Cross Energy

*Cross border energy infrastructure - future design for a changing region*

# **CrossEnergy:** cross-border energy infrastructure – future perspectives for a region in change

Dr. Luis Ramirez Camargo

Technische Hochschule Deggendorf

on behalf of the CrossEnergy team

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# CrossEnergy Team


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*University of West Bohemia* (UWB)

- Faculty of Applied Sciences (Lead partner)
- Faculty of Electrical Engineering

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*Technische Hochschule Deggendorf* (THD)

OTH REGENSBURG

*Ostbayerische Technische Hochschule Regensburg* (OTH)



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# UWB- Faculty of Applied Sciences

UNIVERSITY OF WEST BOHEMIA

FACULTY OF APPLIED SCIENCES
UNIVERSITY OF WEST BOHEMIA

laps

## University of West Bohemia

- 9 faculties (60+ departments)
- 12 000+ students

## Faculty of Applied Sciences

- 6 departments
- 2 000+ students
- Focused on applied research

## Laboratory for Advanced Power Systems

- 2x professors
- 4x Ph.D
- 2x Ph.D. or master students

## Core Competences

*Renewable Energy Sources*

- Modelling and prediction of RES production
- Safe integration of RES into power networks

*Power Network Planning and Development*

- Probabilistic modelling of network elements
- Stochastic power flow algorithms for power networks with high share of renewables

*Ancillary Services*

- Set optimization tools for AnS purchase
- DSS tools for ancillary services portfolio determination

*Power Network Operation*

- State estimation tools for WAMS
- DSM for distribution networks with high RES share
- Dynamic line rating methods



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# UWB- Faculty of Electrical Engineering

UNIVERSITY OF WEST BOHEMIA

FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITY OF WEST BOHEMIA

## University of West Bohemia

- 9 faculties (60+ departments)
- 12 000+ students

## Faculty of Electrical Engineering

- 5 departments
- 2 000+ students
- Focused on electrical engineering

## Department of Electric Power Engineering and Ecology

- 4x professors
- 18x Ph.D
- 20x Ph.D. or master students

## Core Competences

*Power quality*

- Voltage quality assessment
- Evaluation of VQ monitoring
- Evaluation of power flows in distribution system

*Distribution of electric energy*

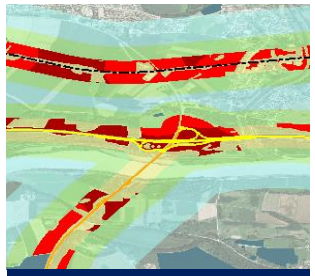
- Modelling of power systems (steady states and transients)
- Power system security analysis and contingency evaluation
- State estimation tools for WAMS

*Power Network Planning and Development*

- Improving continuity of supply
- Integration of distribution automation into MV overhead networks
- Analysis of closed-loop MV networks and interconnected feeders
- Integration of RES into power networks

# THD-TCF- Applied Energy Research Group

Technologie Campus Freyung



Angewandte Energieforschung

- THD: 5200 Students 552 Employees (126 Professors)
- TCF: 25 Researchers and 4 Professors

Core Competences:

- Electromobility concepts
- Regional energy use plans
- Location analysis for renewable energies
- District heating and solar mapping
- Consumption and generation monitoring
- Virtual power plants concepts
- Building automatization (eu.bac certification)
- Informational and educational events about Energy and GIS.

# Ostbayerische Technische Hochschule Regensburg – OTH Regensburg

- ~ 11.000 students
- 220 professors
- 470 employees
- 8 faculties, 24+3 Bachelor and 16+3 Master courses
- Focus: technology, economy, design, social and health care
- 3 Regensburg Center: Biomedical Engineering, Energy and Resources, Health Sciences and Technology

# Supporting Partners

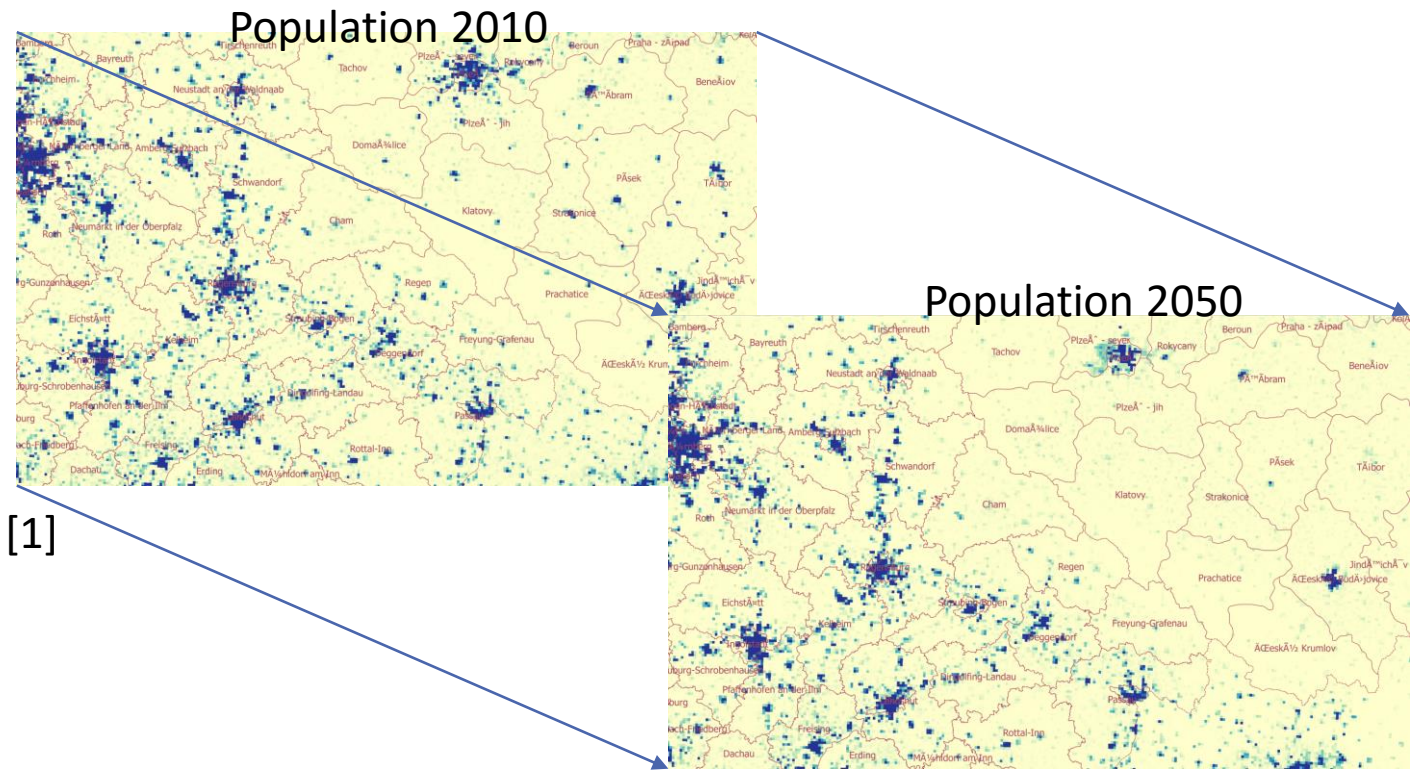
- Distribution system operators
  - CEZ Distribution a.s.
  - EoN Distribution a.s.
  - BayernWerk GmbH

- Public Bodies (regional development departments)
  - Pilsen, South Bohemia, Carlsbad district

# Motivation

## How will/should the future energy system in the rural Czech-Bavarian border region look like in 2050?

Long-term and short-term spatio-temporal forecasts of demographic, technological and economical changes specific to the Czech-Bavarian border region.




[1]



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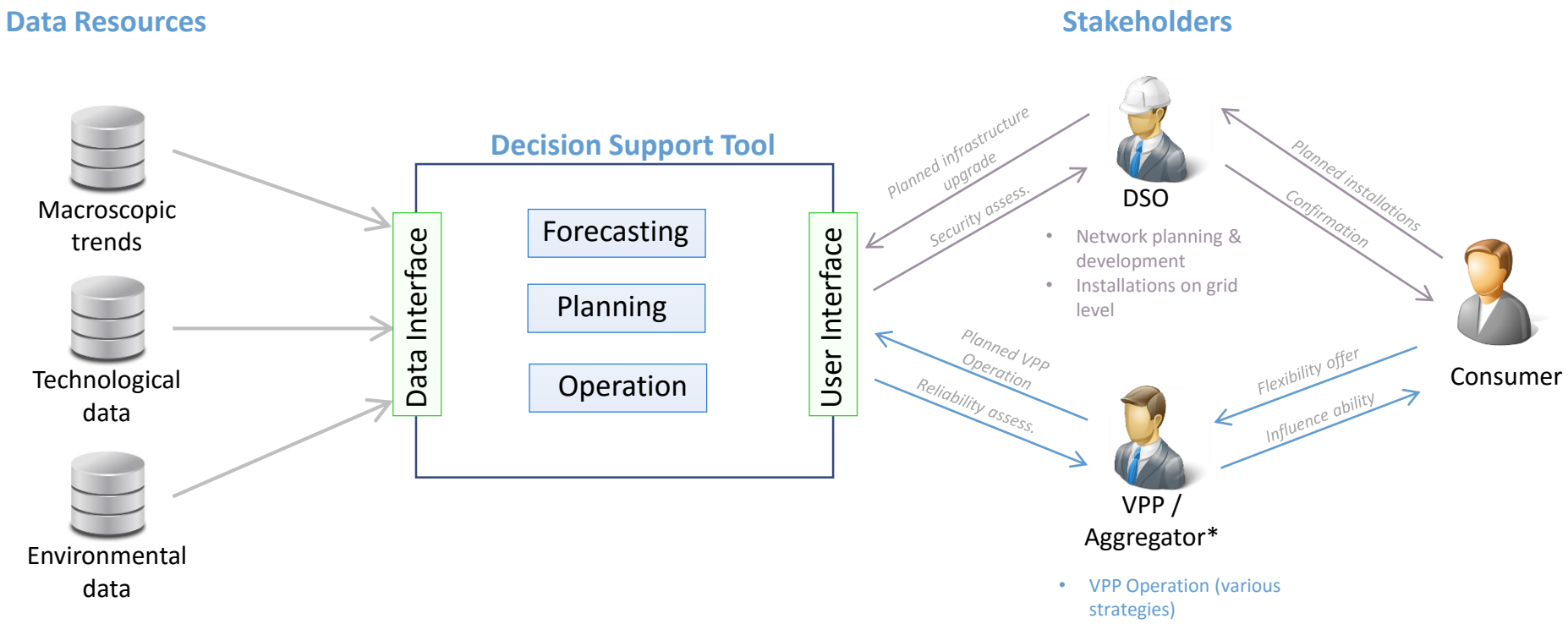
# CrossEnergy research institute

Development of a research infrastructure and team that will provide Know-how and expertise in (rural) energy systems planning and operation.

- It will be beneficial for regional and national energy suppliers
- It will be a trustable partner for energy suppliers and grid operators
- And it will become a reference for applied energy research on the European level

# Specific Objectives

A decision support system for optimization of long-term infrastructural plans and short-term operations with special consideration for international coordination in the highly heterogeneous border region.



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# Specific Objectives

- Create a methodology and prepare data for forecasting of future energy demand, supply and storage requirements with horizon 2030 and 2050.
- Analyze current planning procedures in both countries, where overlaps and differences will be identified.
- Develop and implement decision support system for the design of (cross) border energy infrastructure able to evaluate impacts of a strategic decision from various stakeholders' perspectives.



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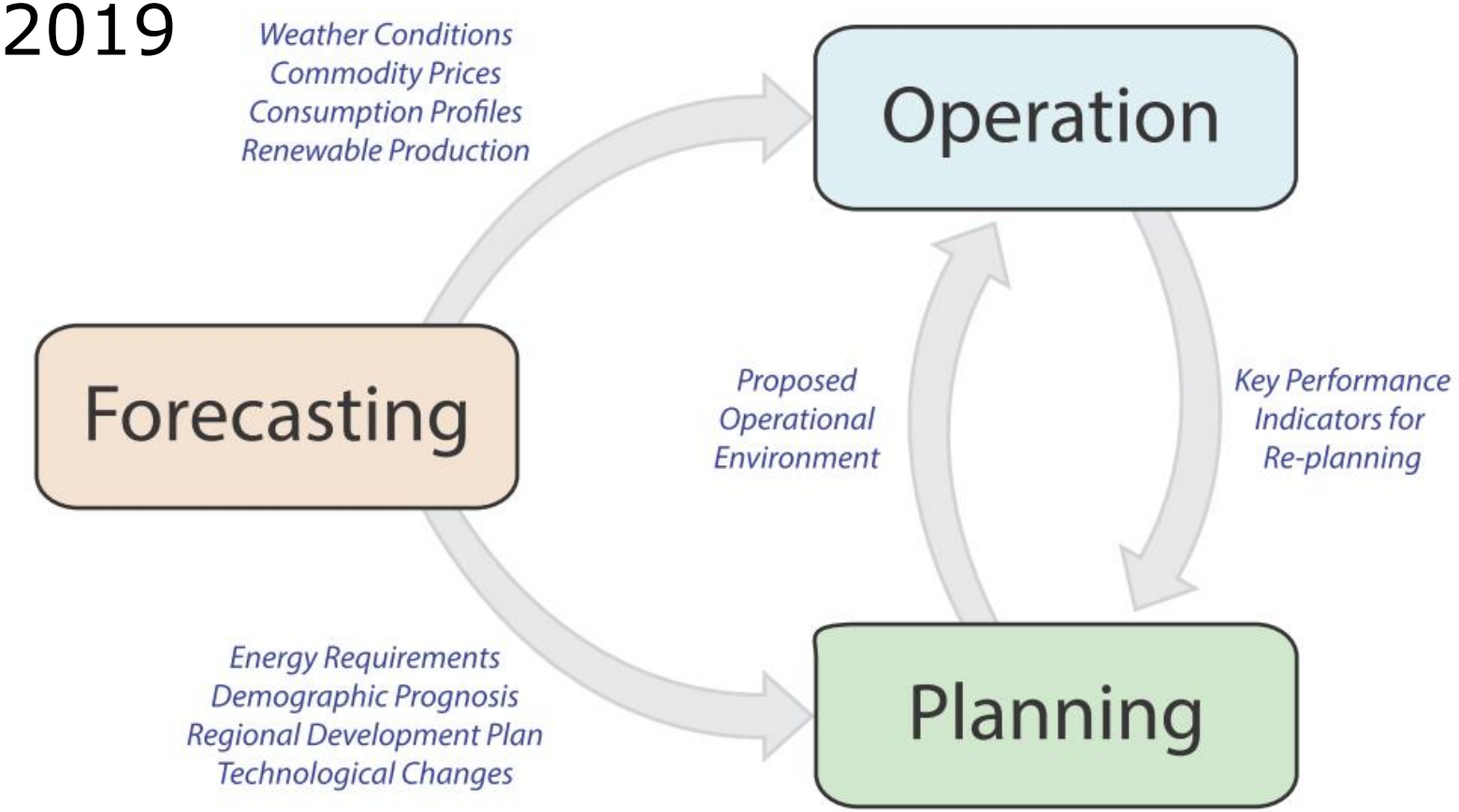
# Project Plan - Overview

- Begin: 01.01.2017
- End: 31.12.2019



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# Project Plan - Overview

**WP1:** FORECASTING **THD**

- Data collection and system setup
- Energy consumption modelling
- Supply and storage analysis
- Data management system, mapping and cartography

**WP2:** OPERATION **UWB**

- DSS for future design
- T,E&E case study specifications
- Operational analysis under security constraints and market conditions

**WP3:** PLANNING **OTH**

- Inventory and analysis of requirements for network planning
- Concept of the planning process
- Implementation of the planning procedure

# Deliverables

- CrossEnergy research institute
- Web service for distribution of regional energy data
- Decision support system for future design of (cross) border energy infrastructure enabled by economically reasonable, technically safe and societally acceptable measures
- Scientific publications



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# Thank you for your attention!

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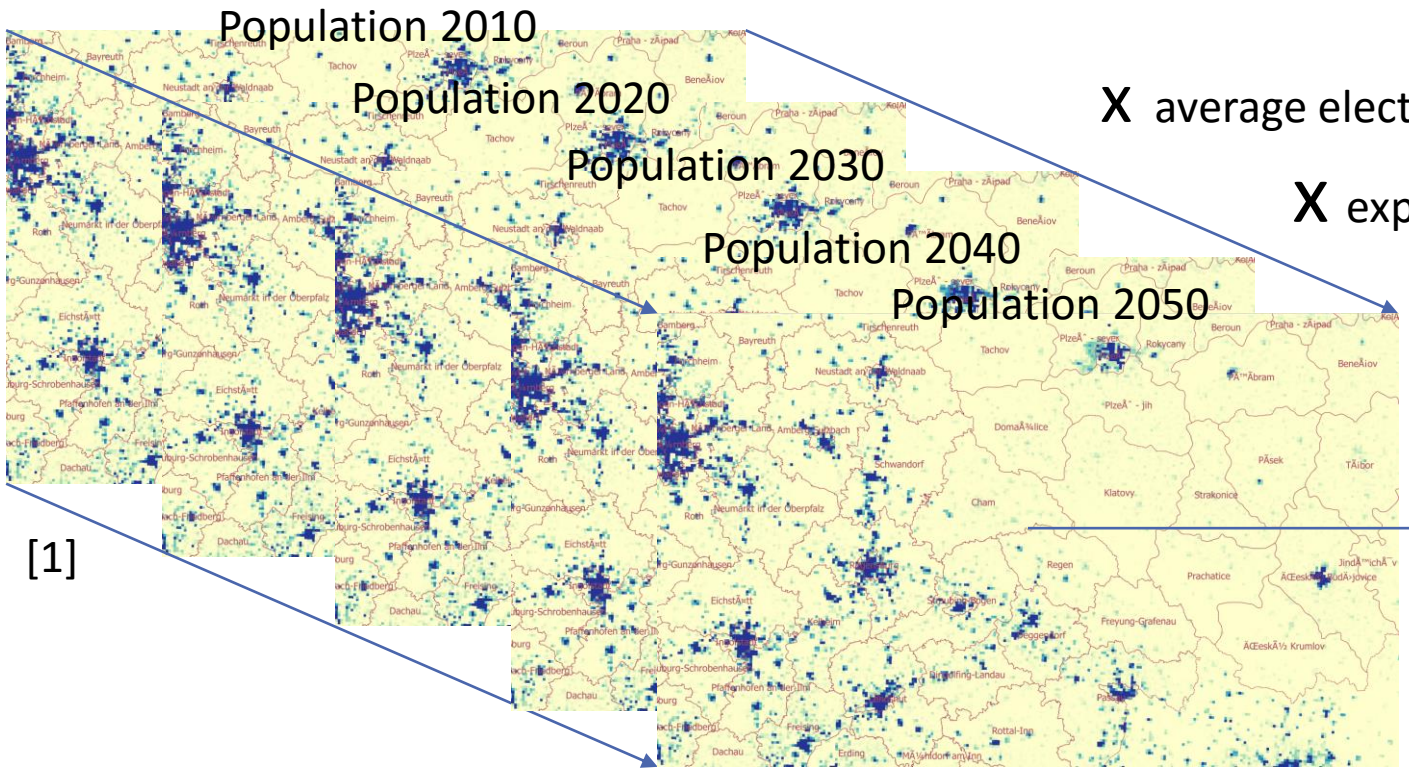
***NTIS – Research Centre***
University of West Bohemia
strelec@ntis.zcu.cz

# References


- [1] LUISA-Project: https://ec.europa.eu/jrc/en/luisa
- [2] C. Bollmeyer, J.D. Keller, C. Ohlwein, S. Wahl, S. Crewell, P. Friederichs, A. Hense, J. Keune, S. Kneifel, I. Pscheidt, S. Redl, S. Steinke, Towards a high-resolution regional reanalysis for the European CORDEX domain, Q.J.R. Meteorol. Soc. 141 (2015) 1–15. doi:10.1002/qj.2486.
- [3] S. Wahl, C. Bollmeyer, S. Crewell, C. Figura, P. Friederichs, A. Hense, J.D. Keller, C. Ohlwein, A novel convective-scale regional reanalysis COSMO-REA2: Improving the representation of precipitation, Meteorologische Zeitschrift. (2017). doi:10.1127/metz/2017/0824.
- [4] L. Ramirez Camargo, R. Zink, W. Dorner, Spatiotemporal modeling for assessing complementarity of renewable energy sources in distributed energy systems, ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences. II-4/W2 (2015) 147–154. doi:10.5194/isprsannals-II-4-W2-147-2015.

# Attachment - Project Plan - Forecasting

- Electricity demand

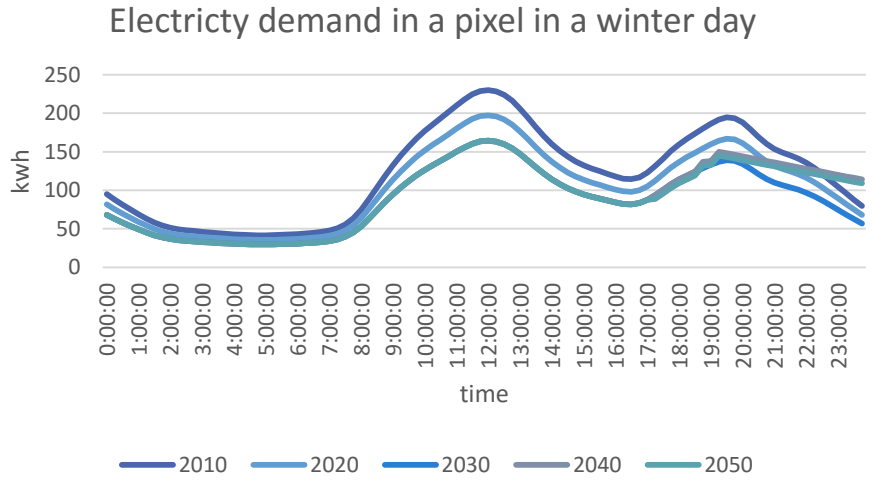



[1]

X average electricity demand per inhabitant

X expected efficiency improvements

X economically feasible adoption of new (efficient) technologies



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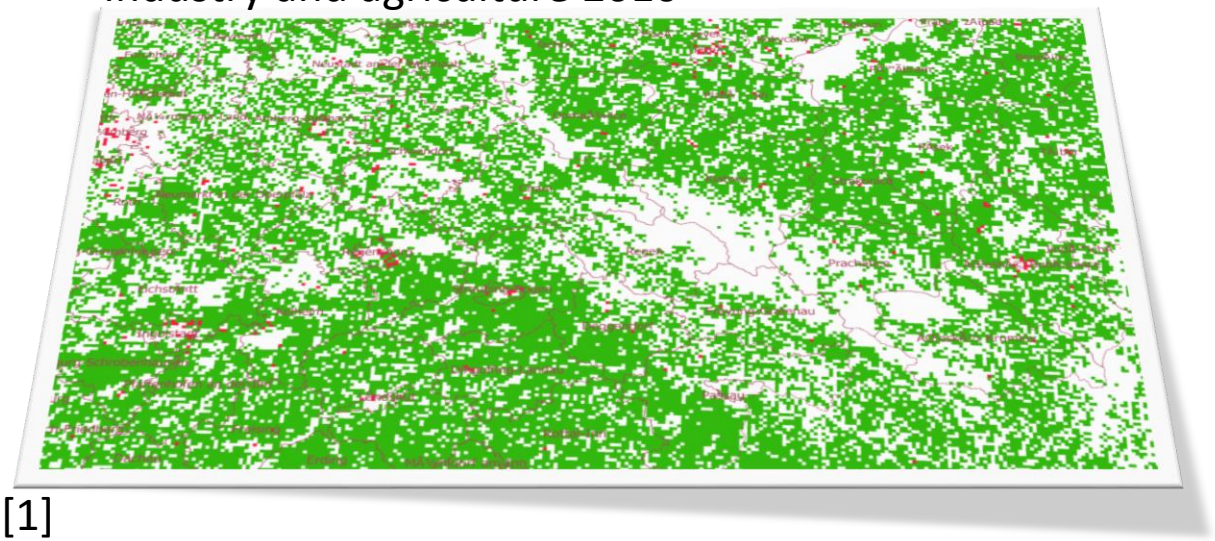
- Electricity demand

Industry and agriculture 2010



[1]

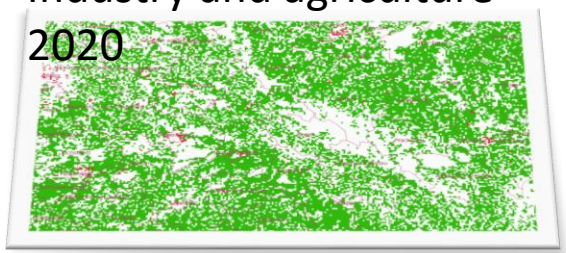
Reference scenario (double check):

- National energy statistics
- Regional energy statistics
- Heavy industries spatial data (http://prtr.ec.europa.eu/#/home)

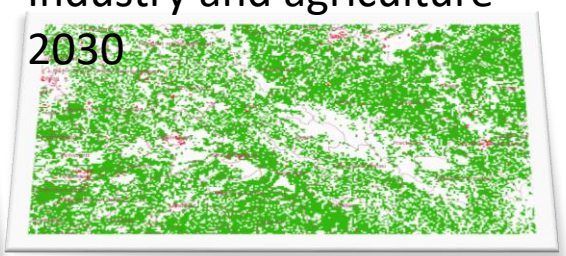
Forecast:

- Analogous to population
- Minimum 60 min (15 min is possible) time series per pixel

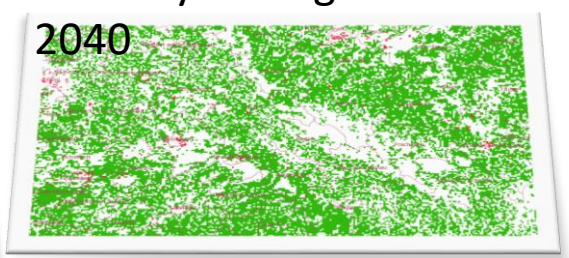
Industry and agriculture 2020



Industry and agriculture 2030



Industry and agriculture 2040

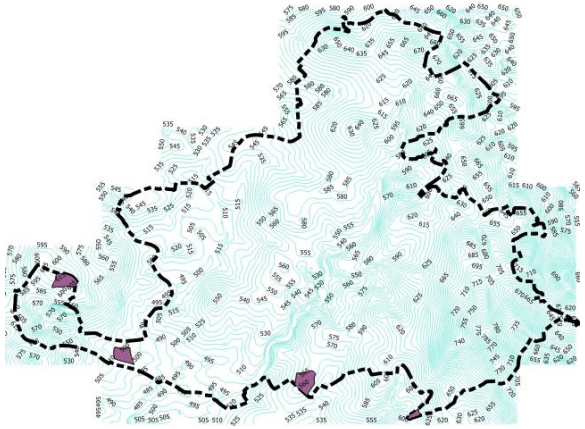


Industry and agriculture 2050

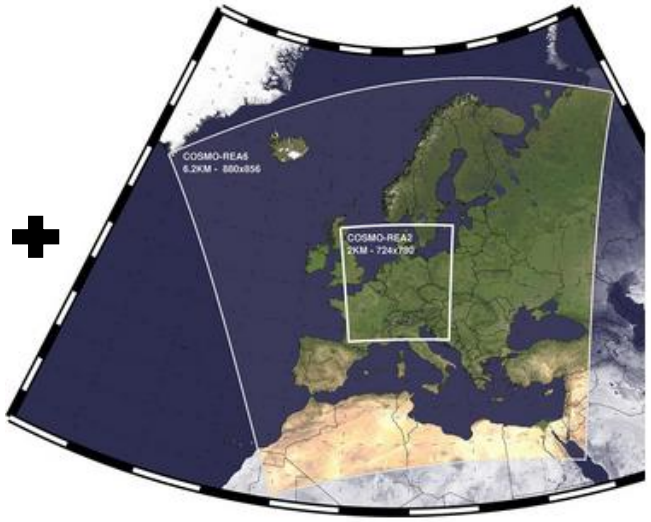
[1]

# Attachment - Project Plan – Forecasting - Electricity generation

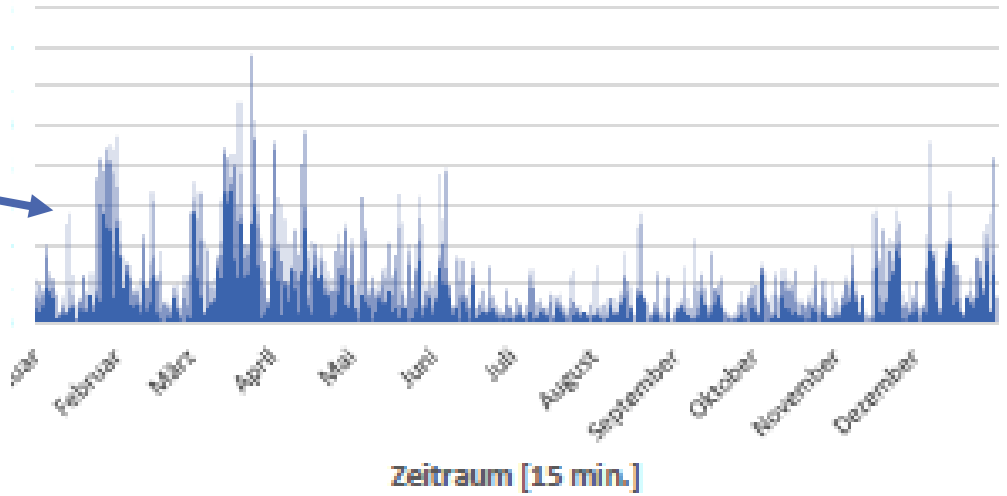
- Wind energy example:



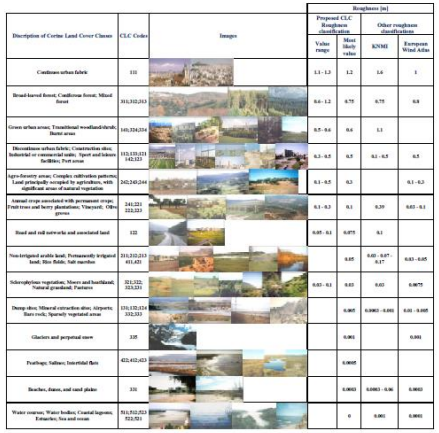
Suitable Areas for Wind Turbines




Reanalysis data[2-3]




Wind speed time series for every location



Land use data



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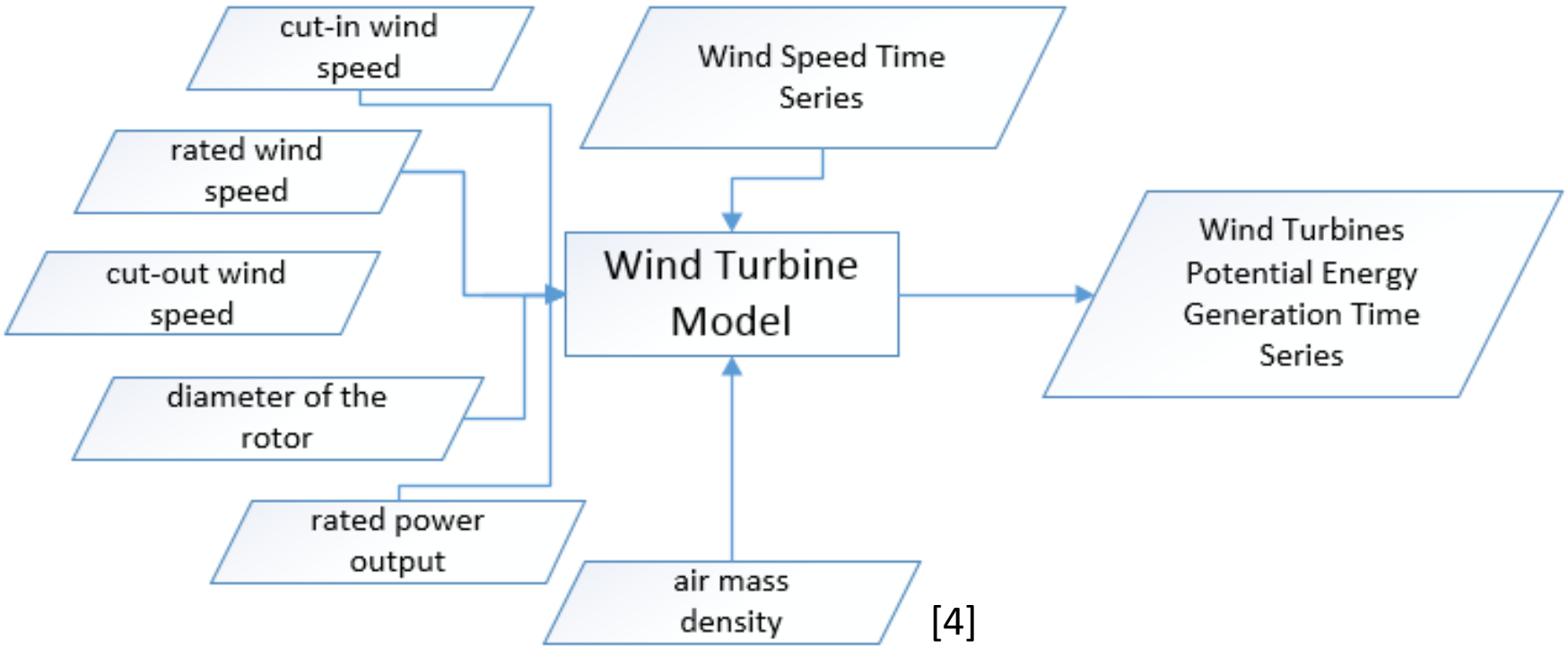
- Wind energy example:

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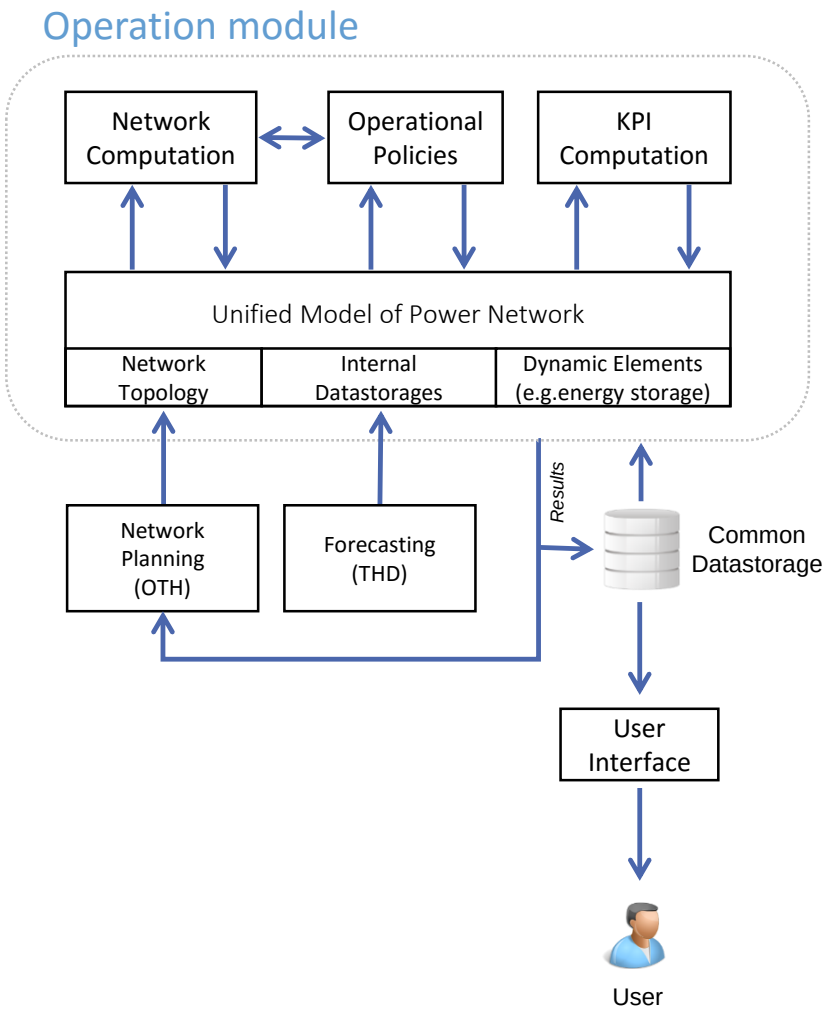
# Attachment - Project Plan – Planning

- Integration of new network elements with automated grid planning in dependence of forecasted consume and potentials of RES
- Consideration of technical and economical aspects
- Network Optimization with different technologies for power flow and voltage management (Reactive Power Regulation, Regulated Distribution Transformer, Active Power Capping)
- Comparison of different grid expansion strategies in technical and economical view with feedback of operational side

# Attachment - Project Plan – Operation




## Main functionalities

- Probabilistic simulation and assessment platform
- Short term forecasting of stochastic variables
- Probabilistic load flow computation in an efficient way
- Assesses operational policies under topology changes and expected trends
- Evaluation of technical KPIs

## Novel functionalities

- New network elements integration in network computation
- Dynamic elements (energy storage – active, passive)
- Operational Policies module and its interconnection with PLF computation
- Common Datastorage



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