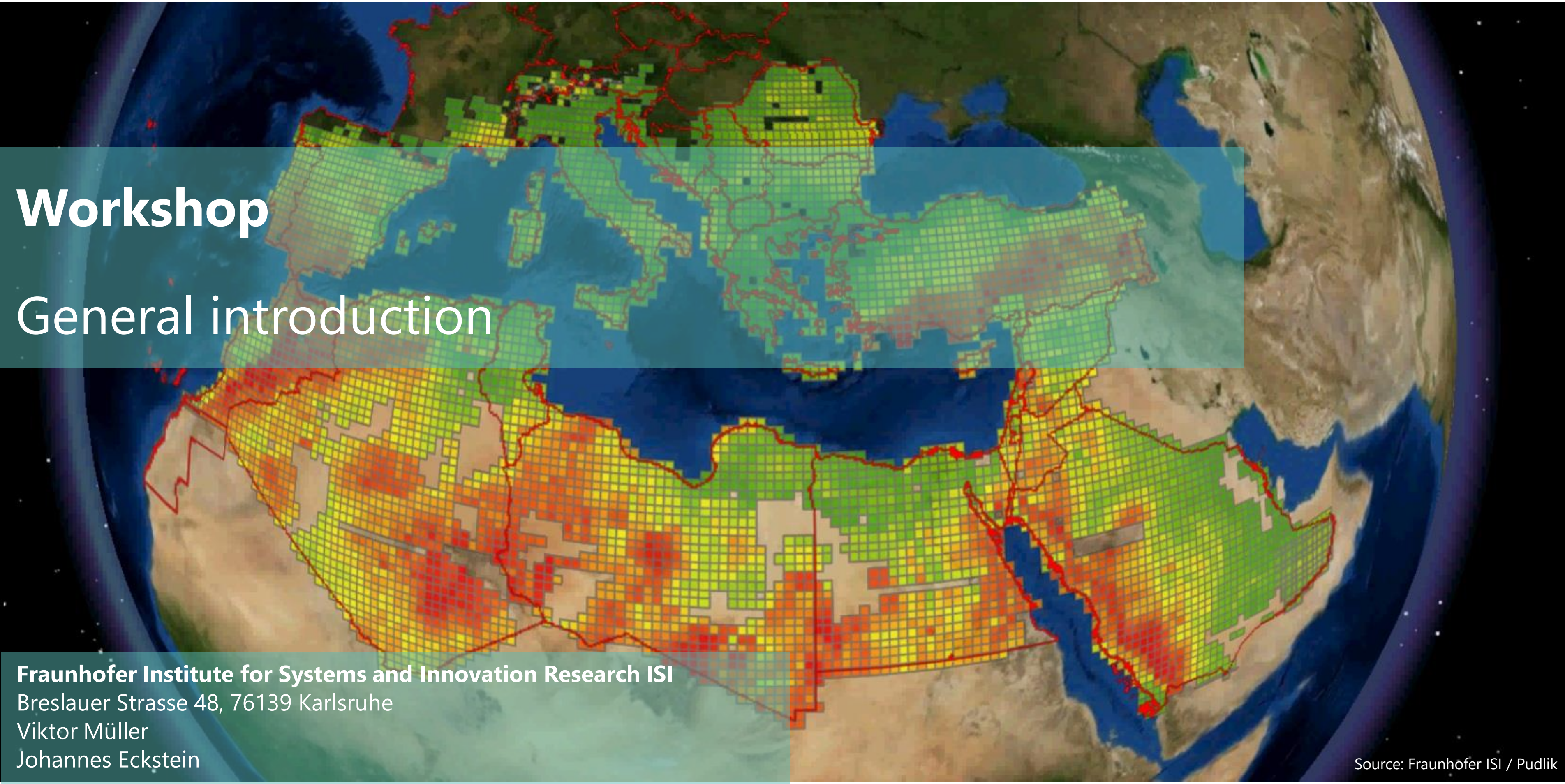
LEAP USER GROUP WORKSHOP AS PART OF THE REGIONAL EXCHANGE OF MODELLING EXPERTS IN THE WB6



Workshop

General introduction

Fraunhofer Institute for Systems and Innovation Research ISI
Breslauer Strasse 48, 76139 Karlsruhe
Viktor Müller
Johannes Eckstein

Source: Fraunhofer ISI / Pudlik

WORKSHOP PROGRAM

- 24.02: Selecting and programming indicators
- 03.03: Integrating non-energy sectors and emissions in LEAP
- 10.03: Structuring your LEAP model to reflect policies
- 17.03: Supply-side optimization with LEAP

BUSINESS UNIT: CLIMATE POLICY

- Questions regarding climate policy developments (part. gas markets, hydrogen) and innovation support policies (EU Innovation Fund, CCfDs)
- Questions related to emission trading systems (EU and other ETS)
- Climate change mitigation strategies and their assessment

- **Johannes Eckstein** is senior researcher in the business unit Climate Policy in the Competence Center Energy Policy and Energy Markets
- Work focus:
  - energy and climate policy development and evaluation
  - focus on industrial applications and policies
  - scenario-based energy system modelling

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

BUSINESS UNIT: GLOBAL SUSTAINABLE ENERGY TRANSITIONS

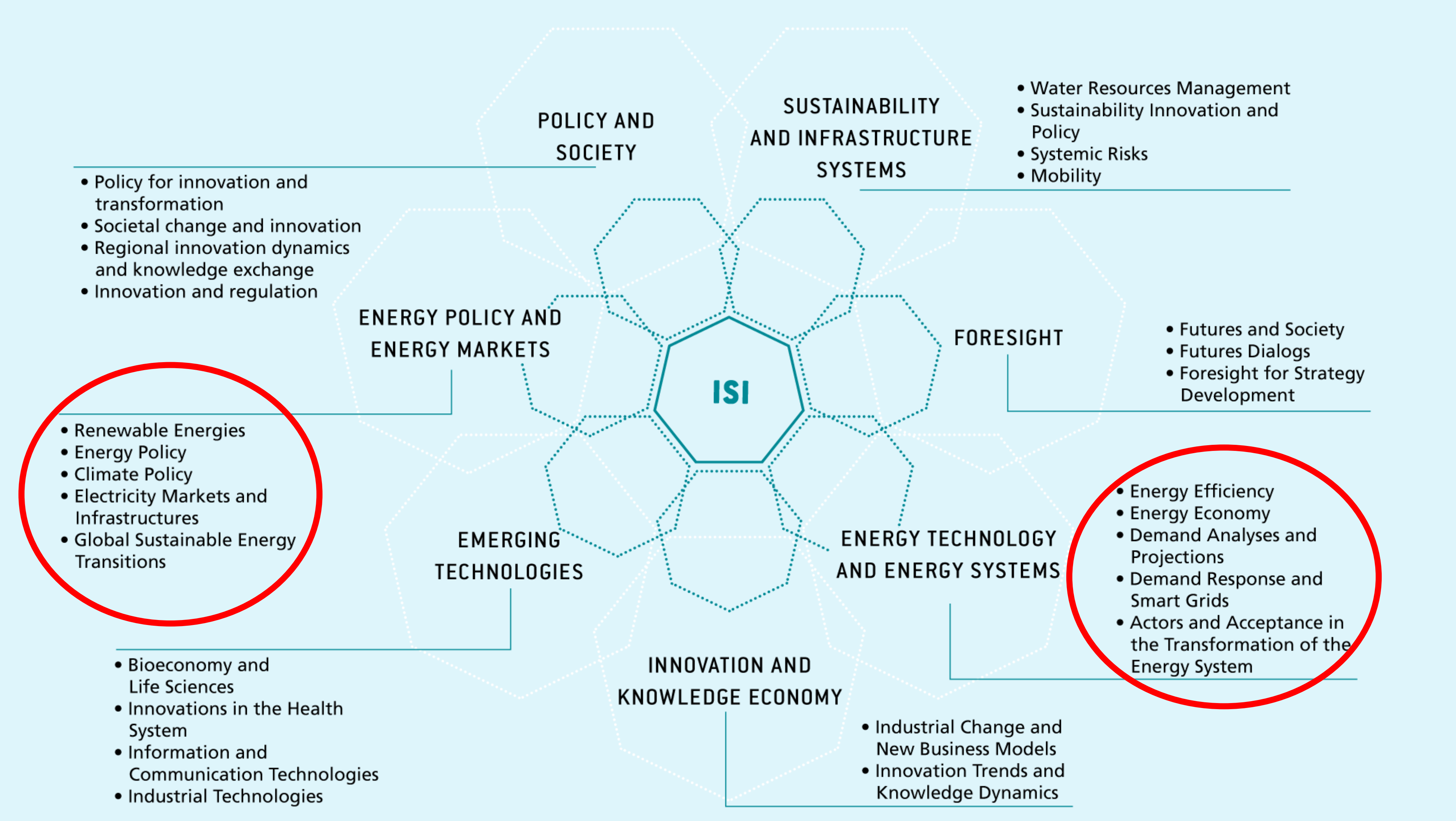
- **Support of planning and implementation of sustainable energy and development strategies in emerging and developing countries.**
  - assessment of potentials and possible diffusion pathways for renewable energy technologies
  - model-based analyses of energy systems
  - evaluation of local value creation potentials for energy technologies
  - development of policy instruments and strategies supporting sustainable energy transitions.

- **Viktor Müller** is junior researcher in the business unit Global Sustainable Energy Transitions in the Competence Center Energy Policy and Energy Markets
- Work focus:
  - promotion strategies for renewables energies
  - hydrogen technologies and synthetic fuels
  - modelling of energy systems

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

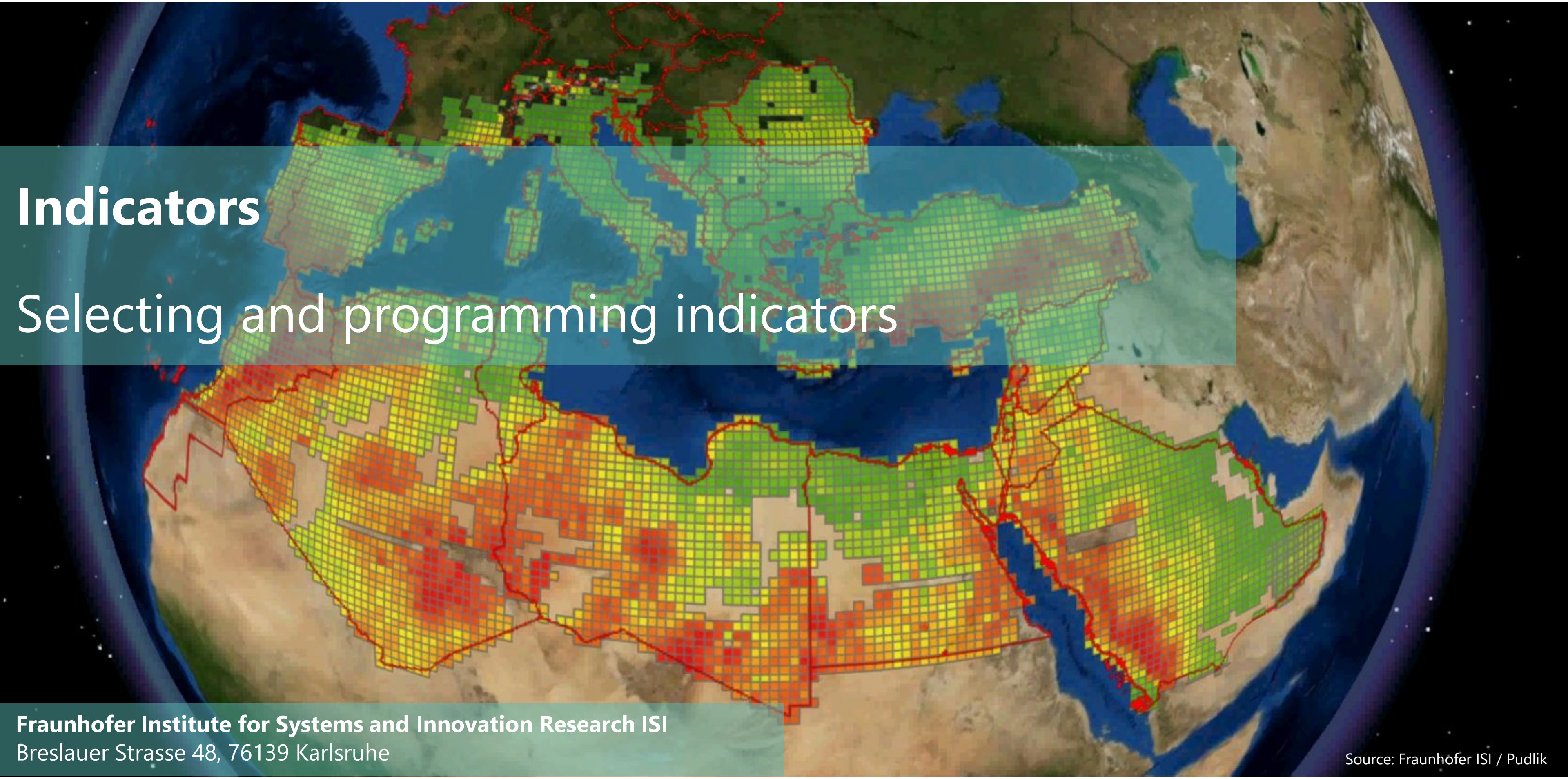
Fraunhofer Institute for Systems and Innovation Research ISI



giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

LEAP USER GROUP WORKSHOP AS PART OF THE REGIONAL EXCHANGE OF MODELLING EXPERTS IN THE WB6



Indicators

Selecting and programming indicators

Fraunhofer Institute for Systems and Innovation Research ISI
Breslauer Strasse 48, 76139 Karlsruhe

Source: Fraunhofer ISI / Pudlik

SELECTING AND PROGRAMMING INDICATORS

- How do you currently use and generate indicator data, such as SHARES results?
- How to program these in LEAP to facilitate your work
- My model is slow now! Pitfalls and shortcomings to consider

LEAP INDICATORS

- Indicators are interesting to generate common output variables
  - energy intensities, globally or per sector
  - renewable energy shares
  - anything else you regularly look at that requires a combination of variables

- Advantages of using indicators
  - See them as internal post-processing
  - Programming these indicators reduces/eliminates the time you spend on excel!

LEAP INDICATORS

- Indicators are a technical component of LEAP
  - They need to be activated under Scope in Settings

- Indictors are output variables
  - They cannot be referenced by model variables
  - But they can reference any variable, incl. all result variables
  - Indicators can also reference other indicators

LEAP INDICATORS

- Remember how LEAP works on time iteration:
  - It calculates year 1 in current accounts
  - then moves on to year 2 – here, it can make use of data in year 1!
  - then it moves on to year 3, where it can make use of data in years 1 and 2
  - and so on to the end of the time horizon

- Two functions to keep in mind when working between time steps:
  - PrevYearValue(Branch:Variable)
    - [my preference]
  - LaggedValue(Branch:Variable, Years)
    - [can be confusing and is slower]

IMPLEMENTING SHARES FUNCTIONALITIES

- SHARES considers a normalisation of wind and hydro availabilties over the last years

L 140/48 EN Official Journal of the European Union 5.6.2009

ANNEX II

Normalisation rule for accounting for electricity generated from hydropower and wind power

The following rule shall be applied for the purpose of accounting for electricity generated from hydropower in a given Member State:

$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

where:

N	=	reference year;
$Q_{N(norm)}$	=	normalised electricity generated by all hydropower plants of the Member State in year N, for accounting purposes;
Q_i	=	the quantity of electricity actually generated in year i by all hydropower plants of the Member State measured in GWh, excluding production from pumped storage units using water that has previously been pumped uphill;
C_i	=	the total installed capacity, net of pumped storage, of all hydropower plants of the Member State at the end of year i, measured in MW.

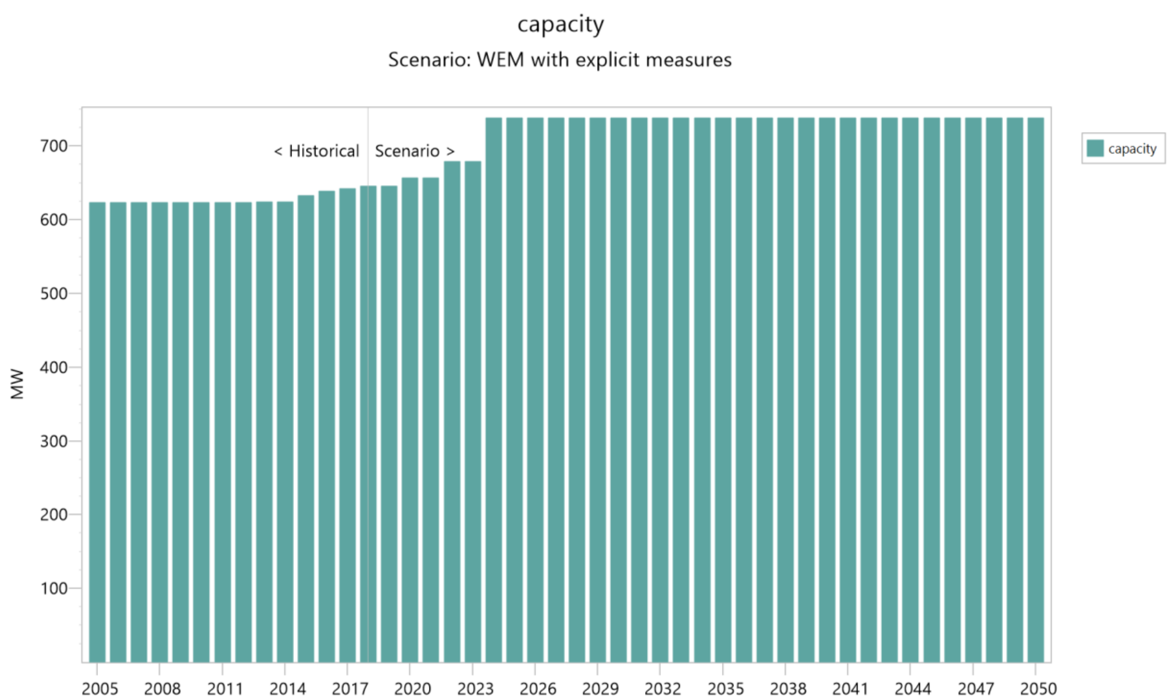
RED 1 Annex

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

RES-E HYDRO

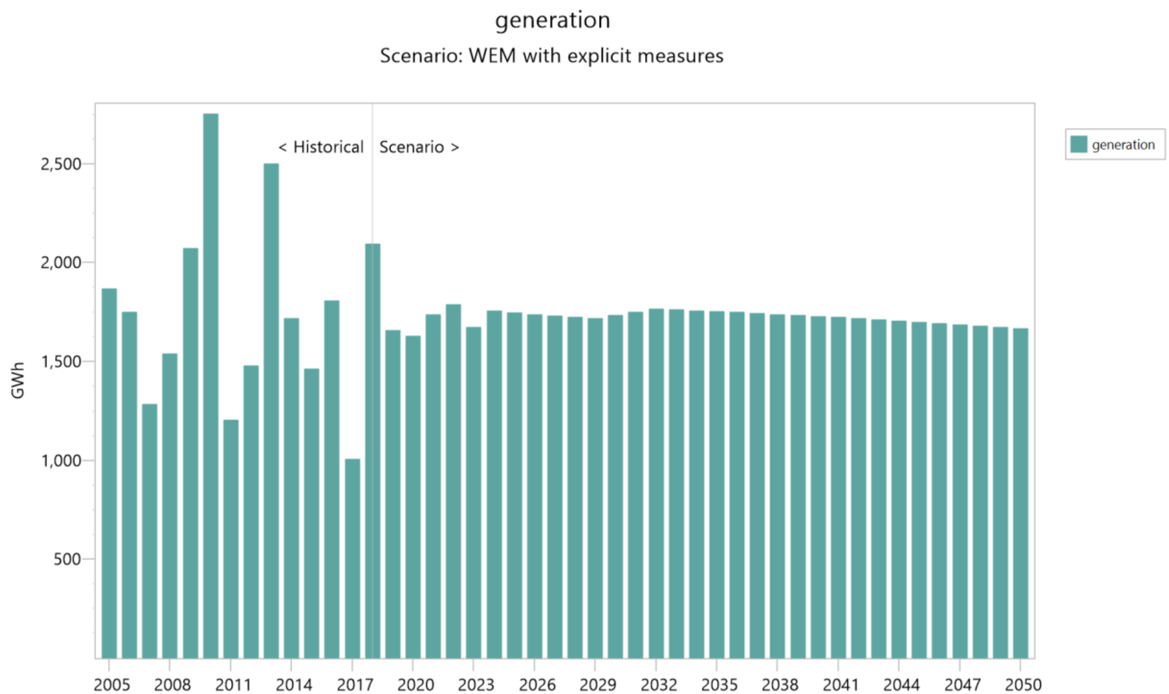
- All hydro capacities summed into one indicator



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

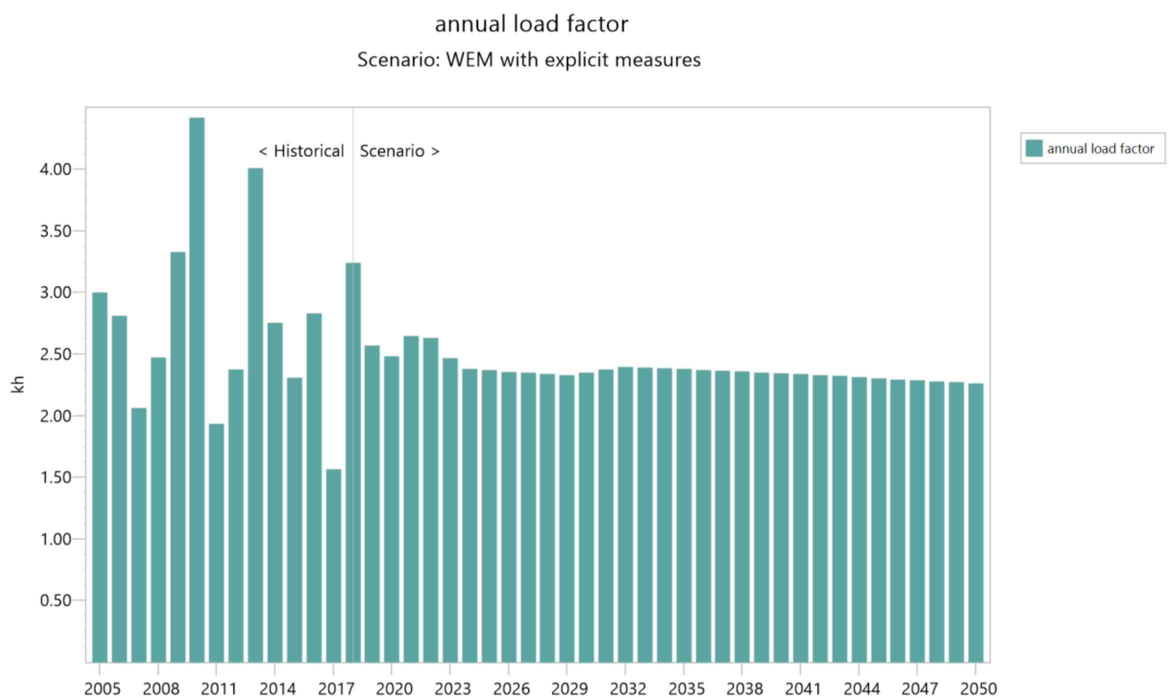
- All hydro generation in one indicator



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

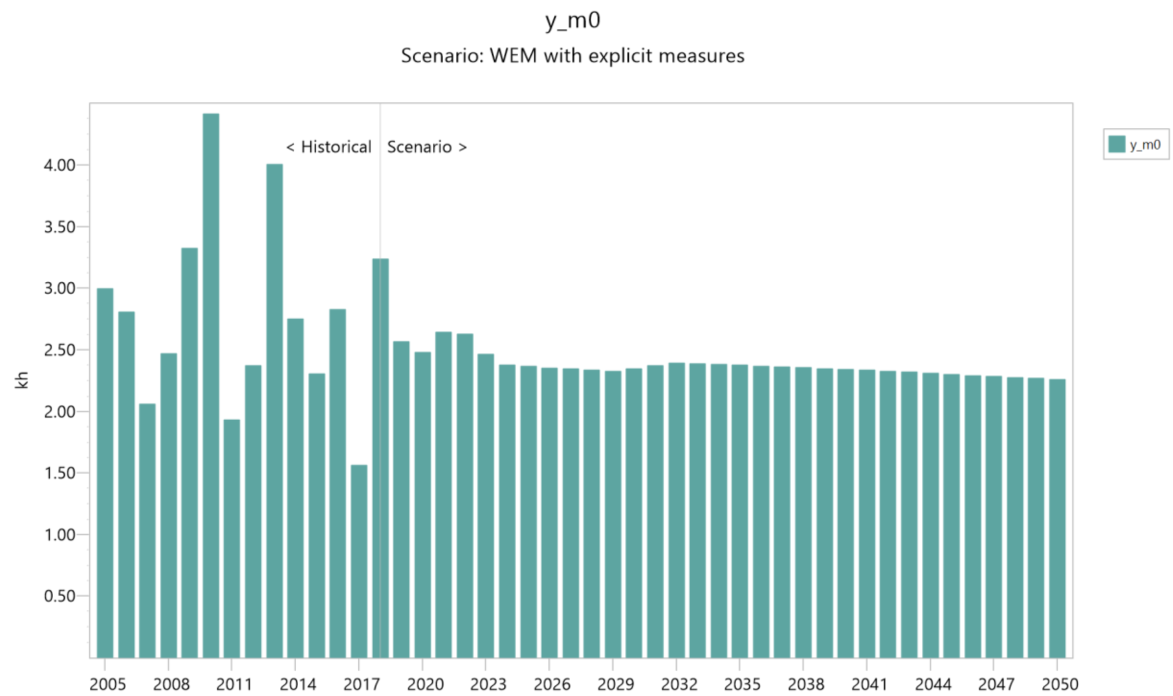
- The load factor as indicator: generation divided by capacities



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-1}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

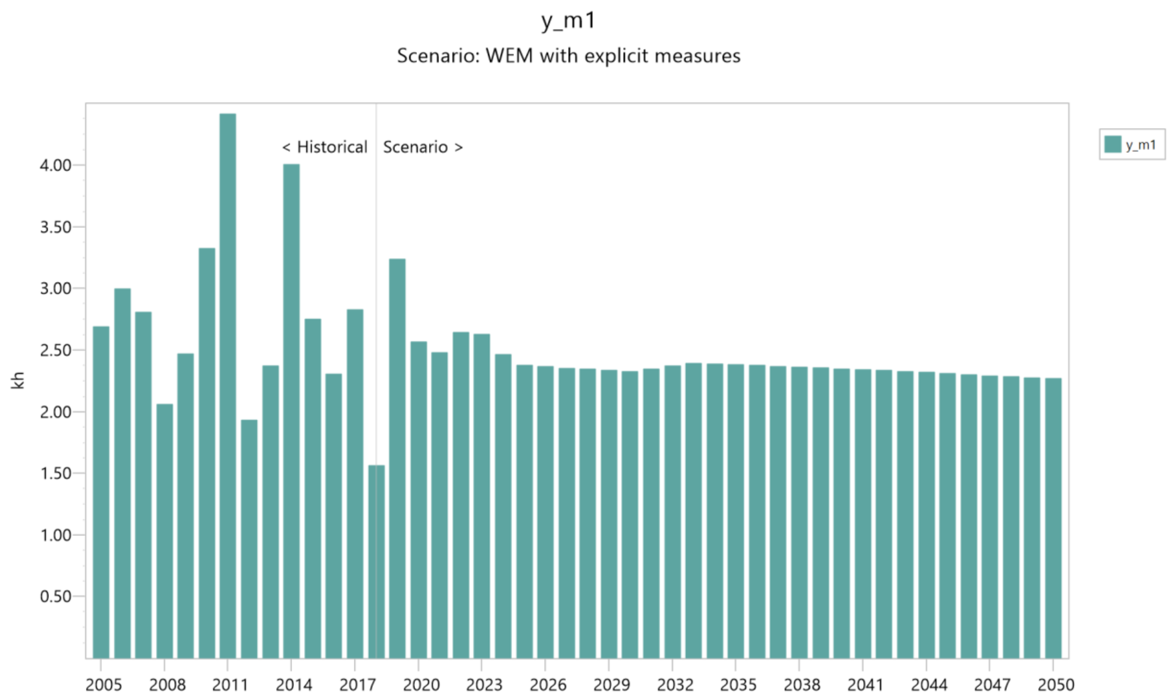
- prevyearvalue function on the load factor: shift by 0 years



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

- prevyearvalue function on the load factor: shift by 1 years



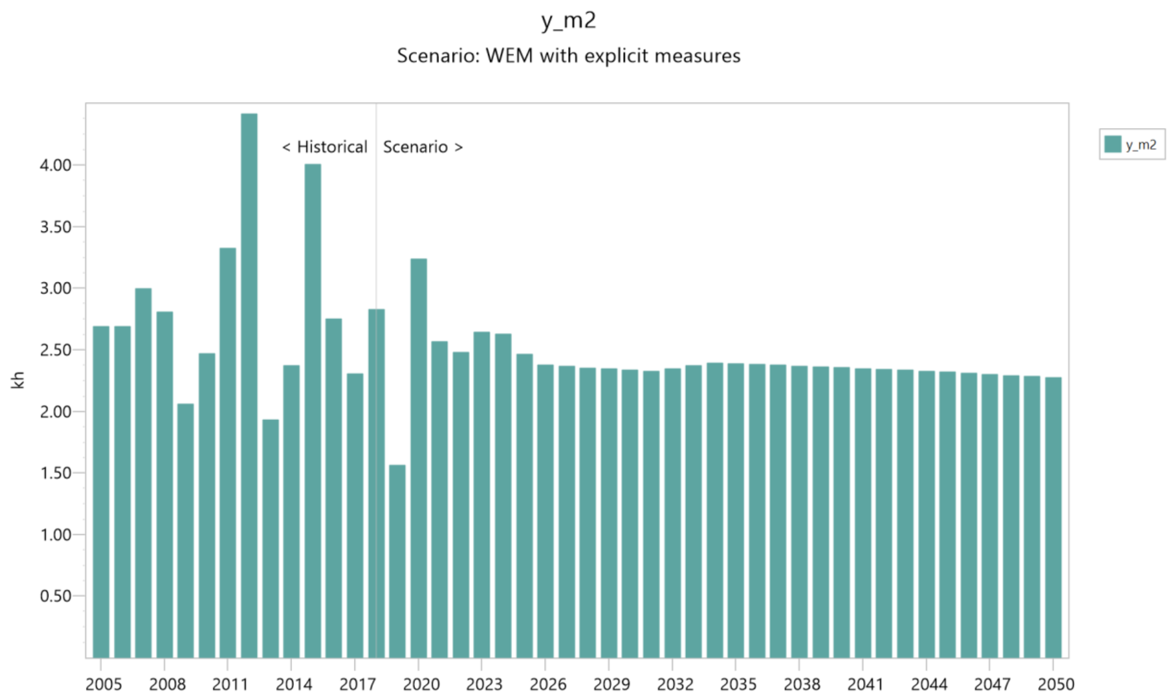
$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

RES-E HYDRO

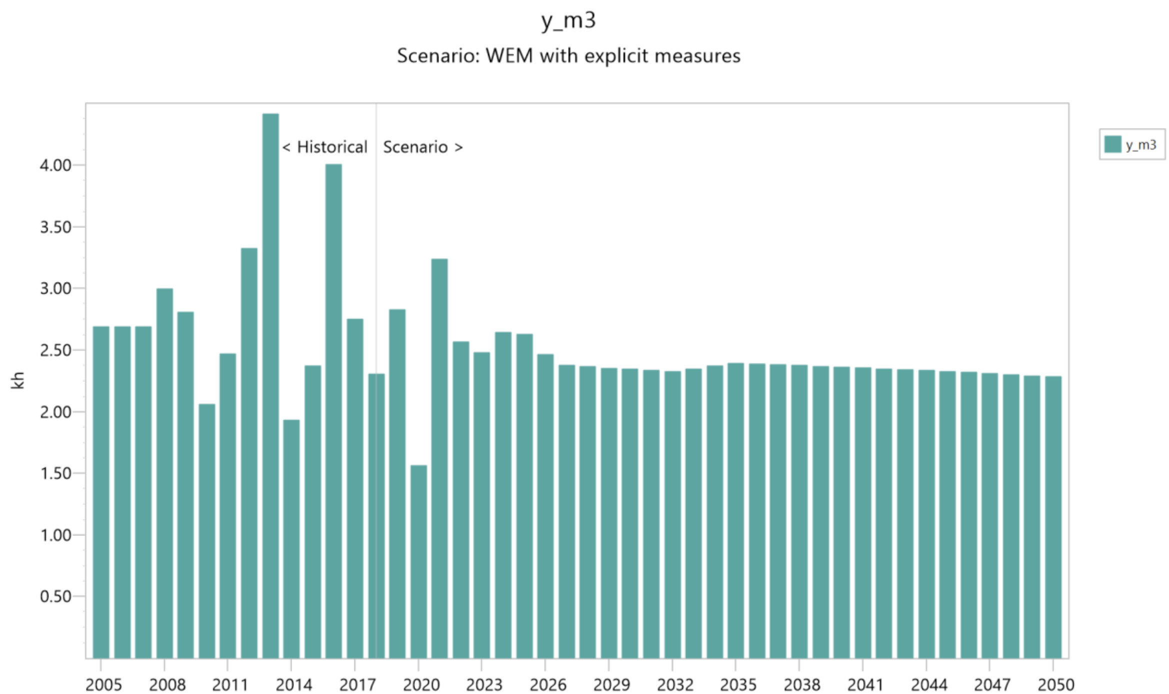
- prevyearvalue function on the load factor: shift by 2 years



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

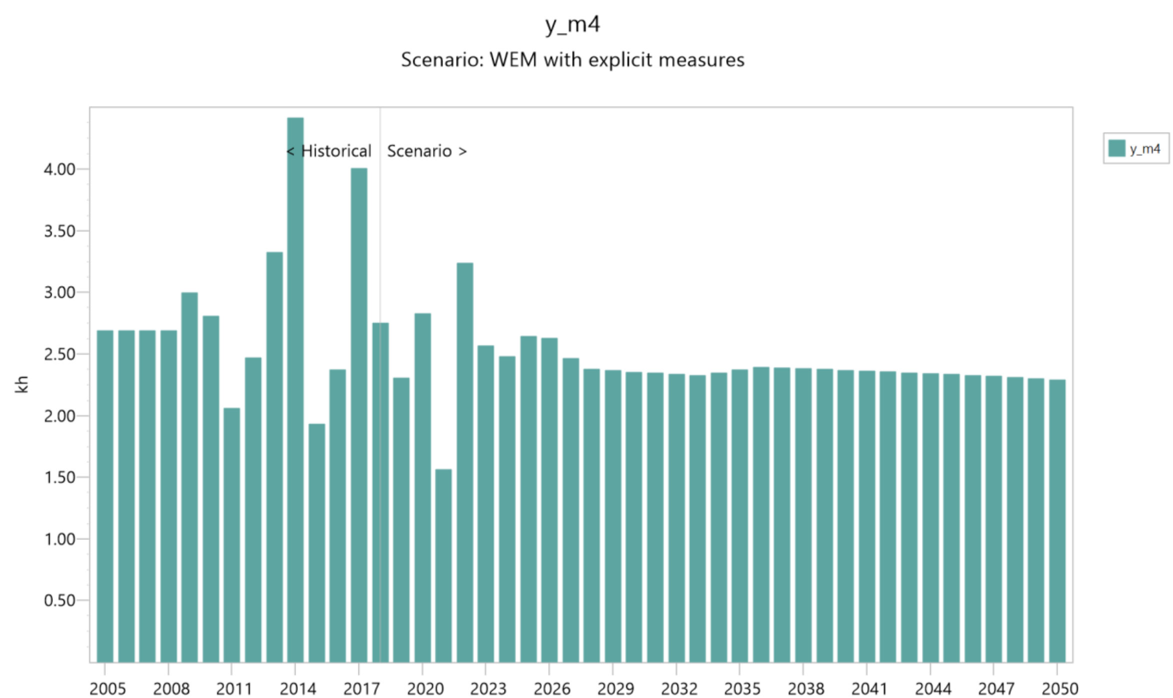
- prevyearvalue function on the load factor: shift by 3 years



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-1}^{N} \frac{Q_i}{C_i}\right] / 15$$

RES-E HYDRO

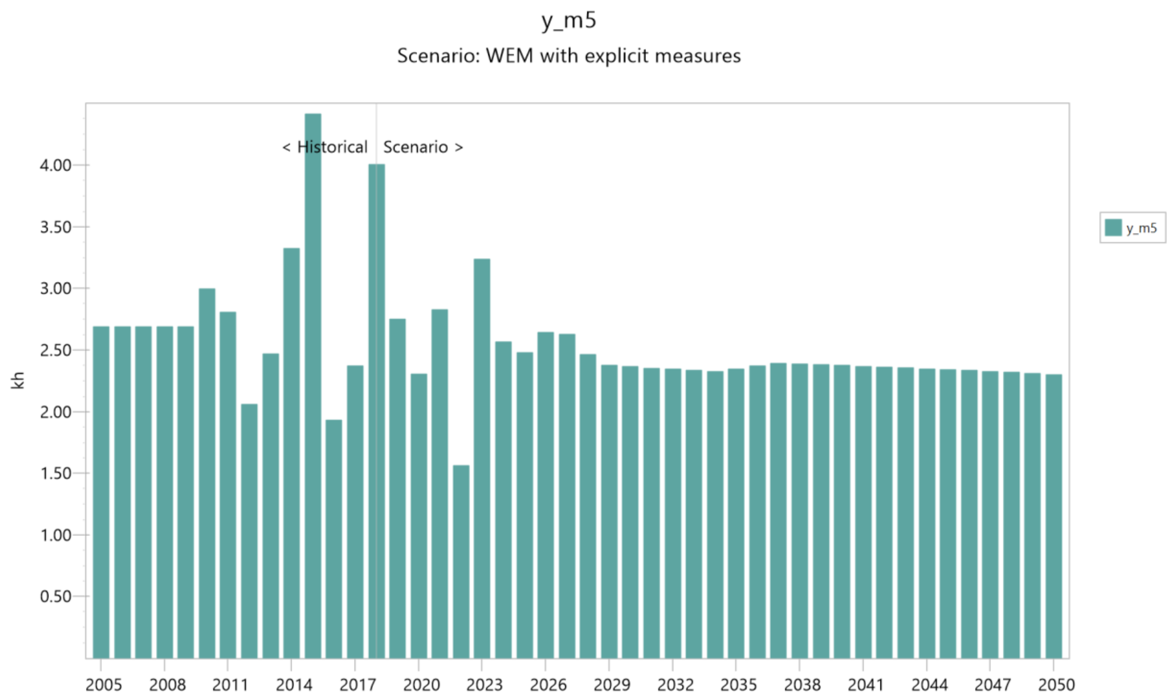
- prevyearvalue function on the load factor: shift by 4 years



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \left(\frac{Q_i}{C_i} \right) \right] / 15$$

RES-E HYDRO

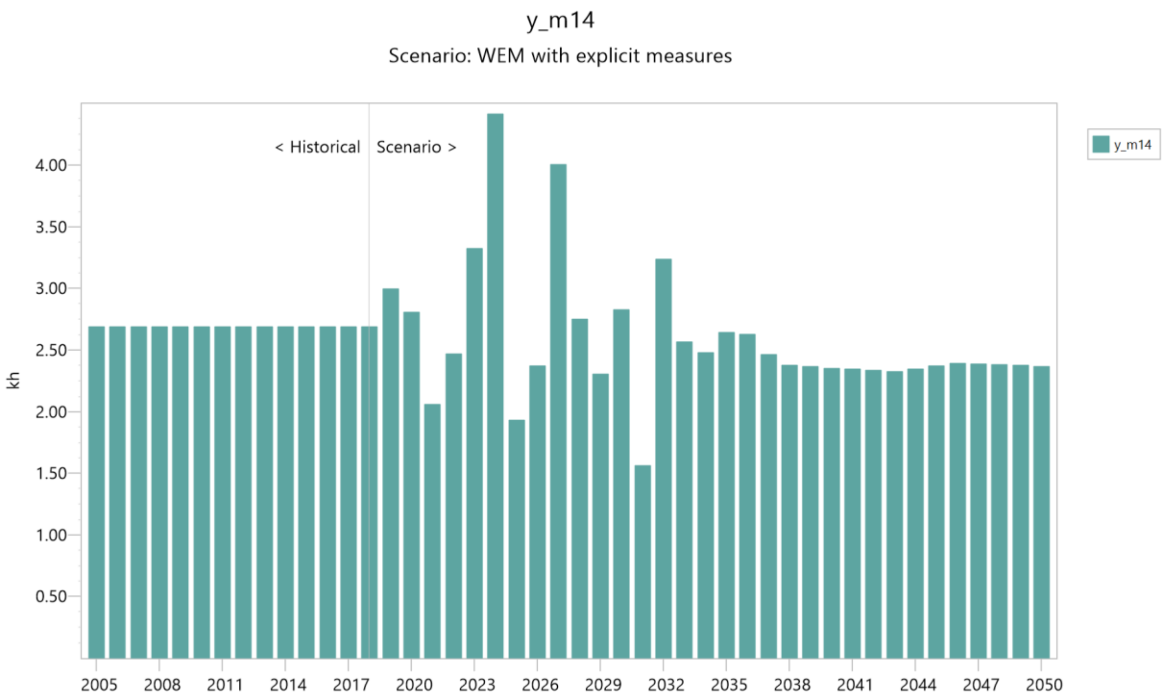
- prevyearvalue function on the load factor: shift by 5 years



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-1}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

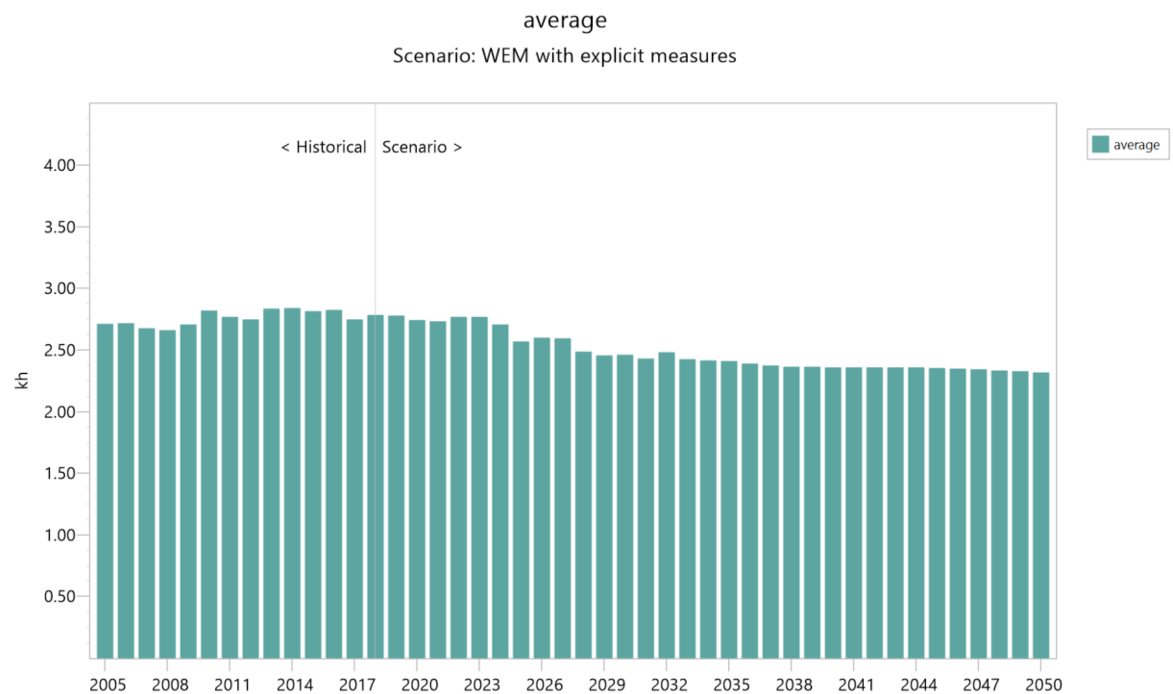
- prevyearvalue function on the load factor: shift by 14 years



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

- Average of all shifted load factors



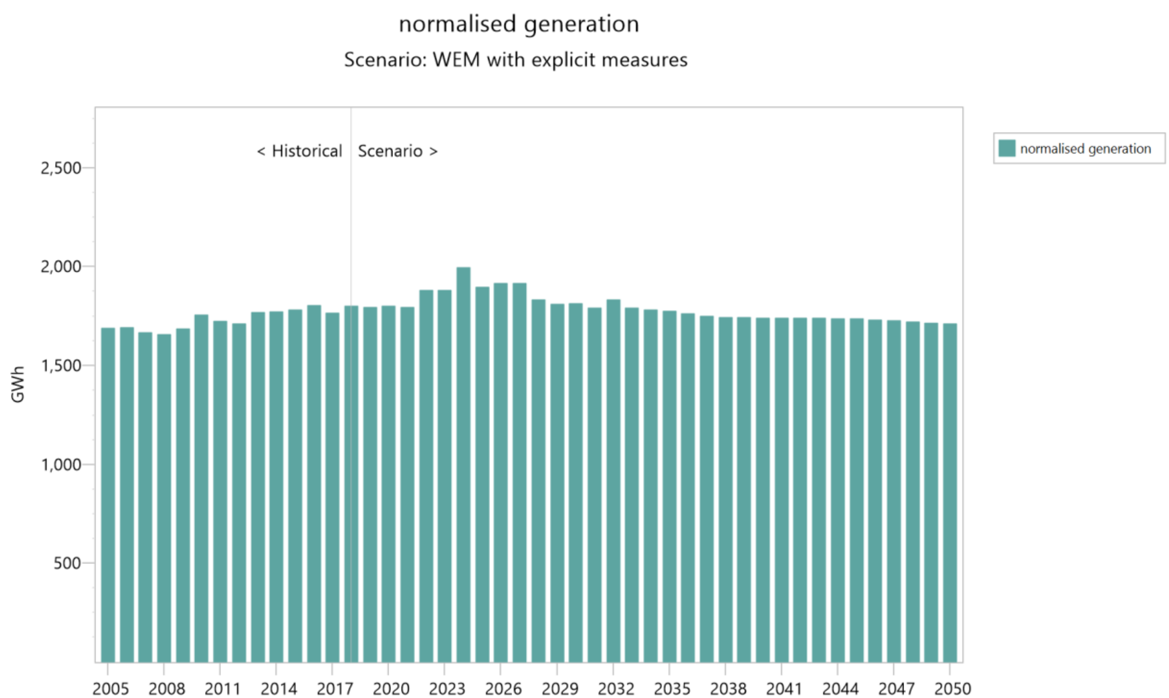
$$Q_{N(norm)} = C_N \cdot \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

RES-E HYDRO

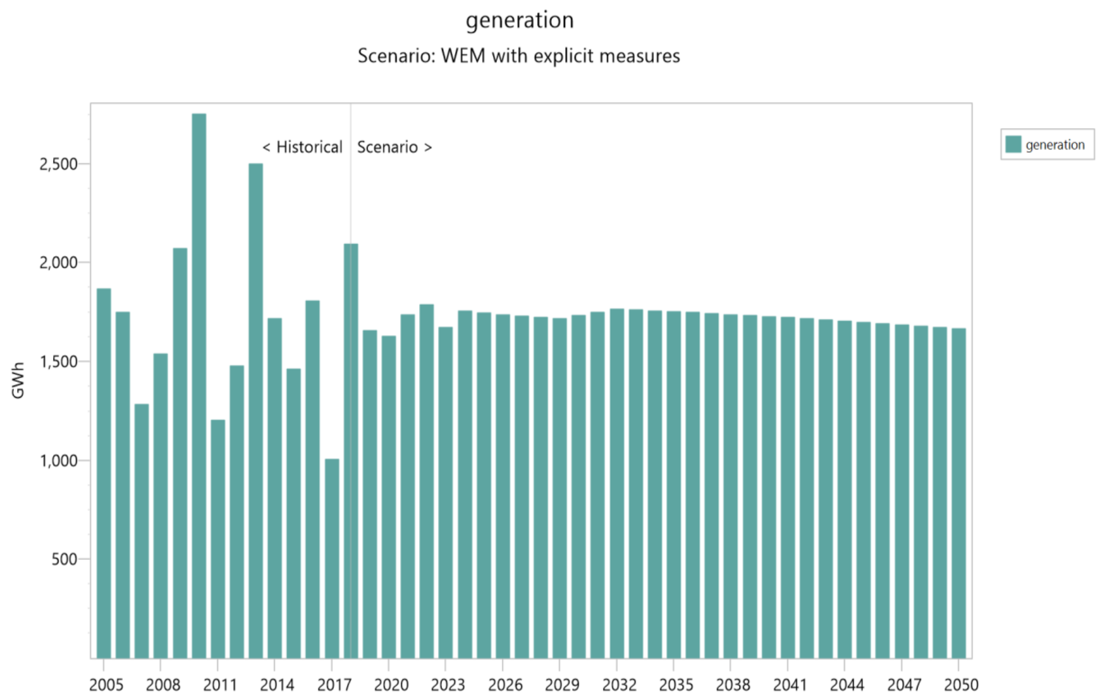
- Result: normalized generation



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

RES-E HYDRO

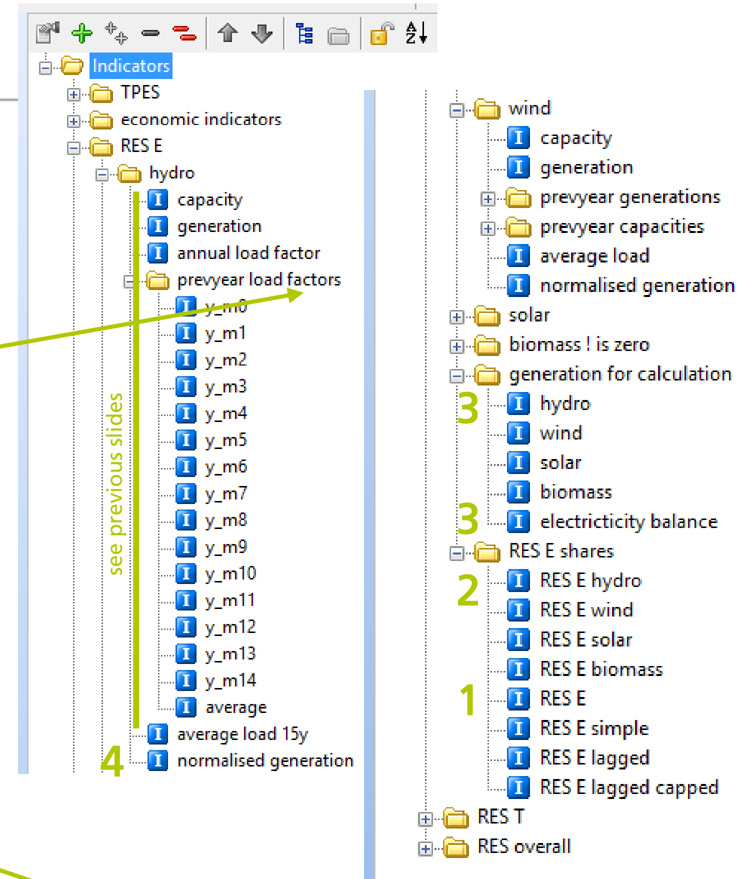
- Comparing to non-normalized generation



$$Q_{N(norm)} = C_N \times \left[\sum_{i=N-14}^{N} \frac{Q_i}{C_i} \right] / 15$$

LEAP INDICATORS: RES-E SHARE

- Let's take a look at the hierarchical structure of the indicators underlying the RES-E share (see right)
- wind is conceptually similar to hydro
- Each load factor is the prevyearvalue of the preceding one (see bottom)
- You need to take care of those values before the model start (2005 in this case)
  - Best to look up in eurostat table

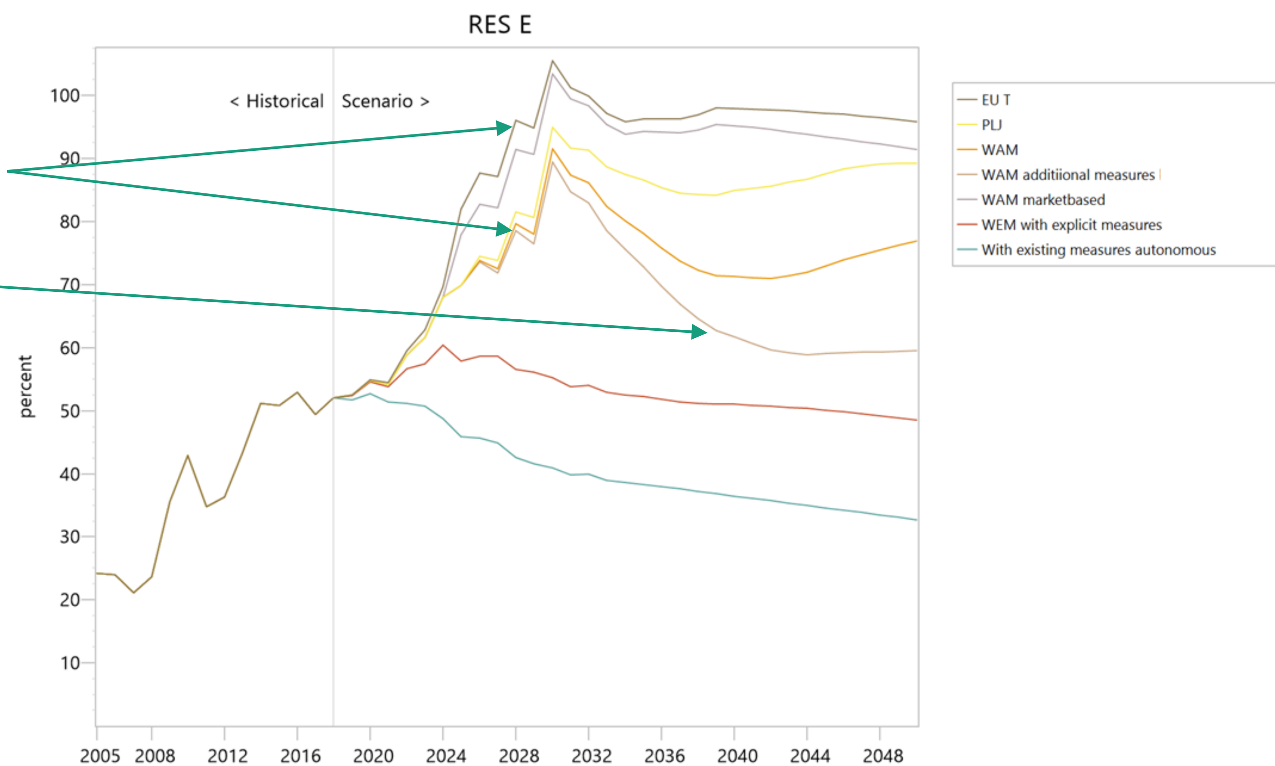


y_m0	Indicators\RES E\hydro\annual load factor:Indicator[kh] ?
y_m1	If(~year >= BaseYear + 1; ~PrevYearValue(y_m0:Indicator[kh]);~Key\Indicatordata\hydro load factor prior 2005[kh]~)
y_m2	If(~year >= BaseYear + 2; ~PrevYearValue(y_m1:Indicator[kh]);~Key\Indicatordata\hydro load factor prior 2005[kh]~)
y_m3	If(~year >= BaseYear + 3; ~PrevYearValue(y_m2:Indicator[kh]);~Key\Indicatordata\hydro load factor prior 2005[kh]~)
y_m4	If(~year >= BaseYear + 4; ~PrevYearValue(y_m3:Indicator[kh]);~Key\Indicatordata\hydro load factor prior 2005[kh]~)

LEAP INDICATORS: RES-E SHARE

- You then have access to RES-E share in LEAP directly, calculated according to SHARES

- nicely also shows the statistical effect of new hydro capacity which is not used in the model



giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

LEAP INDICATORS: RES SHARE

- RES-T
  - needs to collect electricity use in cars, railways; biofuels; etc
  - then use multipliers
  - builds on RES-E share
  - becomes a lengthy expression (~50 lines in the Builder tab)
- RES HC
  - is more difficult to implement as you need to consider the heat pump specialties
  - remember to leave out electricity here
- RES overall
  - you will need to collect RE energy demand (non-electricity) from all demand branches
  - and the normalised generation used for RES-E

LEAP INDICATORS: RECOMMENDATIONS

- Only changing indicators does not trigger a recalculation of results. Press ctrl while clicking results to force a recalculation

- Complex indicators make the model slow!
  - When entering indicators, remember that LEAP attempts to calculate these live, which can take time and cause the analysis view to be wrong
  - If you make indicator expressions too complex, this slows down LEAP enormously, so keep them as simple as possible
  - Personal experience shows that the combination of stacking indicators with prevyearvalue can be a tedious task
  - This also increases calculation time

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI

LEAP INDICATORS

Questions, comments?

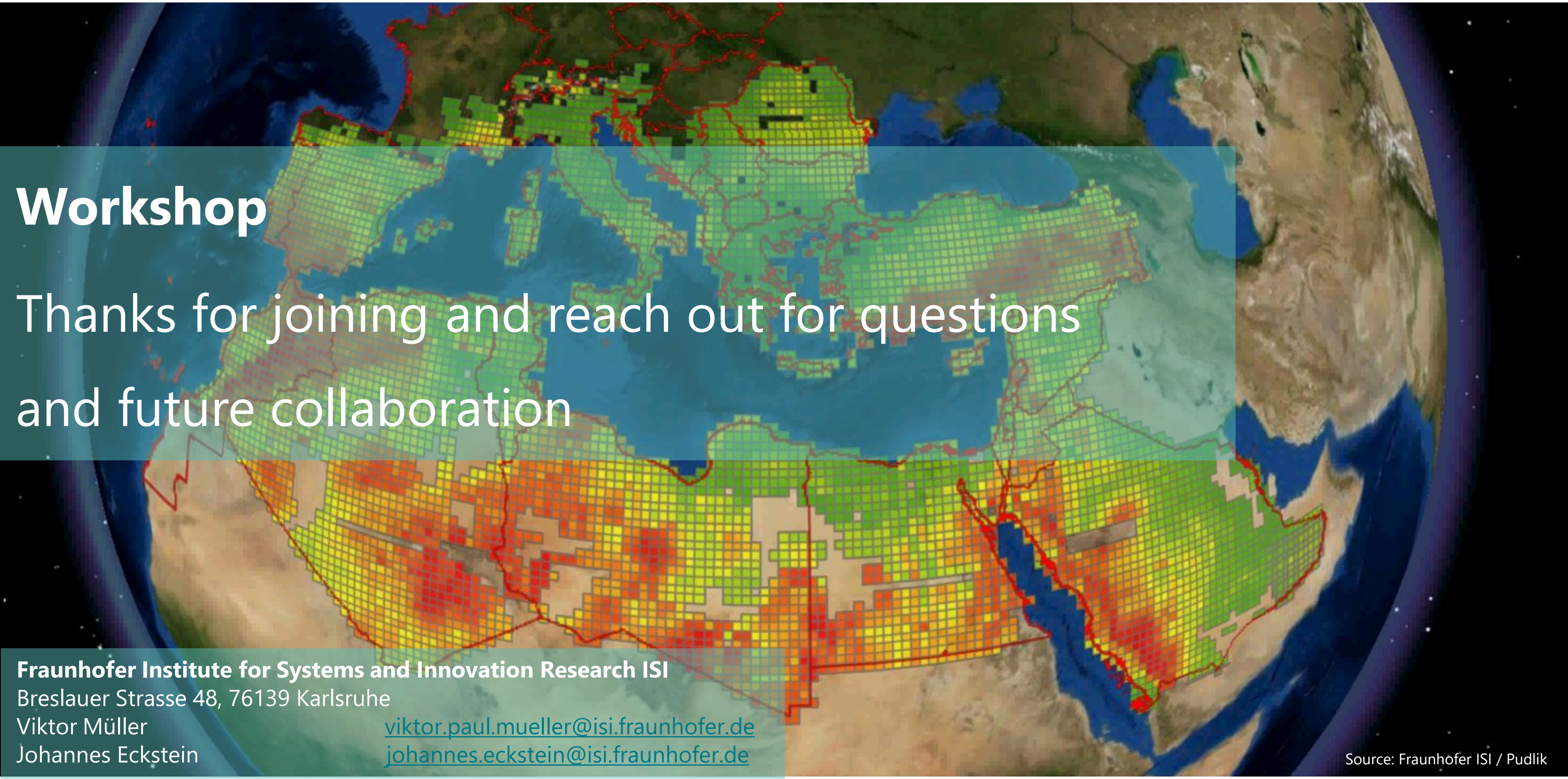
Your own experience?

How to make use of the fact you are all

- *working with the same tool*
- *in similar projects ?*

⇨ *Does everything need to be developed again and again in each CP?*

LEAP USER GROUP WORKSHOP AS PART OF THE REGIONAL EXCHANGE OF MODELLING EXPERTS IN THE WB6



Workshop

Thanks for joining and reach out for questions and future collaboration

Fraunhofer Institute for Systems and Innovation Research ISI
Breslauer Strasse 48, 76139 Karlsruhe
Viktor Müller viktor.paul.mueller@isi.fraunhofer.de
Johannes Eckstein johannes.eckstein@isi.fraunhofer.de

Source: Fraunhofer ISI / Pudlik

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Fraunhofer ISI