Solidarities and flexibilities within electrical grids

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Workshop on Demand-Side Management:
Responsive consumers and value of flexibility

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Outline

- Combine theoretical perspectives on the electrical grid with empirical observations
- Electrical grid: central in the energy transition(s)
- Five solidarities: territorial, technical, economic, ecological, sociological
  - The object « electrical grid » is made of heterogeneous knowledge/community of practices
  - Enlarging the analysis beyond technology and market
  - Ecology: economy < human society < biosphere
- Solidarities offer new perspectives on flexibility
  - Co-evolution of usages and grids
  - Energy communities: at which scale?
- Four profiles observed in a study on heat pump users

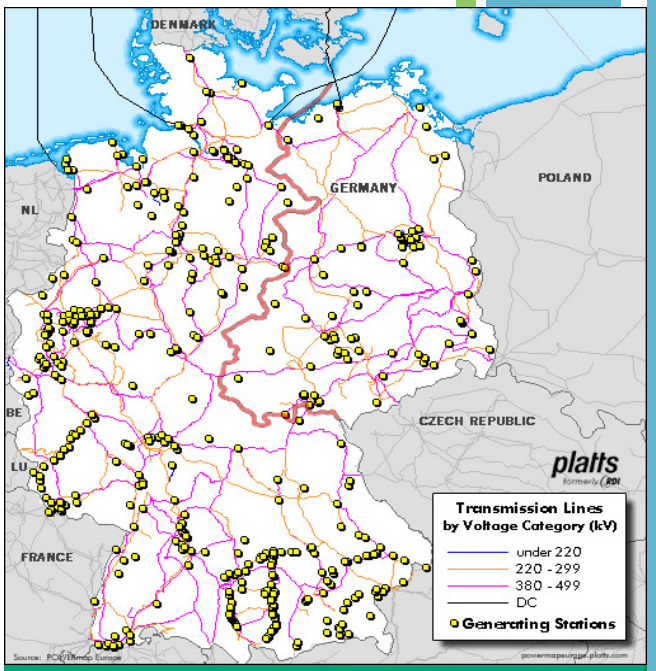
Searching for a concept of “electrical solidarity”

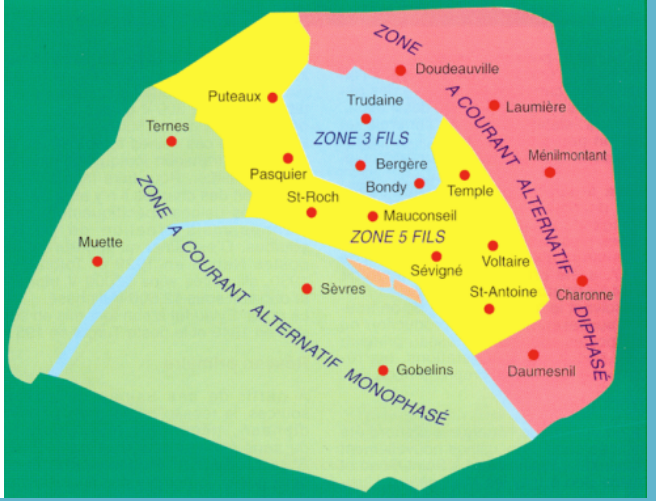
- Several coherent points of view on the grid
  - Selection of relevant entities (specific properties)
  - Ontology: relationships between entities
  - Informed by scientific disciplines or communities of practice (geography, engineering, economics, ecology, sociology)
  - Struggle between ontologies
- Solidarity as a plan of consistency
  - Etymology: community of interests or responsibilities
  - Matter of fact: how entities are held together
  - Unity of action in a given ontology
  - The way a given set of entities are acting together to perform actual relationships
  - Without moral dimension
  - Possibility to sum up electrical activities into figures (indicators)

5 types of electrical solidarity

Territorial solidarity

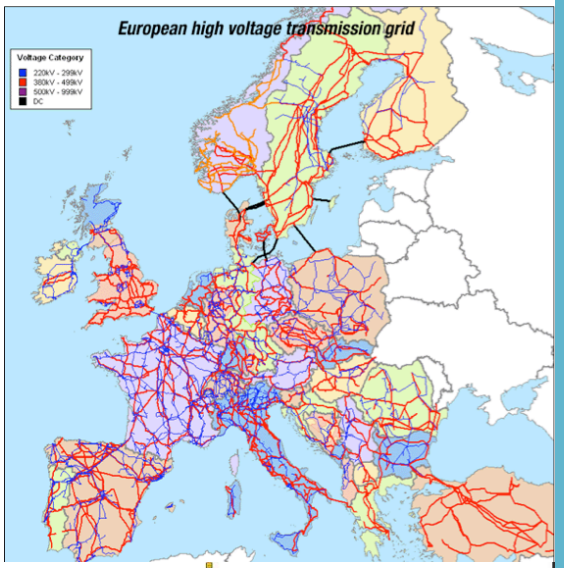
- Territory: area of land under the jurisdiction of a ruler
  - Many possible scales
  - Human and nonhuman activities
  - Specific infrastructures and productions
  - Regional and historical features
- Electrical solidarity: equal access to modernity
  - After WWII in Europe, grid built as a national solidarity (with many regional discrepancies)
  - Development of the grid = modernisation front
  - Challenged by microgrids

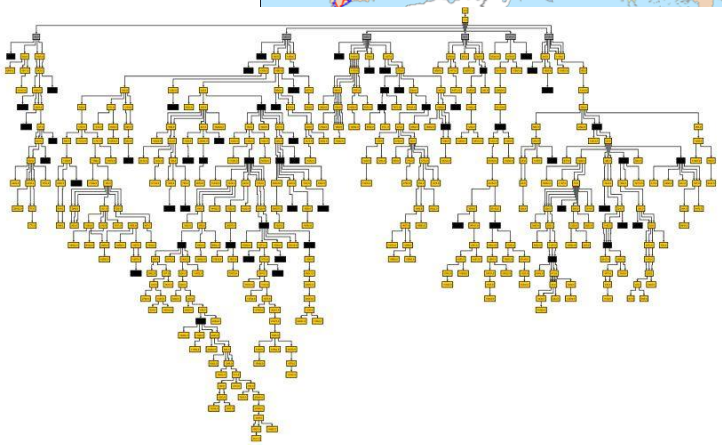




Technical solidarity

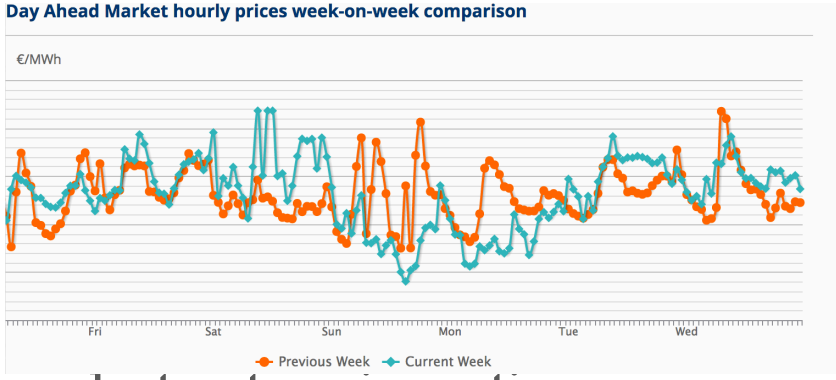
- Engineer's world: machines, cables, infrastructures (incl. their maintenance).
- Achieving balance between production and consumption at all times
  - Automation (capacity reserves)
  - Flexibility: industry integrated
  - TSO coordinates the balance (with BRP)
- Centralised and vertical grid
  - Transport: meshed network
  - Distribution: tree-like network
- Demand is apprehended through forecasts
- Figure of solidarity: 50Hz





Economic solidarity

- Neo-classical ontology:
  - buyers and sellers
  - Maximisation of functions of utility (products) and of production (labour, capital)
  - Relationships: equilibrium on markets, temporary contracts
- Electrical solidarity:
  - Unity of action: market
  - Money flows from consumers to providers
  - Liberalisation performs this solidarity
- Active consumer: change of provider
- Instruments for flexibility
  - Feedback
  - Time of Use
  - Dynamic tariffs (real time pricing)



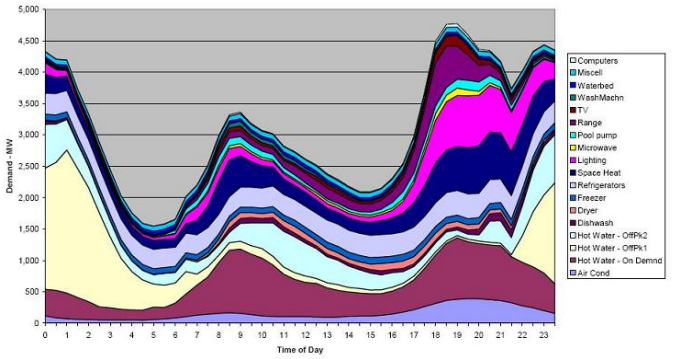
- Figures of solidarity: volumes on markets at a given time.

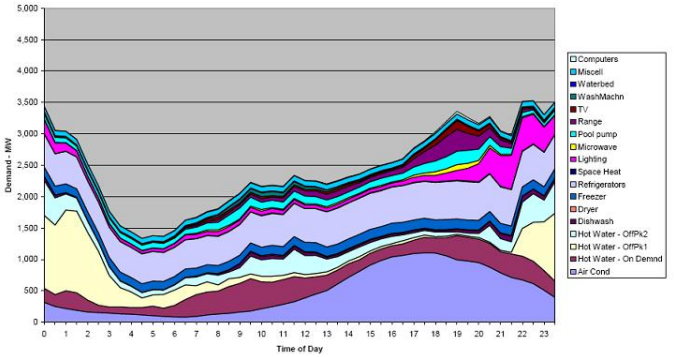
Ecological solidarity

- Ontology:
  - Ecosystems
  - Reproduction of living species
  - Multiple solidarities: ontology of relationships and processes (energy and material flows)
- Electrical solidarity:
  - Objective: fast transition towards 100% renewables
  - Need to decrease the absolute level of energy consumption (in developed countries)
  - Gives limits: adapt demand to available energy (weather forecast)
  - Renewable has priority on the grid (transform generation market)
- Issues:
  - Embedded energy of the transition + other mineral resources (e.g. rare earths)
  - Landscape transformation
- Figures of solidarity: CO2, other material flows

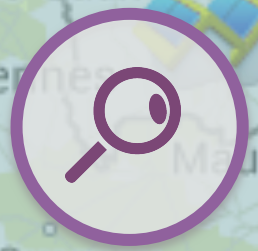
Sociological solidarity

- The grid is inherently collective: cf. profusion of production and consumption that smooths load curves
- Relations between multiple practices through the grid
  - Billions of interconnected objects
  - Rhythms and synchronisation (peaks and valleys)
  - Usage and power associated
- Usage solidarity revealed through provision threat (blackout)
  - Existence of the grid in daily practices
  - Reactions: blackout party, “we are in Africa”
- Prosumer solidarity revealed in local congestions
- Material participation (Marres 2012)
  - Make emerging new publics
  - Reactions to rare and meaningful signals (CPP, Tempo)
  - Greater flexibility (?)
  - Desynchronisation of practices
- Figures of solidarity: instantaneous power (choreography of power), smoothed curves





FLEXIPAC project



- Main objective: to evaluate the potential of flexibility of heat pump use in well insulated buildings.
- Funded by DGO4 (Walloon Region)
- Research team: ULg (BEMS, LCT, LT), HEPL, 3E, Lampiris, Eliosys, ULB (IGEAT).
- Sample composed with 70 households and 15 small businesses which use heat pumps.
- Strong biaises of the sample:
  - Have newly built (big) houses
  - Have accepted smart meters to collect data on their energy consumption and production.

FLEXIPAC's theoretical Framework and methodology

- observe the relationships between technology, everyday life and the environment, notably in using the diverse dimensions of practices (Shove et al. 2012)
- 48 Interviews / 3 Focus groups / 2 Online surveys

Research questions :

- How do households manage their comfort?
- How do they use and control their heating system?
- How do respondents manage their electricity consumption?
- Are they willing to delegate the management of their devices to external operators?

→ Establish a typology : 4 types have been identified

The Economist

"The advantage of PV panels is financial. It is above all this. It is environmentally friendly in second place. I told you it's the dough that changes many people's behaviour. So this means that for me, bah, the advantage is a financial one, is the main criterion. If it would have cost me money without bringing more in, I would have never done it."

- Logic of economic calculation is predominant over environmental practices
- No representation of the grid
- Actions directed towards profitability and comfort
- Actions determined by the maximisation of their utility under budget constraint
- Heat pump shows enough his environmental responsibility
- 20% of the sample

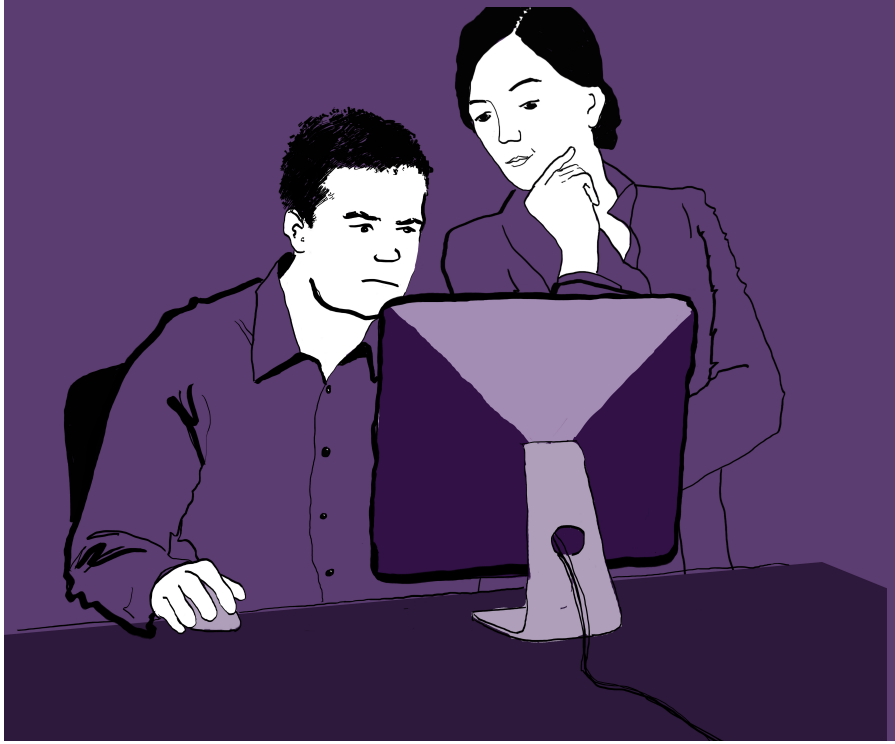
The Environmentalist

« We wanted a clean energy. Well, it was not 100% organic, or ecological. The principle is that we purchase 100% green energy via Lampiris [Belgian supplier]. So, there you have to follow things through their logical conclusion. We heat with electricity via a heat pump, and if we do not always take green electricity … well we do not close the loop. »

- Daily efforts for the environment (collective project, heating, food, electricity, etc.)
- Perception of a large grid
- Logic of economic calculation is weak
- Environmental values prevail over the logic of economic calculation
- Discourse is clearly oriented towards ecological issues
- Interested in energy communities
- 20% of the sample

The Technician

[In front of his heat pump] "At first it was hard to increase the temperature. Here we had set to 5 [load curve]. There were 5 positions to adjust. And I confess that since we are on this curve everything works fine. I haven't touched it anymore. Now I should return to the books if I had to change it. »



- Empirical approach with his heat pump settings
- Has technical capability to control various heat pump programmes
- Look for electricity losses and try to limit them
- Economic calculation also present
- Favorable to automation or autonomy
- 30% of the sample

The Compromiser

« **Husband:** Today we take steps that everyone does not take.
Wife: Yes, but we talk here between a financial impact and a nature/environment impact.
Husband: Both. Yes both anyway. We have always worked like that. You need a good balance between the two. For all our investments. The pump again, if it was twice the price, if it was unaffordable, we would not have done it. It is necessary that soon or later we find our way in the feasibility of the project. »

- Actions are the result of a compromise between economic logic and environmental logic.
- An environmental investment must remain competitive and cost-effective to be implemented.
- Take the environment into account in their actions, but do not adopt measures that they would consider too “extreme”
- Interested in the social solidarity of the grid
- 30% of the sample

Conclusion

- Important criteria for flexibility participation: relationship with the electricity grid, i.e. the kind of electrical solidarity.
- Mainstream smart grid policies focus mainly on Economist and Technician profiles (price and technology): exclude "normal" humans.
- Environmentalist and Compromiser profiles are more committed to a flexible grid, not for financial interest (e.g. energy community), but with more suspicion regarding grids actors.
- Current policies not adapted to 50% of users (of the sample): citizens and communities are poorly considered.
- Need to develop projects that consider "ecologies": plurality of practices and values, and their relationships. (e.g. neighbours on the same feeder).
- Dominant ontologies are performative →How to make ecological and sociological ontologies more performative?
  - No need of smart meters everywhere to perform them

Thank you for your attention

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