

Lua as a script language for industrial process design and optimization with energy integration

Min-Jung Yoo
Swiss federal institute of Technology
School of Engineering

Agenda

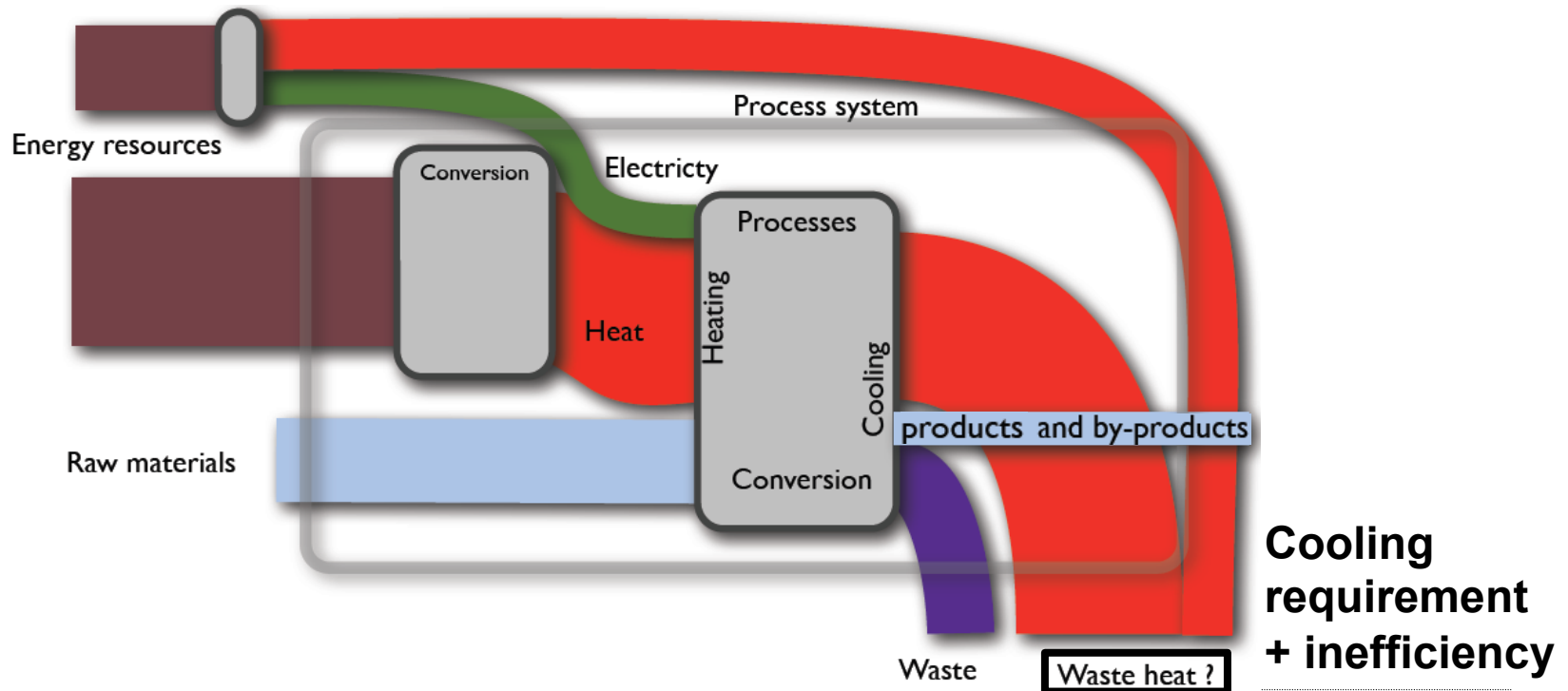
- Background history
 - Previous work in Energy Integration and Optimisation
- Context of the work
 - Industrial project
 - Towards holistic “Simulation – Analysis – Optimisation” of Industrial Processes
- Taking advantage of Lua language
- Sharing and collaborating with the community of Lua
- Closing remarks

Background History

- Previous work in “Osmose”
- Transferring from Matlab to Lua
 - Performance problems
 - License problems: public distribution
 - Industries, academic institutions, research collaborations

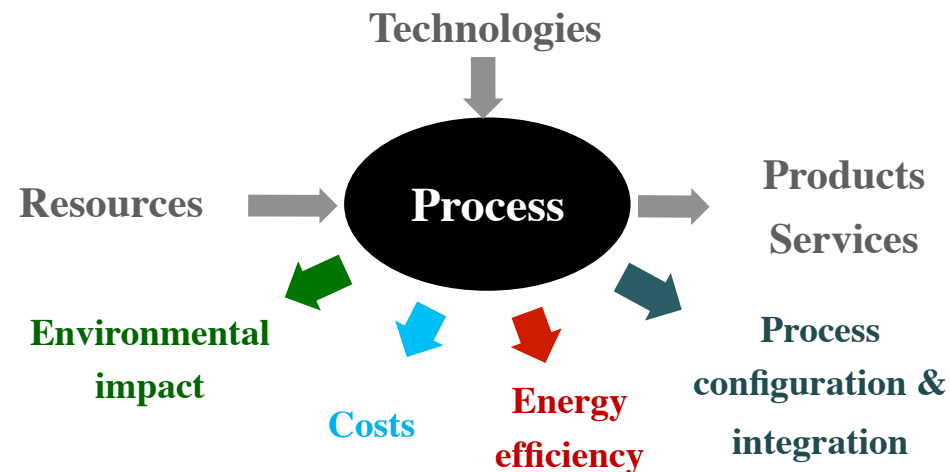
Background work (1) - Issues

- Industrial process/es or plant
 - Energy efficiency ?
 - Heat recovery
 - Waste valorization
 - Use of waste heat for district heating ?



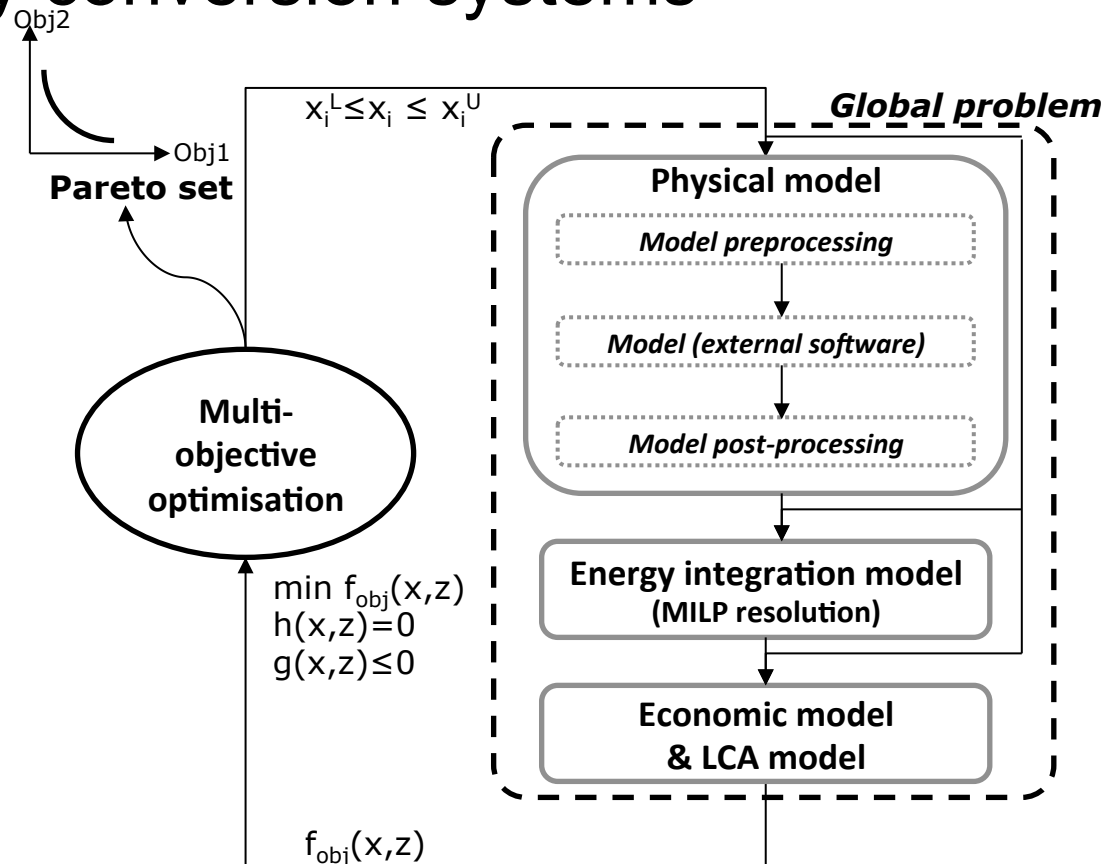
Background work (2) - Context

- Rational use and conversion of energy in industrial energy systems
 - Need for a systematic framework
 - Thermo-environomic optimisation methodology
 - **Systematic approach** to design complex integrated energy conversion systems
 - Computer-aided tool for process integration & optimization



Background work (3) - Methodology

- Osmose (Matlab) - Platform for studying energy conversion systems



Background work (4) - Transition

- Re-implementation in Lua
 - Another presentation in Lua Workshop 2014 with more detail
- Extension to additional dimension: Holistic approach including GIS functions, Environmental Impact Analysis, Database functions

Agenda

- Background history
 - Previous work in “Osmose” Matlab -> Lua
 - My research interests
- Context of the work
 - Industrial project
 - Towards a holistic approach to “Simulation – Analysis – Optimisation” of Industrial Processes
- Taking advantage from Lua
- Sharing and collaborating with the community of Lua
- Closing remarks

New horizon: current and future work

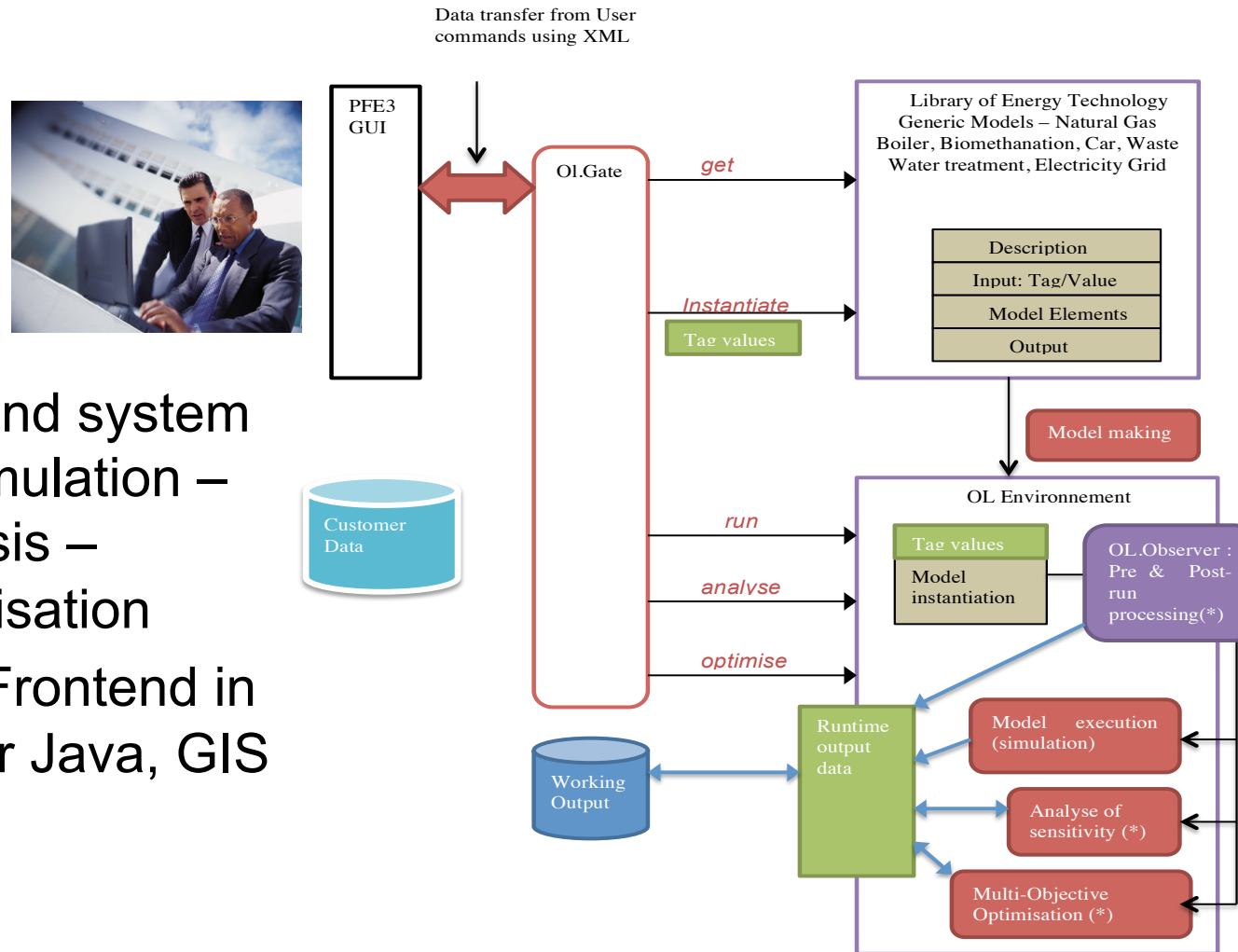
- Adding more dimensions
 - Capable of covering generic issues in industrial processes (by and large)
 - Supply Chain
 - Geographical notations
 - LCI (Lifecycle Inventory) & LCIA (Lifecycle Impact Analysis) with the new version of Ecoinvent3 databases

Context of the project

- PFE3 –Partly funded by the program SEED 2012 from the French National Agency for Research ANR in the frame of the Plate-Form(E)3 project
 - Industrial Project, consortium composed of several French industries and academic institutions
 - Outcome – A tool for Energy Integration and Optimization for generic simulation of industrial use cases
 - Components for Energy System Modeling
 - Focused on territorial use
 - Manufacturing factories
 - Graphic User Interface running with Model libraries

Context of the Work – The role of Osmose-Lua

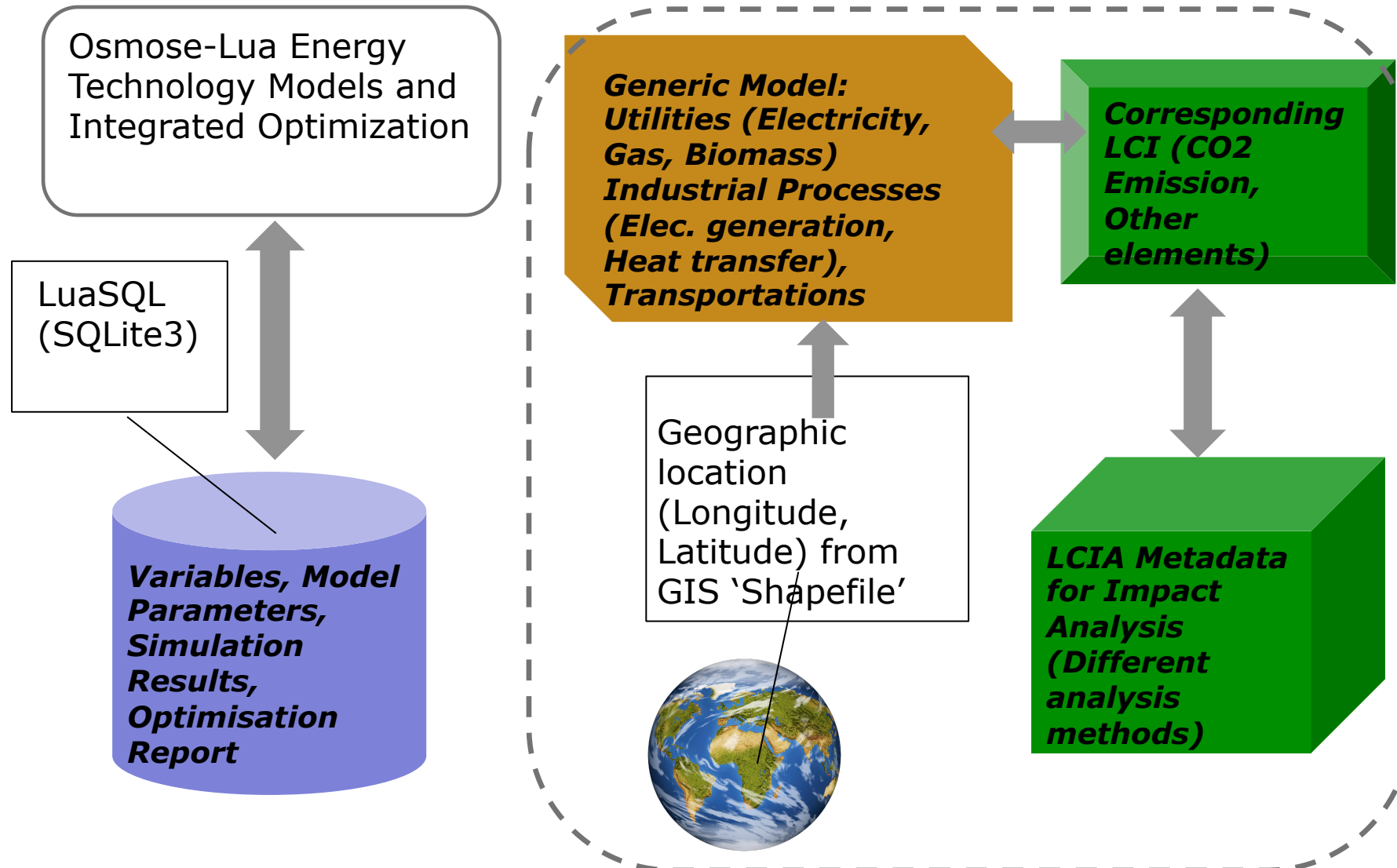
- Backend system for Simulation – Analysis – Optimisation
- User Frontend in C++ or Java, GIS tools



(*) External API integration

Figure. OsmoseLua Global architecture

Osmose-Lua extended architecture



Agenda

- About myself
- Background history
 - Previous work in “Osmose” Matlab -> Lua
 - My research interests
- Context of the work
 - Industrial project
 - Towards holistic “Simulation – Analysis – Optimisation” of Industrial Processes
- Taking advantage from Lua
- Sharing and collaborating with the community of Lua
- Closing remarks

Taking advantage of Lua...

- Adding new sub-systems, such as GIS data handler, LCI dataset integration and LCIA meta tables, to the existing Osmose-Lua
 - Such an API extension: Not always straight forward
- Which happens in general : Existing system was not designed to be extended in an unknown direction

Lua ?! – Object orientation without ‘Class’



- With the help of flexibility in terms of structuring SW architecture
 - Allow us some relaxed ways of restructuring own Object-Oriented Architecture

Lua ?! : Table management flexibility

- The target system – characteristics
 - Must to handle many different types of data (model parameters and simulation variable) and attributes in a flexible way
 - Without using a particular spreadsheet or RDBMS
 - Already Lua allows to model database accessing in a friendly manner

Substantial difficulties

- Lua: language not very well known and not penetrated into our research society
 - Finding students and assistant in development
 - Promoting the project outcome
- Technical difficulties
 - Exploiting the resulting API on different machines / several types of OS
 - Not always successful in providing a set of generally installable & Executable API

What we are doing in parallel

- New course in Doctoral Student Programs
 - Specialized Field : “Energy”
 - Learning Lua and Osmose-Lua,
 - October..November, 2weeks intensive, 4 ETCS
- Technical support to Swiss and French industries
 - Promoting the approach

Sharing and Communicating with the Community of Lua

- Result sharing
- Academic staffs/students exchange
- Creating other industrial projects

Closing remarks

- We are happy to join the Lua community !