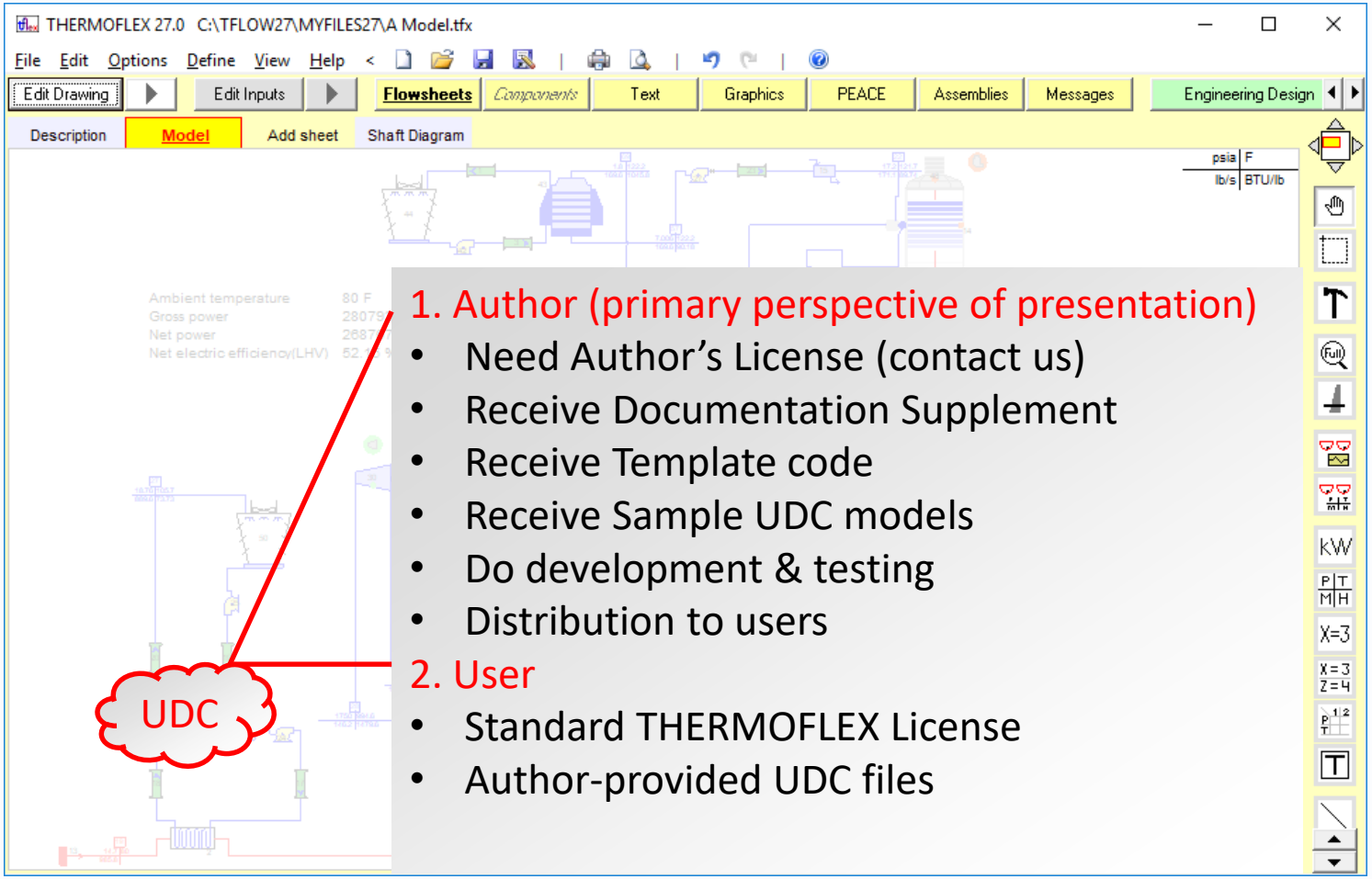
Thermoflow's User-Defined Component (UDC)

Creating, using, and distributing a THERMOFLEX component (icon) to run your calculation code

UDC: Who, What, Where, When, & Why

- **Who:** OEMs, R&D, IP Developers, Tinkerers
- **What:** system to create & use your own code & methodology in our modeling environment
- **Where:** THERMOFLEX– fully flexible modeling environment with > 220 standard built-in components handling 7 fluid types
- **When:** THERMOFLEX since 1995, UDC since 2004
- **Why:** Model systems built with widely-accepted, proven, robust components in commercially-available and widely-used modeling environment, including your code.

UDC: Overview



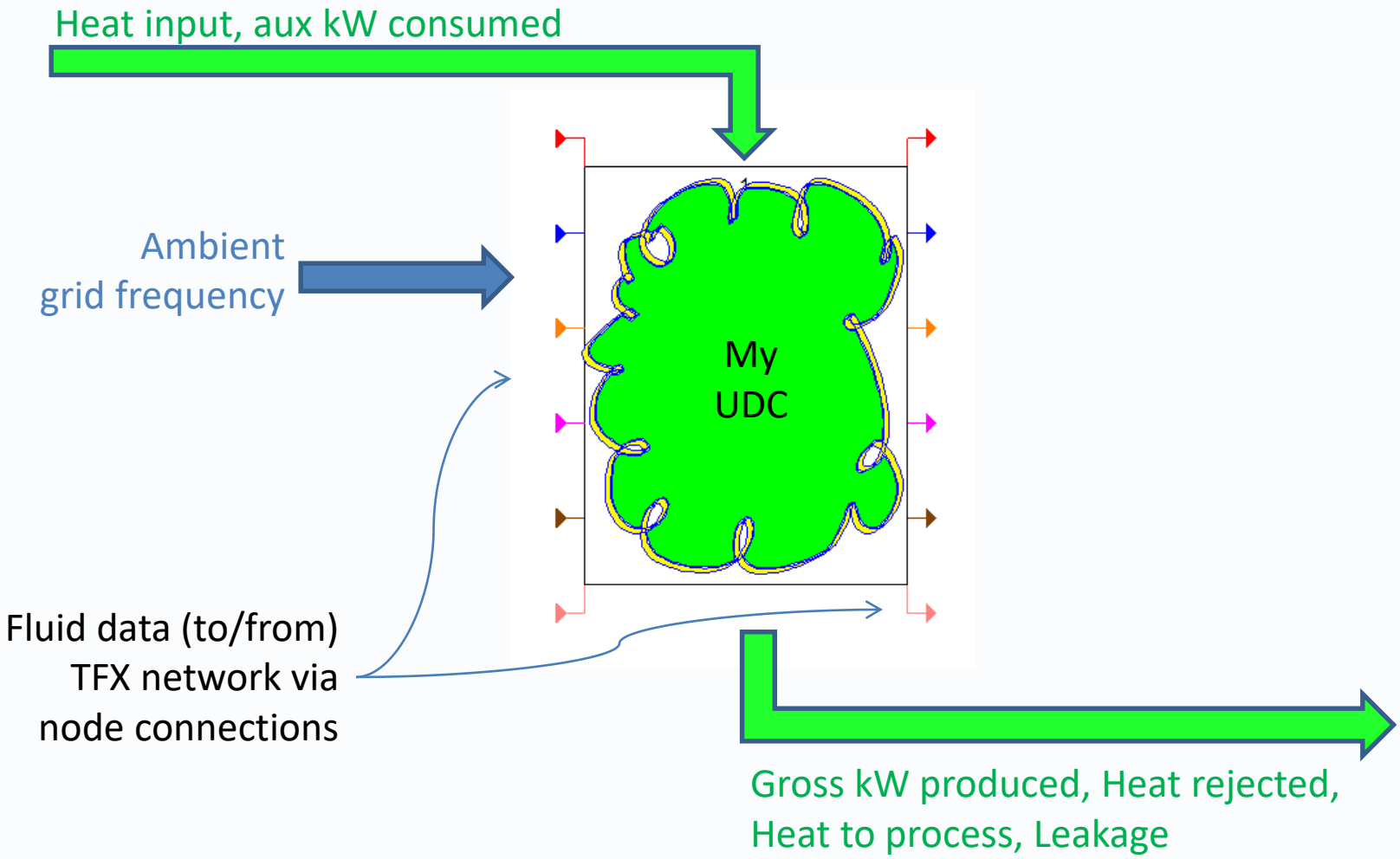
Component **Author** – TFX Build Steps

- Define icon's shell (image & nodes) so THERMOFLEX knows how to connect your component into a network and it has a visage
- Define inputs so the user can edit parameters needed by your model
- Define outputs that will be returned to the user so s/he knows how the calculation turned out
- Define messages (error, warning, advisory, or remarks) so your code can communicate with the user
- Add your code to the automatically-generated Excel workbook or to the template FORTRAN project. (EXE's can be built in any language).
- Test, fix, test, fix, … so the component is robust and useful
- Distribute UDC files - (model.myc, model.xlsx/model.exe, any required datafiles used by the component) to THERMOFLEX users.

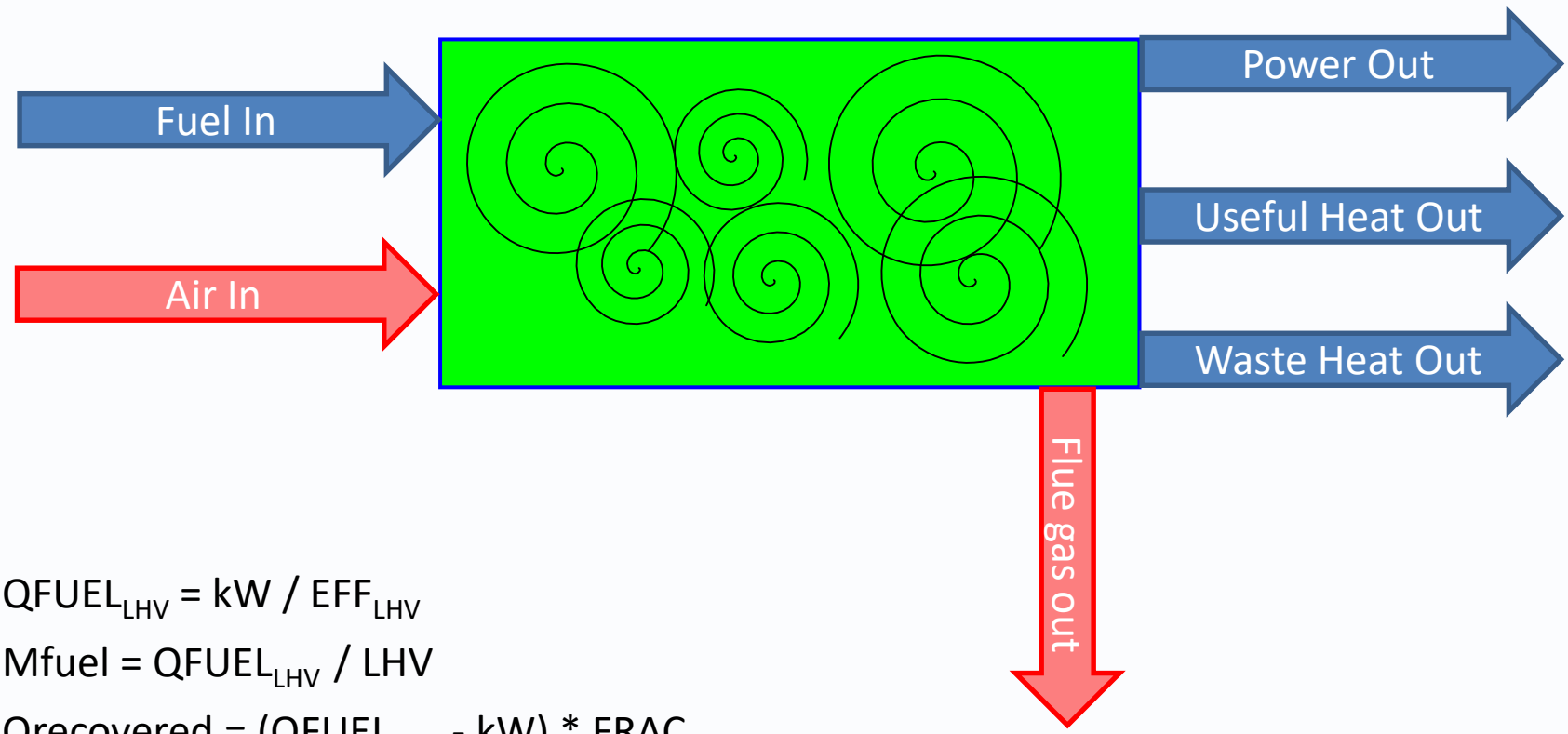
Component **Users** – How To

- Acquire UDC file package (model.myc, model.xlsx/model.exe, any required datafiles used by the component)
- Place UDC file package in your `MyComponents` folder
- Start THERMOFLEX - all UDC models are listed under **My Components** tab of the icon bar
- Use like any other built-in THERMOFLEX component to create system models

TFX↔UDC Information Flow



Demo Model – Basic Fuel Cell (at design)



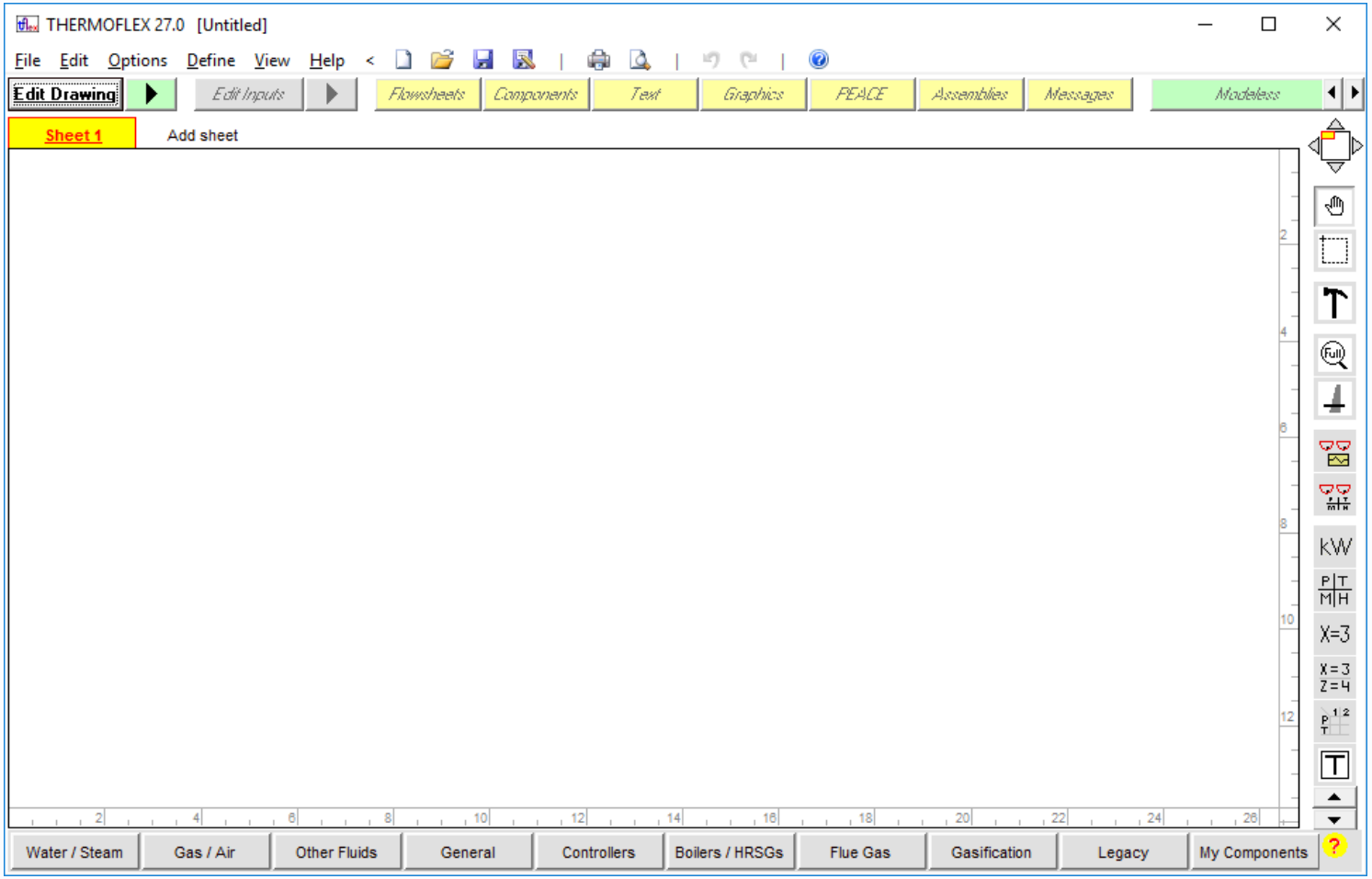
$QFUEL_{LHV} = kW / EFF_{LHV}$

$Mfuel = QFUEL_{LHV} / LHV$

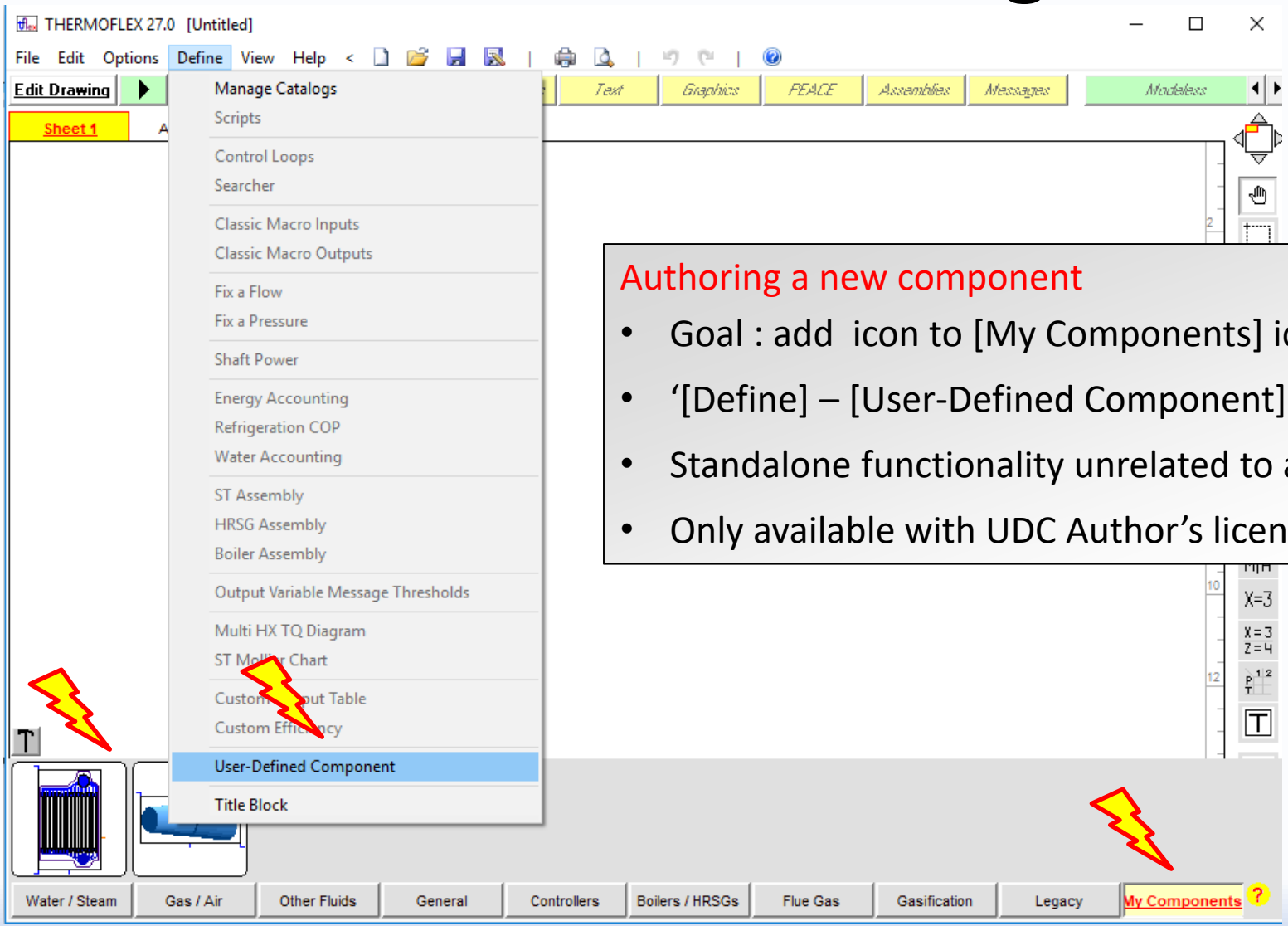
$Qrecovered = (QFUEL_{LHV} - kW) * FRAC_{RECOVER}$

$Qrejected = (QFUEL_{LHV} - kW) * (1 – FRAC_{RECOVER})$

Start THERMOFLEX



#UDC Author – Getting Started



Authoring a new component

- Goal : add icon to [My Components] icon bar
- '[Define] – [User-Defined Component] menu
- Standalone functionality unrelated to a TFX model
- Only available with UDC Author's license

#UDC Author – Define ‘Shell’

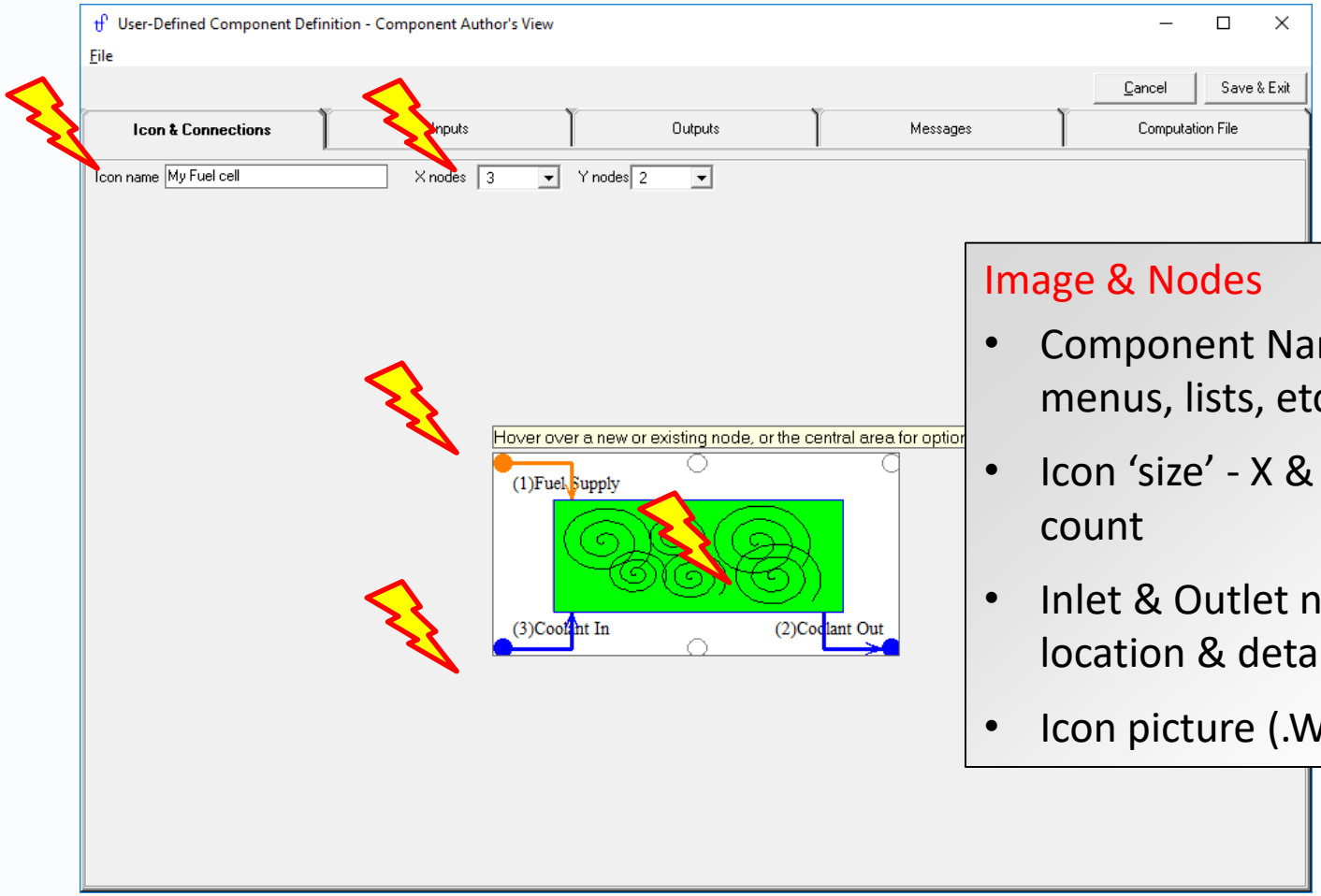
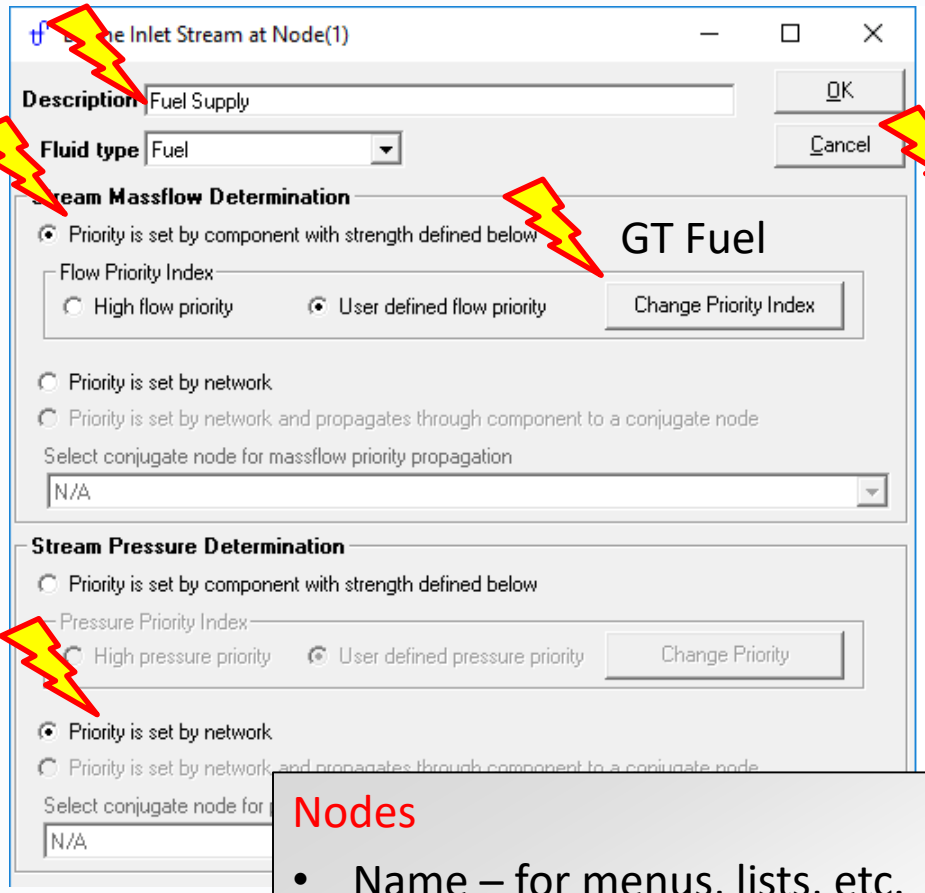
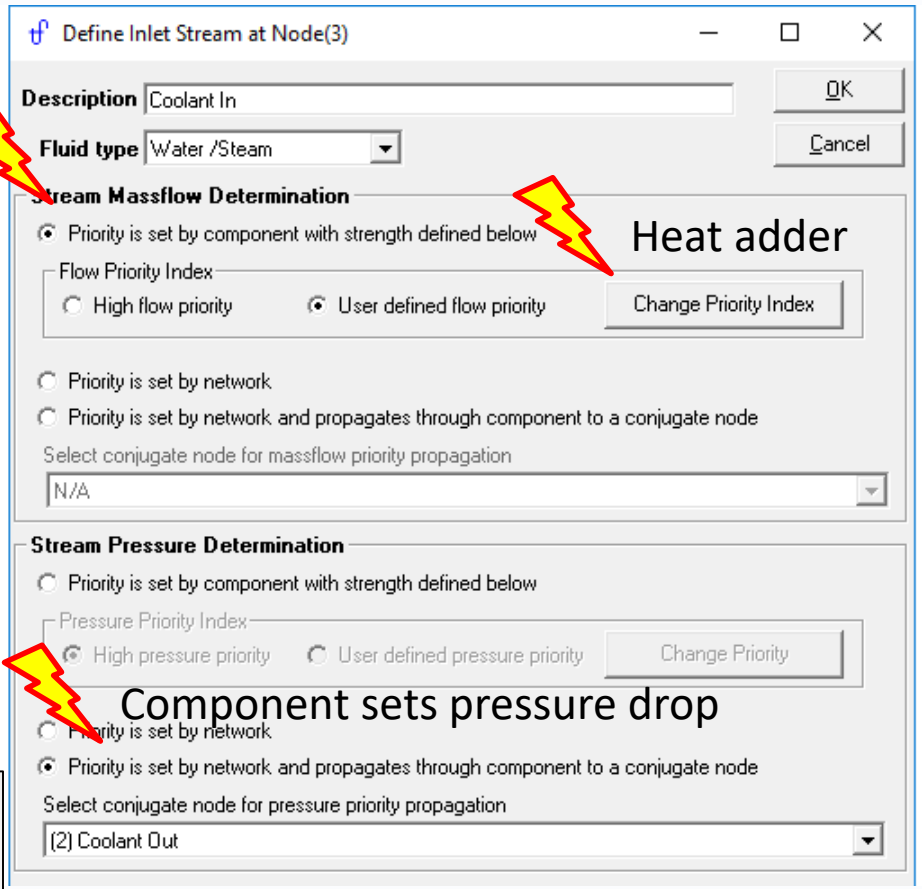


Image & Nodes

- Component Name – for menus, lists, etc.
- Icon ‘size’ - X & Y node count
- Inlet & Outlet nodes – location & details
- Icon picture (.WMF file)

#UDC Author – Node Details

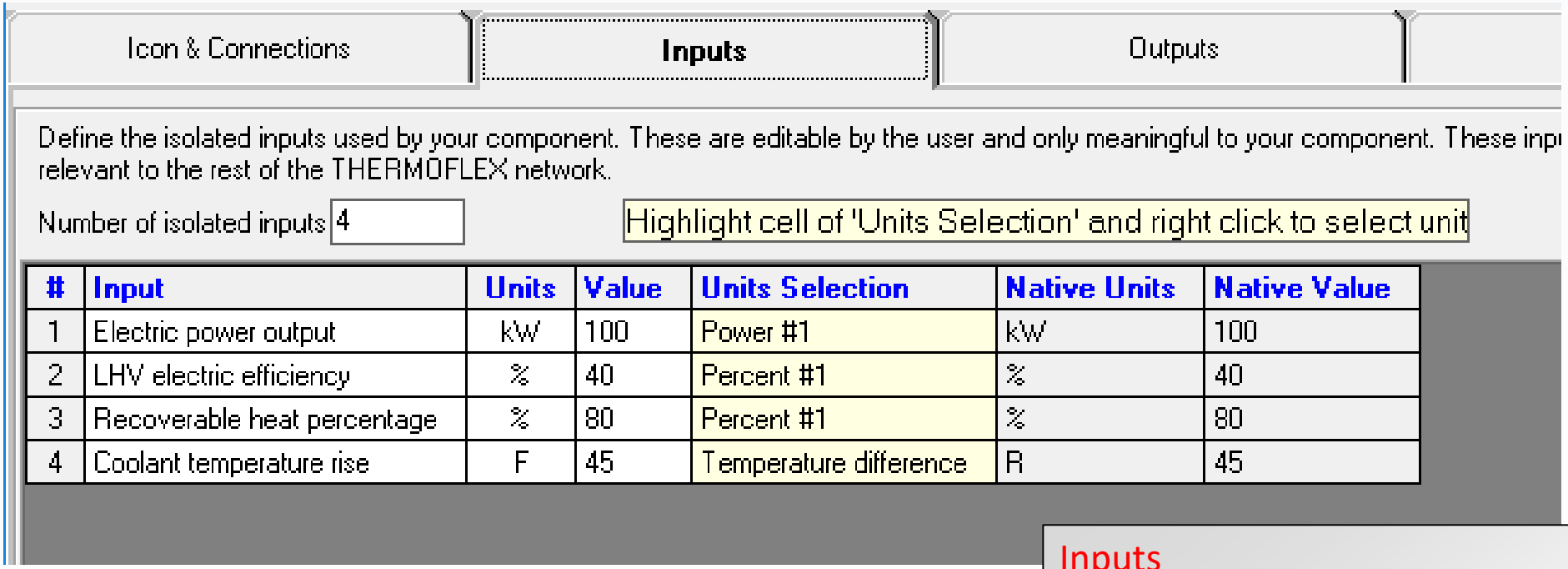




Nodes

- Name – for menus, lists, etc.
- Network Handling:
  - Massflow Priority
  - Pressure Priority

#UDC Author – Component Inputs

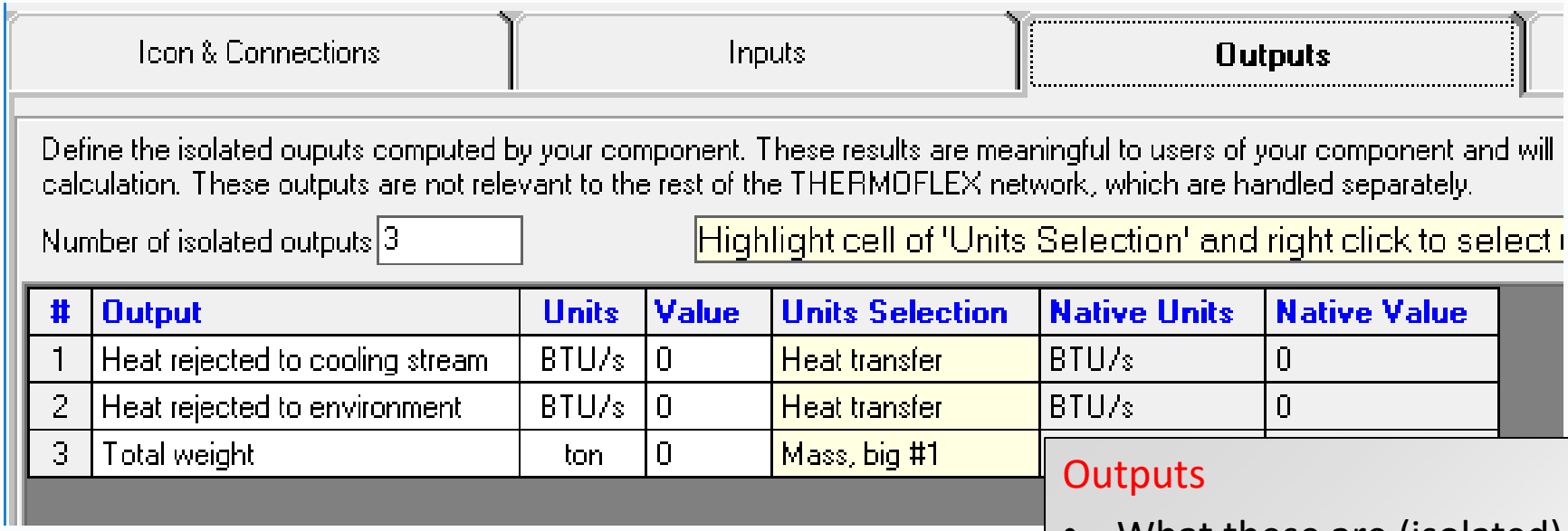


#	Input	Units	Value	Units Selection	Native Units	Native Value
1	Electric power output	kW	100	Power #1	kW	100
2	LHV electric efficiency	%	40	Percent #1	%	40
3	Recoverable heat percentage	%	80	Percent #1	%	80
4	Coolant temperature rise	F	45	Temperature difference	R	45

Inputs

- What these are (isolated)
- What these are not (inter-related)
- Description
- Units (native vs. current)
- Default values

#UDC Author – Component Outputs

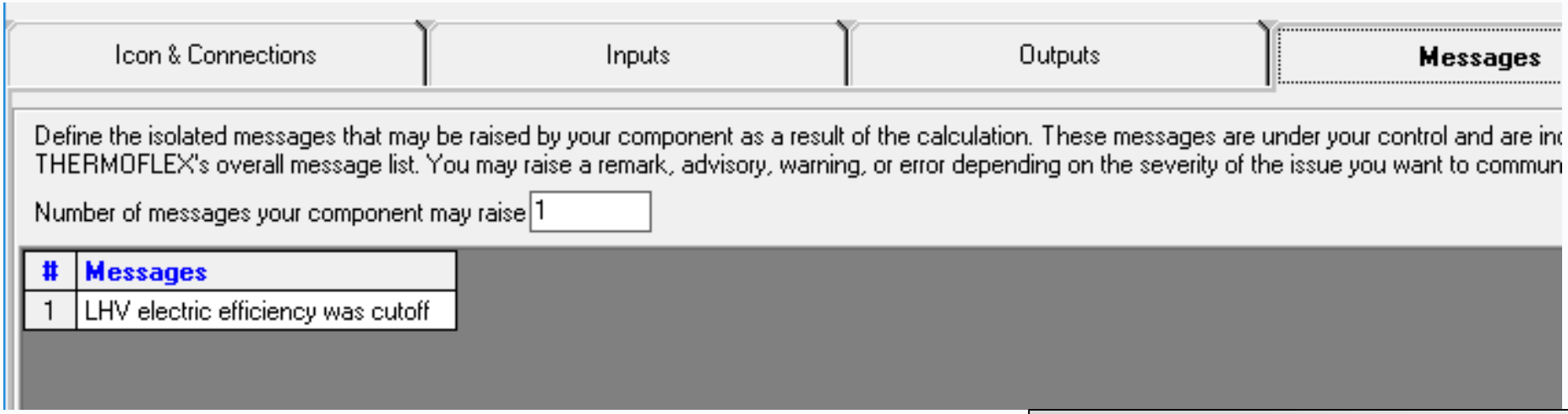


#	Output	Units	Value	Units Selection	Native Units	Native Value
1	Heat rejected to cooling stream	BTU/s	0	Heat transfer	BTU/s	0
2	Heat rejected to environment	BTU/s	0	Heat transfer	BTU/s	0
3	Total weight	ton	0	Mass, big #1		

Outputs

- What these are (isolated)
- What these are not (inter-related)
- Description
- Units (native vs. current)
- Whatever is defined is included in ‘Component Output’ reports

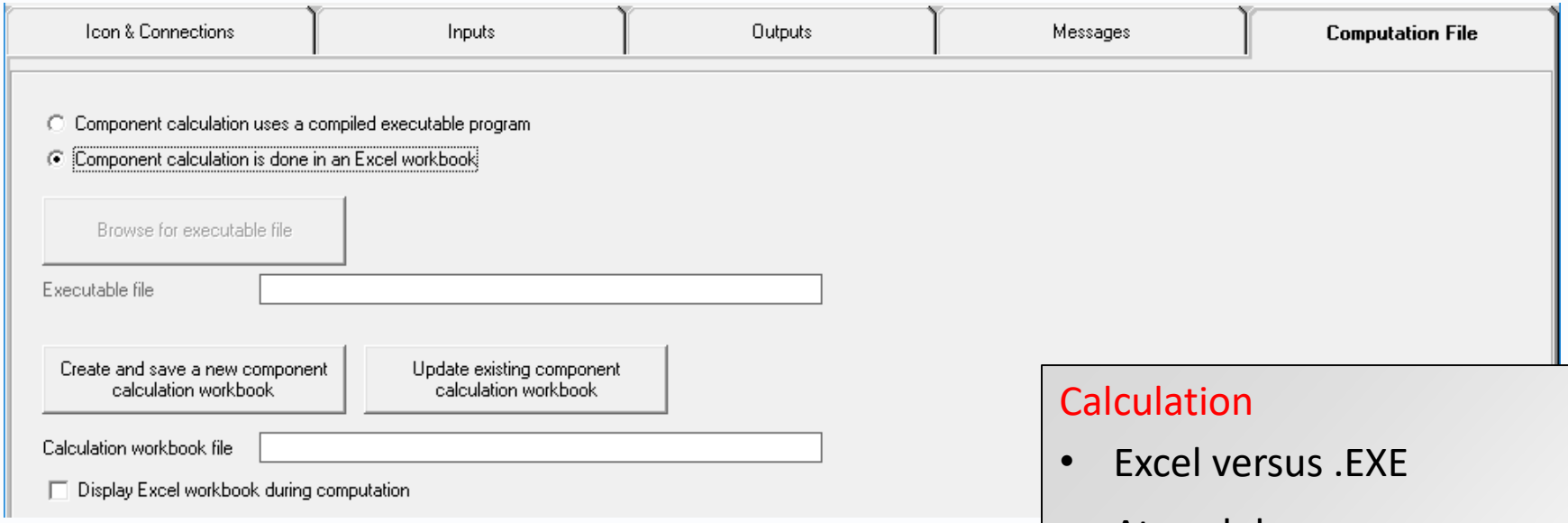
#UDC Author – Component Messages



Messages

- What these are (isolated)
- What these are not (inter-related, ie. not overall HBE)
- Description
- Severity (set in code)
- Presented in TFX message stream as for all other components

#UDC Author – Define “Guts 1”



Calculation

- Excel versus .EXE
- At each loop:
  - TFX sets inputs (native units)
  - TFX runs your program & waits
  - TFX reads outputs (native units)
- Template code (Excel & EXE)