Models: what are they [good for] anyway?

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Remco two weeks ago:

The best decision in the project

- Discard PyPSA
"PhDs [...] often invest large amounts of effort to get a full picture of
the model. Probably this also relates to stepwise model developments
over longer periods of time, each adding additional layers of complexity,
whereby the senior scientist(s) and/or group leaders are the only ones
who still have (or are still able to keep) an overview."

"PhD students reported lower ratings for model usability and
documentation standards than more senior researchers. This may
highlight the difficulties of young researchers applying models."

Scheller et al. (2021), “An expert survey to assess the current status and future
challenges of energy system analysis”
https://arxiv.org/abs/2106.15518
What models

Used for decision support in the planning and implementing the energy transition, e.g.:

- produce pathways for a 100% renewable energy supply
- inform capacity expansion of the power grid
- examine trade-offs between different generation capacity deployment strategies

Energy system models
Power system models
Power market models

Large optimisation problems
Energy conversion pathways in a simplified European energy system model
Story so far

• The larger and more complicated the model, the harder it is to understand and use (whether open source or not)
How are models made and used?

- Assessing impacts of policies
- Setting policy targets
- Designing policy options

**Example:**
- There needs to be a price on CO$_2$ of x EUR/t

**Modelling**

- Data and assumptions
- Study scope

**Policymaking**

- “the real world”

**Example:**
- Nuclear or coal+CCS is/is not acceptable

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What matters is not (just) “truth”

When using models, you should not just ask: “Are the assumptions correct?” but “what do the assumptions represent?”

Funtowicz and Ravetz (1993), https://doi.org/10.1016/0016-3287(93)90022-L
Story so far

• The larger and more complicated the model, the harder it is to understand and use (whether open source or not)
• The models we are talking about here are not objective depictions of reality but embed modellers’ values and often unacknowledged uncertainties
Theory and practice

**Theory**
- Research question
- Assumptions and data
- Model formulation and software choice
- Results
- Interpretation

**Practice**
- Original research question
- Model
- Different research question
- Results
- Interpretation

- Text
- Data
- Code
What is a model?

Research question → Assumptions and data → Model formulation and software choice → Results → Interpretation

Text
Data
Code

research question + assumptions + maths + code

just maths
maths + code

The larger and more complicated the model, the harder it is to understand and use (whether open source or not).

The models we are talking about here are not objective depictions of reality but embed modellers’ values and often unacknowledged uncertainties.

“Model” can mean many different things - applying a “model” without understanding embedded values is dangerous.
What is a model?

Open access publications

Open data

Open source code

Research question → Assumptions and data → Model formulation and software choice → Results → Interpretation

Text

Data

Code
Understandable models: made up of understandable parts

Research question

Assumptions, data, model formulation, and software choice

Open data

Open source code

e.g. a dataset of all European nuclear power plants

e.g. a electricity demand simulation tool

Results

Interpretation

Text

Data

Code
Story so far

• The larger and more complicated the model, the harder it is to understand and use (whether open source or not)
• The models we are talking about here are not objective depictions of reality but embed modellers’ values and often unacknowledged uncertainties
• “Model” can mean many different things - applying a “model” without understanding embedded values is dangerous
• “Composing” models from simpler building blocks could improve trustworthiness and understandability
Discussion
Has Covid killed off business cards for good?

By Adrienne Murray
Business reporter

6 September
Business cards for modelling resources

Understandable model

Research question

Assumptions, data, model formulation, and software choice

Linny-R

What? Software

Where? https://sysmod.tbm.tudelft.nl/linny-r/

Key strength? Visual model builder
Business cards for modelling resources

Understandable model

Research question

Assumptions, data, model formulation, and software choice

Euro-Calliope

What? Data / assumptions

Where? https://euro-calliope.readthedocs.io/

Key strength? Data to build Europe-wide energy system model
Renewables.ninja

I can make wind and solar power generation time series for you
Linny-R

What? Software
Where? https://sysmod.tbm.tudelft.nl/linny-r/
Key strength? Visual model builder

Euro-Calliope

What? Data / assumptions
Where? https://euro-calliope.readthedocs.io/
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Discussion