MESSAGE$_{ix}$ Workshop - Session III: Building an Energy System Model (Part 2)

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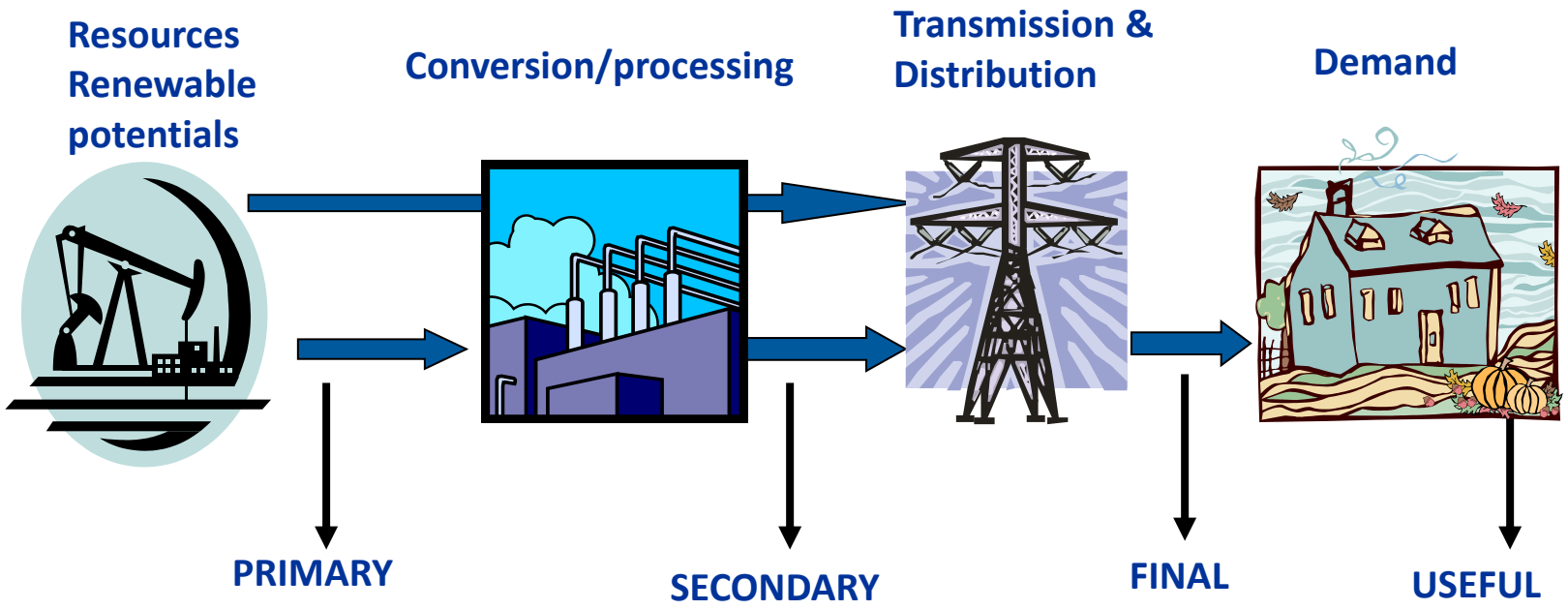
MESSAGEix Workshop, Previous Session

Recap…

- MESSAGEix as a cost minimization model
- A system of interlinked resources, technologies, commodities, levels, etc. to deliver certain services
- Getting familiar with Jupyter Notebook: building a simple model from scratch

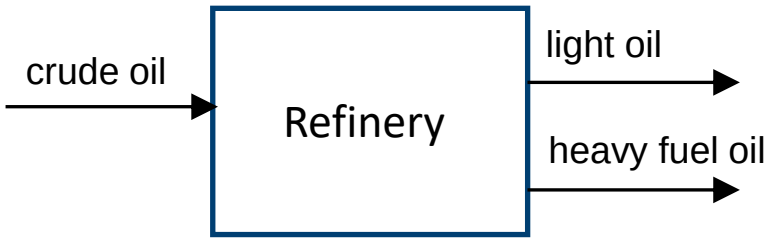


MESSAGEix: A flexible mathematical formulation

Recap…

- There is no pre-defined sectors, technologies, commodities, etc.
- The level of technical detail depends on the user's preferences and research questions
- Flexibility remains for temporal and spatial representation

Aggregate representation



Detailed representation

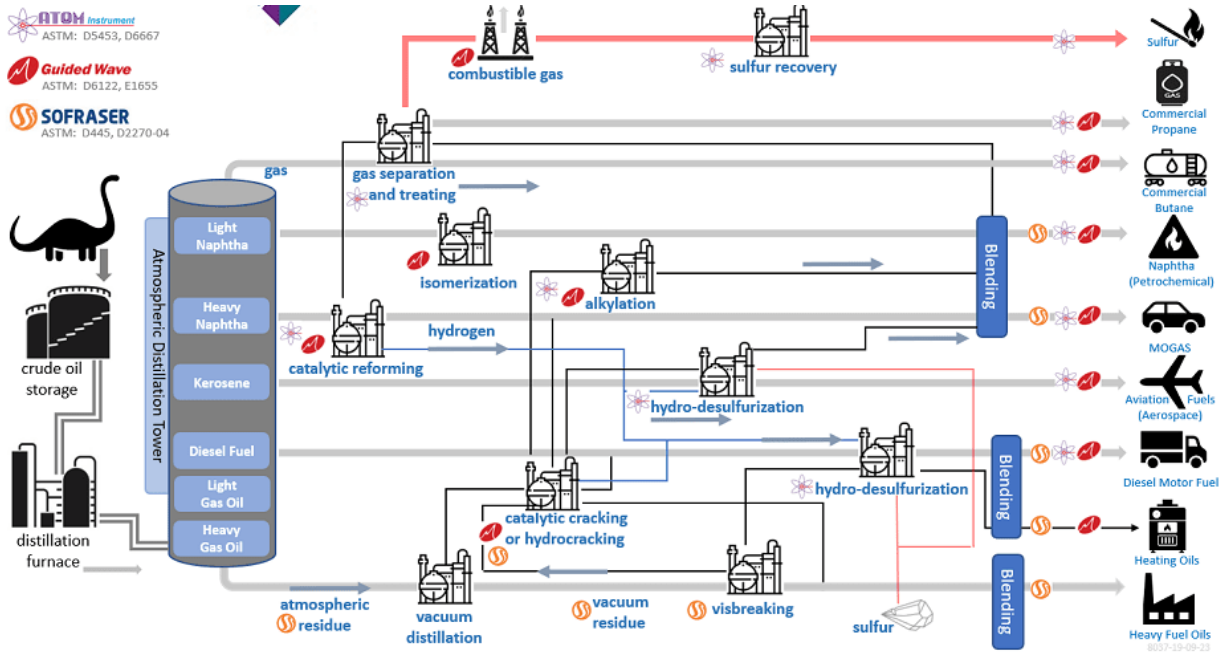
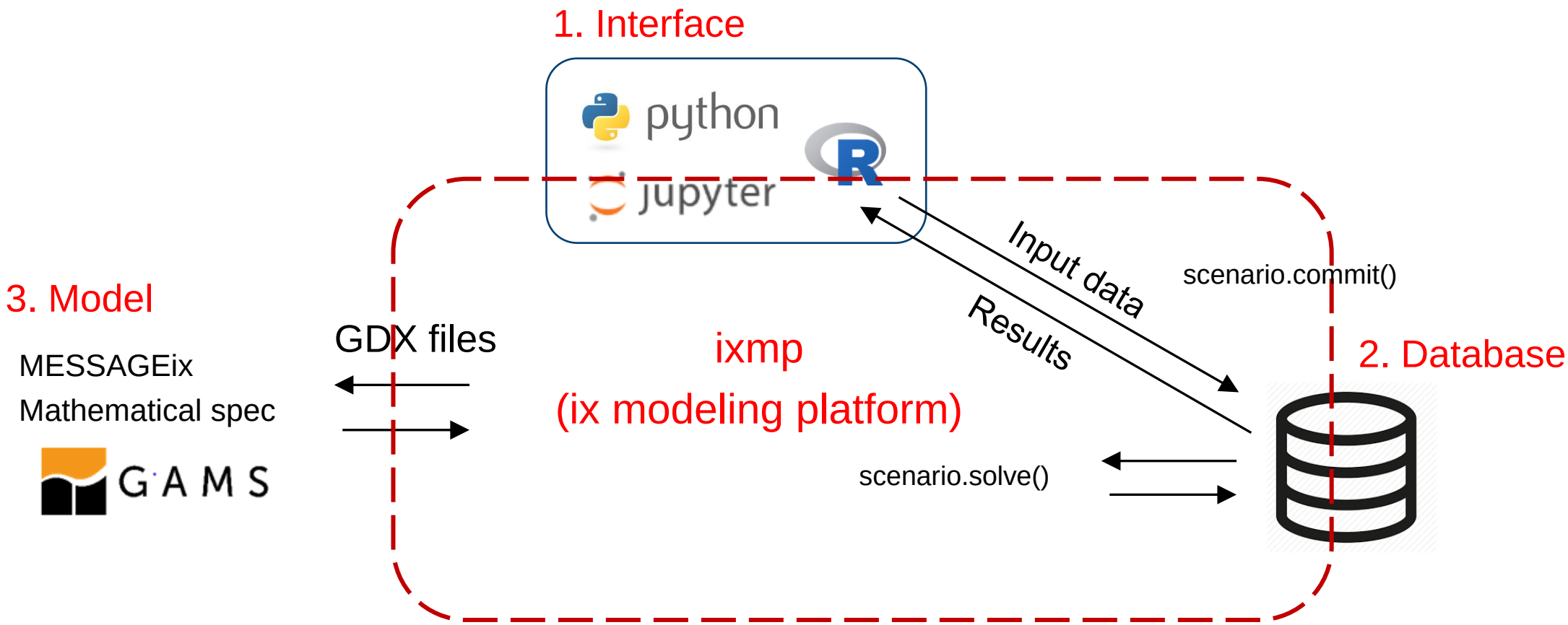


image: www.azom.com

The MESSAGE$_{ix}$ framework: Workflow of modeling

Recap…



A tutorial to the MESSAGEix framework – Part 2

Agenda of this Session

- Working with MESSAGEix tutorials:
- Building an energy system model (with some main parameters)
- How to add policies and constraints

After this tutorial

The goal is to…

- Learn about available MESSAGEix tutorials and their purposes
- Be able to build a simple energy model using Jupyter Notebook
- Be able to model some general constraints and policies

- bound emissions
- share constraints

Requirements

- MESSAGEix framework installed and running
- Knowledge on energy systems
- Patience, motivation, and curiosity

Building a MESSAGEix model

Different steps of modeling

- Creating a new scenario (or loading an existing one)
- Declaring required sets (*node, technology, commodity, level*, etc.)
- Defining required parameters (adding numeric data, relating sets to each other, etc.)

  - demand

  - techno-economic parameters

  - bounds and dynamic constraints
- Solving the model
- Postprocessing and plotting

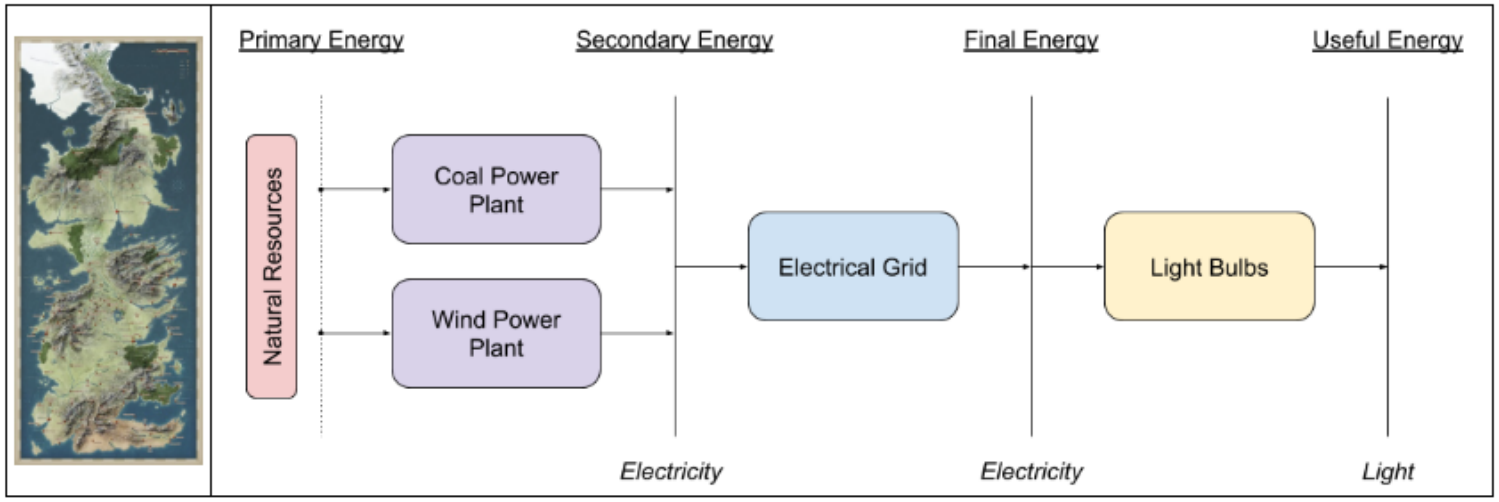
Working with tutorials

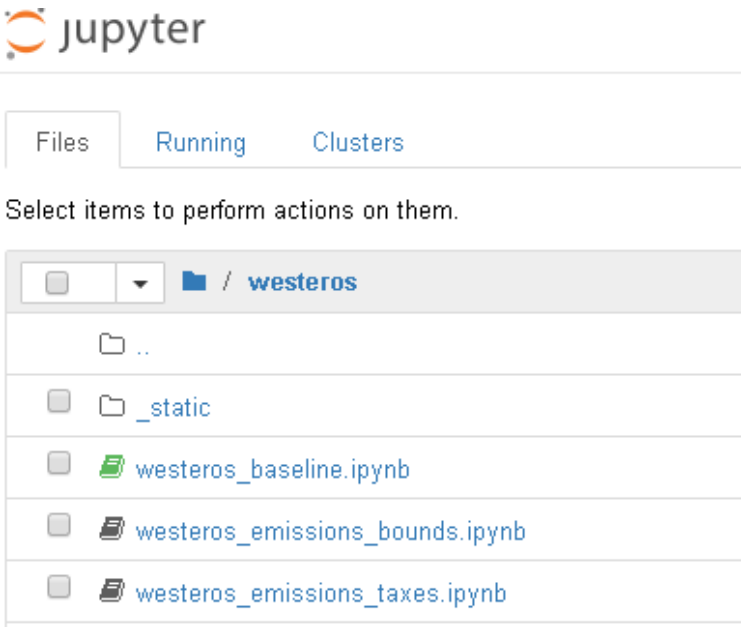
Building an energy system from scratch

- Locate your tutorial folder in your machine
- Then, open a command window and call ***jupyter notebook***
- Navigate to the folder for Westeros tutorials and open the baseline

A stylized reference energy system model for Westeros

This tutorial is based on the country of Westeros from the TV show "Game of Thrones".





Working with MESSAGEix scenarios

A short note on model/scenarios

- Importing required software packages

```
import ixmp
import message_ix
```

- Loading the ixmp platform (connection to the database):

```
mp = ixmp.Platform()
```

- Creating a new scenario:
- `my_scen = message_ix.Scenario(mp, model, scenario, version='new')`

Modeling platform

model/scenario identifiers

Example: `model = 'building energy system', scenario = 'baseline' (or 'high-efficiency')`

- Working on the scenario:

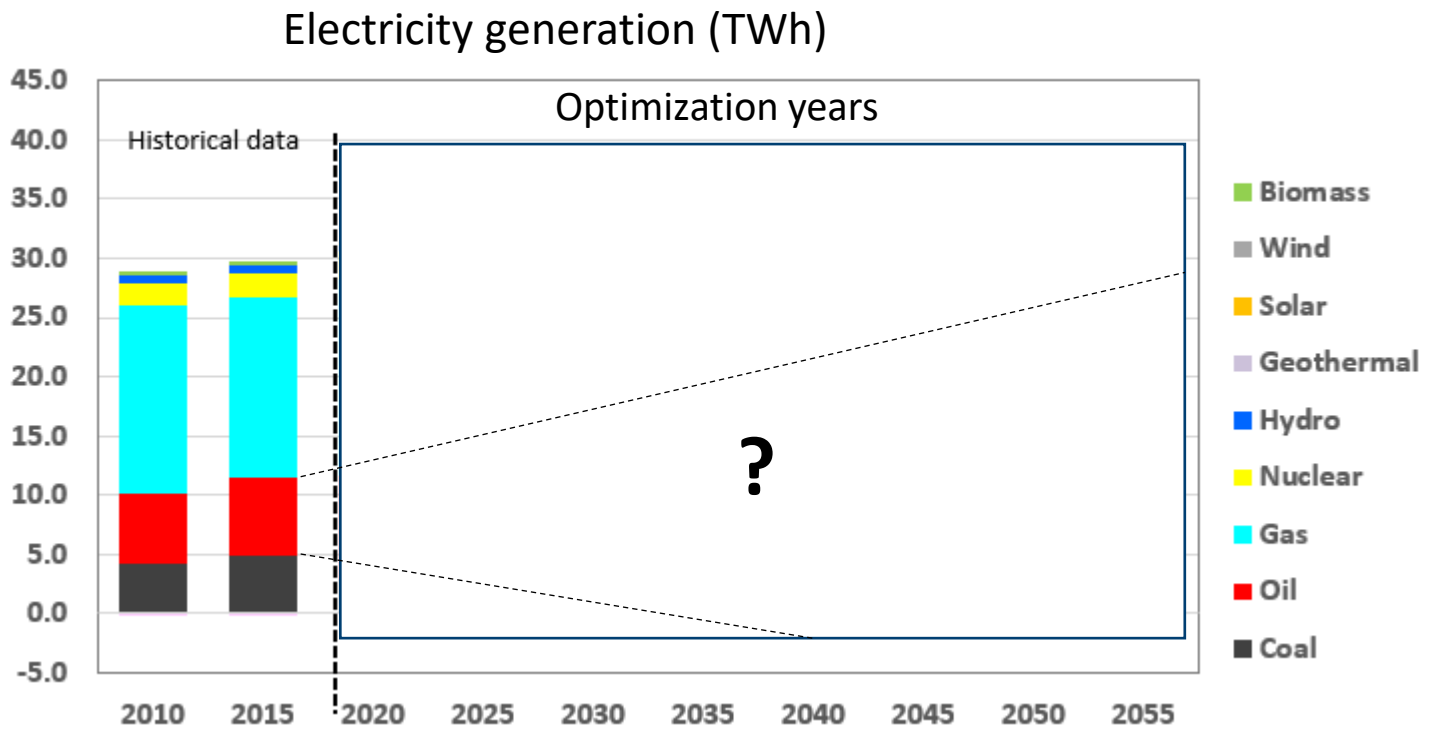
MESSAGEix set

```
my_scen.add_set('technology', 'item') or my_scen.add_set('technology', ['item1', 'item2'])
my_scen.add_par('technical_lifetime', df)    ➔ df is a DataFrame (looks like a table)
```

MESSAGEix parameter

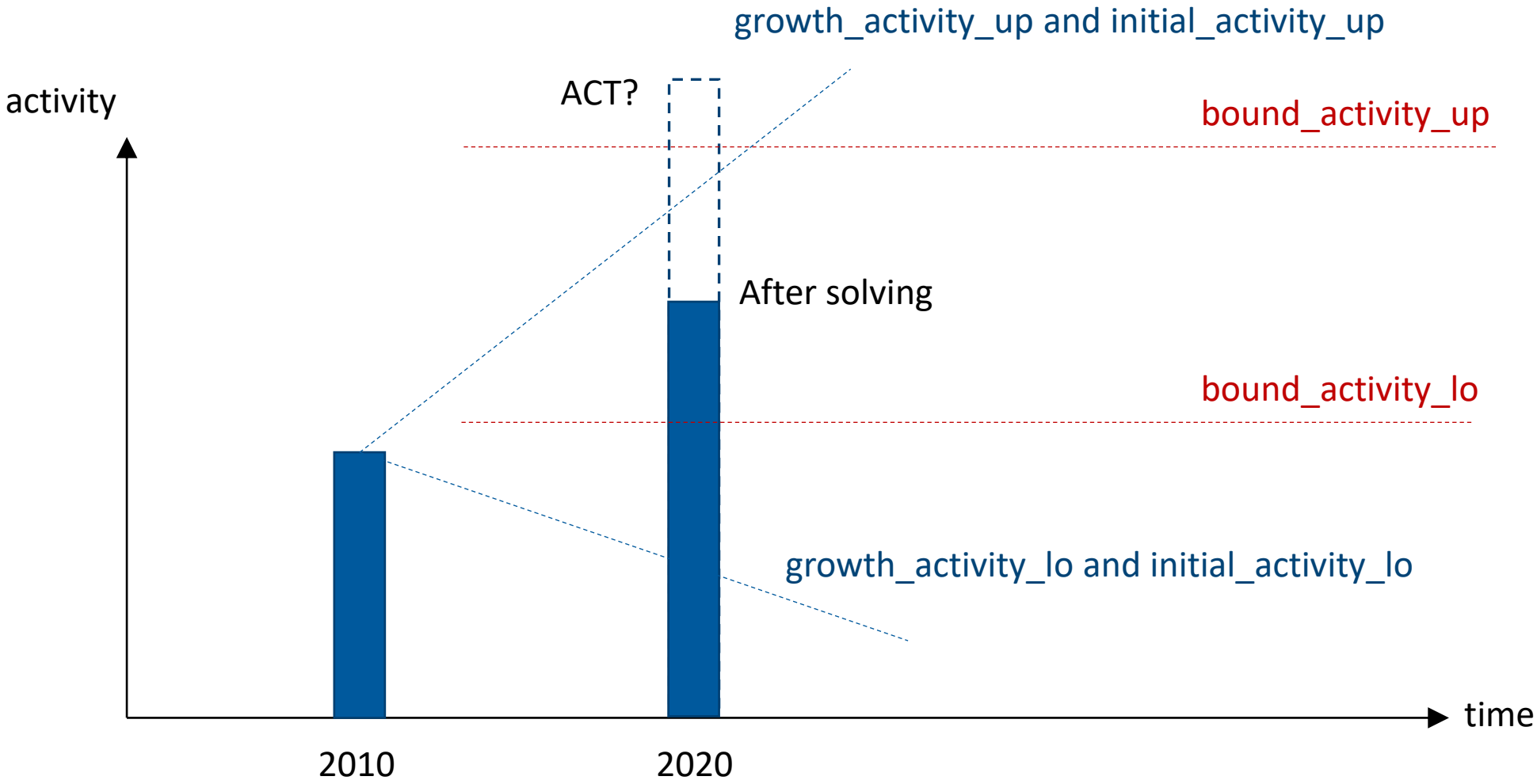
The MESSAGE$_{ix}$ framework : Investment planning

From historical activity/capacity to model years



Dynamic constraints

Diffusion and contraction of technologies over time



Link to the documentation

Thank you very much for your attention!

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