Dynamic Optimization

Innovate Training Session

October 11, 2024

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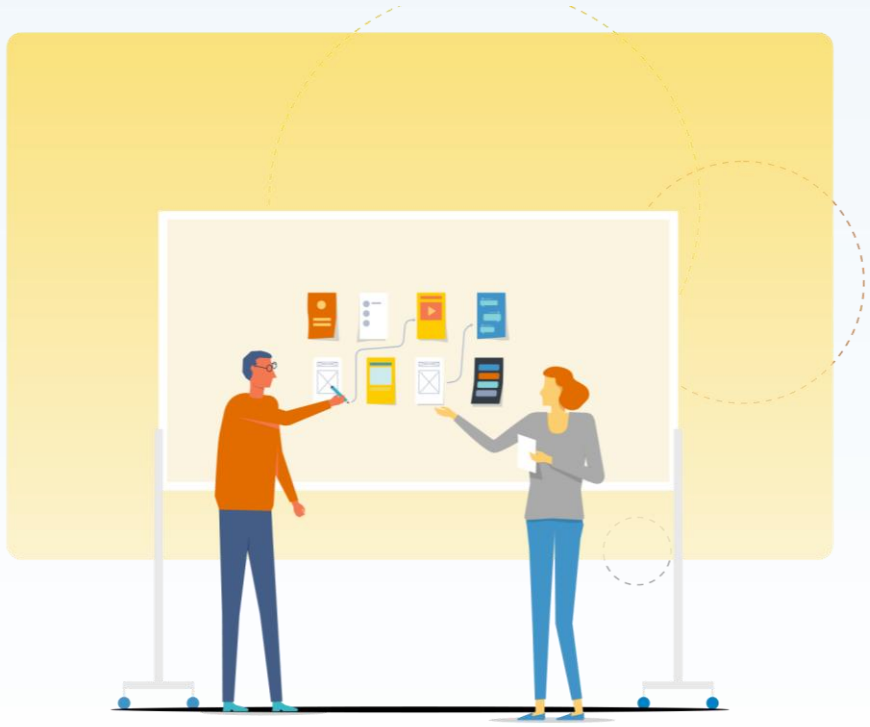
Modelon

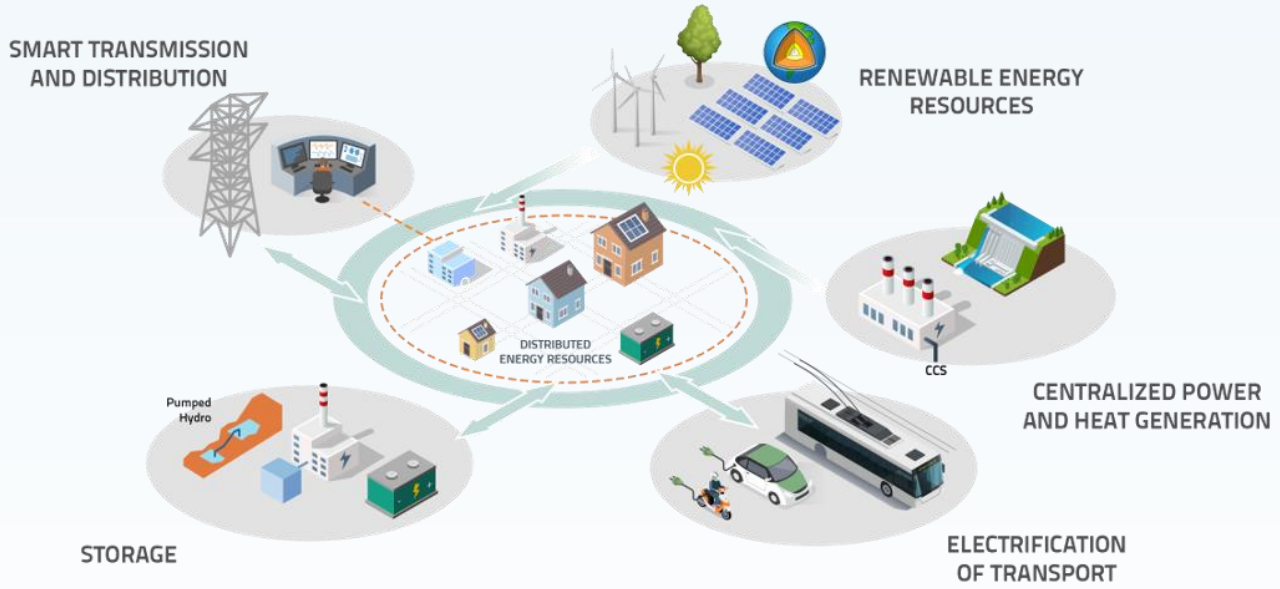
Goals of this Session

- Basic differences between simulation and optimization covered
- Brief overview of Energy Systems library given
- Simple techno-economic optimization model built and executed
- Impact of carbon tax analyzed



Short Introduction

- System complexity is increasing
- Typical questions
  - What design choices can/should be made?
  - What is the best way to operate the system?
  - What are the costs and cash flows?
- Advanced computational methods needed

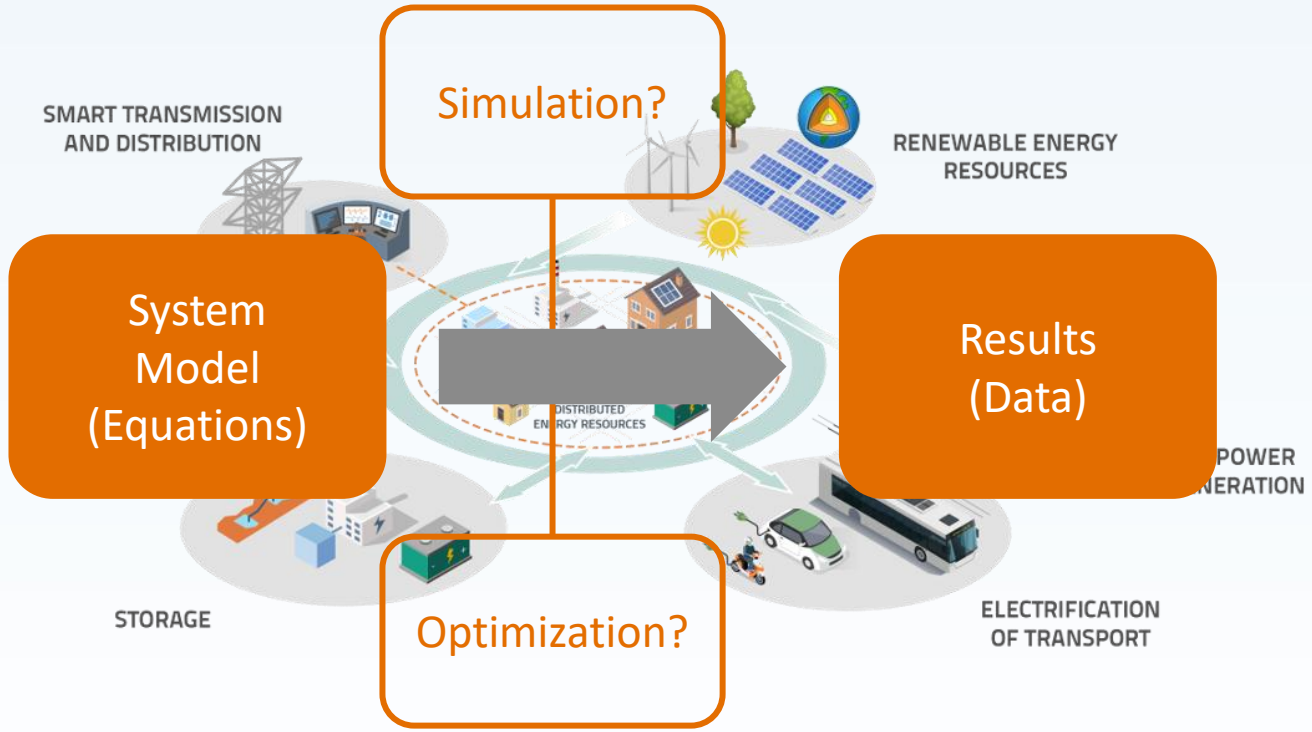


Simulation vs. Optimization

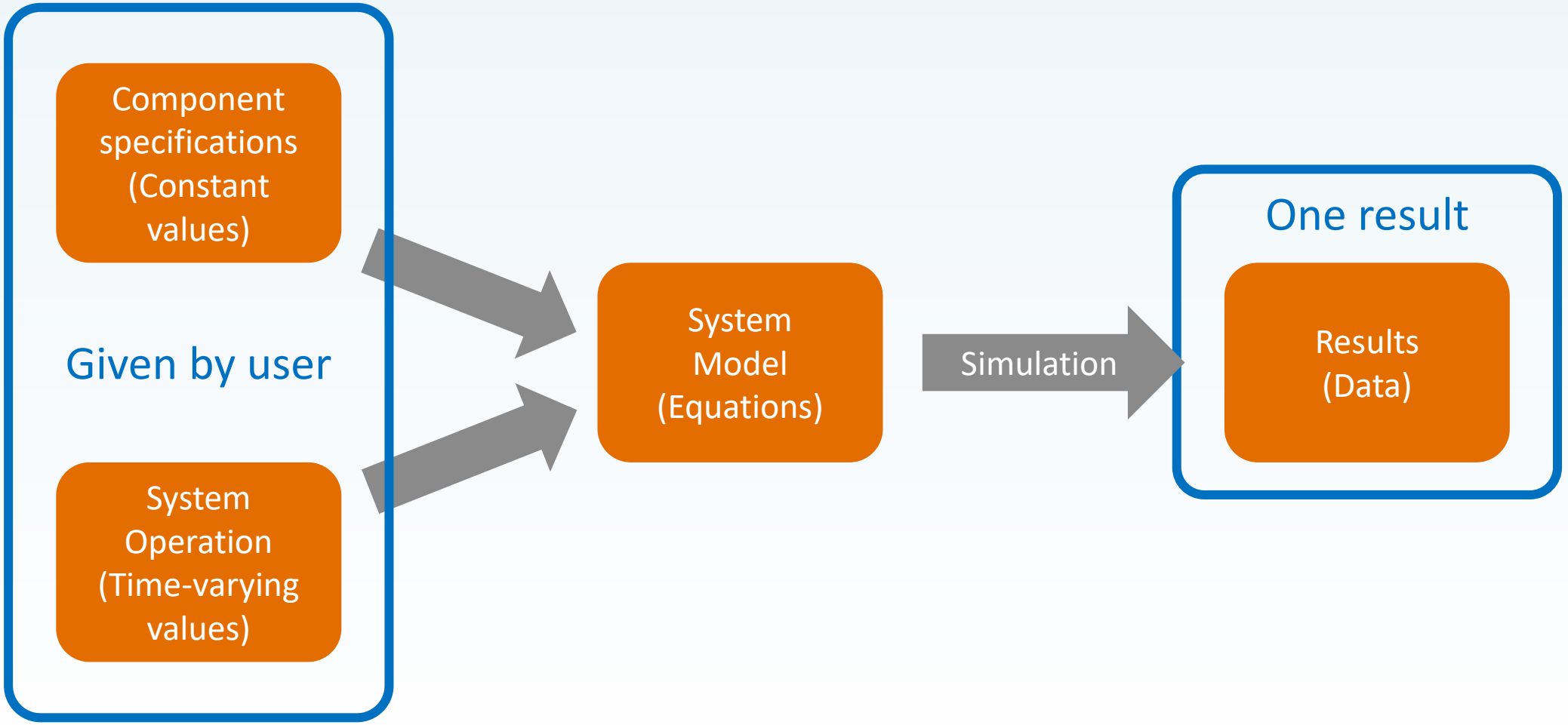
Component specifications (Constant values)

- What ... ca.../should be made?
- What is the best way to operate the system?
- What ... nd ... flows?

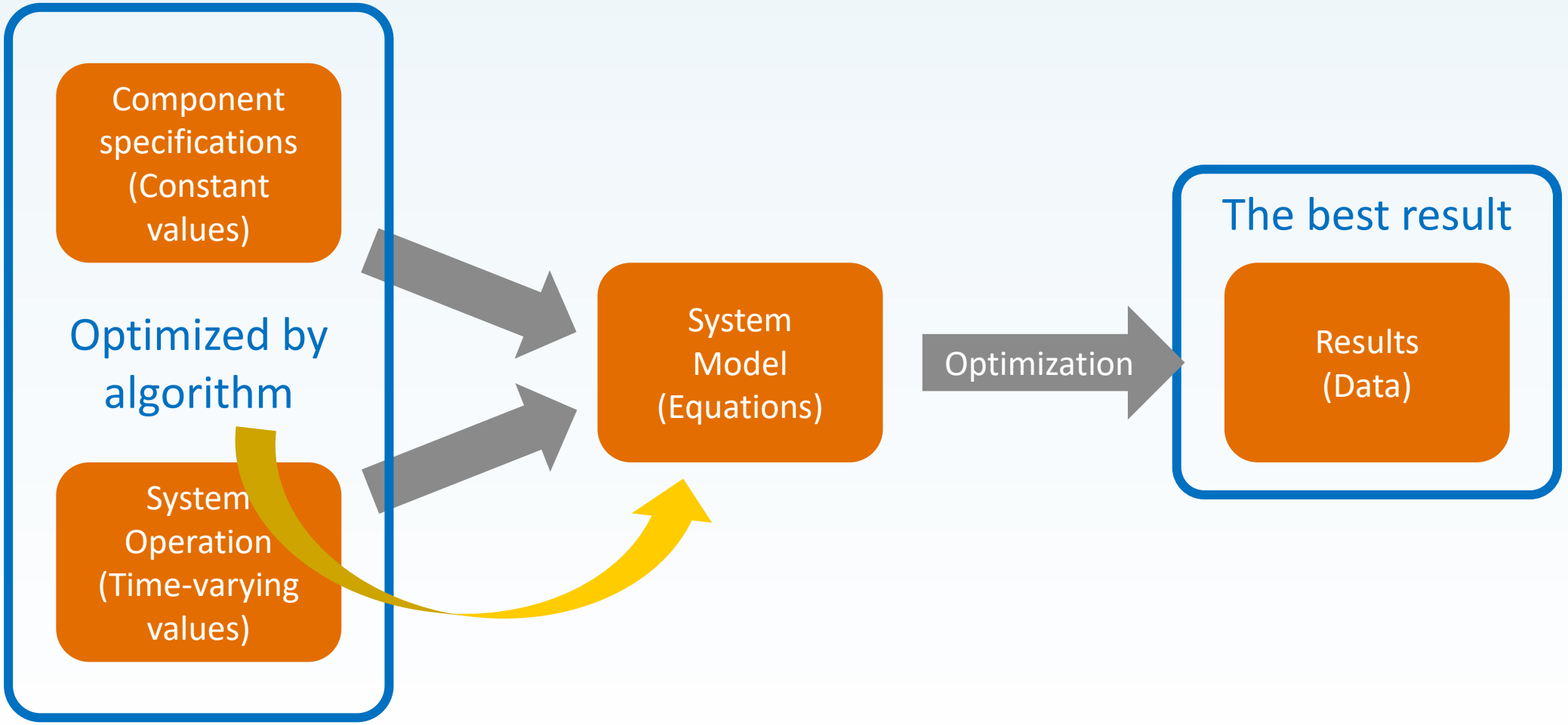
System Operation (Time-varying values)



Simulation vs. Optimization

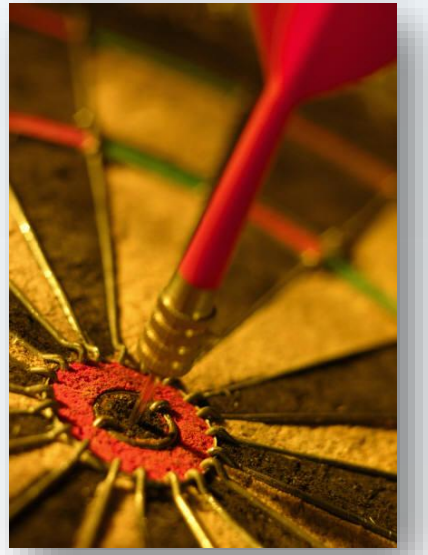


Simulation vs. Optimization



Remember:

Equations are handled very differently during **simulation** (finds one solution) and **optimization** (finds the best solution out of very many).



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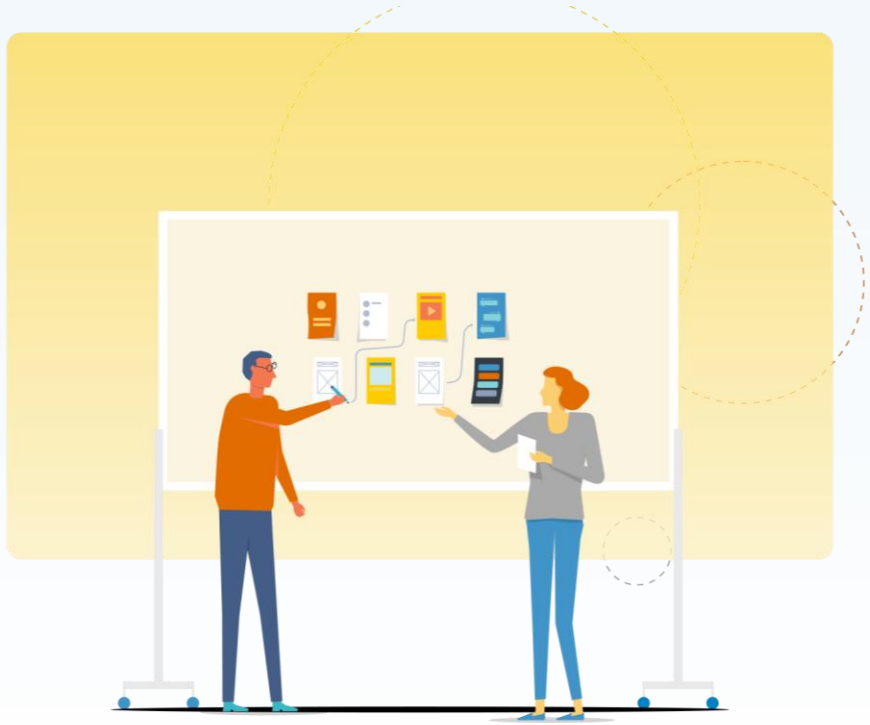
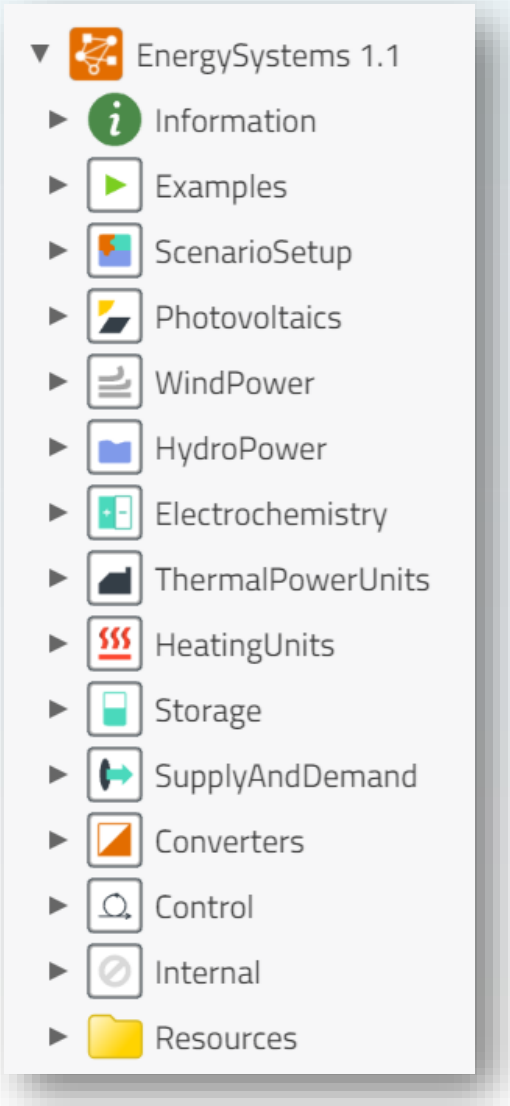


Energy Systems Library

- Models for techno-economic optimization of hybrid energy systems (sector-coupling)
- Optimal sizing included in components
- Simple to use model for optimal control



Energy Systems Library

- Utility-scale systems / industrial sites
- Typically many 1-year scenarios with different loads, prices, costs, etc.
- “Best” result depends on objective function (free to chose)

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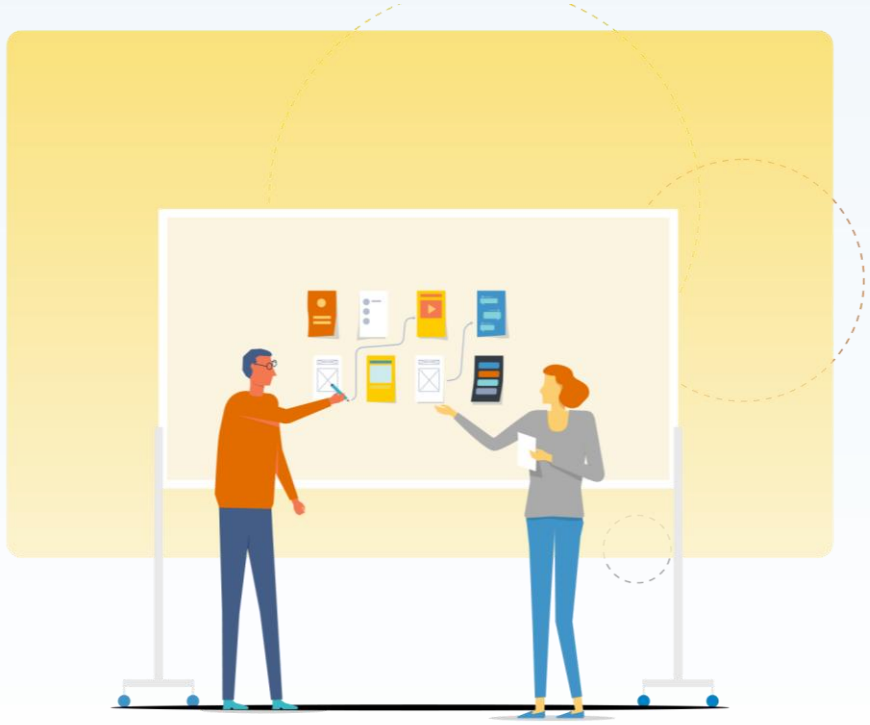
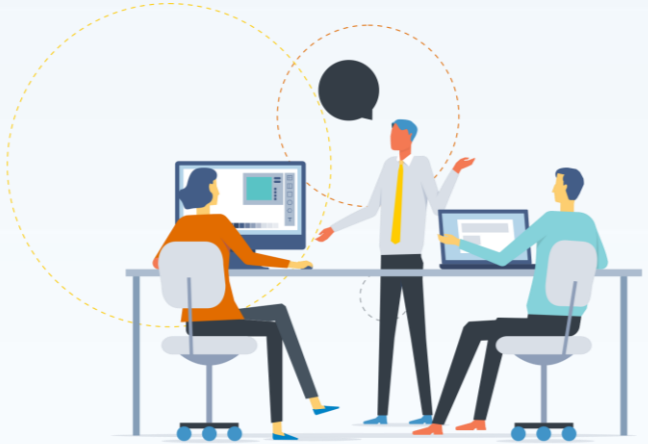
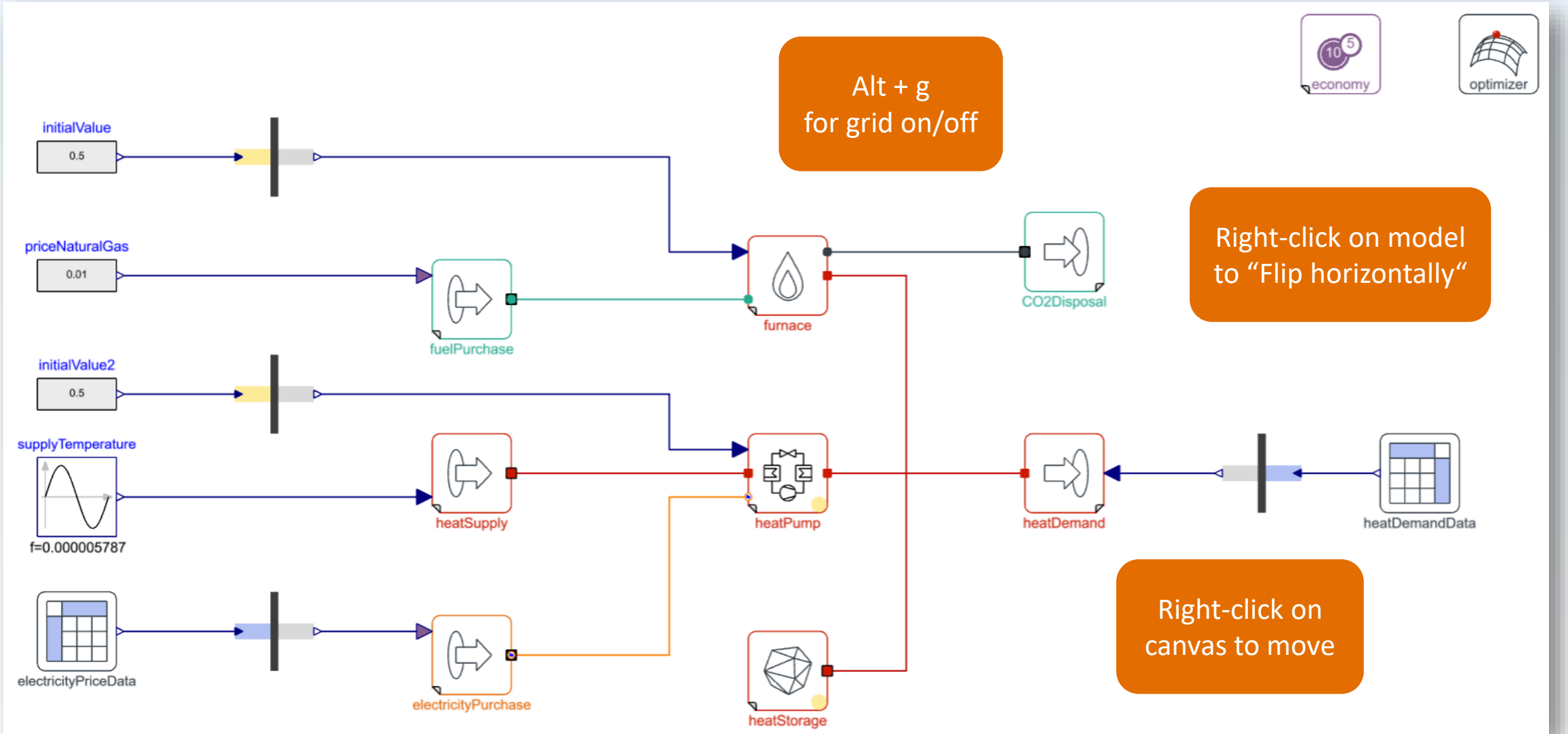


Hands-on

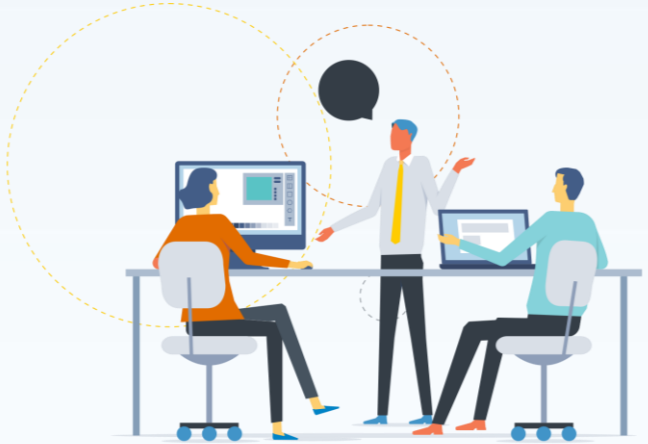
1. Open Chrome or Edge
2. Go to impact.modelon.cloud and sign in with your Innovate login
3. Copy workspace import link from Teams
4. Paste link in browser to import workspace “Innovate-DynamicOptimization”
5. Open the model “SystemModel” (double click)





Hands-on

7. Click play button to run an optimization
8. Plot
   - economy.summary.capex
   - economy.summary.opex_total
   - heatPump.scalingFactor
   - heatStorage.scalingFactor
9. Conclusion?



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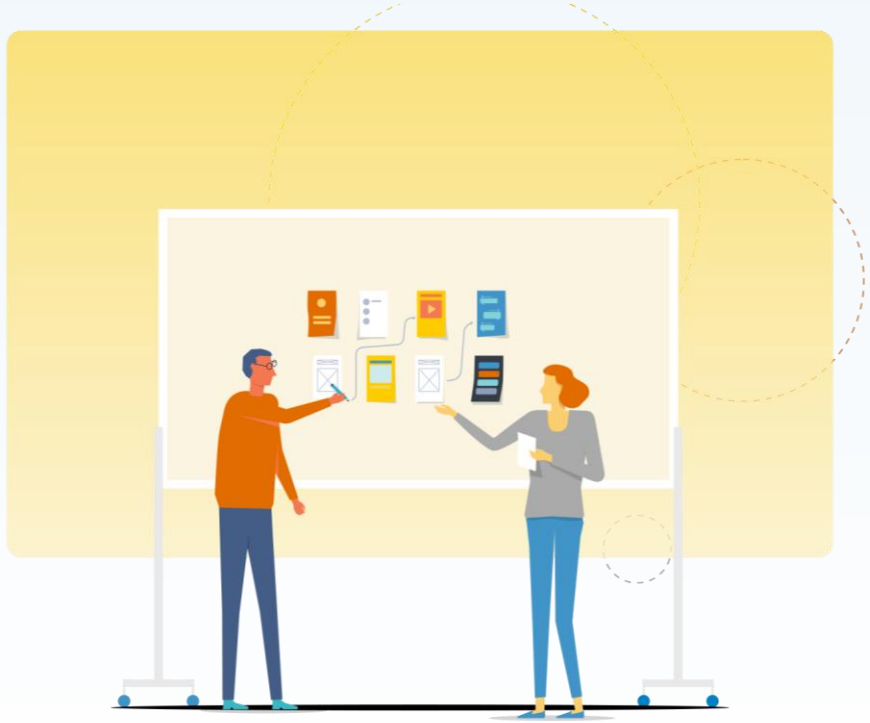
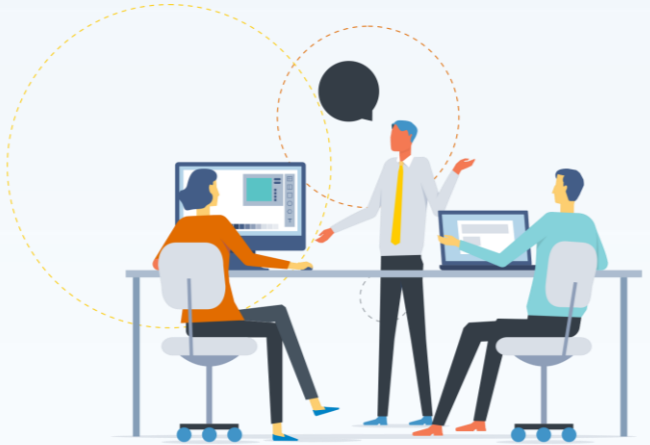


Analyzing Carbon Tax

1. Click on the model “CO2Disposal“ and enter 0.15 in the field “price_kg” (= 150/ton)
2. Compare result plots
   - Is the heat pump used?
   - Is the storage used?
3. Click on the model “CO2Disposal“ and enter 0.25 in the field “price_kg” (= 250/ton)
4. Compare result plots again. Also “heatStorage.SOC”
5. Conclusion?



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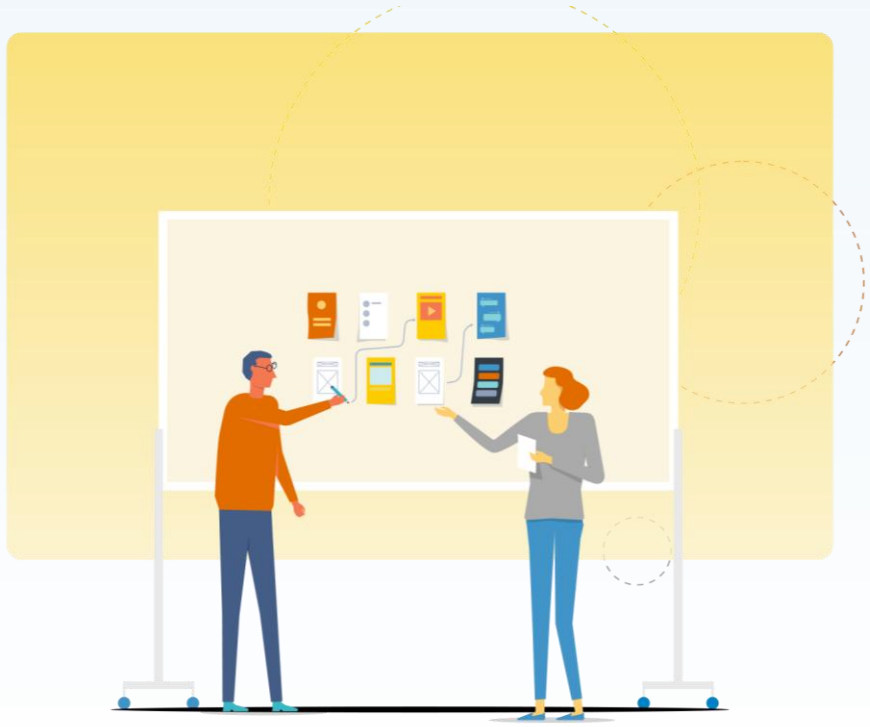

Summary

Simulation or optimization? Depends on the question to be answered.

The Energy Systems Library makes dynamic optimization easily accessible.

Comparing different future scenarios leads to informed invest-ment decisions.

Not covered

- Details of optimization workflow
- Different objective functions
- Good initialization
- Constraints
- Limitations of methodology
- Excel Add-in
- Debugging

Thanks for participating!

Feedback: Please fill out form 🥲

Questions: daniel.rohde@modelon.com

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