HeatXSysPro

From Excel to robust tool for Air Fan Coolers performance assessment

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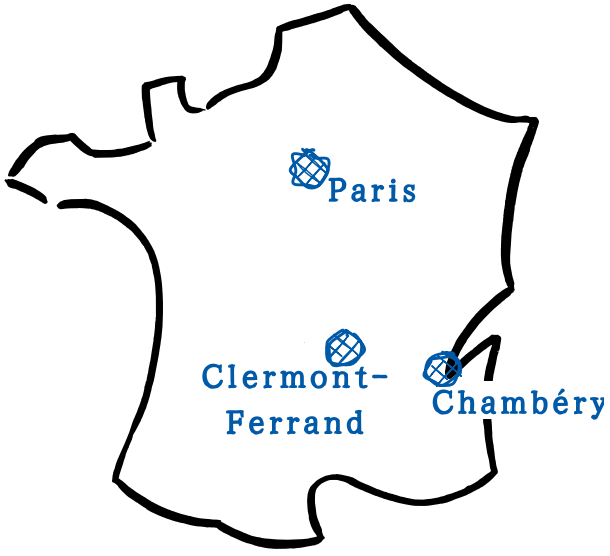
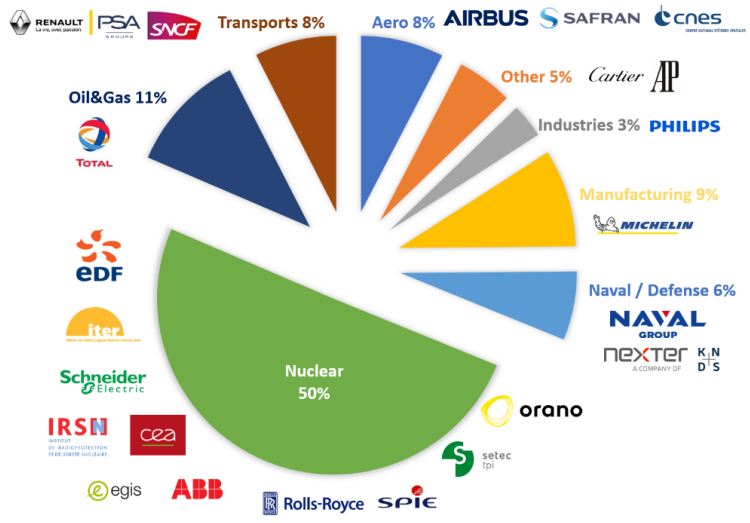
Phimeca: the responsible engineering

Build together, through innovative engineering, an industry caring for human and its environment.





- Since 2001
- 35 engineers and PhDs
- Modeling & Simulation + Data science & Machine learning
- Tech. studies, software development, R&D, consulting, training

“Build together”: a business model

We believe in **cooperation**: build deep and evolutive learning relationships with clients and partners.

- They continuously educate us about their exact specific needs.
- We strive for insightful & contextual answers, focusing on tech & skill transfer and knowledge co-creation.

We gauge success not solely on what we achieve, but more on what we **enable**.

Outline

Edvance assesses cooling systems for emergency diesel generators used in civil nuclear reactors.

A recently developed Excel-based tool proved to be useful

It is cumbersome to use, difficult to explain, and not perennial.

We developed a Modelica and Python toolchain to capitalize and expand this knowledge

Enters HeatXSysPro

Design office

- International REX shows systematic sizing errors by suppliers
- Performance data-sheet without justification: difficult to assess project requirements.

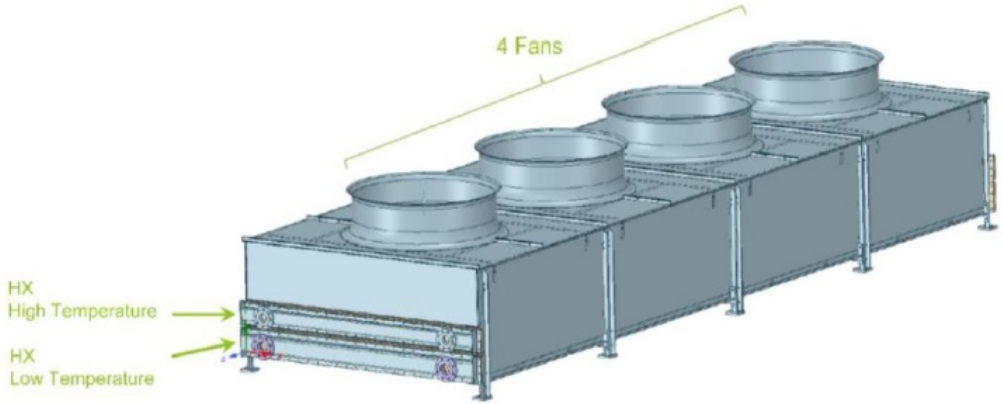
Site

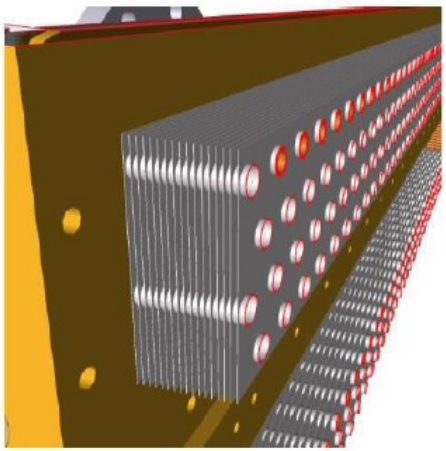
- ASN demands verification of performance with qualified tool.
- Assembler provides a service for commissioning with manufacturers:
  - high cost & delay
  - Non sustainable when aiming at 60 year longevity

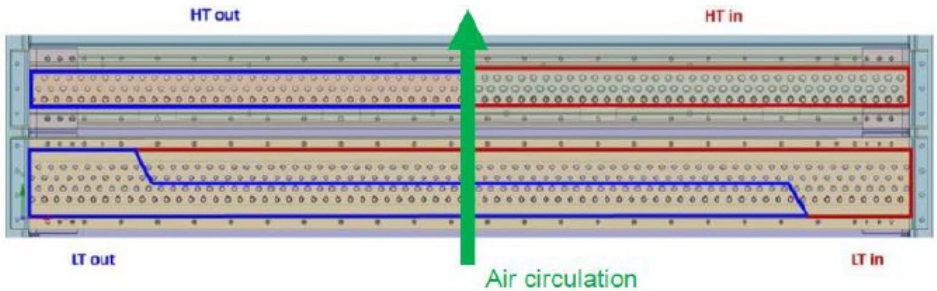
$\rightarrow$ *There is no off-the-shelf tool on the market meeting our needs.*

Air-fan cooling (AFC) system

Flamanville's AFC unit







HeatXSysPro's spec overview

Excel-based tool:

- Heat Exchangers performances.
- Air flow produced by fans.
- Recirculation phenomenon in case of fan failure or stop.

Need to:

- Automate computations.
- Get a maintainable and robust tool.
- Optimize the cooling system.
- Get an ergonomic and durable tool.

HeatXSysPro design principles

Robust: Modelica language.

Maintainable: Gitlab and documentation.

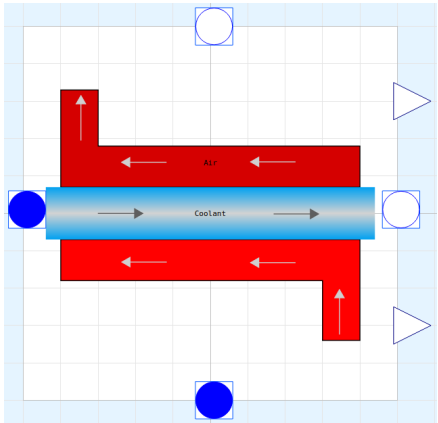
Generic: Basic components to model AFC systems.

Specialized: Specific models for existing sites.

Ergonomic: Easy to tune, exportable to FMU.

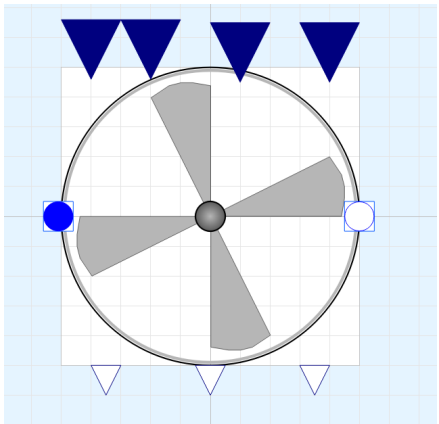
HeatXSysPro - generic components

Heat Exchanger



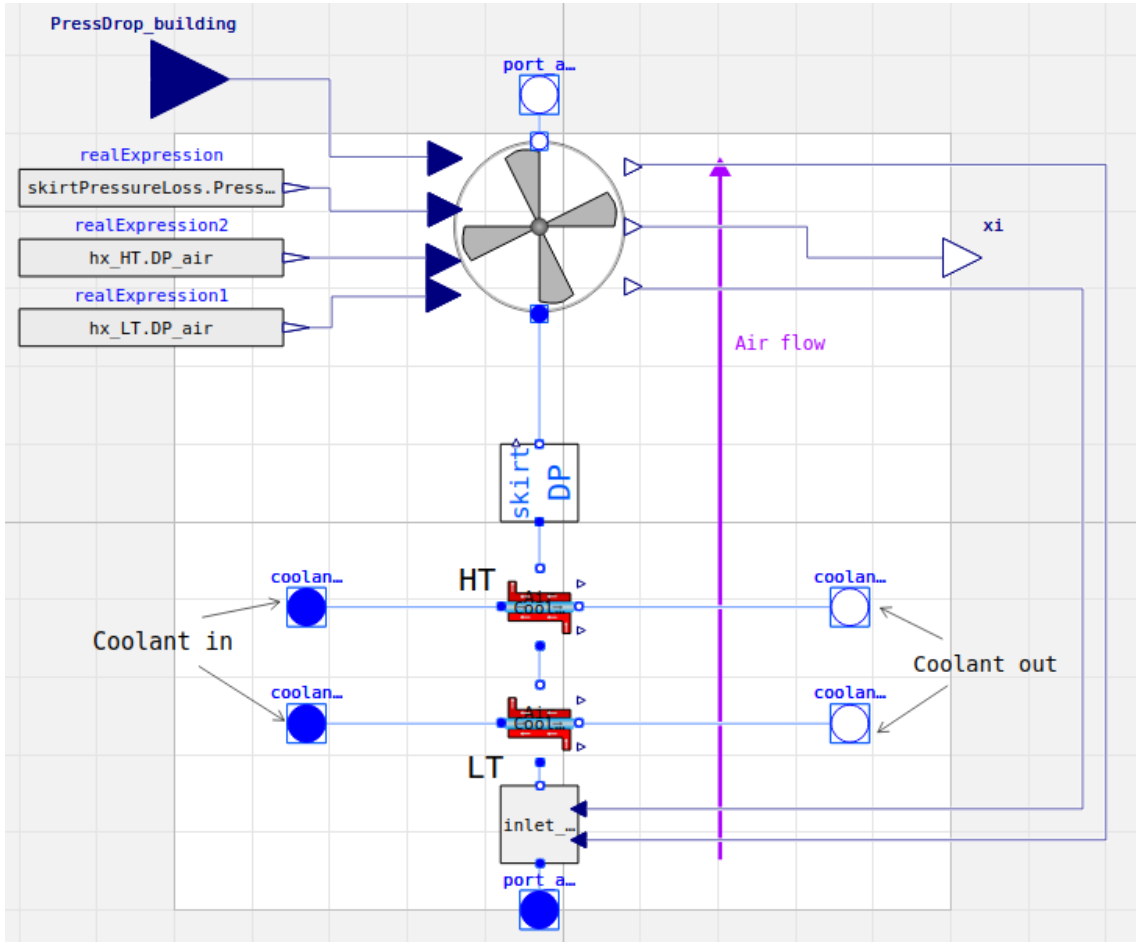
- Definition of Fins and tubes.
- Compute heat exchange and outlet temperatures.
- Compatible with different system configurations.

Fan

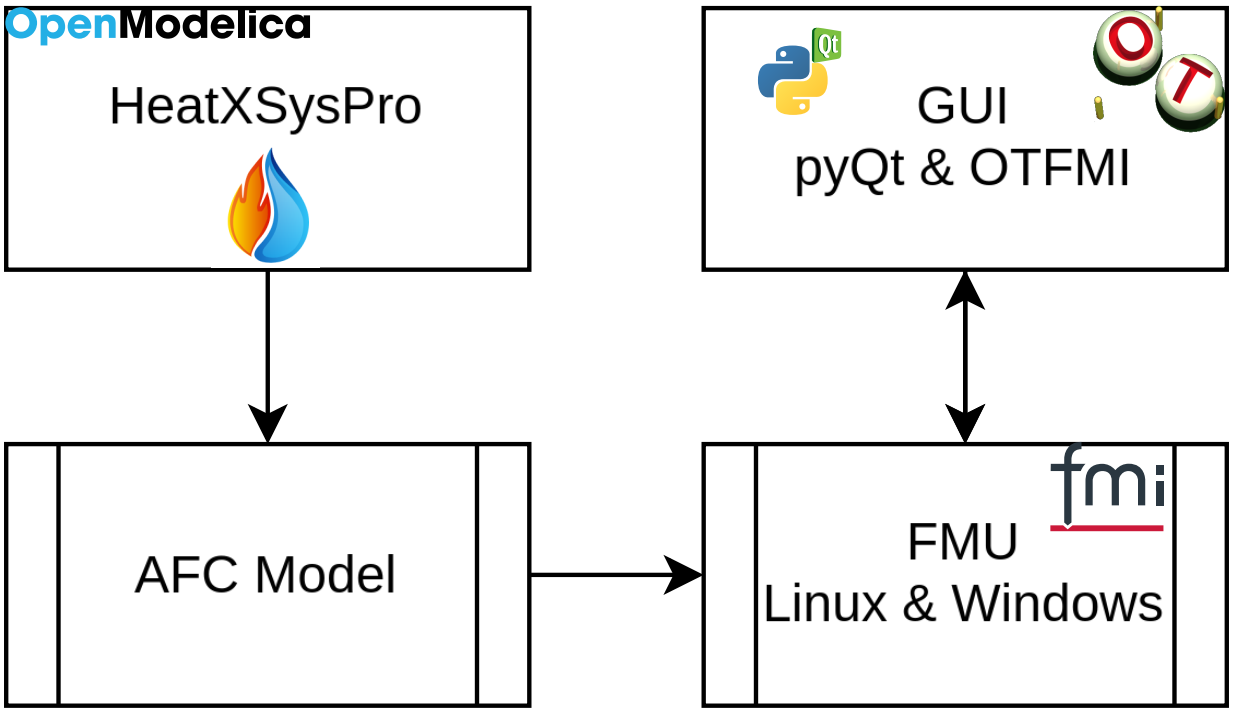


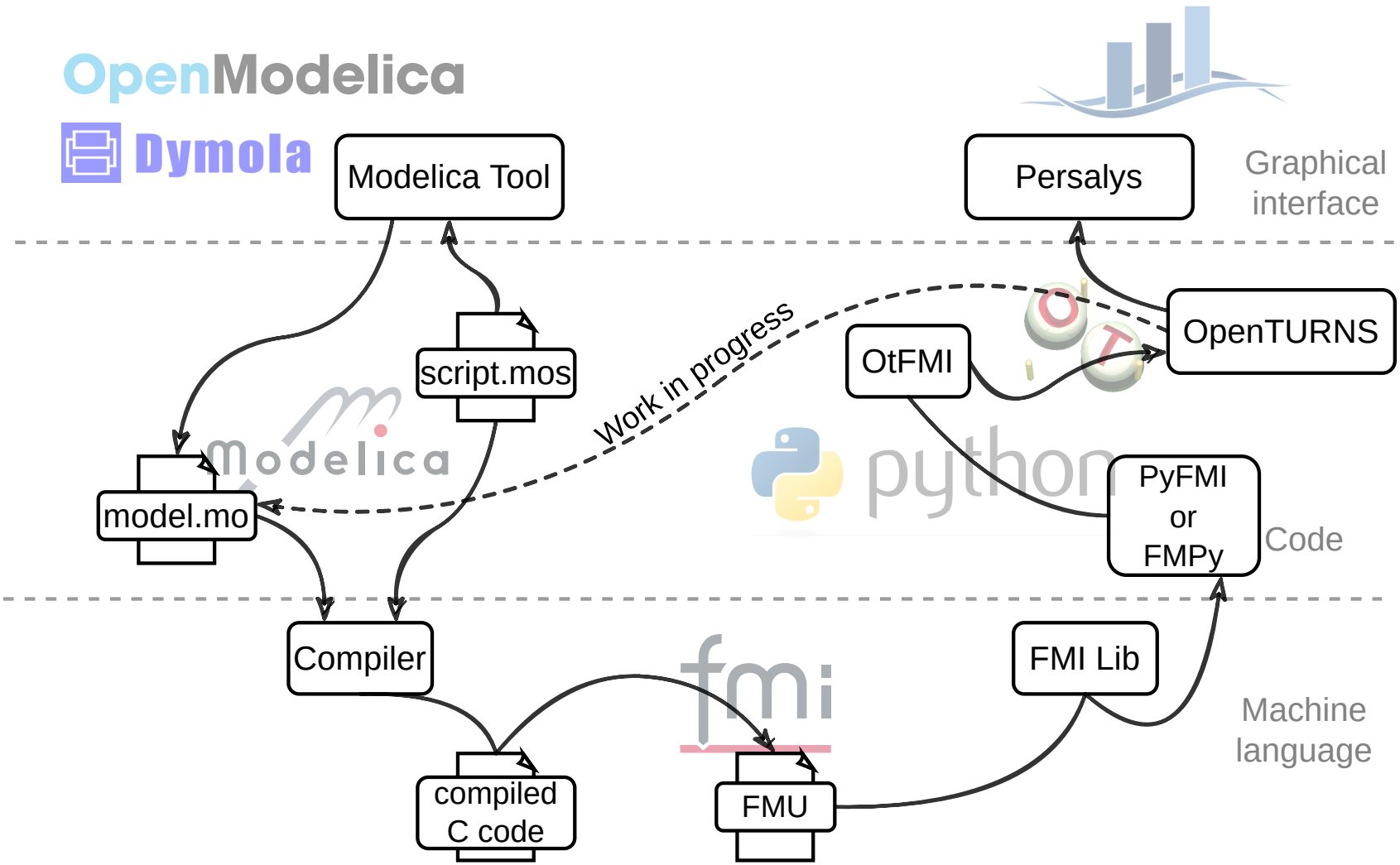
- Air flow, according to pressure drops and fan curve.
- Scalable
- Recirculation effect.

Example of AFC model: HX and Fan



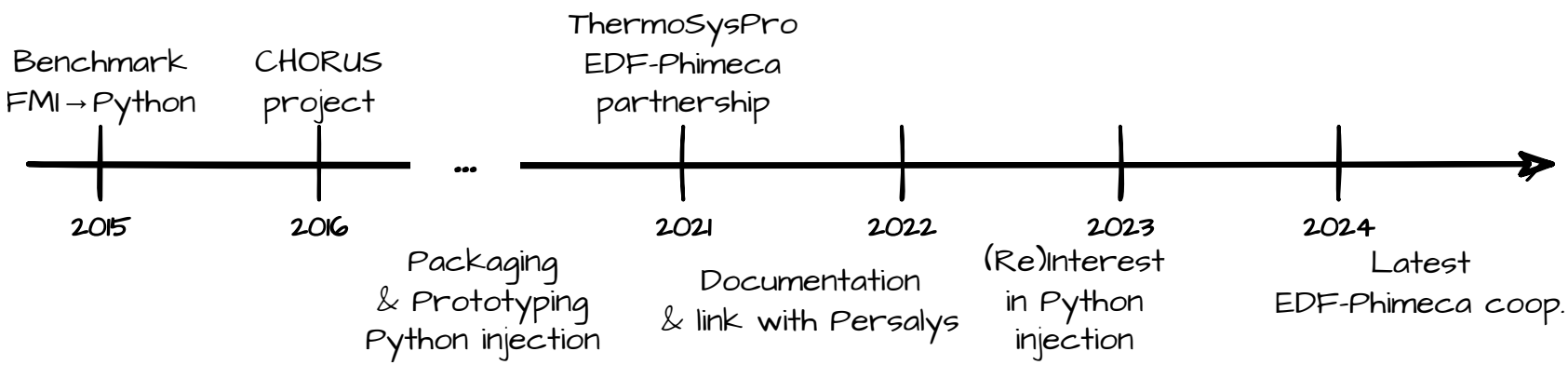
HeatXSysPro architecture




OpenModelica
Dymola
Modelica Tool
Persalys
Graphical interface
script.mos
Work in progress
OtFMI
OpenTURNS
model.mo
PyFMI or FMPy
Code
Compiler
FMI Lib
compiled C code
FMU
Machine language

OtFMI: *Since 2015!*

A long term cooperation between EDF and PHIMECA L'ingénierie responsable.



Git: https://github.com/openturns/otfmi

Documentation : http://openturns.github.io/otfmi/master/

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Demonstration

Merci de votre attention.

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