MESSAGE$_{ix}$ Workshop
Session III: Building an Energy System Model (Part 2) and Adding energy policies

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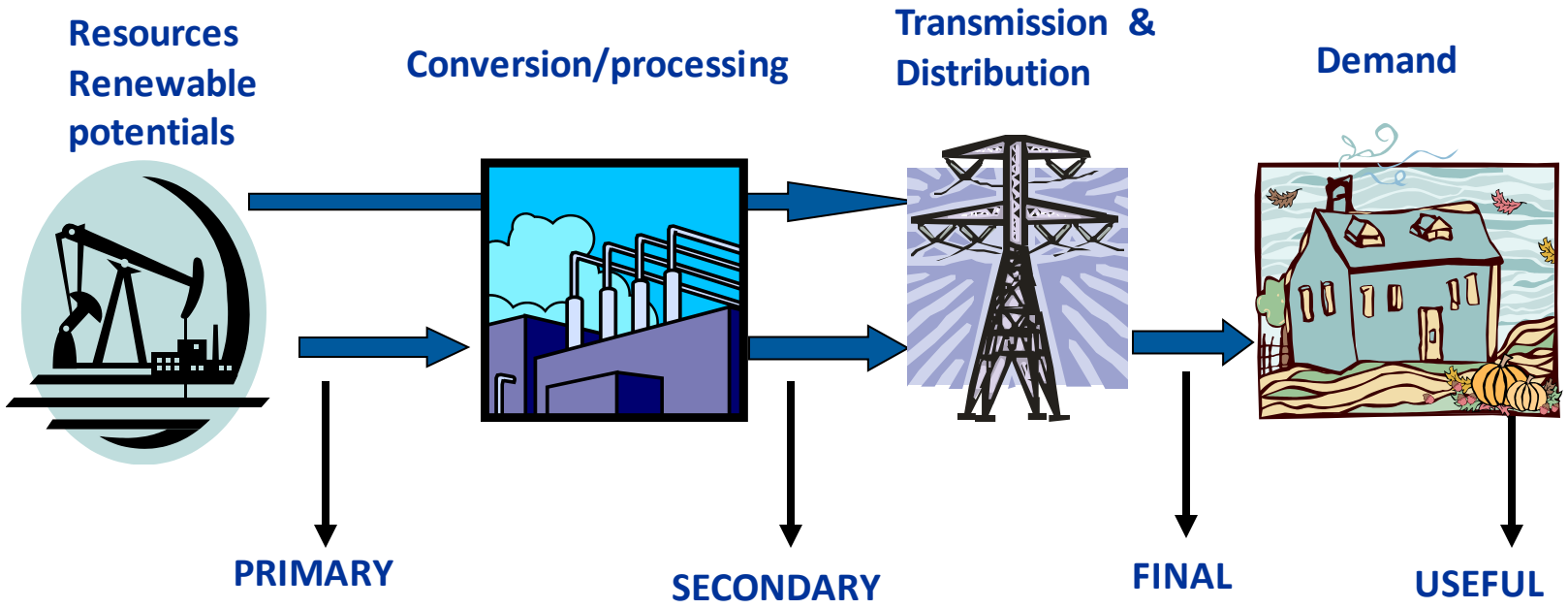
MESSAGEix Workshop, Previous Session

Recap…

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

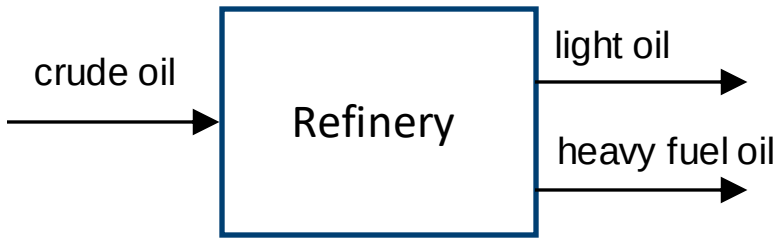


MESSAGEix: A flexible representation of the system

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

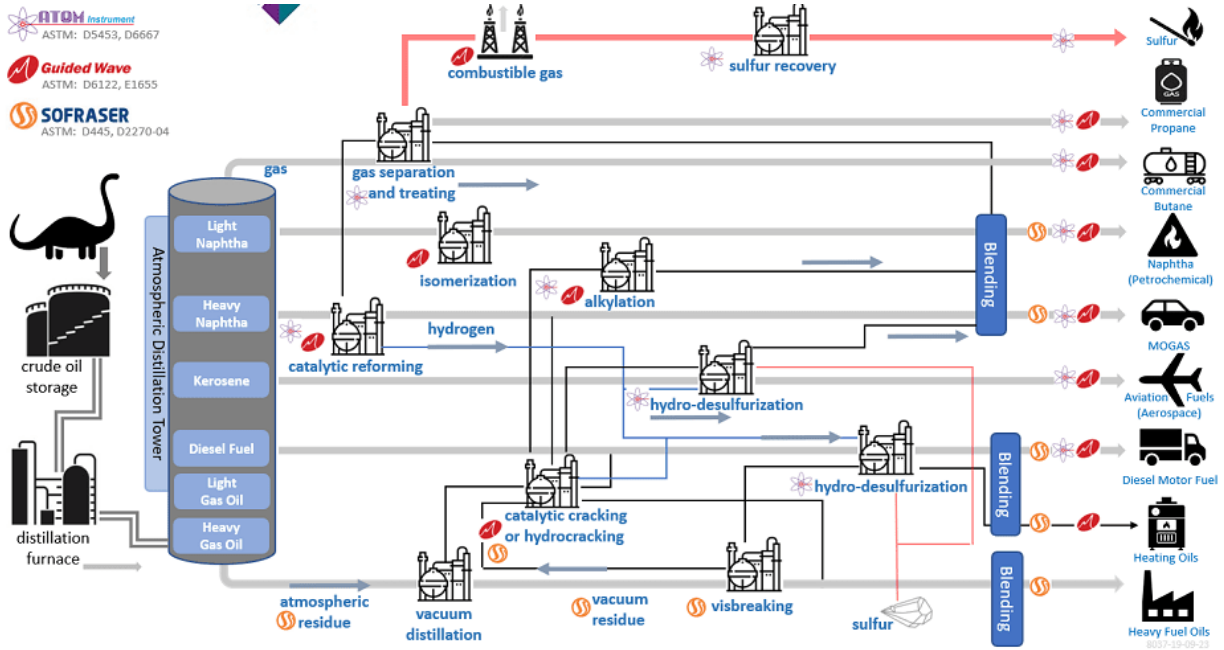
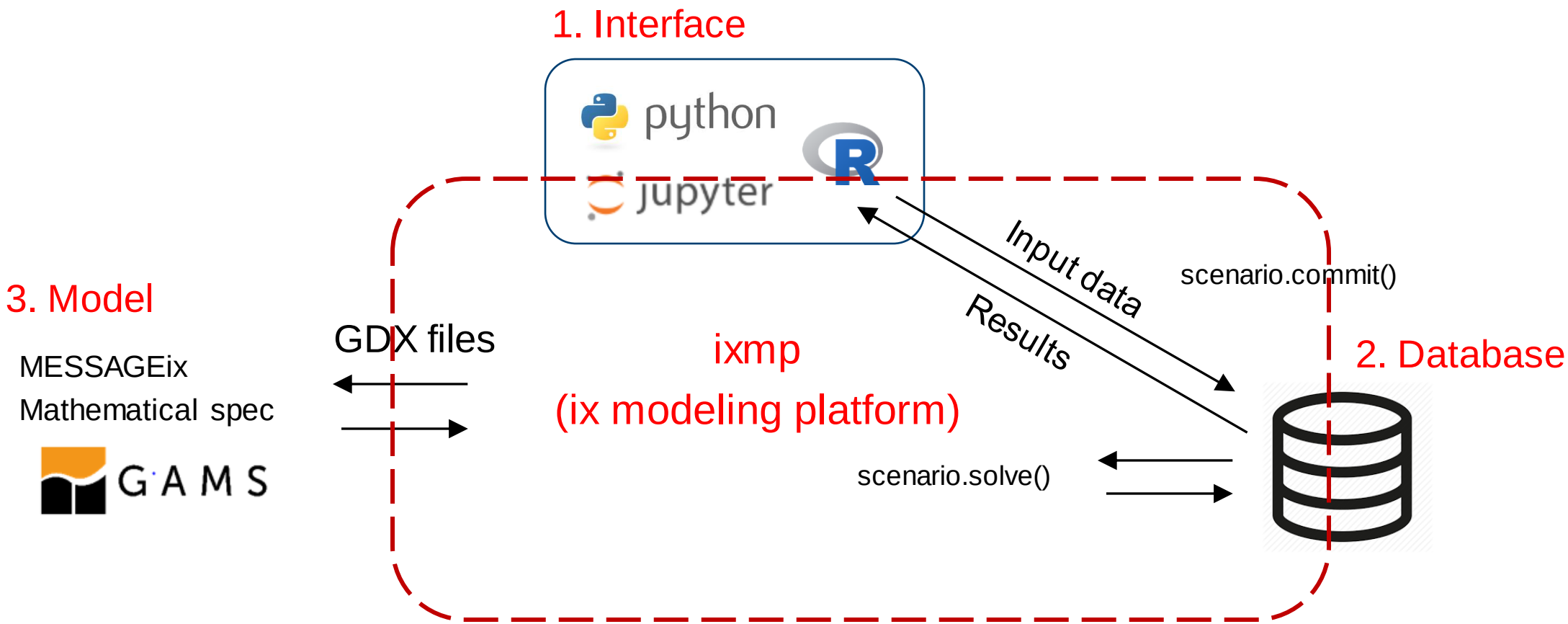


image: www.azom.com

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

Recap…



A tutorial to the MESSAGEix framework – Part 2

Agenda of this Session

- Working with MESSAGEix tutorials (hands-on sessions):

1. Reviewing Westeros Baseline as a simple energy system model
2. Adding policies and constraints to a scenario

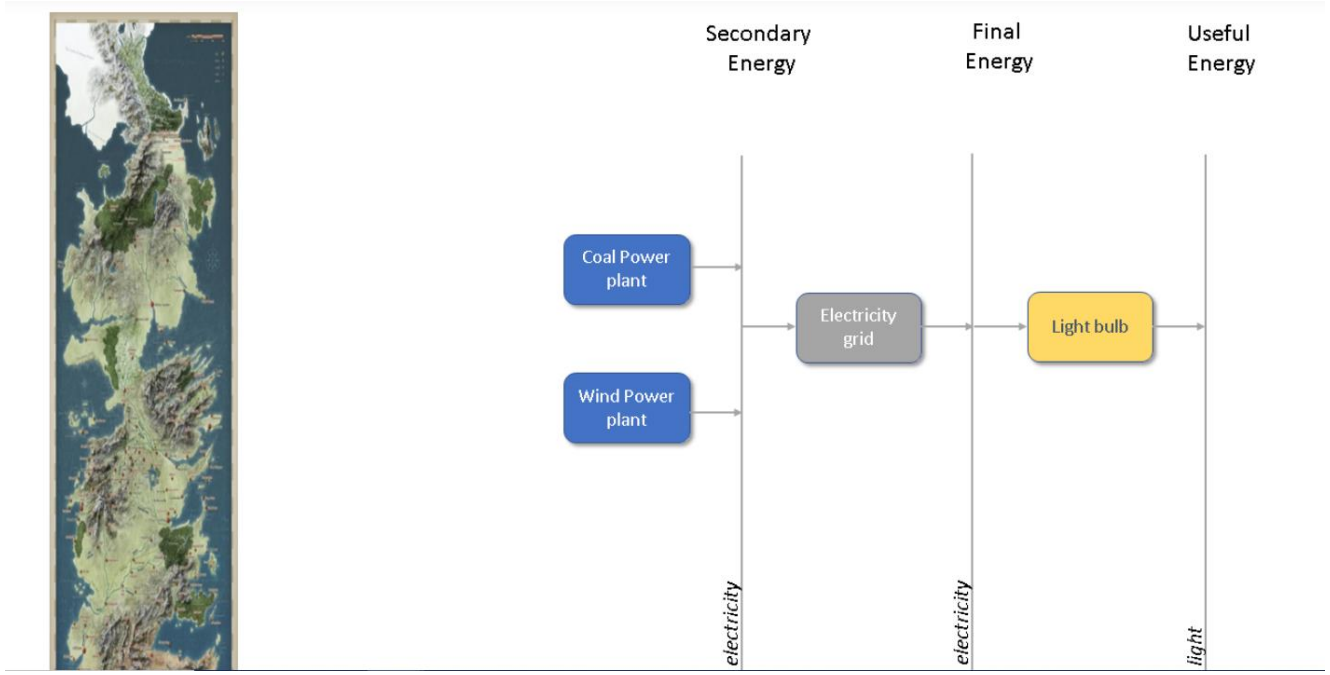
The objective:

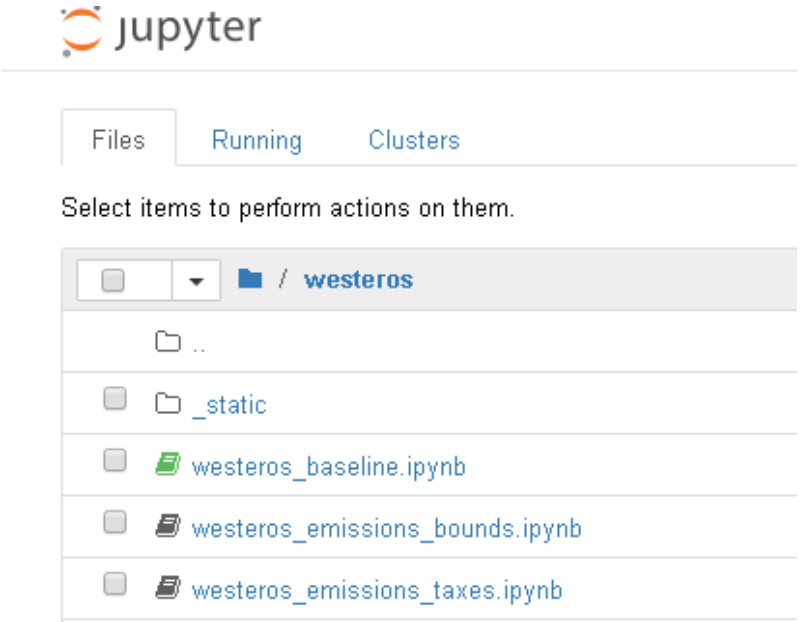
- Be able to find information on MESSAGEix sets, parameters, and equations
- Learn about MESSAGEix tutorials and their main features
- Be able to build a simple energy model using Jupyter Notebook
- Learn how to represent some general constraints and policies

Working with tutorials

Building an energy system from scratch

- Locate your tutorial folder in your machine
- Open an Anaconda command window, activate your message_ix environment, and call ***jupyter notebook***
- Navigate to the folder for Westeros tutorials and open the baseline





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 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:

Modeling platform

model/scenario identifiers

```
my_scen = message_ix.Scenario(mp, model, scenario, version='new')
```

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

Working with MESSAGEix scenarios

A short note on model/scenarios (2)

Modeling platform

model/scenario identifiers

Creating a new scenario

```
my_scen = message_ix.Scenario(mp, model, scenario, version='new')
```

Listing your scenarios

```
mp.scenario_list()
```

model	scenario	version	default
MESSAGEix-mymodel	baseline	1	1
MESSAGEix-mymodel	baseline	2	0
MESSAGEix-mymodel	baseline	3	0
MESSAGEix-mymodel	low-emissions	1	1
MESSAGEix-mymodel	low-demand	1	1

Loading scenarios

```
my_scen = message_ix.Scenario(mp, model, scenario, version=3)
my_scen = message_ix.Scenario(mp, model, scenario)
```
(loading the default version)

Working with MESSAGEix scenarios

Adding, modifying, and removing data

- Working with sets:

MESSAGEix set

```
my_scen.add_set('technology', 'item')
my_scen.add_set('technology', ['item1', 'item2'])
```

`my_scen.set('technology')` ➔ shows the content of a set

`my_scen.remove_set('technology', 'item2')` ➔ removes an item from a set

- Working with parameters:

MESSAGEix parameter

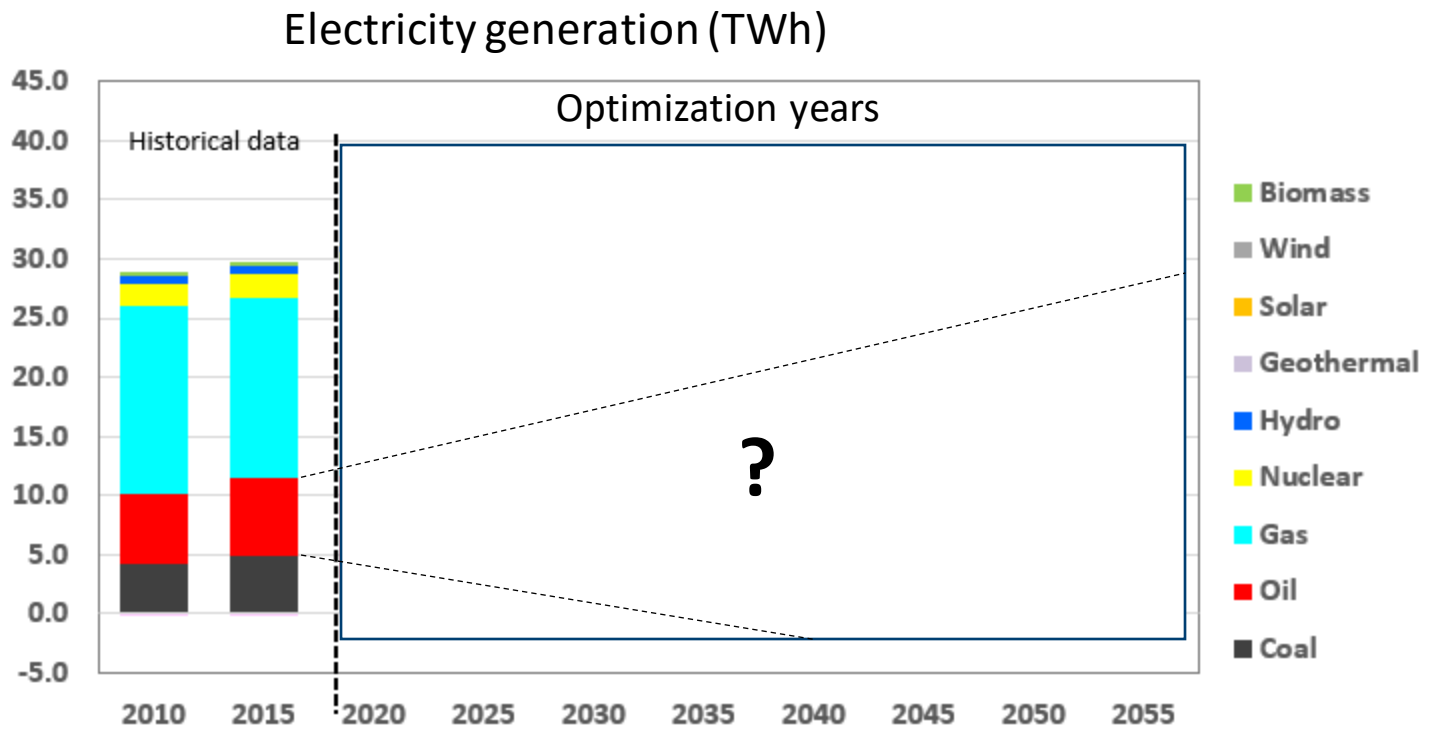
`my_scen.add_par('technical_lifetime', df)` ➔ df is a Pandas DataFrame (like a table)

`my_scen.par('technical_lifetime')` ➔ shows the content of a parameter

`my_scen.remove_par('technical_lifetime', df)` ➔ removes an item from a parameter

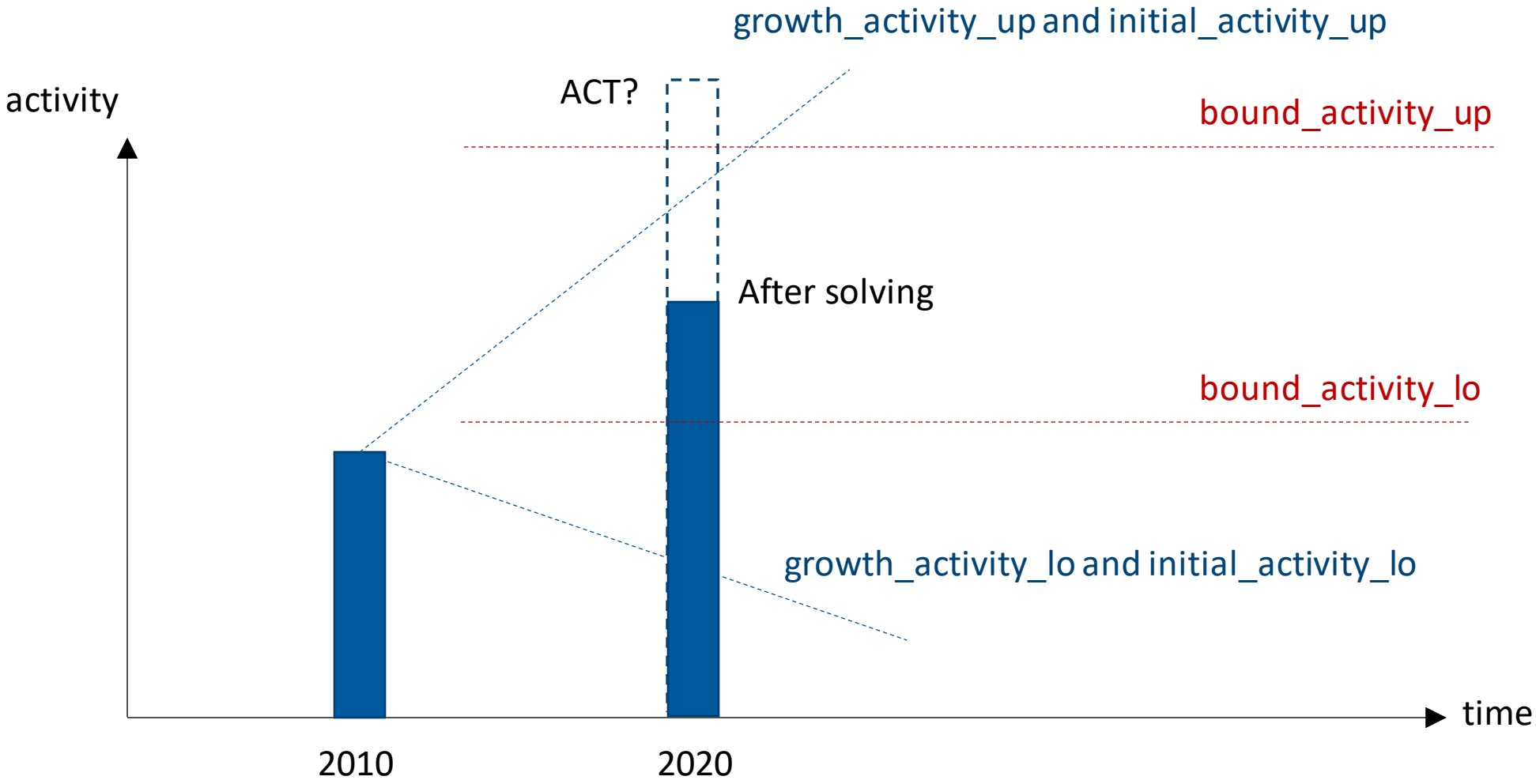
The MESSAGE$_{ix}$ framework：Investment planning

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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