E-shape and DestinE:
Use-cases on renewable energy

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Energy Modelling Applications

**FlexiGIS and REMix** supports potential users such as:

- Network and Grid Operators
- Decision-makers in urban planning
- Industry
- Aggregators for solar power trading
- Citizens
- and Researchers

FlexiGIS (e-shape): Susanne Weyand, Hauke Bents, Jethro Betcke
REMix (DestinE): Bruno Schyska, Thomas Schmidt, Francesco Witte

Source: Alhamwi et al., 2017
Online available at: https://github.com/FlexiGIS

Source: https://www.dlr.de/ve/
Online available at: https://gitlab.com/dlr-ve/esy/remix
Pilot 3.2: High photovoltaic penetration at urban scale: Energy Modeling Application - coupling to FlexiGIS
Data implementation:

- **CAMS Radiation** Service to retrieve irradiation and temperature data via soda
- Airborne based **Digital Surface Model (DSM)** from DLR optical overflight 2019 (20 cm GSD)
- **Building footprints** extracted from DLR optical overflight 2019 (20 cm GSD)
- **Corine Land Cover (CLC)** data provided by DLR German Remote Sensing Data Center

Timeseries process chain development:

- Use
  - PV location by single system
    - ERA 5 data access
    - PV modeling chain
- Enhanced inside FlexiGIS with
  - CAMS Radiation data as well as
  - PV multi location data from airborne data collection
FlexiGIS development – still ongoing

Current

Ongoing implementation

single scaled system

multiple systems with varying geometry

DLR- ASI Network “Eye2Sky”
Data impact on demand simulation – OSM vs. CLC

Electric demand calculation by FlexiGIS on SLP for OSM and CLC input data sets
DestinE - Use Case Energy Systems: Adapting Energy Systems to a changing Climate

- Demonstrator development for climate information use in energy system applications.
- Ground-based validation of DestinE Digital Twin Climate Adaptation by DLR’s unique Eye2Sky network.
- Comparison of several meteorological data-sets and model sensitivities quantification.
- Tools and method development for climate scenarios integrate into energy system workflows.
- Collaboration between European grid operators, public authorities and stakeholders.

Joint activity of DLR, Aarhus University, Renewables Grid Initiative
Solar irradiance measurement:
  • Global, Diffuse and Direct Irradiation Components (GHI, DNI and DHI)

Weather data:
  • Temperature
  • Relative Humidity

Cloud monitoring and forecasting (generate irradiance maps)
  • high temporal (30 sec) and spatial resolution (e.g. 5 m x 5 m).
  • high accuracy for the next 20 minutes and overall lead times of up to 2 hours
Demonstrator development

Current data input
Existing open source databases

Ongoing Implementation

REMix Model

Input
- Energy resources
- Energy demand
- Scenario assumptions
- Technology data
- Infrastructure data

Mathematical Optimisation (Linear programming)
Minimisation of system costs
\[ \text{Min/Max} \sum_{j=1}^{n} c_j x_j \quad \sum_{j=1}^{n} a_j x_j \geq b_i \quad \forall i \in 1..m \quad x_j \geq 0 \]

Output
- Hourly system operation
- Infrastructure capacity expansion (conversion, storage, transport, ...)

Power, Heat, Hydrogen, Gas, Transport, E-Fuels
First results

- REMix simulation output based on the Pan-European Market Modeling Data Base\(^1\)

- Differences in electricity market clearings of four weeks in 2010 based on Pan-European Climatic Data Base (PECD)\(^1\), University of Reading\(^2\) and renewable.ninja data\(^3\)

References:
Conclusion

• Intensive co-design with application and library developers initiated.
• Several code adaptations deep inside FlexiGIS code.
• FlexiGIS: several EO data implemented -> CAMS radiation, Corine Land Cover, building footprints and still ongoing - PV system information.
• Both energy model tools show:
  Simulation output impact by:
  • EO data usage (or in combination with OSM data) (FlexiGIS)
  • and geophysical data usage (DestinE)
• Further application and data evaluations ongoing.

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Next Generation Weather and Climate Models

MSG, next generation satellites MTG

ICON – D2 Weathermodel