

VTT Technical Research Centre of Finland

and Apros[®]

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VTT is a visionary research, development and innovation partner for companies and the society, and one of the leading research organizations in Europe.

261 M€
OPERATING INCOME

2,213
EMPLOYEES

32%
A DOCTORATE OR A
LICENTIATE'S DEGREE

51
NATIONALITIES

45%
OF THE NET
TURNOVER
FROM ABROAD

1942
ESTABLISHED
OWNED BY MINISTRY OF
ECONOMIC AFFAIRS AND
EMPLOYMENT



Office of Nuclear Energy @GovNuclear · Apr 26

"This cooperation between the U.S. and Finland will strengthen energy security, boost clean energy production, and enable sharing of valuable lessons learned on how to manage spent nuclear fuel." 🇺🇸 🇫🇮

- Katy Huff

VTT

@FinlandinUSA @TEM_uutiset



MoU between US and Finland on nuclear energy cooperation signed a few weeks ago

/ond the obvious

VTT's roles as an independent expert organization

For policy development

Multi-disciplinary studies to support energy, climate and innovation policies from national, European and global perspectives

For nuclear investment projects

Safety analyses – for the regulator
Licensing support – for the industry

For nuclear power plants

Material performance studies
Plant life and performance analysis

For decommissioning

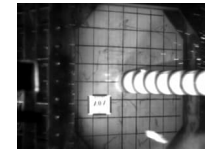
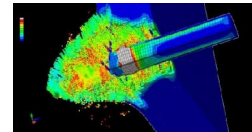
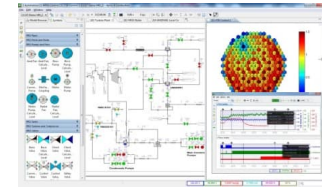
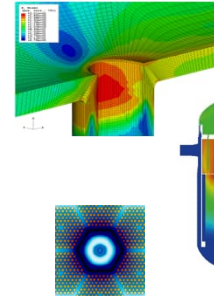
Experience from research reactor decommissioning
E.g. inventory calculations and measurements

For waste management

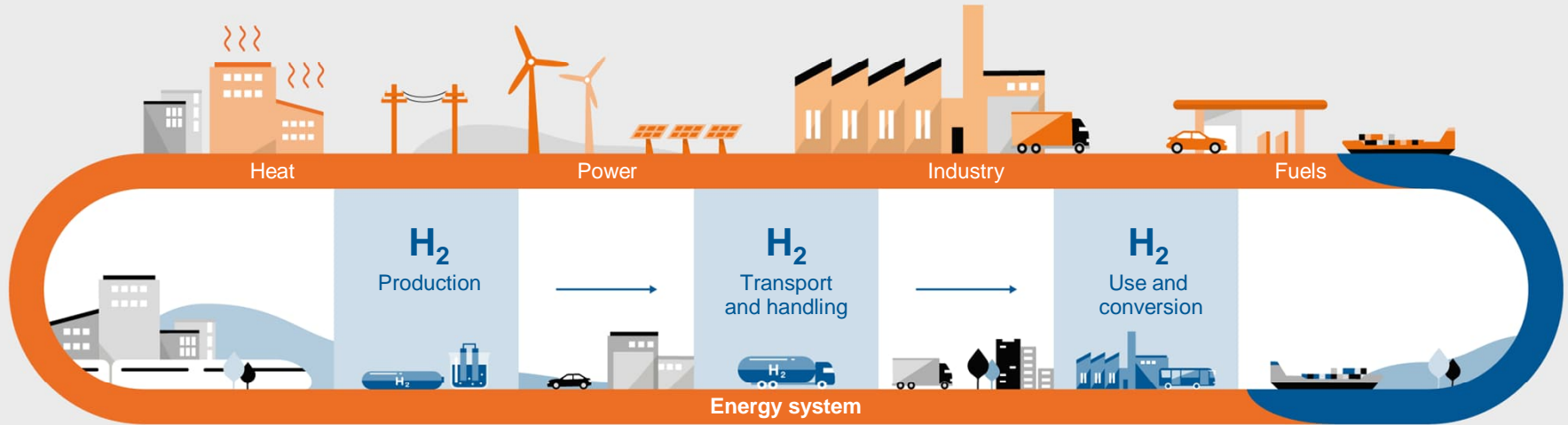
Technology development
Site specific studies

For the future of nuclear

SMR feasibility and licensability studies
GenIV and fusion technologies
Digitalization



Focus areas in the hydrogen value chain



SOEC technology
development

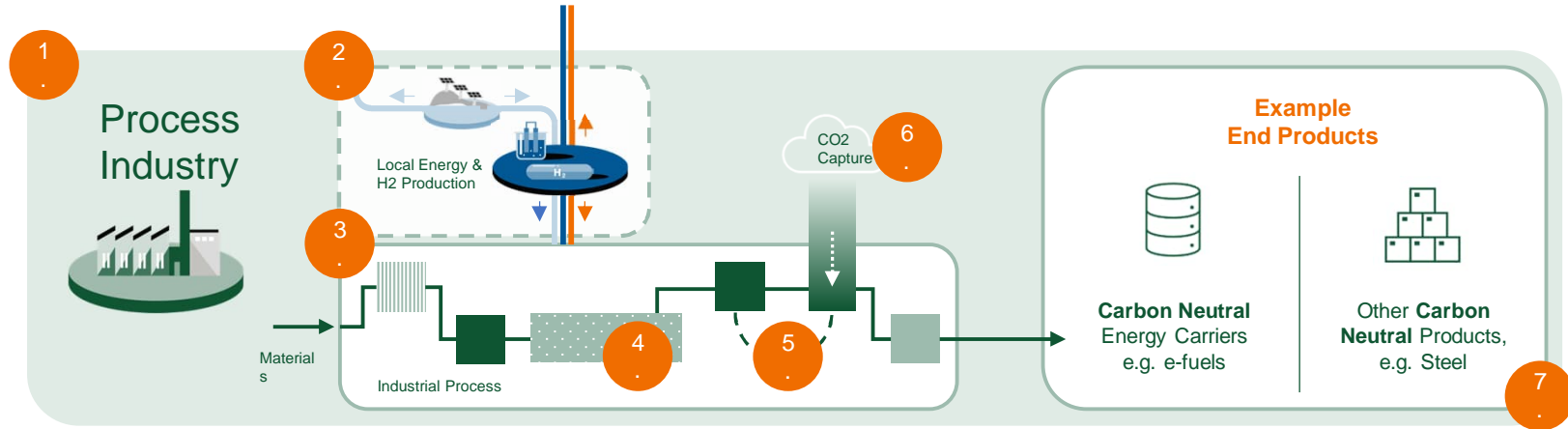
Electrolyser and
fuel cell systems design,
manufacturing and operation

Hydrogen quality
and safety

Hydrogen and
power-to-X systems

Hydrogen fuelling
stations and heavy
duty vehicles

How Do We Support Process Industry?



Key Questions We Can Help With

1. How could we reduce CO₂ emissions in our production to meet the regulation and customer expectations?
2. How to get clean energy for our processes to reduce CO₂ emissions?
3. – 7. How to optimize our processes to reduce CO₂ emissions?

VTT Expertise and Services Include

1. P2X/H₂/CCU concept development and techno-economic assessment
2. Industrial electrification and electrolytic hydrogen production and supply
3. Industrial process and system modelling
4. Equipment research and development (PEM & SO electrolyzers, fuel cells)
5. Side stream and waste heat utilization
6. CO₂ capture (industry, inherent sources, air)
7. Concept and process scale up and piloting

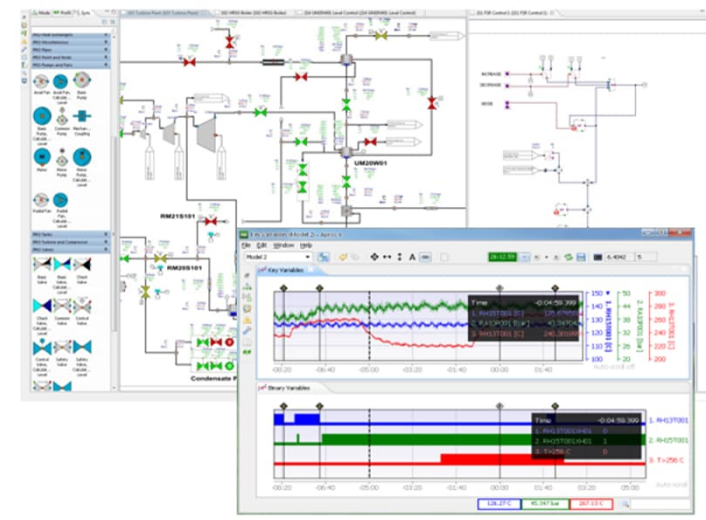
Apros® for engineering simulators

Try it out well before the commissioning

- optimize the dimensioning of large process components
- check and pre-tune the controls
- validate the input data for the suppliers of all systems
- involve plant personnel early in the project

Scope - the entire plant with all interconnections:

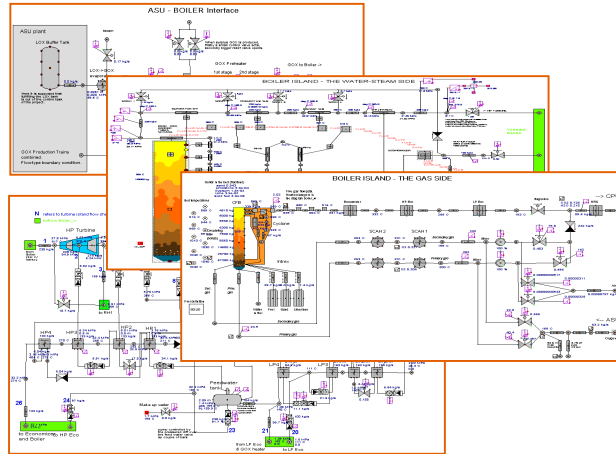
- Nuclear reactor
- Heat storages
- Turbines
- Hydrogen production
- Paper machine
- etc.



<http://www.apros.fi/>

Process & control concept evaluation

Co-simulation Apros - Aspen



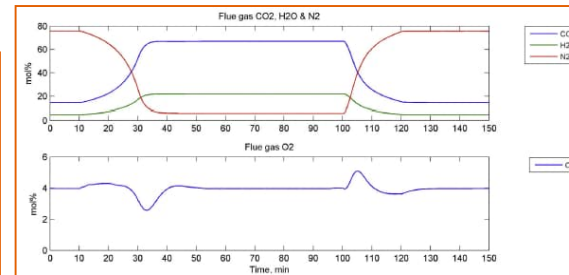
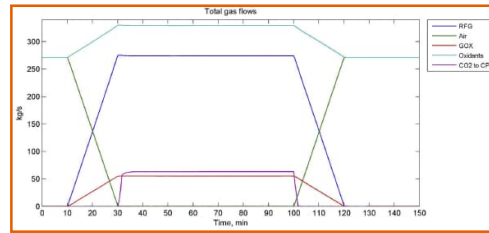
Example: a CCS capable power plant concept including

- Interface to Air Separation Unit
- Supercritical CFB boiler
- Turbine island
- CO2 Compression and Purification Unit
- Controls

Simulation control through Simulink

Simulation example:
Mode switch from air
firing to oxy firing and
back

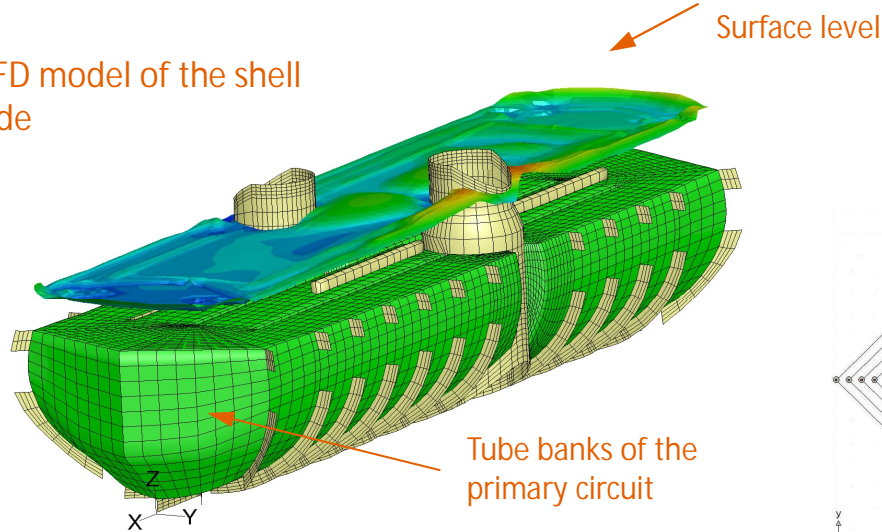
Ref: Lappalainen et al.
International Journal of
Greenhouse Gas
Control, 28(2014)11-24



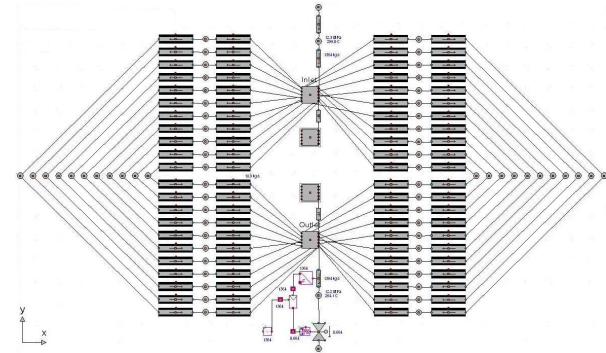
Modelling of a steam generator

Co-use of thermo-hydraulics software

CFD model of the shell side



Apros model of a tube layer of the primary circuit



- The primary circuit is modelled with the Apros system-level software
 - The shell side is modelled the ANSYS Fluent CFD software
 - The Apros and Fluent models are coupled
- Detailed information about shell side dynamics in system-level analysis

Process furnace and distillation column

Co-simulation Apros – NAPCON SIMULATOR (ProsDS) by Neste

- Apros model:

- Piping and combustion of the furnace

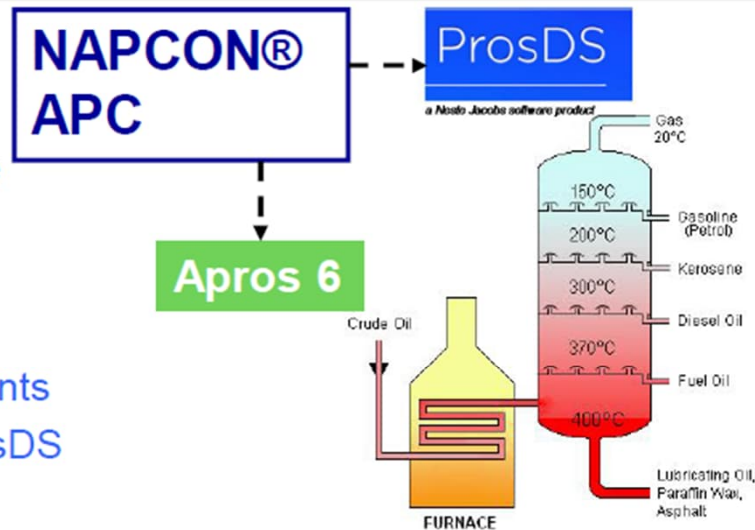
- ProsDS model:

- Distillation column and the crude oil flow through the furnace

- NAPCON APC manipulates the setpoints of the base controls in Apros and ProsDS

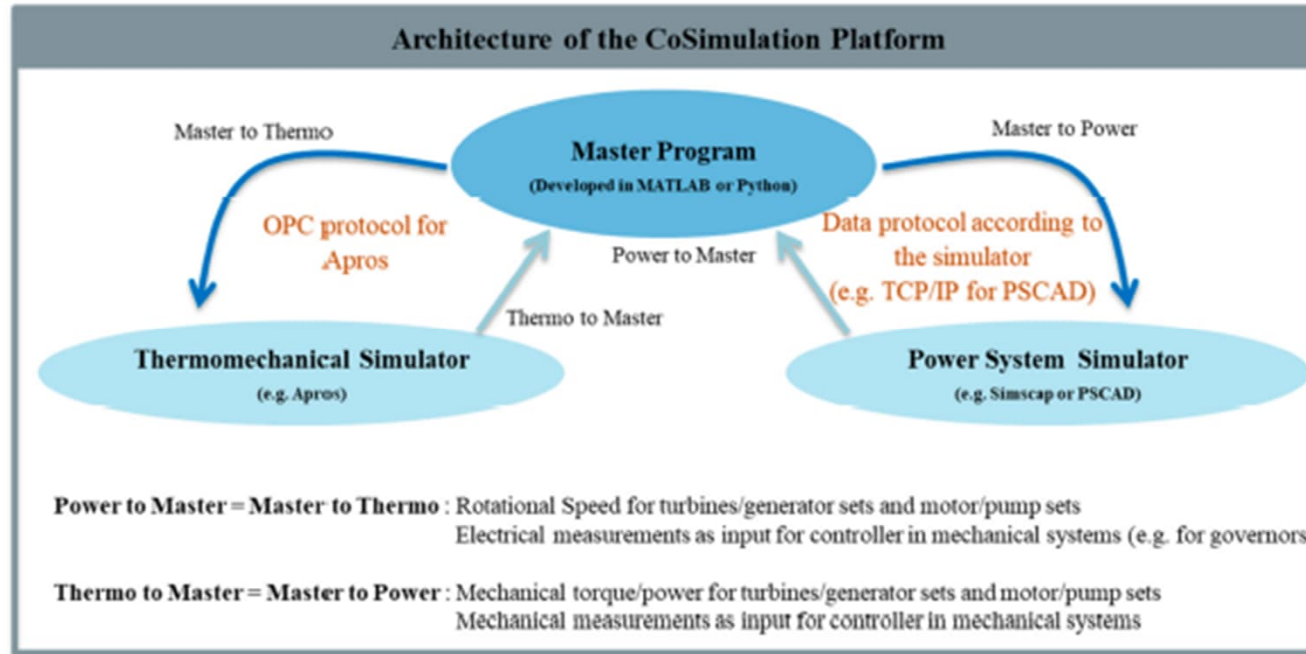
- The furnace interface:

- To Apros: The crude oil temperature in the tubing within the furnace
- To ProsDS: the heat flow from the tubing to the crude oil
- The tube divided into 54 sections, each of which exchange temperature and heat flow



Integrated plant and power grid analysis

Co-simulation Apros and PSCAD



For more, see

<http://vttresearch.com/nuclear>

<http://apros.fi>