

Instructions for operating FTT:Power for Matlab in Windows or MacOSX.

- 1- This working version of FTT:Power on Matlab is FTT59x24v7 for Windows and MacOSX
- 2- The file to fire it up in matlab is called FTT59x24v7Gui.m (GUI = Graphical User Interface)
- 3- The main simulation code is in the file called FTT59x24v7f.m
- 4- Download the FTT .zip file from Blackboard
- 5- Decompress files in a working folder that you choose
- 6- Start Matlab.
- 7- Change the Matlab current directory to your FTT working directory
- 8- Type **FTT59x24v8Gui** in the command line to fire up the FTT window
 - 9- FTT needs to know in which directory to find assumption files. Press the '...' button under 'Assumptions Spreadsheet'. Choose the excel file with the policy assumptions. The default file in the bundle is called '**Assump_FTTpower_61.xlsx**'.
 - 10- Do the same for the 'Historical Data Spreadsheet' and the 'Natural Resources File' These files are '**FTT61x24v8.1_HistoricalData2017.xls**' and '**FTT61x24v8_CSCurvesHybrid.xlsx**'.
- 11- At this point, FTT knows where to find information. You can click on 'Calculate'. You should wait and see two progress bars appear one after the other. A green square next to the button will also appear, indicating that a calculation is in progress. When finished, that square becomes red, indicating that the calculation is done.
- 12- Before calculating scenarios, (in this new version) you must load the historical, natural resources and costs data into the program by pressing the 'Load History' button. This remains in memory until you shut the program.
- 13- You can calculate any scenario you want by choosing a scenario number and clicking on 'Calculate'. This will read all 6 policy sheets and calculate a scenario based on them. (NOTE: costs data are read with pressing 'Load History').
- 14- You can also calculate a list of scenarios using 'Calculate List'. You can specify which ones using for example '0:9' for scenarios 0 to 9, or you can specify particular ones using e.g. '1 5 6 7' separated by spaces. The baseline corresponds to scenario 0.
- 15- When calculated, red rectangles appear next to the scenario numbers. Each scenario calculated can be explored by plotting graphs. The name of variables (see below for details) are consistent with the paper Mercure Energy Policy (2012), and given in the list below. In version 7, only one scenario is given, the baseline. All sets of pages for scenarios 1 to 6 are identical to the set 0 and can be used to add new policies to the baseline.
- 16- You can save to disk the scenarios calculated using the 'Save Scns' button. This enables to quickly load previously calculated scenarios using the 'Load Scns' button later if you close FTT. The filename under which this is saved is in the field 'Matlab Scenario Save File', name to which FTT adds scenario numbers in the file name.
- 17- You can have as many projects as you want using different assumptions files and scenario save files. Each project can have up to 10 scenarios in one excel file.
- 18- To start editing the policy numbers, you must keep the baseline scenario, which is in the 6 pages with names finishing with the number 0 (i.e. Sub0, Fit0, Reg0 .. MWKA0). To create new scenarios, you can use existing sets of pages, or copy-paste these 6 pages (right click on a sheet name, use 'move or copy') with the same names, replacing 0 by a new scenario number between 1 and 9.
- 19- Data can be exported to disk in either excel **xlsx** or **csv** files, using the 'Excel' or 'Csv' buttons on the bottom right of the interface. NOTE: exporting in **xlsx** does not work on macs, but csv does, which can then be opened with excel. Reading mac excel works however.
- 20- For those who would like to work with FTT numbers directly in the Matlab command line (e.g. plot in ways that the interface does not do), you can export all variables from one scenario to the main Matlab workspace (memory) using the button 'Workspace'. A structure will appear in memory called either Baseline or ScenarioX. You can access data through the structure, e.g. for shares or generation it is in Sc0.S and Sc1.G etc, the number indicating the scenario number.
- 21- In case the simulation crashes before the end date, the 'crash info' button can sometimes tell you where the problem originated. Whenever this happens, it is almost always due to exceeding the maximum of a cost-supply curve (exceeding natural resources, see Mercure & Salas 2012) leading to infinity costs and LCOEs. The button tells you in which country and technology the crash

originated. When this happens it is best to go back to the previous scenario specification that worked, and/or ask me for help.

List of variables:

S – Shares of capacity $S_i = \frac{U_i}{\sum U_i}$

G – Electricity generation in GWh/y

U – Electricity generation capacity in GW (power plants)

E – CO2 emissions (Gt)

CF – Capacity factors (% of full time generators are operating)

LCOE – Levelised cost of electricity (2013\$/MWh), including carbon price but no other policies

TLCOE – LCOE as seen by investors, with all policies, used in the choice model

LCOEs – LCOE without any policies, only technology and resource effects

W – Cumulative capacity production for learning curves (GW)

I – New built generation capacity, (GW/y)

P – Marginal costs of producing fuels, per fuel type.

TPED – Total primary energy demand by fuel type.

T – Taxes or subsidies (fraction between 0 and 1)

Fcosts – Fuel costs (2013\$/MWh)

ICosts – Investment costs in the LCOE (2013\$/kW)

CFCosts – Inverse of the capacity factor as appears in the LCOE

CO2Costs – Carbon costs (2013\$/MWh)

S_lim – Share limits 1 (see Fig 2 in Mercure 2012)

S_lim2 – Share limits 2 (see Fig 2 in Mercure 2012)

Policy levers in FTT:

FTT:Power is a model with one of the most detailed list of policy options of all global electricity models available. Evaluating policy impacts, and, especially, the impacts of combinations of policies is what FTT is designed for. FTT currently has 5 types of policies that can be applied independently in all regions, specified in corresponding excel sheets

- 1- **Subsidies** (Sub): Subsidies on the capital cost of technologies (e.g. public-private partnerships). This is specified as a negative % of the capital cost by region and technology in the 'SubX' spreadsheet (X is the scenario number)
- 2- **Feed-in tariffs** (FiT): Feed-in tariffs are prices offered to producers for their electricity below market price. They are specified in \$/MWh subtracted from the bare LCOE (the producer receives this additional amount of money, which makes his costs this much less). Take care that FiTs can lead to negative LCOEs, which is highly unrealistic.
- 3- **Regulations** (Reg): Capacity cap in GW. Determines what can be built or not. If the current capacity in a country/technology is higher than the regulation value, no more units can be built and existing units are replaced at the end of their lifetime by other technologies. Capacities below the cap cannot grow to values above the cap. Specified in the RegX sheet.
- 4- **Carbon price/tax** (CO2P): Tax applied to emissions by electricity generators proportional to their emissions, in \$/tCO2. This is specified in sheet CO2PX, either in Euro/tC (top matrix) or 2008 US\$/tCO2 (lower matrix). The software reads the matrix below, but a conversion can be used. One value per country and year can be specified.
- 5- **Exogenous capacities** (MWKA): Command and control government planning on electricity generation capacity. This is specified in sheet MWKAX, in which capacities are specified in GW per technology/country.
- 6- **Demand management** (DP): This is not quite a policy instrument, but exogenous parameters, which can be related to policy, the total electricity demand per country. For students working with the economic model, this can be obtained from E3ME.