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INTEROPERABILITY FOR COGNITIVE CITIES

BY&FORCITIZENS
European Conference on Smart, Sustainable and Resilient Cities

Agenda

Introduction
Background
Interoperability
Organisational interoperability
Semantic Interoperability
Conclusions

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European Conference on Smart, Sustainable and Resilient Cities

Introduction

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- Mondragon University
  - Part of MONDRAGON Corporation (world leader in the co-operative movement) 74.335 people and 260 cooperatives
  - 4 faculties with 4000 students (22 degrees and 15 Master)
  - Faculty of Engineering (9 degrees and 5 Master)
  - Close ties with industry (Research and Knowledge Transfer)

75 urte jakintza sustatuz etorkizuna eraikitzen

- European Projects (IoT, Smart Cities)
  - System integration and interoperability
  - Data platform provision
  - Data analysis
  - Application development for human interaction
  - UCD Methodologies, …

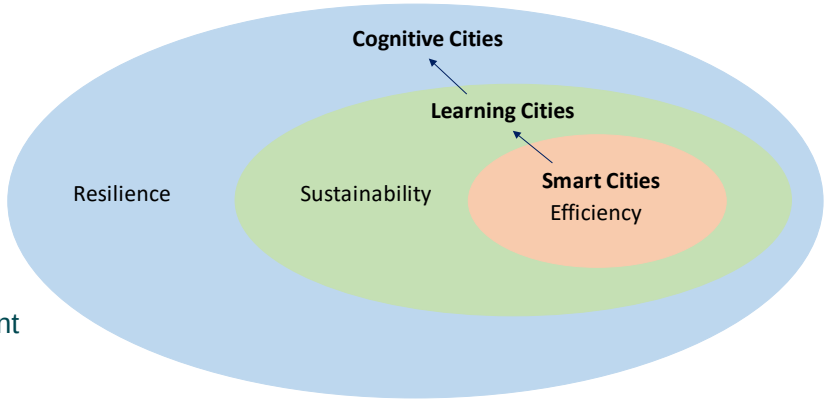
CITyFiED RepliCable and InnovaTive Future Efficient Districts and cities

RENNOVATES

smart en city

Background

- Smart Cities
  - Optimize infrastructures, making possible an **efficient** use of resources simplifying life for citizens.
- Learning Cities
  - Address **sustainability** challenges (environmental, economical, social)
  - **Human involvement** (not only technical)
  - Suggestion of actions to change management behavioural patterns

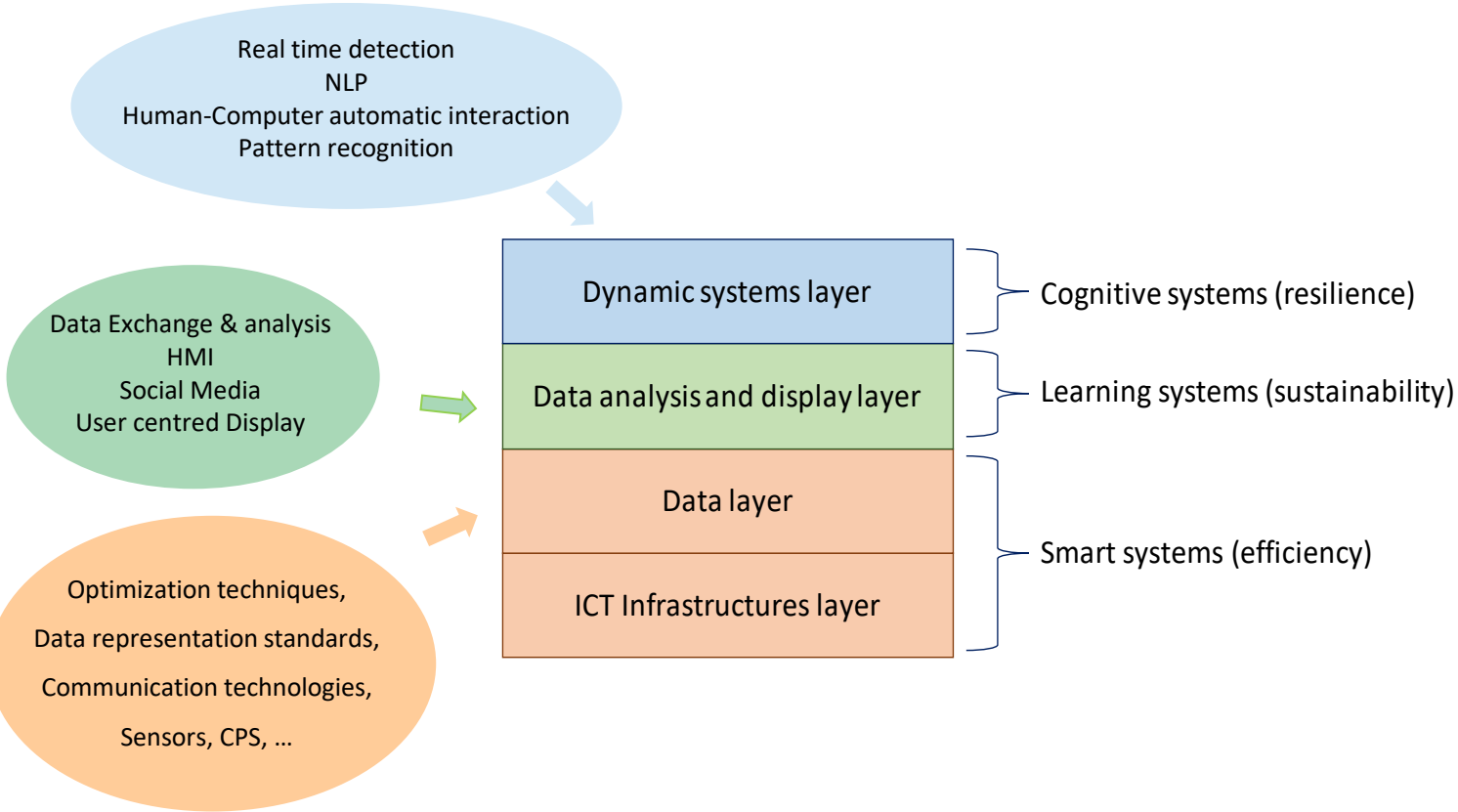


Cognitive Cities

Cognitive cities are those capable to predict and react to disruptive changes or natural disasters. They must address **resilience** challenges.

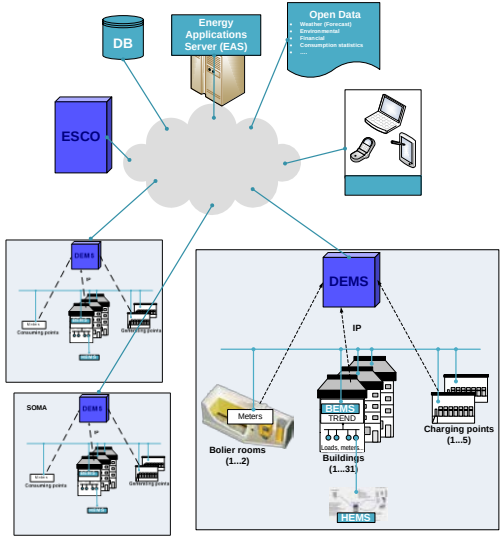
Matthias Finger and Edy Portmann. What are cognitive cities? In Towards Cognitive Cities, pages 1–11. Springer, 2016.

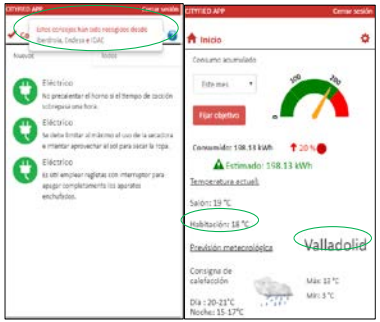
Background (Cognitive Cities)

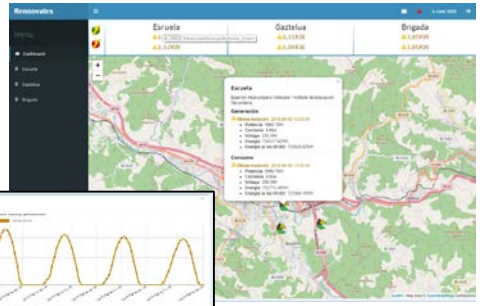


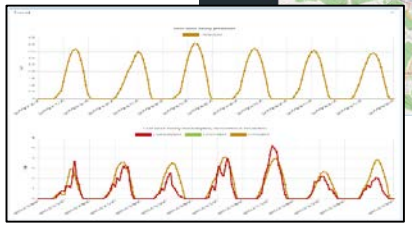
Background

Efficiency









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Objective and requirements

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Overall objective

- Learn from different urban environments and assist actors in changing their behavioral patterns and adapting to disruptive changes in collaboration with humans.
- Exchange, extract knowledge and make decisions about different domains for large volumes of data collected at high rates and in most cases in real time

Specific requirements

- Overcome technological and organizational silos
- Reduce the complexity brought by heterogeneous technologies
- Create models of urban data for different domains
- Represent and exchange data in a standardized and machine-readable way

Interoperability

Interoperability

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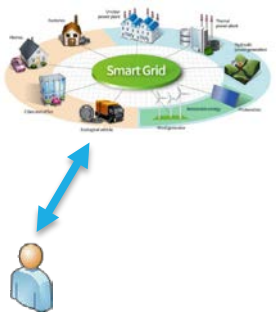
Interoperability

The ability of two or more systems or components to exchange data and use information.

3rd Generation Partnership Project

- There are four types of interoperability:

1. Technical interoperability → hardware/software
2. Syntactical interoperability → data format
3. Semantic interoperability → meaning of data
4. Organizational interoperability → data exchanged among organizations

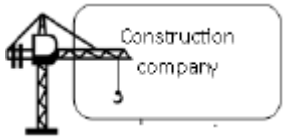


Hans van der Veer and AnthonyWiles. Achieving technical interoperability. European Telecommunications Standards Institute, 2008.

Organizational Interoperability

building stock

stakeholders



competitors

norms & regulations

Key factors

Cost

ROI-Funds

Legislation

…

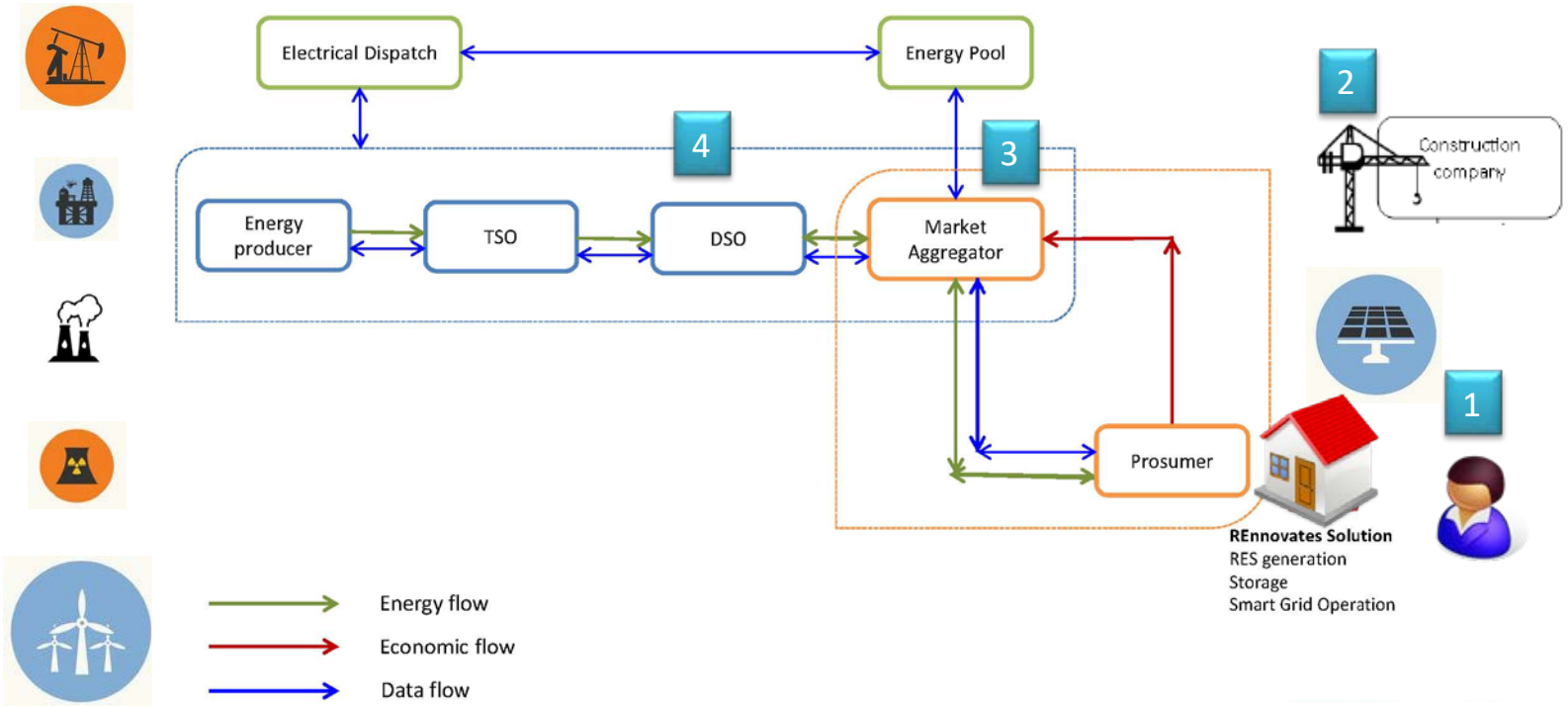
Technology

…

People

Collaboration (win-win)

Organizational collaboration example



Semantic Web

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Semantic Web

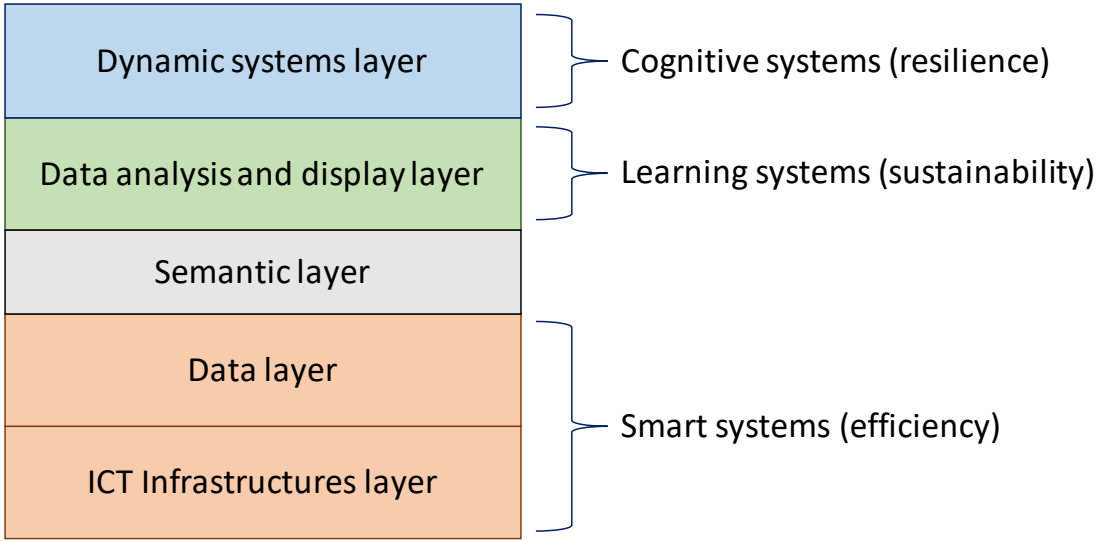
An extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.

Berners-Lee et al.

- Describes **content**, **meaning** and data **relationships**.
- The content on the web is structured as in any database, creating the **Linked Data**. Data can be linked across different domains, eliminating data silos.
- **Link**, **exchange** and **process** data on the Web in a standardized, as well as **machine** and **human-readable** way (reduce complexity and increase machine-human interoperability)
- Humans can communicate with machines using a common vocabulary, a common set of rules and even natural language. (Ontologies)
- Machines are capable of inferring knowledge from explicit facts (intelligent agents).

Tim Berners-Lee, James Hendler, Ora Lassila, et al. The semantic web. Scientific american, 284(5):28–37, 2001.

Semantic Layer

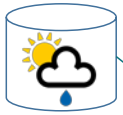


- Provides a bridge between Smart systems and Learning systems and Cognitive systems.
- Key requisite in the Smart Cities evolution process towards Cognitive Cities

Cuenca, J., Larrinaga, F., Eciolaza, L., Curry, E.: Towards cognitive cities in the energy domain. In: Designing Cognitive Cities: Linking citizens to computational intelligence to make efficient, sustainable and resilient cities a reality. Springer,In press (2018)

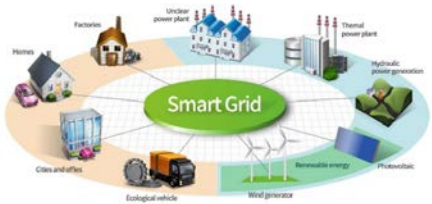
Analysis (Energy Domain)

Energy data domains



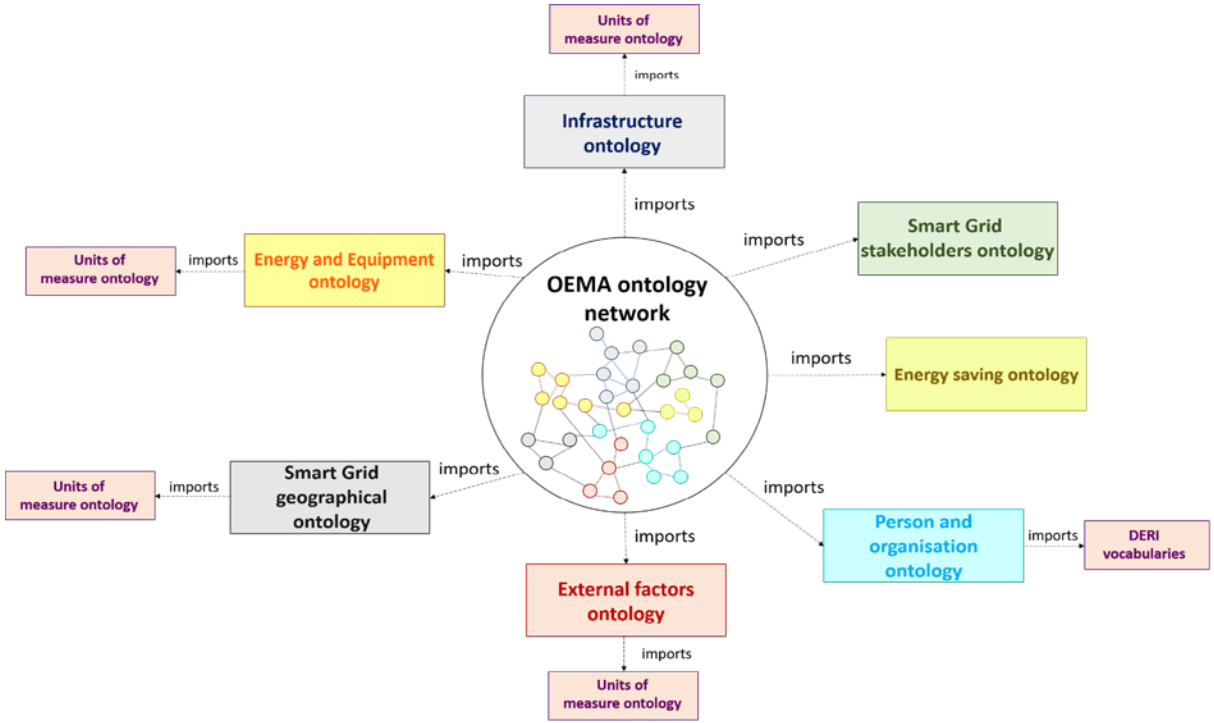
Learning/cognitive systems

Human-machine interaction



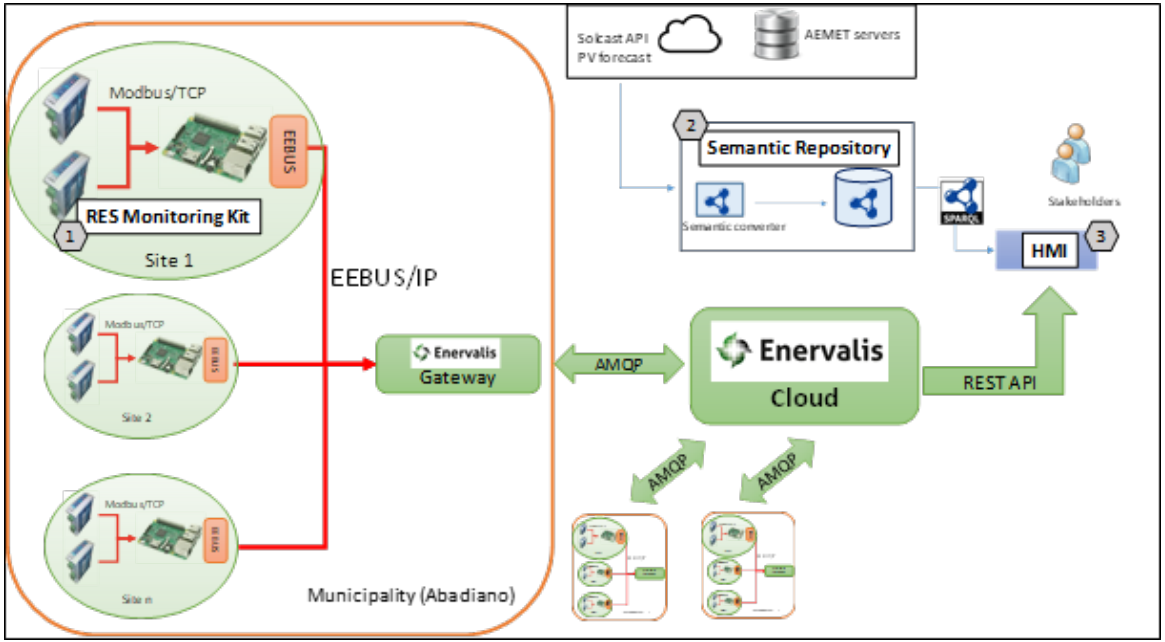
- Energy assessment
- Power outage reaction
- Demand response
- …

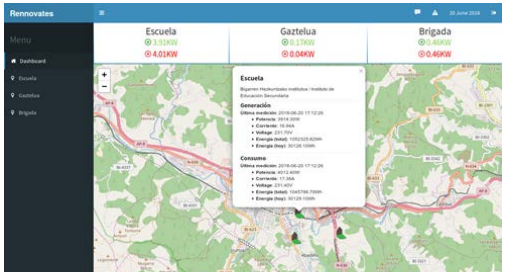
Ontology advantages

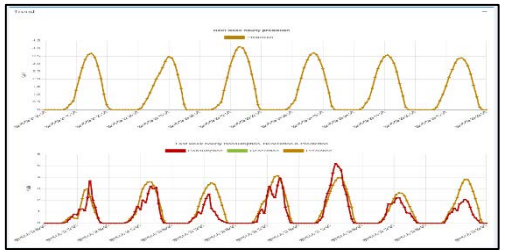


OEMA ontology www.purl.org/oema/infrastructure
J. Cuenca, F. Larrinaga, E. Curry "A Unified Semantic Ontology for Energy Management Applications" 2nd International Workshop on Ontology Modularity, Contextuality, and Evolution (WOMoCoE 2017). Vienna. 21-25 October

Implementation (projects)







Ontology: http://www.purl.org/dabgeo

Conclusions

- Find room for collaboration among stakeholders (win – win)
  - Involvement of financial entities
- Technological platform must be prepared for the future
  - Today technology improvements focus on optimization (Efficiency)
  - Interoperability and standardization (semantics key)
- Identify the challenges to overcome

Conclusions (Challenges vs solutions)

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- Long ROI periods vs Short ROI periods (funding in win-win)
- Social acceptance vs facilitators
- Actual Regulation restrictions vs Change of regulation (e.g. support energy management and prosumer)
- Administration Processes burden vs Formulas to speed up processes
- Technical challenges vs good communication skills (facilitators)

- Keep on building demonstrators to validate proposals and improve solutions
- Disseminate results towards administration and regulators

Conclusions (Semantic interoperability)

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- Human – machine interoperability essential. Consider mainly in research (no market deployment of solutions towards Cognitive Cities yet)
- Semantic Web solution (bridge between Smart systems and Learning & Cognitive systems).
- Semantic representation of different urban domains is a key requisite in the Smart Cities evolution process towards Cognitive Cities
- Many opportunities for research and businesses are opened:
  - Ontology standardization
  - Models and methods for ontology building
  - Guidelines for semantic implementation in Smart Cities towards Cognitive Cities
  - Applications for sustainability and resilience based on semantics
  - ….

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THANK YOU FOR YOUR ATTENTION!

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