Comparison of different methods of spatial disaggregation of electricity generation and consumption time series

First Part

Oriol Raventós (DLR-VE)
in coordination with Thomas Dengiz (KIT- IIP)

Comparing Transmission Grid Models: MODEX-NET

25.11.2021

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

Outline

First Part

1. Introduction
2. Comparison of disaggregation workflows

Second Part (Thomas Dengiz, KIT – IIP)

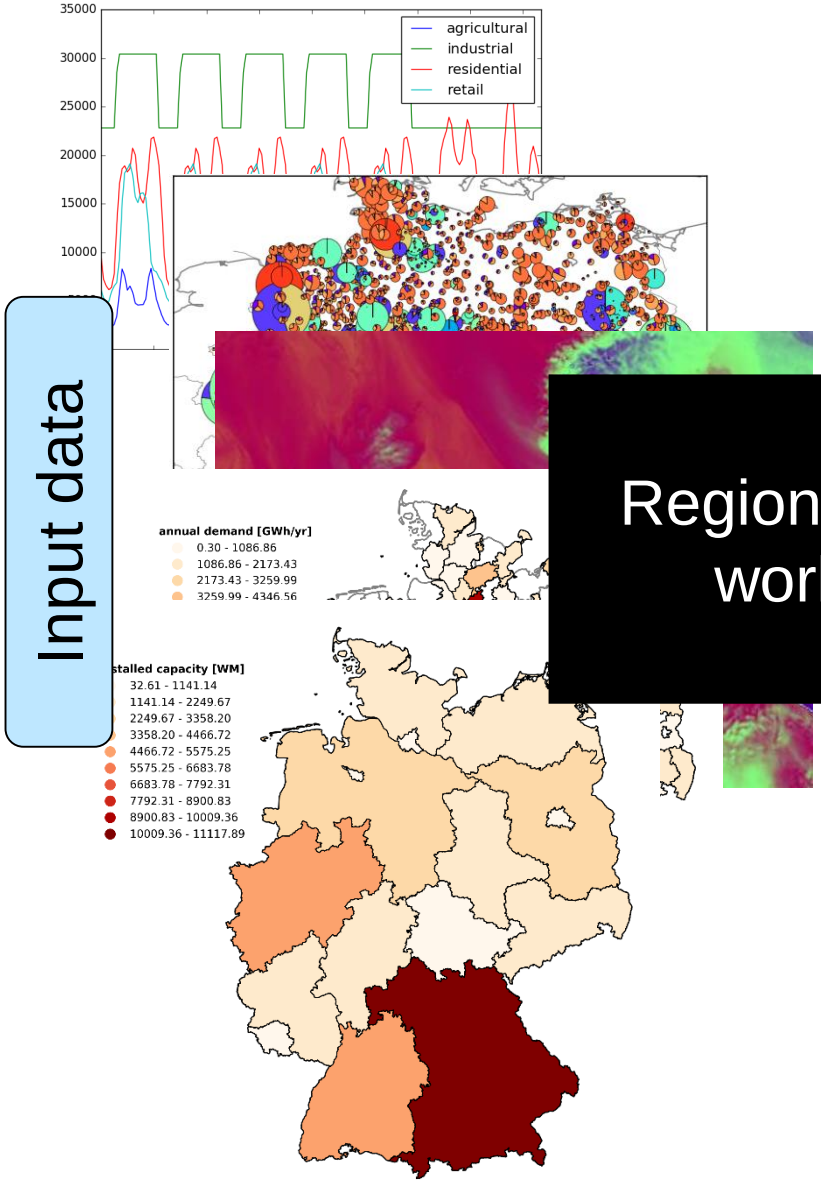
1. Comparison of disaggregated output
2. Conclusions

Preprint: https://arxiv.org/abs/2109.04203

MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

1. Introduction



Input data

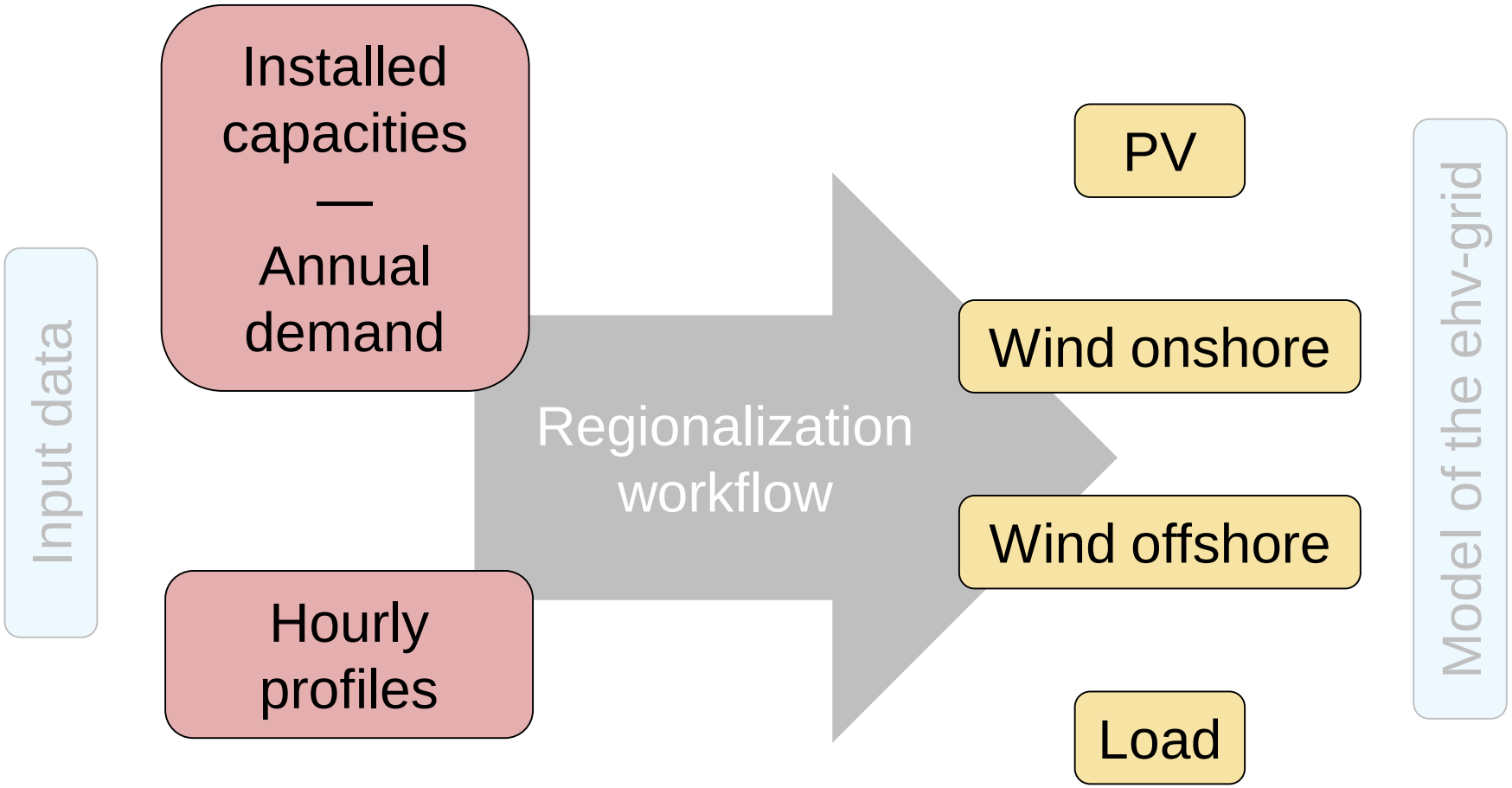
Regionalization workflow

Model of the ehv-grid for a historical scenario

ehv = extra high voltage

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

1. Introduction



MODEX Net
Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

1. Introduction

We want to compare the following 8 models

eTraGo

PERSEUS

ELMOD

ISAaR

MarS/ZKNOT

MILES

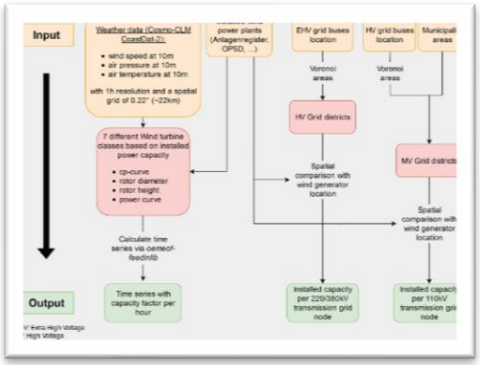
Europower

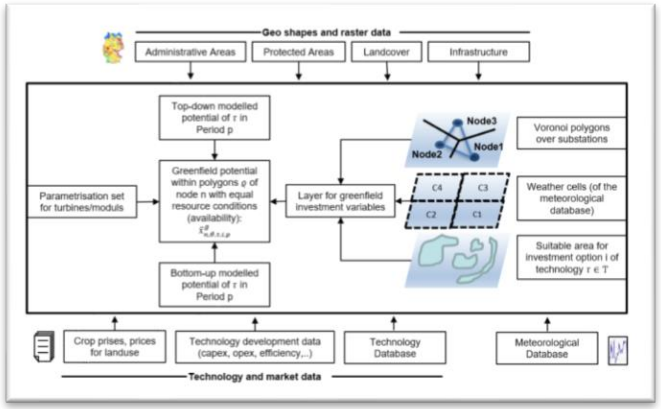
PowerFlex

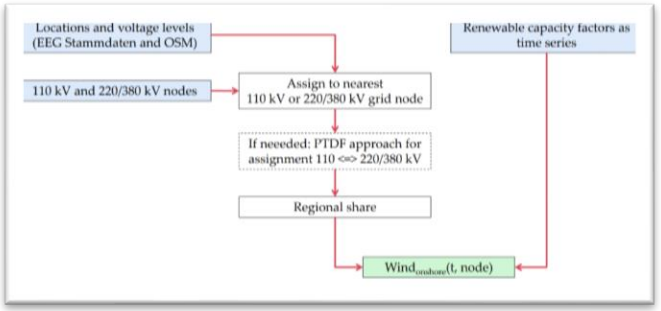
Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

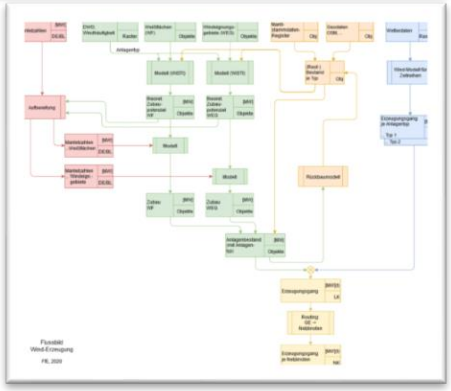
1. Introduction

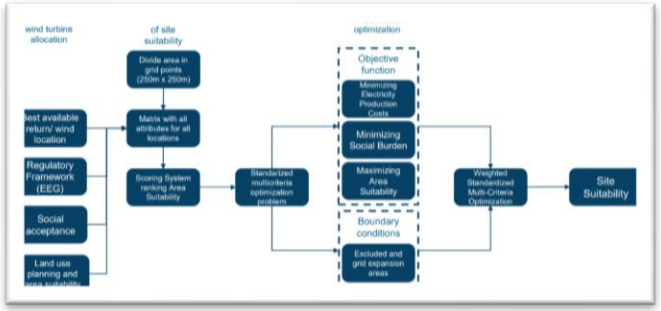
We want to compare the following 8 models

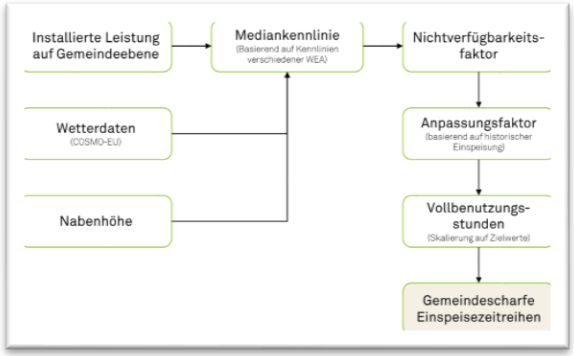


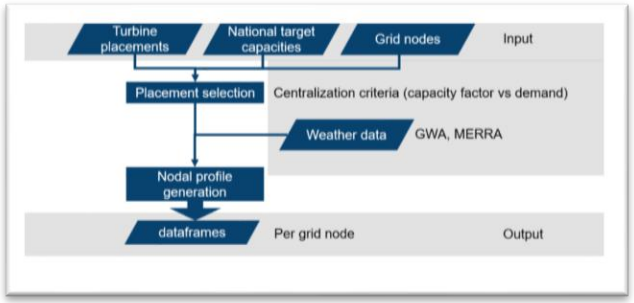


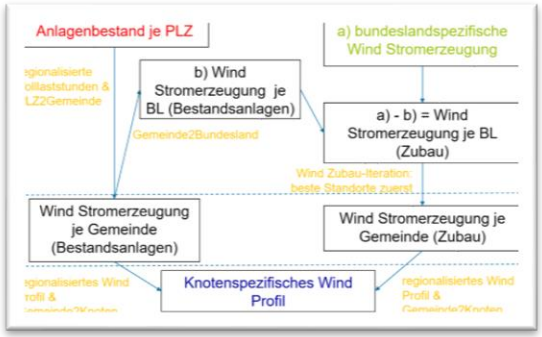












Wind onshore regionalization workflows

MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

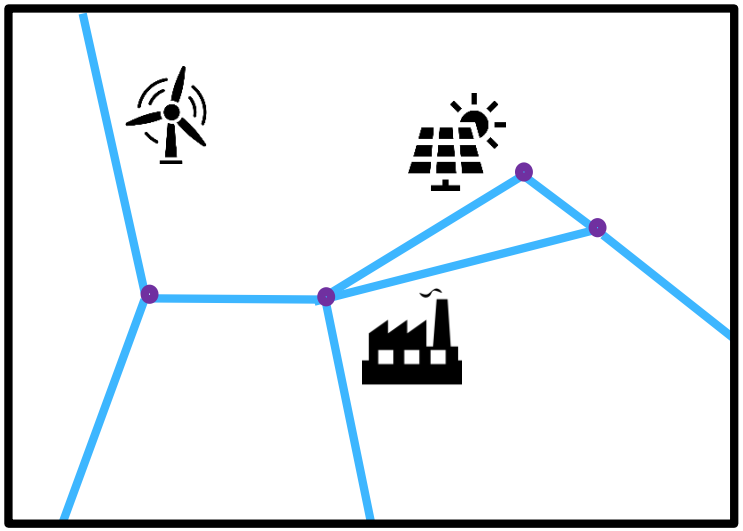
2. Comparison of disaggregation workflows

Allocation methods:

I. Allocate data inside a node region into its node

II. Distribute data region values into its nodes

III. Overlap of data and node regions



MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

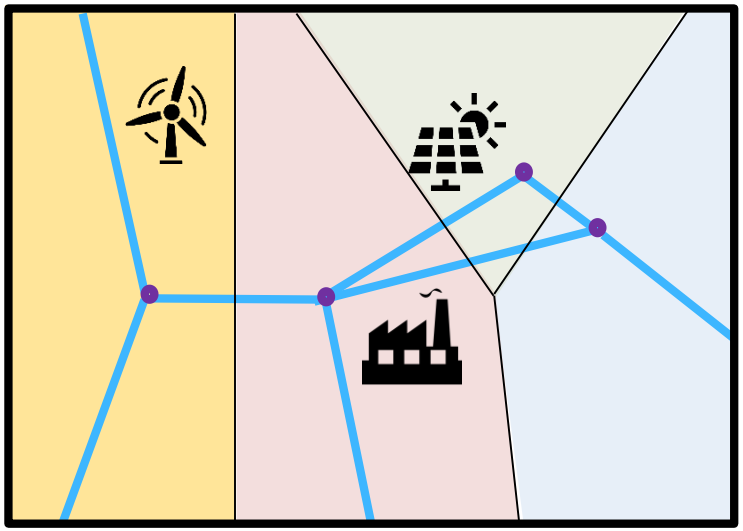
Allocation methods:

I. Allocate data inside a **node region** into its node

II. Distribute data region values into its nodes

III. Overlap of data and node regions

- Voronoi cells



MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

Allocation methods:

I. Allocate data inside a **node region** into its node

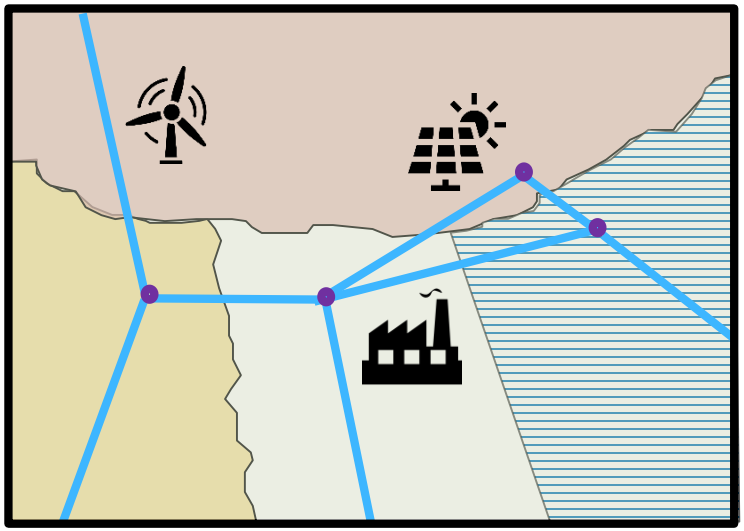
II. Distribute data region values into its nodes

III. Overlap of data and node regions

- Voronoi cells
- Administrative regions

Typically
- LAU (municipalities)
- NUTS 3 (districts)

If more than one node in a region:
- Voronoi subdivision
- Weightings



MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

Allocation methods:

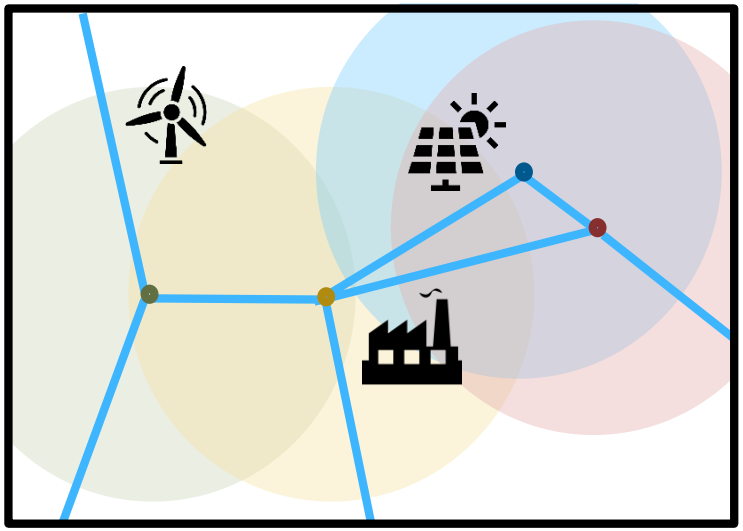
I. Allocate data inside a **node region** into its node

II. Distribute data region values into its nodes

III. Overlap of data and node regions

- Voronoi cells
- Administrative regions
- Circles

If more than one data location in a region, they can be distributed using a distance weighting



MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

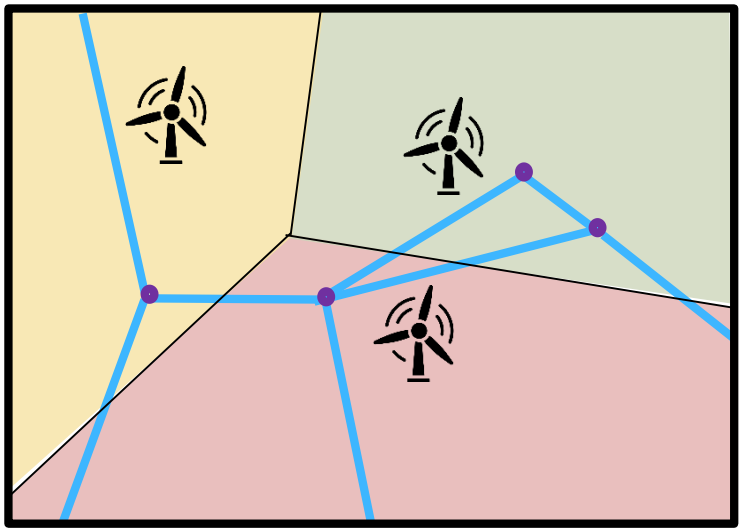
2. Comparison of disaggregation workflows

Allocation methods:

I. Allocate data inside a node region into its node

II. Distribute **data region** values into its nodes

III. Overlap of data and node regions



- Voronoi cells

MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

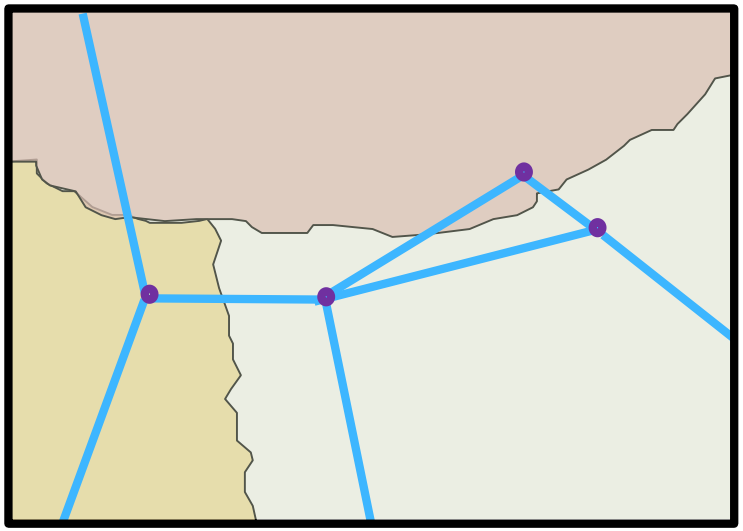
2. Comparison of disaggregation workflows

Allocation methods:

I. Allocate data inside a node region into its node

II. Distribute **data region** values into its nodes

III. Overlap of data and node regions



- Voronoi cells
- Administrative regions

MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

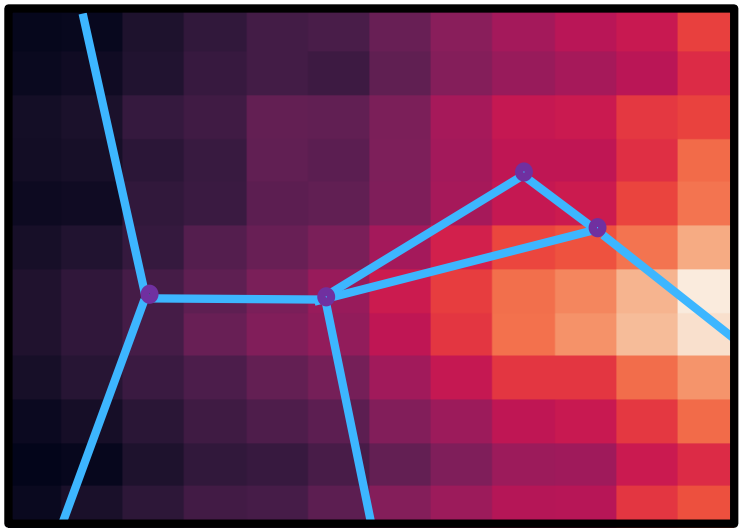
2. Comparison of disaggregation workflows

Allocation methods:

I. Allocate data inside a node region into its node

II. Distribute **data region** values into its nodes

III. Overlap of data and node regions



- Voronoi cells
- Administrative regions
- Lattice

Typically derived from weather data

MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

Allocation methods:

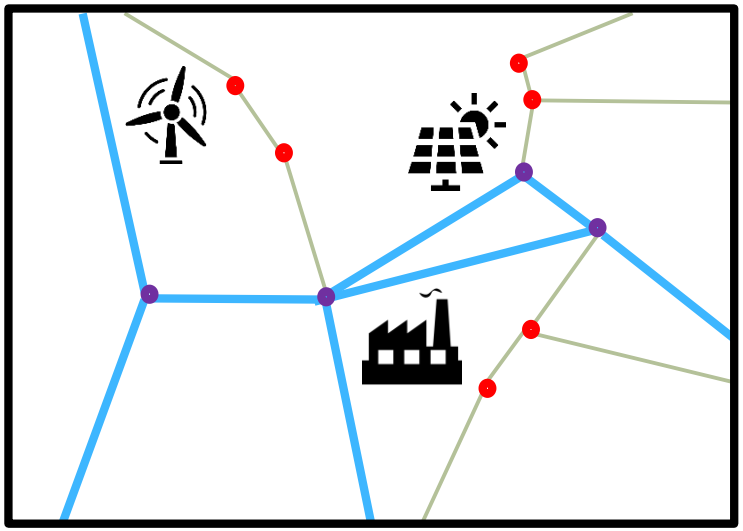
I. Allocate data inside a node region into its node

II. Distribute data region values into its nodes

III. Overlap of data and node regions

110 kV-nodes could be used instead + shortest path to ehv-node

It could be a **post-processing**, e.g. harmonize national values



MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

PV installed capacity:

Bottom-up / Top-Down

As LAU or NUTS level

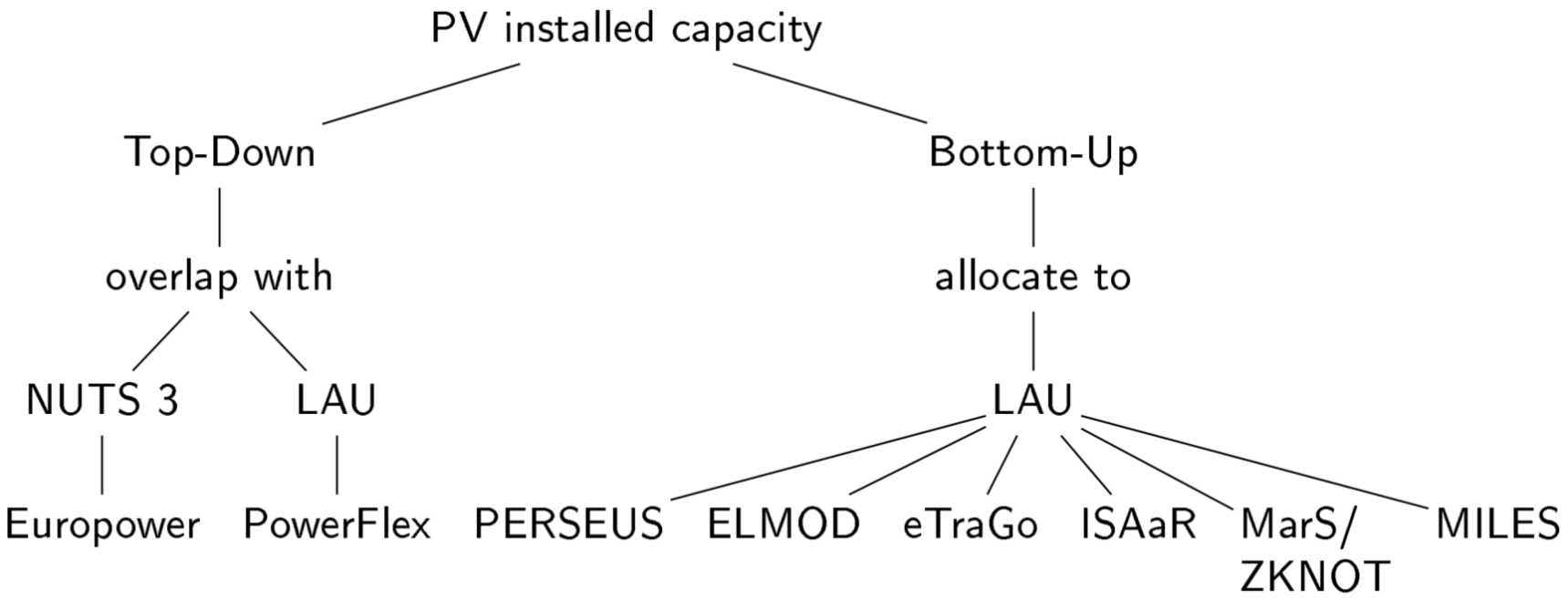
	BU/ TD	Input resolution & source	Node allocation
ELMOD			Generator belonging to a node region
eTraGo			Generator belonging to a node region
Europower			Overlap of generation regions and node regions
ISAaR			Generator belonging to a node region
MarS/ZKNOT			Generator belonging to a node region
MILES			Generator belonging to a LAU region (& distributed to nodes in the allocation region)
PERSEUS			Generator belonging to a node region
PowerFlex			Overlap of LAU generation region and node regions

MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

PV installed capacity:

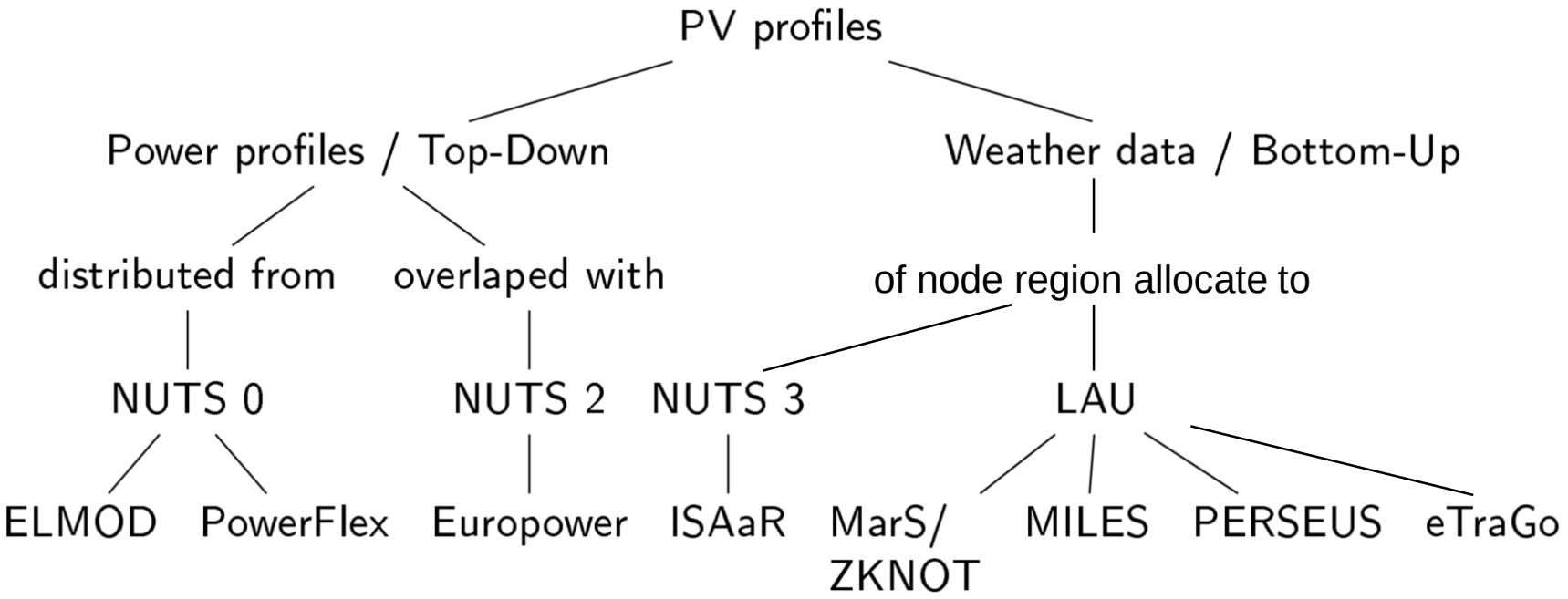


MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

PV profiles:



Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

2. Comparison of disaggregation workflows

Summary of wind and demand regionalization:

- **Wind onshore** regionalization is mostly done as for PV:
  - Installed capacity using a bottom-up allocatopm from LAU regions
  - Profiles from weather data using high spatial resolution

- **Wind offshore** regionalization**:**
  - Installed capacities mostly allocated to the grid connection points
  - Profiles either use offshore region potentials or one location

- **Demand** regionlization:
  - Mostly done by a top-down distribution from national sectoral load profiles (e.g. agricultural, residential, retail, industry) and
  - Annual demand factor using bottom-up allocation based on administrative regional parameters (e.g. GDP, population, temperature, land use...)

MODEX Net

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

Continues in the second part ...

Oriol Raventós, Institute of Networked Energy Systems,
Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR),
Tel.: +49 0441 99906-153, email: oriol.raventosmorera@dlr.de

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages