**Models.py**

* Abstract factory pattern
* Assumptions:
  + Boiler
    - EPA Report from 1978 to populate model based off of input heat rate (not output)1
    - Boiler best practice is to operate near full load to maximize efficiency – could make a blanket assumption that the boiler is capable of doing that2
    - Currently using the maximum sized boiler and make up the remaining capacity with a smaller one. In the future need to look at average boiler size – distinguish between fire-tube, water-tube and packaged vs field-erected3
    - Assumed under 5MM BTU<hr uses 5 MM BTU<hr boiler from EPA rather than sourcing from <https://www.osti.gov/servlets/purl/797810> (For NG). Under 15 MMBTU <hr coal uses 15 MMBTU boiler.
    - For coal intersection around the 200-250 in coal models select pulverized as pulverized more efficient than stoker 4
    - Efficiencies sourced from the IEA technology brief for boilers5
    - For now uniform 8760 peak heat load assumption
    - Chemical engineering cost index + PPI chemicals for index\_mult
    - Get\_efficiency not a function of hload atm
    - Heating values for different fuel types done manually atm because no need to load a large CSV file just to grab 1 value – will change when using dask
    - Depreciation schedule – 15 years
    - 0.5 shifts per new boiler

**Create\_LCOH\_Obj**

* Abstract factory pattern
* Assumptions
  + ITC time year based
  + Corp\_Tax added on state basis
  + MACRS 5 year schedule for solar
    - Straight line for anything outside of 5/7/10 year MACRS
  + Working with nominal discount rate

**Get\_API\_Params**

* NG -> industrial price ($ per thousand cubic feet)
* COAL -> other industrial use price ($ per short ton)
* Petroleum -> residual fuel oil prices by area -> wholesale/resale price by all sellers annual ($ per gallon)
* Grabs latest available fuel year – if national average 2 years more recent than state -> take national average

**Create\_cost\_index:**

* https://fred.stlouisfed.org/series/WPU061 - producer price index csv
* https://www.chemengonline.com/pci - chemical eng cost index - by year

**create\_Format**

* string format creation from pre-defined lists

**References**

[1] COST EQUATIONS FOR INDUSTRIAL BOILERS PEDCo Environmental - US EPA + CAPITAL AND OPERATING COSTS FOR INDUSTRIAL BOILERS PEDCO Environmental

[2] <https://www1.eere.energy.gov/femp/pdfs/OM_9.pdf>

[3] <https://iea-etsap.org/docs/TIMES_Dispatching_Documentation.pdf>

[4] <https://www.epa.gov/sites/production/files/2015-12/documents/iciboilers.pdf>

[5] <https://iea-etsap.org/E-TechDS/PDF/I01-ind_boilers-GS-AD-gct.pdf>