New methodological approach for planning cities sustainable and resilient energy futures – the case of the InSMART project

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Rocco De Miglio, E4SMA
Email: rocco.demiglio@e4sma.com
Brings together cities, scientific and industrial organizations.

Establish and implement a comprehensive methodology for enhancing sustainable planning (focusing on energy).

Integrative and multidisciplinary planning approach.
- Specialized tools and models:
  - Comprehensive GIS energy database
  - Building simulator
  - Transport simulator
  - Technology explicit planning model (cost-optimal mix of measures)
  - Multi-criteria decision making method

Outputs:
- integrated analysis of the mid-term measures,
- applicable mid-term implementation plan (the necessary steps, required resources and monitoring procedures) at city level.

Key words: integrative / participatory / multi-model
InSMART cities

- Nottingham
- Evora
- Cesena
- Trikala
Work Packages

WP1: Development of the city’s GIS platform on energy use and needs
Analyse the current status of the cities’ energy strategy and data availability, design and conduct city specific surveys and develop a GIS energy database for each city.

WP2: Analysis of the city building stock
Provide the necessary techno-economic input for the energy modelling of the building sector in each city.

WP3: Transport and mobility analysis
Analyse the transport and mobility system of each city, identify possible measures for energy saving and sustainable transport and propose actions for further investigation.
Work Packages

WP4: Analysis of the cities’ energy systems and networks
Analyse the current status of urban spaces, water/sewage system, waste chain and decentralised energy supply at city level, identify applicable technical solutions and develop the GIS energy database for each city.

WP5: Integrated planning tool for the development of Strategic Sustainable Energy Plans
Develop city specific energy system models in order to optimise the system’s path towards sustainability targets identifying the economically optimum mix of the measures. Multi-criteria approach taking into account stakeholders’ and decision makers’ input.

WP6: Development of mid-term Implementation Action Plans
Analyze further the economics of the mid-term sustainability measures and develop realistic and feasible implementation action plans indicating specific capacity needs at city level.
### City: geographical representation

<table>
<thead>
<tr>
<th>City sectors</th>
<th>Blocks</th>
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<tbody>
<tr>
<td><img src="image1" alt="City sectors" /></td>
<td><img src="image2" alt="Blocks" /></td>
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<table>
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<tr>
<th>Road segments</th>
<th>Individual buildings</th>
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<tr>
<td><img src="image3" alt="Road segments" /></td>
<td><img src="image4" alt="Individual buildings" /></td>
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</table>

This platform is used to supply all the thematic models that are developed for the participating cities and to visualize and analyse the results.

Key: identification of the basic geographical entities zones that may represent the geographical distribution of the information (according to the planning criteria).
City: geographical representation

WP2
Players: households

WP3
Players: households / public bodies /.....

WP4
Players: public bodies

Supply (centralised)
Building analysis

Survey/Analysis

Simulation

Synthetic stock
Zone (i) – Node of the graph

Fraction of occupied surface (m²) by "actor"

Share of space heaters by type, share of electricity consumption by service, share of PV over the total PV stock

\[ X_{Zone_i} = \sum_{actor=1}^{n} X_{actor} \]
Residential building stock

Retrofitting scenarios in order to calculate the potential energy saving were examined for each typology (roof, external walls, windows)
Transport analysis

Movements between model zones

<table>
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<tr>
<th>All Purposes</th>
<th>Centro Urbano 2</th>
<th>Fiorenzuola</th>
<th>Cerro Sordo 1</th>
<th>Otro Sordo 2</th>
<th>Cerro Sordo 1</th>
<th>Dire Sordo</th>
<th>Ravennate</th>
<th>Distigano</th>
<th>Centro Urbano 1</th>
<th>Valle Seco</th>
<th>Borelo</th>
<th>Rubicone</th>
<th>Al Mare</th>
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Transport analysis

Technology options

Energy form 1
...
...
Energy form n

Private vehicle stock

From zone “i” to zone “j”
...
...

From zone “i” to zone “k”

Zone “i”

Detached [000dwellings]

Semi-Detached [000dwellings]

Flat [000dwellings]

Energy form 1
...
...
 ...

Energy form n

Private vehicle stock

From zone “i” to zone “j”
...
...

From zone “i” to zone “k”

→ Cross-sectoral integration!
Municipality: key actor of energy governance

Modes of Governance in the energy sector
- Regulator and planner
- Consumer (behaviour of the municipal administration)
- Supplier of energy (and services)
- Support and information

- New district in the city (all buildings in class B + district heating)
- Standards on refurbishment measures in the building sector
- Production / Consumption of a certain fraction of electricity from RES
- Development of new bike lanes
- Creation of new bus stops / and new bus between zone “y” and zone “k”
- Reorganization of school schedule
- 10% of work from home for Municipality workers
- Communication campaigns on efficiency and renewable development
- ……..

→ different combinations of actions generate “Alternative planning hypotheses”
Model allows the exploration of a set of alternative planning hypotheses, with an explicit representation (till 2030) of energy flows, technology and measures, costs, and emissions.
City ESM – Results (examples)

Savings by component

Savings by building type

Electricity consumption by zone - Scen X

Shift in electricity demands
Stakeholders engagement
Criteria (MCDA)

- **C1**: Energy consumption in the building sector. Quantitative.
- **C2**: Total CO2 emissions. Quantitative.
- **C3**: Total particulate emission. Quantitative.
- **C4**: Investments (and maintenance) costs. Quantitative.
- **C5**: Onsite production of energy. Quantitative.
- **C6**: Indicator of private vehicles dependency (private vehicles movements: cars, moto). Quantitative.

- **C7**: Aesthetics/architectonic integration of technologies and infrastructures (green areas, land use,…). Qualitative.
- **C8**: Complexity of implementation of the strategy (licencing procedures, consistency with laws and regulation, administrative approvals). Qualitative.
- **C9**: Local development (e.g. job creation. A 5-points scale ranging from “long-term & highly skilled job” to “short-term & low skilled job”). Qualitative.
Conclusions

- The specific interventions identified by the “planning tool” will form the technical part of each city’s Sustainable Energy Action Plan.

- Urban planning and energy planning are carried out together in an integrative manner, making use of ad-hoc models.

- Participation of the Municipalities and of a broad stakeholder group is the “key”.
Thank you!

De Miglio R. (a), Chiodi A. (a), Simoes S. (b), Long G. (c), Pollard M. (d), Gouveia J.P. (b), Gargiulo M. (a), Giannakidis G. (e)

(a) E4SMA S.r.l., Turin, Italy
(b) CENSE, Faculdade Ciências e Tecnologia, Universidade Nova de Lisboa, Lisbon, Portugal.
(c) University of Nottingham, Nottingham, United Kingdom
(d) Systra Consultancy, United Kingdom
(e) Centre for Renewable Energy Sources and Saving (CRES), Athens, Greece