	1.00	0.99	0.99	0
Tech4	PCR Biogas menos 1 MW	1.00	1.00	0.99	0.99	0.98	0.98	0
Tech5	PCR Biogas mas 1 MW	1.00	1.00	0.99	0.99	0.98	0.98	0
Tech6	PCR Biogas RSU	1.00	1.00	0.99	0.99	0.98	0.98	0
Tech7	PCR Biomasa menos 5 MW	1.00	1.00	0.99	0.99	0.98	0.98	0
Tech8	PCR Biomasa entre 5 y 15	1.00	1.00	0.99	0.99	0.98	0.98	0
Tech9	PCR Biomasa mas de 15 M	1.00	1.00	0.99	0.99	0.98	0.98	0
Tech10	PCR Residuos	1.00	1.00	0.99	0.99	0.98	0.98	0
Tech11	PCR Eolico 1	1.00	1.00	1.00	1.00	1.00	1.00	1
Tech12	PCR Eolico 2	1.00	1.00	1.00	1.00	1.00	1.00	1
Tech13	PCR Eolico 3	1.00	1.00	1.00	1.00	1.00	1.00	1
Tech14	PCR Eolico 4	1.00	1.00	1.00	1.00	1.00	1.00	1

Default breakdown of technology costs

Setup scenarios, define technologies, input costs, salaries and scenario pathway data (capacity, retirements, generation)

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

Scenario_Setup

General INPUT_S1/2/3…

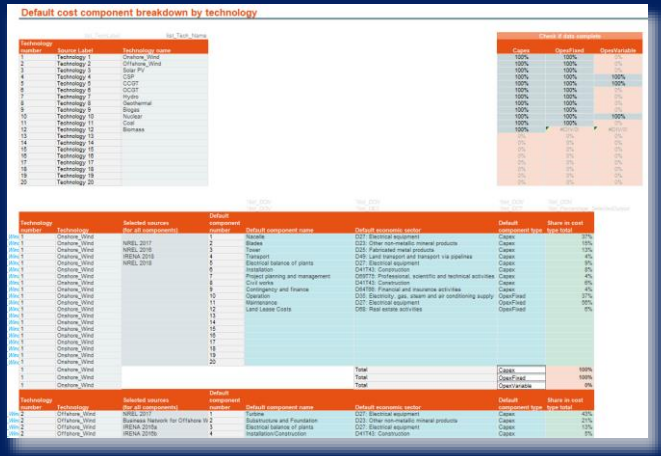
Cost INPUT_S1/2/3…

Fuel_Costs

Learning_Curves

DefaultComponent Summary

- Provides a **default breakdown of capex and opex** investments by component part for a selection of technologies
- Also includes sector mapping to ISIC rev4 sectors
- Sheet acts as an interface to a separate database that analyses publicly available technology cost breakdowns from literature



Model is set up for OECD input output database

Include the most recent Input Output table for the country

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

- Standard version of the model is set up to work with the 45 sectors included in **OECD data tables** (2021 version)
- Excel file downloaded from OECD and data input directly as values
- A limitation of the analysis using Input Output tables is that the energy sector is represented at a relatively aggregated level
- The model **can be configured to accommodate alternative sources of Input Output tables** with different sector configurations

https://stats.oecd.org/Index.aspx?DataSetCode=IOTS_2021

Run scenarios in the model

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

Scenario_Setup

General INPUT_S1/2/3…

Cost INPUT_S1/2/3…

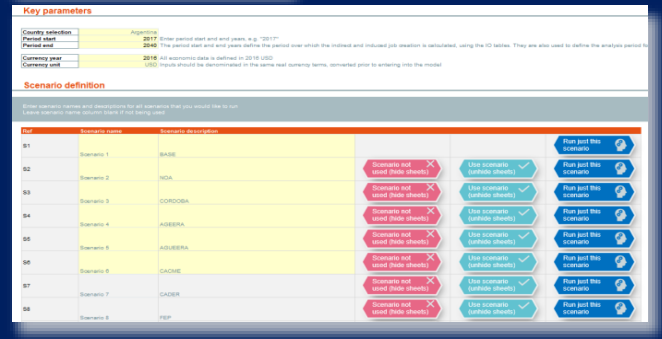
Fuel_Costs

Learning_Curves

DefaultComponent Summary

- When all input data is entered into the model return to the Scenario_Setup sheet
- All scenarios **where a scenario name is entered** can be run using the large turquoise button labelled Run all scenarios
- **Individual scenarios** can be run using the blue buttons

Note: Depending on the processing speed of the computer, each scenario can take approximately a minute to run. It is advisable to **save and close any other Excel files that are open** prior to executing the scenario runs.



Automatically looping through scenarios

Sheets used to run through scenarios using buttons (automated process using VBA)

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

CALCULATIONS > >

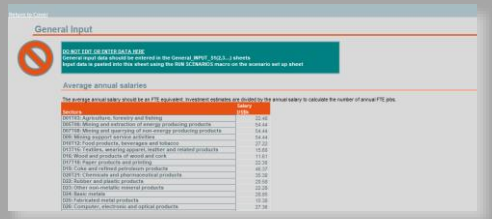
General_INPUT

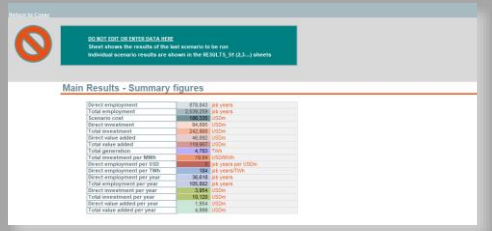
Cost_INPUT

ScenarioRESULTS

- Sheets are used to facilitate the automation of scenario runs
- The sheets should **not be edited and can be left hidden** for ease of navigating the model. Their structure needs to remain aligned to the scenario input and results sheets
- The following steps are performed automatically when running a scenario (via buttons):
  1. Copies the data from the General… and Cost… INPUT_S1/2/3 sheets
  2. Pastes the data as values into the General… and Cost… INPUT sheets
  3. Calculates the model generated results in the ScenarioRESULTS sheet
  4. Copies the results to the respective RESULTS_S1/2/3 sheets as values

  Steps 1-4 are repeated for all scenarios that are selected to run





Reviewing the scenario results

Displays the results for each scenario as well as a comparison of the headline scenario results

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

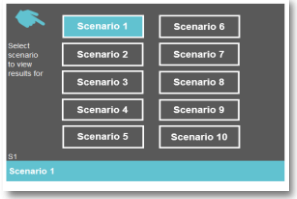
CALCULATIONS > >

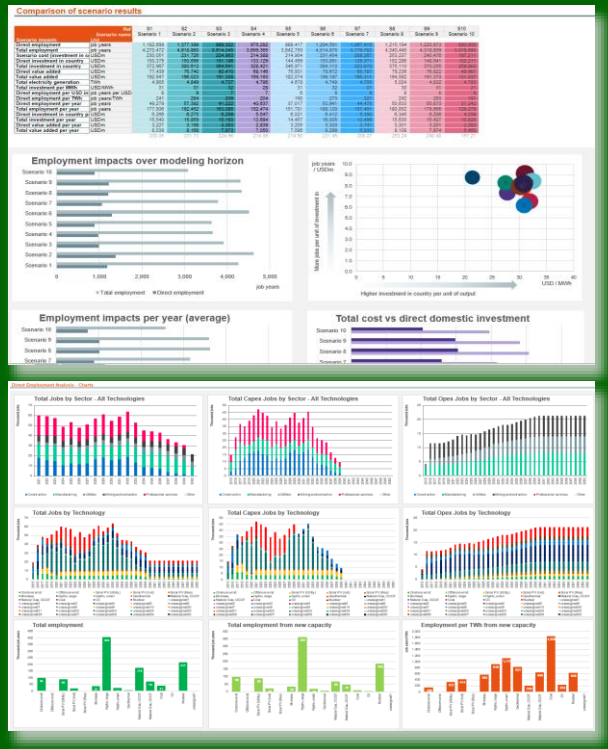
Scenario Comparison

RESULTS_Charts

RESULTS _S1/2/3…

- Scenario Comparison sheet provides a **high level summary and comparison of the employment and wider economic impacts** across the different scenarios
- RESULTS_Charts sheet allows the user to select a scenario at the top (click the box for the desired scenario) and view a dashboard of result charts, including technology specific visualisations.
- Individual scenario results sheets include **detailed tables of results** broken down by:
  - Technology
  - Economic sector
  - Year of analysis
  - Direct, indirect, induced
  - Capex, opex
  - Etc.





Calculation sheets for each of the technologies

Where the calculations are performed for each technology as well as aggregated indirect and induced economic impacts

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

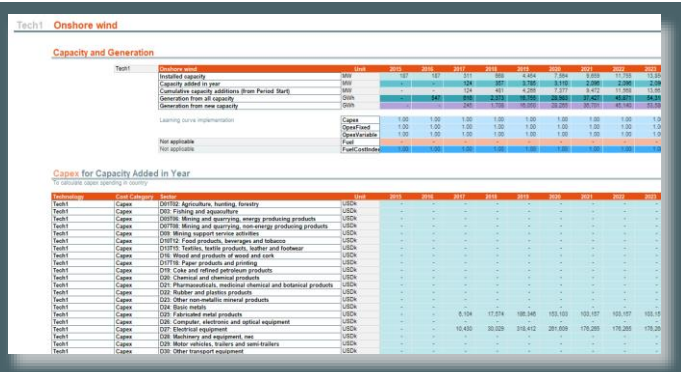
CALCULATIONS > >

Tech 1,2,3…

Sectoral_IMPACTS

I_O_TABLE

- There is a Calculation sheet for each of the 35 potential technologies
- Calculates the **direct** investment in each year for capex and opex as well as the **direct** investment in the labour market
- These sheets **should not be edited and can be left hidden** for ease of navigating the model (button in TECHNOLOGIES >> sheet)
- Data in the sheets will always reflect the last scenario to run in the model
- Results sheets summarise the estimates of **direct employment and investment** in each of these technology sheets



Calculation sheets to derive indirect and induced effects

Where the calculations are performed for each technology as well as aggregated indirect and induced economic impacts

Ambition to Action

INPUTS > >

IO_INPUT > >

Scenario_Loop > >

RESULTS > >

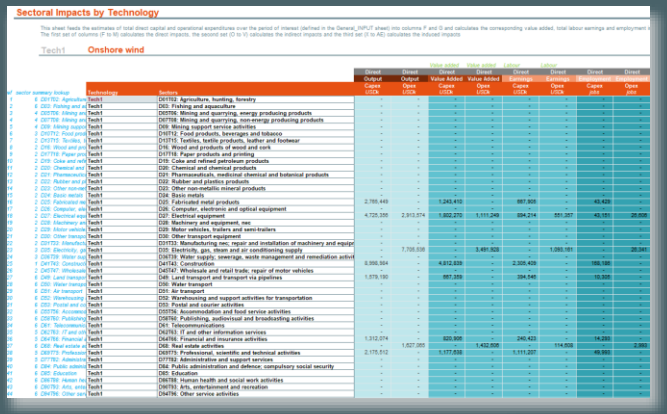
CALCULATIONS > >

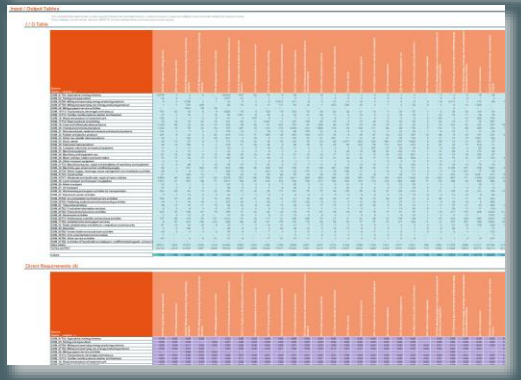
Tech 1,2,3…

Sectoral_IMPACTS

I_O_TABLE

- Direct, indirect and induced economic and employment impacts are calculated in the Sectoral_IMPACTS sheet
- Calculations take the aggregate investment over the period defined in the Scenario_Setup sheet
- Calculations are carried out at the economic sector level
- Type 1 and Type 2 multipliers are derived from the IO table in the I_O_TABLE sheet and used to estimate indirect and induced impacts of investments, respectively
- Sectoral level local share estimates are also derived from the IO table data





QUESTIONS / COMMENTS / FEEDBACK

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Ambition to Action