

The Energy Justice Tool Suite

an interdisciplinary and comprehensive method
for energy transition territorialization

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- Assessment: how to **implement the energy transition** in the field of **thermal building renovation** ?
 - through territorialized **public policies**
 - **despite the non-adherence** of the **users or prescribers**
- **Tensions** posed in a **compartmentalized way**:
 - either **through technology, public action or participation**,
 - or **in a normative way** by neglecting the constraints of past energy and economic choices

- Research based on:
 - an **interdisciplinary** approach
 - combining **spacial** sciences, **social** sciences and **engineering** sciences
- aims to **co-construct an inclusive territorialisation of the energy transition**, which will bring about energy justice, by presenting:
 - the **French context** of the territorialisation of energy public action
 - the **technical and socio-economic challenges** of the fight against fuel poverty linked to housing
 - the **methodology** that the project team wishes to set up and test on two complementary fields of study

- **Fuel poverty** (Guyet, 2015)
 - affects nearly **6 millions people** in France (ONPE, 2017)
- We are working on two areas of observation and experimentation:
 - Grenoble-Alpes Métropole
 - the agglomération de la region de Compiègne

I. The territorialisation of energy action in the French context

- Kyoto Protocol:
 - France has committed itself to reduce its greenhouse gas emissions by a factor of **4** (MEDDE, 2013)
- Actions:
 - **territorialization** of energy action, through **local and regional authorities** (Bertrand and Rocher, 2011, Chanard, 2011, Godinot, 2011, Theys and Vidalenc, 2011, Bertrand and Richard, 2014, Durand *et al.*, 2015, Poupeau, 2016)
 - **scenarios** for energy transition in cities, **linking actors, regulations and technologies** (Debizet and Dupuy, 2015)

- **Territorial public action** is facing **difficulties**:
 - working on the **real energy efficiency of urban forms at the scale of a city** - and not just at the building scale (Maïza, 2007, Arantes *et al.*, 2016)
 - reporting on fuel poverty, **on a small scale, through indicators and criteria** (Devaliere and Teissier, 2014, Charlier *et al.*, 2015, Thomson *et al.*, 2017)

II. Fuel poverty and its interdisciplinary modelling

- **Modelling** the question of fuel poverty and its counterpart in **energy justice** (Guyet, 2015)
- **Fuel poverty** depends on:
 - forms of governance at the territorial level
 - the role of institutional actors, companies prescribing technical solutions, and ordinary citizen-users(Heffron and McCauley, 2017 Jenkins *et al.*, 2016)

- **Identifying household's fuel poverty** depends on:

- Poor thermal quality of housing
- Low incomes

(Devalière, 2007, Réseau RAPPEL, 2011, Charlier *et al.*, 2015)

⇒ Poor housing insulation increase the risk of fuel poverty

⇒ **Thermal renovation of buildings**: increase the quality of energy services, plus fight against climate change (Dubois, 2007)

⇒ Important to **identify priority geographical areas** with homogeneous areas of high energy loss, as well as a high percentage of vulnerable people

(Devaliere, 2008, Molines and Henriot, 2017a, Molines and Henriot, 2017b, Molines and Henriot, 2019)

- **Modelling of energy losses (1/2):**
 - Offers concrete **quantitative support** to decision-making (Caputo et al., 2013)
 - carried out at two different scales:
 - the **building scale modelling** (well-developed scientific field)
 - TRNSYS (Beckman et al., 1994), Energyplus (Crawley et al., 2001), Pleiades-Comfie (Peuportier et al., 1990)
 - the **neighbourhood or city scale** (emerging field of research)
 - such as Citysim (Robinson et al., 2009)
 - Some models combine building scale energy modelling with urban modelling
 - (Thomas et al., 2014, Martins et al., 2017, Wang et al., 2017, Osterbring et al., 2018)

Using consumption monitoring and GIS data as input for CitySim

Use : multi-scale energy forecasting

Goal : guide public-funded residential retrofits in Compiègne (France)

City or regional scale



Public-owned GIS data (real estate files)



Categorization of buildings based on age, height, materials



CitySim simulations for each typology



Results visualization in GIS



Zone 1



Zone 2

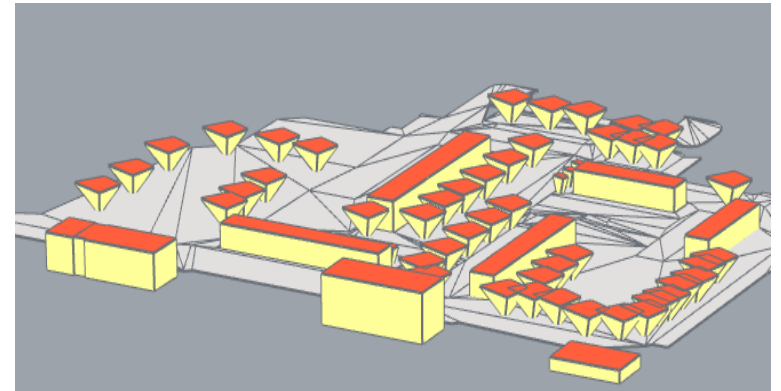


Neighborhood scale

Existing consumption monitoring + construction materials



Simulation results for several neighborhoods



Results comparison between the 2 methods



Retrofitting scenarios

- **Modelling of energy losses (2/2):**

- models require the construction of geometric and non-geometric data
 - The most commonly used data models are building information models (**BIMs**), used for **individual construction simulations**
 - Geographic information systems (**GIS**), generally based on 3D technology, for **assessing larger territories**

(Bahu *et al.*, 2013, Wate and Coors, 2015, Nowacka *et al.*, 2018)

- non-geometric data can be retrieved in two ways
 - Data can be **collected, in real time, from sensors**
expensive and very localized
 - Typology of different urban forms, **building archetypes** (Sousa Monteiro *et al.*, 2015, Ali *et al.*, 2018), for urban-scale energy modelling
focus on national archetypes, instead of local ones (Ali *et al.*, 2018)

III. Our case studies: Grenoble and Compiègne:

areas of observation of fuel poverty

areas of experimentation with energy justice

- **Grenoble « laboratory » specificities (Ambrosino and Novarina, 2015):**
 - role and place of the university actor
 - A laboratory of local democracy
 - Local urban projects based on:
 - inhabitant participation
 - search for quality of life around the environmental issue and the vision of a post-carbon city (energy and mobility)
 - Mur|Mur2 thermal insulation campaign (2016-2020)
 - Fieldworks:
 - District of Bonne EcoQuartier
 - Requalification of the district of Presqu'île scientifique

- **The region of Compiègne (ARC)**

- 21% poverty in Compiègne city (INSEE) and 73% of the public social housing stock of ARC
- **Aerial thermography // socio-economic GIS analysis** (Molines and Henriot, 2017a, Molines and Henriot, 2017b, Molines and Henriot, 2019)
 - Priority intervention area + ultra-priority intervention area
 - Based on aerial thermography campaign results + socio-economic datas via GIS
- "Positive Energy and Green Growth Territory" (TEPCV)
- "Energy Renovation Platform" < ADEME
- Fieldworks:
 - The Royaumont Linières district in Choisy au Bac (individual housing in peri-urban areas)
 - The Aramont and Pierre Lamaresse districts in Verberie (individual housing in peri-urban areas)
 - The district of the great Gardens in Compiègne (a little individual but especially private collective and social landlord areas)
 - The Venette district (joint housing in peri-urban areas)

IV. ENERGY JUSTICE TOOL SUITE

⇒ **to evaluate the partnership process** of energy efficiency of buildings and their stakeholders

⇒ **while developing a modelling, decision-making and consultation tool** to assess the efficiency and cost of the proposed scenarios

⇒ **ENERGY JUSTICE TOOL (1/2):**

⇒ **diagnostic of the fuel housing poverty**

⇒ will provide decision-makers with a new tool for understanding their territory

⇒ **political decision-making processes**

⇒ to analyze the technical and managerial implementation of these decisions and to question the socio-economic logics involved

⇒ the sets of actors involved in these processes, their postures and needs to validate their capital of “responsible citizenship”

⇒ ENERGY JUSTICE TOOL (2/2):

⇒ Interoperable and interdisciplinary multiscalar model

⇒ Based on "archetypes of complex systems" (Vorger, 2014) of multiscalar energy systems, combining:

⇒ **physical phenomena** (real energy performance, socio-economic statistics of INSEE data at the IRIS and INSEE grid scales - which is unprecedented)

⇒ **and human behaviour** - by integrating not only users, but also the whole ecosystem working for energy and socio-territorial justice, and from an empowerment perspective

⇒ Development of an open-access and **collaborative database of urban typologies**

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