Technische Hochschule Ingolstadt
Institute of new Energy Systems

Modelling of a Thermal Network with CARNOT & Simscape

OREWA project

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AGENDA

- Objective / Motivation
- Modelling with Simscape and CARNOT
- Results / Outlook

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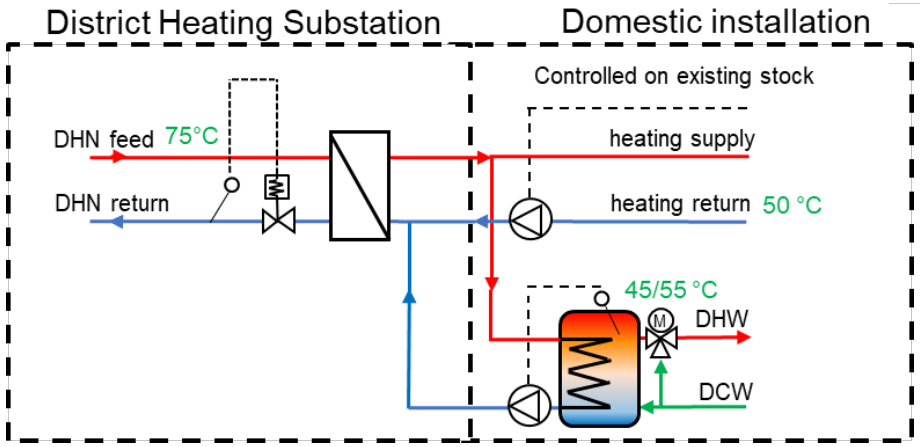
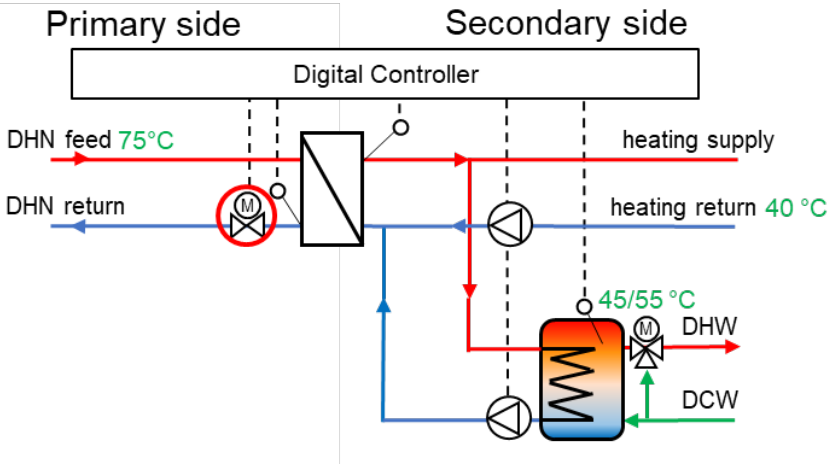
OBJECTIVE / MOTIVATION

Dynamic simulation of heating networks:

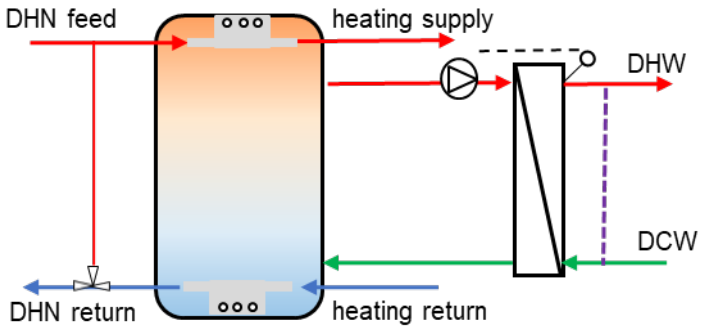
- Influence of different district heating substation types on heat network parameters such as return temperature, volume flow requirement



Thermostatic controlled substation



Electronic controlled substation



Buffer storage substation

- Investigation of the benefit of an innovative operating strategy

MOTIVATION FOR SIMSCAPE

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- Physical modelling
- Simscape allows a bidirectional flow of information.
- Flow directions of flow variables are not mandatory from the beginning and result depending on the physical characteristics of the components used.

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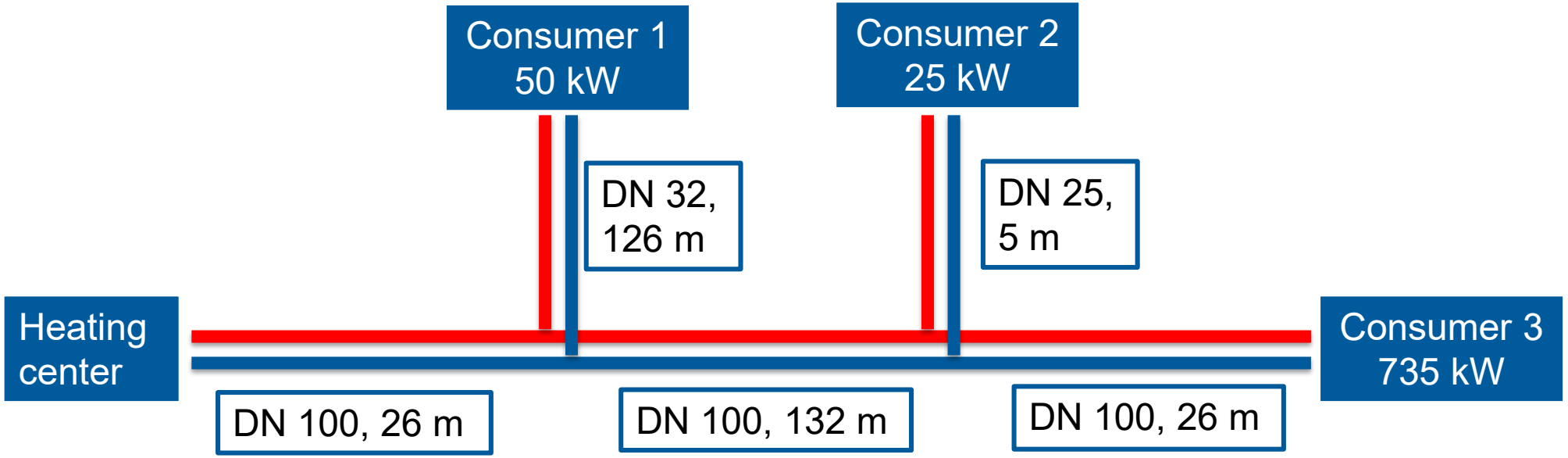
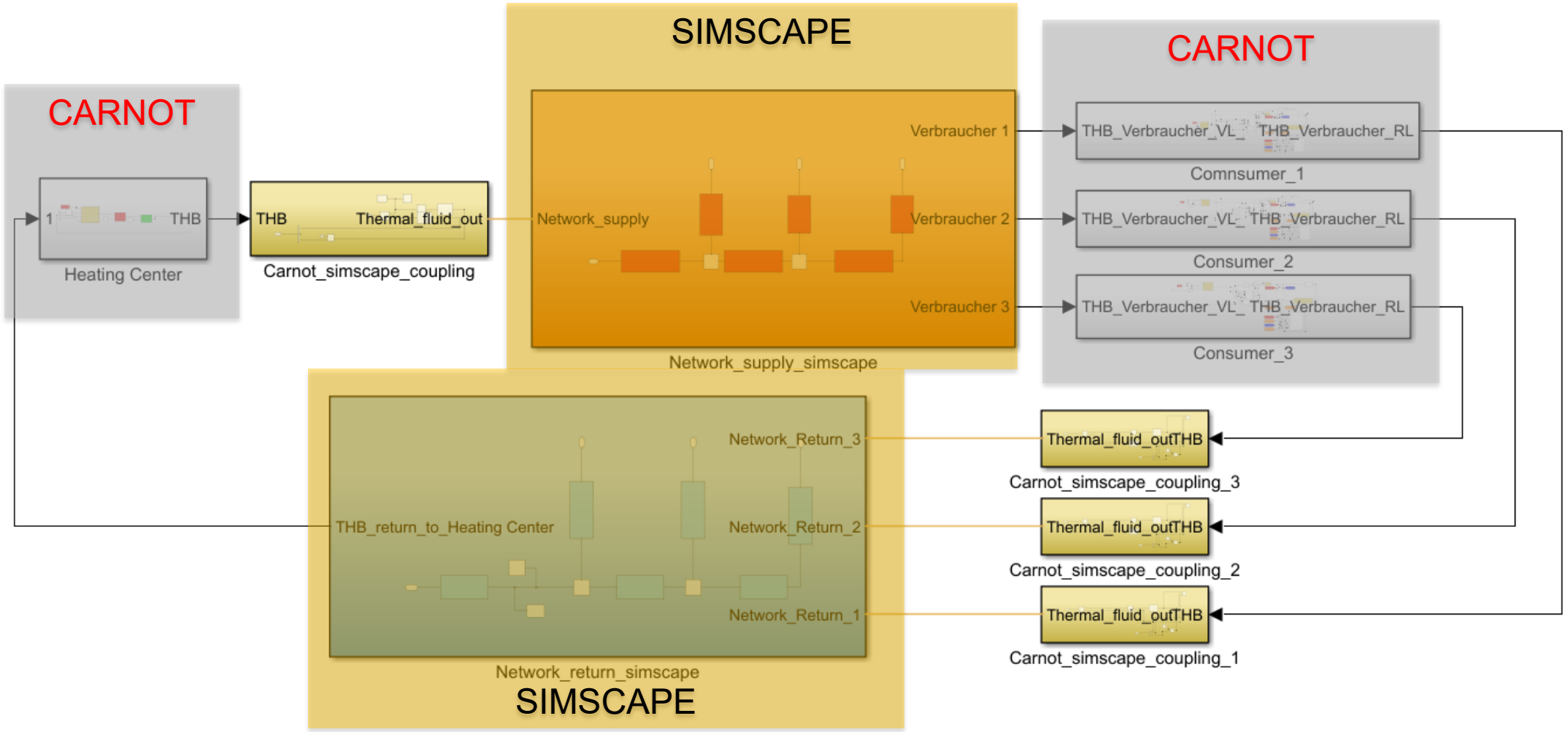
EXISTING HEAT NETWORK

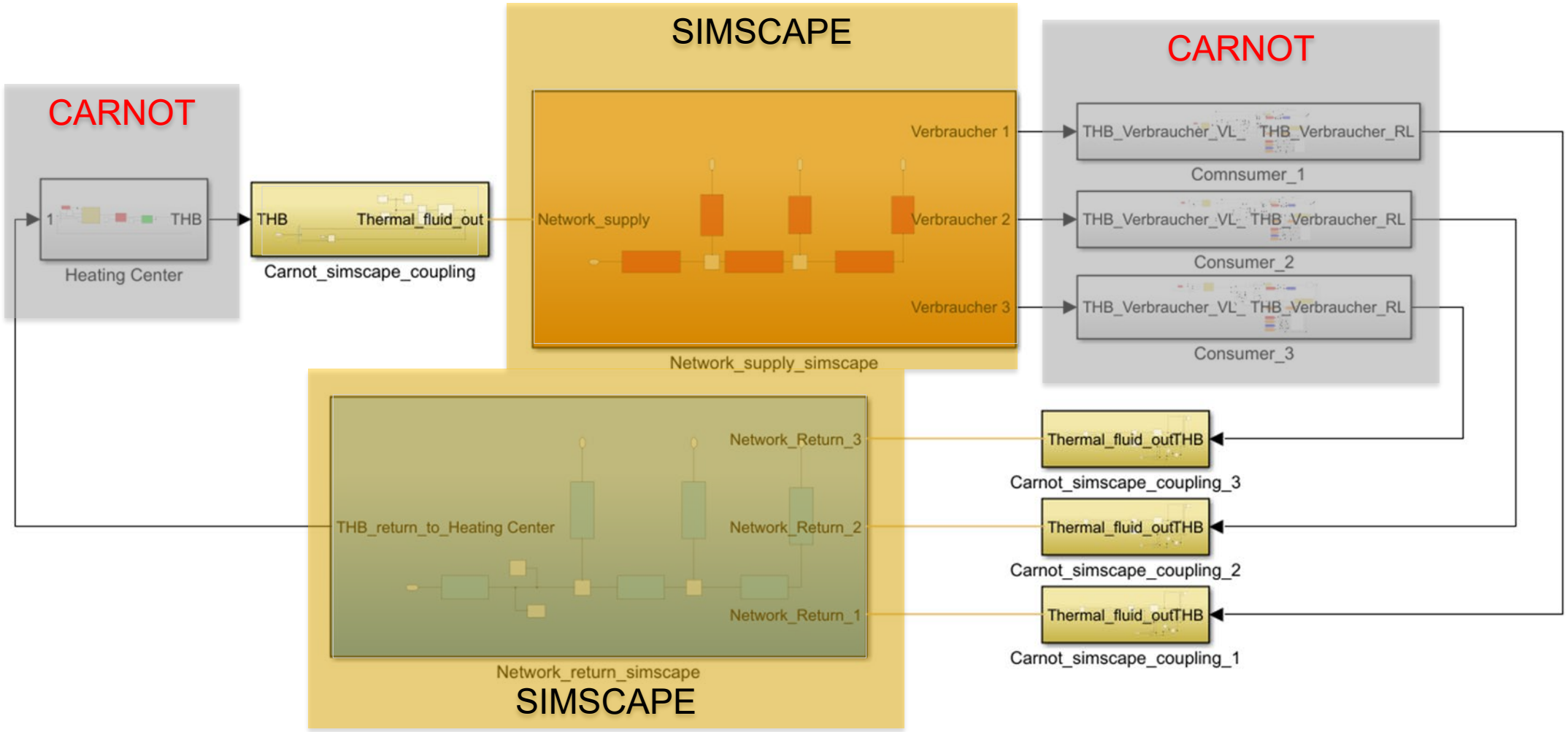
- Section of an existing thermal heat network (see figure below)
- According to existing heat network plan
  - Total connected loads: around 900 kW
  - ➢ 40 consumers → simultaneity factor: 0.9 → 810 kW max. power required by the source
  - In contrast, the yearly measurement data show approx. 500 kW peak power
  - ➢ Pipe network designed too large!



MODELLING OF THERMAL NETWORK IN SIMSCAPE

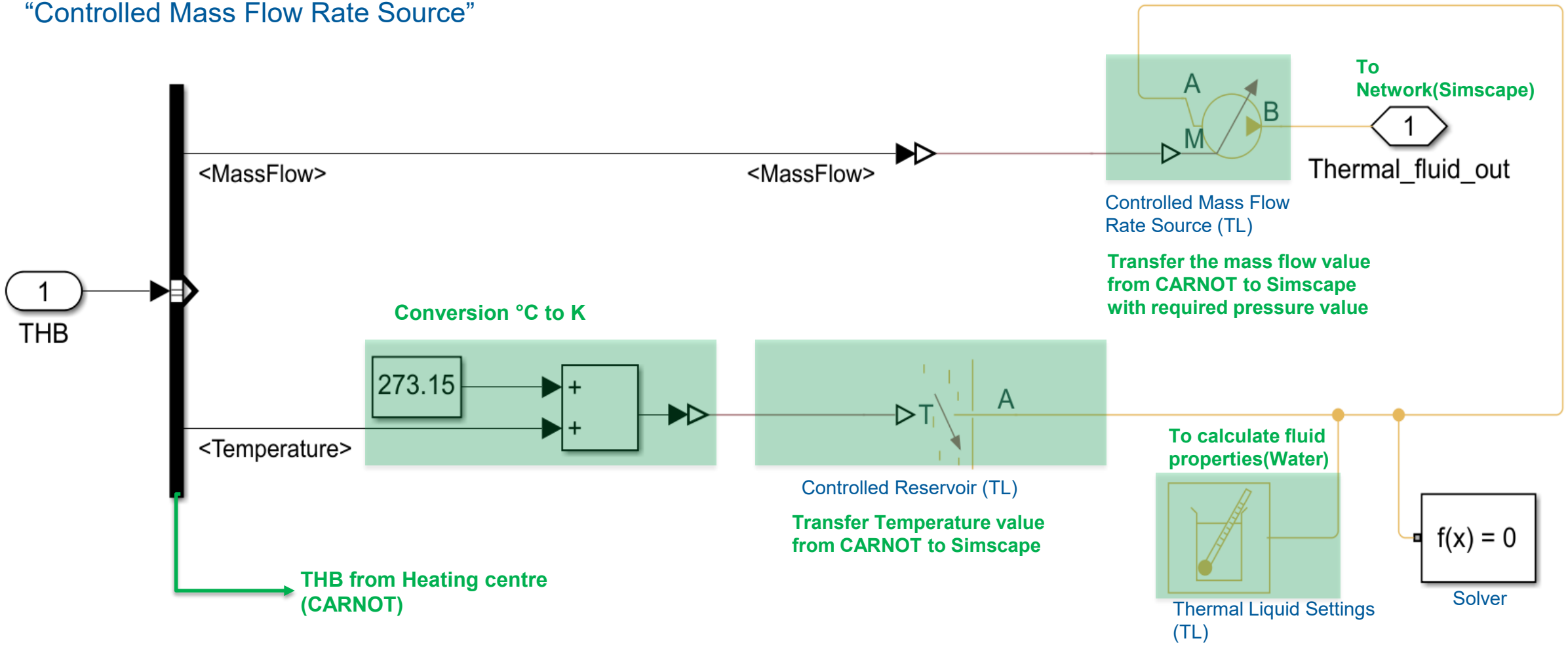


MODELLING OF THERMAL NETWORK IN SIMSCAPE



CARNOT – SIMSCAPE COUPLING

Converting CARNOT thermo-hydraulic bus into SIMSCAPE thermal fluid network with help of “controlled reservoir” and “Controlled Mass Flow Rate Source”



HEATING NETWORK (SUPPLY)

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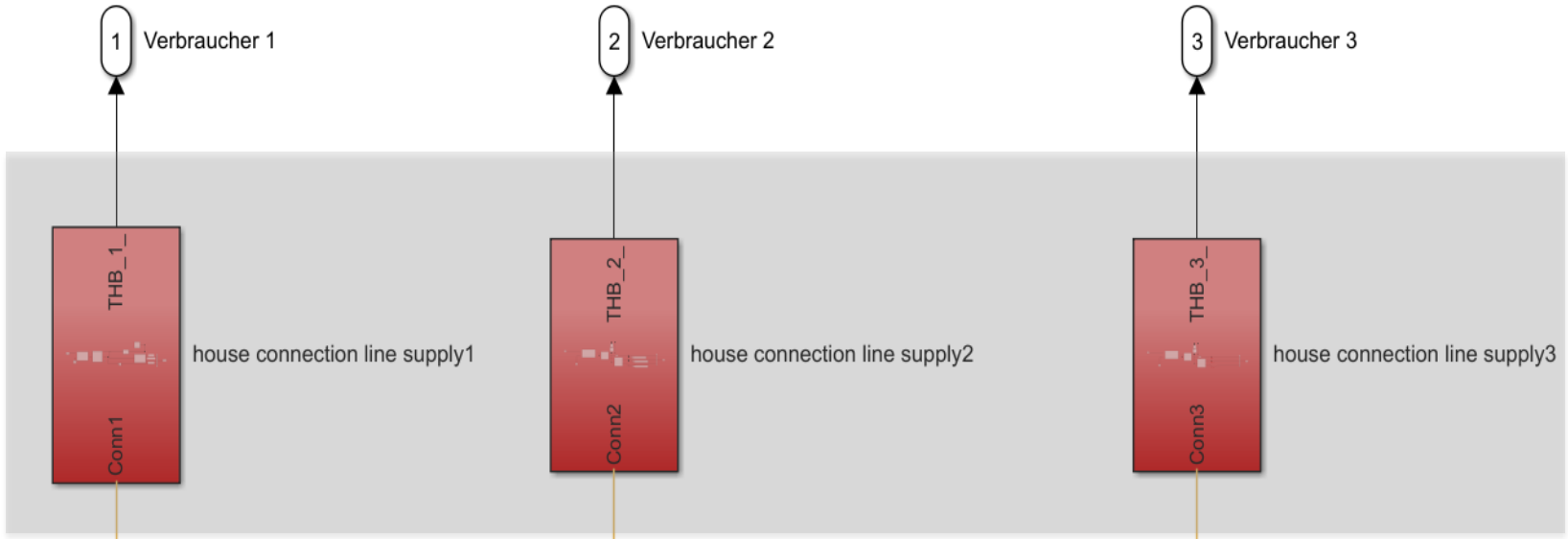
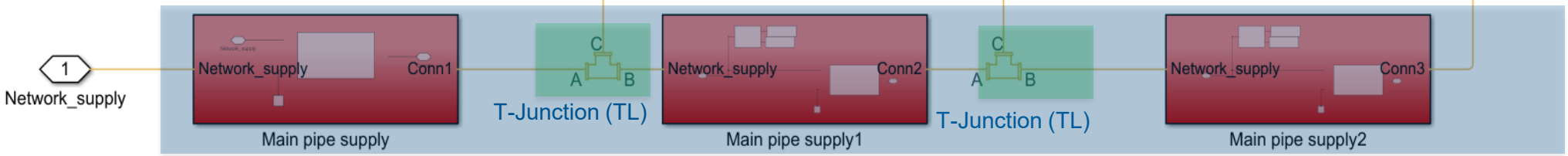
House Connection Pipes (Three Consumers)



Main Supply Pipe



To split the flow based on the pressure drop of physical system

HEATING NETWORK (SUPPLY)

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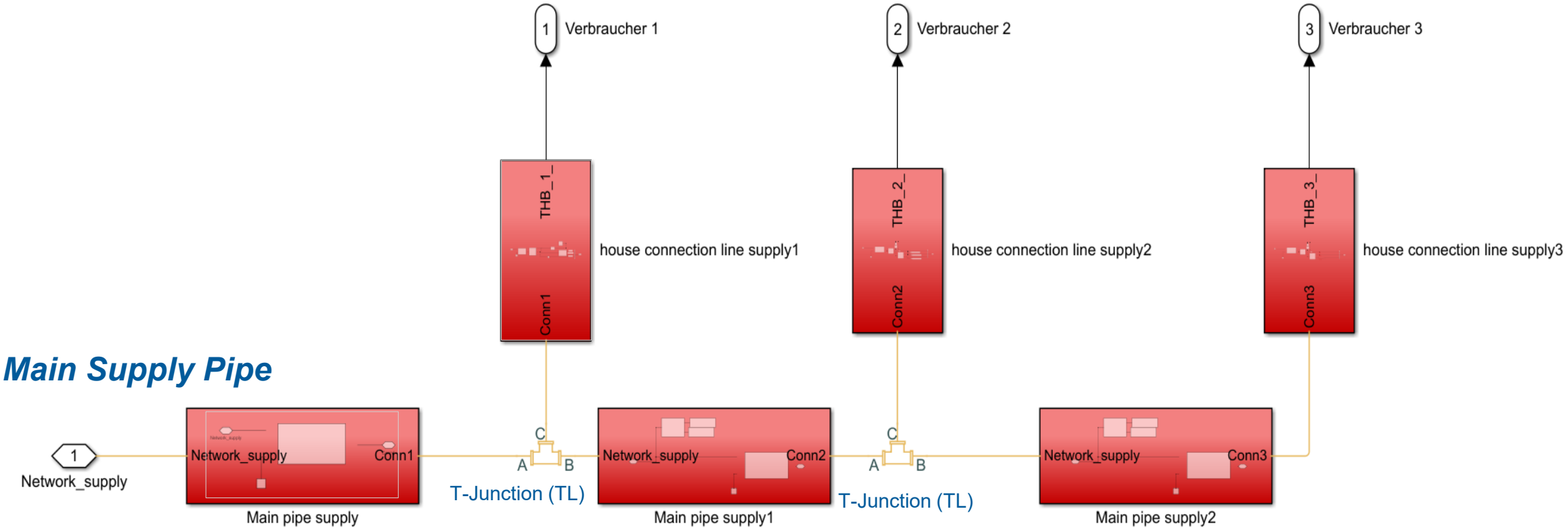
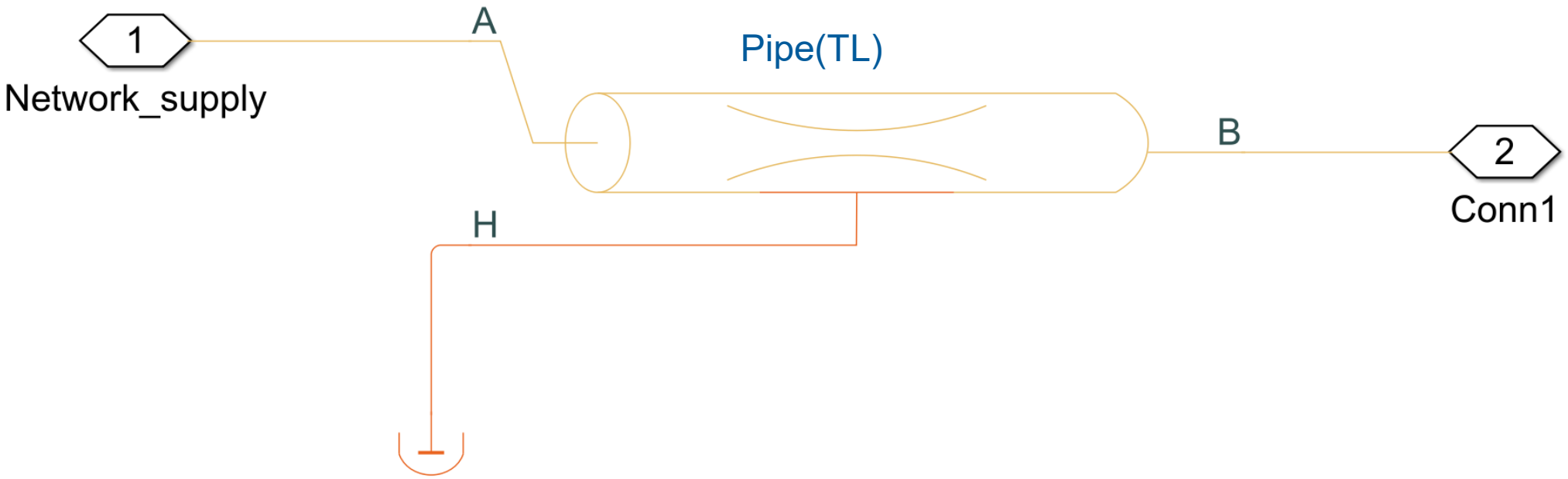
House Connection Pipes (Three Consumers)



HEATING NETWORK(SUPPLY)

MAIN SUPPLY LINE PIPE CONNECTION

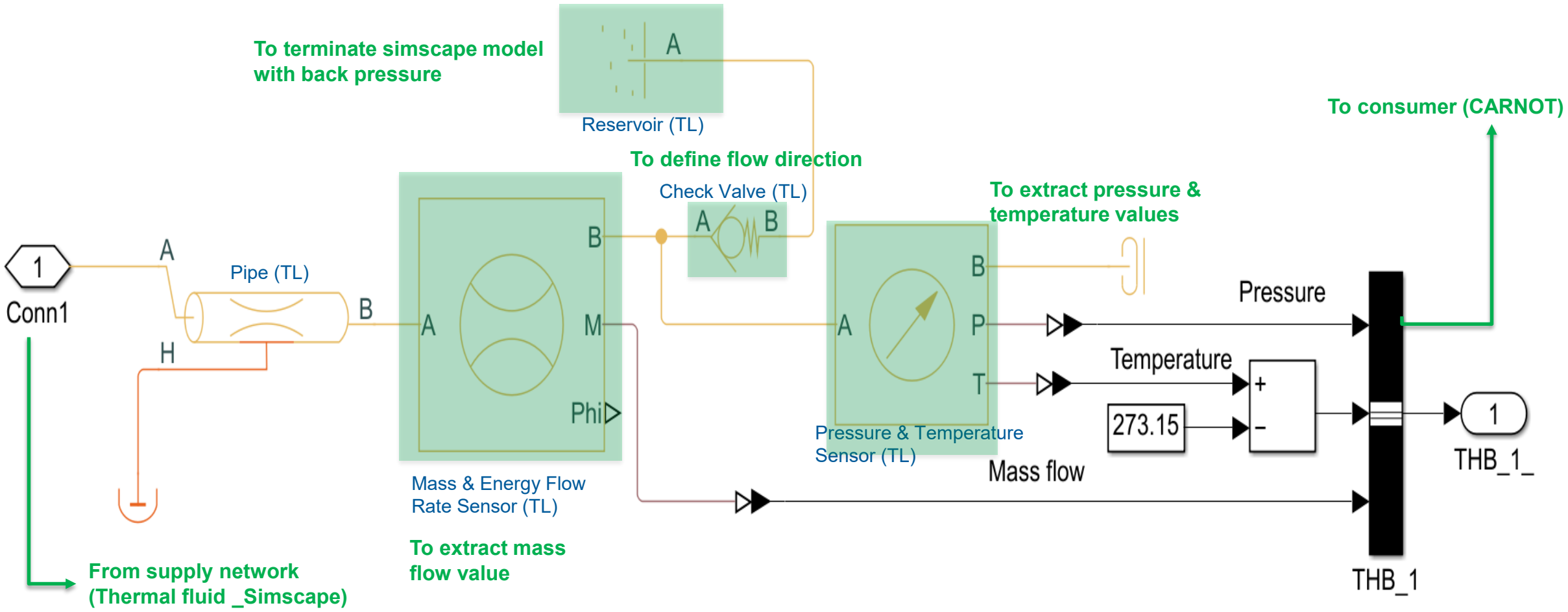
Pipe block to simulate pressure drop



HEATING NETWORK (SUPPLY)

CONSUMER'S SUPPLY CONNECTION PIPES

Terminate the supply network by setting back pressure according to designed total pressure drop of the "consumers" & "return network" by "Reservoir" and "check valve" blocks



HEATING NETWORK (RETURN)

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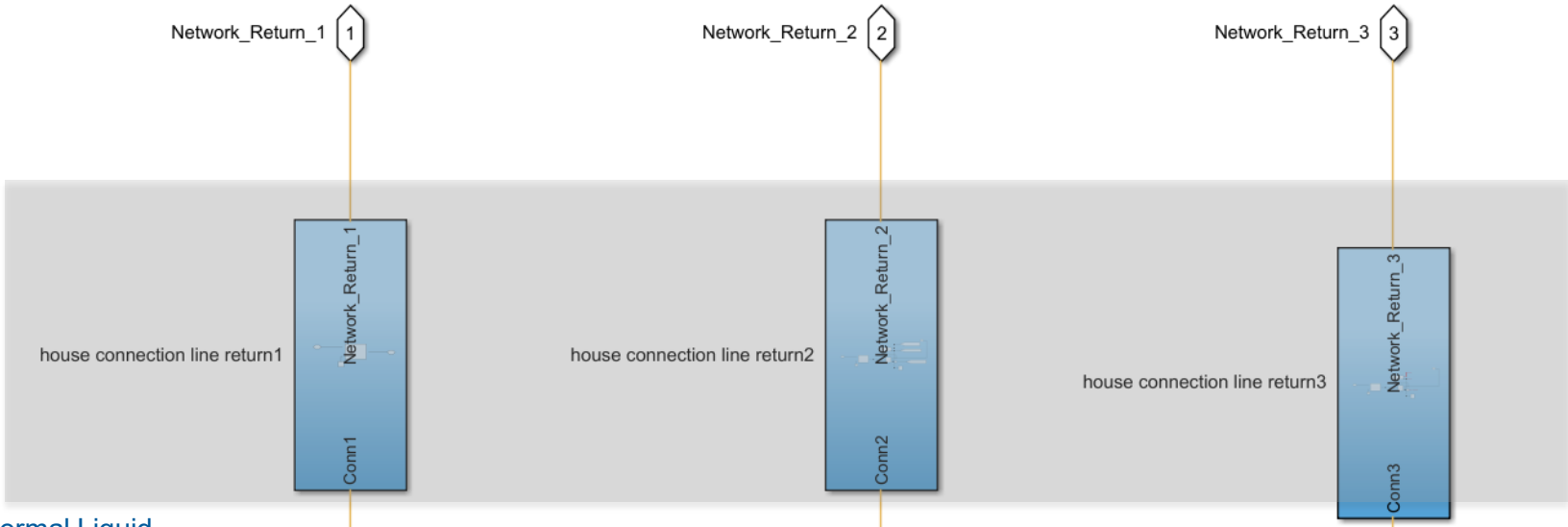
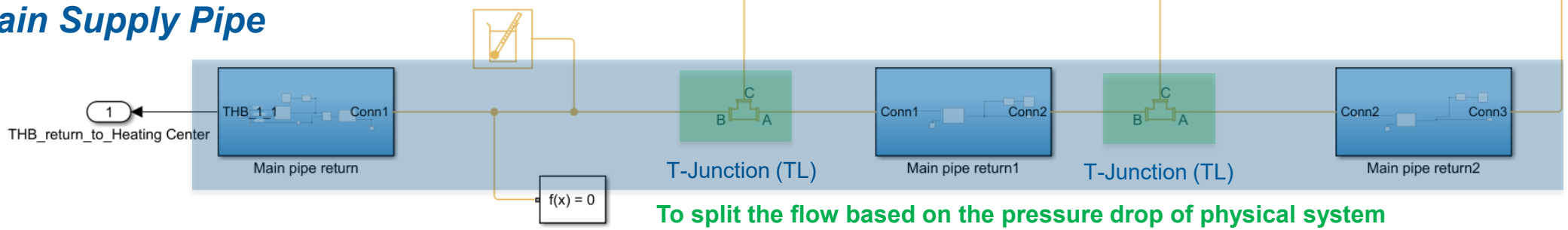
House Connection Pipes (Three Consumers)



Thermal Liquid Settings (TL)

Main Supply Pipe



To split the flow based on the pressure drop of physical system

HEATING NETWORK (RETURN)

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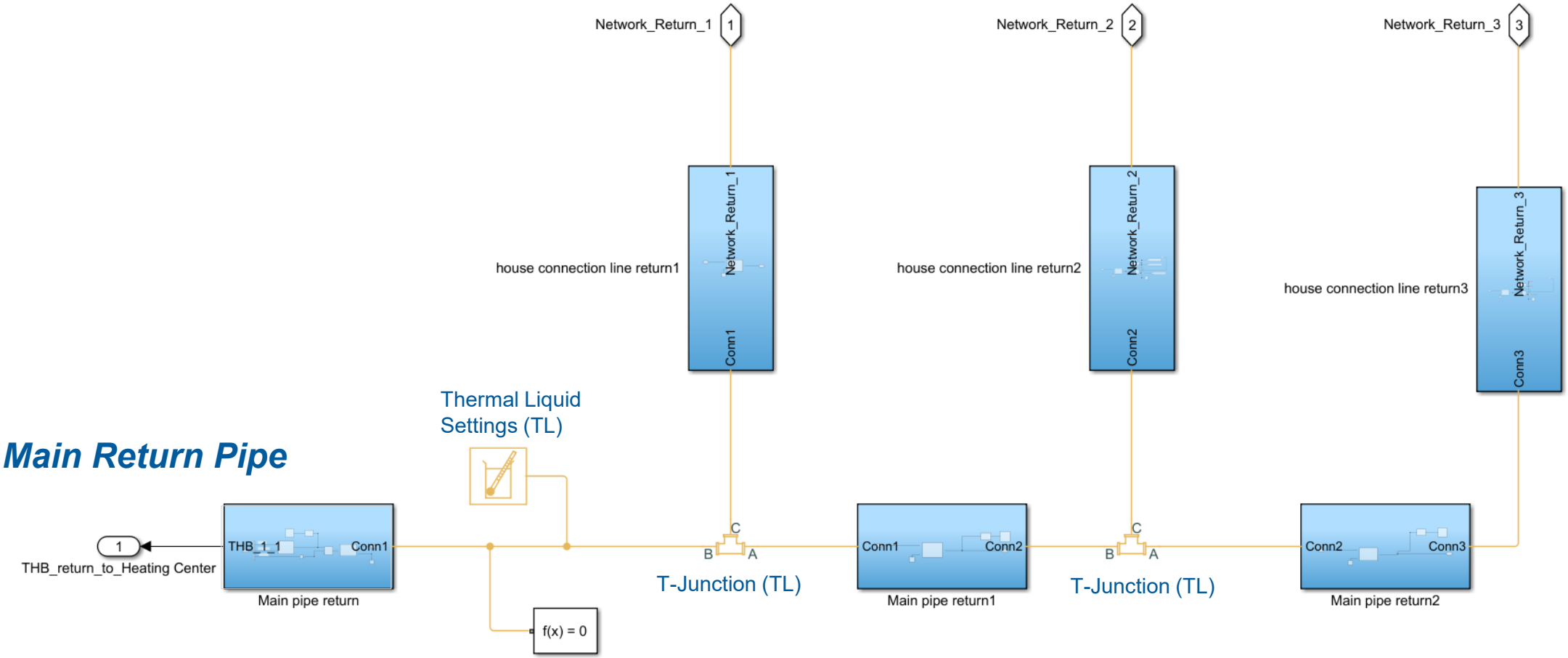
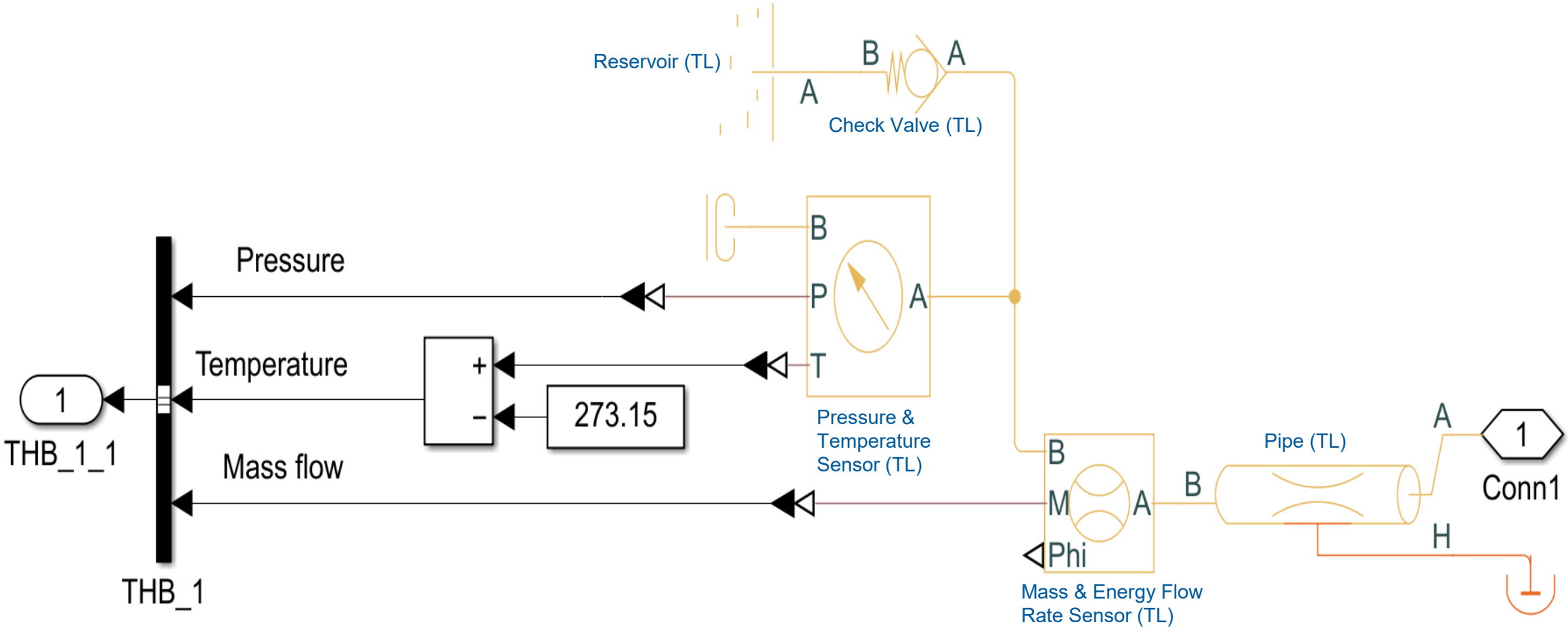
House Connection Pipes (Three Consumer)



HEATING NETWORK (RETURN)

MAIN RETURN LINE PIPE CONNECTION

Terminate the return network by setting back pressure according to designed total pressure drop of the “Heating centre” by “Reservoir” and “check valve” blocks



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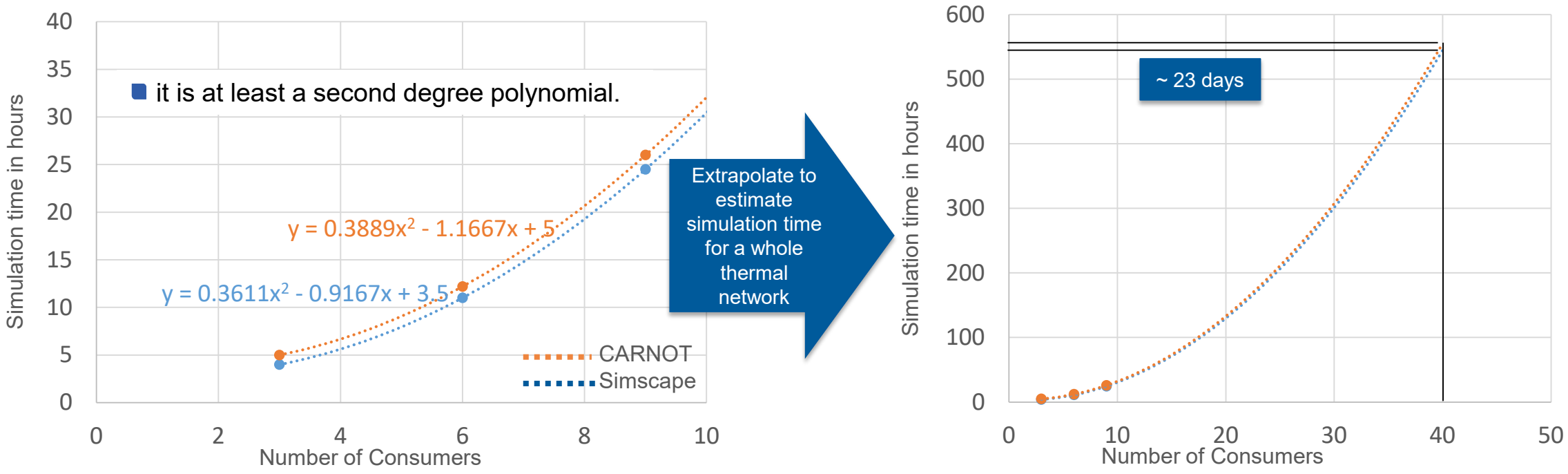
Time for yearly simulation



Extrapolate to estimate simulation time for a whole thermal network

How to decrease simulation time?

- Simplify consumer model
- …
- Aggregation is not possible as an innovative operating strategy that works with the consumers is to be explored.
- At some point, someone from the Institute of new Energy Systems would like to look at modeling consumer substation in Simscape

Thank you for listening!

Gefördert durch:

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Projektträger Jülich Forschungszentrum Jülich

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