Weather intelligence for Renewable Urban Areas Gaps, Challenges and future perspectives

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Published in:
Program Book. 3rd International Conference Energy and Meteorology (ICEM 2015)

Publication date:
2015

Document Version
Peer reviewed version

Link back to DTU Orbit

Citation (APA):

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Weather intelligence for Renewable Urban Areas
Gaps, Challenges and future perspectives

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ICEM 2015, Boulder 26/06-2015
The objective of the meeting
To gather experts for discussing the progress of the urban area meteorology finalized to the well functioning of a town and its energy system;

The goal
To identify and reach a consensus on research challenges, gaps, and research and technological priorities to be addressed in integrating distributed renewable power sources in the low voltage grid.
Weather intelligence for Renewable Urban Areas

Weather intelligence is a core issue for managing the Urban Area electrical grid system in the frame of the fast growing urbanization.

There are mainly three lines of research of interest:

• To define Key Performance Indicators (KPIs) of use for the well functioning of urban areas power system.

• To provide tools for RE resources mapping for the strategic planning of the renewable energy supply and for e.g. dimensioning the storage capacity of the urban electrical grid.

• To design, implement and test modelling strategies and tools for forecasting meteorological parameters and define their associated uncertainties for e.g. distributed power plants production, demand, storage capacity strategies and preparedness to extreme events.
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METEOROLOGICAL AND CLIMATE CHARACTERIZATION

High Density observation

SOLAR ENERGY
- Radiation
- Cloudiness
- Aerosols
- Temperature
- Humidity
- Rain

WIND ENERGY
- Wind speed
- Direction

SURFACE CHARACTERIZATION IN MODELS
- Roughness of different Urban components
- Land use
- Orography

http://www.actionbioscience.org/environment/
Design an “Urban Control Center” were to access information for estimating **KPIs of use** for **end users** for the well functioning of the town. (e.g. preparedness of administrators, industry, operators and citizens)
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Strategic planning of distributed RES

Need of **tools** for mapping resources for the urban area spatial strategic planning: integration of renewable plants into strategic town planning and impact of urbanization

- Improving urban climate simulation
- Assessing the effect of building layout on city ventilation
- Developing tools to optimise urban renewable energy generation

[Diagram of urban and rural boundary layers with wind flow]

![Image of sunflowers and wind turbines]

[Image of a cityscape and renewable energy infrastructure]
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Strategic planning of distributed RES

Need of tools for mapping resources for the urban area spatial strategic planning: integration of renewable plants into future town planning and impact of urbanization
Once renewable power plants are installed, we need Model/Algorithms for

- Forecasting input in the grid from distributed sources
- Forecasting demand patterns according to weather
- Storage dimensioning and charge & discharge strategies (including vehicle to grid)
- Optimization of the energy efficiency of buildings, district etc.
CHALLENGES

- Translating meteorology into power production and demand at urban scales
- Power production curve of a town for each technology according to meteorological situations
- Bridge models from large scale to microscale at different time and space horizons
- Evaluating uncertainties of models and tools
Results from a questionnaire

Specific research challenges for energy meteorology in urban areas to advance the state-of-the-art?

CHALLENGES

- Interplay of models at different space and time scale
- **Adaptive scalable renewable energy power curves of a town (per technology).**
- Impact of meteorology on demand at different space and time scales.
- Models for the impact of urban emissions on urban meteorology functional for the energy sector. Clouds are the largest factor, what about aerosols and other species?
- Monitoring and forecasting of solar irradiance and wind at high spatial and time resolution. Near real time data from satellites. Sky Imagers.
- Strategies for atmospheric measurements inside urban areas, both ground-based and along vertical profiles.
- Characterize the representativeness of micro-scale processes e.g. urban street level with respect the circulation, to improve wind speed and direction forecast and the assessment of the surface energy balance.
- Characterize the impact of changes in “urban land use” on large scale circulation. E.g. coastal urbanization.
RESULTS FROM A QUESTIONNAIRE

Specific gaps for energy meteorology in urban areas to advance the state-of-the-art?

REQUIREMENTS

• Content management system containing information on cloud distributed meteorology data, production and demand.

• Analysis tools for “making sense” of “Big data”, QUALITY OF DATA

• Benchmarking platforms for evaluating uncertainties from observations and models

• High temporal resolution data of renewable energy production and demand as a standard urban service.

• Strategies for optimised observational networks in urban areas and innovative instruments

CADASTER

• Availability and continuous update of a high resolution 3D model of the city.

• Standardized information layers containing all information needed optimizing the integration of distributed energy systems. i.e. Type of renewable solution, nominal power, solar panel type, exposition, consumption patterns, storage availability.
• Harmonization of methods/models/tools/measurements/evaluation.

• The consumers of energy forecasts would likely include large pan-European entities (Utilities/grid operators).

• Incentives for adopting new technologies through European regulation.
THE H2020 SCIENCE 2.0 Approach for sharing data, knowledge, remote collaboration.

The above points can largely be addressed by existing technologies - the key is their convergence and by mandating their application.

- ICT Technology for content management strategies and systems. E-platforms for integrating cloud distributed data of different nature for advanced statistics and multi-problem solving.
- Exploit new satellite data and remote ground based sensing devices as scanning Lidars.
- Smart phones: citizen-science style meteorology using to increase faith in science and technology.
- The 100EUR weather station (built into cars, city busses, traffic cameras, residential PV, etc.)
- Two-way communication “smart objects” for transmitting to data platforms:
  1) meteorological information from model or high density observation networks
  2) sensible data i.e. demand and production patterns.

- Tools for non scientist with online help.
Results from the questionnaire

**Prerequisites/framework:** What are the factors that could stimulate research?

**SOCIO-POLITICAL**

Diffidence of citizens toward authority and operators (e.g. DSOs) concerning the disclosure of sensitive data on production and consumption functional to test forecasting strategies.

**POLICY**

- Regulatory issues for accessing data, how to maintain confidentiality and exploit databases.
- Town administrator awareness of needs in investing time and funding for scientific and technological advancement for smart town management.
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Thank you for your attention!