



Thermoflow's User-Defined Component (UDC)

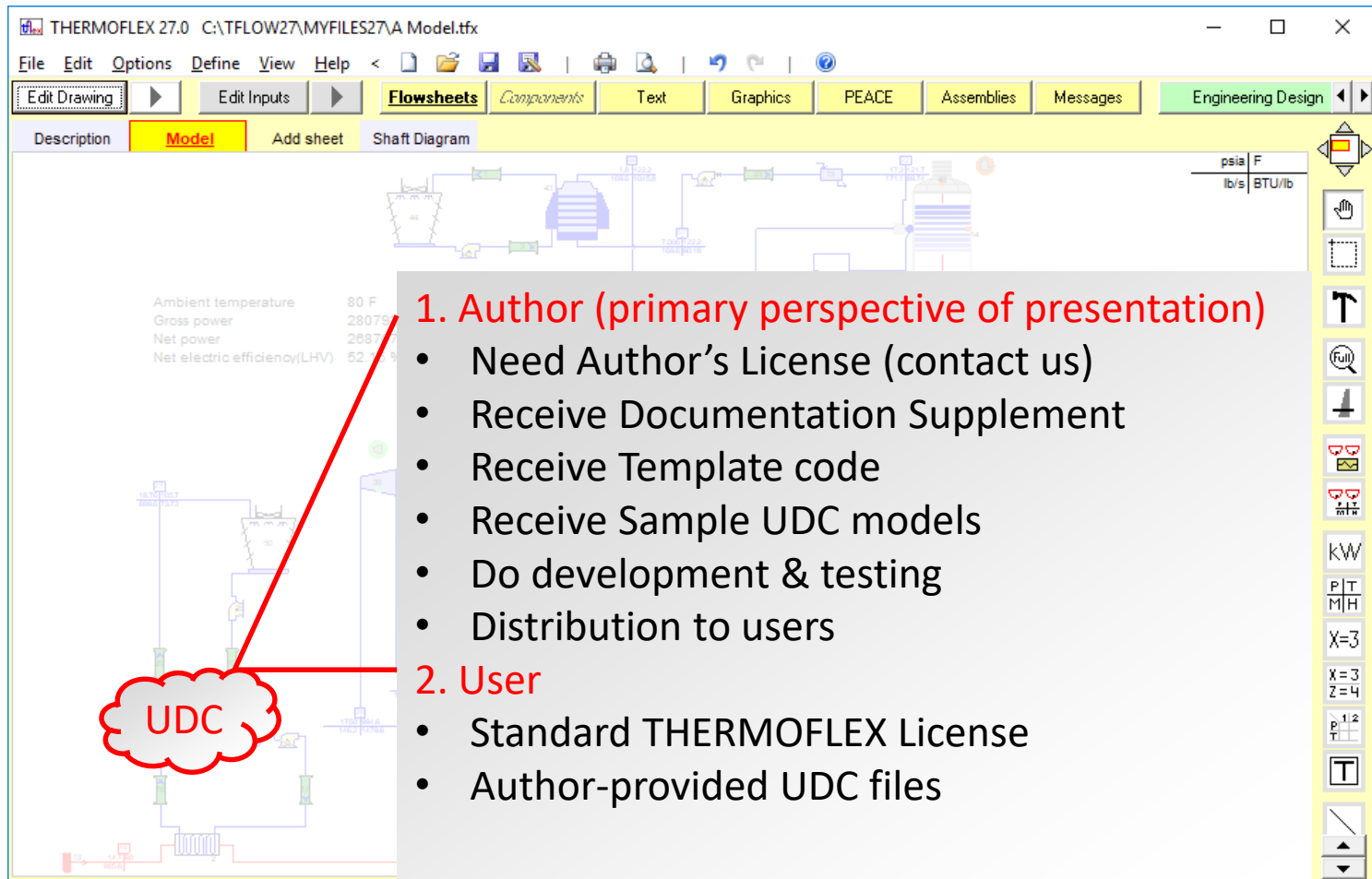
Creating, using, and distributing a
THERMOFLEX component (icon) to
run your calculation code

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.

website: www.Thermoflow.ir
 Telegram: @Thermoflow_users

UDC: Overview



The screenshot shows the THERMOFLEX 27.0 software interface. The title bar indicates the file path is C:\TFLOW27\MYFILES27\A Model.tfx. The menu bar includes File, Edit, Options, Define, View, and Help. The toolbar contains icons for various functions. The main window displays a process flow diagram with a central compressor and several heat exchangers. A red cloud labeled "UDC" is positioned over the diagram, with a red arrow pointing to the first role in the list.

1. Author (primary perspective of presentation)

- Need Author's License (contact us)
- Receive Documentation Supplement
- Receive Template code
- Receive Sample UDC models
- Do development & testing
- Distribution to users

2. User

- Standard THERMOFLEX License
- Author-provided UDC files

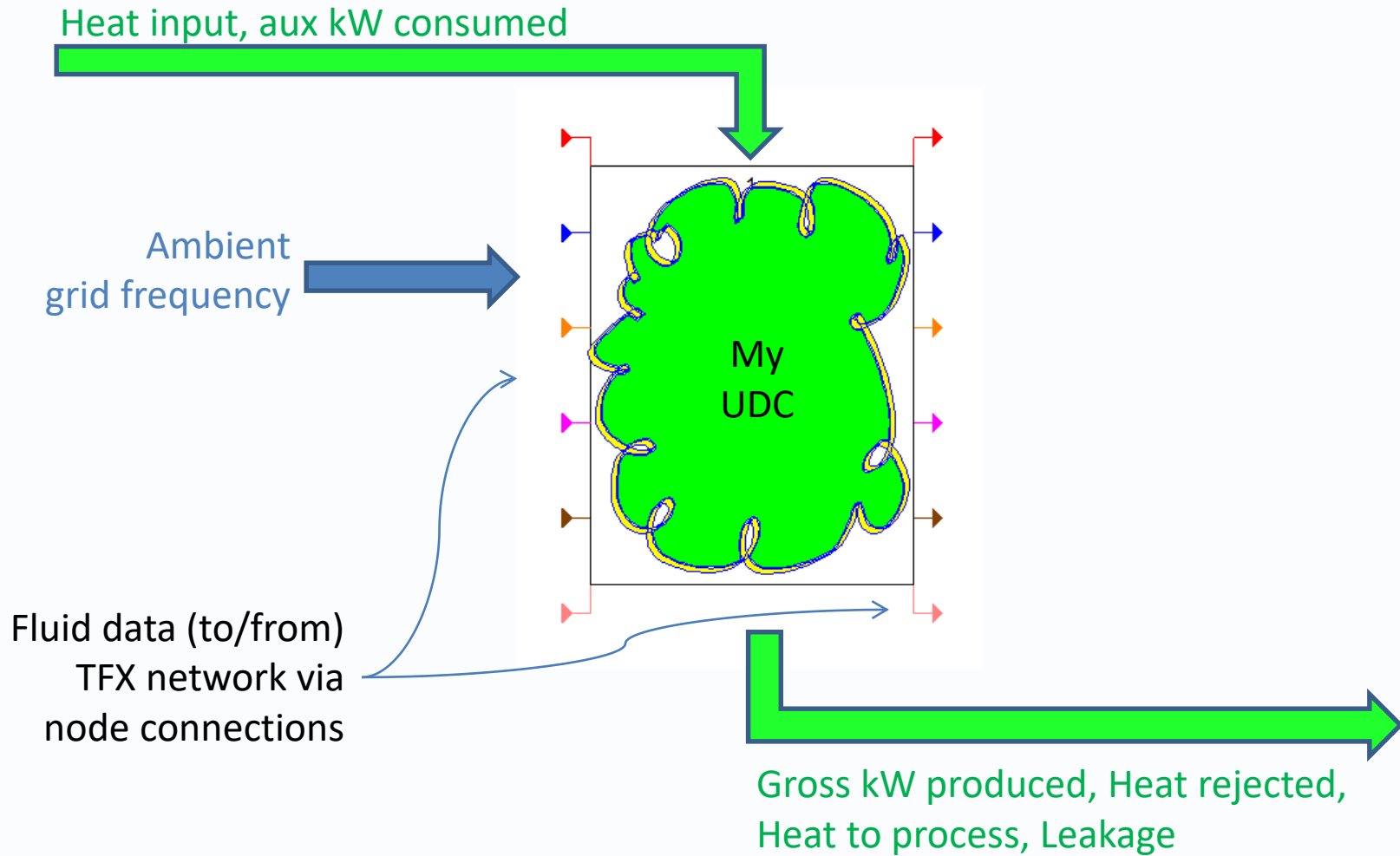
Component **Author** – TFX Build Steps

- 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.

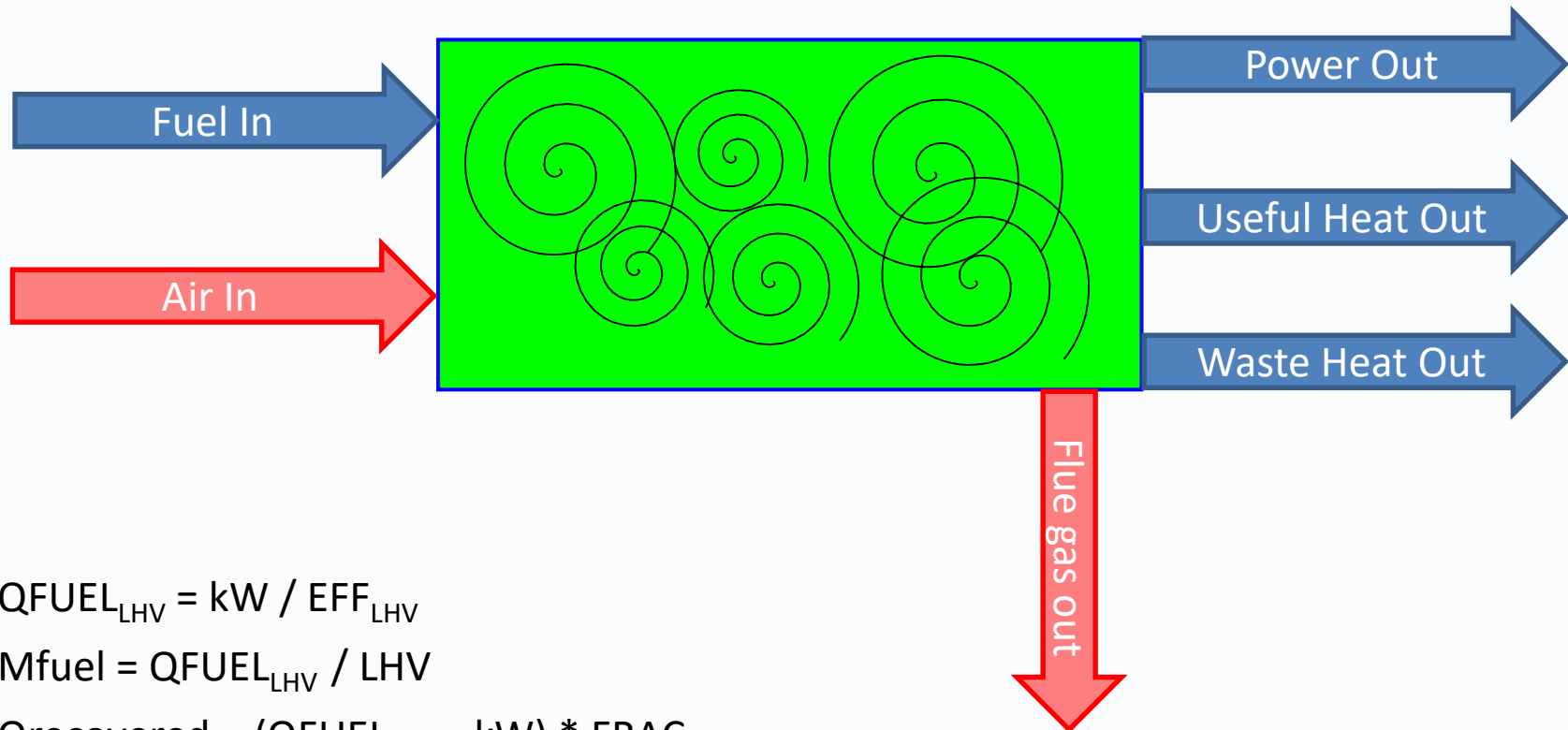
Component **Users** – How To

- 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)



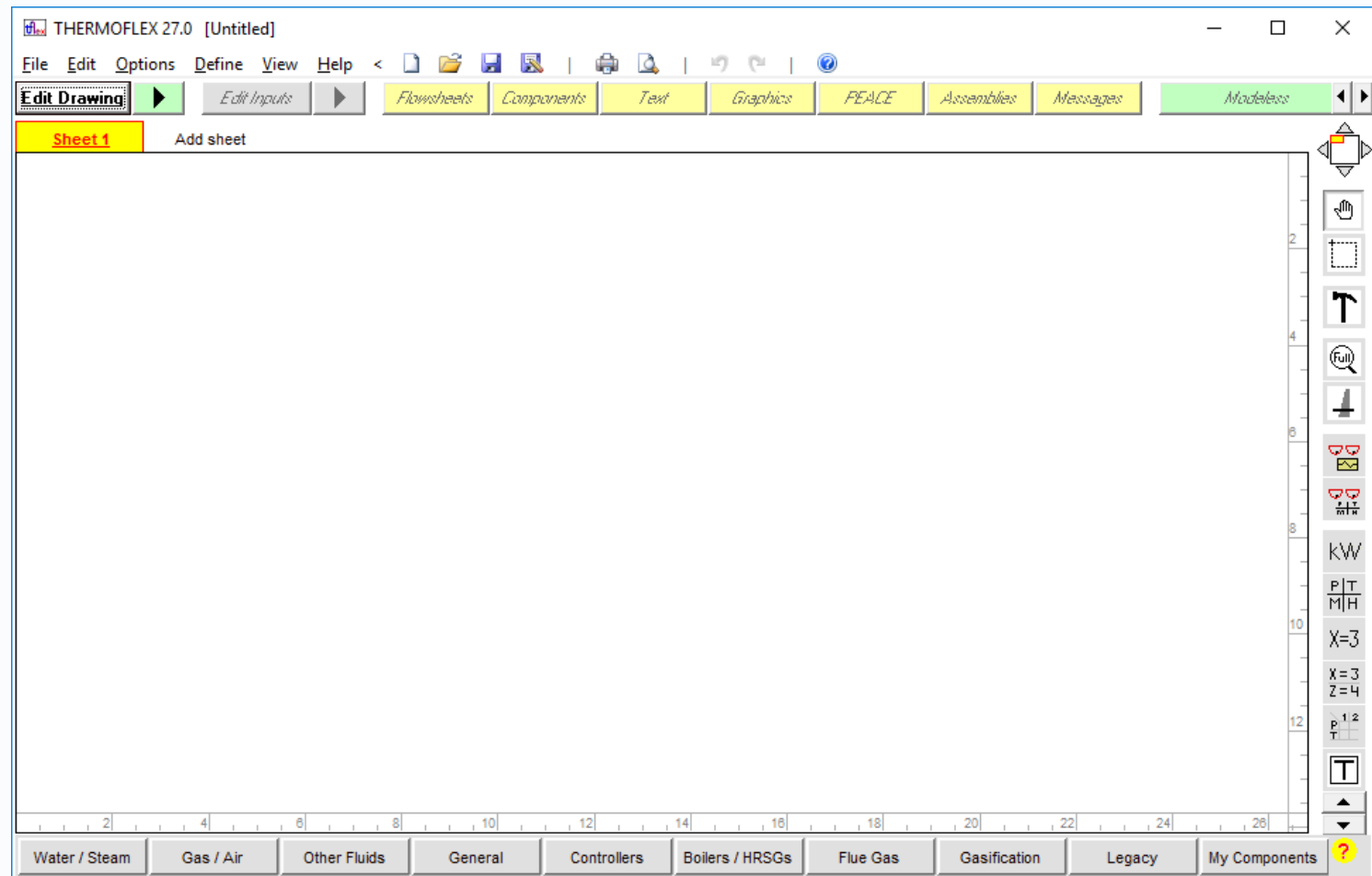
$$Q_{FUEL_LHV} = kW / EFF_{LHV}$$

$$M_{fuel} = Q_{FUEL_LHV} / LHV$$

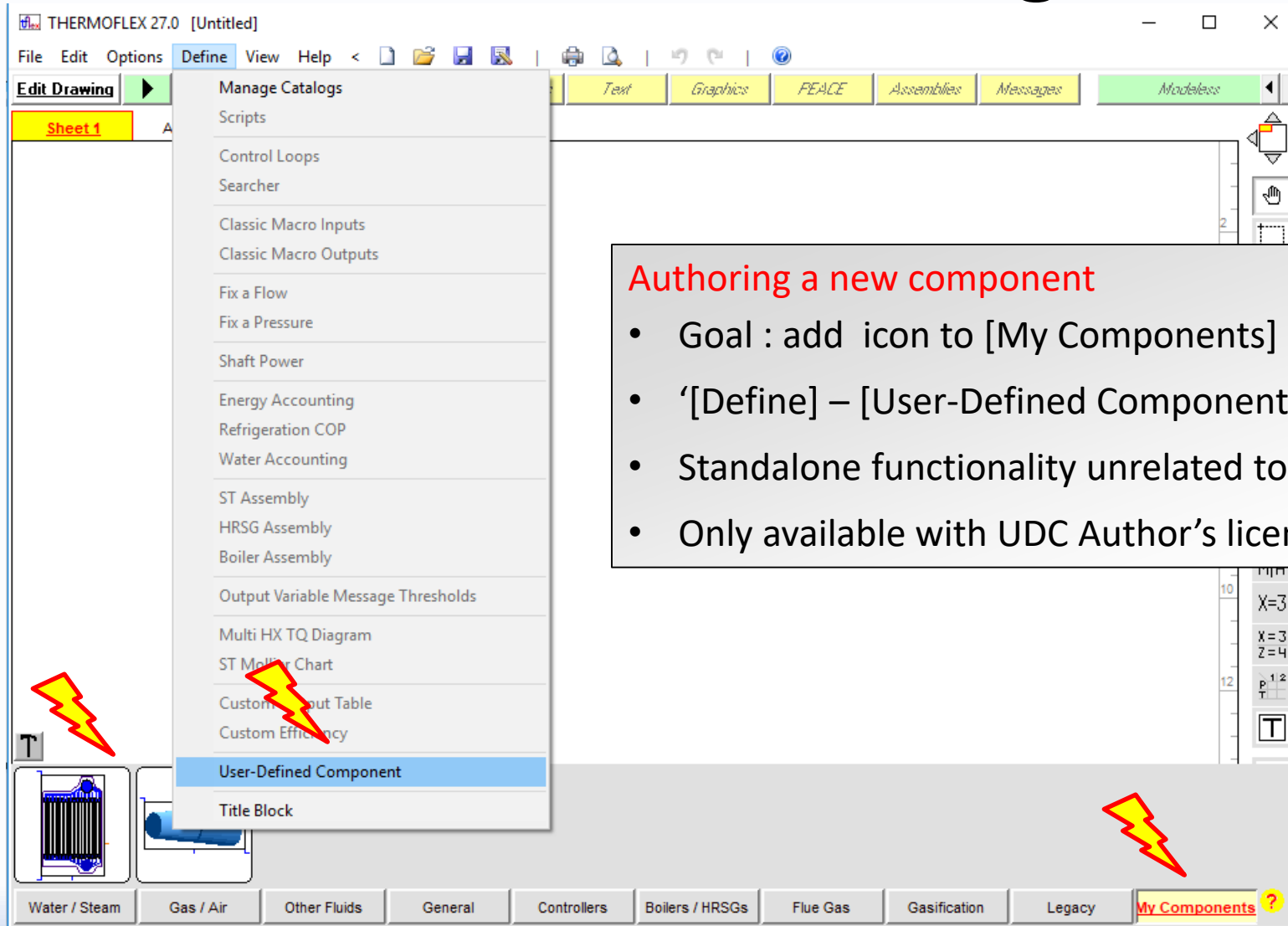
$$Q_{recovered} = (Q_{FUEL_LHV} - kW) * FRAC_{RECOVER}$$

$$Q_{rejected} = (Q_{FUEL_LHV} - kW) * (1 - FRAC_{RECOVER})$$

Start THERMOFLEX



#UDC Author – Getting Started



#UDC Author – Define ‘Shell’

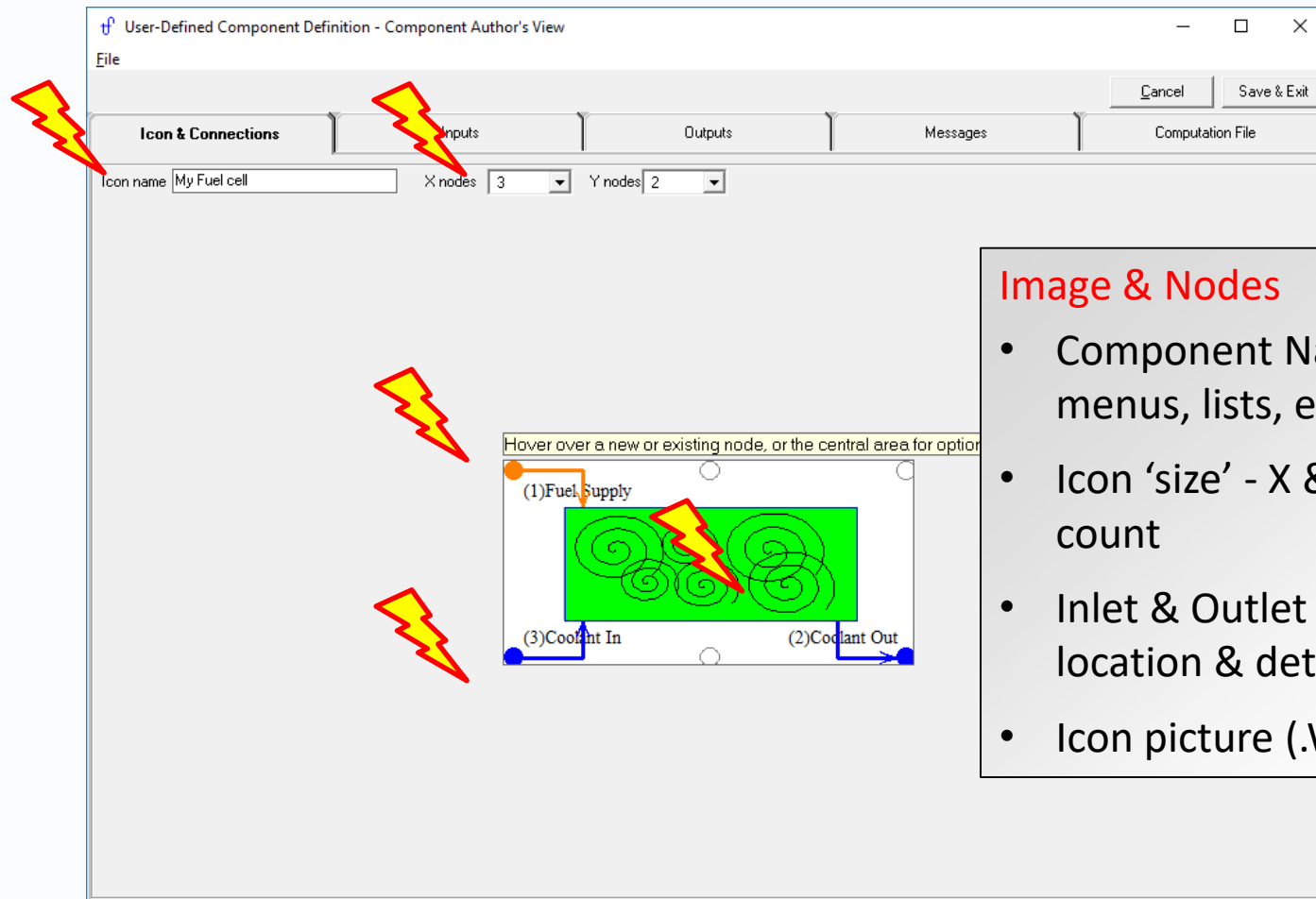
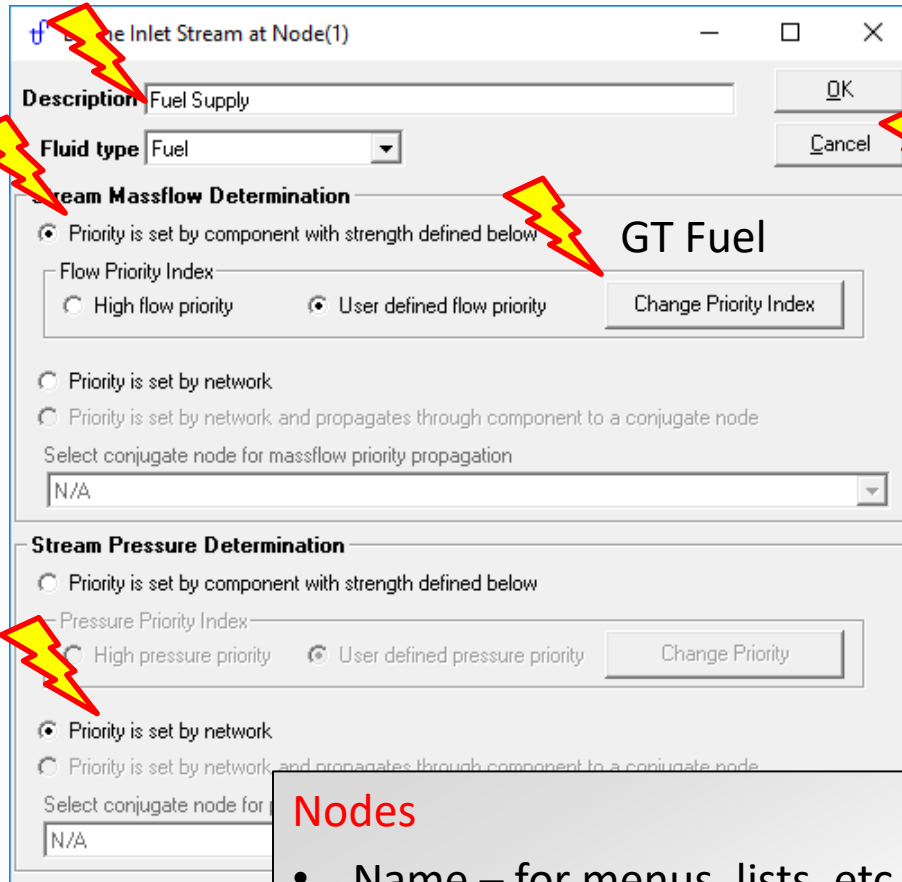


Image & Nodes

- 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



Define Inlet Stream at Node(1)

Description: Fuel Supply

Fluid type: Fuel

Stream Massflow Determination

☒ Priority is set by component with strength defined below

Flow Priority Index

☐ High flow priority ☒ User defined flow priority [Change Priority Index](#)

☐ Priority is set by network

☐ Priority is set by network and propagates through component to a conjugate node

Select conjugate node for massflow priority propagation

N/A

Stream Pressure Determination

☐ Priority is set by component with strength defined below

Pressure Priority Index

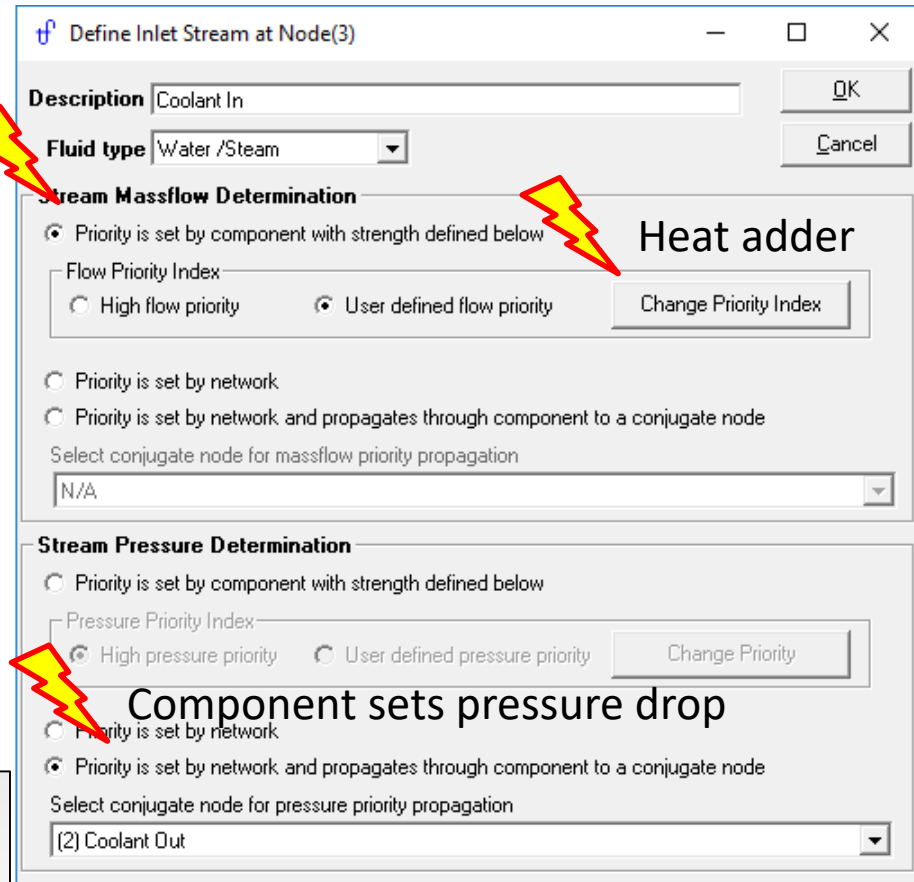
☐ High pressure priority ☒ User defined pressure priority [Change Priority](#)

☒ Priority is set by network

☐ Priority is set by network and propagates through component to a conjugate node

Select conjugate node for pressure priority propagation

N/A



Define Inlet Stream at Node(3)

Description: Coolant In

Fluid type: Water /Steam

Stream Massflow Determination

☒ Priority is set by component with strength defined below

Flow Priority Index

☐ High flow priority ☒ User defined flow priority [Change Priority Index](#)

☐ Priority is set by network

☐ Priority is set by network and propagates through component to a conjugate node

Select conjugate node for massflow priority propagation

N/A

Stream Pressure Determination

☐ Priority is set by component with strength defined below

Pressure Priority Index

☒ High pressure priority ☐ User defined pressure priority [Change Priority](#)

☐ Priority is set by network

☒ Priority is set by network and propagates through component to a conjugate node

Select conjugate node for pressure priority propagation

(2) Coolant Out

Nodes

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

#UDC Author – Component Inputs

Icon & Connections

Inputs

Outputs

Define the isolated inputs used by your component. These are editable by the user and only meaningful to your component. These inputs are not relevant to the rest of the THERMOFLEX network.

Number of isolated inputs

Highlight cell of 'Units Selection' and right click to select unit

#	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

Icon & Connections

Inputs

Outputs

Define the isolated outputs computed by your component. These results are meaningful to users of your component and will calculation. These outputs are not relevant to the rest of the THERMOFLEX network, which are handled separately.

Number of isolated outputs Highlight cell of 'Units Selection' and right click to select

#	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

Icon & Connections
Inputs
Outputs
Messages

Define the isolated messages that may be raised by your component as a result of the calculation. These messages are under your control and are included in THERMOFLEX's overall message list. You may raise a remark, advisory, warning, or error depending on the severity of the issue you want to communicate.

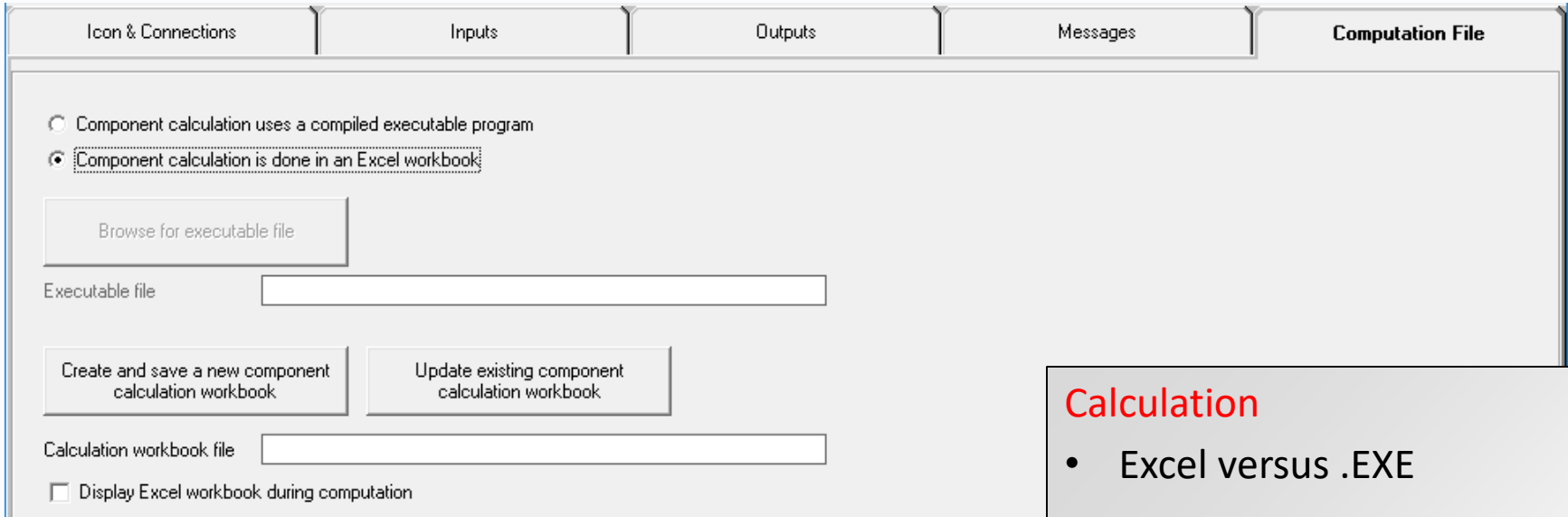
Number of messages your component may raise

#	Messages
1	LHV electric efficiency was cutoff

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”



The screenshot shows the 'Computation File' tab in the THERMOFLEX UDC Author interface. The interface has five tabs: 'Icon & Connections', 'Inputs', 'Outputs', 'Messages', and 'Computation File'. The 'Computation File' tab is active, displaying two radio button options for component calculation. The first option, 'Component calculation uses a compiled executable program', is unselected. The second option, 'Component calculation is done in an Excel workbook', is selected. Below these options is a 'Browse for executable file' button. Further down is an 'Executable file' text input field. Below that are two buttons: 'Create and save a new component calculation workbook' and 'Update existing component calculation workbook'. Below these buttons is a 'Calculation workbook file' text input field. At the bottom is a checkbox labeled 'Display Excel workbook during computation', which is currently unchecked.

Icon & Connections Inputs Outputs Messages **Computation File**

☐ Component calculation uses a compiled executable program

☒ Component calculation is done in an Excel workbook

Browse for executable file

Executable file

Create and save a new component calculation workbook Update existing component calculation workbook

Calculation workbook file

☐ Display Excel workbook during computation

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)