Open Access and Open Data in practice

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(with ackn. to all funding sources, data providers, collaborators and students, for material and ideas)

Outline

- **Two anecdotes**
- **When I have to explain what we do...**
- **Open research motivating feedback** (RESGen and the P2P market App)
- **Open research based on "events"**
- **Pushing data and benchmark case studies in the open**

... an introduction to our group and the way we work on YouTube

Anecdote 1

Ownership of our research works

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Consensus-based Approach to Peer-to-Peer Electricity Markets with Product Differentiation

3 Author(s) Etienne Sorin ; Lucien Bobo ; Pierre Pinson View All Authors

Abstract
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Keywords
Metrics

Abstract:
With the sustained deployment of distributed generation capacities and the more proactive role of consumers, power systems and their operation are drifting away from a conventional top-down hierarchical structure. Electricity market structures, however, have not yet embraced that evolution. Respecting the high-dimensional, distributed and dynamic nature of modern power systems would translate to designing peer-to-peer markets, or at least to using such a structure in the background for a bottom-up approach to future electricity markets. A peer-to-peer market structure based on a Multi-Bilateral Economic Dispatch (MBED) formulation is introduced, allowing for multi-bilateral trading with product differentiation, for instance based on consumer preferences. Consequently a Relaxed Consensus+Innovation (RCI) approach is proposed to solve the MBED in fully decentralized manner. A set of realistic case study analyses shows that such peer-to-peer market structures can effectively reduce externalities on power systems with a limited cost increase compared to centralized market approaches. Additionally, the RCI solving approach allows for a fully decentralized market clearing which converges with a negligible optimality gap, with a limited amount of information being shared.

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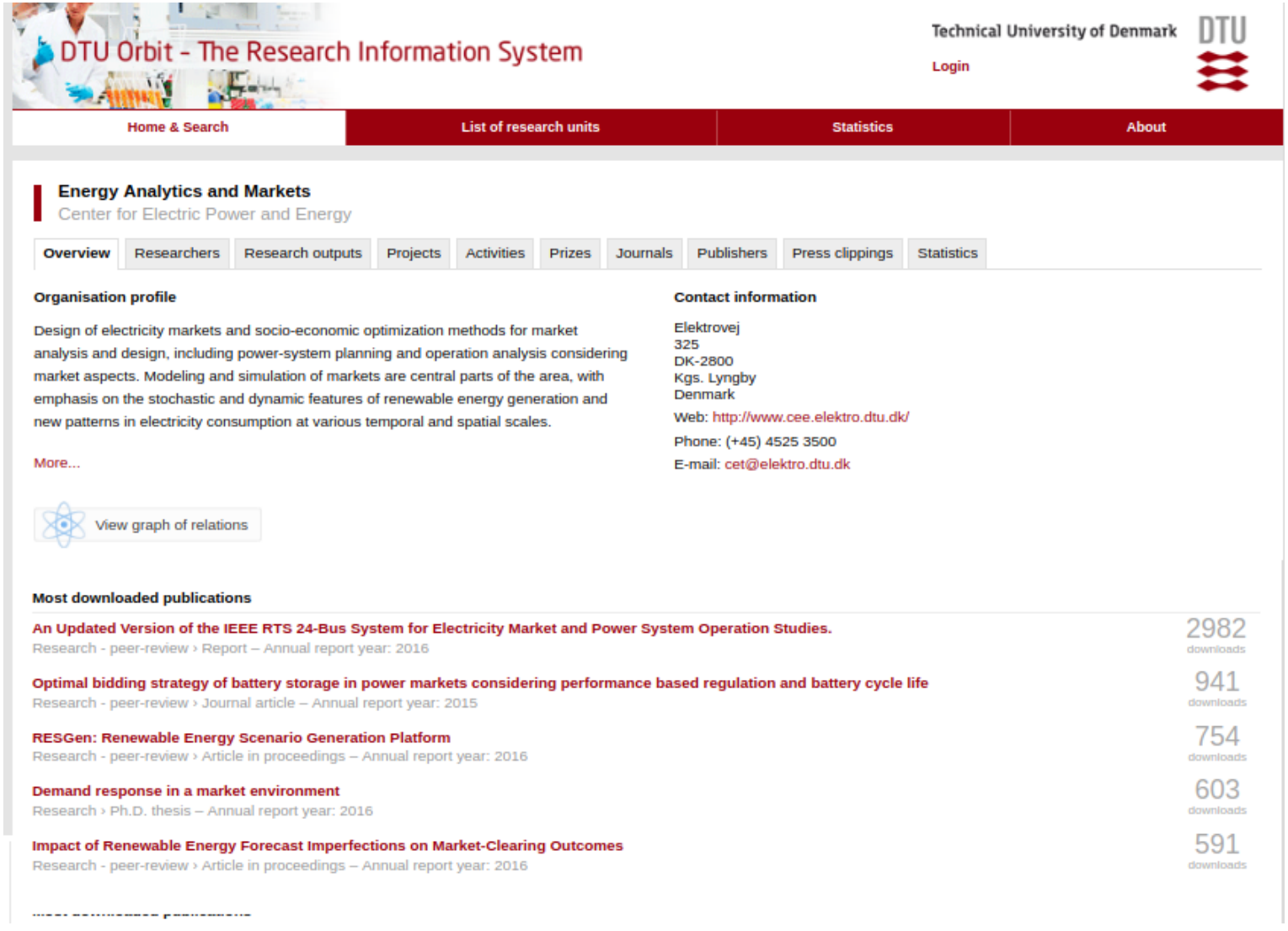
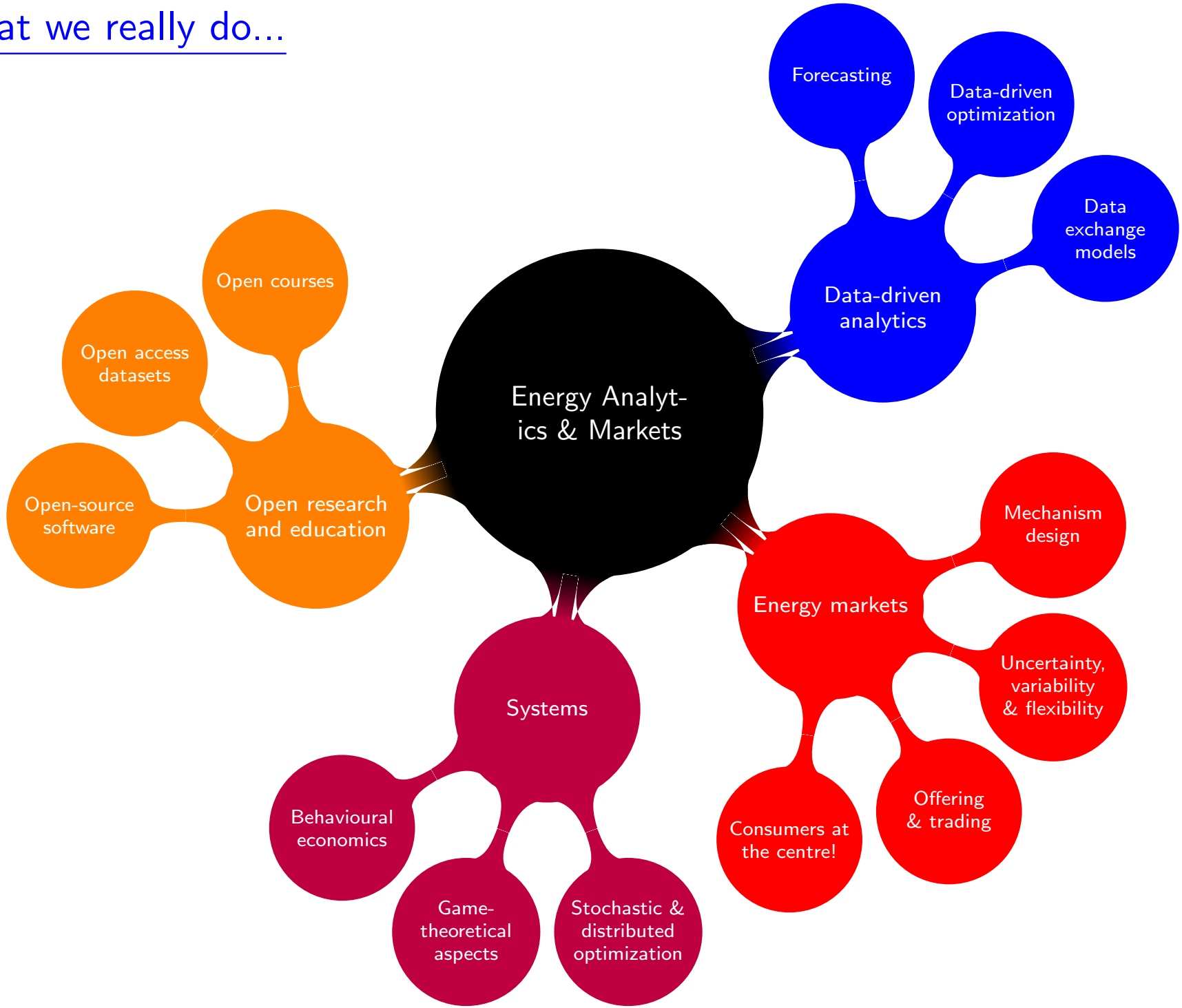
Anecdote 2

Unsuspected impact with open initiatives



1. **When I have to explain what we do...**

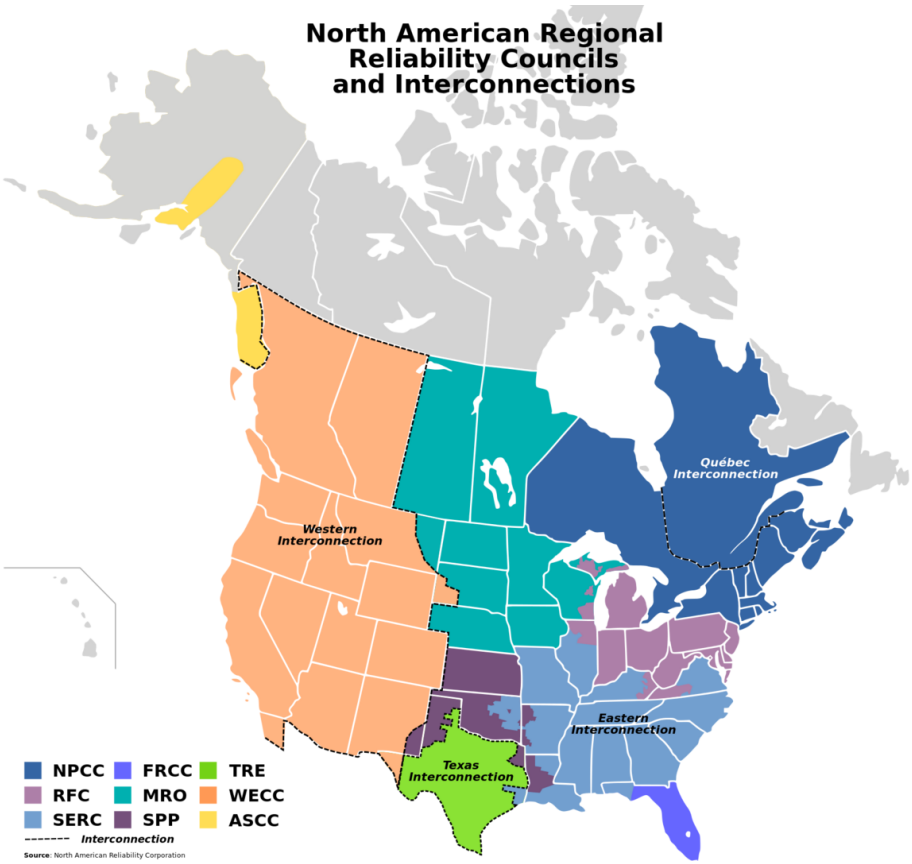
What we really do...

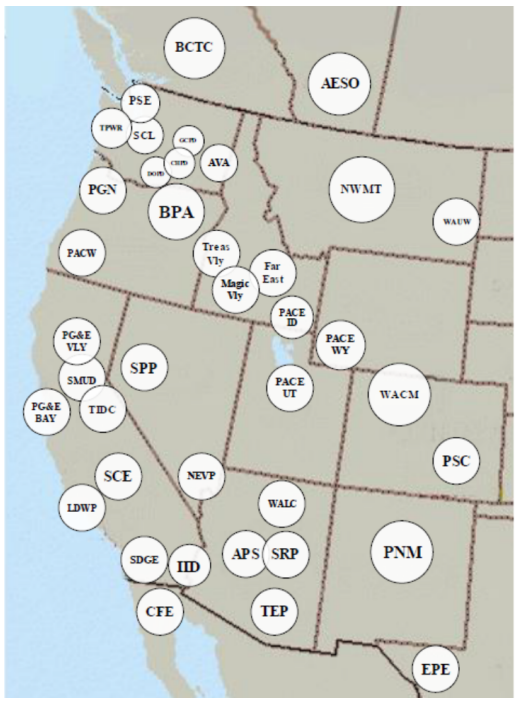


2. **Open research motivating feedback**

RESGen: Renewable Energy Scenario Generation platform

- EPRI, US, sponsored us to produce open-source code to generate space-time scenarios (for wind and solar power):
  - the application area is the whole US Western Interconnection!
  - software used to feed system studies for the US energy system



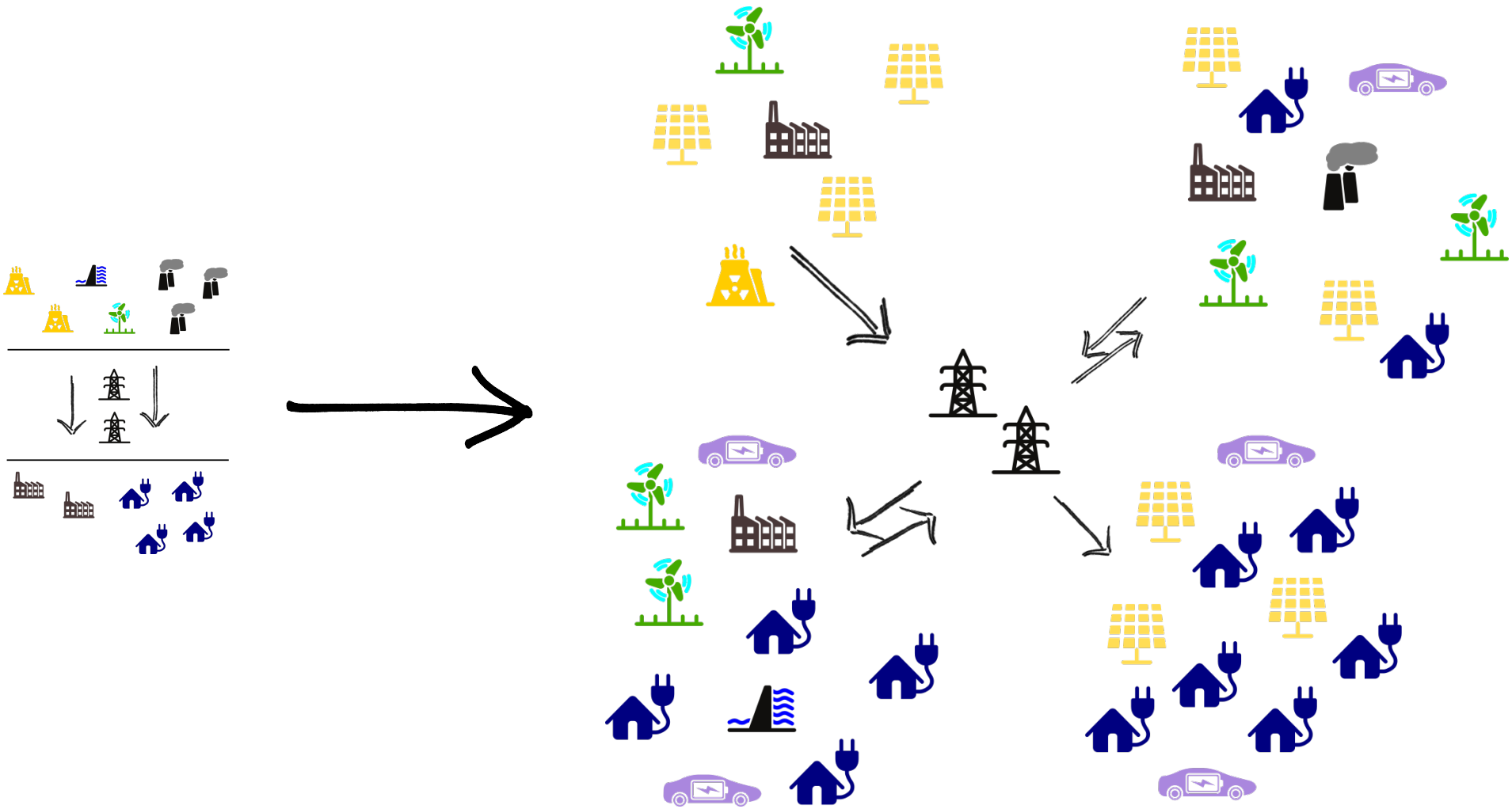


Legend

AESO	Alberta Electric System Operator
APS	Arizona Public Service
AVA	Avista
BCTC	British Columbia Transmission Corp
BPA	Bonneville Power Administration
CFE	Comision Federal de Electricidad
CHPD	Chelan Co PUD
DCPD	Douglas Co PUD
EPE	El Paso Electric
Far East	Far East (Idaho Power)
GCPD	Grant Co PUD
IID	Imperial Irrigation District
LDWP	Los Angeles Dept of Water & Power
Magic Vly	Magic Valley (Idaho Power)
NEVP	Nevada Power
NWMT	Northwestern Montana
PACW	PacifiCorp West
PACE ID	PacifiCorp East – Idaho
PACE UT	PacifiCorp East – Utah
PACE WY	PacifiCorp East – Wyoming
PG&E Bay	Pacific Gas & Electric Bay Area
PG&E VLY	Pacific Gas & Electric Valley Area
PGN	Portland Gen Electric
PNM	Public Service New Mexico
PSC	Public Service Colorado (Xcel)
PSE	Puget Sound Energy
SCE	Southern California Edison
SCL	Seattle City Light
SDGE	San Diego Gas & Electric
SMUD	Sacramento Municipal District
SPP	Sierra Pacific Power
SRP	Salt River Project
TEP	Tucson Electric Power
TIDC	Turlock Irrigation District
TPWR	Tacoma Power
TreasVly	Treasure Valley (Idaho Power)
WACM	Western Area Power Admin Colorado/Missouri
WALC	Western Area Power Admin Lower Colorado
WAUW	Western Area Power Admin Upper Missouri

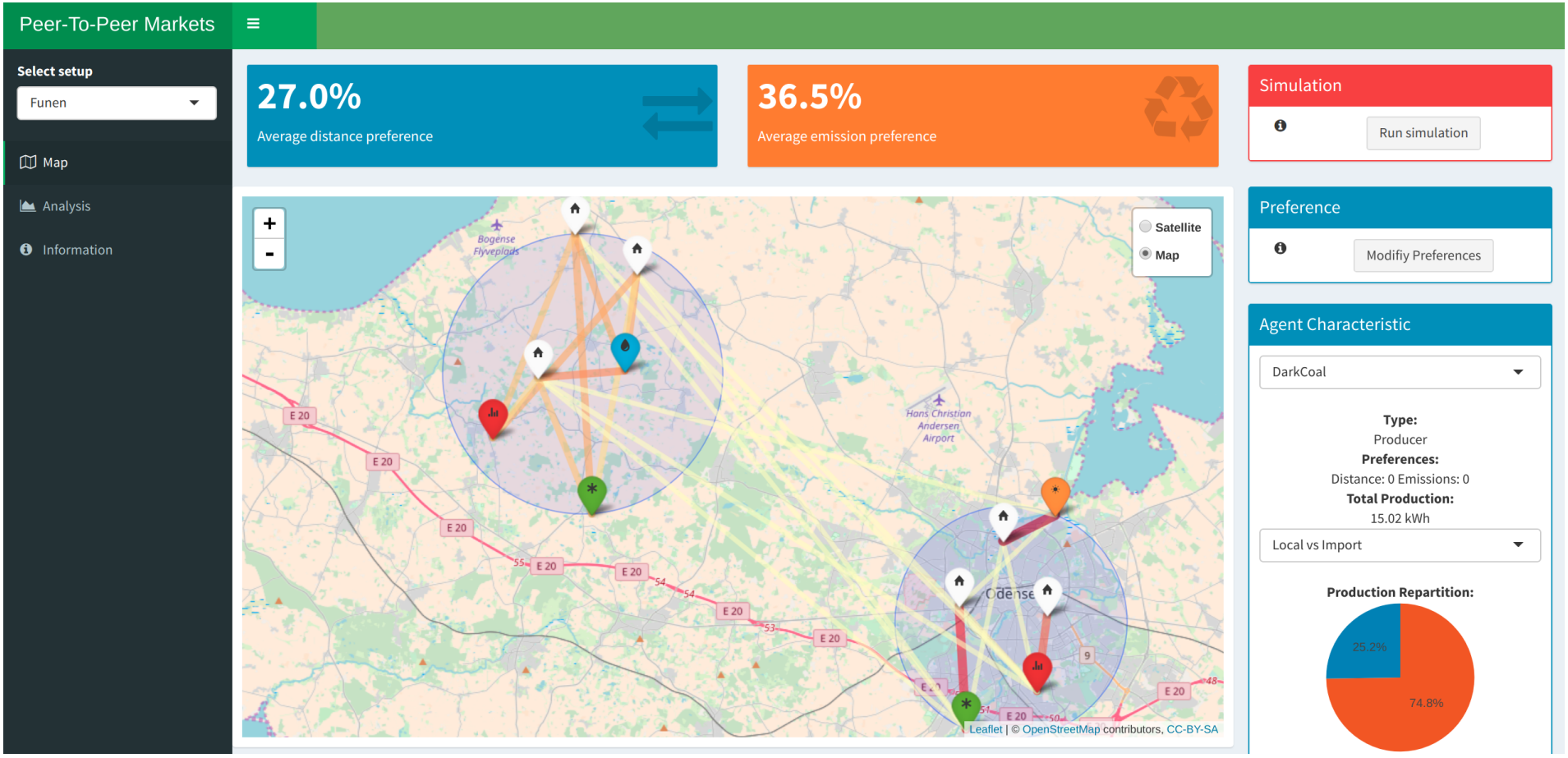
- RESGen is **open-source**: anyone can use it for operational/planning studies, for any test case of interest, or further develop it...

Towards decentralized electric energy systems



Eventually, let's exchange electric energy in a peer-to-peer framework, which may have substantial benefits

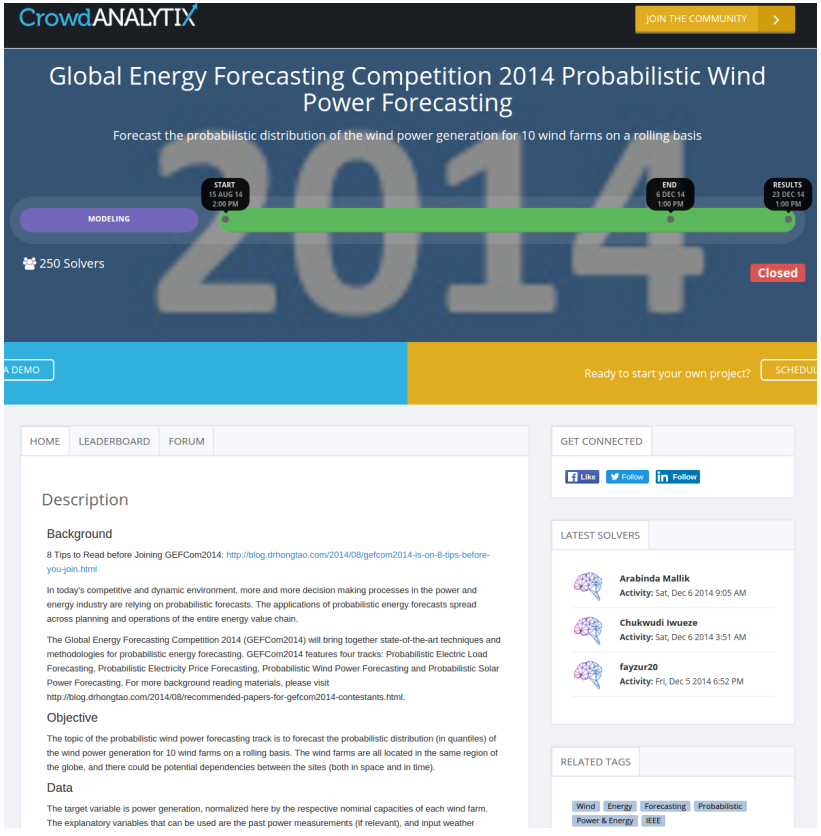
The peer-to-peer electricity market app



https://p2psystems.shinyapps.io/ShinyApp_Project/

3. **Open research based on events**

Organizing open energy forecasting competitions



Another approach to benchmarking and sensing the state of the art... eventually to be brought in the classroom(!)

In practice: impact and challenges

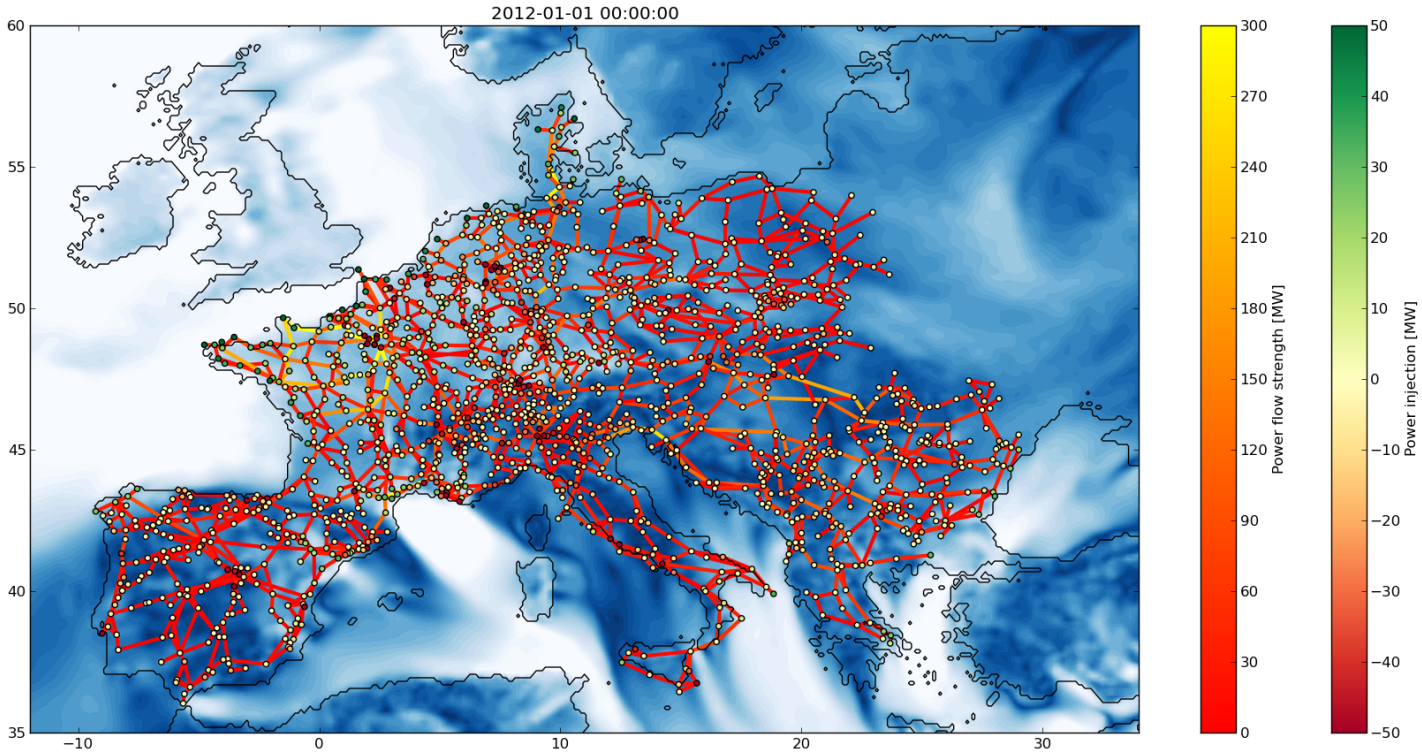
- Let's be frank: **it is *A LOT* of work!** But now:
  - Accepted benchmark cases are out there, with data freely available and well documented (reproducibility, benchmarking, etc.)
  - Methods and approaches employed by top-ranked teams were documented, presented at conferences and published
  - **There is a "before" and "after" GEFCom forecasting competitions**

- We eventually got **600 teams worldwide** to enter the GEFCom 2014 competition
- It allowed for unrivalled sensing of the state of the art in the field
- It led to very strong insights on novel approaches to invest in
- It debunked some myths, e.g., about who would win such competition
- Such initiatives may evolve in very interesting ways...

4. **Pushing data and benchmark case-studies in the open**

A personal objective

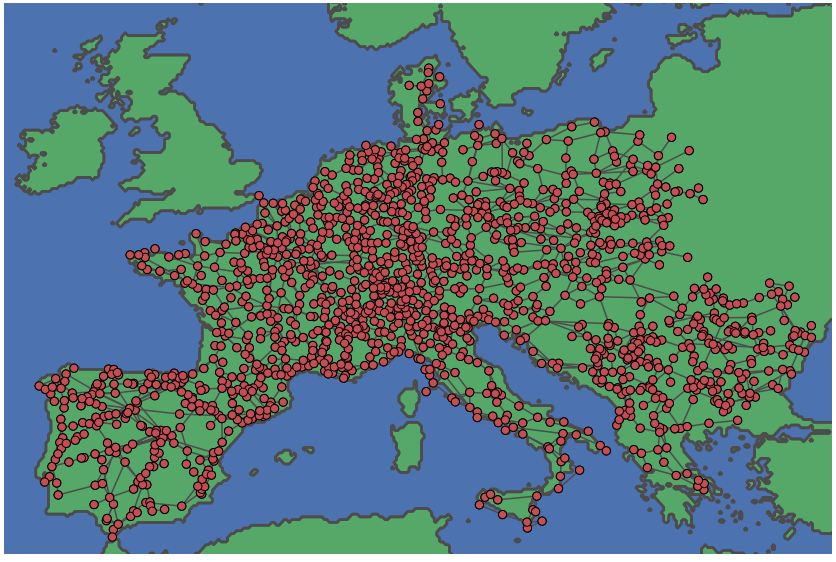
- The **"grand forecasting challenge"**: predict *renewable power generation*, *elastic loads* and *flexibilities* at once for the whole Europe...!

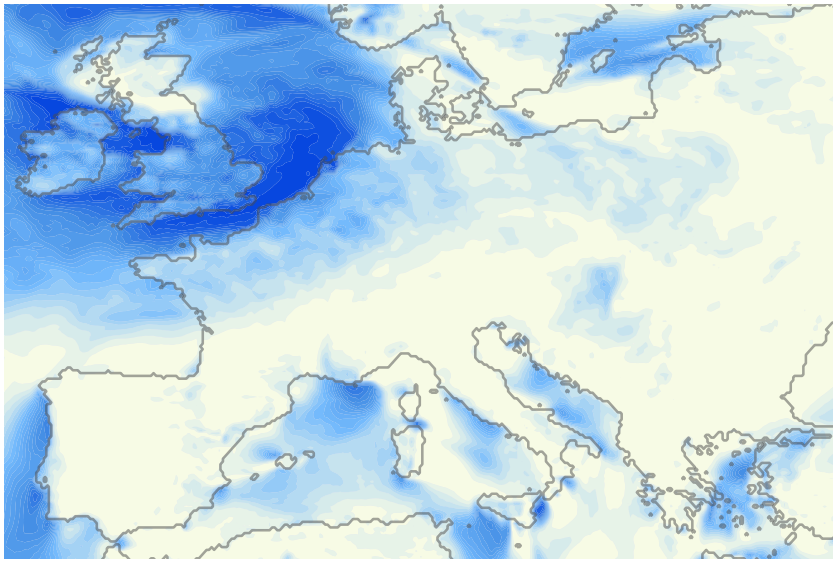


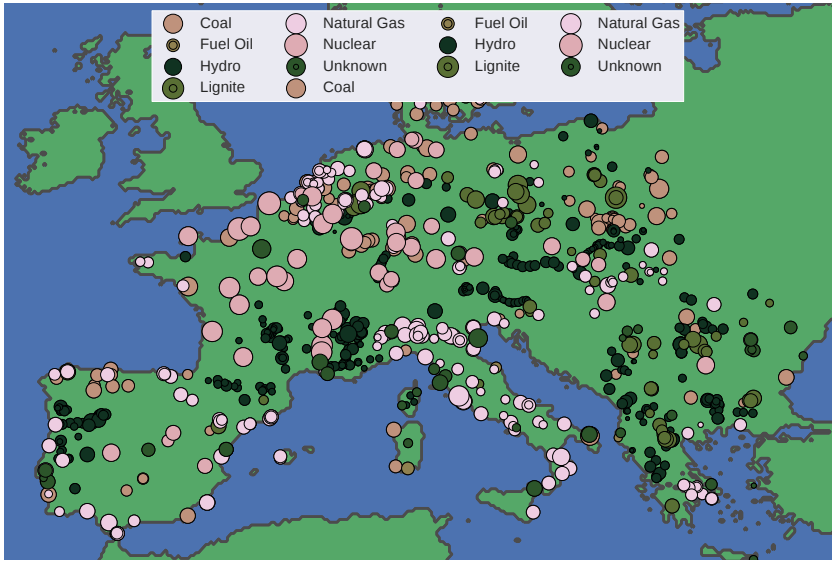
- Innovate for a **highly-renewable and market-based European energy system**, e.g.,
  - Collaborative approach to analytics (distributed learning, data markets, etc.)
  - Accommodating all data streams, heterogenous information in operation and decision processes

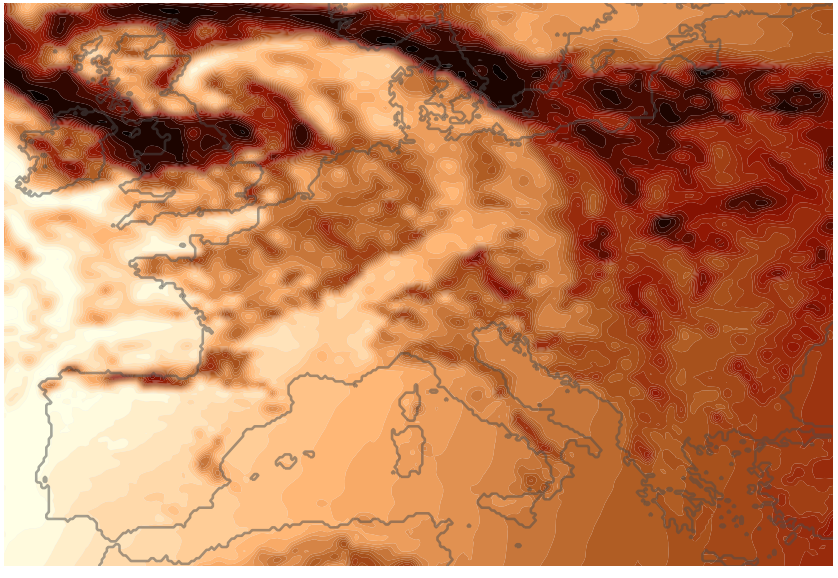
How to get there?

Let us build a (very) large-scale dataset for the whole European system









Available CC-BY! (on `zenodo.org`) with companion paper in *Nature Scientific Data*

Outlook

- Research (and education) is about a **collaborative common** e.g. knowledge, which justifies an **open approach**
- The right environment is there - think of Github/Zenodo, Arxiv, licences, etc.
- The first step(s) may be seen as difficult (requirements from grant givers, licencing, new ways to collaborate, etc.)... but after that **it feels so natural**
- **Be creative**
- The potential **benefits are substantial**, in terms of
  - impact and its strength
  - speed of diffusion of ideas
  - network development
  - possibility to bring research knowledge and material into education
  - etc.

Thanks for your attention!