Smart Grid Energy Management Staff Exchange

SMARTGEMS
energy network

D2.2 Webinars in smart grids and smart communities: Recordings

WP2 - SMART GEMS Training Activities

WP Leader: BRUNEL UNIVERSITY

REPORT

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H2020-MSCA-RISE-2014

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This document has been distributed to:

Name	Partner	Date
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Riccardo Paci	AEA	23 Sep 2016
Dr. Laura Standardi	AEA	23 Sep 2016
Dr. Nerijus Kruopis	EGM	23 Sep 2016
Karolis Koreiva	EGM	23 Sep 2016
Gabija Silienė	EGM	23 Sep 2016
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Dr. Siew Eang	NUS	23 Sep 2016
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Gozde Unkaya	Exergy	23 Sep 2016
Fernando Centeno	Exergy	23 Sep 2016
Federica Fuligni	Exergy	23 Sep 2016

Table of Contents

1. Introduction

The report for the Deliverable 2.2 concerns the webinars in smart grids and smart communities, which are under the task 2.2 of Work Package 2 (SMART GEMS Training Activities). The webinars for the task 2.2. commenced on the 17th of February 2016 and were completed on the 16th of September 2016. The completion date has been extended to accommodate some delays due to the Grant Agreement Amendment which was completed in June 2016.

Five webinars of one hour duration each including the questions and discussion, were organised and presented by UoA, TUC, CyI, ELGAMA, AEA and IDEA, using the Webex Platform. The assigned staff of the Smart Gems partners attended the series of the five webinars with the following topics:

1. Definitions of Smart Grids, organised by TUC, 17 February 2016
2. Smart Communities, organised by UOA/CyI, 6 May 2016
3. Smart metering solution: systematic approach, flexible implementation organised by ELGAMA, 18 July 2016
4. Smart Grids district heating/cooling and cogeneration organised by IDEA
5. A case study of a smart community: The LEAF Community and Camp IT organised by AEA/TUC
   Seminars 4 and 5 took place on 16 September 2016 (combined)
6. In addition, a webinar was organised on the topic of 'Innovation to Zero' by UOA to the UK trainee participants of the MEnS project, 4 July 2016.

The summaries of the five webinars were distributed by TUC (Task 2.2 leader) to all partners well before the beginning of each webinar.

2 The webinars

2.1 Webinar 1 – Definition of Smart Grids by TUC

2.1.1. General Information

The first webinar was organised by TUC with the topic "Definition of Smart Grids". It took place on the 17th February 2016 and had a total duration of 48 minutes. The webinar started at 13:09 CET and finished at 13:57 CET. Fifteen members of Smart Gems Project participated the webinar, the names of them are below:

1. Nikos Kampelis (TUC) – Presenter
2. Kostas Gompakis (TUC) – Host
3. Filippo Paredes (IDEA)
4. Theoni Karlessi (UOA)
5. Konstantina Vasilakopoulou (UOA)
6. Marina Kyprianu Dracou (CyI)
7. Vagias Vagias (TUC)
8. **Professor Denia Kolokotsa (TUC)**
9. Fabio Montagnino (IDEA)
10. Lucas Samulevicious (Elgama)
11. Christina Georgatou (TUC)
12. Chryso Chatzinikola (CUT)
13. Gegiminas Valevičius (Elgama)
14. Arnoldas
15. Cristina Cristalli (AEA)

2.1.2. Summary of the first webinar

The main objective of the Definitions of Smart Grids Webinar, presented by TUC, was to introduce the fundamental principles of smart grids. Various definitions and different approaches were highlighted. EU policies, standards, benefits for key stakeholders, as well as advanced metering infrastructure and communication technologies were presented.

Webinar contents/ structure

- Introduction in Smart Grids
- Various definitions and classifications of Smart Grids
- EU policies for Smart Grids
- Smart Grid benefits and standards
- Smart Grids vs Microgrids
- Advanced Metering Infrastructure (AMI)
- Communication technologies in Smart Grids
- Perspectives and challenges in Smart Grids
- Best practices
- Conclusions

2.2 Webinar 2 - Smart Communities organised by UoA and CyI

2.2.1. General Information

The second webinar was organised by UoA and CyI on the topic "Smart Communities". It took place on the 6th of May 2016 and had a total duration of 1 hour and 10 minutes. The webinar started at 11:04 CET and finished at 12:14 CET. Twelve members of Smart Gems Project participated the webinar, the names of them are below:

1. Kostas Gompakis (TUC)
2. Prof. Maria Kolokotroni (UBRUN)
3. Vagias Vagias (TUC)
4. Theoni Karlessi (UoA) - Presenter
5. Lukas Samulevičius (Elgama)
6. Prof. Denia Kolokotsa
7. Gozde Unkaya (EXE)
8. Laura Standardi (AEA)
9. Luca Venezia (IDEA)
10. Nikos Kampelis (TUC)
11. Daniela Isidori (AEA)
12. Andrea Ferrante (AEA)
13. Georgios Artopoulos (CyI) – Presenter

2.3.2. Summaries of the second webinar

2.3.2.1. Summary of the presentation by UoA

The main objective of the Smart Communities Webinar, presented by the UoA, was to underline the development of Smart and NZEB for Europe, analysing the major problems and setting a roadmap with involving future quantitative and qualitative targets. The methodology applied in this webinar is summarized in the steps described below:

1. Presentation of The Development of Smart and NZEB protocols for Europe
2. Objectives
   - Analysis and identification of 3 major problems of the built environment
   - Energy consumption
   - Energy poverty
   - Local climatic change
3. Set of a roadmap involving future quantitative and qualitative targets, investigating the major technological, economic and social forces and policies

4. What are the links, synergies, impacts and the interrelated nature and characteristics of the 3 sectors?
5. Benefits for the society, including the impact on the economy, employment, the environment and health
6. Conclusions

2.3.2.1. Summary of the presentation by CyI

The main objective of the Smart Communities Webinar, presented by the CyI, was to underline the principles of smart grids and smart communities' technologies through the presentation of materialized examples across Europe on how public spaces have been used to promote innovative technologies through the use of ICT and participation of citizens.

Webinar contents/ structure:

1. **Presentation of Smart Urban Open Air Spaces**

2. **Objectives**
    a. Use of ICT and Description of the combination of innovative technologies
    b. Types of Spaces / Production and Use of Public Open Spaces
    c. Relevance to Sustainable Development of communal spaces (cities & settlements)

3. **How can ICT contribute to a better understanding of needs and requirements on public spaces from users' perspective?**
    a. Communication Medium
    b. Outdoor Activities and the *social function of public spaces*
    c. Principles
    d. Examples of intersection of ICT and public space

4. **What is the contribution of various disciplines and how should they work together in the process of making better public open spaces?**

5. **Conclusions**

2.3 Webinar 3 - Smart metering solution: systematic approach, flexible implementation, organised by ELGAMA

2.3.1. General Information

The third webinar was organised by Elgama with the topic "Smart metering solution: systematic approach, flexible implementation". It took place on the 18th of July 2016 and had a total duration of 1 hour and 33 minutes. The webinar started at 11:04 CET and finished at 12:37 CET. Nineteen people participated in the webinar (members of Smart Gems Project and open to public), the names of them are below:

1. Dr. Nerijus Kruopis (ELGAMA) - Presenter
2. Kostas Gompakis (TUC)
3. Denia Kolokotsa (TUC)
4. Nikos Kampelis (TUC)
5. Stefan Pallantzas
6. Fabio Montagnino(IDEA)
7. Theoni Karlessi (UOA)
8. Christian
9. Laura Standardi (AEA)
10. Daniela Isidori (AEA)
11. Thiago Santos (UBRUN)
12. Zoi Mylona (UBRUN)
13. Georgios Chalkiadakis (TUC)
14. Vasilis Lontorfos (UoA)
15. Kousis Ioannis (UoA)
16. Spyros Saramaskos
17. Felipe Maya (EXE)
18. Eli Tsirintoulaki (TUC)
19. Giorgos Kyriakodis (UoA)

2.3.2. Summary of the third webinar

The main objective of the Smart metering solution: systematic approach, flexible implementation Webinar, was presented by ELGAMA. The aim was to provide information about AMI architecture,basic principles, constituent devices, communication interfaces and state-of-art functionality. Solutions covering infrastructure from Central Systems (e.g. Meter Data Management Software MDMS) to Home Area Network (e.g. In-Home-Display) were illustrated. As the most critical element in such solutions, Smart Electricity meters are described in detail, pointing out advanced features and advanced employed technologies.

Webinar contents/ structure

1. Elgama Elektronika
2. Smart metering pilot in Greece
3. Advanced Metering Infrastructure (AMI)

    a. Main principles of AMI solution
4. Elgama (smart metering) solution for domestic sector
5. Open meter architectural model
6. Open meter interfaces
7. Functionality of AMI system
8. Smart electricity meters
    a. Main features of GAMA 100/300
        i. Advanced features of GAMA 100/300
    b. MI1: Meter – concentrator Interface
    c. MI2: Meter – AMI Central System Interface
    d. MI3: Meter – Local O&M device interface
    e. MI4: Meter – Multi-utility Meters Interface
    f. MI5: Meter – End of customer Device Interface
9. Wireless M-Bus communication to In-home Displays
10. Load Management
11. Security
12. Commissioning and inspection of meter
13. SI 1/CI2: AMI Central System
14. DC Key features
15. Maintenance

2.4 Webinar 4 – Smart Grids district heating/cooling and cogeneration organized by IDEA

2.4.1. General Information

The fourth webinar was organised by IDEA with the topic "**Smart Grids district heating/cooling and cogeneration**". It was performed on the 16th of September 2016 and had a total duration of 53 minutes. The webinar started at 10:06 CET and finished at 10:59 CET. Twenty one members of the Smart Gems project participated in the webinar the names of them are below:

1. Laura Standardi (AEA)
2. Daniela Isidori (AEA)
3. Cristina Cristalli (AEA)
4. Professor Denia Kolokotosa (TUC)
5. Professor Maria Kolokotroni (UBRUN)
6. Fabio Montagnino (IDEA) – Presenter
7. Theoni Karlessi (UoA)
8. Vagias Vagias (TUC)
9. Nikos Kampelis (TUC)
10. Afroditi Synnefa (UoA)
11. Angeliki (TUC)
12. Sergio Milone (IDEA)
13. Alaric Montenon (CyI)
14. Frederica Fuligni (EXE)
15. Kostas Gobakis (TUC)
16. Giorgos Kyriakodis (UoA)
17. Kousis Ioannis (UoA)
18. Marina Kyprianou (CyI)
19. Vasilis Lontorfos (UoA)
20. Zoi Mylona (UBRUN)
21. Thiago Santos (UBRUN)

2.4.2. Summary of the fourth webinar

The main objective of the fourth webinar was to present an overview about district heating and cooling (DHC), its link with cogeneration, the perspectives in terms of improved efficiency, integration with renewables sources and evolution in the smart cities framework.

District heating and cooling is an integrative technology that can contribute to reducing emissions of carbon dioxide, improving air quality in urban areas and to increasing energy security. The fundamental idea of DHC is connecting multiple thermal energy users through a piping network to optimized energy sources, such as combined heat and power (CHP), industrial waste heat and renewable energy generators. Some countries in northern regions, show a significant penetration of DHC, while it still represents only a small fraction of the total heat market of the European Union. Therefore the potential is large and varies in each country depending on past national policies. Integration of renewables, waste heat reuse, and lower operating temperature are the key issues in the present evolution of DHC, as well as the integration of more advanced IT management tools and the introduction of new business models.

Webinar Contents/Structure

- Definition of DHC
- Advantages of DHC
- Main components of DHC
- DHC in a smart city/community framework
- Solar hybridization of DHC
- Good practices
- Topics/activities for Smart GEMS participants

2.5 Webinar 5 – LEAF Community and CAMP IT organized by AEA and TUC

2.4.1. General Information

As mentioned before, the fifth webinar was held on the same day as the fourth webinar to maximise participation. The seminar started at 10:59 with a total duration of 39 minutes. The webinar started at 10:59 and finished at 11:38. The same twenty one members of the Smart Gems project participated to this webinar. For completeness they are listed below:

1. Laura Standardi (AEA)-Presenter
2. Daniela Isidori (AEA)
3. Cristina Cristalli (AEA)
4. Professor Denia Kolokotosa (TUC)
5. Professor Maria Kolokotroni (UBRUN)
6. Fabio Montagnino (IDEA)
7. Theoni Karlessi (UoA)
8. Vagias Vagias (TUC)
9. Nikos Kampelis (TUC)_Presenter
10. Afroditi Synnefa (UoA)
11. Angeliki (TUC)
12. Sergio Milone (IDEA)
13. Alaric Montenon (Cyl)
14. Frederica Fuligni (EXE)
15. Kostas Gobakis (TUC)
16. Giorgos Kyriakodis (UoA)
17. Kousis Ioannis (UoA)
18. Marina Kyprianou (Cyl)
19. Vasilis Lontorfos (UoA)
20. Zoi Mylona (UBRUN)
21. Thiago Santos (UBRUN)

2.4.2. Summary of the fifth webinar

First part: Seminar by AEA. The seminar described the materialised activities under the LEAF initiative/project at Loccioni.

Multiple Renewable Energy Sources (RESs), consumers, Electrical Energy Storage systems (ESSs), offices, industrial and residential buildings are all successfully integrated into the Leaf Community. Sun and water produce energy to such a smart community through micro-hydro power plants distributed along a river and PV rooftop installations located on top of each building; moreover, an energy storage system is integrated with buildings of various type (four industrial, one office and one residential) and electric vehicles and bicycles improve smart transportation. Additionally, measurements from the sensors and meters placed are collected via the web-based monitoring and control platform, developed by the Loccioni Group as well, called MyLeaf. Based on that data a dedicated control algorithms, implemented on the MyLeaf platform, efficiently coordinates all the energy systems by providing the optimal signals for production and charging/discharging strategy to all the energy sources in order to minimize energy costs and satisfy energy demand in real time. The health of out earth and of man is the main goal of the Leaf Community.

The contents of the presentation is as follows:

1. Loccioni for Energy
2. The LEAF Community
3. THE LEAF Community and the IUndustrial Micro-grid
4. Loccioni Microgrid 2012
5. Loccioni Microgrid 2014
6. MyLeaf
7. MyLeaf: Energy Management System
8. Loccioni Leaf Roof
9. Loccioni Leaf Water
10. Storage Systems
11. Electric Vehicles
12. Concludions

Second Part: Seminar by TUC. The seminar described the activities at the TUC campus and the development of models for buildings and outdoor spaces considering energy and environmental conditions as well as integration with myLeaf technology.

The contents of the presentation is as follows:
1. Description of TUC campus
2. Building and outdoor space modelling
3. Measurements and validation of models
4. Development of Prediction model
5. Next steps: integration with MyLeaf and modelling TUC micro-grid.

2.6 Additional webinar on the topic of 'Innovation to Zero' by UOA to the UK trainee participants of the MEnS project, 4 July 2016.

2.6.1. General Information

A sixth webinar was organised by UoA on the topic "Innovation to Zero". It took place on the 4th July 2016 and had a total duration of 44 minutes and 38 seconds. The webinar started at 12:04 CET and finished at 12:48 CET. This webinar was delivered to UK Short Course attendees of the MEnS project (Contract: 649773 - H2020-EE-2014-2015/H2020-EE-2014-3-MarketUptake) which focusses on NZEB. UBRUN is a partner in MEnS and the two project took the opportunity for further dissemination of Smart GEMS and training of professionals. The webinar was delivered by Dr Theoni Carlessi of UoA and was based on her presentation for Webinar 2. This webinar was attended by thirty five attendees of the MEnS training short course. It is not possible to list their names for data protection reasons. A photo of the majority of the attendees during the webinar is included below.

2.6.2. Summary of the additional sixth webinar

In this webinar, Theoni Carlesi (UoA) presented the Development of Smart and NZEB protocols for Europe. The structure of the presentation was a follows:

1. Analysis and identification of 3 major problems of the built environment
    1. Energy consumption
    2. Energy poverty
    3. Local climatic change
2. Set of a roadmap involving future quantitative and qualitative targets, investigating the major technological, economic and social forces and policies

4. What are the links, synergies, impacts and the interrelated nature and characteristics of the 3 sectors?
5. Benefits for the society, including the impact on the economy, employment, the environment and health
6. Conclusions

3. Conclusions

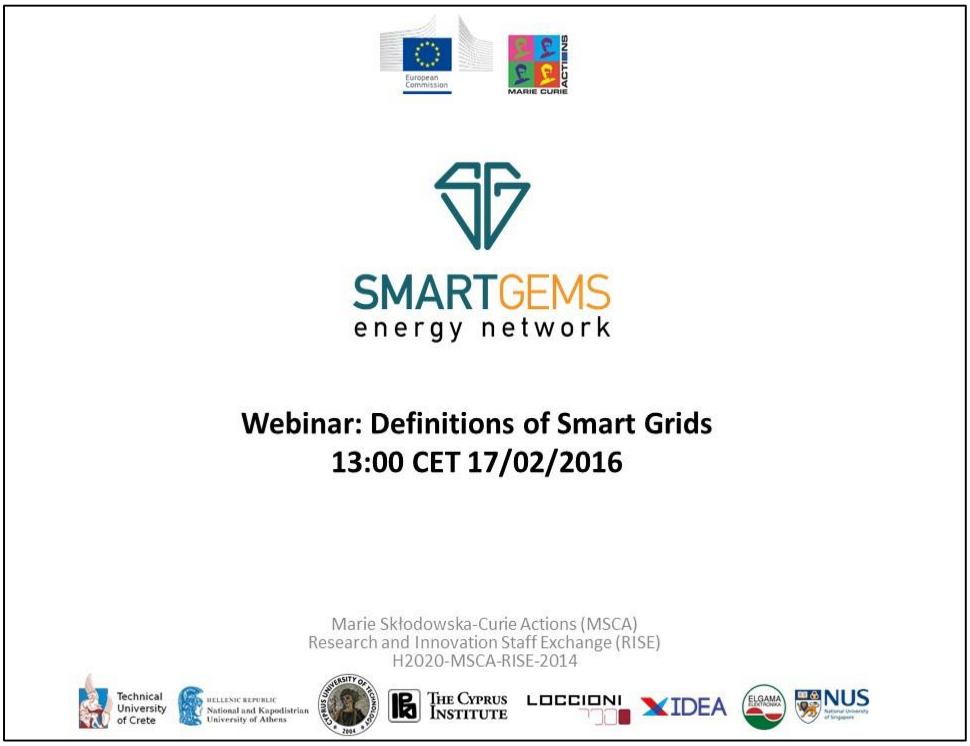
In this report the five webinars for the task 2.2 - Training in Smart Grids and Smart Communities via webinars and seminars of Work Package 2 (WP2 - SMART GEMS Training Activities) were summarised and presented. The Power Point presentations are included as Annexes to this report.

In addition the video recordings of the webinars are available at the YouTube channel of the Energy Management in the Built Environment Laboratory (EMBER) of Technical University of Crete in the following URL:
https://www.youtube.com/user/EmberTUC

As a next step, the webinars for the task 2.3 - Integration and Innovation Management of Work Package 2 will be organised and they will be presented as already scheduled.

4. Annexes

Annex I: Slides of the 1st Webinar - Definitions of Smart Grids. organised by TUC



Contents

- Webinar objectives
- Introduction in Smart Grids and definition
- Traditional Power Grid
- Benefits of Smart Grids
- NIST Smart Grid conceptual model, characteristics, key issues
- Smart Grid Technologies, Deployment, Priorities, Future Trends
- Policies, regulatory framework and Standards
- Conclusions

Objectives

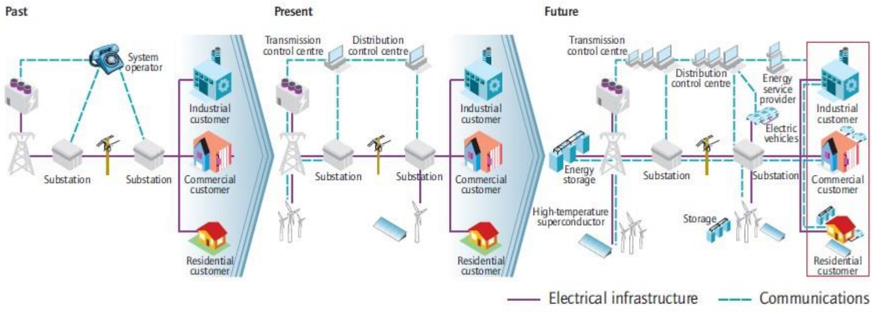
- The main objective of the Definitions of Smart Grids Webinar, is to introduce the various components, benefits and fundamental principles of smart grids.
- Smart Grid definitions, structures and challenges will be highlighted.
- EU and global policies with a focus on initiatives and various technological developments will be presented.

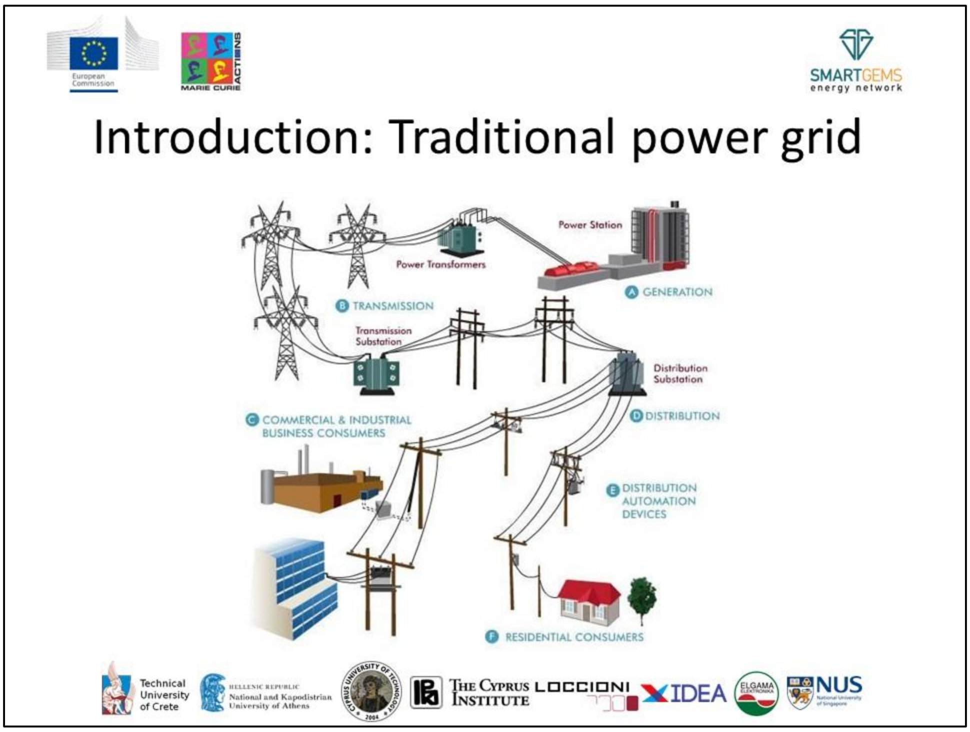
Introduction

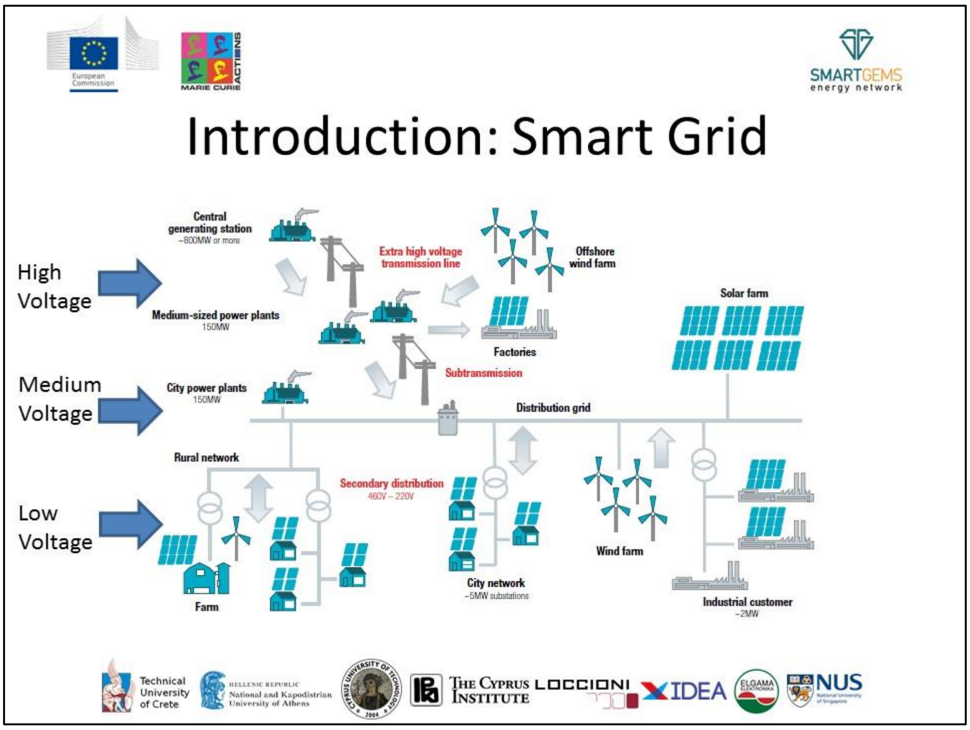
- Current trends in energy supply and use are unsustainable environmentally, socially and economically.
- Fossil fuel increased demand – security of supply
- CO_2 emissions more than double in 2050
- Energy efficiency, Renewable Energy Sources, Storage

Introduction

- The term *grid* is used for an electricity system that may support all or some of the following four operations:
  - Generation, Transmission, Distribution & Control




SMARTGEMS
energy network
Introduction: Traditional power grid
Power Station
Power Transformers
A GENERATION
B TRANSMISSION
Transmission Substation
Distribution Substation
C COMMERCIAL & INDUSTRIAL BUSINESS CONSUMERS
D DISTRIBUTION
E DISTRIBUTION AUTOMATION DEVICES
F RESIDENTIAL CONSUMERS
Technical University of Crete

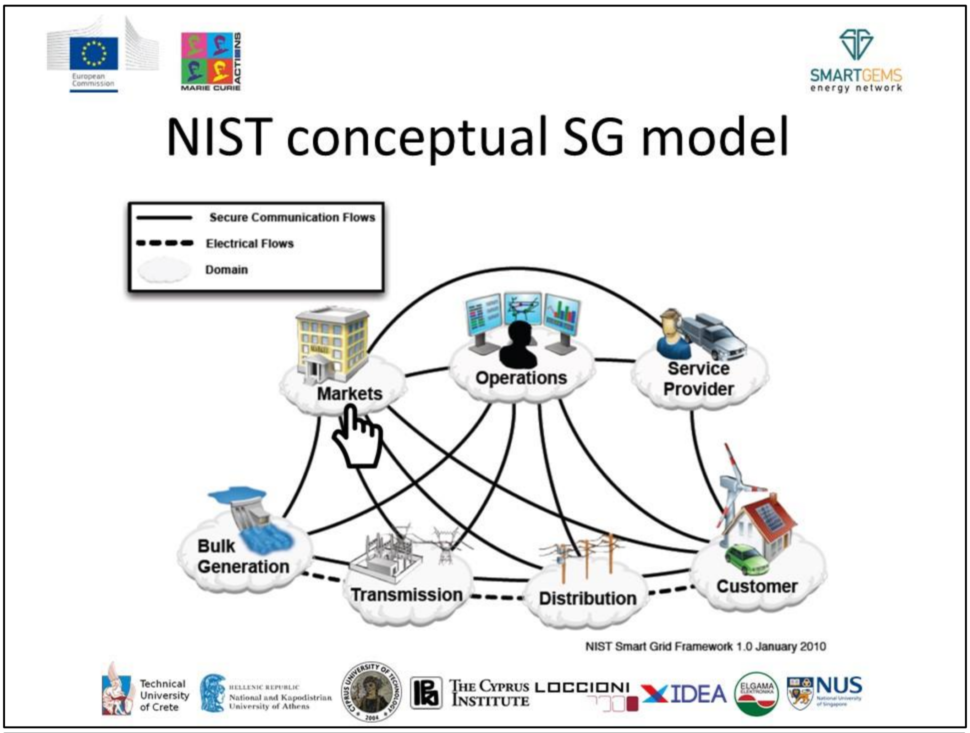

SMARTGEMS
energy network
Introduction: Smart Grid
High Voltage
Medium Voltage
Low Voltage
Central generating station
~800MW or more
Extra high voltage transmission line
Offshore wind farm
Medium-sized power plants
150MW
Factories
Solar farm
Subtransmission
City power plants
150MW
Distribution grid
Rural network
Secondary distribution
460V – 220V
Wind farm
City network
~5MW substations
Farm
Industrial customer
~2MW
Technical University of Crete

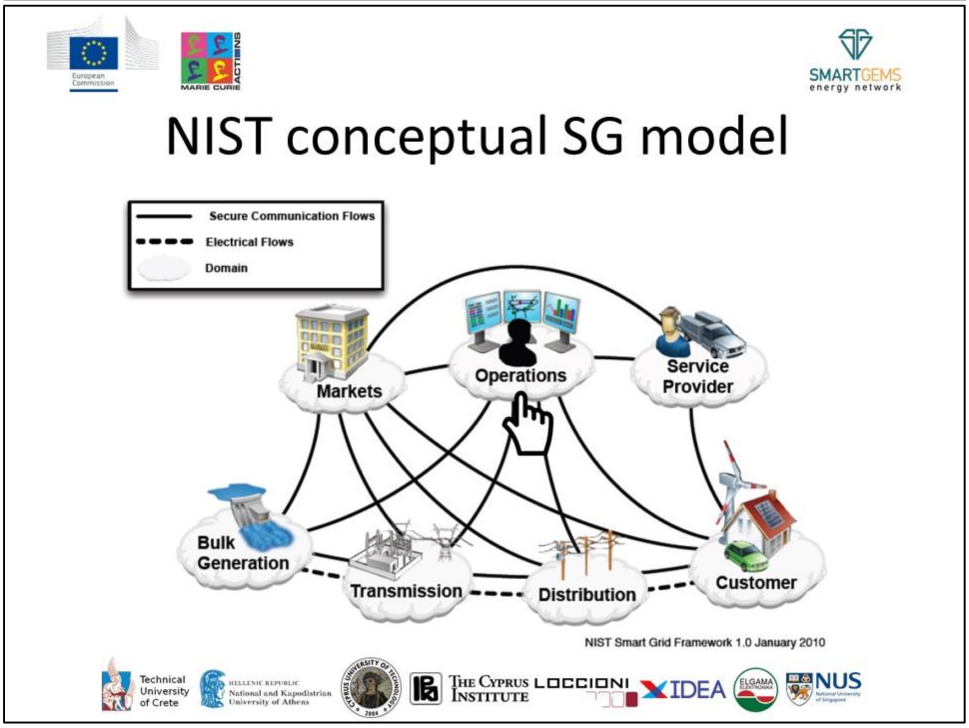
Benefits of SG

Improving power reliability and quality	Accommodating distributed power sources
Optimizing facility utilization and averting construction of back-up (peak load) power plants	Reducing greenhouse gas emissions by enabling electric vehicles and new power sources
Enhancing capacity and efficiency of existing electric power networks	Presenting opportunities to improve grid security
Improving resilience to disruption	Enabling transition to plug-in electric vehicles and new energy storage options
Enabling predictive maintenance and self-healing responses to system disturbances	Increasing consumer choice
Facilitating expanded deployment of renewable energy sources	Enabling new products, services, and markets

Existing vs Smart Grid

Existing Grid	Smart Grid
Electromechanical	Digital
One-way communication	Two-way communication
Centralized generation	Distributed generation
Few sensors	Sensors throughout
Manual monitoring	Self-monitoring
Manual restoration	Self-healing
Failures and blackouts	Adaptive and islanding
Limited control	Pervasive control
Few customer choices	Many customer choices


SMARTGEMS
energy network
NIST conceptual SG model
Secure Communication Flows
Electrical Flows
Domain
Markets
Operations
Service Provider
Bulk Generation
Transmission
Distribution
Customer
NIST Smart Grid Framework 1.0 January 2010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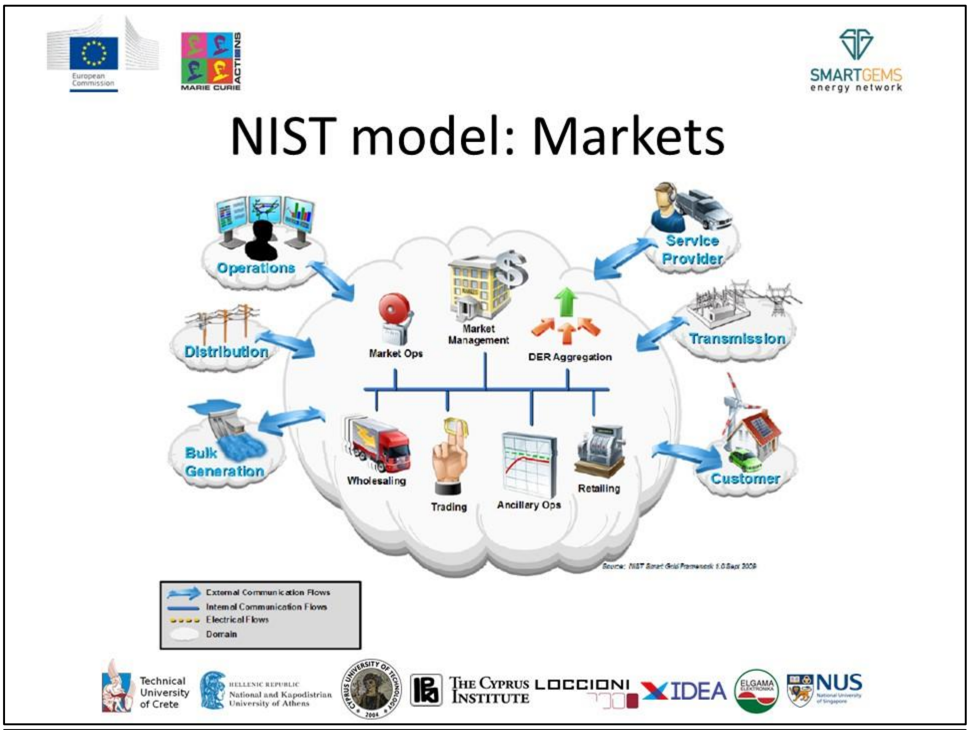
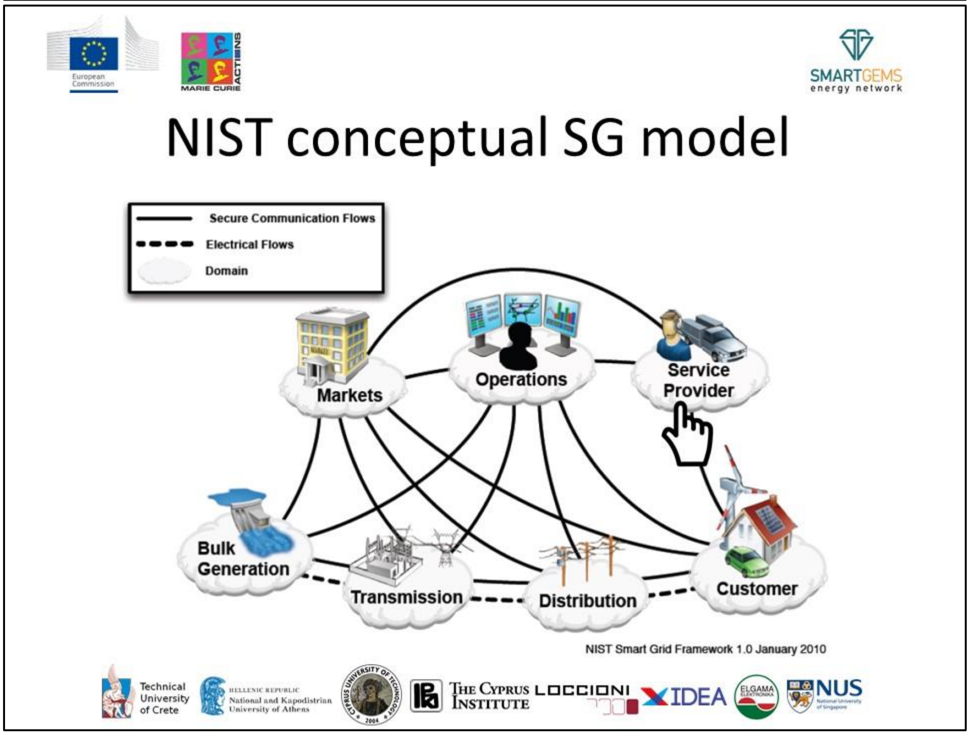

NIST model: Markets
Operations
Service Provider
Distribution
Market Ops
Market Management
DER Aggregation
Transmission
Bulk Generation
Wholesaling
Trading
Ancillary Ops
Retailing
Customer
External Communication Flows
Internal Communication Flows
Electrical Flows
Domain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Electrical Flows
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Bulk Generation
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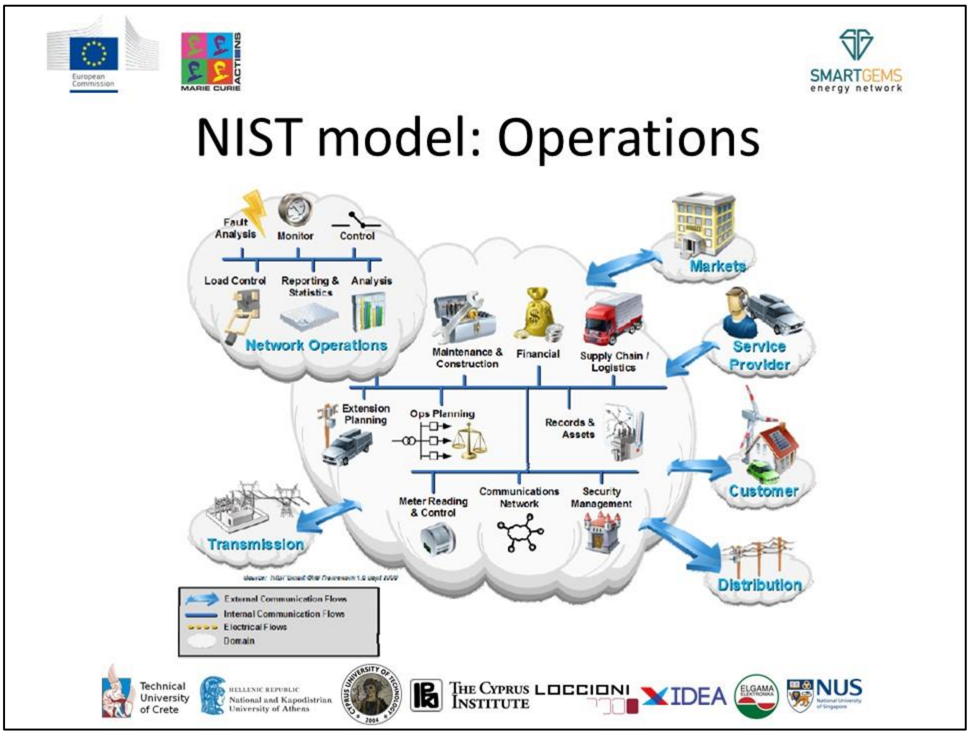
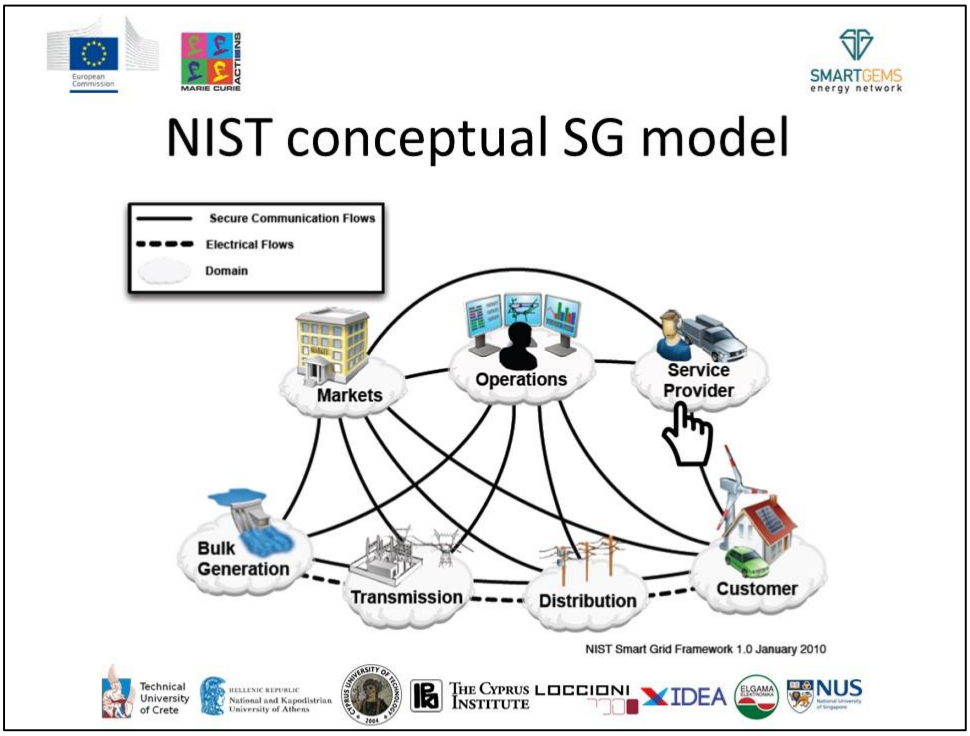

NIST model: Operations
Fault Analysis
Monitor
Control
Load Control
Reporting & Statistics
Analysis
Network Operations
Maintenance & Construction
Financial
Supply Chain / Logistics
Markets
Service Provider
Extension Planning
Ops Planning
Records & Assets
Customer
Meter Reading & Control
Communications Network
Security Management
Transmission
Distribution
External Communication Flows
Internal Communication Flows
Electrical Flows
Domain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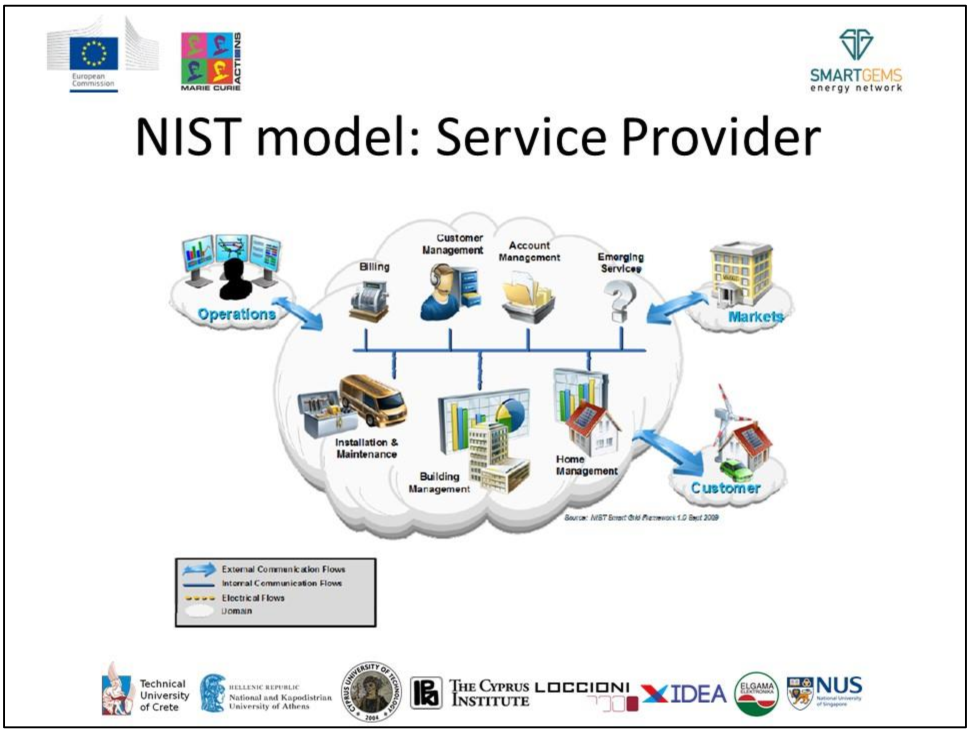
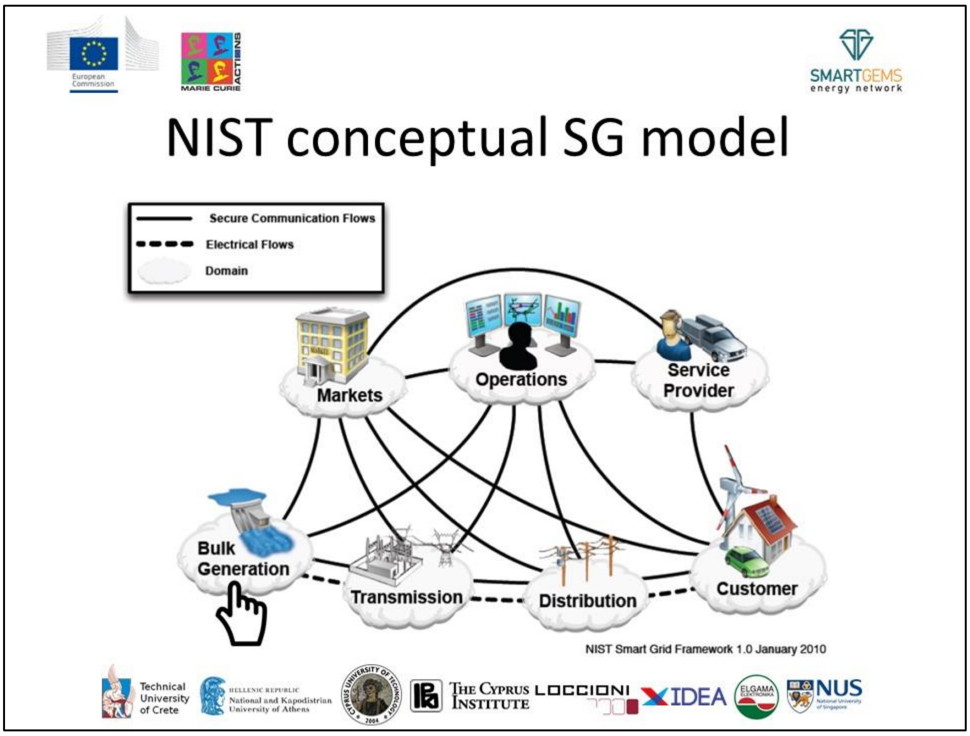

NIST model: Service Provider
Customer Management
Account Management
Billing
Emerging Services
Operations
Markets
Installation & Maintenance
Building Management
Home Management
Customer
External Communication Flows
Internal Communication Flows
Electrical Flows
Domain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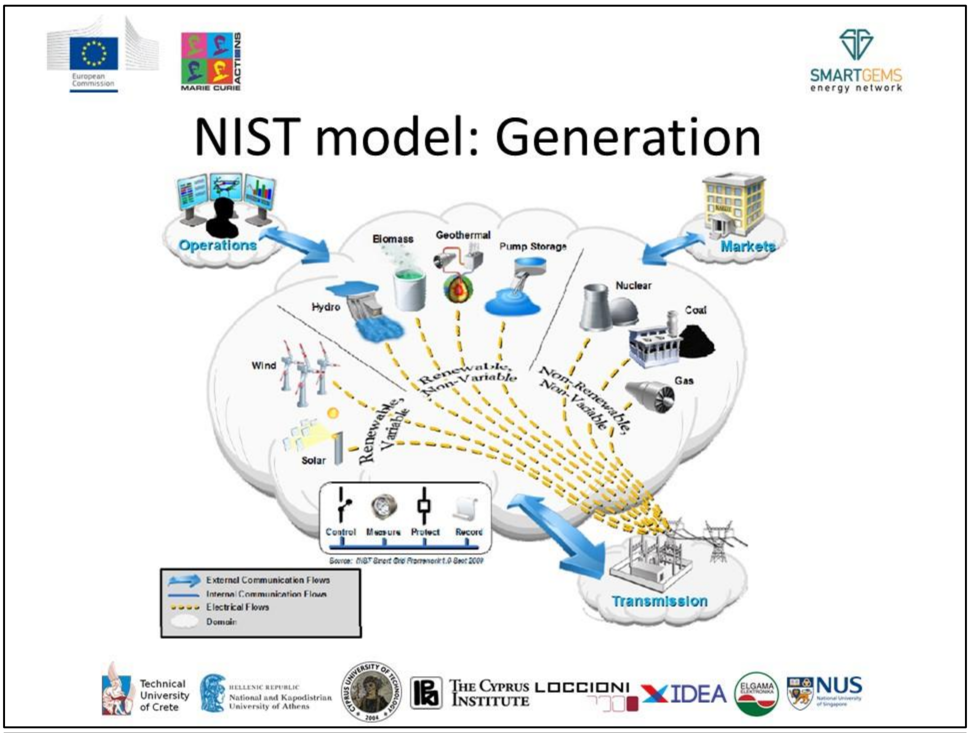
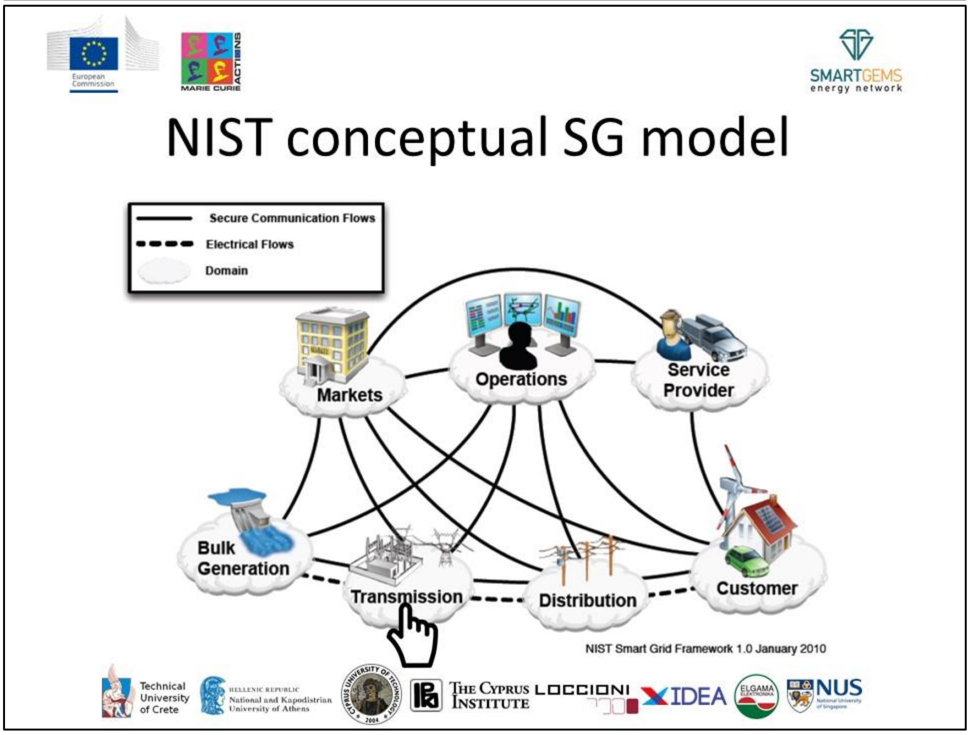
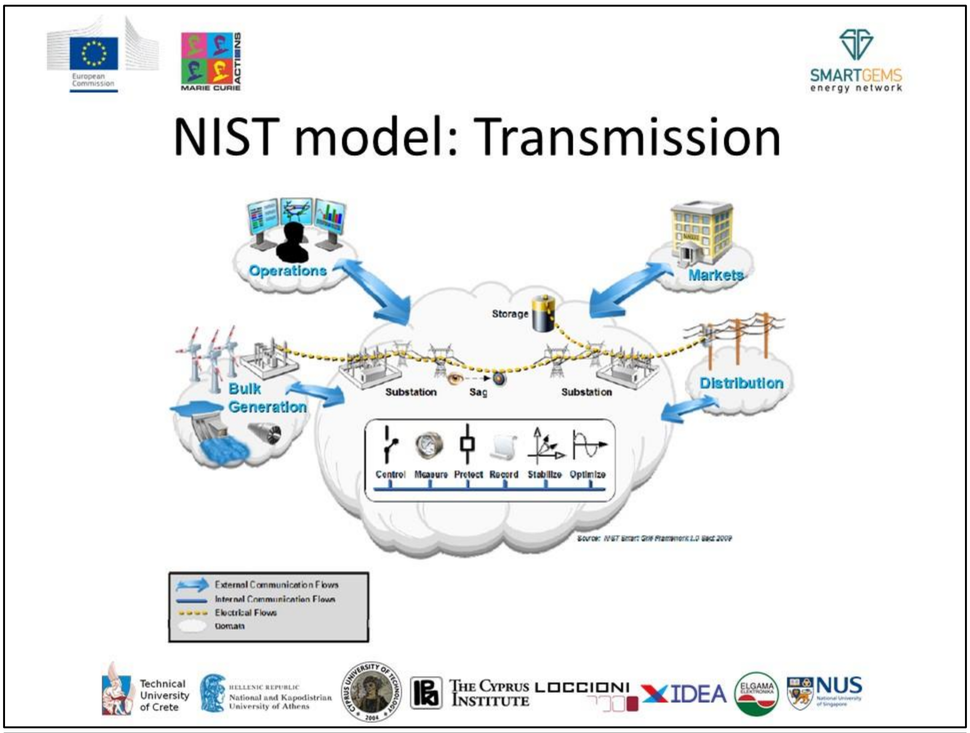
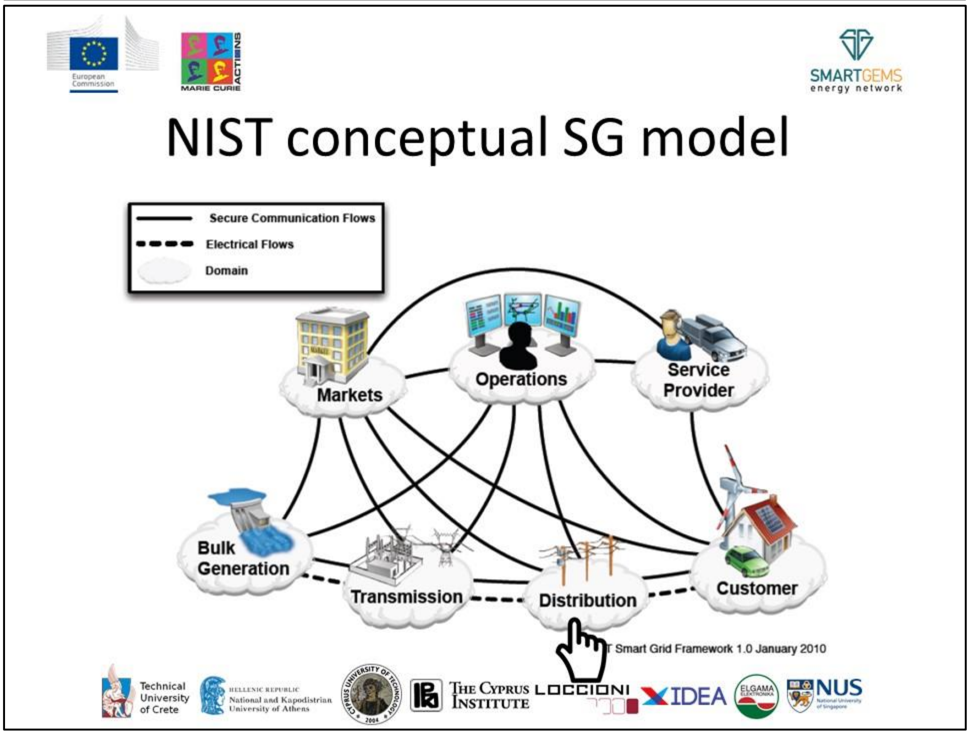
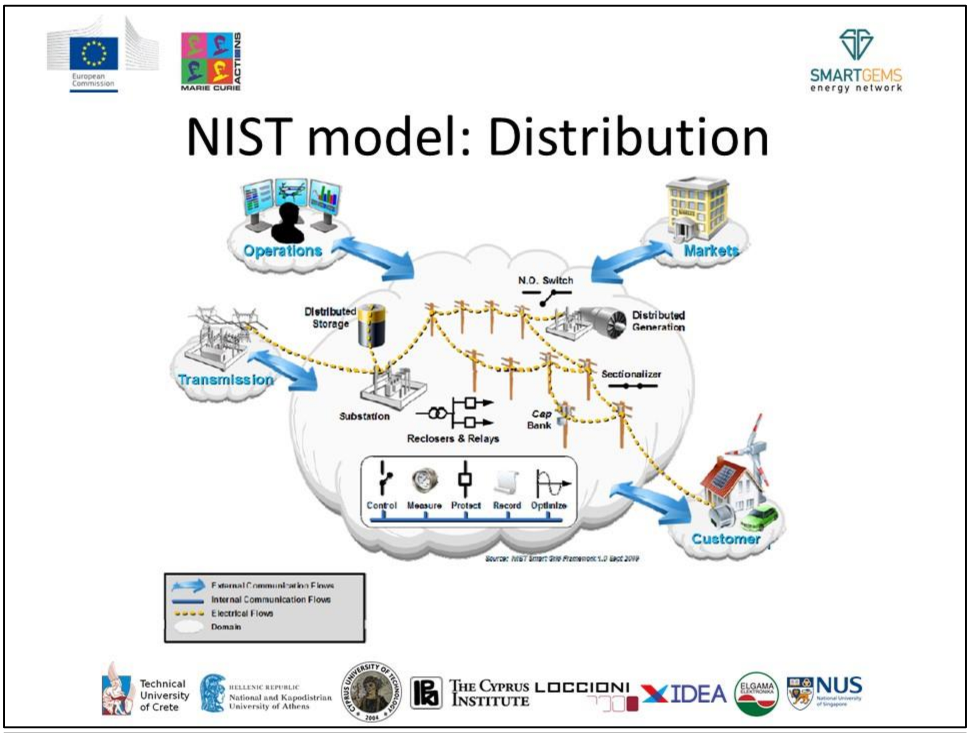
Customer
NIST Smart Grid Framework 1.0 January 2010

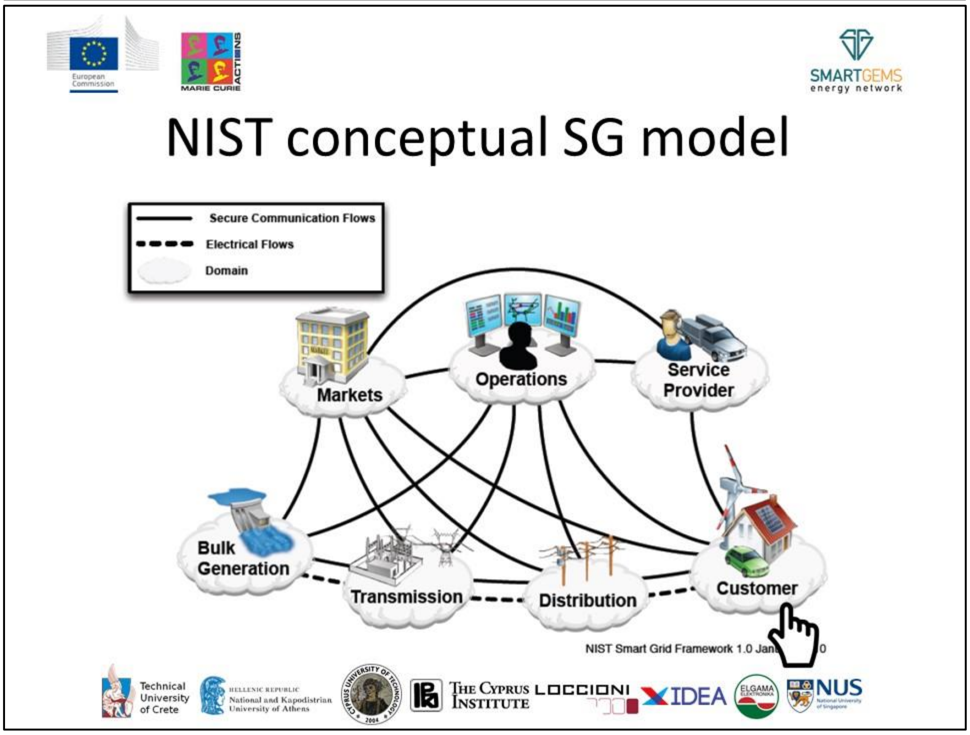

SMARTGEMS energy network
NIST model: Generation
Operations
Markets
Biomass
Geothermal
Pump Storage
Hydro
Nuclear
Coal
Wind
Gas
Solar
Renewable, Non-Variable
Non-Renewable, Non-Variable
Renewable, Variable
Control
Measure
Protect
Record
External Communication Flows
Internal Communication Flows
Electrical Flows
Domain
Transmission


SMARTGEMS energy network
NIST conceptual SG model
Secure Communication Flows
Electrical Flows
Domain
Markets
Operations
Service Provider
Bulk Generation
Transmission
Distribution
Customer
NIST Smart Grid Framework 1.0 January 2010

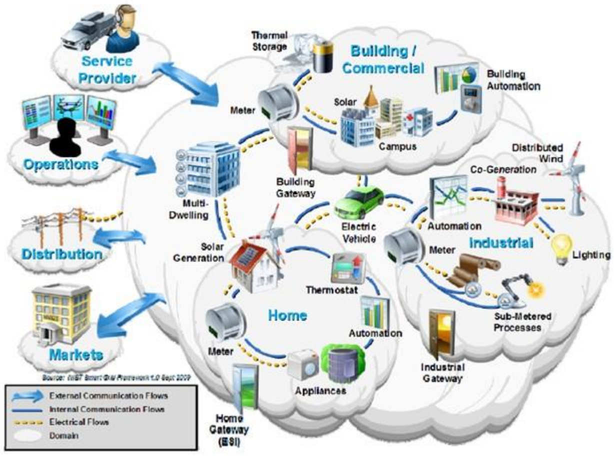

NIST model: Transmission
Operations
Markets
Storage
Bulk
Generation
Substation
Sag
Substation
Distribution
Control
Measure
Protect
Record
Stabilize
Optimize
External Communication Flows
Internal Communication Flows
Electrical Flows
Domain


NIST conceptual SG model
Secure Communication Flows
Electrical Flows
Domain
Markets
Operations
Service Provider
Bulk Generation
Transmission
Distribution
Customer
Smart Grid Framework 1.0 January 2010

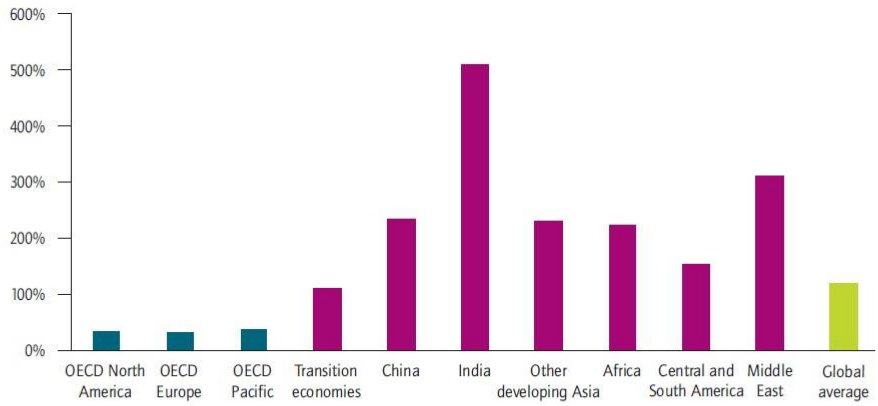

SMARTGEMS
energy network
NIST model: Distribution
Operations
Markets
N.O. Switch
Distributed Storage
Distributed Generation
Transmission
Sectionalizer
Substation
Cap Bank
Reclosers & Relays
Control
Measure
Protect
Record
Optimize
Customer
Internal Communication Flows
Electrical Flows
Domain


SMARTGEMS
energy network
NIST conceptual SG model
Secure Communication Flows
Electrical Flows
Domain
Markets
Operations
Service Provider
Bulk Generation
Transmission
Distribution
Customer

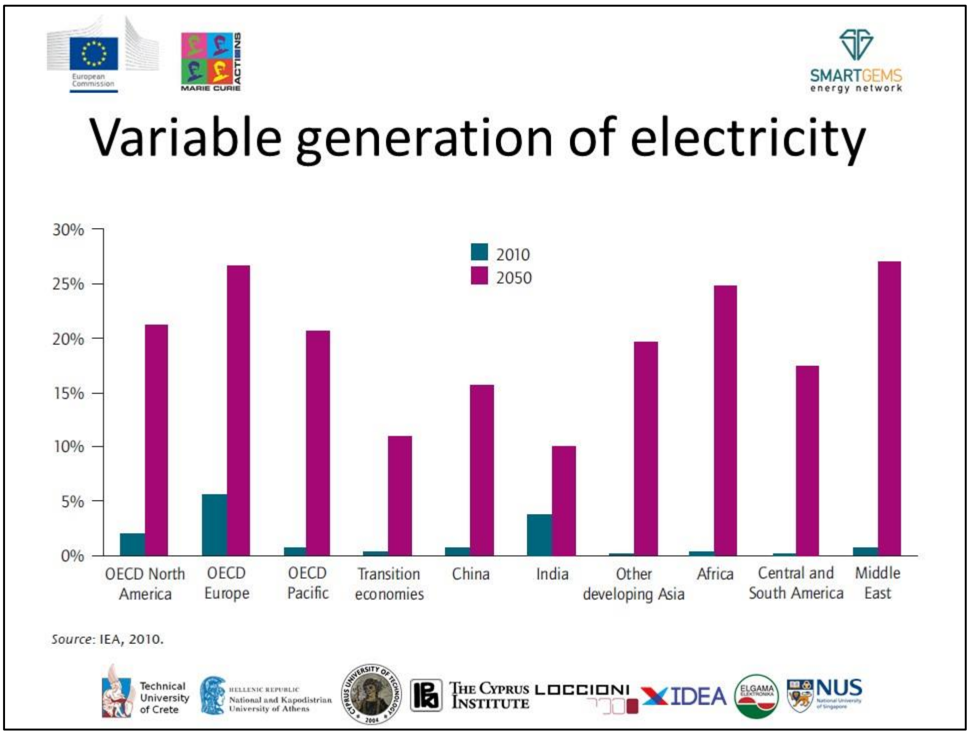
NIST model: Customer

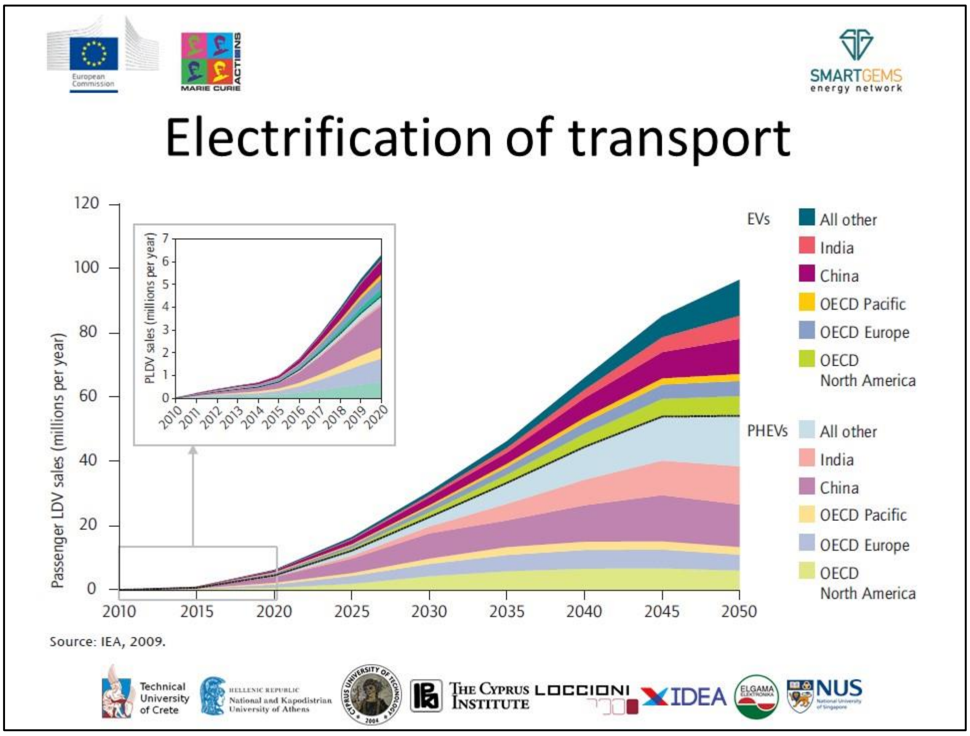


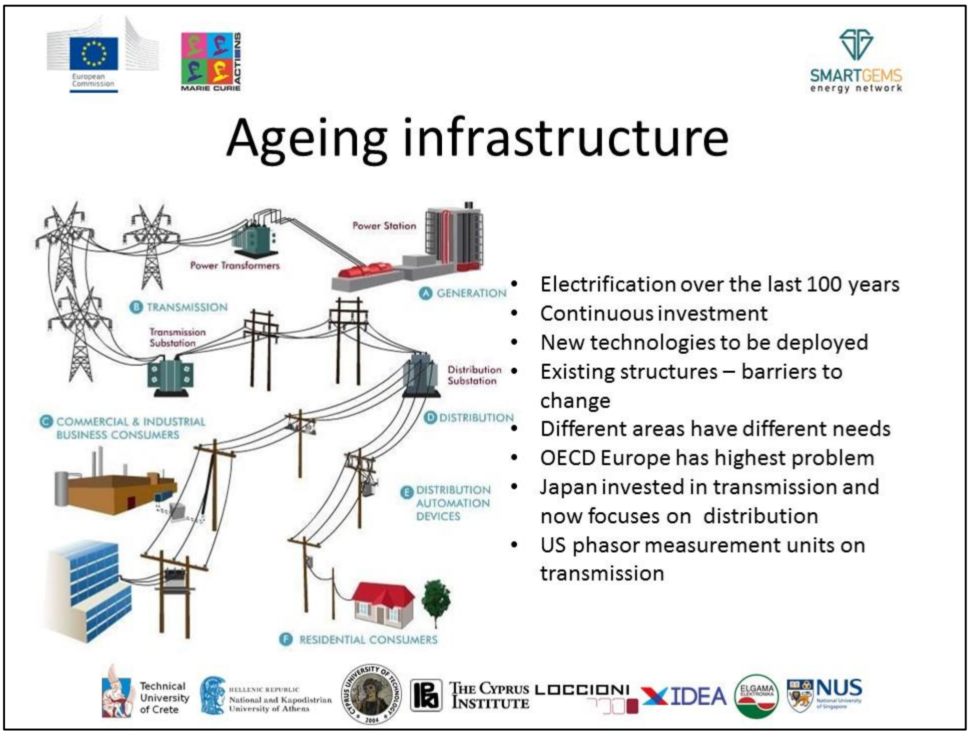
Electricity consumption growth 2007-2050

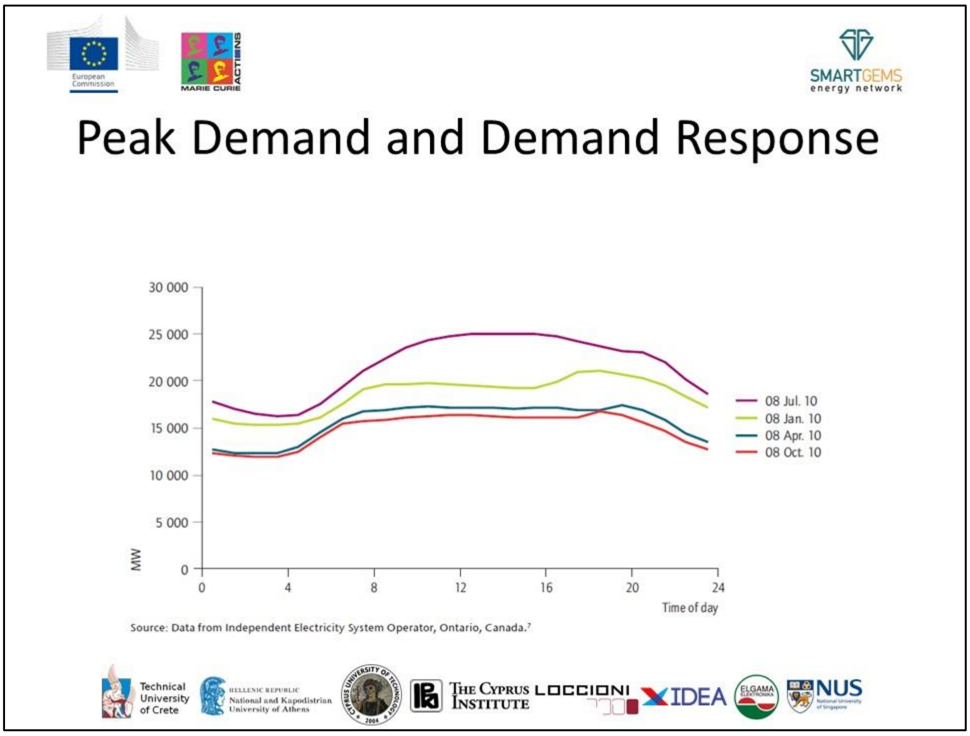


Source: IEA, 2010.

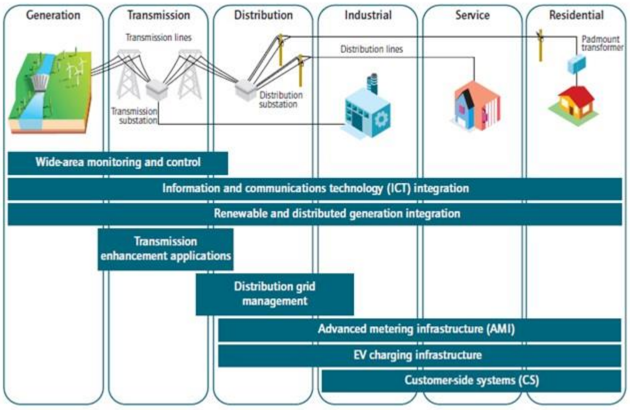

SMARTGEMS energy network
Variable generation of electricity
30%
25%
20%
15%
10%
5%
0%
2010
2050
OECD North America
OECD Europe
OECD Pacific
Transition economies
China
India
Other developing Asia
Africa
Central and South America
Middle East
Source: IEA, 2010.


SMARTGEMS energy network
Electrification of transport
Passenger LDV sales (millions per year)
120
100
80
60
40
20
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
PLDV sales (millions per year)
EVs
All other
India
China
OECD Pacific
OECD Europe
OECD North America
PHEVs
All other
India
China
OECD Pacific
OECD Europe
OECD North America
Source: IEA, 2009.


SMARTGEMS energy network
Ageing infrastructure
Power Station
Power Transformers
A GENERATION
B TRANSMISSION
Transmission Substation
Distribution Substation
C COMMERCIAL & INDUSTRIAL BUSINESS CONSUMERS
D DISTRIBUTION
E DISTRIBUTION AUTOMATION DEVICES
F RESIDENTIAL CONSUMERS
• Electrification over the last 100 years
• Continuous investment
• New technologies to be deployed
• Existing structures – barriers to change
• Different areas have different needs
• OECD Europe has highest problem
• Japan invested in transmission and now focuses on distribution
• US phasor measurement units on transmission


SMARTGEMS energy network
Peak Demand and Demand Response
MW
30 000
25 000
20 000
15 000
10 000
5 000
0
0
4
8
12
16
20
24
Time of day
08 Jul. 10
08 Jan. 10
08 Apr. 10
08 Oct. 10
Source: Data from Independent Electricity System Operator, Ontario, Canada.

Smart Grid Technologies



Source: Technology categories and descriptions adapted from NETL, 2010 and NIST, 2010.

Smart Grid Technologies

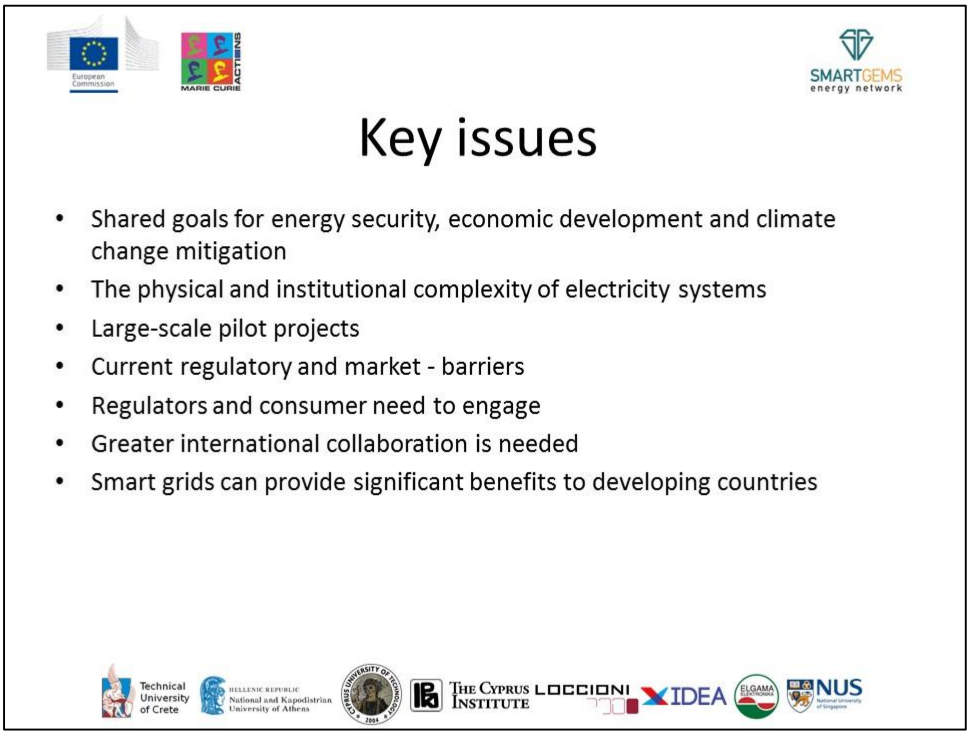
Wide-area monitoring and control	Phasor measurement units (PMU) and other sensor equipment	Supervisory control and data acquisition (SCADA), wide-area monitoring systems (WAMS), wide-area adaptive protection, control and automation (WAAPCA), wide-area situational awareness (WASA)
Information and communication technology integration	Communication equipment (Power line carrier, WIMAX, LTE, RF mesh network, cellular), routers, relays, switches, gateway, computers (servers)	Enterprise resource planning software (ERP), customer information system (CIS)
Renewable and distributed generation integration	Power conditioning equipment for bulk power and grid support, communication and control hardware for generation and enabling storage technology	Energy management system (EMS), distribution management system (DMS), SCADA, geographic Information system (GIS)
Transmission enhancement	Superconductors, FACTS, HVDC	Network stability analysis, automatic recovery systems
Distribution grid management	Automated re-closers, switches and capacitors, remote controlled distributed generation and storage, transformer sensors, wire and cable sensors	Geographic information system (GIS), distribution management system (DMS), outage management system (OMS), workforce management system (WMS)
Advanced metering infrastructure	Smart meter, in-home displays, servers, relays	Meter data management system (MDMS)
Electric vehicle charging infrastructure	Charging infrastructure, batteries, inverters	Energy billing, smart grid-to-vehicle charging (G2V) and discharging vehicle-to-grid (V2G) methodologies
Customer-side systems	Smart appliances, routers, in-home display, building automation systems, thermal accumulators, smart thermostat	Energy dashboards, energy management systems, energy applications for smart phones and tablets

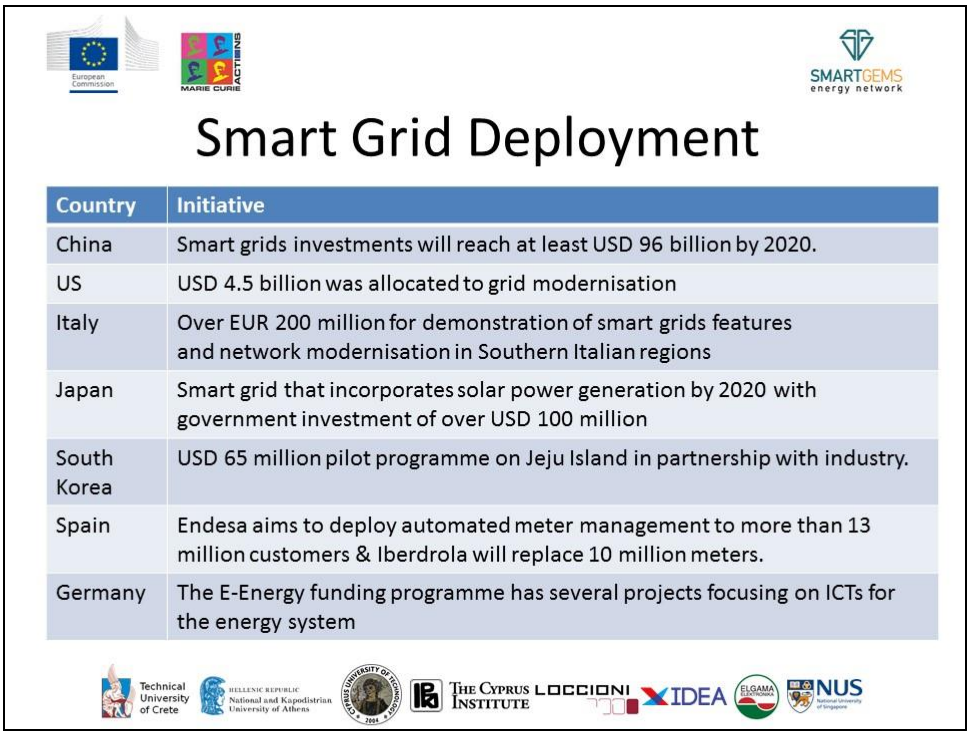
SG technology maturity

Technology area	Maturity level	Development trend
Wide-area monitoring and control	Developing	Fast
Information and communications technology integration	Mature	Fast
Renewable and distributed generation integration*	Developing	Fast
Transmission enhancement applications**	Mature	Moderate
Distribution management	Developing	Moderate
Advanced metering infrastructure	Mature	Fast
Electric vehicle charging infrastructure	Developing	Fast
Customer-side systems	Developing	Fast

SG Technology Development Priorities

- Need for commercial scale application
- Demand Response
- Consumer based enabling technologies





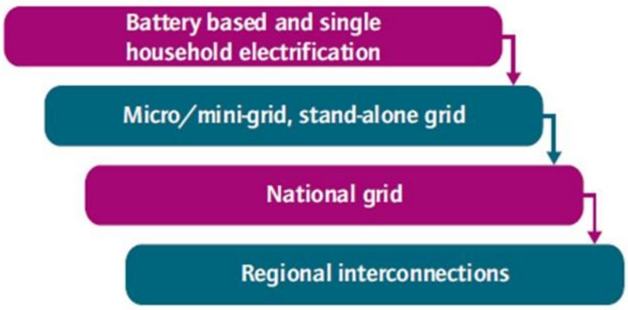
Smart Grid Deployment

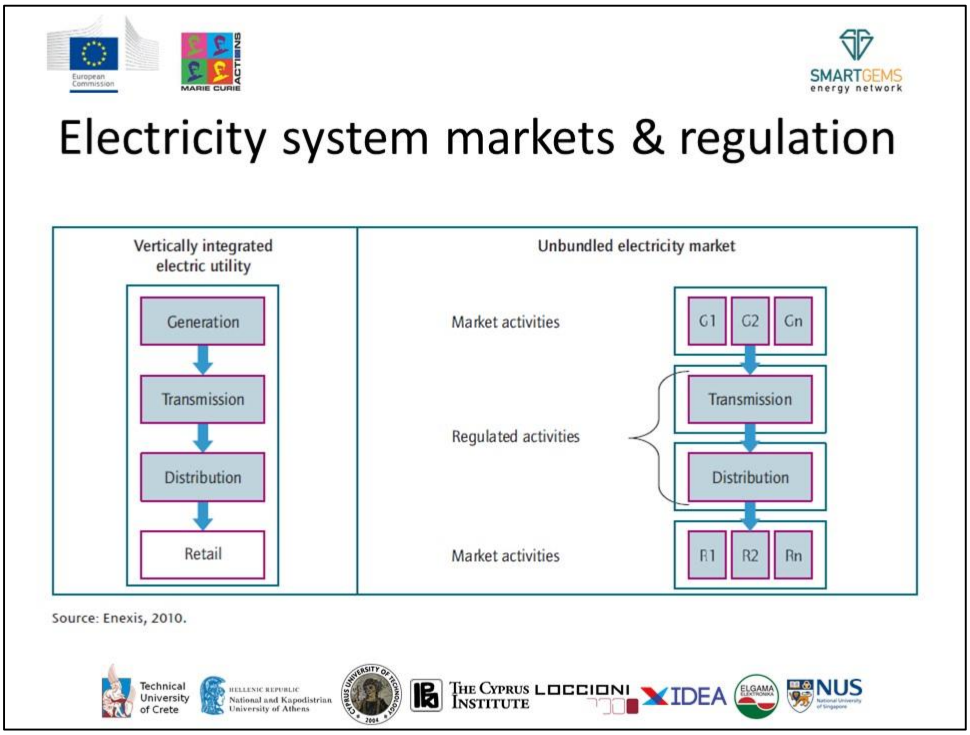
Country	Initiative
China	Smart grids investments will reach at least USD 96 billion by 2020.
US	USD 4.5 billion was allocated to grid modernisation
Italy	Over EUR 200 million for demonstration of smart grids features and network modernisation in Southern Italian regions
Japan	Smart grid that incorporates solar power generation by 2020 with government investment of over USD 100 million
South Korea	USD 65 million pilot programme on Jeju Island in partnership with industry.
Spain	Endesa aims to deploy automated meter management to more than 13 million customers & Iberdrola will replace 10 million meters.
Germany	The E-Energy funding programme has several projects focusing on ICTs for the energy system

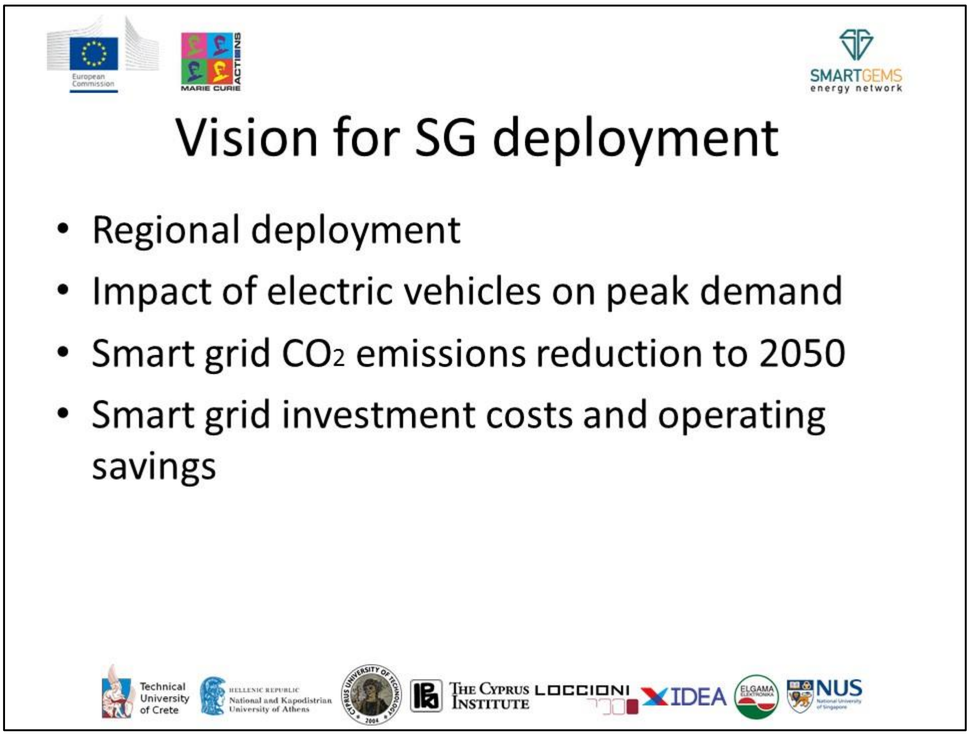
Smart Grid Deployment

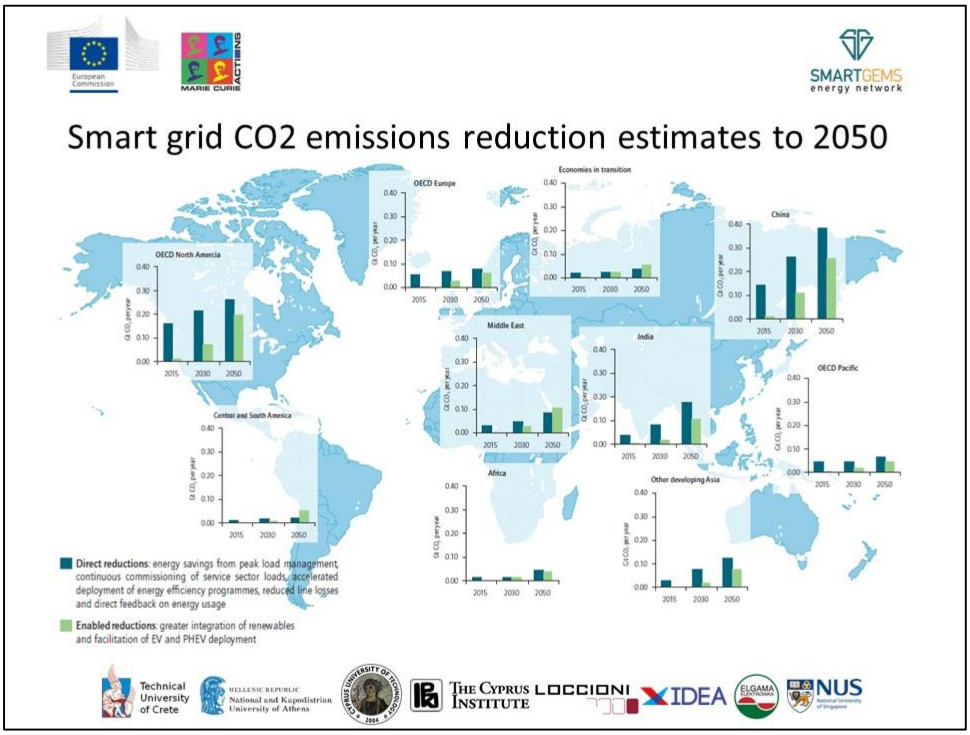
Country	Initiative
Australia	AUD 100 million "Smart Grid, Smart City" initiative
UK	Up to GPB 500m support to DSO projects that test new technology, operating and commercial arrangements
France	ERDF will replace all of its 35 million meters with smart meters from 2012 to 2016
Brazil	Various smart grid on power line carrier trials, smart meters to reduce illegal losses, fibre-optic backbone utilization, research projects etc.
Greece	Pilot implementation of smart meters , research projects

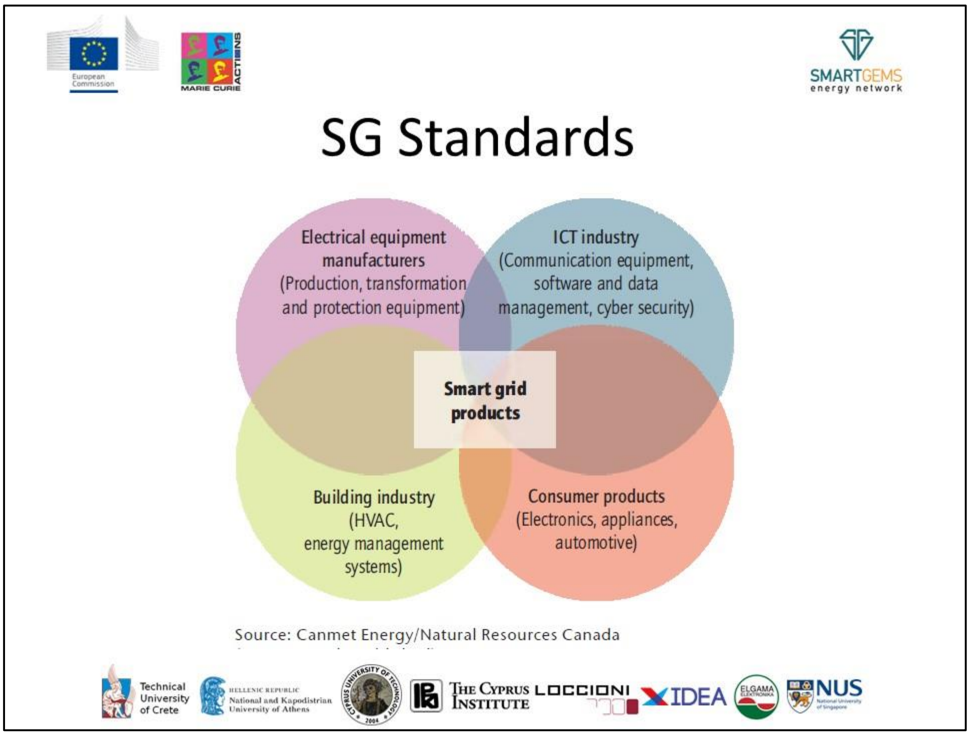
SG in developing countries



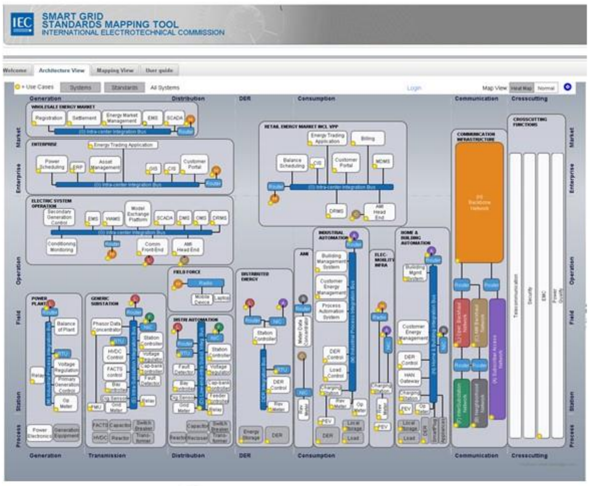

Electricity system markets & regulation
Vertically integrated electric utility
Generation
Transmission
Distribution
Retail
Unbundled electricity market
Market activities
G1
G2
Gn
Regulated activities
Transmission
Distribution
Market activities
R1
R2
Rn
Source: Enexis, 2010.


Vision for SG deployment
• Regional deployment
• Impact of electric vehicles on peak demand
• Smart grid CO2 emissions reduction to 2050
• Smart grid investment costs and operating savings


Smart grid CO2 emissions reduction estimates to 2050
OECD North America
OECD Europe
Economies in transition
China
Middle East
India
OECD Pacific
Central and South America
Africa
Other developing Asia
2015 2030 2050
Direct reductions: energy savings from peak load management, continuous commissioning of service sector loads, accelerated deployment of energy efficiency programmes, reduced line losses and direct feedback on energy usage
Enabled reductions: greater integration of renewables and facilitation of EV and PHEV deployment

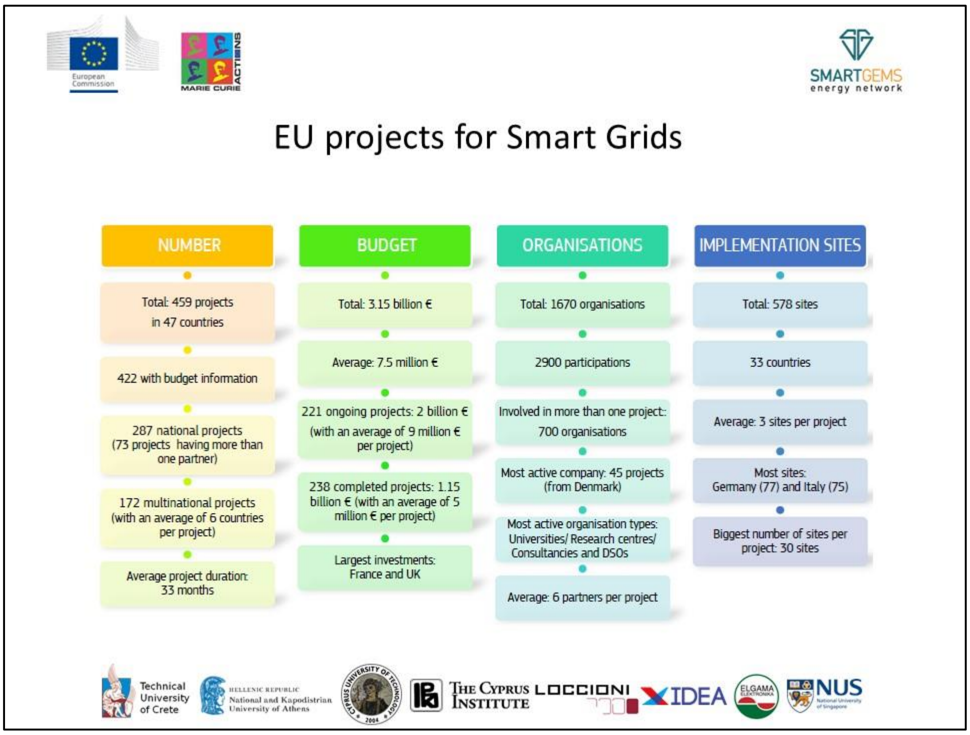

SG Standards
Electrical equipment manufacturers (Production, transformation and protection equipment)
ICT industry (Communication equipment, software and data management, cyber security)
Smart grid products
Building industry (HVAC, energy management systems)
Consumer products (Electronics, appliances, automotive)
Source: Canmet Energy/Natural Resources Canada

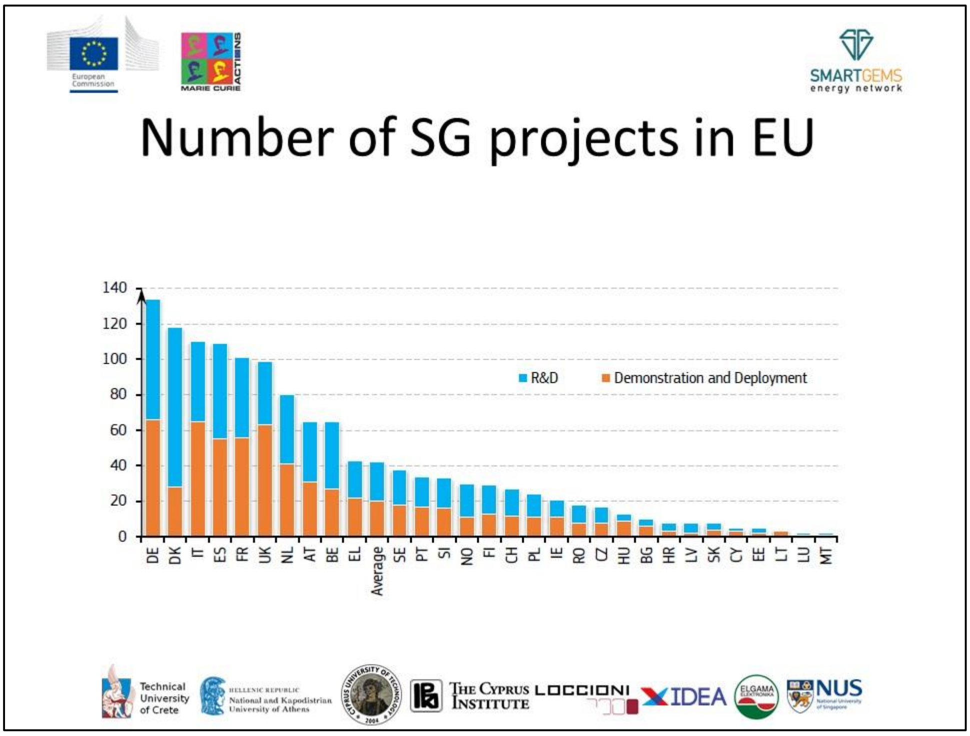
Smart Grid Standards Mapping Tool



Policy & Regulatory Framework

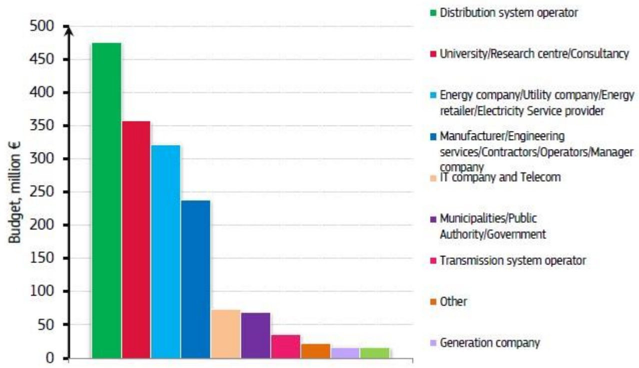
- Foster international collaboration
- Balance in sharing costs, benefits and risks
- Building consensus on smart grid deployment
- Smart consumer and consumer protection policies
- Social safety net


EU projects for Smart Grids
NUMBER
Total: 459 projects in 47 countries
422 with budget information
287 national projects (73 projects having more than one partner)
172 multinational projects (with an average of 6 countries per project)
Average project duration: 33 months
BUDGET
Total: 3.15 billion €
Average: 7.5 million €
221 ongoing projects: 2 billion € (with an average of 9 million € per project)
238 completed projects: 1.15 billion € (with an average of 5 million € per project)
Largest investments: France and UK
ORGANISATIONS
Total: 1670 organisations
2900 participations
Involved in more than one project: 700 organisations
Most active company: 45 projects (from Denmark)
Most active organisation types: Universities/ Research centres/ Consultancies and DSOs
Average: 6 partners per project
IMPLEMENTATION SITES
Total: 578 sites
33 countries
Average: 3 sites per project
Most sites: Germany (77) and Italy (75)
Biggest number of sites per project: 30 sites
SMARTGEMS energy network


Number of SG projects in EU
R&D
Demonstration and Deployment
0
20
40
60
80
100
120
140
DE DK IT ES FR UK NL AT BE EL Average SE PT SI NO FI CH PL IE RO CZ HU BG HR LV SK CY EE LT LU MT
SMARTGEMS energy network

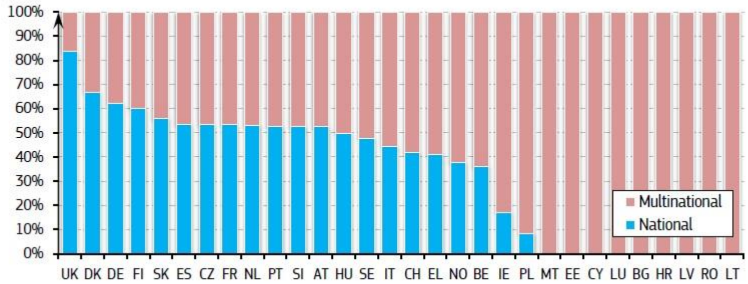
SMARTGEMS energy network

Budget by organisation type

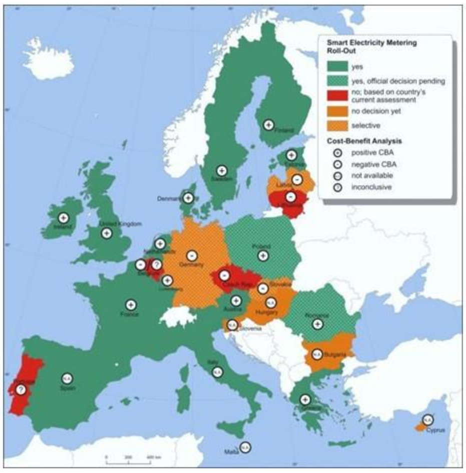


SMARTGEMS energy network

National / Multinational Collaboration

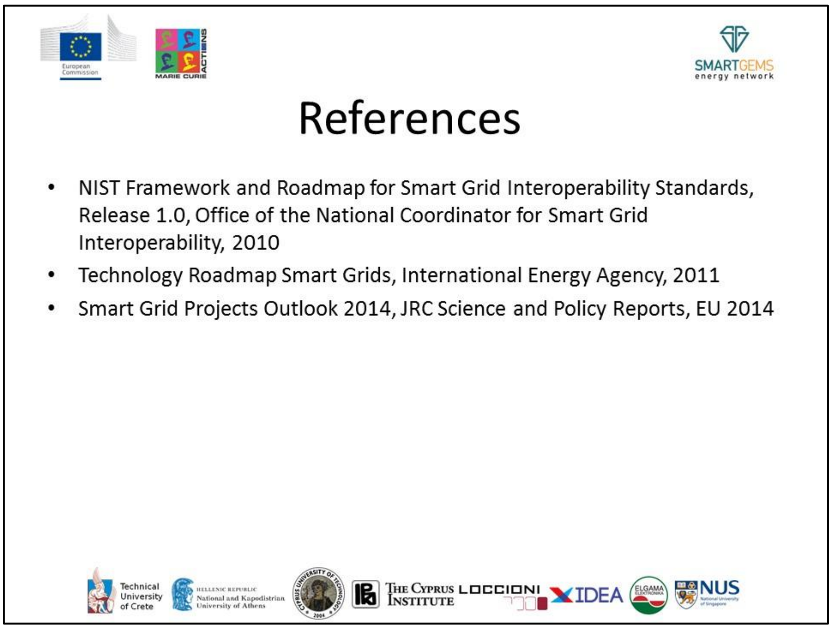


Smart metering roll-out



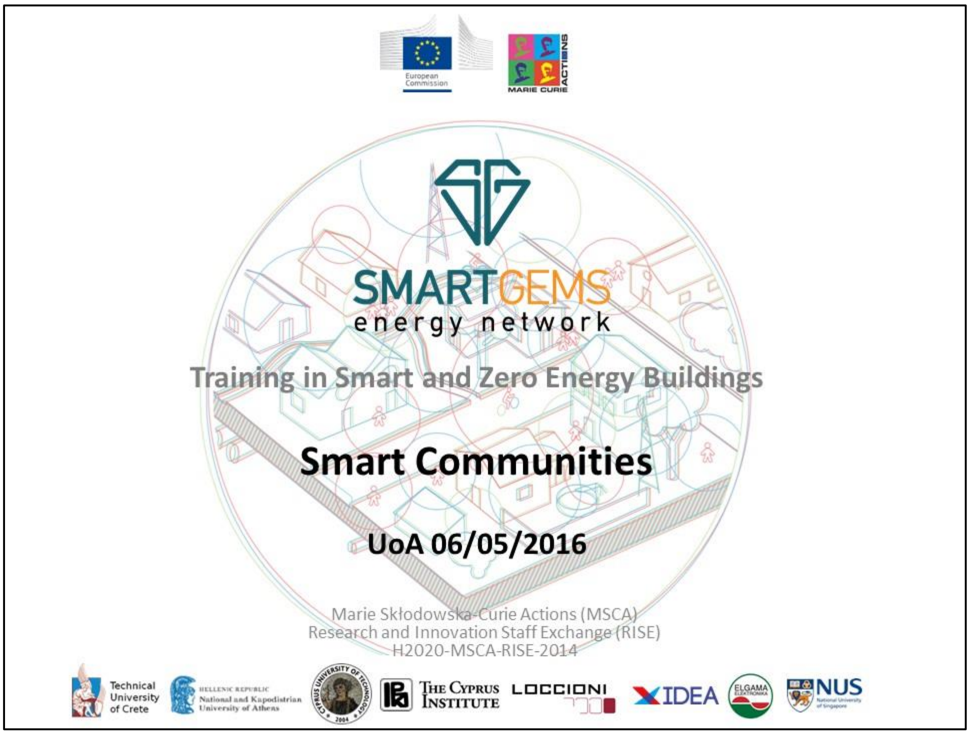
Conclusions

- SG offer potential for moving towards a more sustainable energy supply system
  - Changes power system planning and operation of electricity markets.
  - Empowers customers manage electricity consumption
  - Enables system operators understand and meet users' needs
- Broadness and complexity can be addressed only through the effective collaboration of governments, policy and regulatory organisations and the private sector

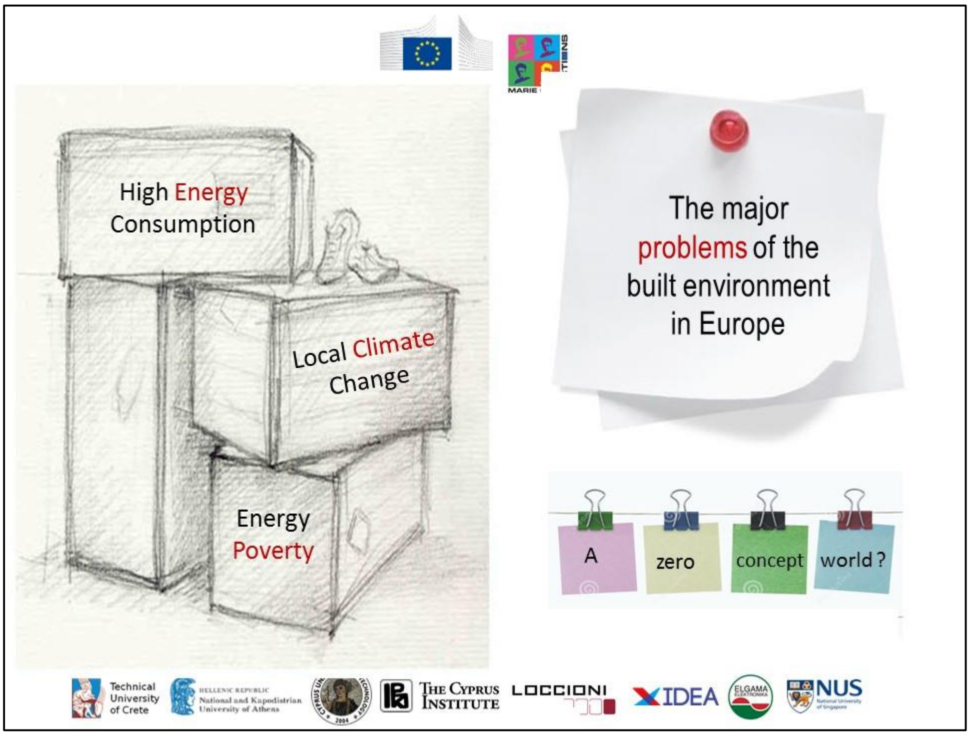

References
NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0, Office of the National Coordinator for Smart Grid Interoperability, 2010
Technology Roadmap Smart Grids, International Energy Agency, 2011
Smart Grid Projects Outlook 2014, JRC Science and Policy Reports, EU 2014

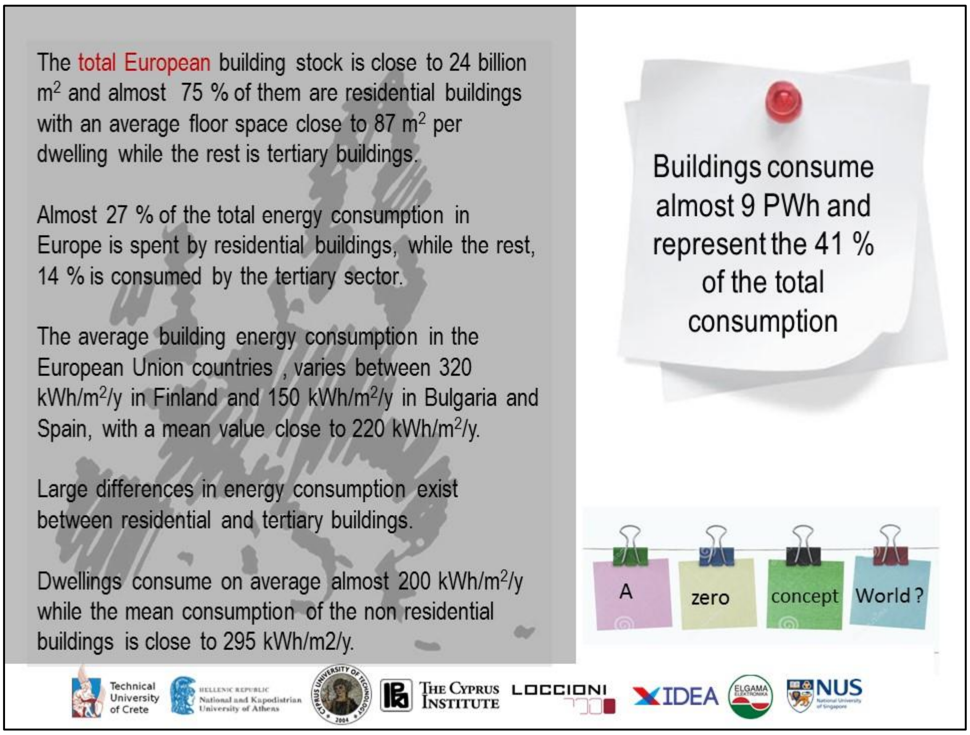
Annex II: Slides of the 2nd Webinar - Smart Communities organised by UOA and CyI

Slides of the Webinar organised by UOA




Development of Smart
and NZEB Protocols
for Europe,
M. Santamouris
Technical University of Crete
The Cyprus Institute
LOCCIONI
IDEA
NUS


High Energy
Consumption
Local Climate
Change
Energy
Poverty
The major
problems of the
built environment
in Europe
A
zero
concept
world ?


The total European building stock is close to 24 billion m2 and almost 75 % of them are residential buildings with an average floor space close to 87 m2 per dwelling while the rest is tertiary buildings.
Almost 27 % of the total energy consumption in Europe is spent by residential buildings, while the rest, 14 % is consumed by the tertiary sector.
The average building energy consumption in the European Union countries , varies between 320 kWh/m2/y in Finland and 150 kWh/m2/y in Bulgaria and Spain, with a mean value close to 220 kWh/m2/y.
Large differences in energy consumption exist between residential and tertiary buildings.
Dwellings consume on average almost 200 kWh/m2/y while the mean consumption of the non residential buildings is close to 295 kWh/m2/y.
Buildings consume almost 9 PWh and represent the 41 % of the total consumption
A
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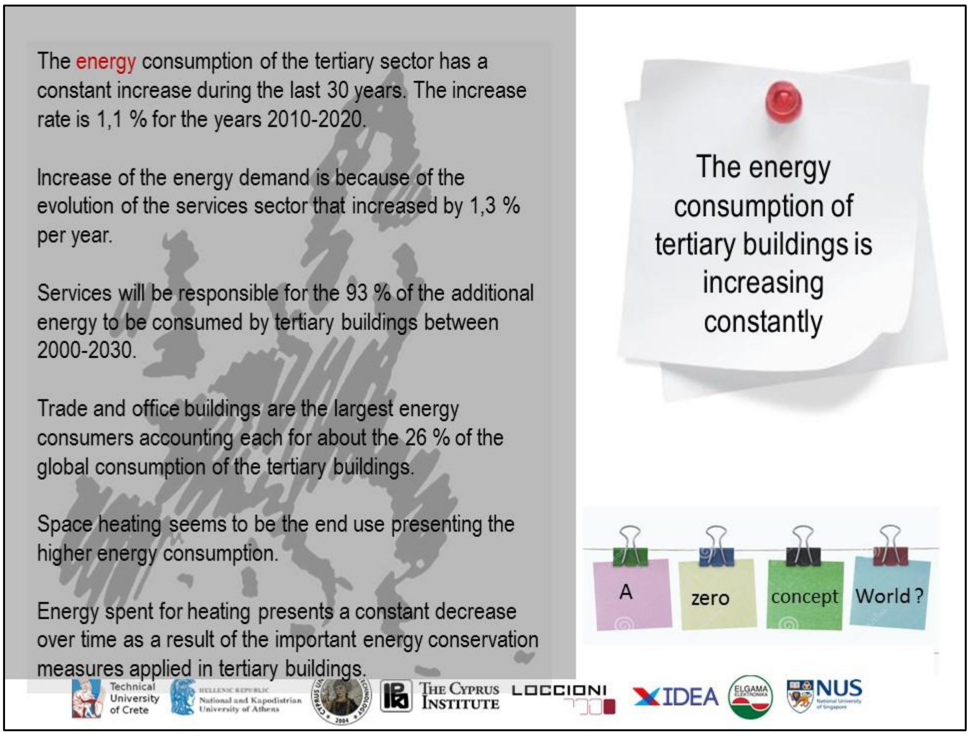
World ?


The energy consumption of the tertiary sector has a constant increase during the last 30 years. The increase rate is 1,1 % for the years 2010-2020.
Increase of the energy demand is because of the evolution of the services sector that increased by 1,3 % per year.
Services will be responsible for the 93 % of the additional energy to be consumed by tertiary buildings between 2000-2030.
Trade and office buildings are the largest energy consumers accounting each for about the 26 % of the global consumption of the tertiary buildings.
Space heating seems to be the end use presenting the higher energy consumption.
Energy spent for heating presents a constant decrease over time as a result of the important energy conservation measures applied in tertiary buildings.
The energy consumption of tertiary buildings is increasing constantly
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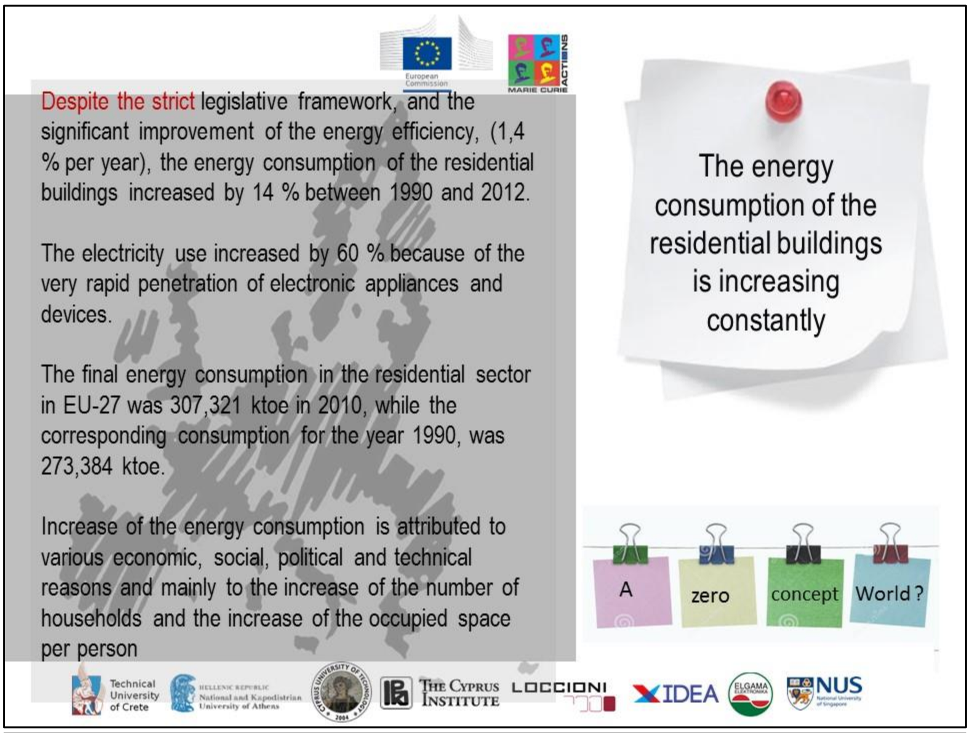
Despite the strict legislative framework, and the significant improvement of the energy efficiency, (1,4 % per year), the energy consumption of the residential buildings increased by 14 % between 1990 and 2012.
The electricity use increased by 60 % because of the very rapid penetration of electronic appliances and devices.
The final energy consumption in the residential sector in EU-27 was 307,321 ktoe in 2010, while the corresponding consumption for the year 1990, was 273,384 ktoe.
Increase of the energy consumption is attributed to various economic, social, political and technical reasons and mainly to the increase of the number of households and the increase of the occupied space per person
The energy consumption of the residential buildings is increasing constantly
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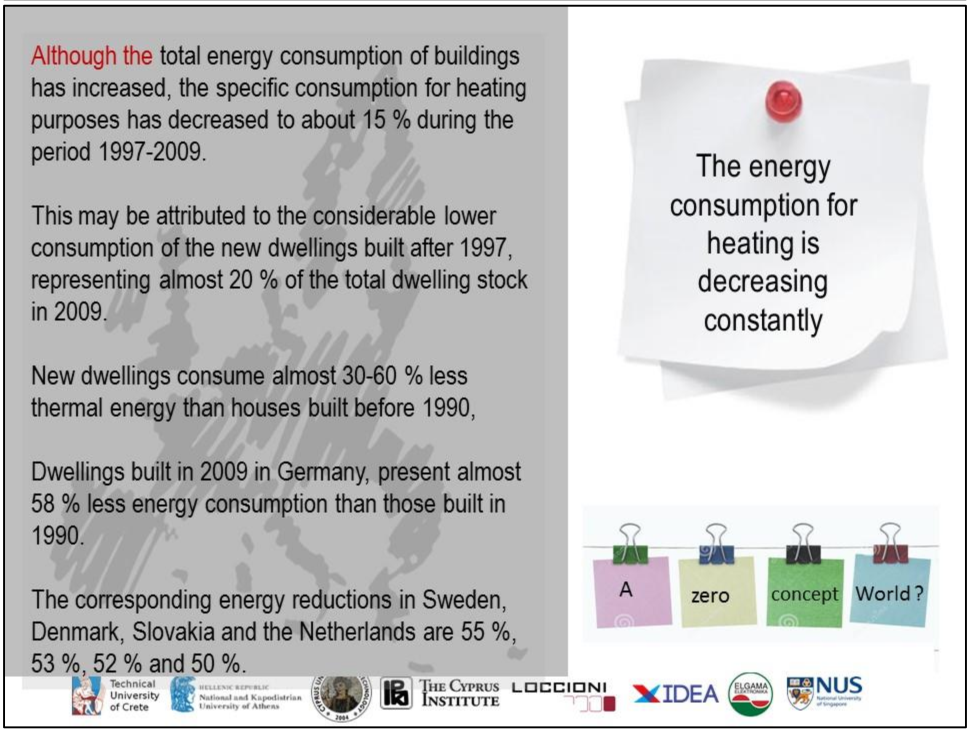
Although the total energy consumption of buildings has increased, the specific consumption for heating purposes has decreased to about 15 % during the period 1997-2009.
This may be attributed to the considerable lower consumption of the new dwellings built after 1997, representing almost 20 % of the total dwelling stock in 2009.
New dwellings consume almost 30-60 % less thermal energy than houses built before 1990,
Dwellings built in 2009 in Germany, present almost 58 % less energy consumption than those built in 1990.
The corresponding energy reductions in Sweden, Denmark, Slovakia and the Netherlands are 55 %, 53 %, 52 % and 50 %.
The energy consumption for heating is decreasing constantly
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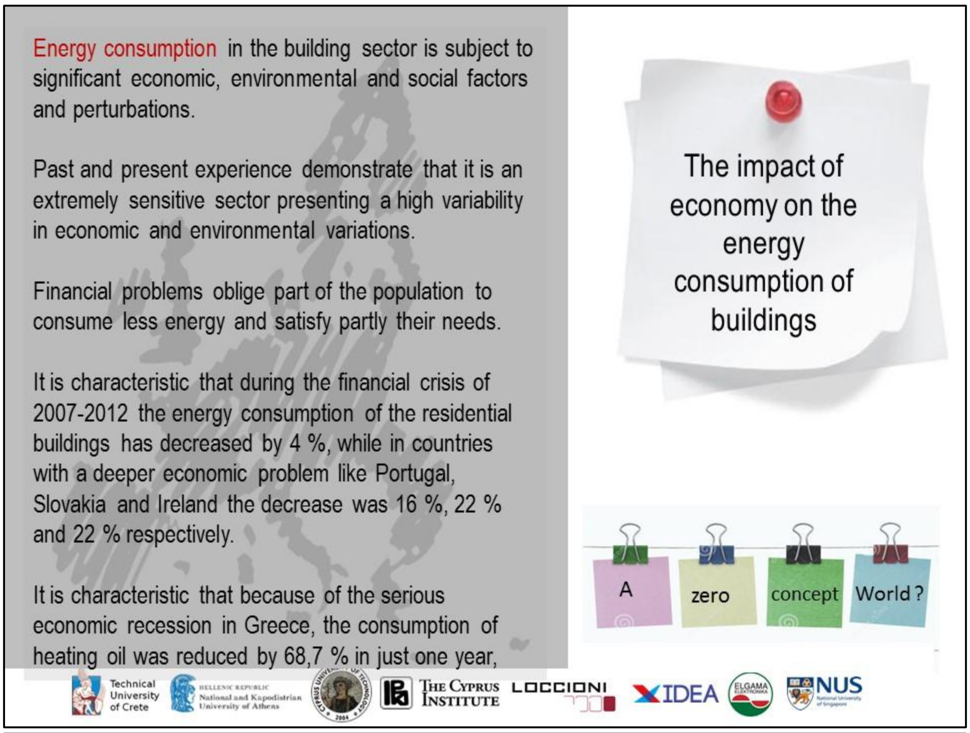
Energy consumption in the building sector is subject to significant economic, environmental and social factors and perturbations.
Past and present experience demonstrate that it is an extremely sensitive sector presenting a high variability in economic and environmental variations.
Financial problems oblige part of the population to consume less energy and satisfy partly their needs.
It is characteristic that during the financial crisis of 2007-2012 the energy consumption of the residential buildings has decreased by 4 %, while in countries with a deeper economic problem like Portugal, Slovakia and Ireland the decrease was 16 %, 22 % and 22 % respectively.
It is characteristic that because of the serious economic recession in Greece, the consumption of heating oil was reduced by 68,7 % in just one year,
The impact of economy on the energy consumption of buildings
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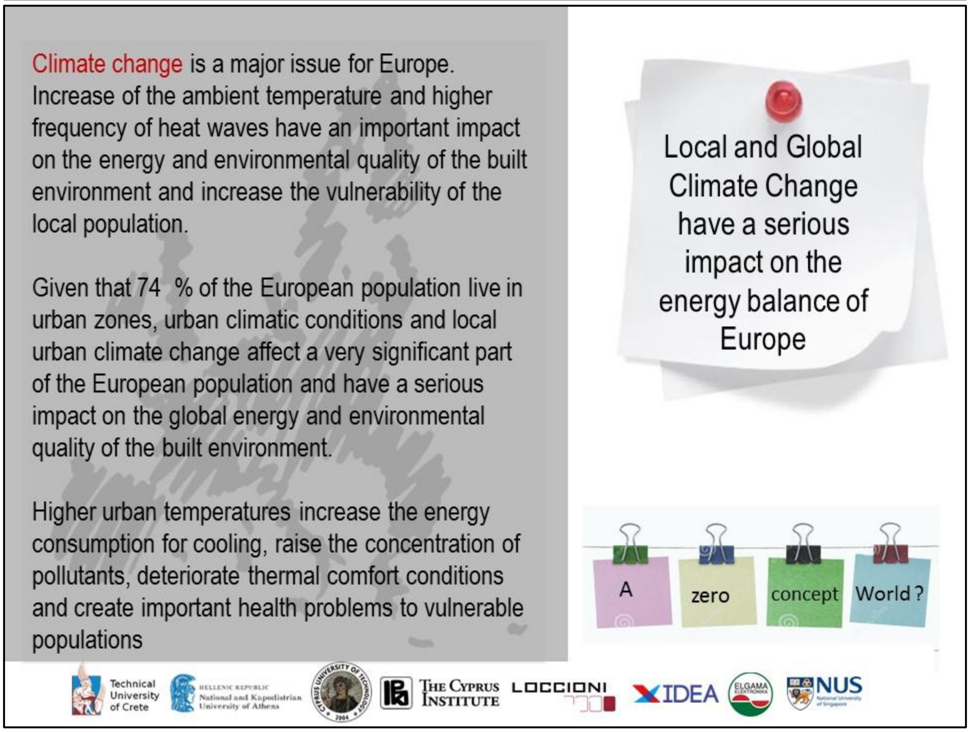
Climate change is a major issue for Europe. Increase of the ambient temperature and higher frequency of heat waves have an important impact on the energy and environmental quality of the built environment and increase the vulnerability of the local population.
Given that 74 % of the European population live in urban zones, urban climatic conditions and local urban climate change affect a very significant part of the European population and have a serious impact on the global energy and environmental quality of the built environment.
Higher urban temperatures increase the energy consumption for cooling, raise the concentration of pollutants, deteriorate thermal comfort conditions and create important health problems to vulnerable populations
Local and Global Climate Change have a serious impact on the energy balance of Europe
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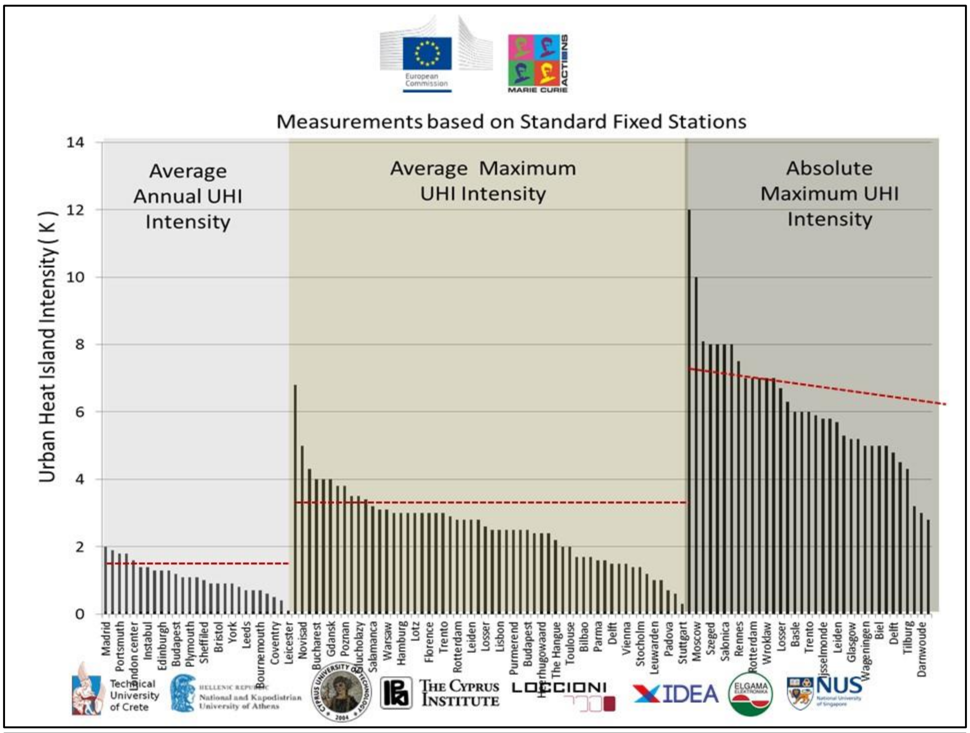
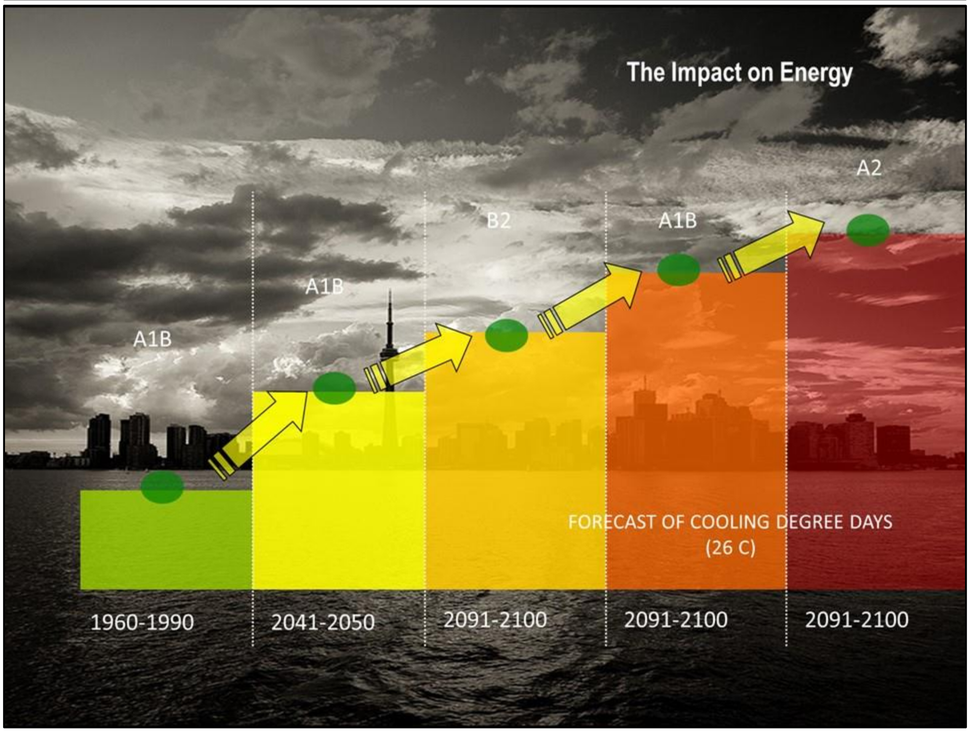
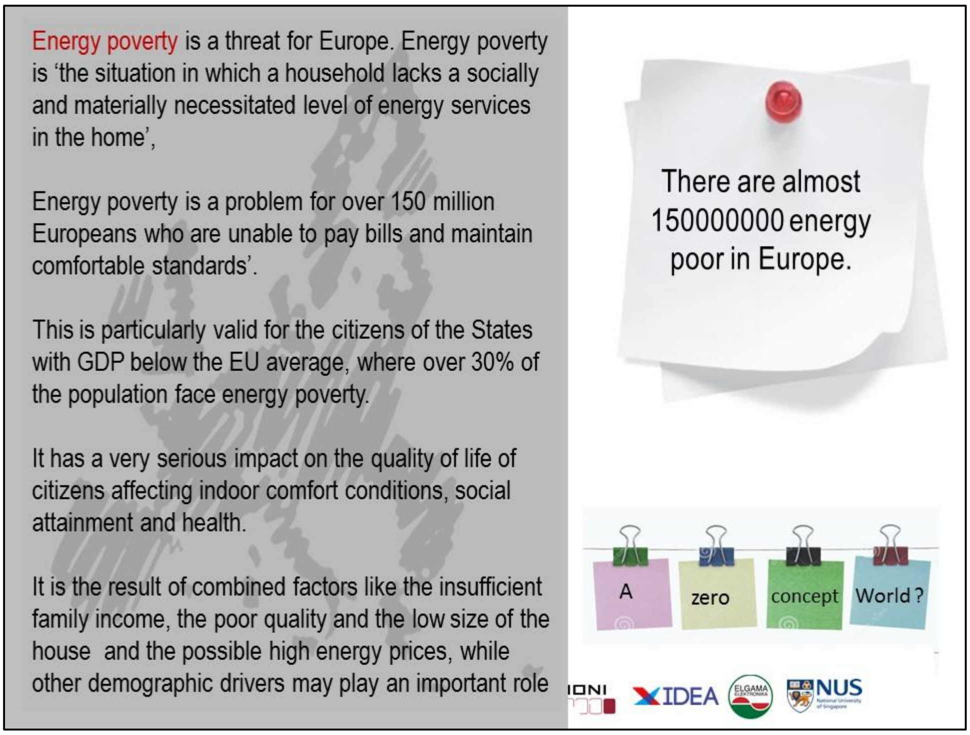
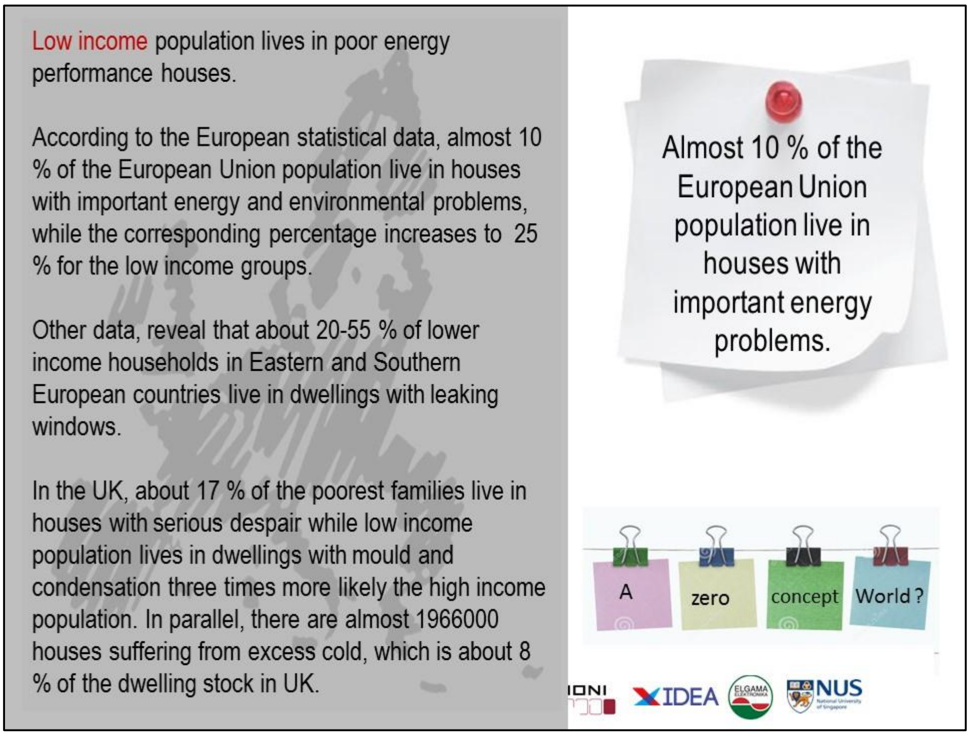
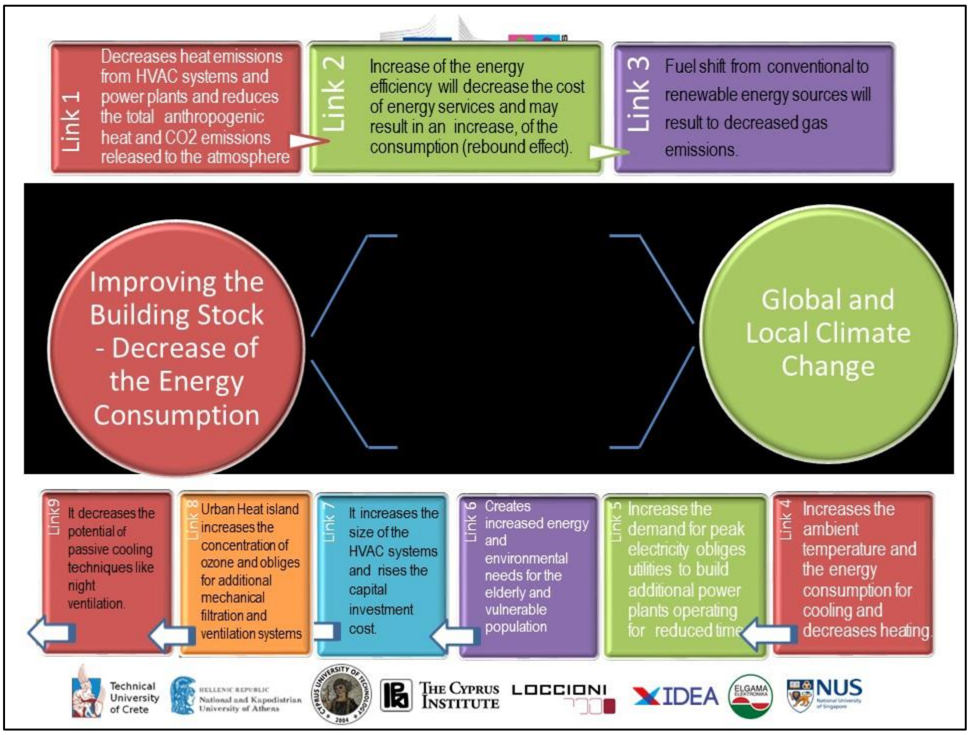

Measurements based on Standard Fixed Stations
Average Annual UHI Intensity
Average Maximum UHI Intensity
Absolute Maximum UHI Intensity
Urban Heat Island Intensity (K)
0
2
4
6
8
10
12
14
Madrid
Portsmuth
London center
Instabul
Edinburgh
Budapest
Plymouth
Sheffiled
Bristol
York
Leeds
Bournemouth
Coventry
Leicester
Novisad
Bucharest
Gdansk
Poznan
Glucholazy
Salamanca
Warsaw
Hamburg
Lotz
Florence
Trento
Rotterdam
Leiden
Losser
Lisbon
Purmerend
Budapest
Heerhugowaard
The Hangue
Toulouse
Bilbao
Parma
Delft
Vienna
Stocholm
Leuwarden
Padova
Stuttgart
Moscow
Szeged
Salonica
Rennes
Rotterdam
Wroklaw
Losser
Basle
Trento
IJsselmonde
Leiden
Glasgow
Wageningen
Biel
Delft
Tilburg
Darnwoude


The Impact on Energy
A1B
A1B
B2
A1B
A2
FORECAST OF COOLING DEGREE DAYS
(26 C)
1960-1990
2041-2050
2091-2100
2091-2100
2091-2100


Energy poverty is a threat for Europe. Energy poverty is 'the situation in which a household lacks a socially and materially necessitated level of energy services in the home',
Energy poverty is a problem for over 150 million Europeans who are unable to pay bills and maintain comfortable standards'.
This is particularly valid for the citizens of the States with GDP below the EU average, where over 30% of the population face energy poverty.
It has a very serious impact on the quality of life of citizens affecting indoor comfort conditions, social attainment and health.
It is the result of combined factors like the insufficient family income, the poor quality and the low size of the house and the possible high energy prices, while other demographic drivers may play an important role
There are almost 150000000 energy poor in Europe.
A
zero
concept
World ?
IDEA
NUS


Low income population lives in poor energy performance houses.
According to the European statistical data, almost 10 % of the European Union population live in houses with important energy and environmental problems, while the corresponding percentage increases to 25 % for the low income groups.
Other data, reveal that about 20-55 % of lower income households in Eastern and Southern European countries live in dwellings with leaking windows.
In the UK, about 17 % of the poorest families live in houses with serious despair while low income population lives in dwellings with mould and condensation three times more likely the high income population. In parallel, there are almost 1966000 houses suffering from excess cold, which is about 8 % of the dwelling stock in UK.
Almost 10 % of the European Union population live in houses with important energy problems.
A
zero
concept
World ?
IDEA
NUS


Link 1
Decreases heat emissions from HVAC systems and power plants and reduces the total anthropogenic heat and CO2 emissions released to the atmosphere
Link 2
Increase of the energy efficiency will decrease the cost of energy services and may result in an increase, of the consumption (rebound effect).
Link 3
Fuel shift from conventional to renewable energy sources will result to decreased gas emissions.
Improving the Building Stock - Decrease of the Energy Consumption
Global and Local Climate Change
Link9
It decreases the potential of passive cooling techniques like night ventilation.
Link 8
Urban Heat island increases the concentration of ozone and obliges for additional mechanical filtration and ventilation systems
Link 7
It increases the size of the HVAC systems and rises the capital investment cost.
Link 6
Creates increased energy and environmental needs for the elderly and vulnerable population
Link 5
Increase the demand for peak electricity obliges utilities to build additional power plants operating for reduced time
Link 4
Increases the ambient temperature and the energy consumption for cooling and decreases heating


The idea of a future 'zero concept world' involves an 'innovation to zero' strategy for all technologies related to emissions, wastes, defects etc.
The ultimate goal of the whole concept is to develop zero emission and zero waste technologies applied in zero energy and zero emission buildings and cities where advanced and innovative technologies and policies will be applied to minimize crime and diseases.
Although such a concept seems to be very radical and perhaps opportunistic, the idea incorporates exceptional features of a development road map that makes it particularly attractive.
Innovating to Zero : Zero Energy Consumption, Zero Climate Change, Zero Energy Poverty
A
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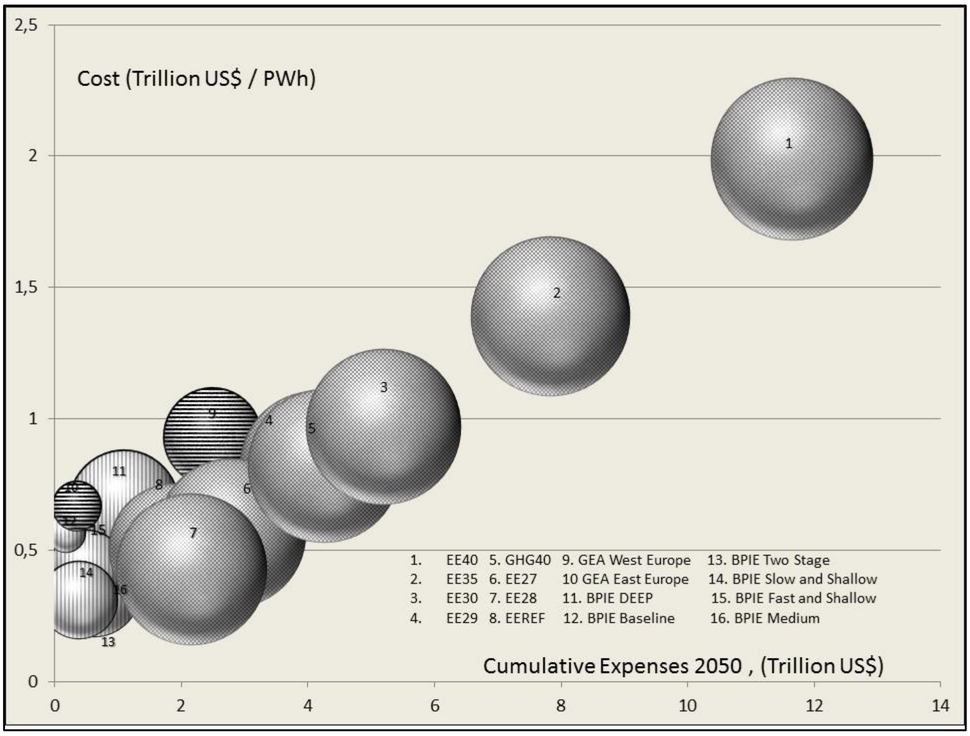
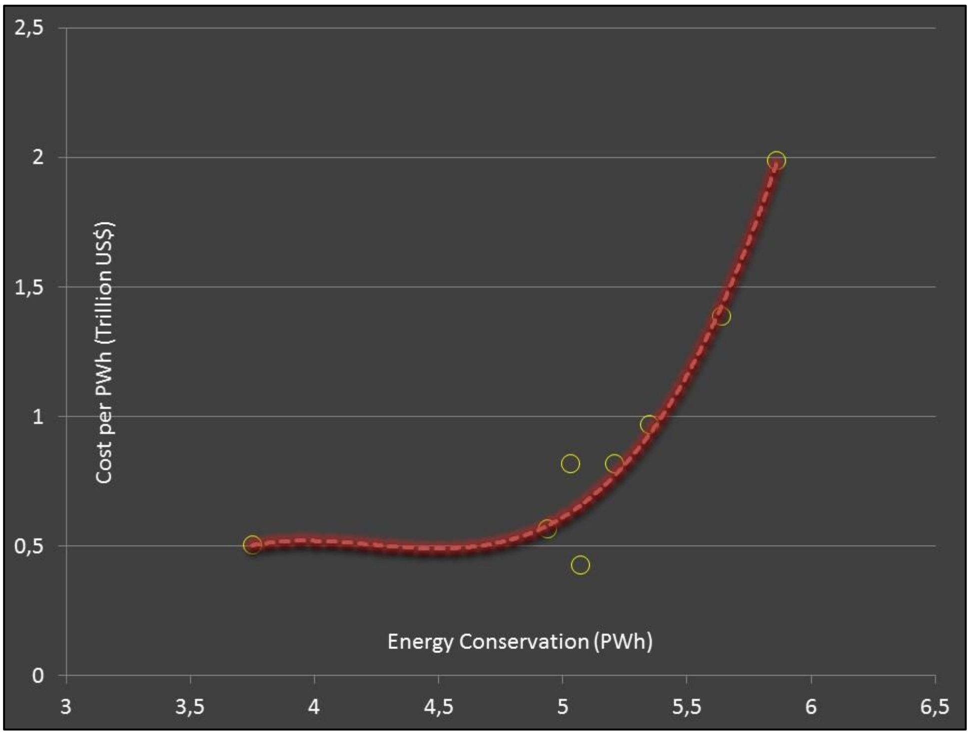
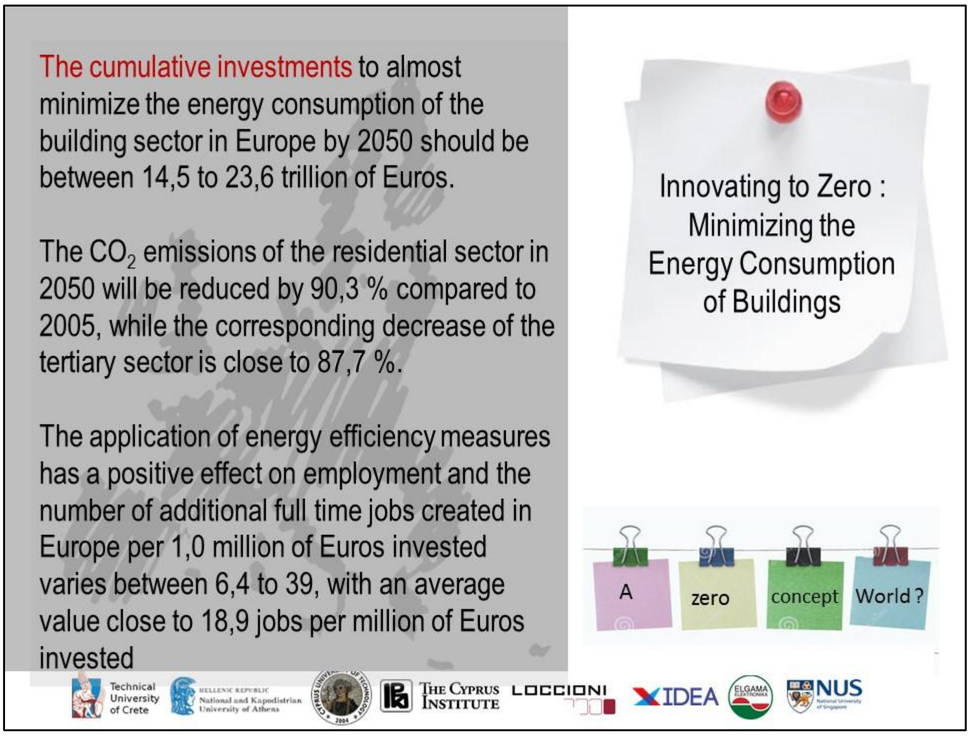
concept
World ?


Setting the future goals regarding :
• the energy consumption of buildings,
• b) the impact of the construction sector on the local climate change, and
• c) the possible levels of energy poverty, to zero
is an almost unequivocal choice.
Mankind needs an ambitious vision to proceed, it ought to set clear and ambitious future goals that certainly will be achieved gradually.
Innovating to Zero : Zero Energy Consumption, Zero Climate Change, Zero Energy Poverty
A
zero
concept
World ?


Even the attainment and satisfaction of some of these goals will be a major success and progress for our societies.
The adoption and achievement of the specific objectives require planning and follow of an innovative scientific and political agenda full of technological breakthroughs.
This involves significant investment in the construction sector , which will create substantial opportunities for the future and will certainly cause major medium and long term benefits for the society while alleviating the population by the intensity and the consequences of the particular problems
Innovating to Zero : Zero Energy Consumption, Zero Climate Change, Zero Energy Poverty
A
zero
concept
World ?


Cost (Trillion US$ / PWh)
2,5
2
1,5
1
0,5
0
0
2
4
6
8
10
12
14
1. EE40 5. GHG40 9. GEA West Europe 13. BPIE Two Stage
2. EE35 6. EE27 10 GEA East Europe 14. BPIE Slow and Shallow
3. EE30 7. EE28 11. BPIE DEEP 15. BPIE Fast and Shallow
4. EE29 8. EEREF 12. BPIE Baseline 16. BPIE Medium
Cumulative Expenses 2050 , (Trillion US$)


Cost per PWh (Trillion US$)
Energy Conservation (PWh)
2,5
2
1,5
1
0,5
0
3
3,5
4
4,5
5
5,5
6
6,5


The cumulative investments to almost minimize the energy consumption of the building sector in Europe by 2050 should be between 14,5 to 23,6 trillion of Euros.
The CO_2 emissions of the residential sector in 2050 will be reduced by 90,3 % compared to 2005, while the corresponding decrease of the tertiary sector is close to 87,7 %.
The application of energy efficiency measures has a positive effect on employment and the number of additional full time jobs created in Europe per 1,0 million of Euros invested varies between 6,4 to 39, with an average value close to 18,9 jobs per million of Euros invested
Innovating to Zero : Minimizing the Energy Consumption of Buildings
A
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concept
World ?

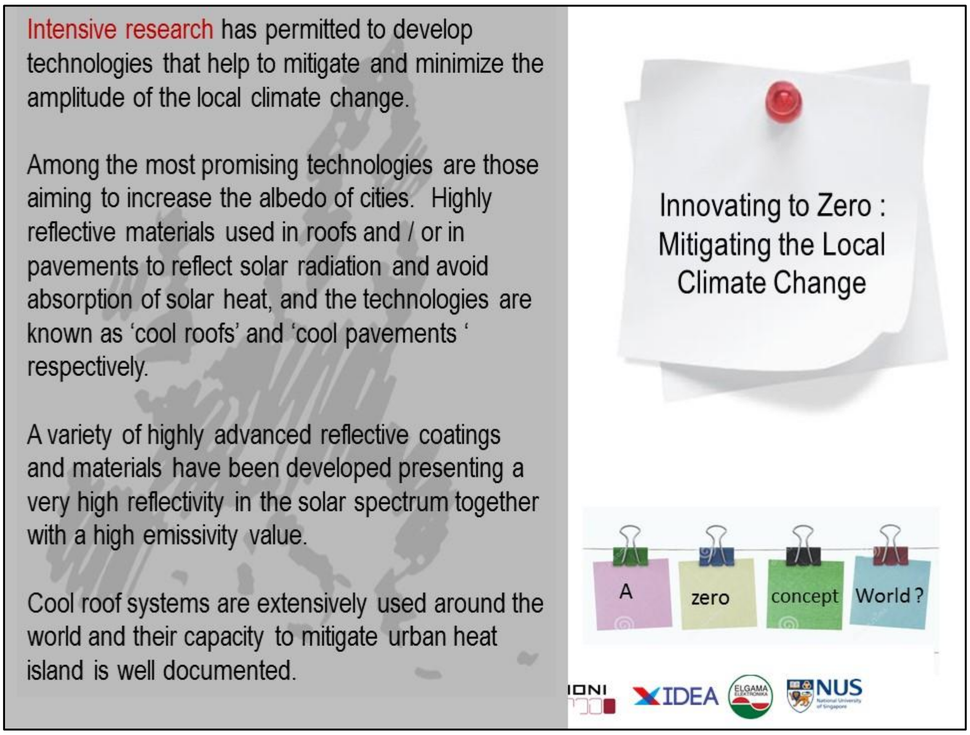
Policies - Actions	Required Investments	Energy Reduction	Full Time Jobs Anually Created (x 1000)	Other Benefits
Minimising the Energy Consumption of the Building Sector, (2007-2050)	Low Scenario :14,5 trillion Euros High Scenario : 23,6 trillion Euros	8,3 PWh	Low – High Scenarios 674-1097 (2jobs/M€) 2023-3293 (6 jobs/M€) 6406-10427 (19 jobs/M€)	Reduction of the CO_2 emissions by 89 %

Policies aiming to minimize the energy consumption of buildings should concentrate on three main technological axes aiming:

a) to increase the global energy efficiency of the building energy systems in order to seriously decrease the energy load and the final needs,

b) to supply the remaining energy load through clean and renewable technologies and

c) to optimize the management of the energy and environmental systems of the buildings through the use of smart and intelligent technologies


Intensive research has permitted to develop technologies that help to mitigate and minimize the amplitude of the local climate change.
Among the most promising technologies are those aiming to increase the albedo of cities. Highly reflective materials used in roofs and / or in pavements to reflect solar radiation and avoid absorption of solar heat, and the technologies are known as 'cool roofs' and 'cool pavements ' respectively.
A variety of highly advanced reflective coatings and materials have been developed presenting a very high reflectivity in the solar spectrum together with a high emissivity value.
Cool roof systems are extensively used around the world and their capacity to mitigate urban heat island is well documented.
Innovating to Zero : Mitigating the Local Climate Change
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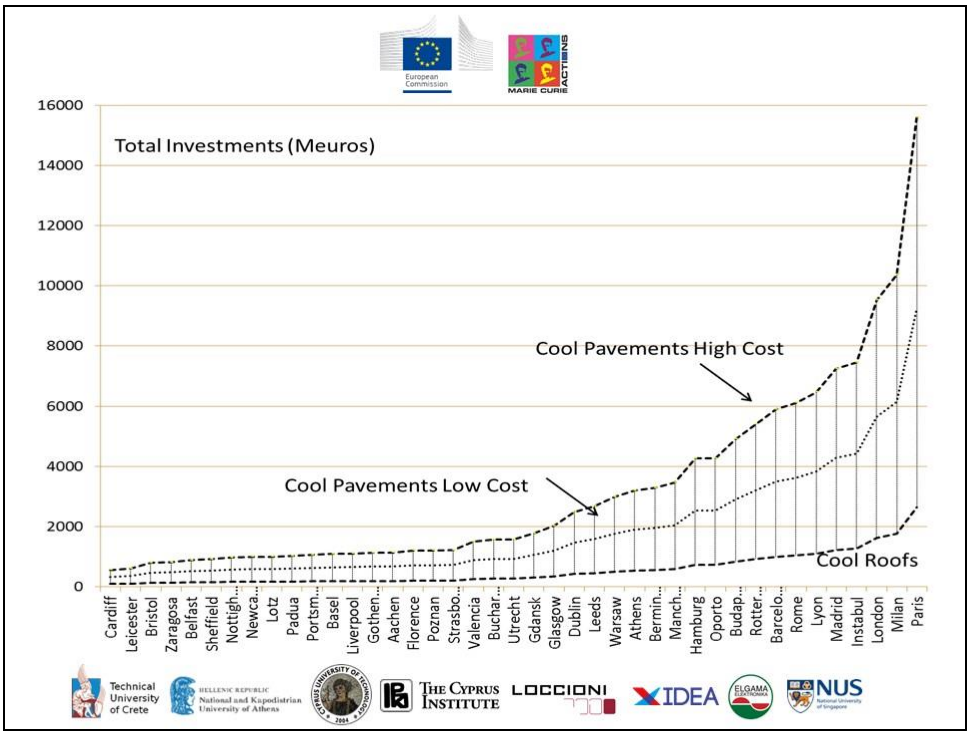
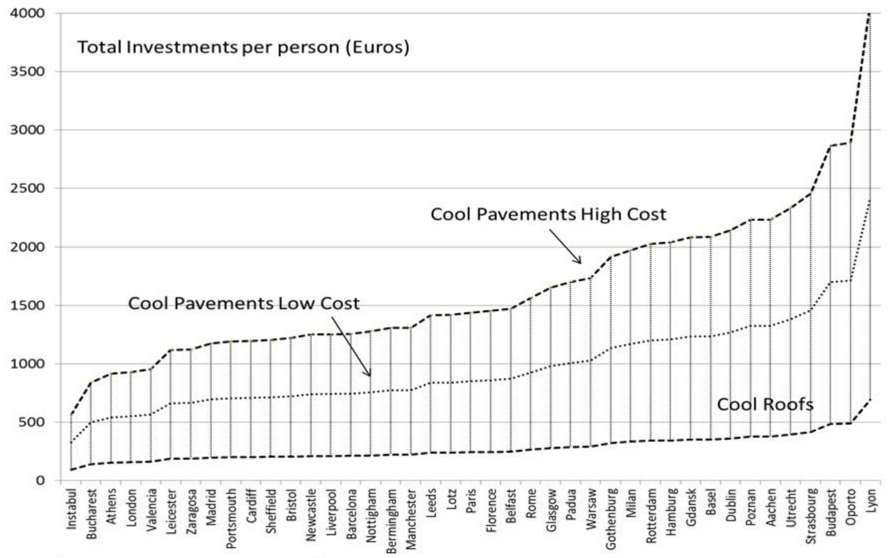
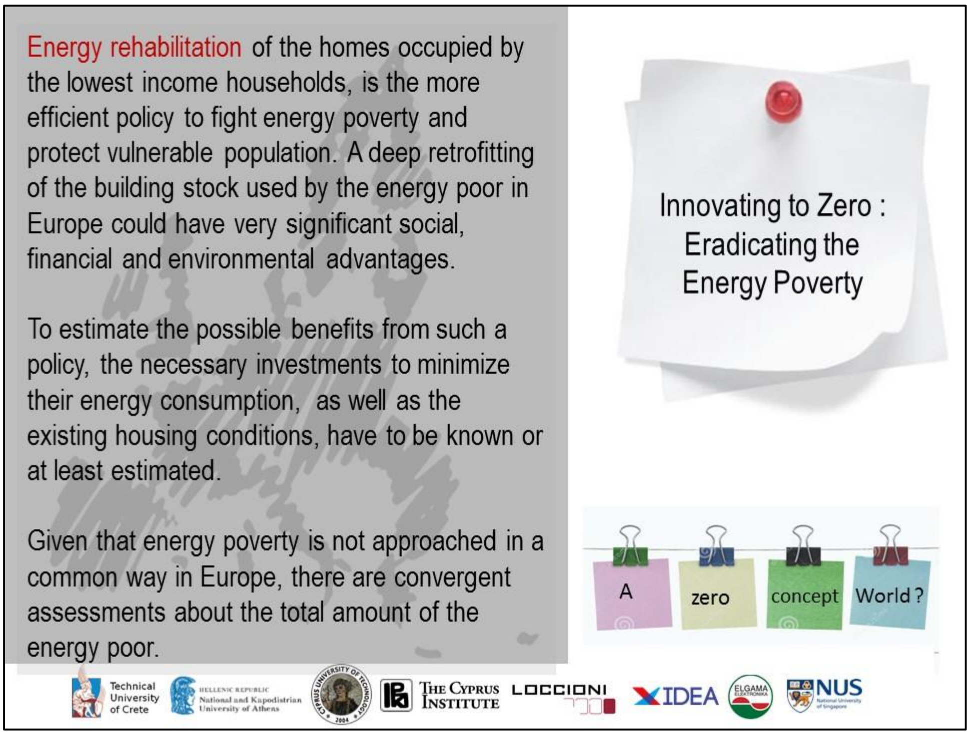

Total Investments (Meuros)
16000
14000
12000
10000
8000
6000
4000
2000
0
Cool Pavements High Cost
Cool Pavements Low Cost
Cool Roofs
Cardiff
Leicester
Bristol
Zaragosa
Belfast
Sheffield
Nottigh...
Newca...
Lotz
Padua
Portsm...
Basel
Liverpool
Gothen...
Aachen
Florence
Poznan
Strasbo...
Valencia
Buchar...
Utrecht
Gdansk
Glasgow
Dublin
Leeds
Warsaw
Athens
Bermin...
Manch...
Hamburg
Oporto
Budap...
Rotter...
Barcelo...
Rome
Lyon
Madrid
Instabul
London
Milan
Paris



Policies - Actions	Required Investments	Energy Reduction	Full Time Jobs Anually Created, (x 1000)	Other Benefits
Mitigating the Urban Heat Island, (2015-2050)	Cool Roofs : 22,2 €bn Cool Pavements Low : 78 €bn Cool Pavements High : 131,5 €bn	0,01-0,079 PWh	Cool Roofs 1,27 (2 jobs/M€) 3,82 (6 jobs/M€) 12,1 (19 jobs/M€) Cool Pavements (low-high) 4,45-7,52 (2 jobs/M€) 13,4-22,6 (6 jobs/M€) 42,3-72,4 (19 jobs/M€)	Cool Roofs : 0,178 $GtCO_2$ Cool Pavements : 0,185 $GtCO_2$


Energy rehabilitation of the homes occupied by the lowest income households, is the more efficient policy to fight energy poverty and protect vulnerable population. A deep retrofitting of the building stock used by the energy poor in Europe could have very significant social, financial and environmental advantages.
To estimate the possible benefits from such a policy, the necessary investments to minimize their energy consumption, as well as the existing housing conditions, have to be known or at least estimated.
Given that energy poverty is not approached in a common way in Europe, there are convergent assessments about the total amount of the energy poor.
Innovating to Zero : Eradicating the Energy Poverty
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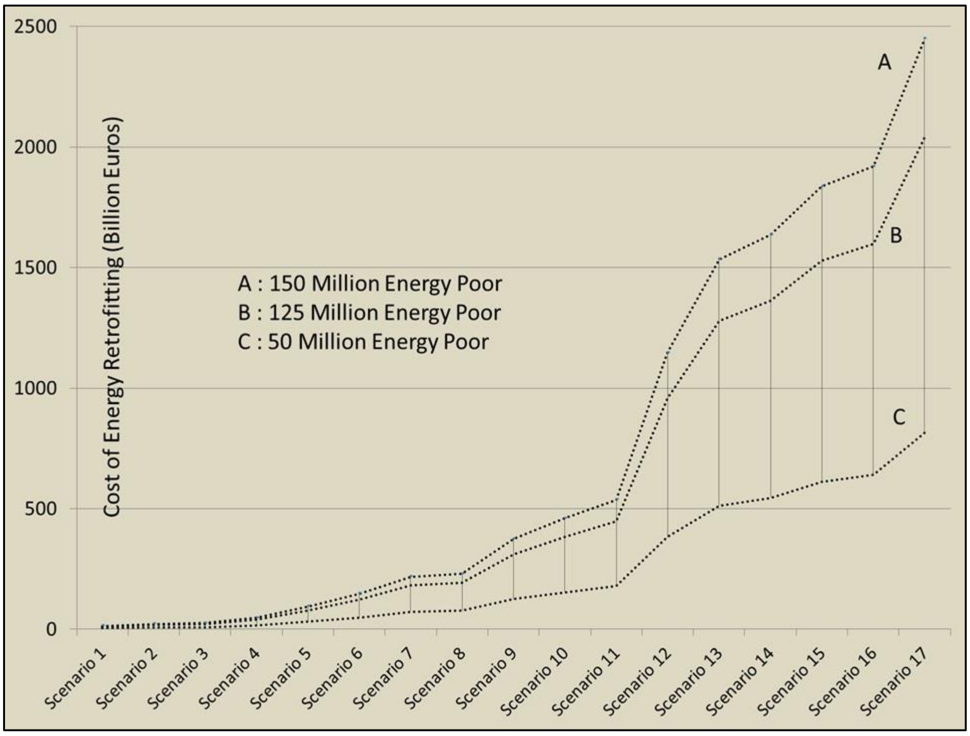
World ?


Cost of Energy Retrofitting (Billion Euros)
2500
2000
1500
1000
500
0
A : 150 Million Energy Poor
B : 125 Million Energy Poor
C : 50 Million Energy Poor
A
B
C
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5
Scenario 6
Scenario 7
Scenario 8
Scenario 9
Scenario 10
Scenario 11
Scenario 12
Scenario 13
Scenario 14
Scenario 15
Scenario 16
Scenario 17

Policies - Actions	Required Investments	Energy Reduction	Full Time Jobs Anually Created, (x 1000)	Other Benefits
Eradicating the Energy Poverty, (2015-2050)	Low Scenario : 1,1 trillion Euros High Scenario : 2,5 trillion Euros	0,61-1,39 PWh	Low – High Scenarios 224-366 (2jobs/M€) 197-420 (6 jobs/M€) 624-1330 (19 jobs/M€)	Reduction of Health Problems between 50-90 %.

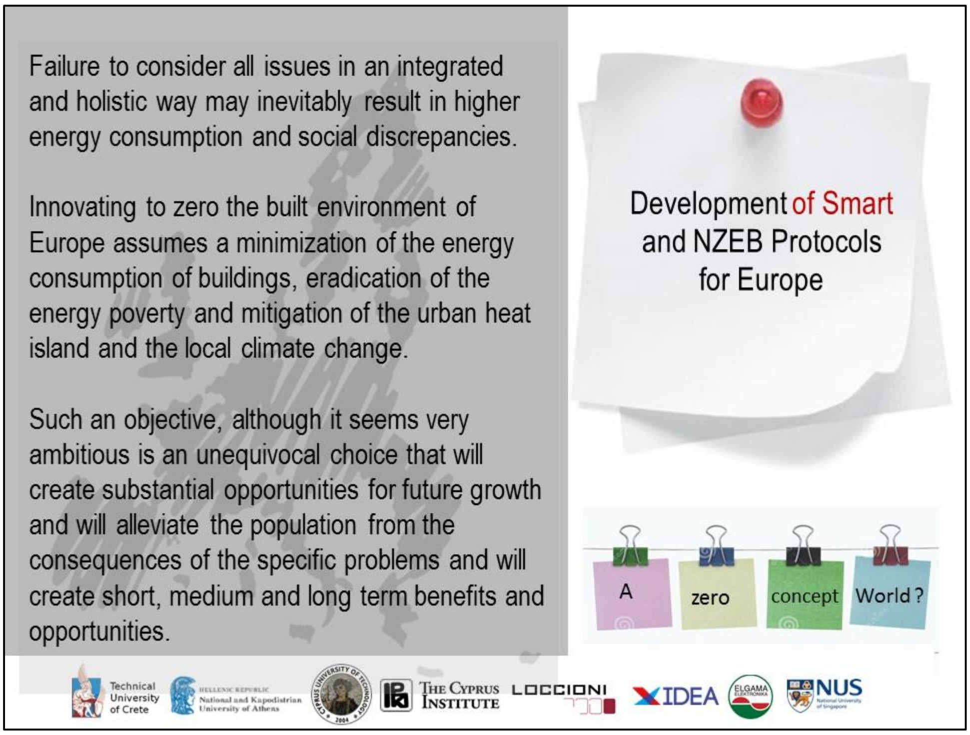
High Energy consumption of the building sector, local climate change and energy poverty are the major problems of the built environment in Europe.

The three sectors are strongly interrelated presenting very significant synergies and trade offs.

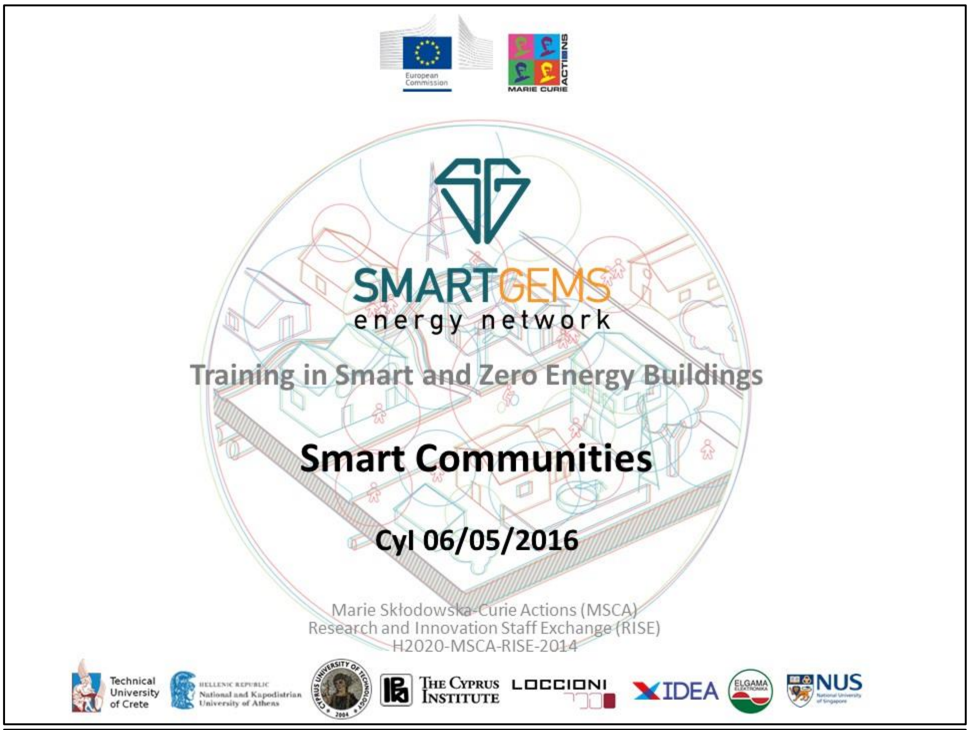
Existing policies aiming to reduce the energy consumption of the buildings usually underestimate the importance and the impact of the local and global climate change as well as the technical, social and economic implications related to the energy poverty.

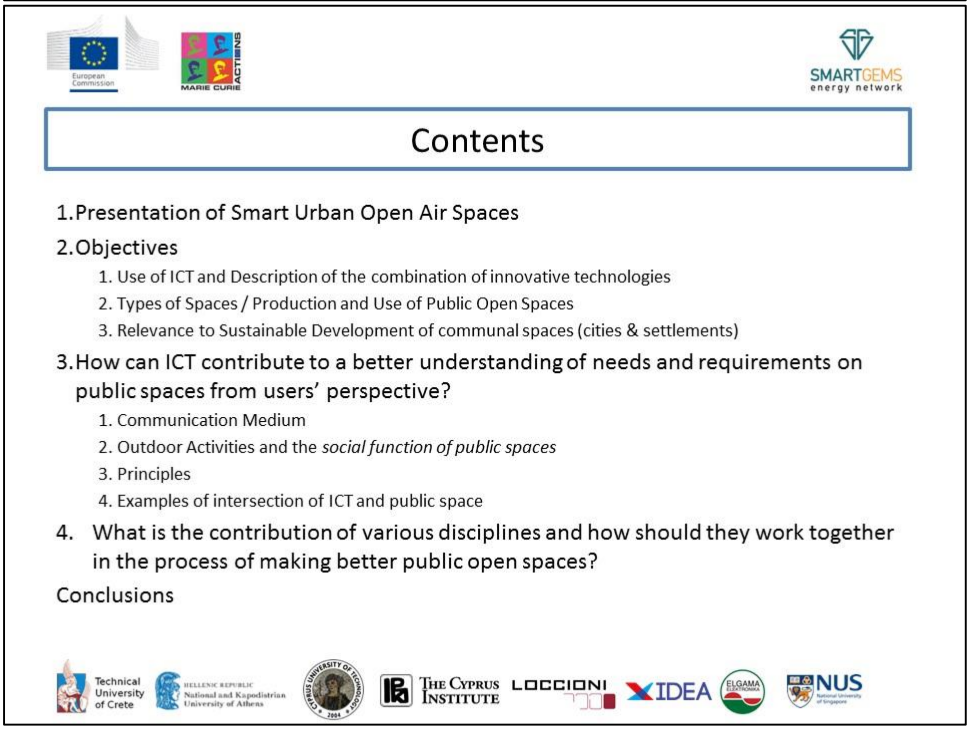
Development of Smart and NZEB Protocols for Europe,

A zero concept World ?


Failure to consider all issues in an integrated and holistic way may inevitably result in higher energy consumption and social discrepancies.
Innovating to zero the built environment of Europe assumes a minimization of the energy consumption of buildings, eradication of the energy poverty and mitigation of the urban heat island and the local climate change.
Such an objective, although it seems very ambitious is an unequivocal choice that will create substantial opportunities for future growth and will alleviate the population from the consequences of the specific problems and will create short, medium and long term benefits and opportunities.
Development of Smart and NZEB Protocols for Europe
A
zero
concept
World ?

Slides of the Webinar organised by CyI



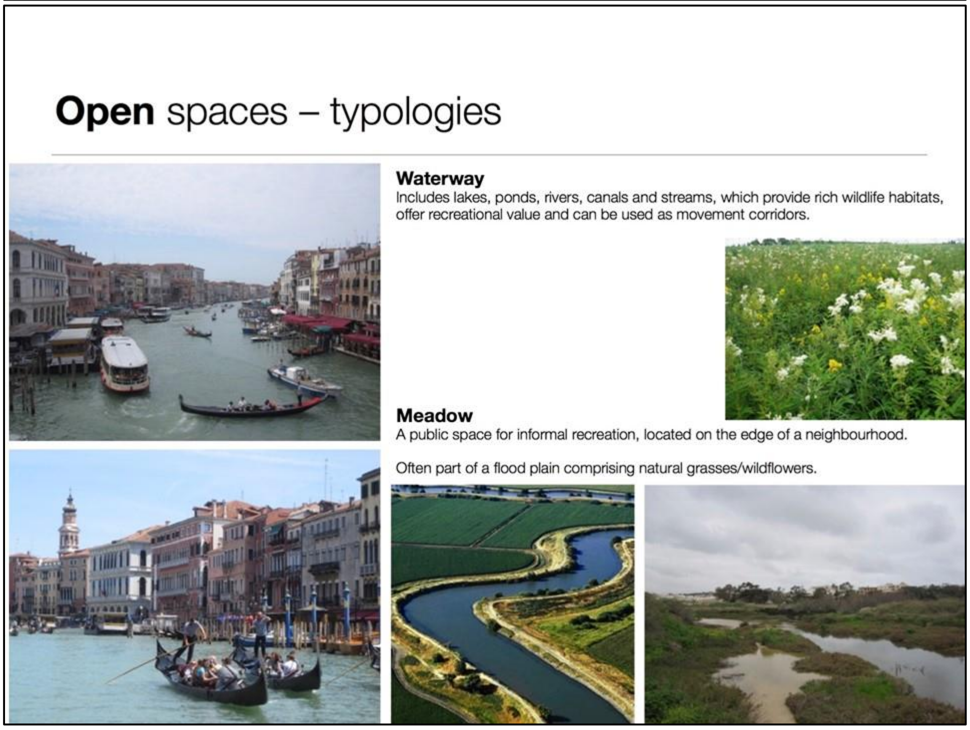


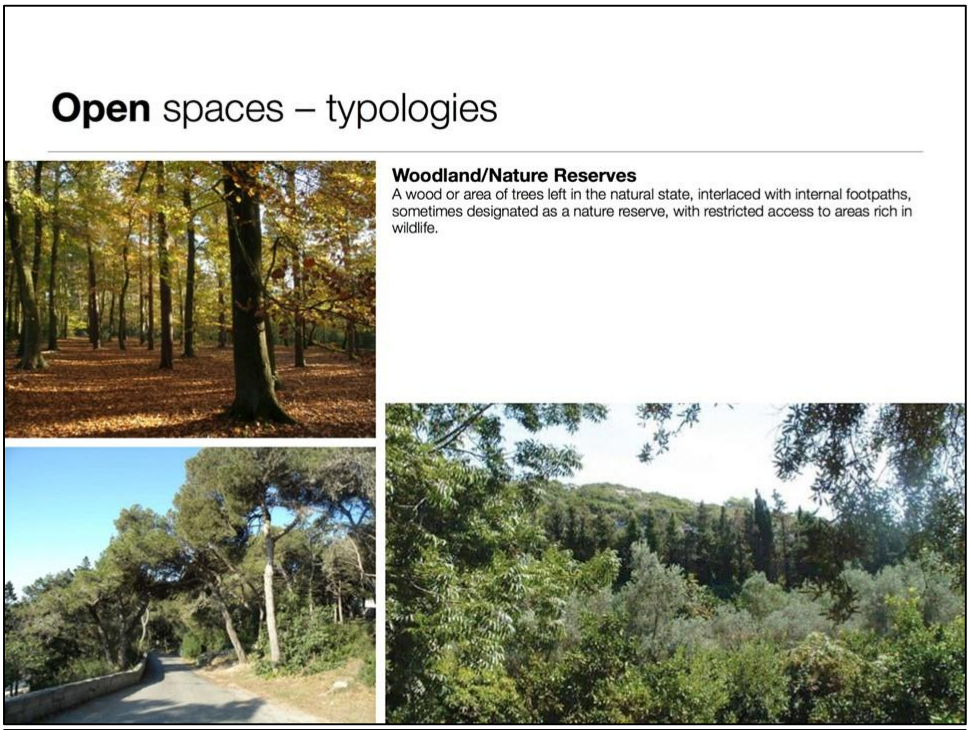
Can we utilize the developments in technology to inform change in the way places are designed and built, to work together with urban design and the physical urban infrastructure to develop socially cohesive, livable, sustainable environments?

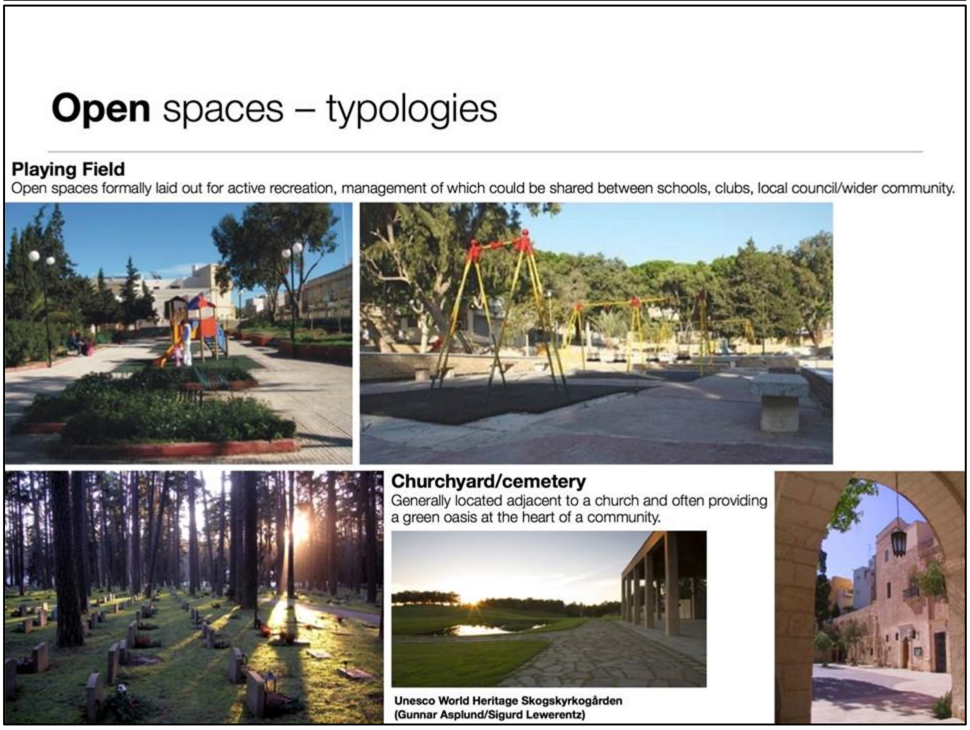
How does ICT Challenge Design thinking?

- **Traditional Affordances**: Exercise, play, socialising, relaxation, reconnection to nature, people watching, cultural and social events in open.
- **Physical Design:** Consideration of physical qualities-boundaries surfaces, street furniture, sculpture and water features, light-works, themed walks, implications for labelling and signing, construction of pavilions with projection or sound – embedded speakers/lights, speakers (corner) or cyber-pulpits. Co-creation, permanent v temporary constructions.
- **Data sharing:** Shared sports data on running route etc., histories- both personal and public. Encouraging social gatherings info (e.g. gaydar / wife-fi / Child-tracking).
- **Virtual spaces related to place:** Virtual art shows. Virtual classrooms. History reconstructions. A space of potential.
- **Monitoring and safety:** Citizen reporting v surveillance.
- **The Methodology** demands Experience Design / experience architecture. De-mark areas for play or non-engagement. Concentrate on enabling hybrid layers and flow. Ensure that any fixed affordances are a non-redundant design.
- **Guiding idea:** Encouraging Public space behaviour, re-focussing attention on the actual space. Avoiding the displacement phenomenon of the mobile and help re-experience the physicality of space.


(Ref: Roger Evans Associates Ltd. 2007. Delivering Quality Places: Urban Design Compendium 2. [online]. London: English Partnerships and the Housing Corporation)
Open spaces – typologies
Greenway
A network of spaces encompassing cycle and footpath routes, but also acting as 'wildlife corridors' – enabling wildlife to travel through urban areas.
Typically these follow linear natural or man-made routes e.g. streams, with 'green fingers' penetrating from the countryside through the town/city edge and into the urban core


Open spaces – typologies
Waterway
Includes lakes, ponds, rivers, canals and streams, which provide rich wildlife habitats, offer recreational value and can be used as movement corridors.
Meadow
A public space for informal recreation, located on the edge of a neighbourhood.
Often part of a flood plain comprising natural grasses/wildflowers.


Open spaces – typologies
Woodland/Nature Reserves
A wood or area of trees left in the natural state, interlaced with internal footpaths, sometimes designated as a nature reserve, with restricted access to areas rich in wildlife.


Open spaces – typologies
Playing Field
Open spaces formally laid out for active recreation, management of which could be shared between schools, clubs, local council/wider community.
Churchyard/cemetery
Generally located adjacent to a church and often providing a green oasis at the heart of a community.
Unesco World Heritage Skogskyrkogården
(Gunnar Asplund/Sigurd Lewerentz)


Open spaces – typologies
Allotments
A semi-public agglomeration of gardening plots rented to individuals by the local authority.


Open spaces – typologies
Park, Green
A formal (park) or informal (green) grassed public space associated with the focal point of village life, that could incorporate a sports pitch.

Open spaces – typologies

Plaza
A public space associated with the extended forecourt of commercial (office/retail) buildings, with formal landscaping.

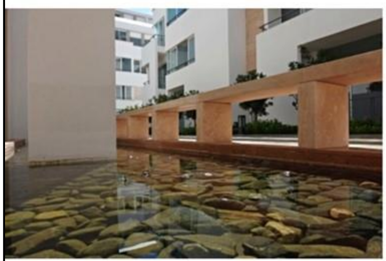
Open spaces – typologies

Square
A formal public space, located at focal points of civic importance fronted by key buildings, usually hard paved and providing passive recreation.

Open spaces – typologies

Playground
An area dedicated for child's play, generally fenced and located within close walking distance to nearby houses, overlooked by residents.

Open spaces – typologies



Communal garden
A semi-private space not accessible to the general public, usually located within the interior of a perimeter block, providing a centrally managed green space for residents.

Private garden
A private space located within the plot of an adjacent building.

Open spaces – typologies

Courtyard
A private open space, possibly for vehicular servicing/parking.

SMARTGEMS energy network

Principles

Interactions
Cities serve people by fostering interactions, both planned and unplanned, among individuals, their ideas, and their creations. Whenever cities are divided—by wealth, race, or any other factor—their people suffer.

Adaptability
Cities thrive when they adapt along with the needs of their citizens, which change constantly but gradually.

Shared Values
Cities work best when their diversity is anchored by a shared set of values. These can vary from city to city, giving each one its unique character.

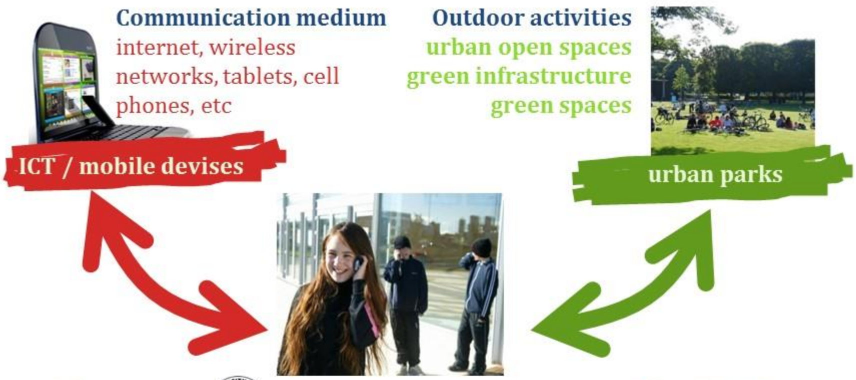
Principles

Sharing
The inherent power of cities is that they are shared, which helps everyone achieve a level of productivity, efficiency, and savings that we can never achieve as individuals.

Diversity
Openness to newcomers—which celebrates equity, inclusion, and diversity—is what keeps even the oldest cities moving forward.

Coordination Without Control
Cities require coordinated actions among people, whether to manage congestion or to preserve public safety. But the most effective coordination is not just top-down; rather, it balances inclusiveness, efficiency, innovation, and preservation.

This presentation discusses how technology can be used to activate people using public space in settlements and cities in order to go out of their houses and use common facilities for interaction, socialization, information exchange, playful use of the urban space, exploration of the outdoors and economies of scale.



SMARTGEMS energy network

Examples of Sustainable Development of communal spaces

The attributes of smart community systems (in accordance to the Smart Cities initiative) could be defined by the use of sensor technologies in a connectable space, accessible to the public through ubiquitous technologies used in sociable and sharable ways where the virtual is made visible or augments the landscape. ICT can be used in this context to give or gather information, to aid co-creation of space, to allow crowd sourcing of information and opinions, and to allow affective sharing or self-monitoring of activities. Hardware may be embedded in the environment in the form of responsive sound or lighting systems, control systems, kinetic objects or artworks, passive sensor technologies and display systems.

SMARTGEMS energy network

- the time of day,
- the duration of the visit,
- the weather and temperature,
- location,
- season,
- individual or group engagement,
- age,
- gender,
- purpose of visit and
- the topology and size of the space.

This effort weaves together physical space occupation, and use (e.g., built infrastructure), and smart cities technologies (e.g., ICT and digital interactive environments for e-learning) thus paving the way for more **efficient implementations of governance concepts**, like inclusive smart collection of feedback by stakeholders as well as, for **new opportunities for citizens in smart cities implementation.**

Examples of intersection ICT & Public Spaces

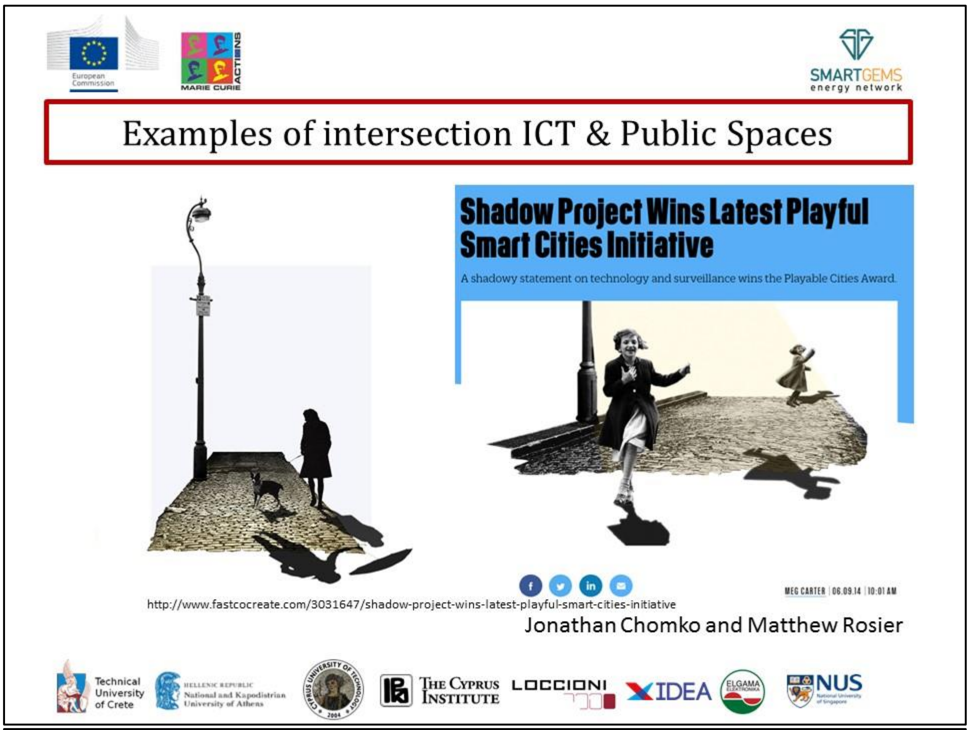
HOLE IN THE EARTH

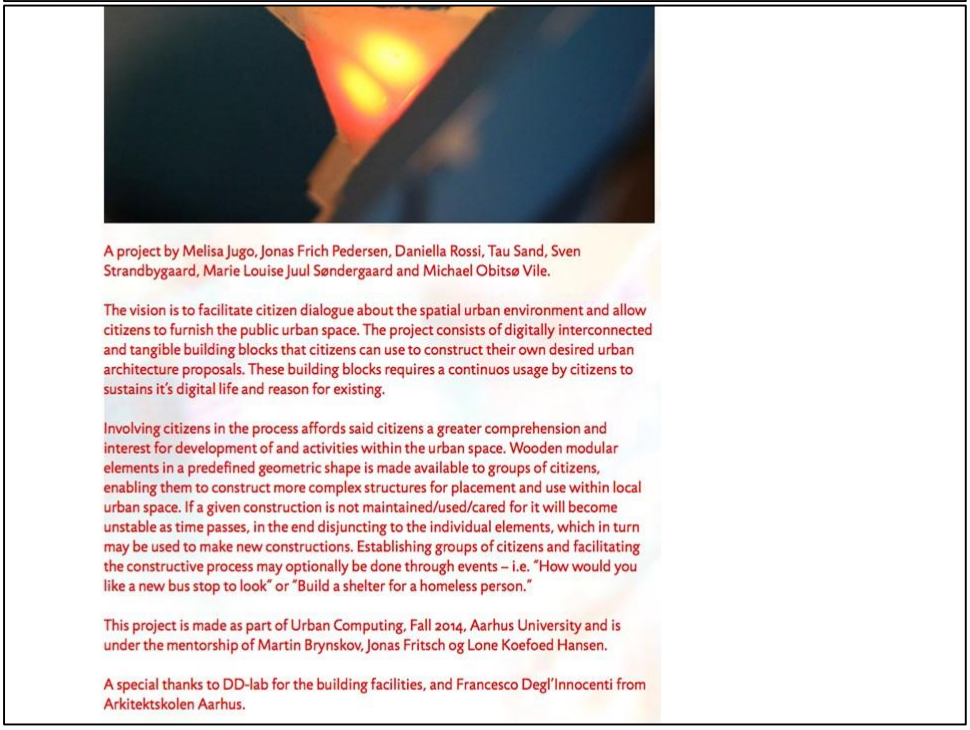
"Hole in the Earth" (2001) is a work by Maki Ueda, realized in cooperation with V2_lab.

Hole in the Earth is an installation for the public space.

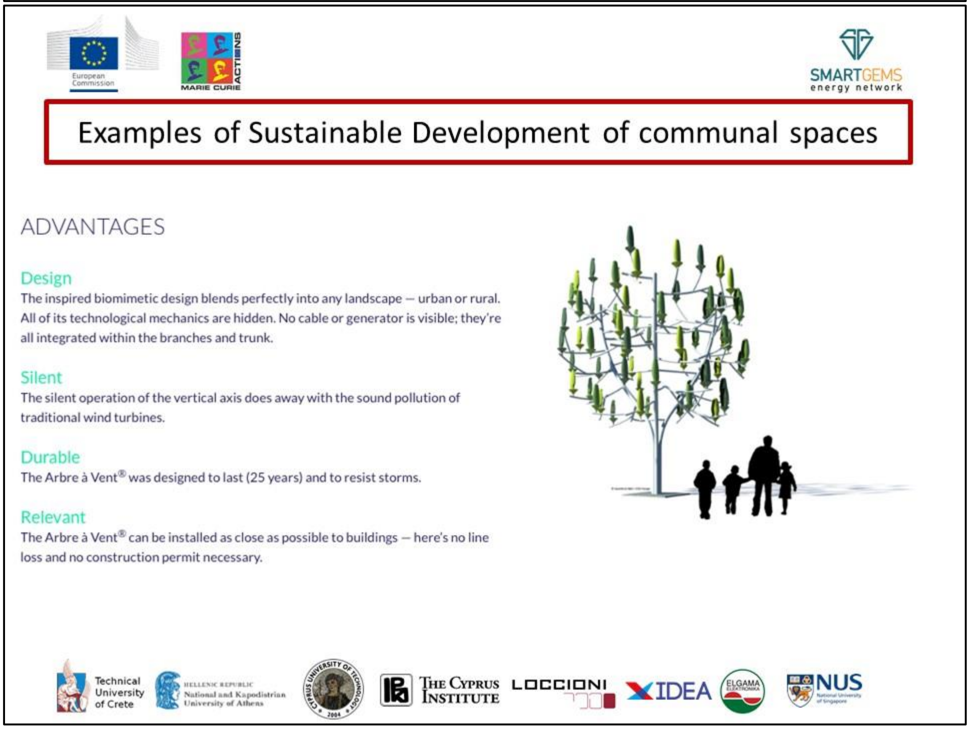
The idea is to create a virtual tunnel through the earth, connecting two public spaces in Rotterdam and Shanghai, so that communication with the other side is possible. Each end of the 'tunnel' consists of a steel turret with a bullet-proof glass lid, sticking about 30 cm (1 foot) out of the pavement. Inside is a good-quality SVGA display (plasma-screen), an AXIS 2120 Intelligent Webcam, speakers and a microphone. The screen is facing upward, so the audience has to look down (into the earth) to see the images from the other side, thereby coming into view of the webcam, capturing images for the other side to see. The same principle is used for the audio; the microphone is plugged into the server, which encodes the received signal as a low-bitrate MP3-stream, which is unicast to the other side, and played back by the other server.

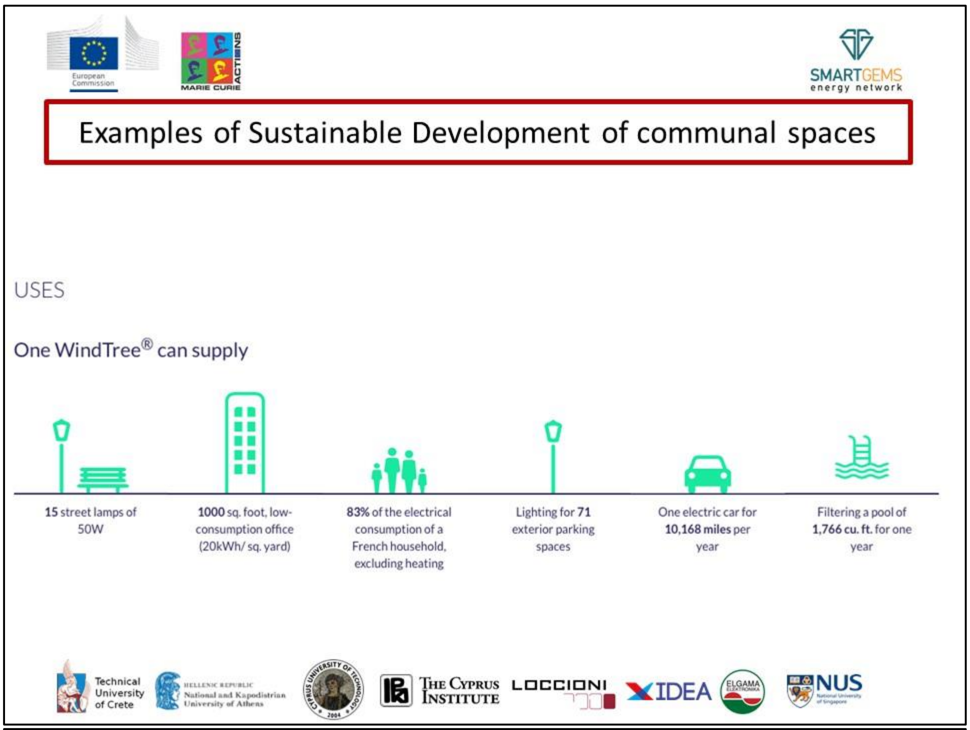
Concept & design by Miss Maki Ueda.
Production: Maki Ueda & CELL (Initiators of Incidents) within the framework of CELL's "Homeport" project for "Cultural Capital Rotterdam 2001".
The technical system design and software & hardware development: V2_Lab for the Unstable Media, Rotterdam.


Examples of intersection ICT & Public Spaces
Shadow Project Wins Latest Playful Smart Cities Initiative
A shadowy statement on technology and surveillance wins the Playable Cities Award.
MEG CARTER | 06.09.14 | 10:01 AM
http://www.fastcocreate.com/3031647/shadow-project-wins-latest-playful-smart-cities-initiative
Jonathan Chomko and Matthew Rosier


A project by Melisa Jugo, Jonas Frich Pedersen, Daniella Rossi, Tau Sand, Sven Strandbygaard, Marie Louise Juul Søndergaard and Michael Obitsø Vile.
The vision is to facilitate citizen dialogue about the spatial urban environment and allow citizens to furnish the public urban space. The project consists of digitally interconnected and tangible building blocks that citizens can use to construct their own desired urban architecture proposals. These building blocks requires a continuos usage by citizens to sustains it's digital life and reason for existing.
Involving citizens in the process affords said citizens a greater comprehension and interest for development of and activities within the urban space. Wooden modular elements in a predefined geometric shape is made available to groups of citizens, enabling them to construct more complex structures for placement and use within local urban space. If a given construction is not maintained/used/cared for it will become unstable as time passes, in the end disjuncting to the individual elements, which in turn may be used to make new constructions. Establishing groups of citizens and facilitating the constructive process may optionally be done through events – i.e. "How would you like a new bus stop to look" or "Build a shelter for a homeless person."
This project is made as part of Urban Computing, Fall 2014, Aarhus University and is under the mentorship of Martin Brynskov, Jonas Fritsch og Lone Koefoed Hansen.
A special thanks to DD-lab for the building facilities, and Francesco Degl'Innocenti from Arkitektskolen Aarhus.


Examples of Sustainable Development of communal spaces
#3
L'ARBRE À VENT®
Chaque feuille de l'Arbre produit de l'électricité à partir du moindre souffle d'air sur 360°. Pour une consommation immédiate de proximité, ajoutant une valeur esthétique et émotionnelle aux paysages urbains.

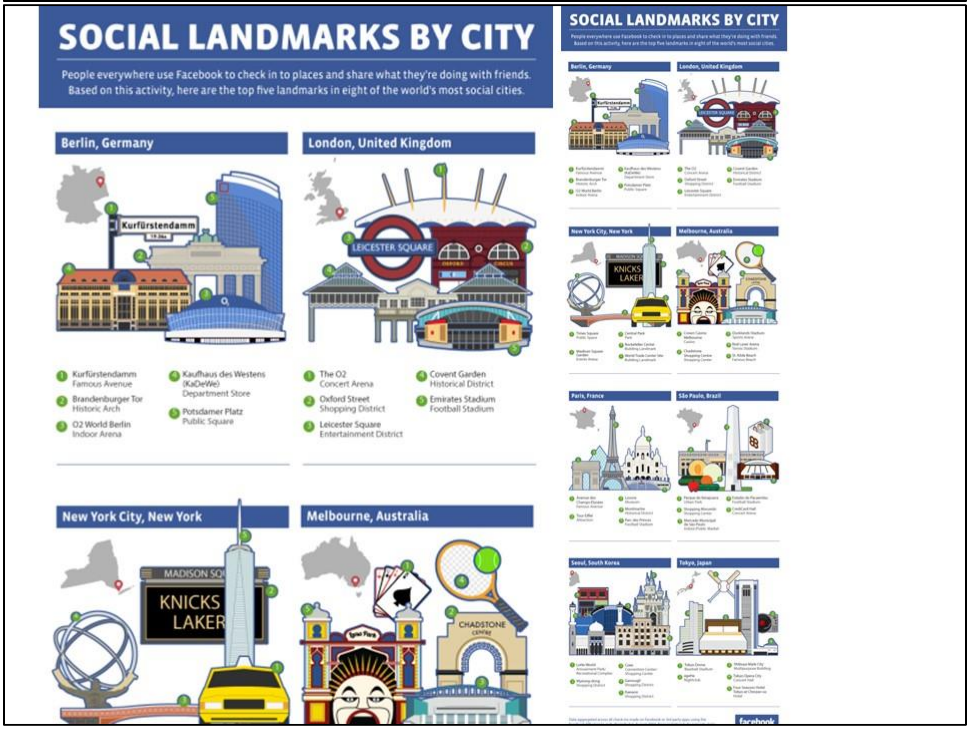

Examples of Sustainable Development of communal spaces
ADVANTAGES
Design
The inspired biomimetic design blends perfectly into any landscape — urban or rural. All of its technological mechanics are hidden. No cable or generator is visible; they're all integrated within the branches and trunk.
Silent
The silent operation of the vertical axis does away with the sound pollution of traditional wind turbines.
Durable
The Arbre à Vent® was designed to last (25 years) and to resist storms.
Relevant
The Arbre à Vent® can be installed as close as possible to buildings — here's no line loss and no construction permit necessary.


Examples of Sustainable Development of communal spaces
USES
One WindTree® can supply
15 street lamps of 50W
1000 sq. foot, low-consumption office (20kWh/ sq. yard)
83% of the electrical consumption of a French household, excluding heating
Lighting for 71 exterior parking spaces
One electric car for 10,168 miles per year
Filtering a pool of 1,766 cu. ft. for one year

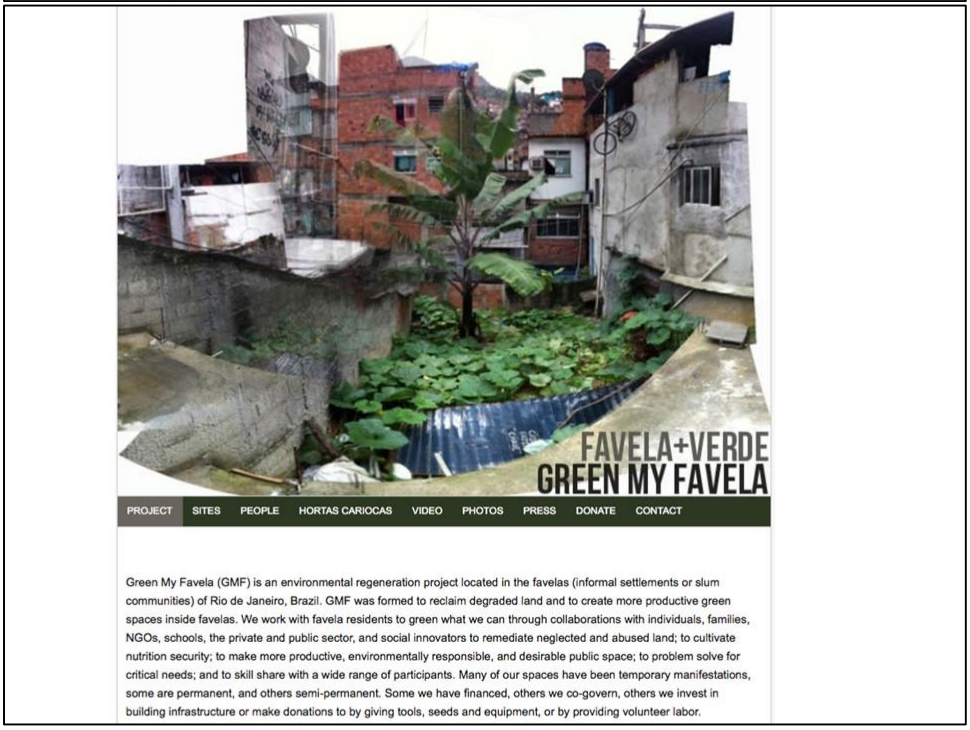

Mathieu Lehanneur: *Escale Numérique*

COTree is a physical installation shaped like a swirl plant. The installation has a CO_2-sensor measuring the surroundings, and depending on the concentration the tree will either wither or grow – the leafs will change shape and colour. The measurements determine the life of COTree. That way the presence of the viewer has a direct impact on the life of COTree. Normally it wouldn't be possible for the human eye to see the impact of CO_2 on our environment but COTree makes it visible. The viewer sees a part of reality that hopefully will be hard to forget.

COTree is made by Lasse Vestergaard, Joakim Old Jensen, Christina Exner, Kirstine West Andersen, Anna Lindebjerg, Agnete Horup, and Nikolaj Christian Mikkelsen.




European Commission
MARIE CURIE ACTIONS
SMARTGEMS energy network
Community participation in planning
Discussions in Space
Designed to engage with you, in your community, about your community
Locations
QUT
Z2 Creative Industries Precinct - QUT
197 posts
GreanHeart Fair @ Mt Gravatt
41 posts
UniMelb
596 posts
Royal Brisbane Hospital
3 posts
The Edge - State Library
3000 posts
Info Point - State Library
547 posts
Brisbane Square
553 posts
Map
Satellite
Brisbane
Herston
Red Hill
Bardon
Fortitude Valley
Spring Hill
New Farm
Hawthorne
Morningside
South Brisbane
East Brisbane
Toowong
The University of Queensland
Coorparoo
Map data ©2016 Google
Technical University of Crete
Hellenic Republic National and Kapodistrian University of Athens
The Cyprus Institute
LOCCIONI
IDEA
ELGAMA ELEKTRONIKA
NUS


FAVELA+VERDE
GREEN MY FAVELA
PROJECT
SITES
PEOPLE
HORTAS CARIOCAS
VIDEO
PHOTOS
PRESS
DONATE
CONTACT
Green My Favela (GMF) is an environmental regeneration project located in the favelas (informal settlements or slum communities) of Rio de Janeiro, Brazil. GMF was formed to reclaim degraded land and to create more productive green spaces inside favelas. We work with favela residents to green what we can through collaborations with individuals, families, NGOs, schools, the private and public sector, and social innovators to remediate neglected and abused land; to cultivate nutrition security; to make more productive, environmentally responsible, and desirable public space; to problem solve for critical needs; and to skill share with a wide range of participants. Many of our spaces have been temporary manifestations, some are permanent, and others semi-permanent. Some we have financed, others we co-govern, others we invest in building infrastructure or make donations to by giving tools, seeds and equipment, or by providing volunteer labor.

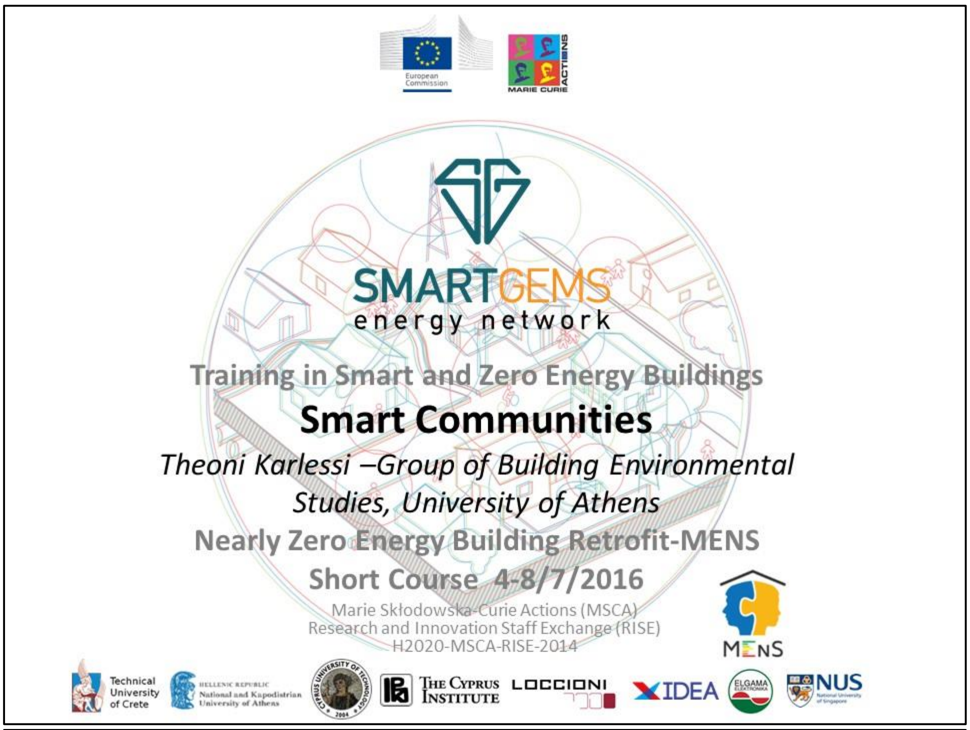
Conclusions & Beginnings

'Since the Industrial Revolution, society and culture have been subservient to technology. One of the compelling tasks today is to reverse the process and make technology serve culture and society.' (Bagdikian 1992)

- To what extent do designers need to take this more active ownership into account?
- Do they need to offer programs that make datasets intelligible, operational and exchangeable for citizens?
- To what extent do governments or designers need to give citizens a voice in the organisation of the metadata?

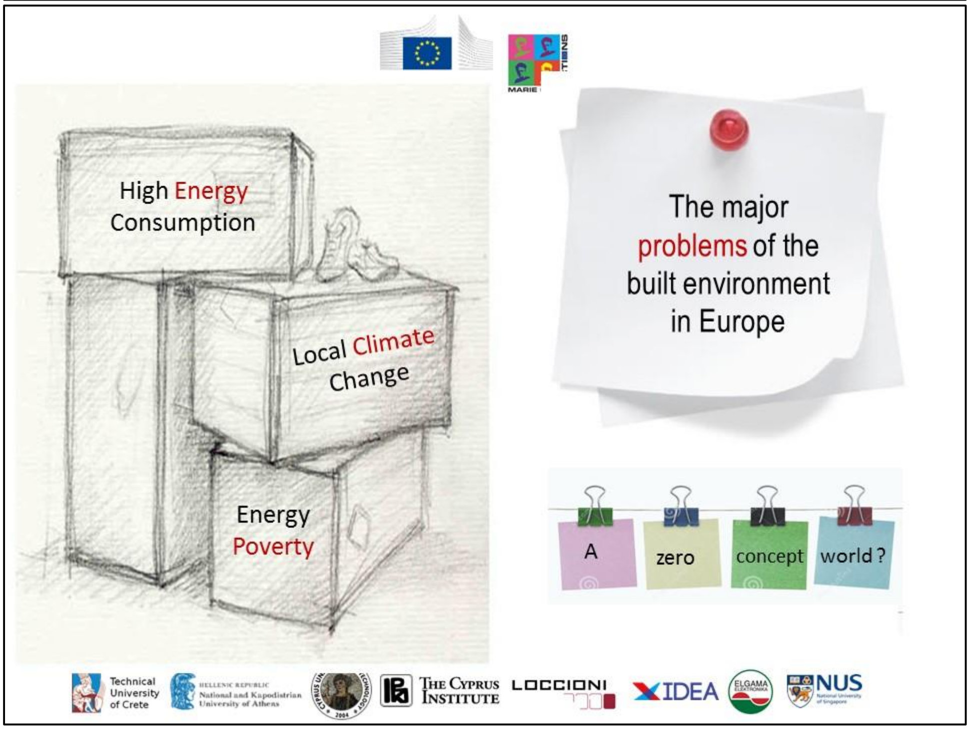
Thank you for your attention

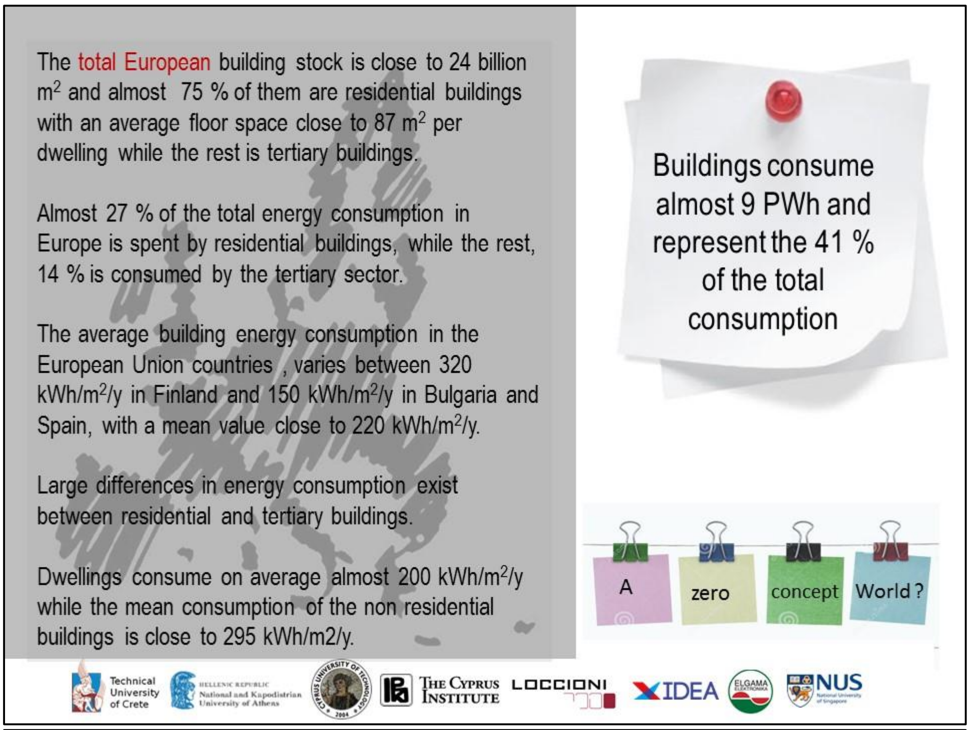
Annex III: Slides of the 3rd Webinar - The smart grids and communities market and innovation potential - Smart metering, organised by ISRI




Development of Smart
and NZEB Protocols
for Europe,

M. Santamouris


High Energy
Consumption
Local Climate
Change
Energy
Poverty
The major
problems of the
built environment
in Europe
A
zero
concept
world ?


The total European building stock is close to 24 billion m2 and almost 75 % of them are residential buildings with an average floor space close to 87 m2 per dwelling while the rest is tertiary buildings.
Almost 27 % of the total energy consumption in Europe is spent by residential buildings, while the rest, 14 % is consumed by the tertiary sector.
The average building energy consumption in the European Union countries , varies between 320 kWh/m2/y in Finland and 150 kWh/m2/y in Bulgaria and Spain, with a mean value close to 220 kWh/m2/y.
Large differences in energy consumption exist between residential and tertiary buildings.
Dwellings consume on average almost 200 kWh/m2/y while the mean consumption of the non residential buildings is close to 295 kWh/m2/y.
Buildings consume almost 9 PWh and represent the 41 % of the total consumption
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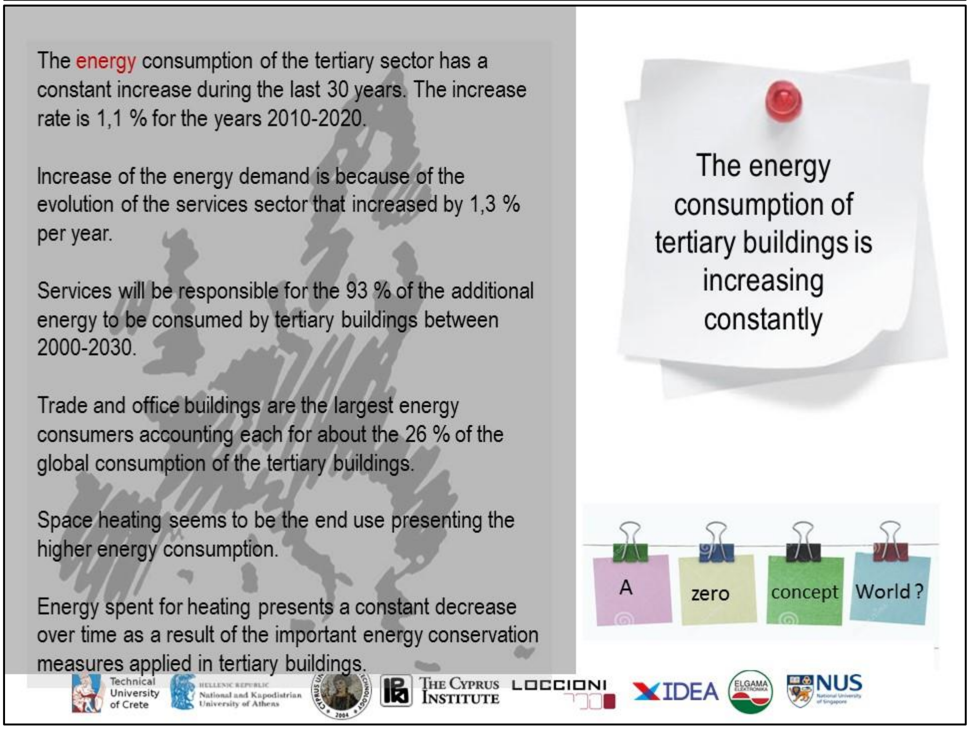
The energy consumption of the tertiary sector has a constant increase during the last 30 years. The increase rate is 1,1 % for the years 2010-2020.
Increase of the energy demand is because of the evolution of the services sector that increased by 1,3 % per year.
Services will be responsible for the 93 % of the additional energy to be consumed by tertiary buildings between 2000-2030.
Trade and office buildings are the largest energy consumers accounting each for about the 26 % of the global consumption of the tertiary buildings.
Space heating seems to be the end use presenting the higher energy consumption.
Energy spent for heating presents a constant decrease over time as a result of the important energy conservation measures applied in tertiary buildings.
The energy consumption of tertiary buildings is increasing constantly
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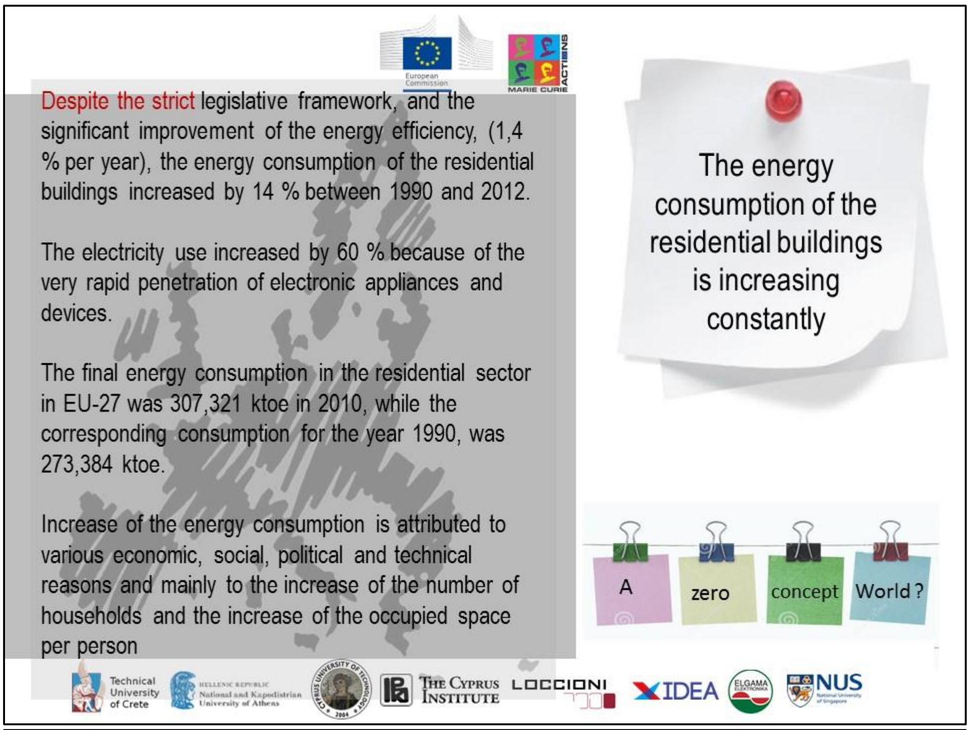
Despite the strict legislative framework, and the significant improvement of the energy efficiency, (1,4 % per year), the energy consumption of the residential buildings increased by 14 % between 1990 and 2012.
The electricity use increased by 60 % because of the very rapid penetration of electronic appliances and devices.
The final energy consumption in the residential sector in EU-27 was 307,321 ktoe in 2010, while the corresponding consumption for the year 1990, was 273,384 ktoe.
Increase of the energy consumption is attributed to various economic, social, political and technical reasons and mainly to the increase of the number of households and the increase of the occupied space per person
The energy consumption of the residential buildings is increasing constantly
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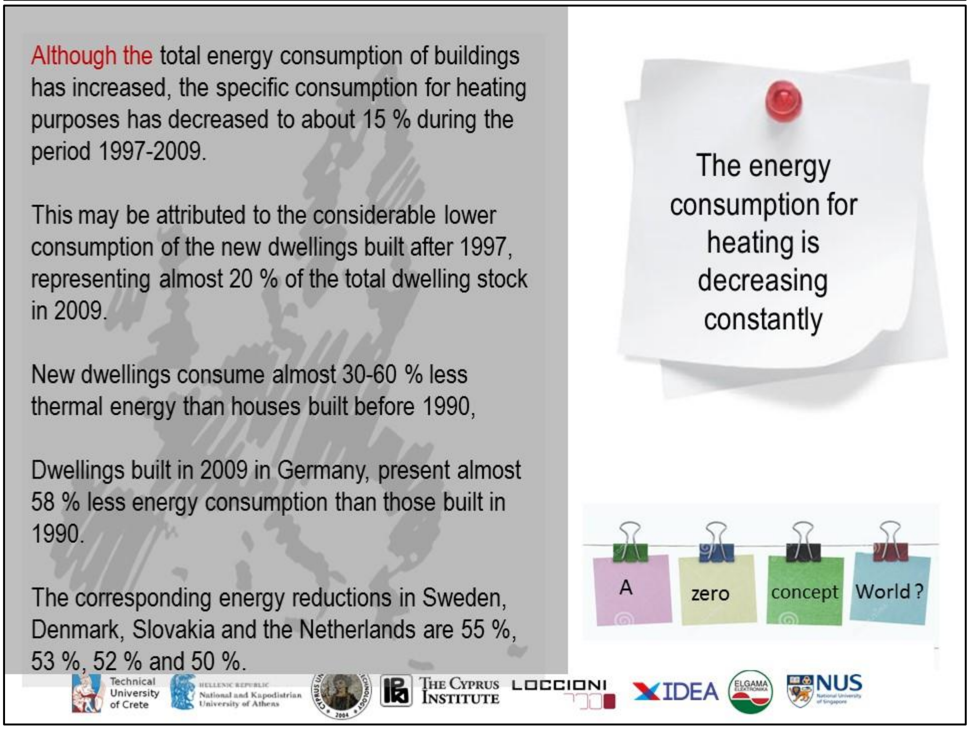
Although the total energy consumption of buildings has increased, the specific consumption for heating purposes has decreased to about 15 % during the period 1997-2009.
This may be attributed to the considerable lower consumption of the new dwellings built after 1997, representing almost 20 % of the total dwelling stock in 2009.
New dwellings consume almost 30-60 % less thermal energy than houses built before 1990,
Dwellings built in 2009 in Germany, present almost 58 % less energy consumption than those built in 1990.
The corresponding energy reductions in Sweden, Denmark, Slovakia and the Netherlands are 55 %, 53 %, 52 % and 50 %.
The energy consumption for heating is decreasing constantly
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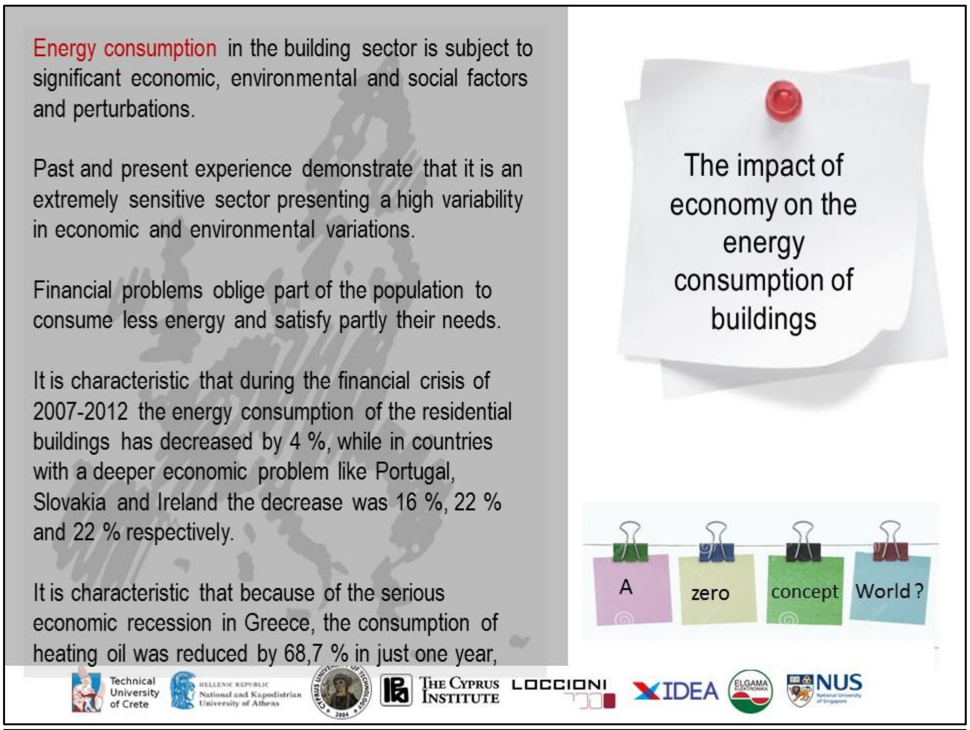
Energy consumption in the building sector is subject to significant economic, environmental and social factors and perturbations.
Past and present experience demonstrate that it is an extremely sensitive sector presenting a high variability in economic and environmental variations.
Financial problems oblige part of the population to consume less energy and satisfy partly their needs.
It is characteristic that during the financial crisis of 2007-2012 the energy consumption of the residential buildings has decreased by 4 %, while in countries with a deeper economic problem like Portugal, Slovakia and Ireland the decrease was 16 %, 22 % and 22 % respectively.
It is characteristic that because of the serious economic recession in Greece, the consumption of heating oil was reduced by 68,7 % in just one year,
The impact of economy on the energy consumption of buildings
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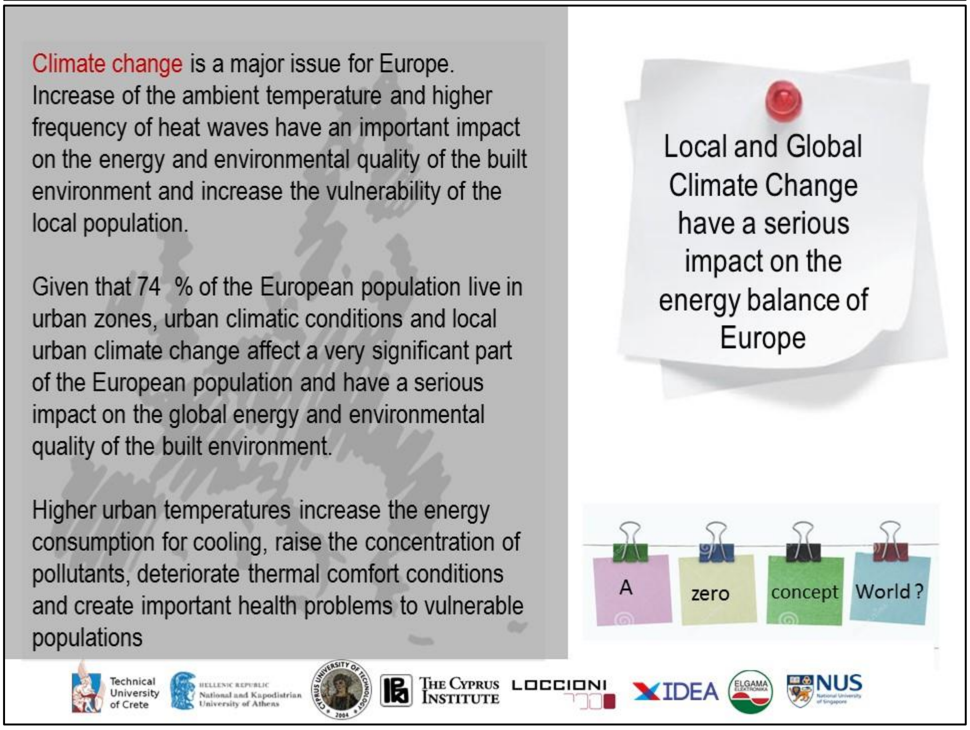
Climate change is a major issue for Europe. Increase of the ambient temperature and higher frequency of heat waves have an important impact on the energy and environmental quality of the built environment and increase the vulnerability of the local population.
Given that 74 % of the European population live in urban zones, urban climatic conditions and local urban climate change affect a very significant part of the European population and have a serious impact on the global energy and environmental quality of the built environment.
Higher urban temperatures increase the energy consumption for cooling, raise the concentration of pollutants, deteriorate thermal comfort conditions and create important health problems to vulnerable populations
Local and Global Climate Change have a serious impact on the energy balance of Europe
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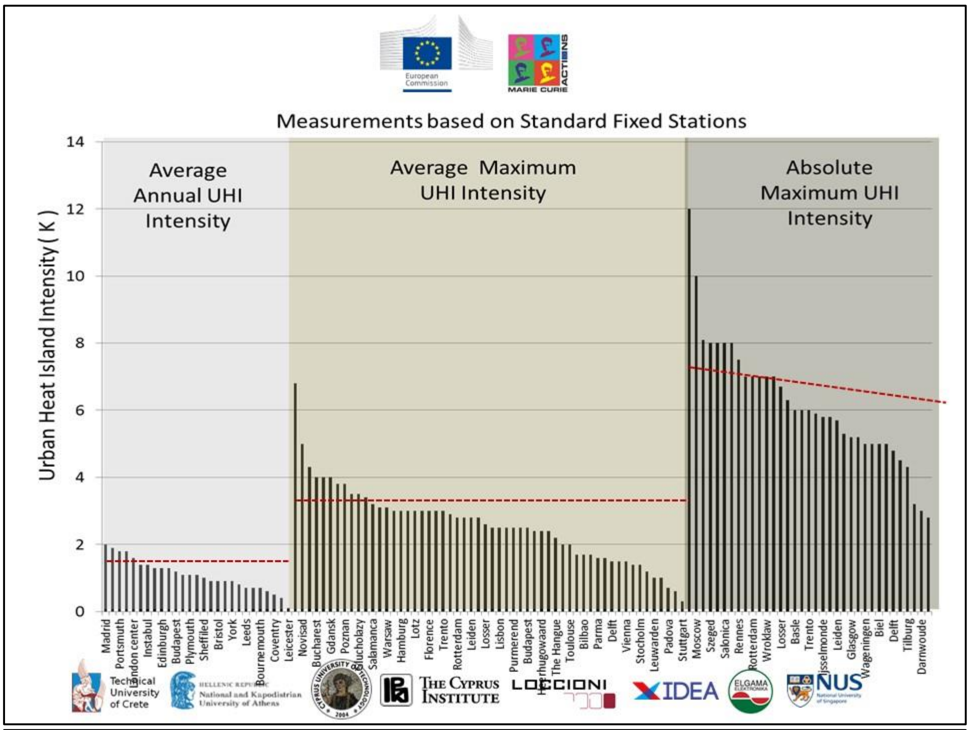
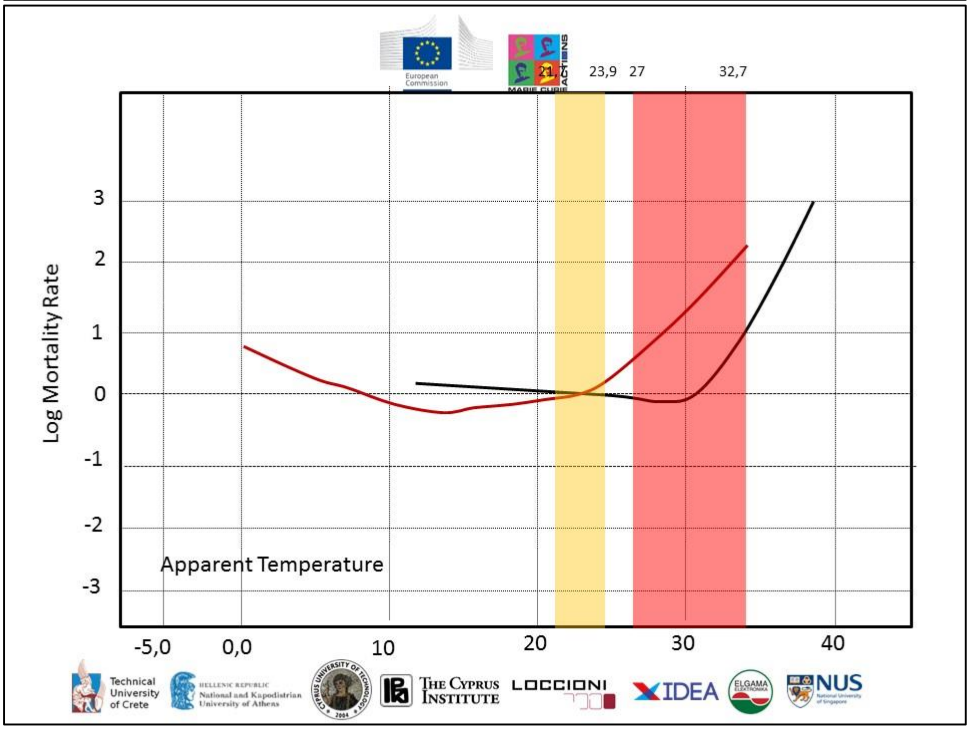
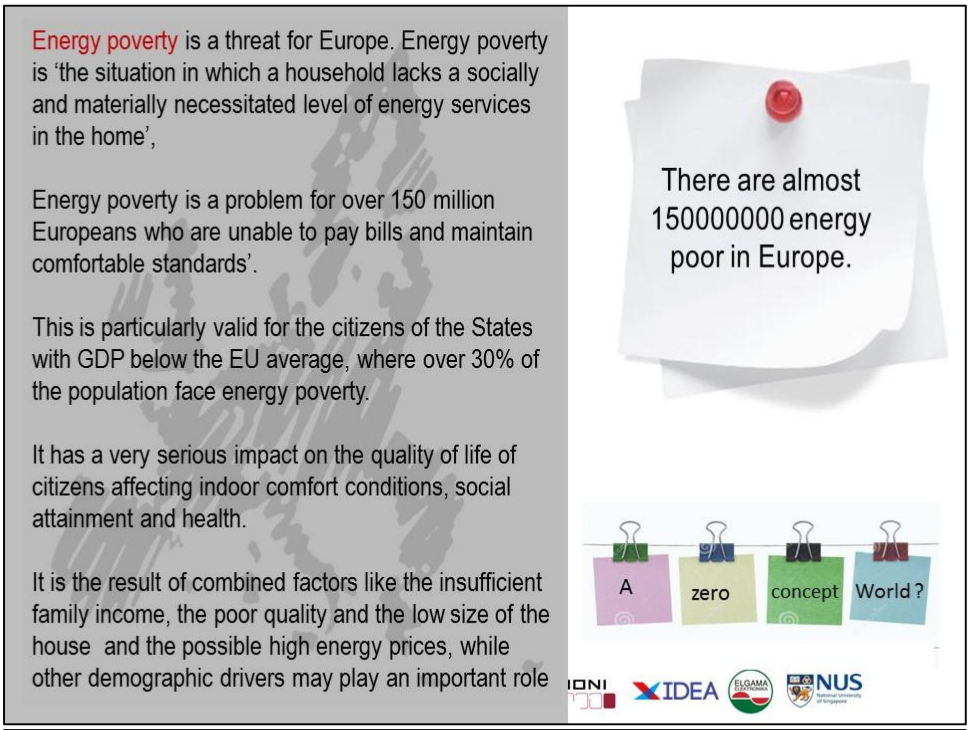

Measurements based on Standard Fixed Stations
Urban Heat Island Intensity (K)
14
12
10
8
6
4
2
0
Average Annual UHI Intensity
Average Maximum UHI Intensity
Absolute Maximum UHI Intensity
Madrid
Portsmuth
London center
Instabul
Edinburgh
Budapest
Plymouth
Sheffiled
Bristol
York
Leeds
Bournemouth
Coventry
Leicester
Novisad
Bucharest
Gdansk
Poznan
Salamanca
Warsaw
Hamburg
Lotz
Florence
Trento
Rotterdam
Leiden
Losser
Lisbon
Purmerend
Budapest
The Hangue
Toulouse
Bilbao
Parma
Delft
Vienna
Stocholm
Leuwarden
Padova
Stuttgart
Moscow
Szeged
Salonica
Rennes
Rotterdam
Wroklaw
Losser
Basle
Trento
Leiden
Glasgow
Wageningen
Biel
Delft
Tilburg
Darnwoude


21
23,9
27
32,7
Log Mortality Rate
3
2
1
0
-1
-2
-3
Apparent Temperature
-5,0
0,0
10
20
30
40


Energy poverty is a threat for Europe. Energy poverty is 'the situation in which a household lacks a socially and materially necessitated level of energy services in the home',
Energy poverty is a problem for over 150 million Europeans who are unable to pay bills and maintain comfortable standards'.
This is particularly valid for the citizens of the States with GDP below the EU average, where over 30% of the population face energy poverty.
It has a very serious impact on the quality of life of citizens affecting indoor comfort conditions, social attainment and health.
It is the result of combined factors like the insufficient family income, the poor quality and the low size of the house and the possible high energy prices, while other demographic drivers may play an important role
There are almost 150000000 energy poor in Europe.
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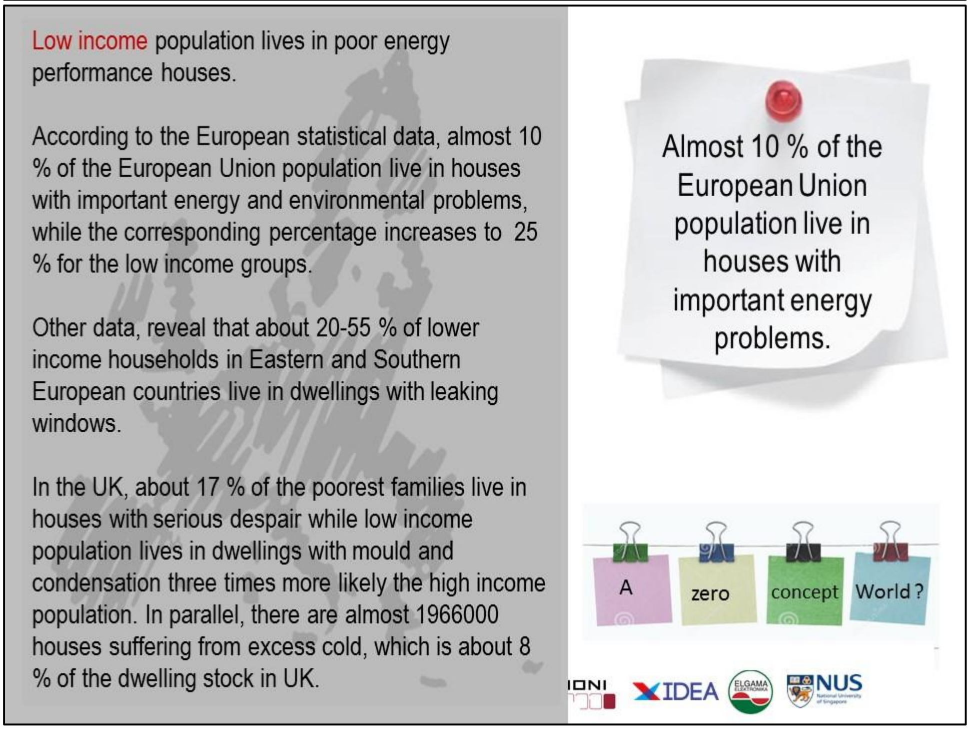
Low income population lives in poor energy performance houses.
According to the European statistical data, almost 10 % of the European Union population live in houses with important energy and environmental problems, while the corresponding percentage increases to 25 % for the low income groups.
Other data, reveal that about 20-55 % of lower income households in Eastern and Southern European countries live in dwellings with leaking windows.
In the UK, about 17 % of the poorest families live in houses with serious despair while low income population lives in dwellings with mould and condensation three times more likely the high income population. In parallel, there are almost 1966000 houses suffering from excess cold, which is about 8 % of the dwelling stock in UK.
Almost 10 % of the European Union population live in houses with important energy problems.
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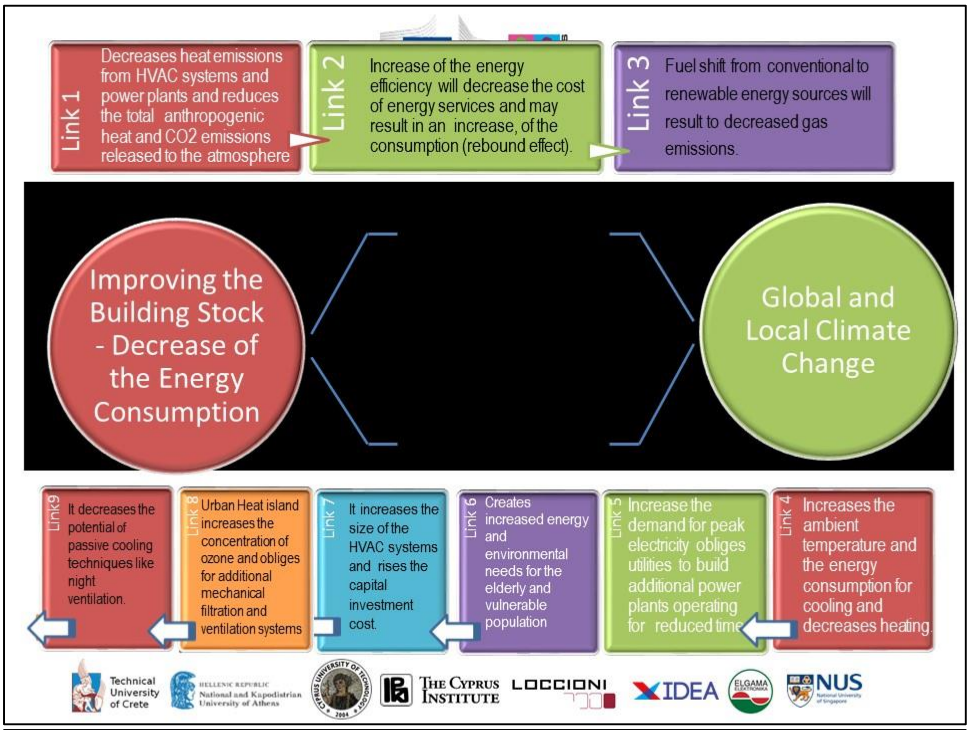
Link 1
Decreases heat emissions from HVAC systems and power plants and reduces the total anthropogenic heat and CO2 emissions released to the atmosphere
Link 2
Increase of the energy efficiency will decrease the cost of energy services and may result in an increase, of the consumption (rebound effect).
Link 3
Fuel shift from conventional to renewable energy sources will result to decreased gas emissions.
Improving the Building Stock - Decrease of the Energy Consumption
Global and Local Climate Change
Link9
It decreases the potential of passive cooling techniques like night ventilation.
Link 8
Urban Heat island increases the concentration of ozone and obliges for additional mechanical filtration and ventilation systems
Link 7
It increases the size of the HVAC systems and rises the capital investment cost.
Link 6
Creates increased energy and environmental needs for the elderly and vulnerable population
Link 5
Increase the demand for peak electricity obliges utilities to build additional power plants operating for reduced time
Link 4
Increases the ambient temperature and the energy consumption for cooling and decreases heating


The idea of a future 'zero concept world' involves an 'innovation to zero' strategy for all technologies related to emissions, wastes, defects etc.
The ultimate goal of the whole concept is to develop zero emission and zero waste technologies applied in zero energy and zero emission buildings and cities where advanced and innovative technologies and policies will be applied to minimize crime and diseases.
Although such a concept seems to be very radical and perhaps opportunistic, the idea incorporates exceptional features of a development road map that makes it particularly attractive.
Innovating to Zero : Zero Energy Consumption, Zero Climate Change, Zero Energy Poverty
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Setting the future goals regarding :
• the energy consumption of buildings,
• b) the impact of the construction sector on the local climate change, and
• c) the possible levels of energy poverty, to zero
is an almost unequivocal choice.
Mankind needs an ambitious vision to proceed, it ought to set clear and ambitious future goals that certainly will be achieved gradually.
Innovating to Zero : Zero Energy Consumption, Zero Climate Change, Zero Energy Poverty
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Even the attainment and satisfaction of some of these goals will be a major success and progress for our societies.
The adoption and achievement of the specific objectives require planning and follow of an innovative scientific and political agenda full of technological breakthroughs.
This involves significant investment in the construction sector , which will create substantial opportunities for the future and will certainly cause major medium and long term benefits for the society while alleviating the population by the intensity and the consequences of the particular problems
Innovating to Zero : Zero Energy Consumption, Zero Climate Change, Zero Energy Poverty
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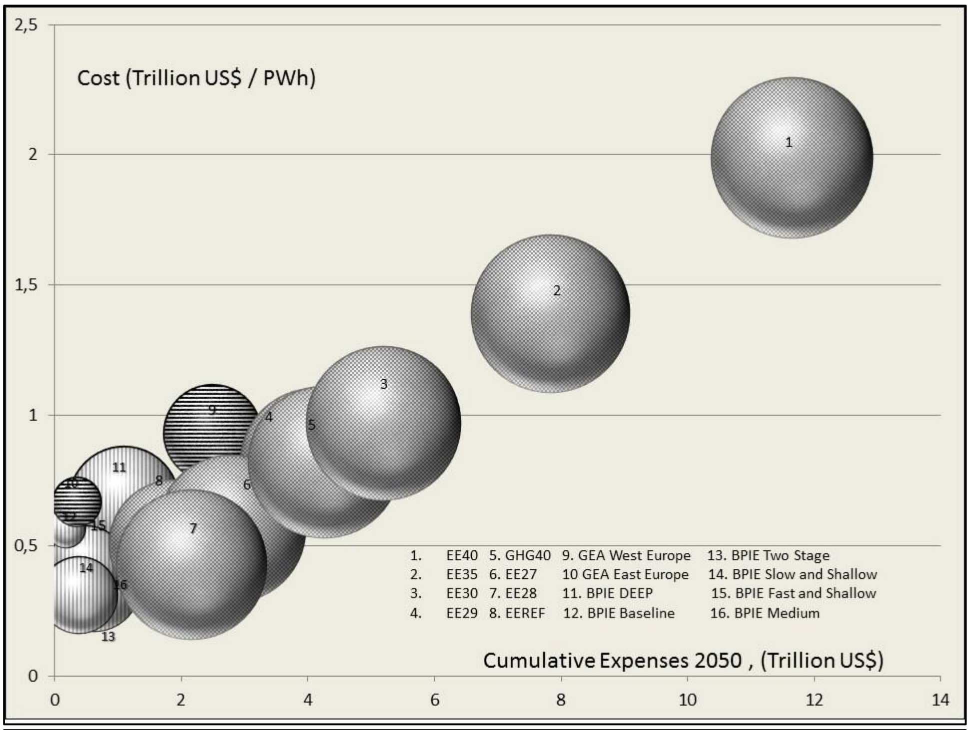
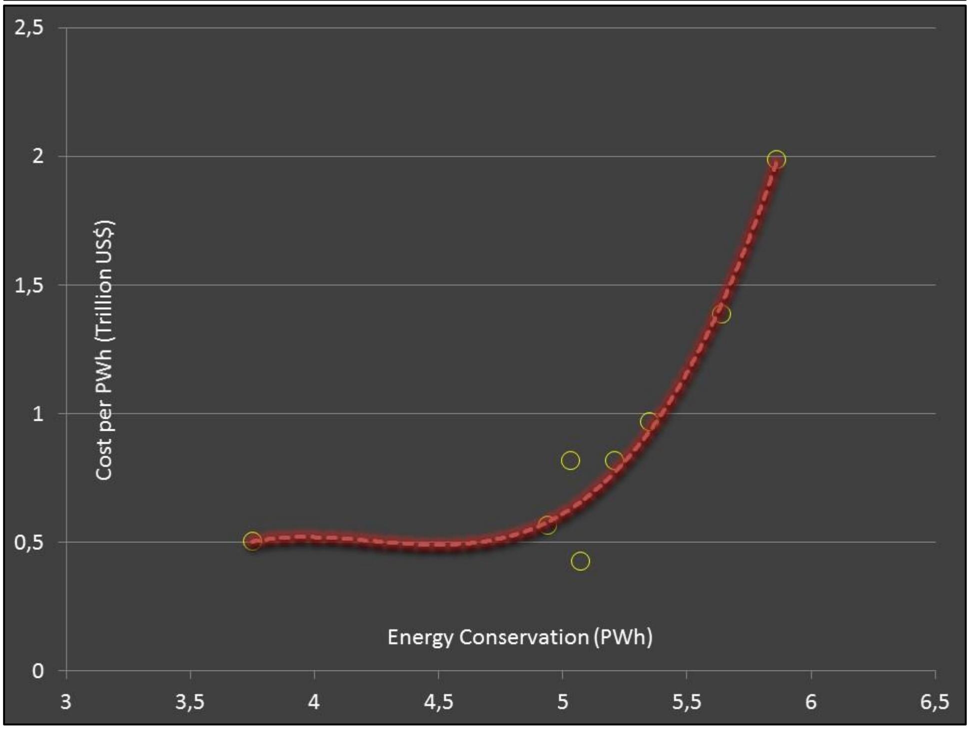
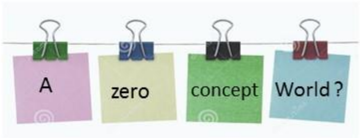

Cost (Trillion US$ / PWh)
1. EE40 5. GHG40 9. GEA West Europe 13. BPIE Two Stage
2. EE35 6. EE27 10 GEA East Europe 14. BPIE Slow and Shallow
3. EE30 7. EE28 11. BPIE DEEP 15. BPIE Fast and Shallow
4. EE29 8. EEREF 12. BPIE Baseline 16. BPIE Medium
Cumulative Expenses 2050 , (Trillion US$)


Cost per PWh (Trillion US$)
Energy Conservation (PWh)

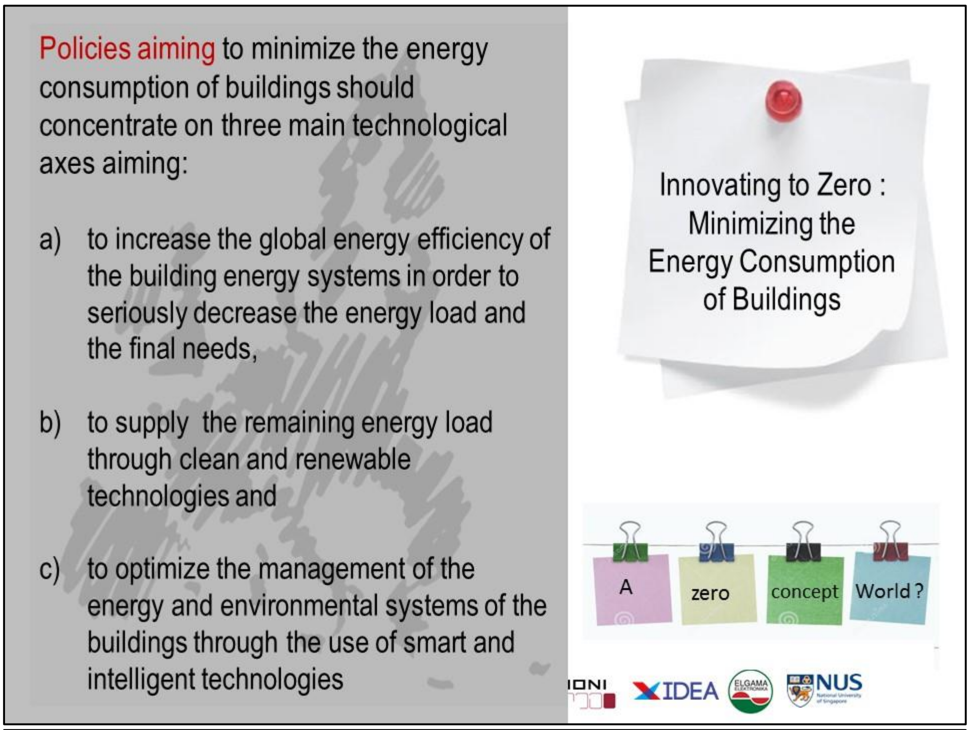
The cumulative investments to almost minimize the energy consumption of the building sector in Europe by 2050 should be between 14,5 to 23,6 trillion of Euros.

The CO_2 emissions of the residential sector in 2050 will be reduced by 90,3 % compared to 2005, while the corresponding decrease of the tertiary sector is close to 87,7 %.

The application of energy efficiency measures has a positive effect on employment and the number of additional full time jobs created in Europe per 1,0 million of Euros invested varies between 6,4 to 39, with an average value close to 18,9 jobs per million of Euros invested



Policies - Actions	Required Investments	Energy Reduction	Full Time Jobs Anually Created (x 1000)	Other Benefits
Minimising the Energy Consumption of the Building Sector, (2007-2050)	Low Scenario :14,5 trillion Euros High Scenario : 23,6 trillion Euros	8,3 PWh	Low – High Scenarios 674-1097 (2jobs/M€) 2023-3293 (6 jobs/M€) 6406-10427 (19 jobs/M€)	Reduction of the CO_2 emissions by 89 %


Policies aiming to minimize the energy consumption of buildings should concentrate on three main technological axes aiming:
a) to increase the global energy efficiency of the building energy systems in order to seriously decrease the energy load and the final needs,
b) to supply the remaining energy load through clean and renewable technologies and
c) to optimize the management of the energy and environmental systems of the buildings through the use of smart and intelligent technologies
Innovating to Zero : Minimizing the Energy Consumption of Buildings
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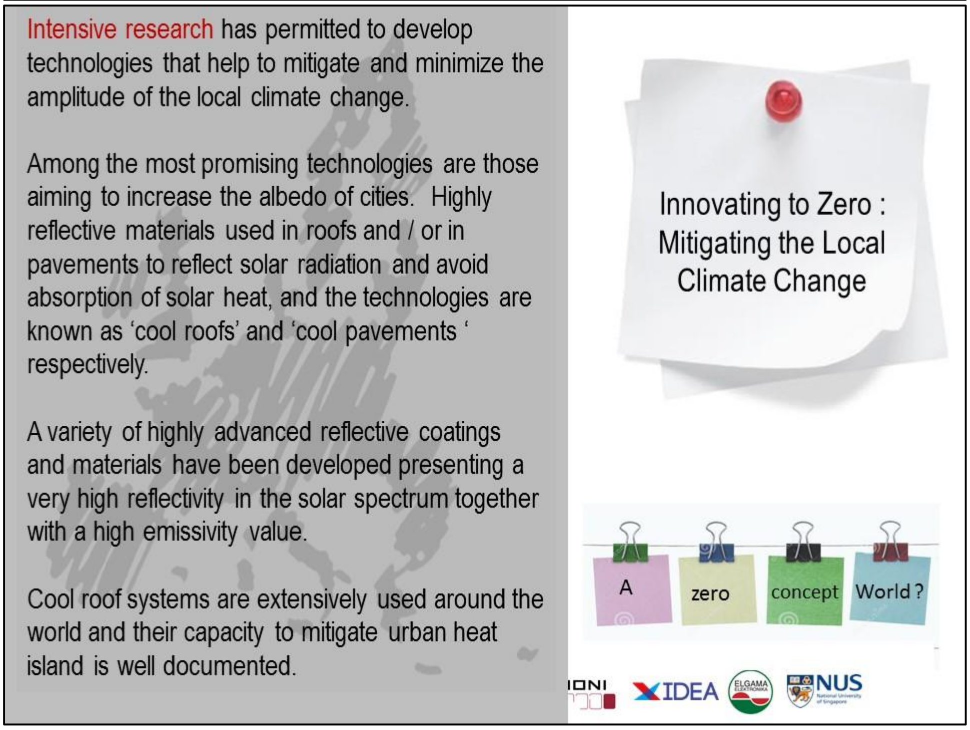
Intensive research has permitted to develop technologies that help to mitigate and minimize the amplitude of the local climate change.
Among the most promising technologies are those aiming to increase the albedo of cities. Highly reflective materials used in roofs and / or in pavements to reflect solar radiation and avoid absorption of solar heat, and the technologies are known as 'cool roofs' and 'cool pavements ' respectively.
A variety of highly advanced reflective coatings and materials have been developed presenting a very high reflectivity in the solar spectrum together with a high emissivity value.
Cool roof systems are extensively used around the world and their capacity to mitigate urban heat island is well documented.
Innovating to Zero : Mitigating the Local Climate Change
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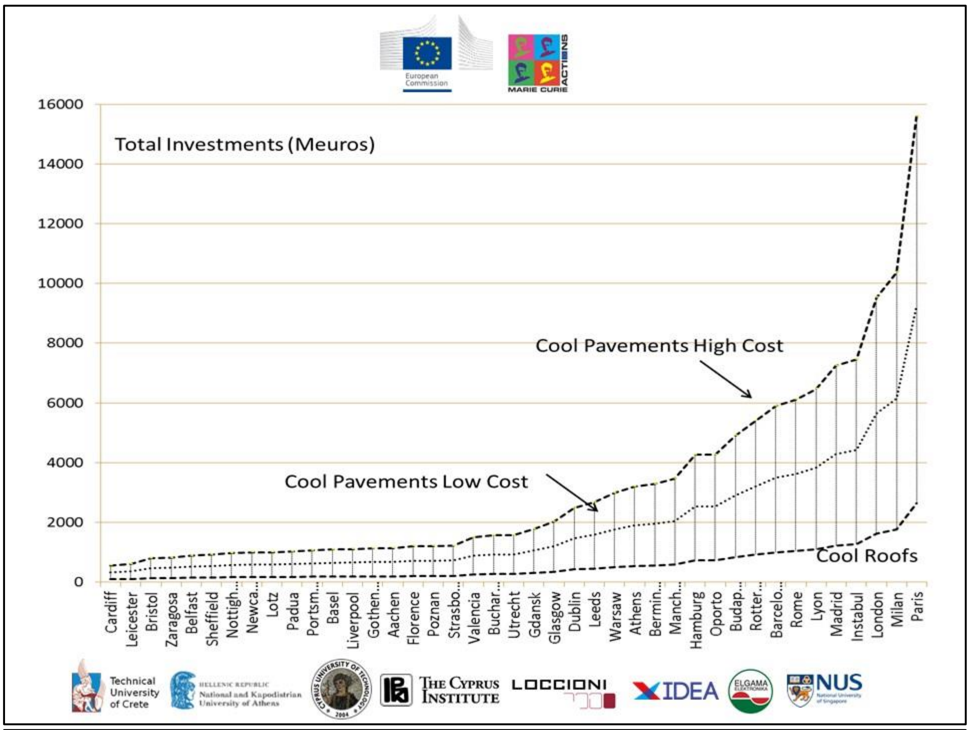
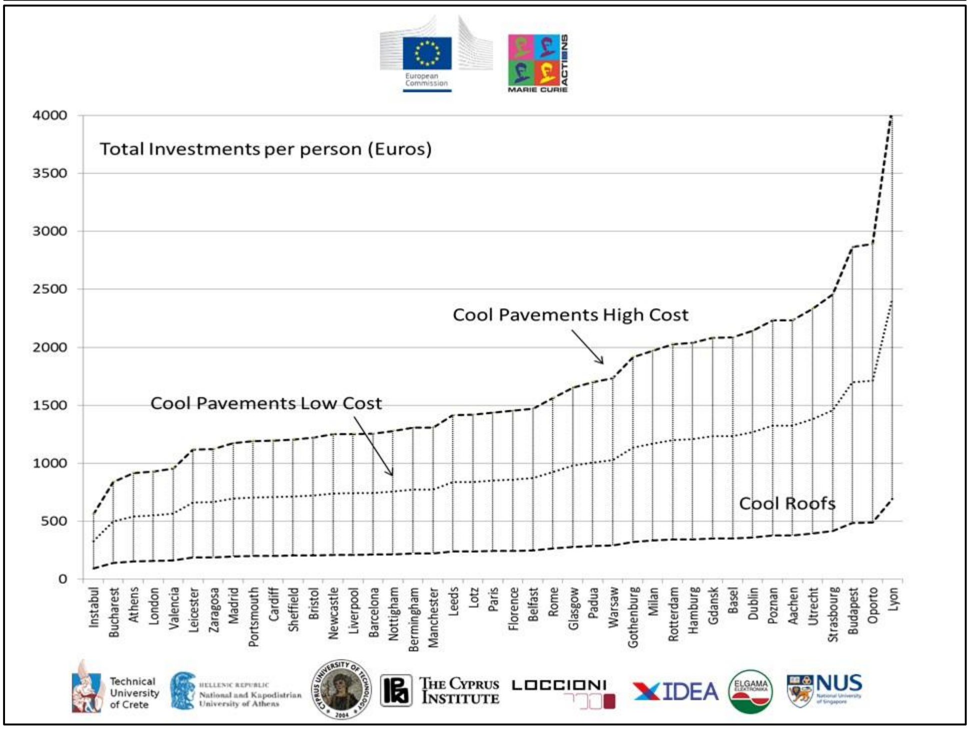

Total Investments (Meuros)
Cool Pavements High Cost
Cool Pavements Low Cost
Cool Roofs
0
2000
4000
6000
8000
10000
12000
14000
16000
Cardiff
Leicester
Bristol
Zaragosa
Belfast
Sheffield
Nottigh...
Newca...
Lotz
Padua
Portsm...
Basel
Liverpool
Gothen...
Aachen
Florence
Poznan
Strasbo...
Valencia
Buchar...
Utrecht
Gdansk
Glasgow
Dublin
Leeds
Warsaw
Athens
Bermin...
Manch...
Hamburg
Oporto
Budap...
Rotter...
Barcelo...
Rome
Lyon
Madrid
Instabul
London
Milan
Paris

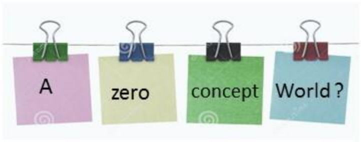

Total Investments per person (Euros)
Cool Pavements High Cost
Cool Pavements Low Cost
Cool Roofs
0
500
1000
1500
2000
2500
3000
3500
4000
Instabul
Bucharest
Athens
London
Valencia
Leicester
Zaragosa
Madrid
Portsmouth
Cardiff
Sheffield
Bristol
Newcastle
Liverpool
Barcelona
Nottigham
Bermingham
Manchester
Leeds
Lotz
Paris
Florence
Belfast
Rome
Glasgow
Padua
Warsaw
Gothenburg
Milan
Rotterdam
Hamburg
Gdansk
Basel
Dublin
Poznan
Aachen
Utrecht
Strasbourg
Budapest
Oporto
Lyon

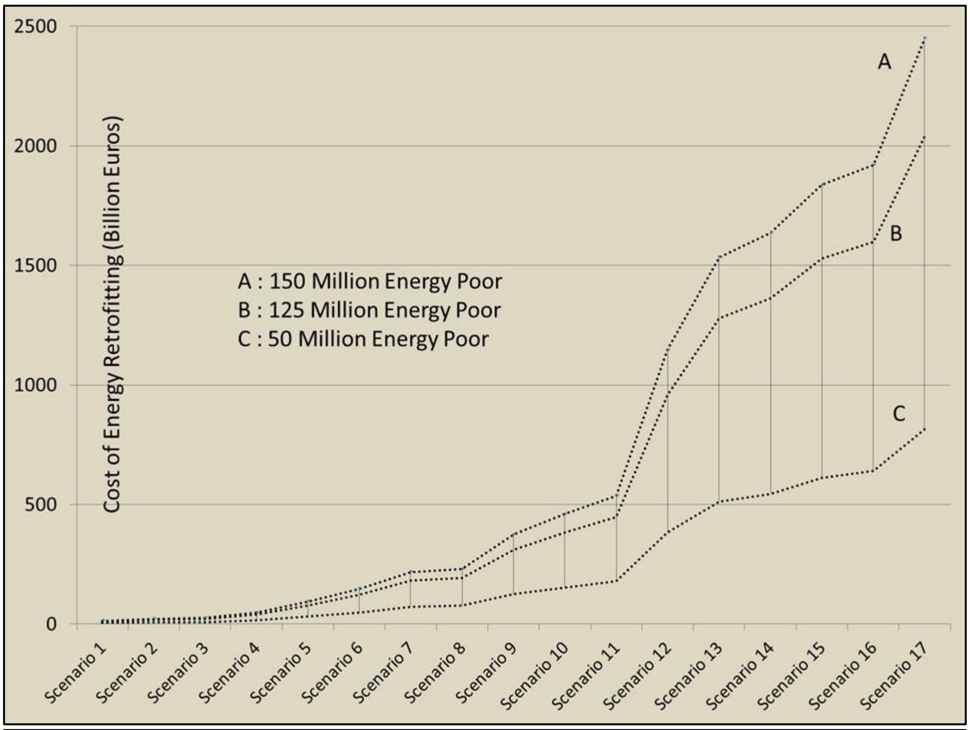
Policies - Actions	Required Investments	Energy Reduction	Full Time Jobs Anually Created, (x 1000)	Other Benefits
Mitigating the Urban Heat Island, (2015-2050)	Cool Roofs : 22,2 €bn Cool Pavements Low : 78 €bn Cool Pavements High : 131,5 €bn	0,01-0,079 PWh	Cool Roofs 1,27 (2 jobs/M€) 3,82 (6 jobs/M€) 12,1 (19 jobs/M€) Cool Pavements (low-high) 4,45-7,52 (2 jobs/M€) 13,4-22,6 (6 jobs/M€) 42,3-72,4 (19 jobs/M€)	Cool Roofs : 0,178 $GtCO_2$ Cool Pavements : 0,185 $GtCO_2$

Energy rehabilitation of the homes occupied by the lowest income households, is the more efficient policy to fight energy poverty and protect vulnerable population. A deep retrofitting of the building stock used by the energy poor in Europe could have very significant social, financial and environmental advantages.

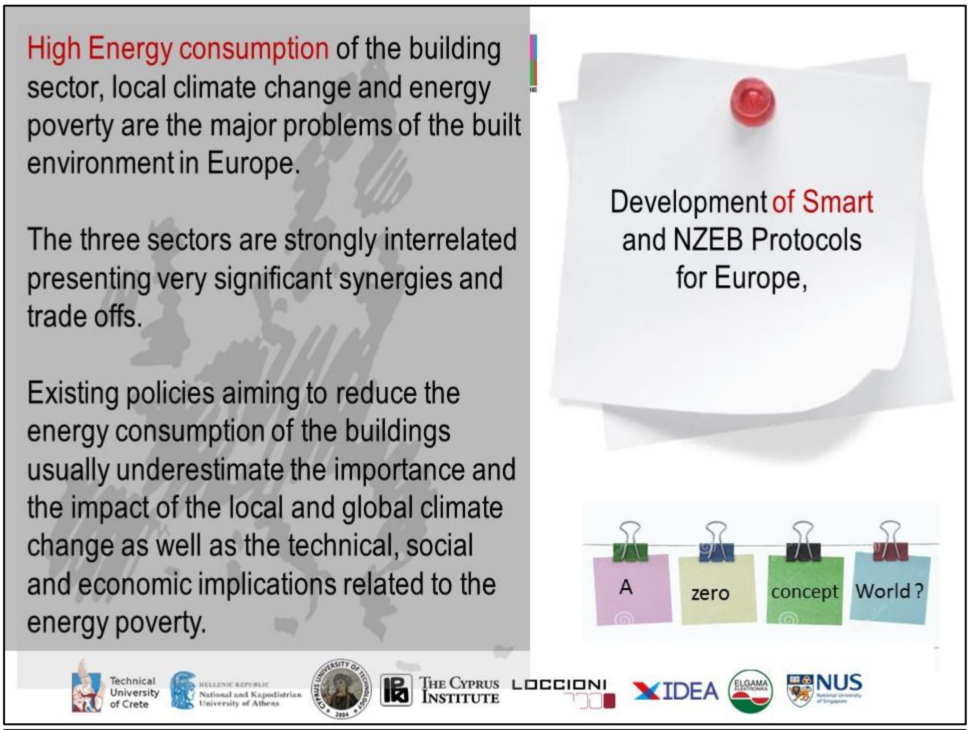
To estimate the possible benefits from such a policy, the necessary investments to minimize their energy consumption, as well as the existing housing conditions, have to be known or at least estimated.

Given that energy poverty is not approached in a common way in Europe, there are convergent assessments about the total amount of the energy poor.





Policies - Actions	Required Investments	Energy Reduction	Full Time Jobs Anually Created, (x 1000)	Other Benefits
Eradicating the Energy Poverty, (2015-2050)	Low Scenario : 1,1 trillion Euros High Scenario : 2,5 trillion Euros	0,61-1,39 PWh	<u>Low – High Scenarios</u> 224-366 (2jobs/M€) 197-420 (6 jobs/M€) 624-1330 (19 jobs/M€)	Reduction of Health Problems between 50-90 %.


High Energy consumption of the building sector, local climate change and energy poverty are the major problems of the built environment in Europe.
The three sectors are strongly interrelated presenting very significant synergies and trade offs.
Existing policies aiming to reduce the energy consumption of the buildings usually underestimate the importance and the impact of the local and global climate change as well as the technical, social and economic implications related to the energy poverty.
Development of Smart and NZEB Protocols for Europe,
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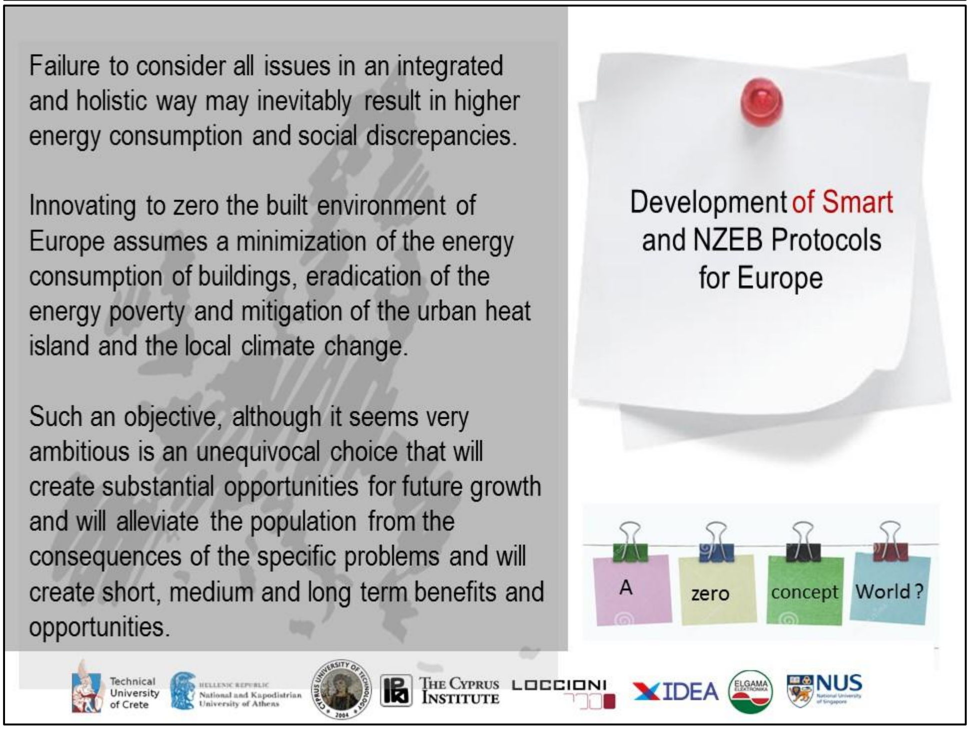
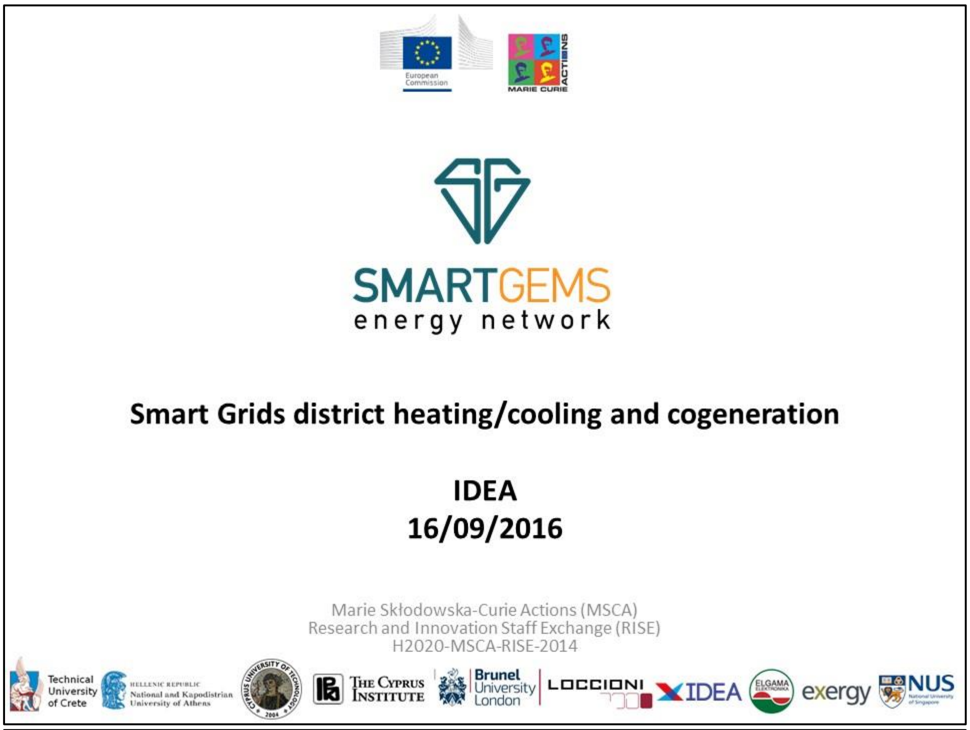
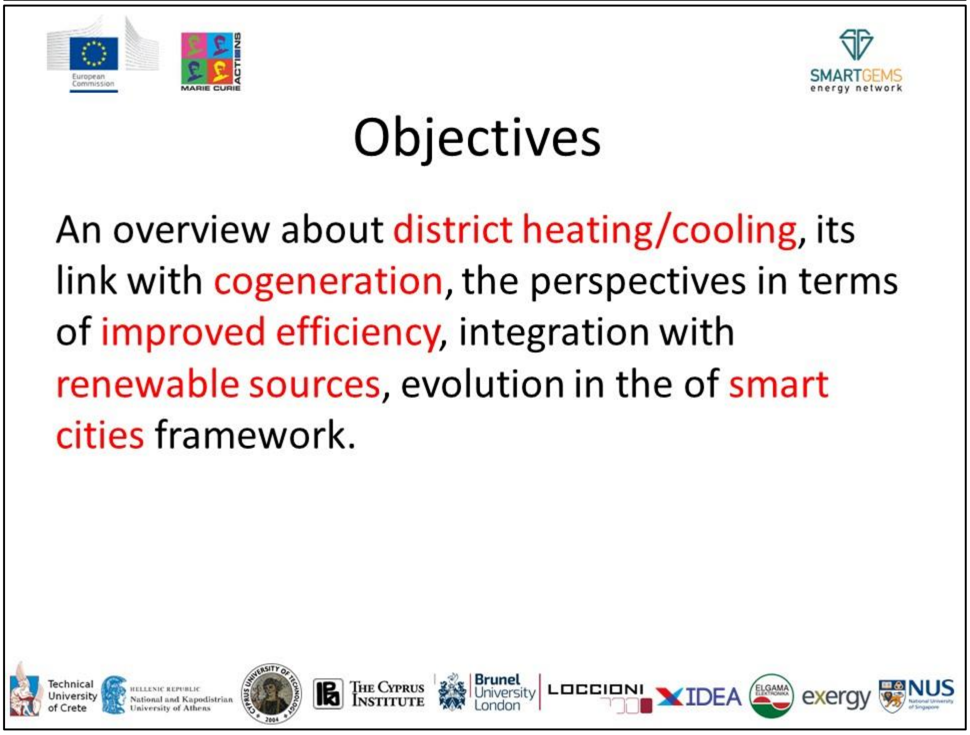
concept
World ?


Failure to consider all issues in an integrated and holistic way may inevitably result in higher energy consumption and social discrepancies.
Innovating to zero the built environment of Europe assumes a minimization of the energy consumption of buildings, eradication of the energy poverty and mitigation of the urban heat island and the local climate change.
Such an objective, although it seems very ambitious is an unequivocal choice that will create substantial opportunities for future growth and will alleviate the population from the consequences of the specific problems and will create short, medium and long term benefits and opportunities.
Development of Smart and NZEB Protocols for Europe
A
zero
concept
World ?

Annex IV: Slides of the 4th Webinar – Smart Grids district heating/cooling and cogeneration organized by IDEA





Outline

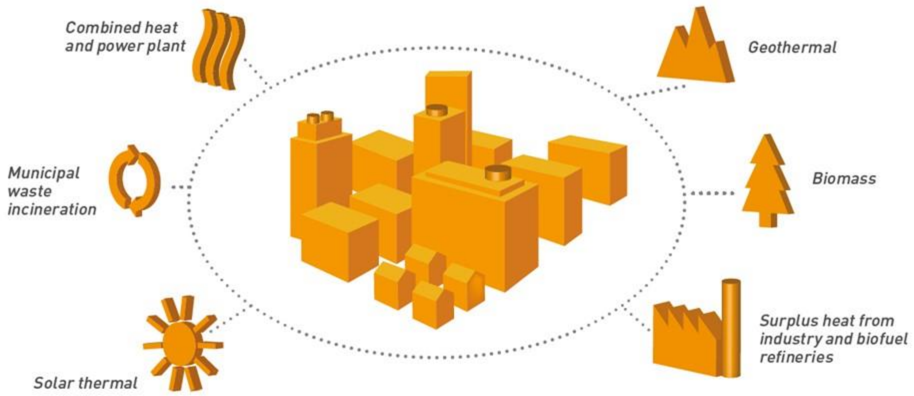
- Definition of DHC
- Advantages of DHC
- Main components od DHC
- DHC in a Smart City/Community framework
- Solar hybridization of DHC
- Good practices
- Topics/activities for SGs

Definition

- The fundamental idea of DHC is simple but powerful: connect multiple thermal energy users through a piping network to environmentally optimum energy sources, such as combined heat and power (CHP), industrial waste heat and renewable energy sources such as biomass, geothermal and natural sources of heating and cooling.
- The ability to assemble and connect thermal loads enables these environmentally optimum sources to be used in a cost-effective way.

Energy sources for district heating

- There are a number of different energy sources that can be used for DHC, including industrial waste heat, geothermal, solar systems and heat pumps, in addition to conventional boilers and co-generation.
- A low DHC return water temperature enables the efficient use of low-grade energy sources. This is because low temperature return water is able to absorb more thermal energy from these sources. For this reason, the temperature level of consumer installations should be as low as possible.
- The level is mostly dependent on specific rules and principles, which varies from country to country. The level of return temperatures from consumer installations may vary as much as from 80 to 30°C. The use of high return temperatures often precludes many of the low grade sources of heat available.

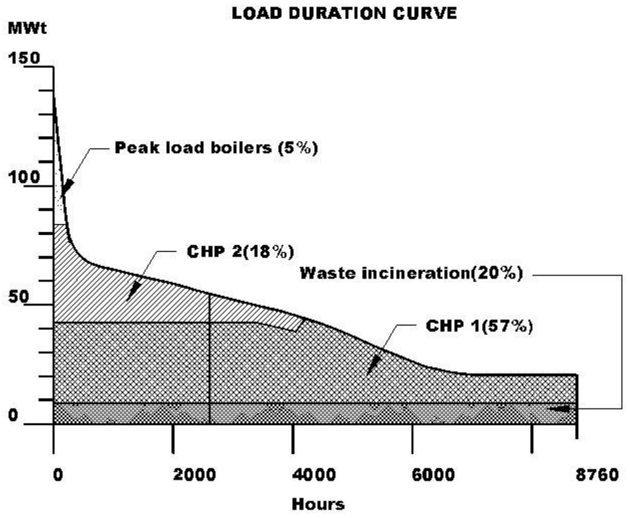


Low temperature DH

- Apart from this regulation over the seasons, many DH operators also aim at a general reduction of the temperature level. This is often possible due to an ongoing improvement of the building standard (improved insulation, double glazing, better control, individual metering etc.) and contributes to a general reduction of energy consumption and corresponding reduction of air pollution.
- Heat losses in modern DH distribution depend on a number of factors such as the length of the system in relation to the heat load, standard of insulation and temperature level. Normally, heat losses fall in the range of 5-20% annually.
- It is common to operate the supply water temperature below 120°C. Studies have shown that by reducing the normal operating temperature and by reducing the effects of pressure fluctuations, the life of the pipe work can increase dramatically.

Source priorities

- In any DH system, a priority regime of the heat sources connected has to be defined. This is in order to secure the operation of the most efficient and most cost-effective plant (such as CHP plants) and fuels (such as waste being treated in incinerators) during base-load periods.
- More expensive sources such as heat only boilers, based on oil or gas, are used for short-term peak loads only. Such plants are normally available as stand-by capacity.
- Where co-generation is used, the temperature level is of utmost importance. The efficiency of any thermal power plant depends on the temperature level of the cooling water. In the case of combined heat and power generation, the DH water is the cooling water of the plant and in order to keep the total efficiency of the plant as high as possible, the return water temperature of the DH system should be as low as possible.



From district heating to DHC

- District heating has a long history. As a technology concept it is a significant presence in many countries and is implemented in many different forms.
- District heating will increasingly move away from fossil fuels, toward recovery and use of waste from power plants, municipal waste and biomass. Network systems are required in order to maximise the environmental benefit of new power technologies such as fuel cells and high efficiency gas turbines as well as older technologies such as coal-fired power plants.
- The heat recovered through CHP or other energy sources can be converted to cooling, and worldwide implementation of district cooling is growing. In addition to integrating the best of new energy supply technologies, there has been and will continue to be progress in improving and reducing the cost of DHC pipe networks.

Advantages of DHC

- DHC is then an integrative technology that can make significant contributions to reducing emissions of carbon dioxide and air pollution and to increasing energy security.
  - efficiency at the generation side is higher
  - concentration of emissions out of the community area
  - avoidance of pollution generated in the life cycle of individual chillers
  - integrated management
  - exploitation of waste heat and renewables as sources.

Adoption of DHC systems

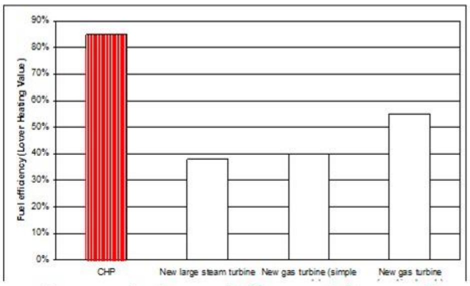
- Some countries, particularly in Scandinavia, show a significant penetration of district heating of over 50% of the heat market.
- However, district heating has only a small fraction of the total heat market of the European Union (EU). Therefore the potential is large and varies in each country depending on past national policies.
- DHC is no longer of importance only in northern latitude countries. Increasingly, in many parts of the world the DHC concept is being implemented for cooling, either through distribution of chilled water or by using the district heating network to deliver heat for heat-driven chillers.
- In the United States and in other countries where cooling is important, use of district cooling has already grown significantly.

Localization of the DHC investment

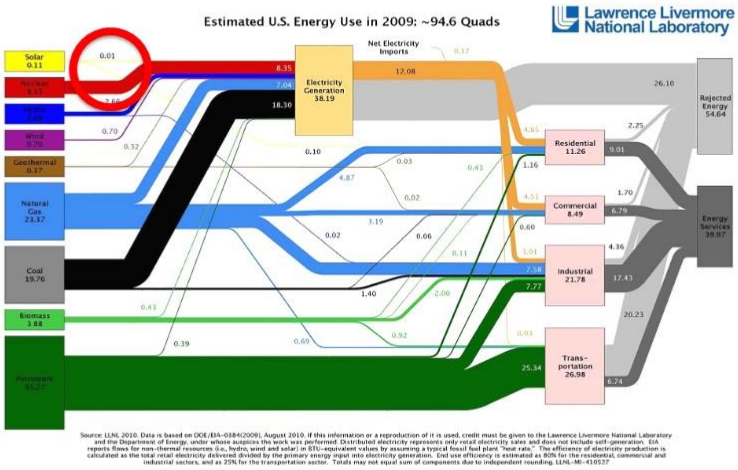
- District heating systems are by their nature local solutions, and have limited ability to raise capital and to absorb early losses.
- National or regional gas and power networks, with much larger capital bases, can often forward-price or discount new gas or power developments and thus they appear more competitive compared to district heating.
- There has been a tradition of national policies favouring large-scale energy supply alternatives, rather than local initiatives. However, when examined on a consistent basis of total long-term cost including environmental impacts, DHC is in many cases the most competitive alternative, and it is essential for fully exploiting the potential for CHP.
- At the same time, building owners are receptive to a long-term energy supply system that is fuel flexible as DHC. This insulates them from the impact of market price shocks.

DHC and CHP

- Electrical demand continues to grow worldwide, with corresponding requirements for new power plants.
- Power plants generate large quantities of low-grade heat, which is wasted unless the plant is designed and operated as a CHP facility.



- DHC is important for implementing CHP because it expands the pool of potential users of recovered thermal energy beyond the industrial sector to include commercial, institutional and multi-unit residential buildings.
- The temperatures required by these users are relatively low, which allows CHP to operate at higher efficiencies compared to plants producing higher-temperature industrial process heat. In addition, as industry becomes more electrically intensive, large industrial heat sinks for low-grade energy are increasingly hard to find.



DHC vs Energy security

- Energy security is an increasing important national and supranational policy issue. DHC and CHP can play a key role in increasing energy security by:
  - Facilitating power generation in load centers. By generating power close to the load, CHP avoids or reduces power transmission and distribution constraints.
  - Reducing cooling-related peak power demand. Air conditioning is a big contributor to peak power demands. By supplying cooling through highly efficient electric chillers and non-electric, heat-driven chillers, district cooling reduces peak power demand.
  - Shifting demand to off-peak periods. DHC can shift power loads to off-peak periods through thermal energy storage systems that store hot water, chilled water or ice at night for use during the day, or by shifting loads seasonally through aquifer or other long-term storage.
  - Increasing fuel flexibility. DHC systems boost reliability and energy security by providing flexibility to use a variety of domestic resources, thereby reducing the impact of supply and price variations.

Interface with the building

- The interface between the DHC system and the building commonly referred to the Energy Transfer Station (ETS) or consumer substation.
- The ETS consists of isolation and control valves, controllers, measurement instruments, energy meter and crossover bridge, i.e. hydraulic decoupler and/or heat exchangers.
- The ETS could be designed for direct or indirect connection:
  - with direct connection, the district fluid is distributed within the building directly to terminal equipment such as air handling and fan coil units, induction units, etc.
  - an indirect connection utilizes one or multiple heat exchangers between the district system and the building system.

Heat exchangers

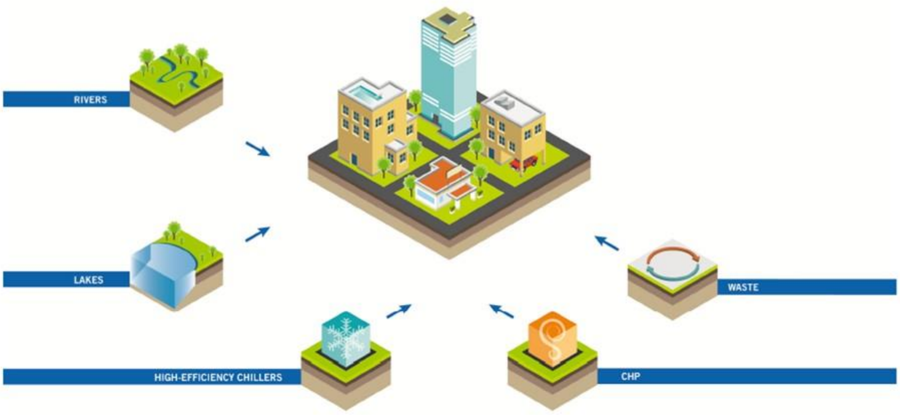
- The heat exchanger is one of the major typical components of the energy transfer station. It is therefore essential that the heat exchangers be carefully selected to provide the duty required, based on the temperature differential (ΔT) and pressure differential (DP) requirements dictated by the specific district system as well as by local code requirements.
- It is quite common for district utilities to select or even provide the heat exchangers. In some instances, the customers provide their own heat exchangers in accordance with a set of design parameters, often outlined in a specification issued by the utility.

Pressure drop in the exchanger

- The allowable pressure drop (DP) across the heat exchanger is one of the critical parameters to be considered for the selection criteria. The higher the pressure drops, the smaller and less expensive the heat exchangers will be. However, the DP should typically not exceed the chiller evaporator pressure drop if the building's existing pumps are to be reused.
- Another important consideration is the temperature approach. It is of the most importance that the system operates with a maximized ΔT, a close temperature approach is required to minimize the temperature "loss" over the heat exchanger.
- Plate heat exchangers are the only ones that can provide a close temperature approach (less or equal to 1°C). Brazed plate heat exchangers, another type of plate heat exchangers without gaskets, could also be used for small buildings. Other types of heat exchangers, i.e. shell & tube or shell & coil, are not typically suitable for district cooling applications since the required close temperature approach cannot be achieved with these units. The physical sizes of these units would also be much larger compared to the plate heat exchangers.

District cooling classification

- District cooling systems can be subdivided into three groups based on supply temperatures:
  - Conventional chilled water temperatures: 4°C – 7°C
  - Ice water systems: +1°C
  - Ice slurry systems: -1°C
- Chilled water is typically generated at the district cooling plant by compressor driven chillers, absorption chillers or other sources like ambient cooling or "free cooling" from deep lakes, rivers, aquifers or oceans.



Losses in district cooling

- District cooling systems typically vary the chilled water supply temperature based on the outside ambient temperature. This temperature reset strategy will allow an increase in the chilled water supply temperature as the system cooling demand decreases, thus increasing the chiller plant efficiencies and reducing the distribution energy losses/gains.
- Seasonal heat gains/losses in buried chilled water distributions systems are generally small. This is due to the normally small temperature gradients between the chilled water in the pipes and the surrounding soil, particularly prevalent in northern climate zones (i.e. Canada and northern US or Scandinavia). Hence, buried district cooling piping systems are generally un-insulated, except for systems located in warmer climate zones where much higher ground temperatures are typically experienced.

Design of a DHC

- The successful implementation of district heating and cooling systems depends greatly on the ability of the system to obtain high temperature differentials (ΔT's) between the supply and return water.
- The significant installation costs associated with a central distribution piping system, and the physical operating limitations (i.e., pressures and temperatures) of district energy systems, require careful scrutiny of the design options available for new and existing buildings HVAC systems connected to a district energy system. It is crucial to ensure that the central district energy system can operate with reasonable size distribution piping and pumps to minimize the pumping energy requirements.
- Generally, it is most cost-effective to design for a high ΔT in the district cooling system because this allows for smaller pipe sizes in the distribution system. These savings, however, must be weighted against higher building conversion costs, which may result from a requirement for a high primary return temperature.

Criticity of temperature controls

- Control of the ΔT's becomes particularly critical for district cooling systems since they operate with significantly lower ΔT's than hot water based district heating systems (which typically operate with design ΔT's ≥40 °C).
- The minimum supply temperature for a system utilizing (ice-based) thermal storage and ice chillers is approximately 1°C. Without the ice the supply temperature is typically limited to 4°C . The corresponding return temperature is at best 12°C at peak operating conditions. The maximum system ΔT is thereby only 11°C at peak conditions for ice based systems and 8°C for conventional chiller based systems

Control strategy

- The controls are another major component of the energy transfer station. A great deal of emphasis should be given to the selection of control valves and control strategy to ensure optimum functioning controls. The objective of the controls is to maintain correct supply temperature to the customer and at the same time, provide high return back to the district system.
- District cooling systems should be designed so that the primary and secondary water temperatures vary according to the outdoor temperature. This control strategy will reduce energy costs and optimize conditions for the control valves, while maintaining comfortable interior temperatures.

Control valves

- The wide range of flows, pressures, and load turndown requires special considerations in the selection of control valves.
- The control valves must be selected for sufficient pressure drops to provide high control authority. A “rule of thumb” is that the pressure drop across the control valve, at fully open position, should be at least equal to the total pressure drop across the heat exchanger, flow meter, and associated piping and equipment. If information on the actual differential pressure (DP) conditions at each ETS is readily available from the district utility, this information should be used to size the control valves in lieu of the “rule of thumb” above.

Control systems

- Microprocessor–based electronic control systems, either direct digital control (DDC) or programmable logical control (PLC), are used for control, monitoring, and data acquisition at the energy transfer stations (ETS).
- With the advances in the building automation industry over the last decade, it has become more common for district energy systems to incorporate full remote control and monitoring capabilities into the ETS design, often integrated with remote energy metering.

- The remote control and metering is done by way of a communication network via conventional cable, fiber optics, modem, or radio. The controls contractor typically provides a "turnkey" for the controls and metering, including installation and commissioning of the communication network.

Energy meters

- The energy meter registers the quantity of energy transferred from the user's secondary system to the primary system. Cooling energy is the product of mass flow, temperature difference, the specific heat of the water, and time. It is difficult to measure mass flow in an enclosed pipe system, so volume flow is measured. The result is corrected for the density and specific heat capacity of the water, which depends on its temperature. The effect of pressure is so small that it can be neglected.
- An energy meter consists of a flow meter, a pair of temperature sensors, and an energy calculator that integrates the flow, temperature data and correction factors. It is desirable that the energy meter be supplied as a complete unit; factory calibrated with stated accuracy performance ratings in compliance with accepted metering standards.
- Meters can be divided into two major groups: dynamic meters, which register flow with the aid of moving parts; and static meters, which have no moving parts.

Dynamic meter

- There are two types of dynamic meters used in DHC: impeller and turbine meters:
  - impeller meters measure flow with the aid of straight-bladed impellers.

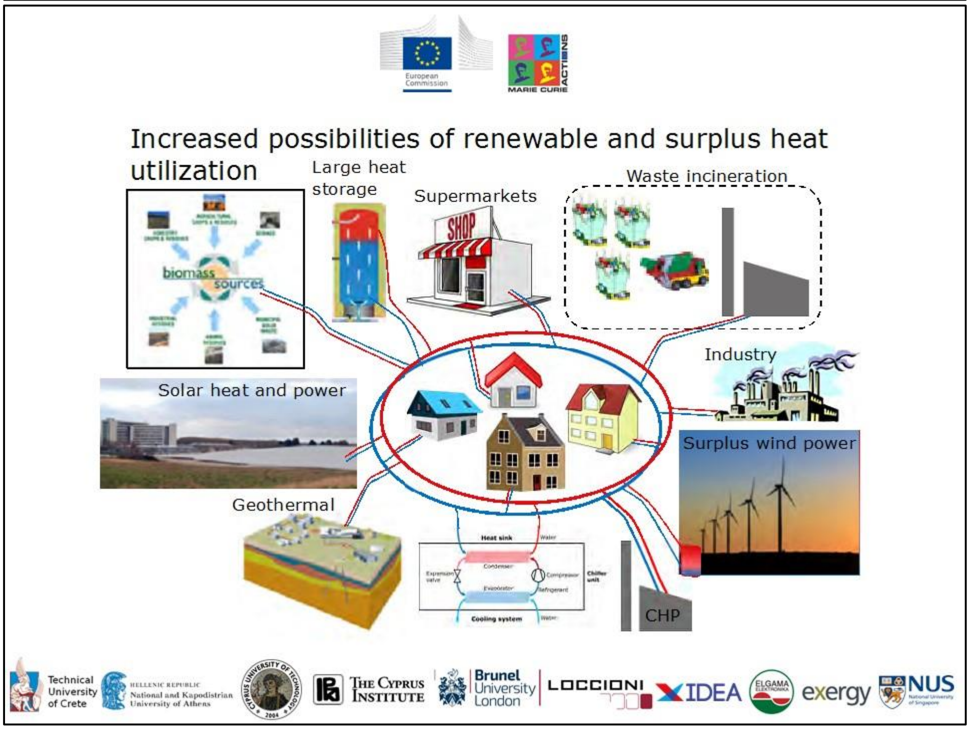
    Multi-jet impeller meters are very sensitive to impurities such as sand and sharp metal particles, but are not sensitive to flow disturbances. This type of meter is best suited to medium-sized buildings but not for small buildings because it does not function well at small loads.

    In single-jet impeller meters, the flow runs through a single nozzle directed tangentially to the impeller blades. Single-jet meters have properties similar to those of multi-jet meters, but they are more suitable for small buildings because a very weak flow is enough to start the meter.
  - in a turbine meter, the flow is always in the direction of the rotor shaft. “Woltmann” and “rotary vane” meters are types of turbine meters. The accuracy of the meter depends on the flow profile before the meter; so strong flow disturbances must be avoided. The flow is directed to the rotor blades via fins. The weaknesses of this meter are its high start-up threshold and rapid wearing of bearings at high loads and in dirty water. Turbine meters are suitable for high flows, but are not suitable for small buildings.

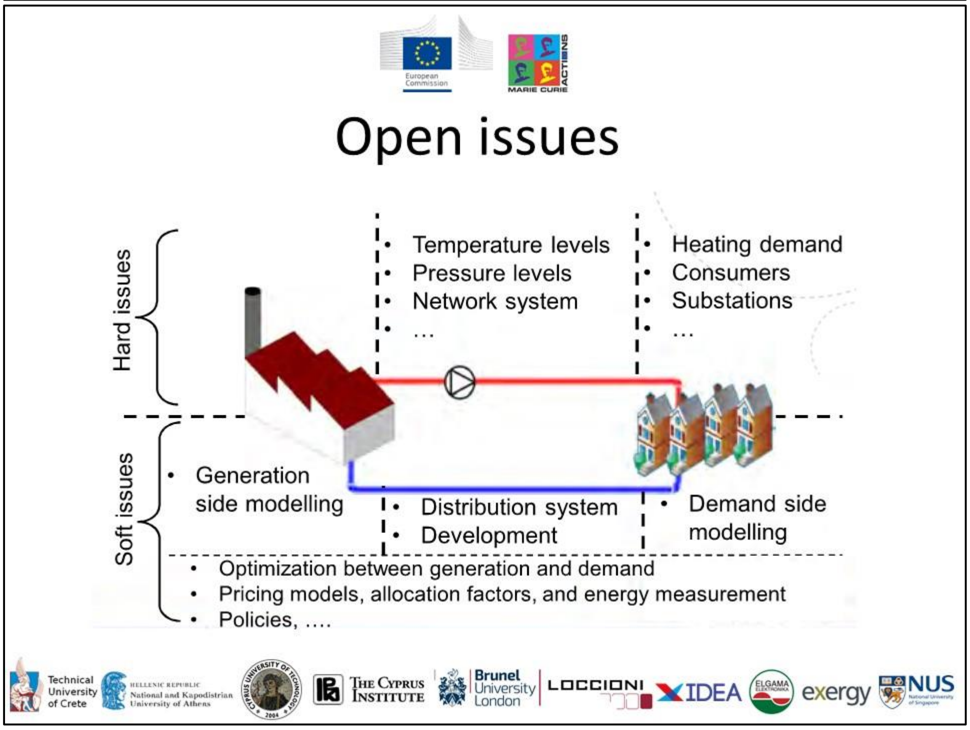
Static meters

- There are two types of static flow meters which are used in district cooling applications: magnetic induction (MID) and ultrasonic.
  - the MID meter is based on the induction of voltage in a conductor moving in a magnetic field. The conductor in this case is water. The water flows through a pipe made of non-magnetic material with an exactly known cross-sectional area. Electrodes connected to powerful electromagnets sense the flow. The voltage induced in the water is measured and amplified and the information is converted by the heat calculator. Although their initial cost is higher than dynamic meters, consideration should be given to their reduced maintenance and increased accuracy.
  - the ultrasonic meter is based on changes in the propagation of ultrasonic waves caused by the velocity of the flow. These changes are registered by measuring the time between the transmission and reception of ultrasonic signals over an exactly known distance, or by measuring changes in the frequency of reflected ultrasonic waves. Recent experience indicates that ultrasonic meters are accurate and cost-effective for large flows.


DHC in a smart city framework
Intelligent electricity grids
Plus-Energy-Buildings/ Communities
Climate adaptive city transformation
Smart Mobility & E-mobility
Renewable Energies
Intelligent Infrastructures

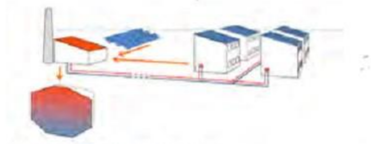

Increased possibilities of renewable and surplus heat utilization
Large heat storage
Supermarkets
Waste incineration
biomass sources
Industry
Solar heat and power
Surplus wind power
Geothermal
CHP


Demand-driven approach
H C E
Hospital
Supermarket
Office
Dwelling
Ice rink
Shop
School
Swimming pool
Source: REAP Projekt, TU Delft


Open issues
Hard issues
Temperature levels
Pressure levels
Network system
…
Heating demand
Consumers
Substations
…
Soft issues
Generation side modelling
Distribution system
Development
Demand side modelling
Optimization between generation and demand
Pricing models, allocation factors, and energy measurement
Policies, ….

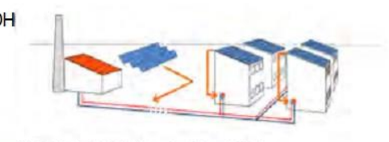
Integration of solar collectors

- Centralized
  - Collectors mounted on buildings transfer heat via a collecting grid
  - Long term storage
  - Lower investment cost



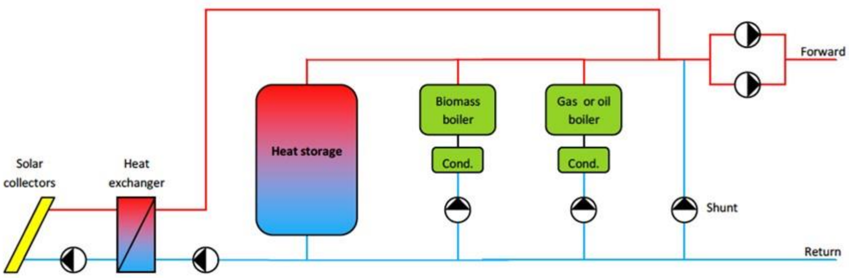
Central solar district heating system. (Source: Solites)

- Decentralized
  - Collectors supply heat directly in DH network
  - Buildings importers/exporters
  - Flexibility
  - Management difficult

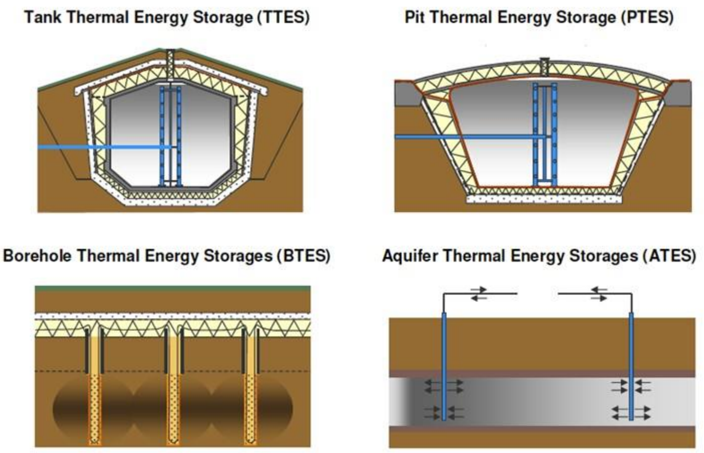


Distributed solar district heating system. (Source: Solites)

Hybrid DHC



Storage solutions



Breakeven of S-DHC

- Solar heat can be combined with other fuels.
- Normally solar heat is competitive where with heat production prices are lower than 3 €cents/kWh in Northern Europe and 2 €cents/kWh in Southern Europe.

From consumers to prosumer

- Users can generate low grade heat that can be delivered to the DHC system.
- This can activate new possible business models:
  - in Denmark DH operators are mosly organized in cooperatives
  - in Sweden, building associations own solar collectors and export heat to the DH
  - in Austria, ESCO own and operat the solar heating system.

Technical obstacles for integration

- Reducing the temperature in existing networks (lower return temperature, high efficent heat exchangers)
- Transition of existing buildings to the low temperature district heating systems
- Network extension with the low temperature system
- Technology for two-ways communication
- Metering technology

From DHC to hybrid microgrids

- A microgrid is a microcosm of the Grid – integrates generation and load
- It can island from the grid
- It can provide services to the grid
- To its owner/operator a microgrid is a micro control area
- To the grid it is both a load and a resource
- A microgrid can also integrate thermal load, energy storage and advanced controls – both internal and grid-facing – making it qualitatively different from other resources.

Trends in microgrids

- Microgrids are resilient – backup generation fails frequently
- Microgrids are efficient – with balanced thermal load, over 90%
- Microgrids can improve integration of renewables providing internal balancing
- Microgrids can incorporate storage – permitting arbitrage
- Microgrids can manage to the tariff – reduce standby charges
- Microgrids support the Grid through:
  - Demand response
  - Regulation
  - Reserves
  - Capacity

Good practices

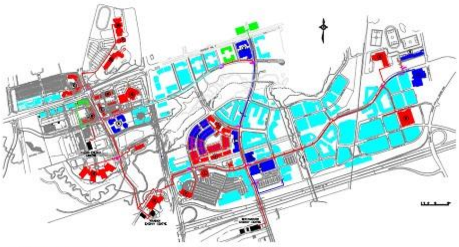
- US
- Finland
- Denmark

University of California, San Diego - San Diego, CA

- **Operates a 42 MW microgrid in parallel with the SDG&E grid**
- **11 million ft^2 of buildings**
- **Energy density (kWh/ft2/yr) is 2X of typical commercial**
- **Self generates approximately 90% of annual demand**
- **30 MW natural gas CHP plant**
- **2.8 MW of fuel cell, 1.2 MW Solar PV**

*Source – Solar Turbines & Maya Smart Energy Consultants

Markham District Energy - Markham, Ontario

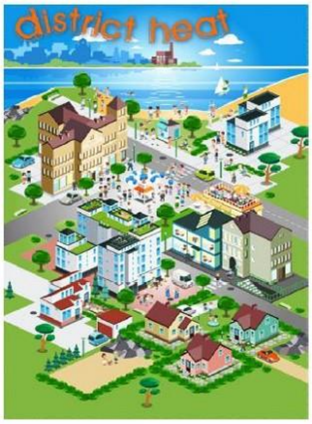


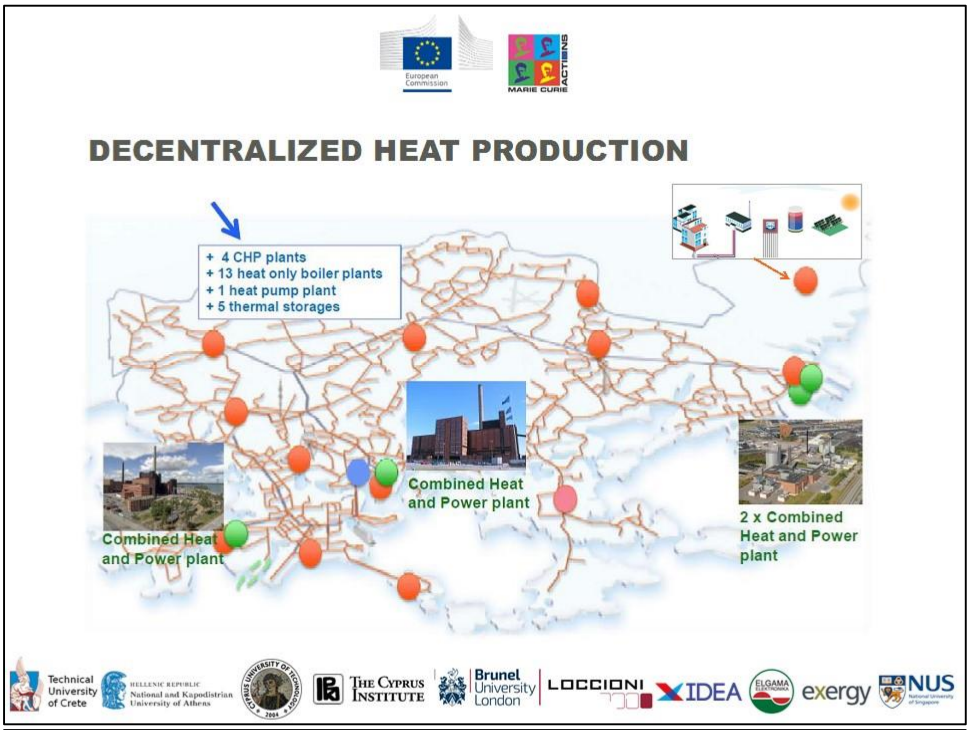
- 3 interconnected Plants
- Condensing hot water generators
- Hot water thermal storage
- Reciprocating engine based CHP (11.5 MW)
- Absorption cooling
- "Effective" overall efficiency with CHP & storage – 116%

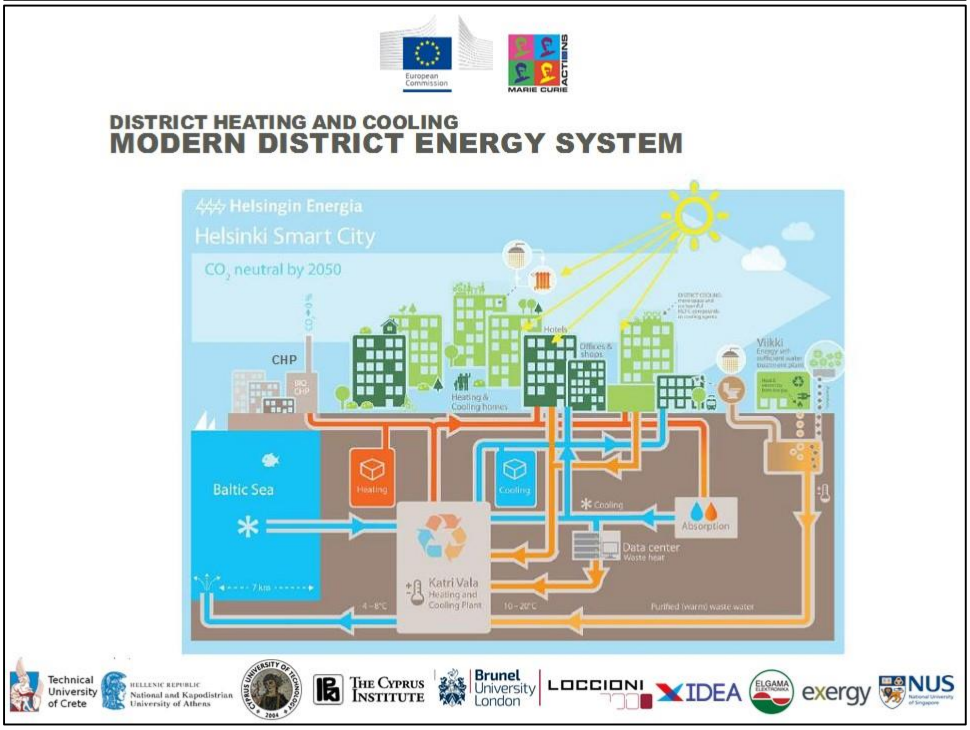
*Source – Markham District Energy

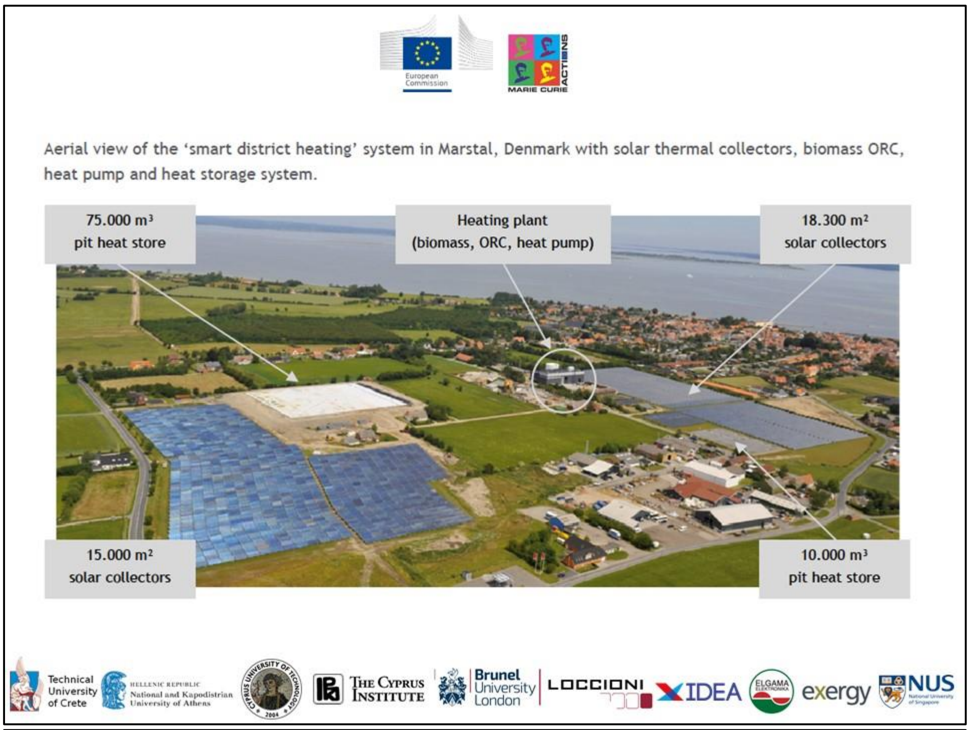
CHP AND DHC IN HELSINKI

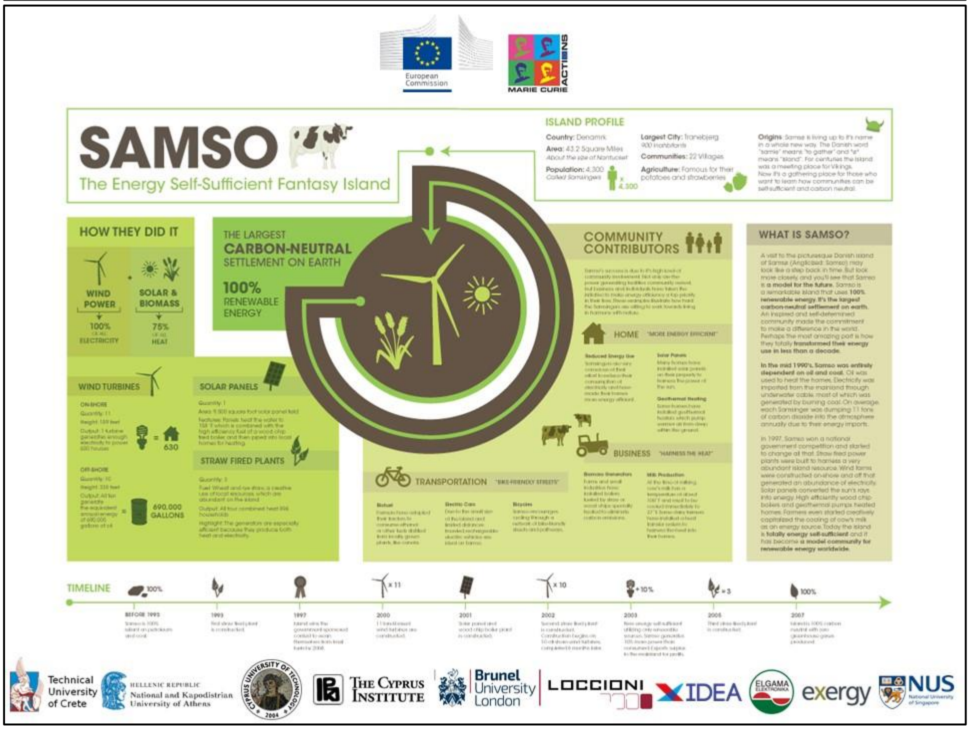
- Helsinki Energy has extensively operated its energy-efficient smart CHP/ hot water based DH system in Helsinki since 1957 (steam 1953)
- Basic reasons for the DH were;
  - Economical
  - Ecological
  - Supply reliability
  - Energy political
- From the very beginning DHC have been economically success
- District Cooling supply started in 1998




DECENTRALIZED HEAT PRODUCTION
+ 4 CHP plants
+ 13 heat only boiler plants
+ 1 heat pump plant
+ 5 thermal storages
Combined Heat and Power plant
Combined Heat and Power plant
2 x Combined Heat and Power plant


DISTRICT HEATING AND COOLING
MODERN DISTRICT ENERGY SYSTEM
Helsingin Energia
Helsinki Smart City
CO2 neutral by 2050
CHP
Hotels
Offices & shops
Heating & Cooling homes
Viikki
Baltic Sea
Heating
Cooling
Cooling
Absorption
Data center
Waste heat
Katri Vala
Heating and Cooling Plant
Purified (warm) waste water


European Commission
MARIE CURIE ACTIONS
Aerial view of the 'smart district heating' system in Marstal, Denmark with solar thermal collectors, biomass ORC, heat pump and heat storage system.
75.000 m³ pit heat store
Heating plant (biomass, ORC, heat pump)
18.300 m² solar collectors
15.000 m² solar collectors
10.000 m³ pit heat store
Technical University of Crete
Hellenic Republic National and Kapodistrian University of Athens
The Cyprus Institute
Brunel University London
LOCCIONI
IDEA
ELGAMA ELEKTRONIKA
exergy
NUS National University of Singapore


European Commission
MARIE CURIE ACTIONS
SAMSO
The Energy Self-Sufficient Fantasy Island
ISLAND PROFILE
HOW THEY DID IT
WIND POWER
SOLAR & BIOMASS
100% ELECTRICITY
75% HEAT
THE LARGEST CARBON-NEUTRAL SETTLEMENT ON EARTH
100% RENEWABLE ENERGY
COMMUNITY CONTRIBUTORS
WHAT IS SAMSO?
WIND TURBINES
SOLAR PANELS
STRAW FIRED PLANTS
HOME
BUSINESS
TRANSPORTATION
TIMELINE
Technical University of Crete
Hellenic Republic National and Kapodistrian University of Athens
The Cyprus Institute
Brunel University London
LOCCIONI
IDEA
ELGAMA ELEKTRONIKA
exergy
NUS National University of Singapore

The Danish lesson

- Three out of four Danes are supplied through collective heat supply systems (district heating or natural gas).
- 99% of them pay less than the costs which would have been charged with individual heat supply systems.
- The goal should be that all the advantages are reflected in the (lower) price, because the price of different solutions is easy to compare.
- Even if a small percentage of district heating customers is paying a higher price than individual heating customers, it has serious consequences on the reputation and thus the acceptance of district heating.

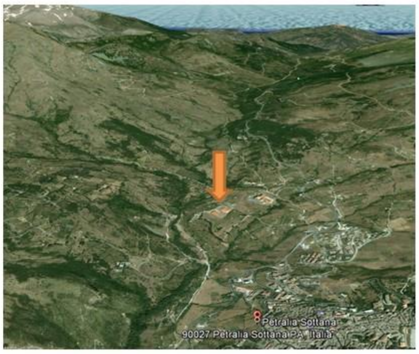
Open issues for SGs

- Advanced design of DHC
- Development of models for hot regions
- Integration of renewables
- Metering systems
- Microgrid management
- "Seeding" DHC starting from smart building projects
- Business models

A DHC in design phase. Available for SGs secondments

Petralia Sottana

The site is located in the inner part of Sicily at 25 Km from the north coastline, about 1.000 m above the sea level. It is representative of the mountain climate in Sicily.



Sport center + Hospital

The site includes a public pool, covered tennis courts and the public hospital. All the buildings could be managed as an energy district. In addition to roofs (700 sqm, well oriented) there are external areas available for solar plants (2,000 sqm).

This objective has been included into the local strategical agenda supported by the regional ERDF/S3 program.

A biomass burner (brand new, 750 kW) is already available. It could be integrated by a solar system to balance the energy production both daily and seasonally. The energy in excess should be delivered to the hospital for heating and cooling. Electricity generation could be performed by photovoltaic panels placed on the back of the solar mirrors.

Petralia is a very pleasent place both in summer and winter time.

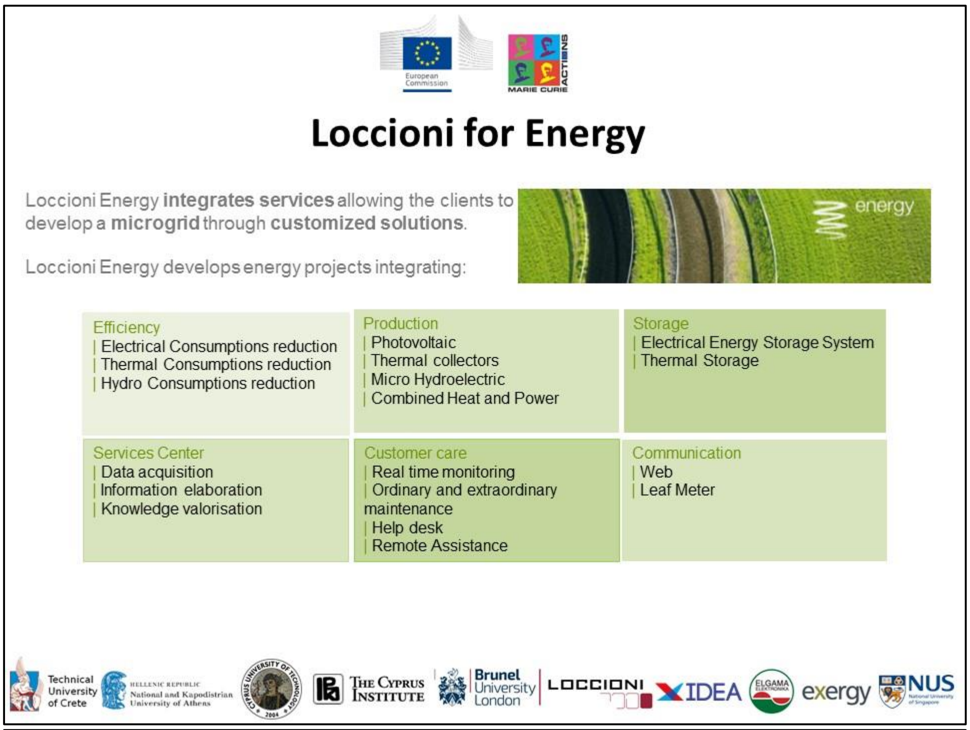
An energy innovation center will be started with the aim to create companies and jobs in the sector, in cooperation with us.

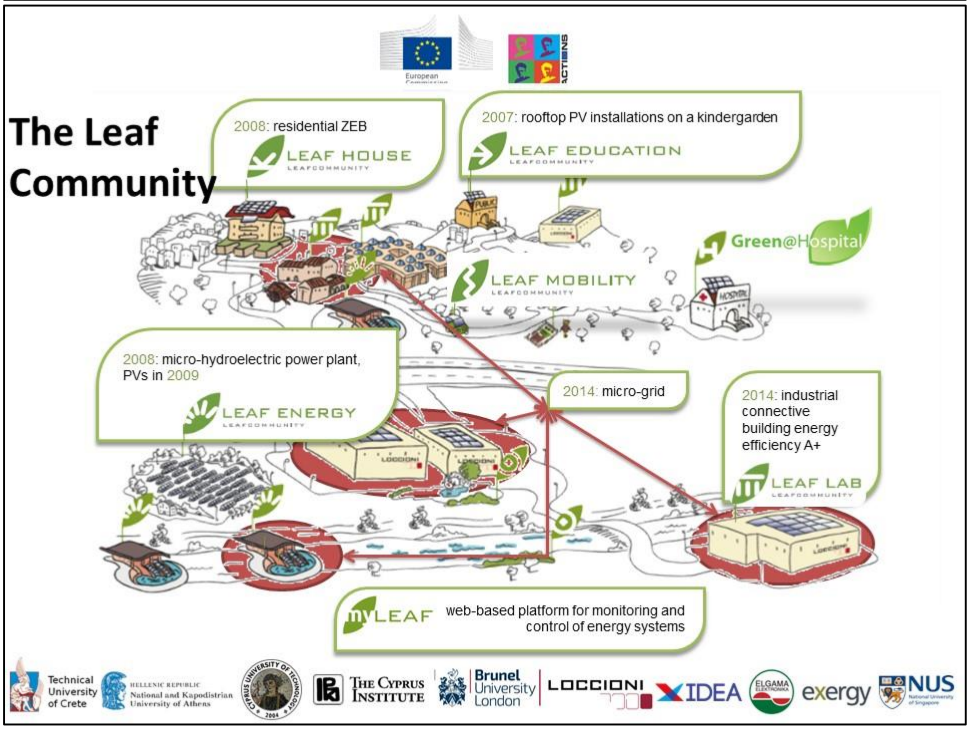
Thus, brave SGs researchers coming for WP4 are invited to work with us on the design of the Petralia district!

Any question?

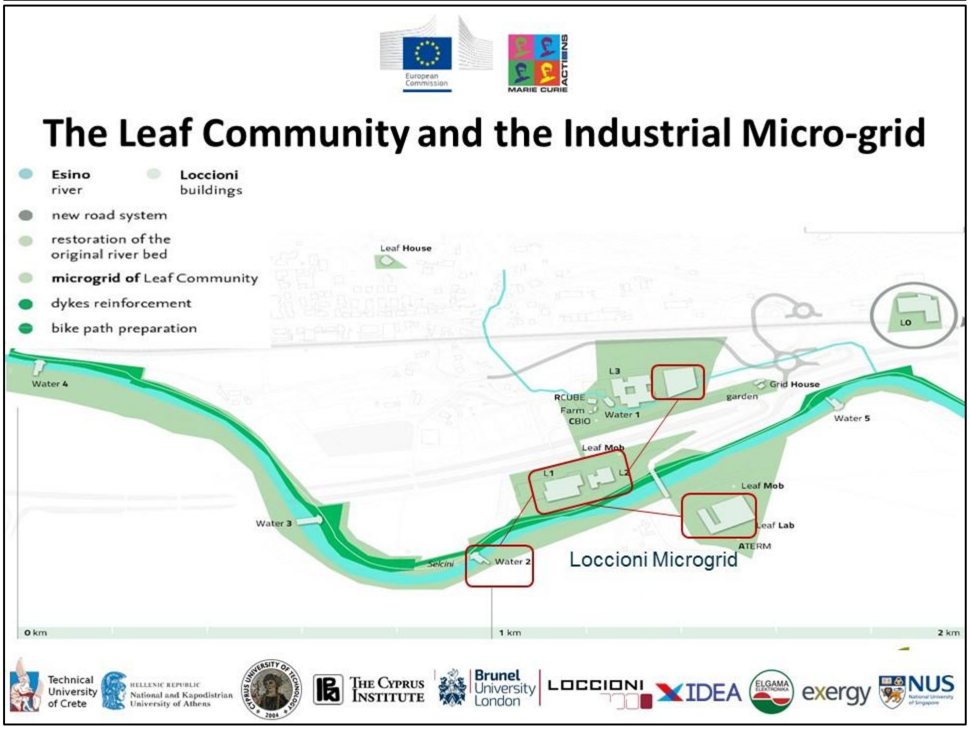
Annex V: Slides of the 5th Webinar - LEAF Community (AEA) and Camp IT (UOC).

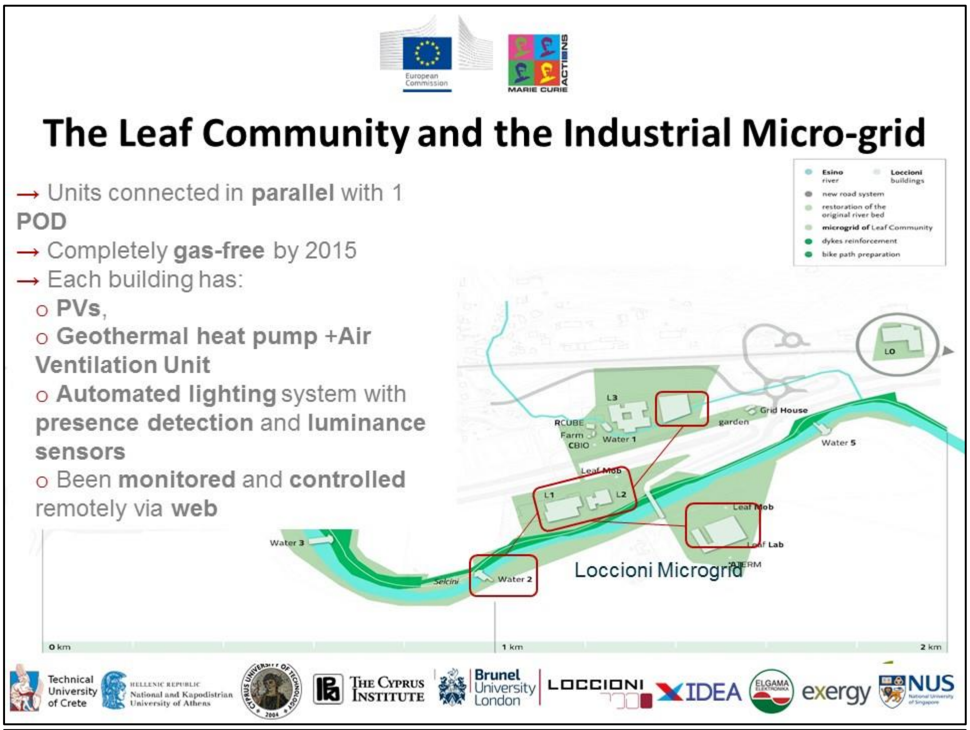
Slides of the Seminar organized by AEA (LEAF Community)

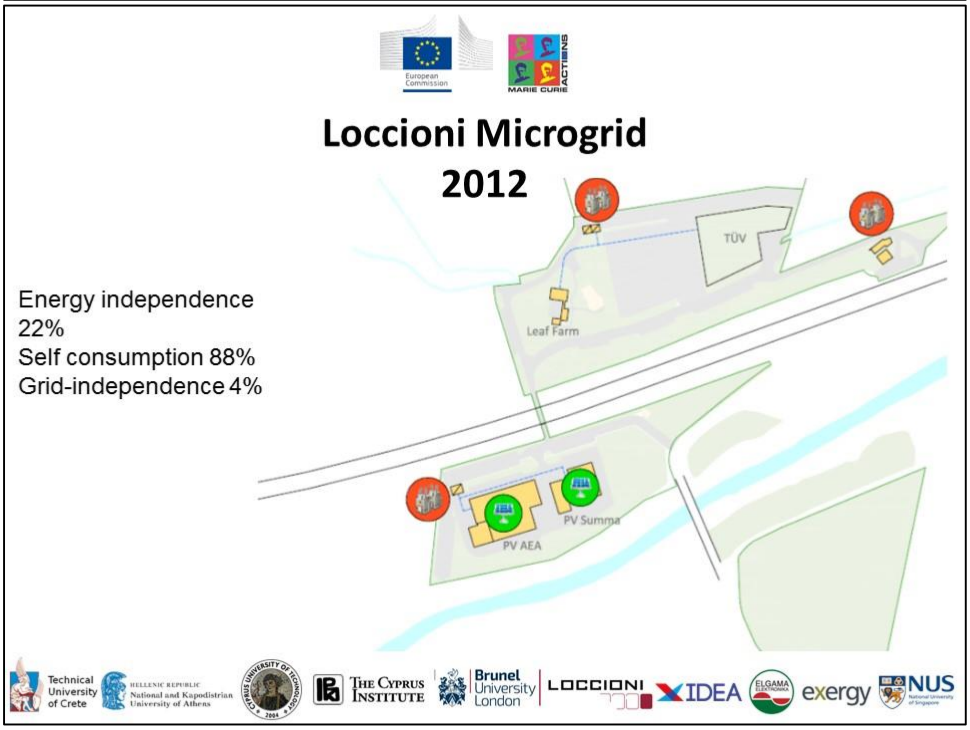

Loccioni for Energy
Loccioni Energy integrates services allowing the clients to develop a microgrid through customized solutions.
Loccioni Energy develops energy projects integrating:
energy
Efficiency
| Electrical Consumptions reduction
| Thermal Consumptions reduction
| Hydro Consumptions reduction
Production
| Photovoltaic
| Thermal collectors
| Micro Hydroelectric
| Combined Heat and Power
Storage
| Electrical Energy Storage System
| Thermal Storage
Services Center
| Data acquisition
| Information elaboration
| Knowledge valorisation
Customer care
| Real time monitoring
| Ordinary and extraordinary maintenance
| Help desk
| Remote Assistance
Communication
| Web
| Leaf Meter

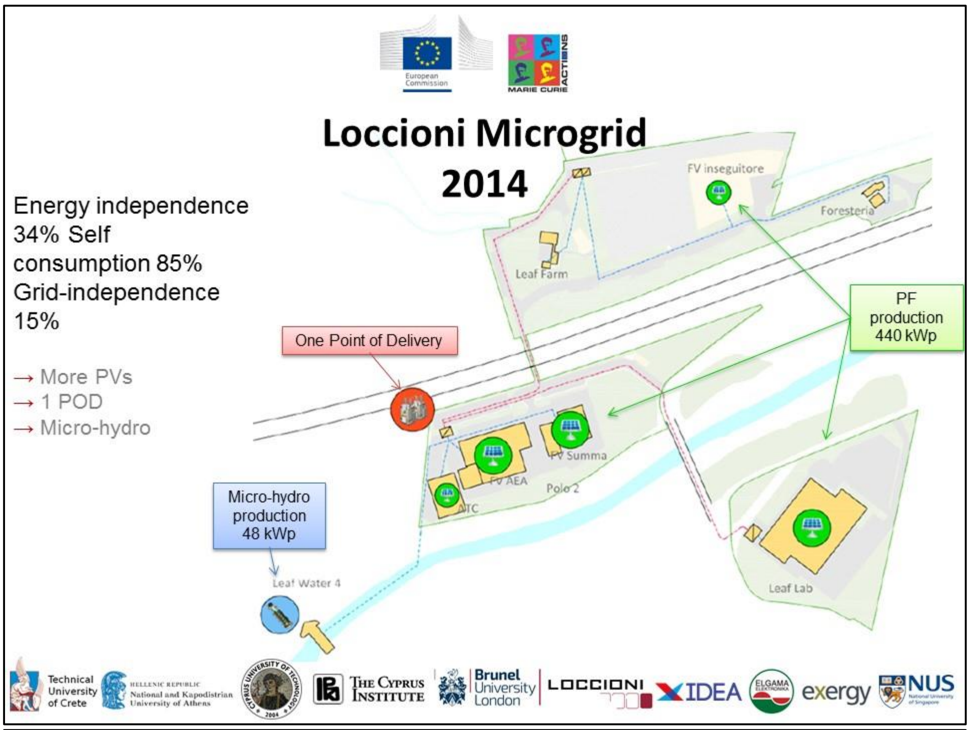

The Leaf Community
2008: residential ZEB
LEAF HOUSE
2007: rooftop PV installations on a kindergarden
LEAF EDUCATION
Green@Hospital
LEAF MOBILITY
2008: micro-hydroelectric power plant, PVs in 2009
LEAF ENERGY
2014: micro-grid
2014: industrial connective building energy efficiency A+
LEAF LAB
myLEAF
web-based platform for monitoring and control of energy systems

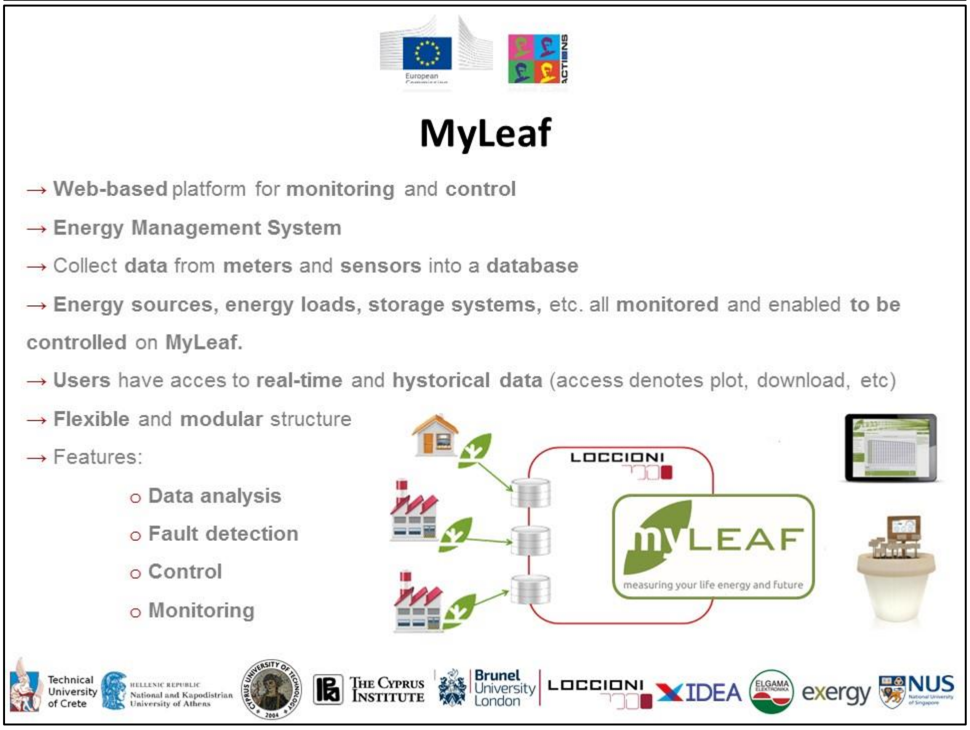

European Commission
MARIE CURIE ACTIONS
The Leaf Community
Leaf Lab
industrial connective
building energy
efficiency class A+
MyLeaf
web-based monitoring
and control
Smart Meters
energy consumption
measurements
LEAF COMMUNITY
LIFE ENERGY AND FUTURE
Energy efficiency
activities to industrial
buildings
Storage Systems
electrical and thermal
storage systems
Leaf House
residential ZEB
Renewable Energy
Sources (RESs)
hydroelectric, solar
Micro-grid
integration of RESs,
monitoring and control
systems
Technical University of Crete
Hellenic Republic National and Kapodistrian University of Athens
The Cyprus Institute
Brunel University London
LOCCIONI
IDEA
ELGAMA
exergy
NUS

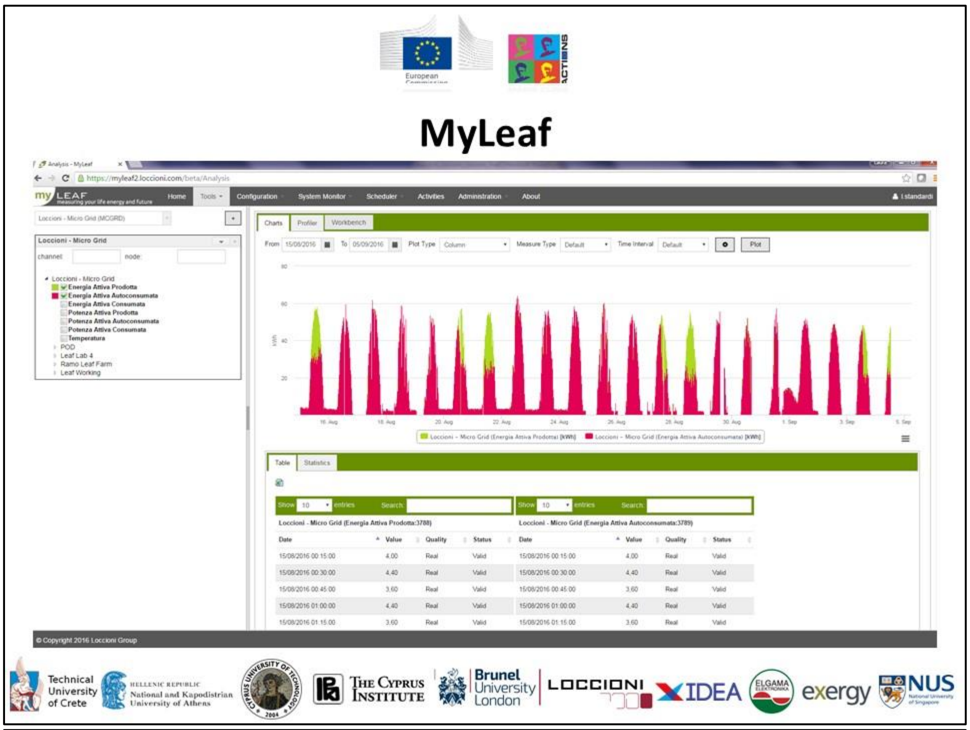

European Commission
MARIE CURIE ACTIONS
The Leaf Community and the Industrial Micro-grid
Esino river
Loccioni buildings
new road system
restoration of the original river bed
microgrid of Leaf Community
dykes reinforcement
bike path preparation
Leaf House
Water 4
Water 3
Water 2
Water 1
Water 5
Grid House
garden
L3
RCUBE
Farm
CBIO
Leaf Mob
Leaf Lab
ATERM
Selcini
Loccioni Microgrid
0 km
1 km
2 km
Technical University of Crete
Hellenic Republic National and Kapodistrian University of Athens
The Cyprus Institute
Brunel University London
LOCCIONI
IDEA
ELGAMA
exergy
NUS

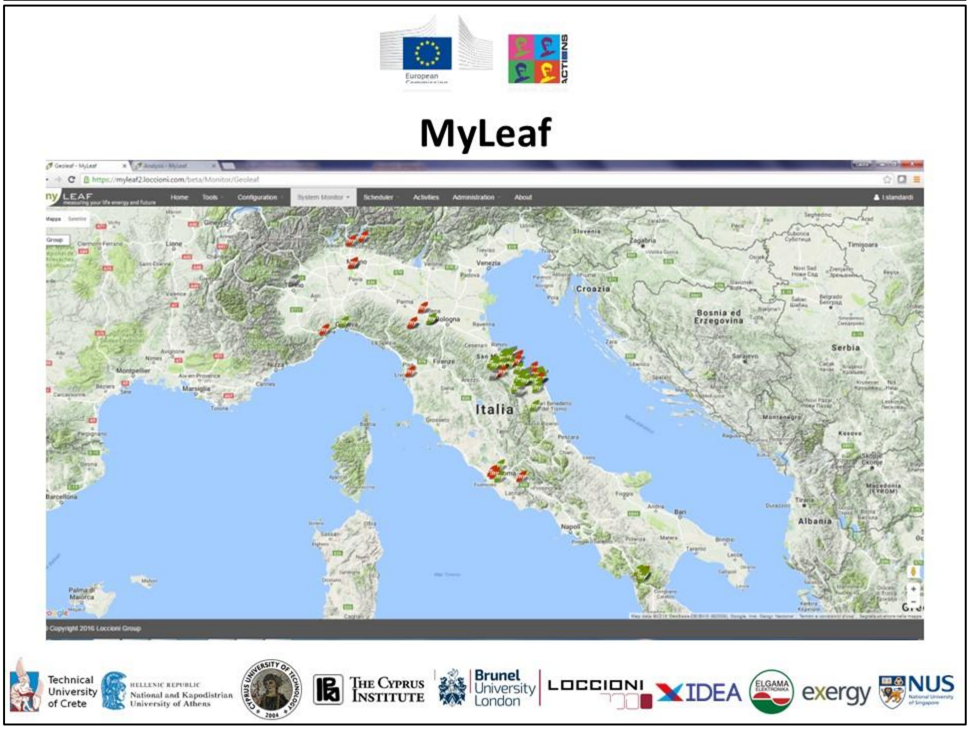

The Leaf Community and the Industrial Micro-grid
→ Units connected in **parallel** with 1 **POD**
→ Completely **gas-free** by 2015
→ Each building has:
o **PVs**,
o **Geothermal heat pump +Air Ventilation Unit**
o **Automated lighting** system with **presence detection** and **luminance sensors**
o Been **monitored** and **controlled** remotely via **web**
Esino river
Loccioni buildings
new road system
restoration of the original river bed
microgrid of Leaf Community
dykes reinforcement
bike path preparation
L3
Grid House
garden
Water 1
Water 5
Leaf Mob
L1
L2
Leaf Lab
Water 3
Water 2
Loccioni Microgrid
0 km
1 km
2 km

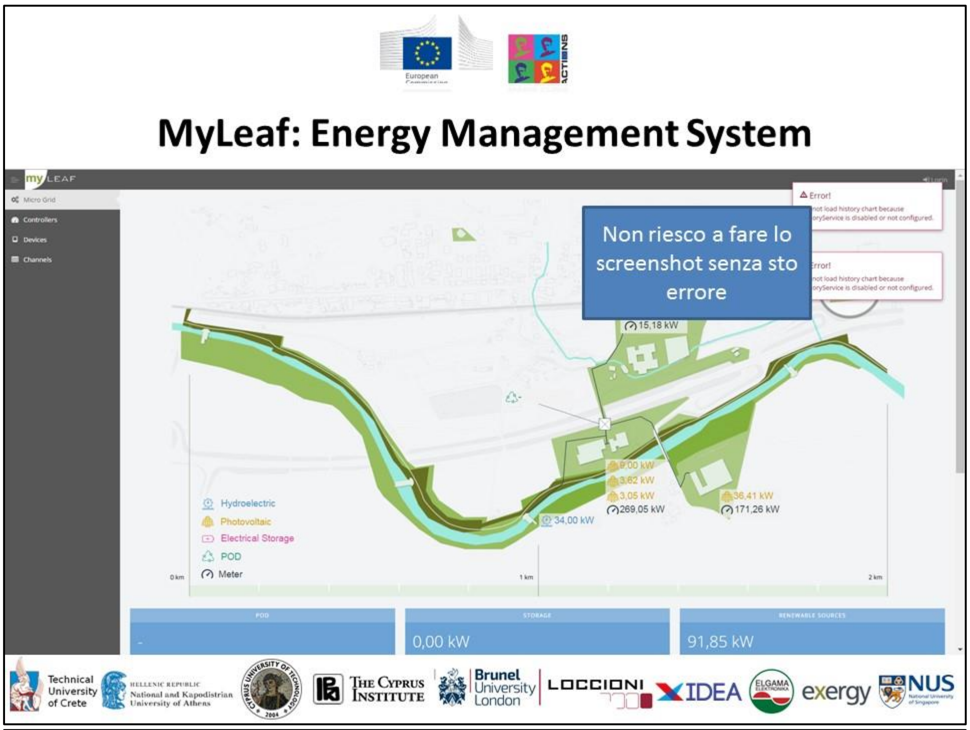

Loccioni Microgrid
2012
Energy independence 22%
Self consumption 88%
Grid-independence 4%
TÜV
Leaf Farm
PV Summa
PV AEA

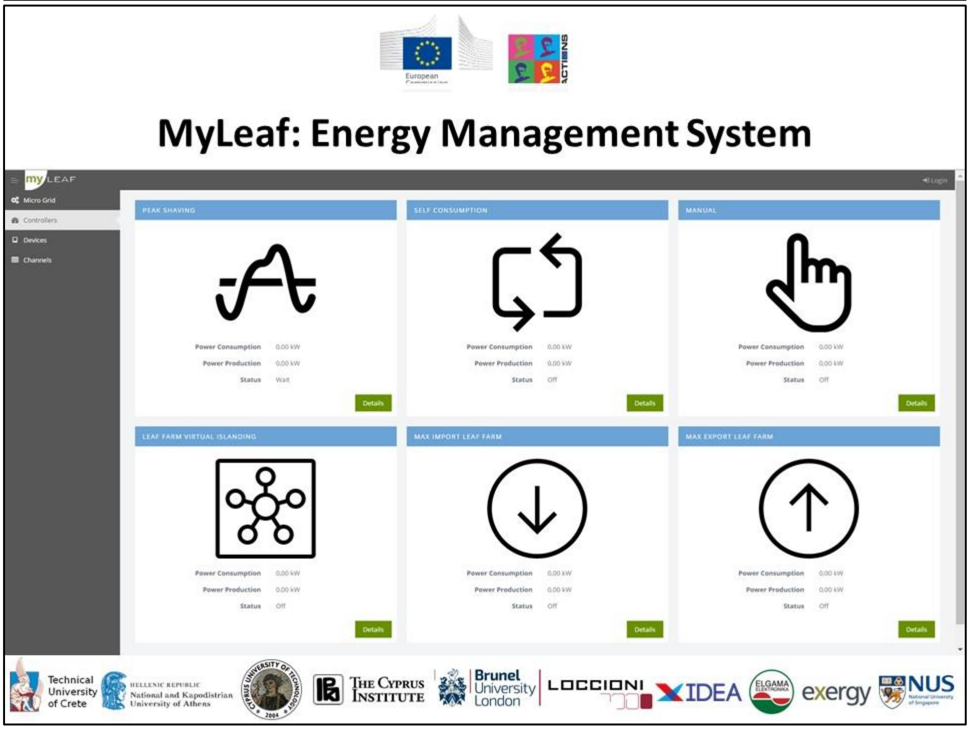

Loccioni Microgrid
2014
Energy independence
34% Self
consumption 85%
Grid-independence
15%
→ More PVs
→ 1 POD
→ Micro-hydro
One Point of Delivery
PF
production
440 kWp
Micro-hydro
production
48 kWp
FV inseguitore
Foresteria
Leaf Farm
FV Summa
PV AEA
Polo 2
ATC
Leaf Water 4
Leaf Lab

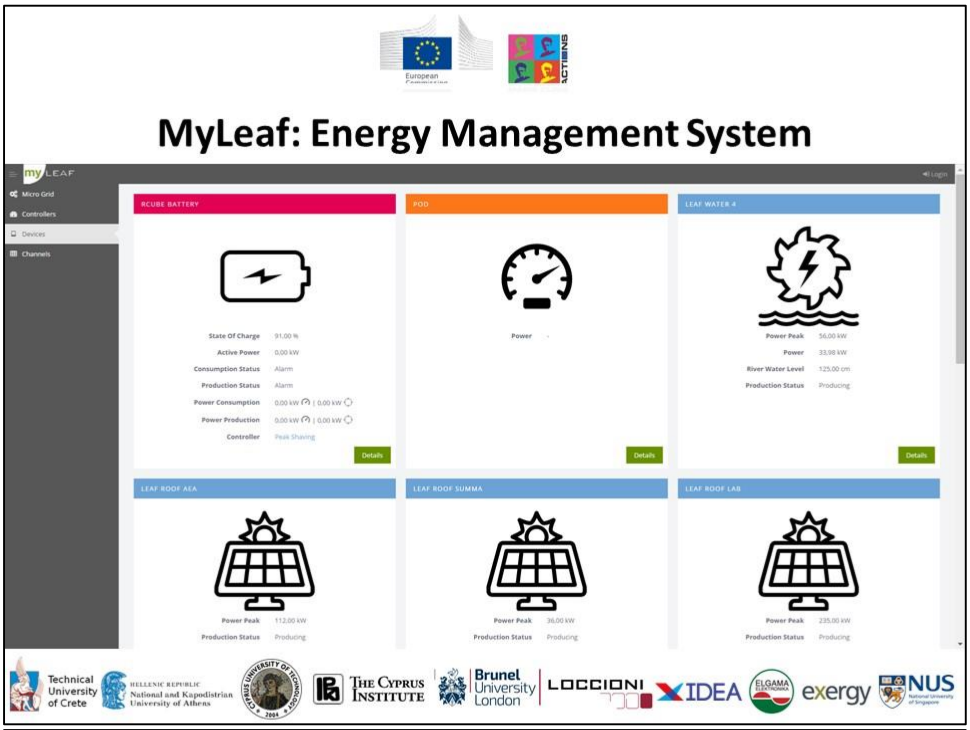

MyLeaf
→ Web-based platform for monitoring and control
→ Energy Management System
→ Collect data from meters and sensors into a database
→ Energy sources, energy loads, storage systems, etc. all monitored and enabled to be controlled on MyLeaf.
→ Users have acces to real-time and hystorical data (access denotes plot, download, etc)
→ Flexible and modular structure
→ Features:
o Data analysis
o Fault detection
o Control
o Monitoring
LOCCIONI
myLEAF
measuring your life energy and future

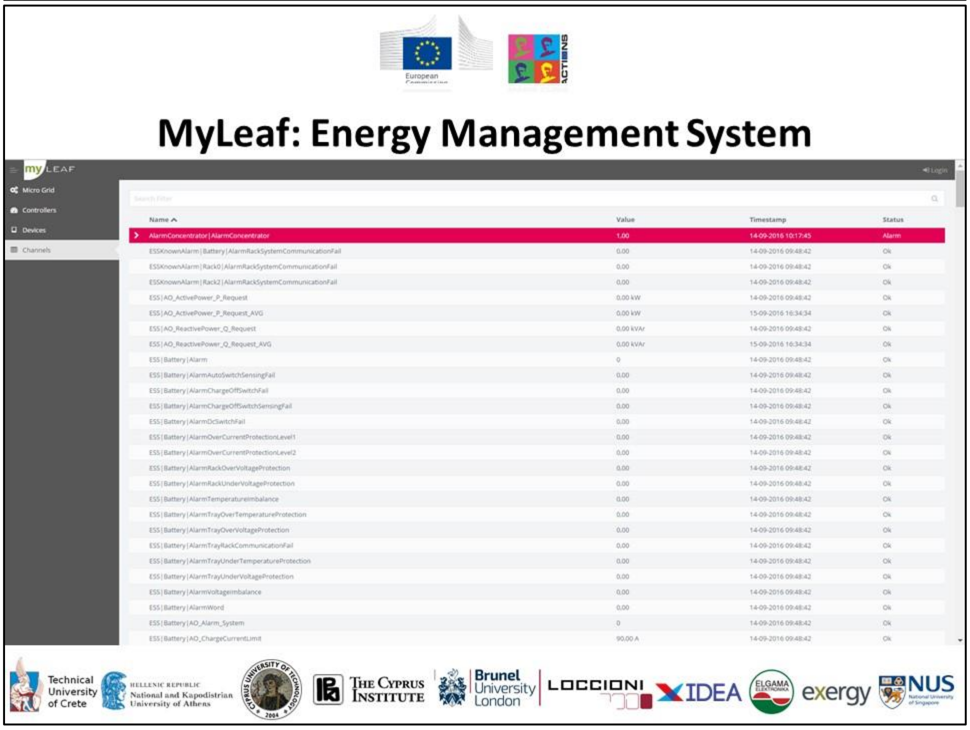

MyLeaf
Home
Configuration
System Monitor
Scheduler
Activities
Administration
About
Charts
Profiler
Workbench
Table
Statistics
© Copyright 2016 Loccioni Group


MyLeaf
Home
Tools
Configuration
System Monitor
Scheduler
Activities
Administration
About
Italia
Croazia
Bosnia ed Erzegovina
Serbia
Albania
© Copyright 2016 Loccioni Group


MyLeaf: Energy Management System
Micro Grid
Controllers
Devices
Channels
Non riesco a fare lo screenshot senza sto errore
15,18 kW
Hydroelectric
Photovoltaic
Electrical Storage
POD
Meter
34,00 kW
269,05 kW
36,41 kW
171,26 kW
0,00 kW
91,85 kW
Technical University of Crete
The Cyprus Institute
Brunel University London
LOCCIONI
IDEA
exergy
NUS


MyLeaf: Energy Management System
Micro Grid
Controllers
Devices
Channels
PEAK SHAVING
SELF CONSUMPTION
MANUAL
LEAF FARM VIRTUAL ISLANDING
MAX IMPORT LEAF FARM
MAX EXPORT LEAF FARM
Technical University of Crete
The Cyprus Institute
Brunel University London
LOCCIONI
IDEA
exergy
NUS


MyLeaf: Energy Management System
Micro Grid
Controllers
Devices
Channels
RCUBE BATTERY
POD
LEAF WATER 4
LEAF ROOF AEA
LEAF ROOF SUMMA
LEAF ROOF LAB


MyLeaf: Energy Management System
Micro Grid
Controllers
Devices
Channels
Name
Value
Timestamp
Status

Loccioni Leaf Roof

→ **Rooftop** installation on **each building** (440 kWp)
→ **MyLeaf** Metering System
→ If the building comsumption is lower than its production, the **extra energy** is **withdrawn** into the **micro-grid.**

Loccioni Leaf Roof

→ **Rooftop** installation on **each building** (440 kWp)
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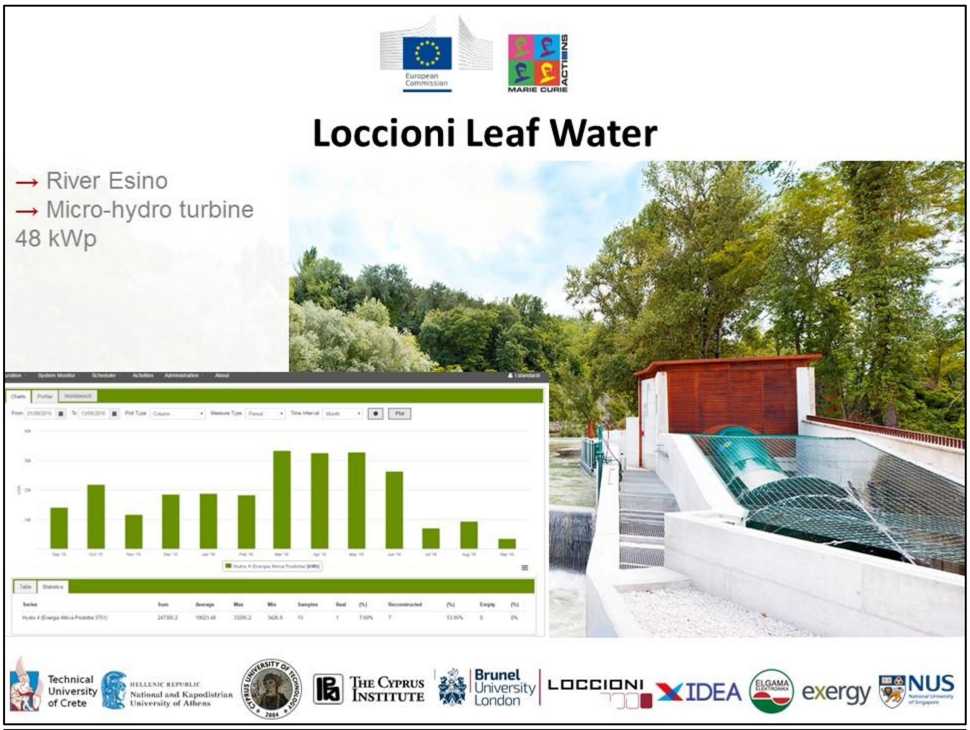
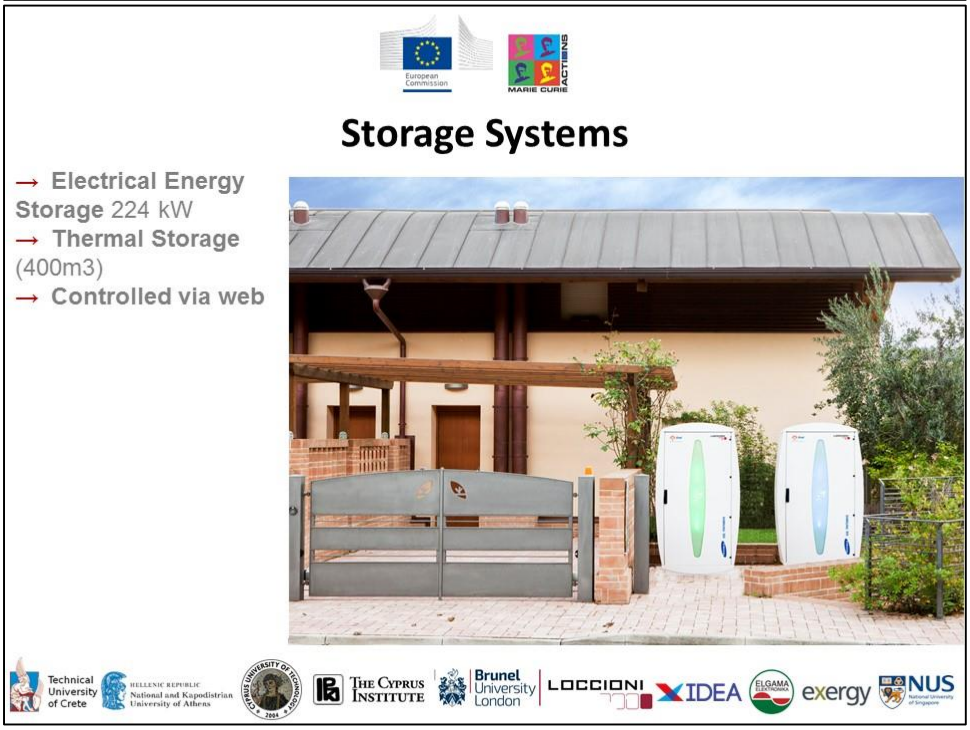
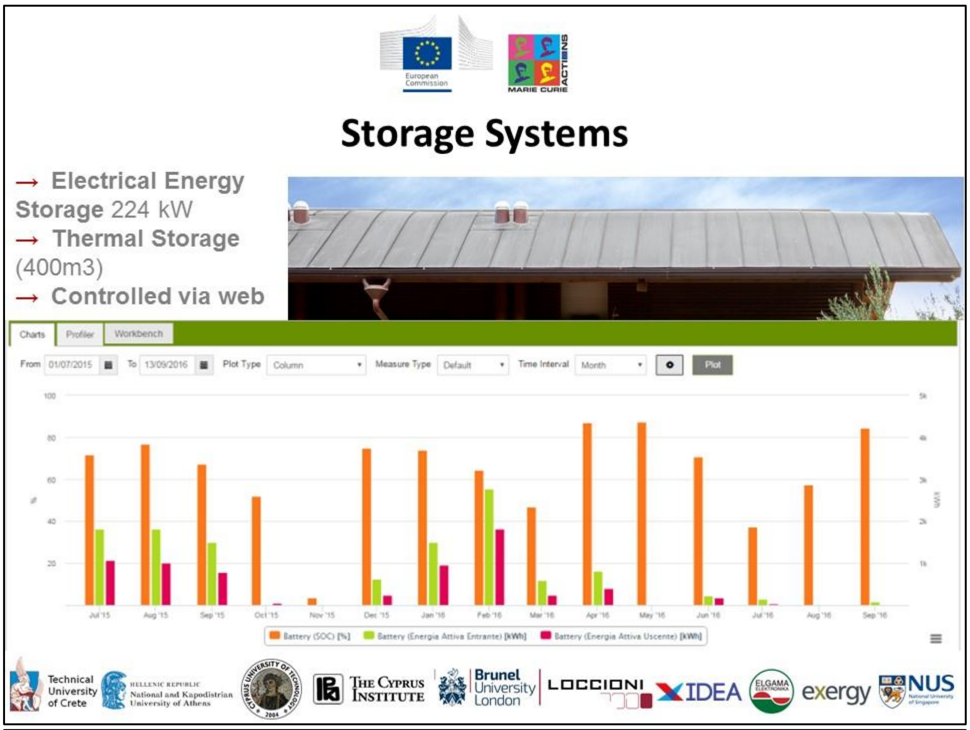

Loccioni Leaf Water
→ River Esino
→ Micro-hydro turbine 48 kWp


Storage Systems
→ Electrical Energy Storage 224 kW
→ Thermal Storage (400m3)
→ Controlled via web


Storage Systems
→ Electrical Energy Storage 224 kW
→ Thermal Storage (400m3)
→ Controlled via web
Charts
Profiler
Workbench
Battery (SOC) [%]
Battery (Energia Attiva Entrante) [kWh]
Battery (Energia Attiva Uscente) [kWh]


Electric Vehicles
→ EVs for employees
→ Charging station in each building
Enel
EV 858ZY

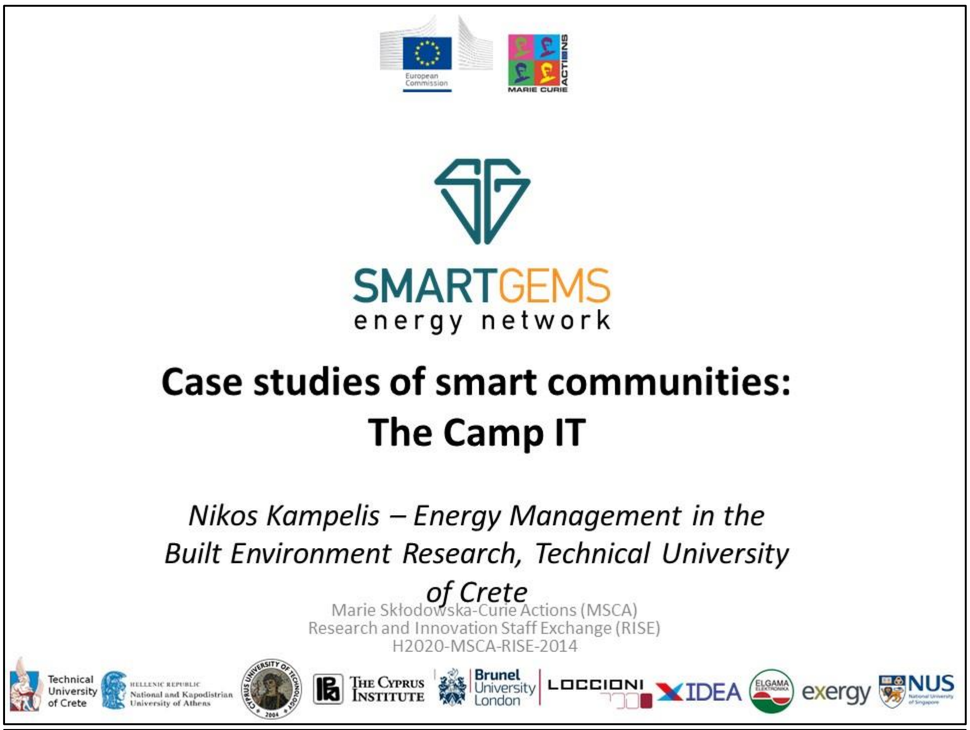
Conclusions

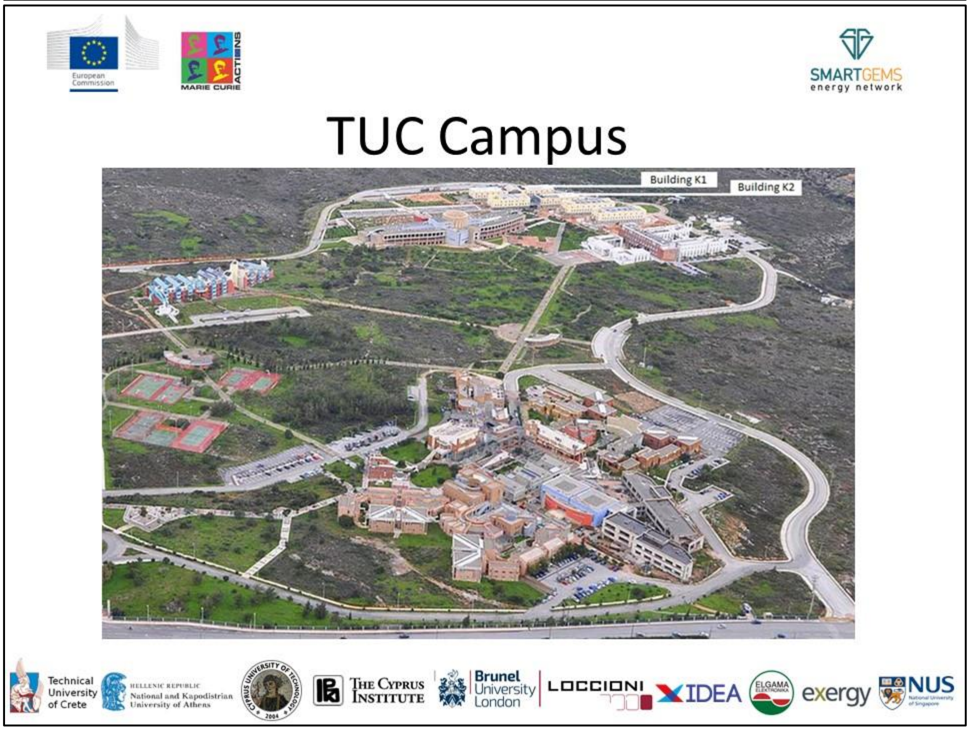
- Savings up to **50%** in **energy from the grid**
- **Data collection** and **analysis**
- **Simulation** and **modelling** activitites aimed to:
  - **Improve performances**
  - **Simulate control** before full-scale tests
  - Being an **open-laboratory**
  - Pilot case study for **national** and **european research projects** in cooperation with universities and companies at international level
- The construction of a **A+ energy** and **connective building** (smart-grid ready) costs up to **20% more** than a traditional one
- **Users consumption** is always **guaranteed** together with their **comfort** (proven by internal questionaire)

Conclusions

- Focus on **Data Analysis** and **Optimization**
- **District heating**
- Tailored **control strategies** for increase **indepence** from the national grid
- **Island-mode** simulation
- Export micro-grid experience to our customers worldwide

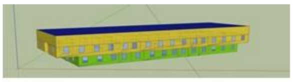
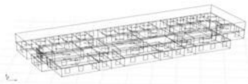
Slides of the Seminar organized by TUC (The Camp IT)





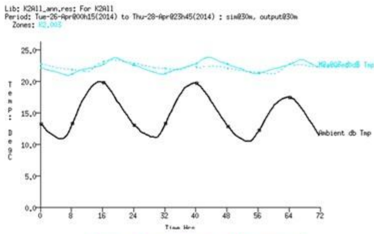
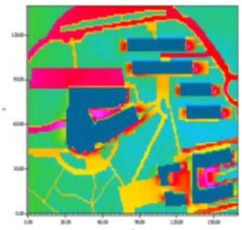
Building & outdoor spaces modelling

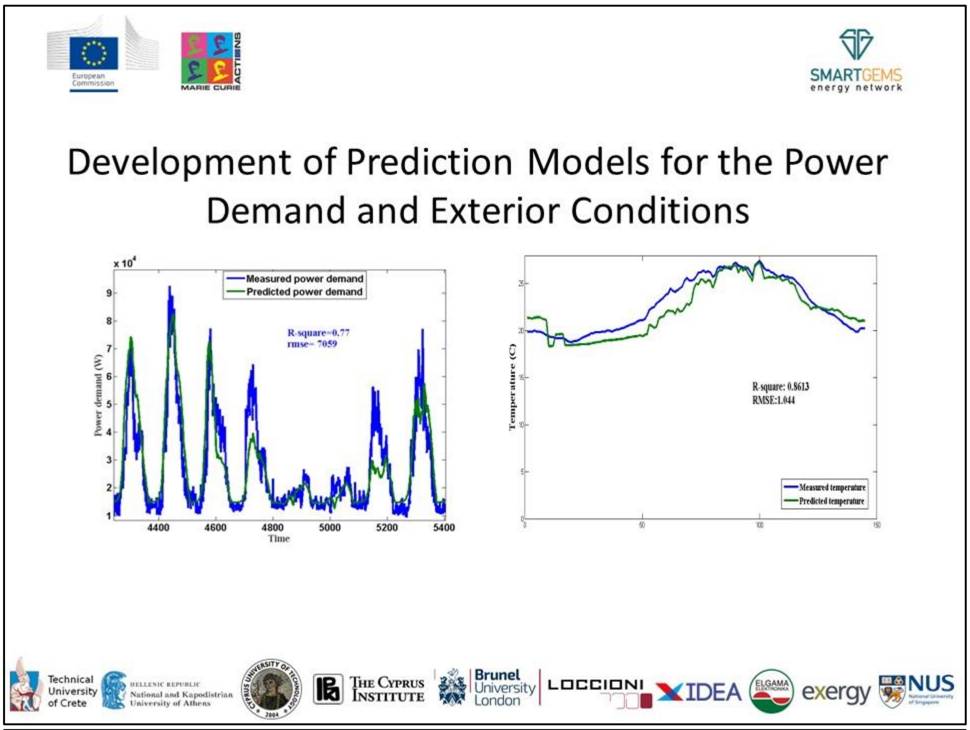
- Building models (ESPr, Energy Plus)
  - Envelope data
  - Equipment
  - Use
  - Meteorological data
- Outdoor spaces
  - Morphology
  - Ground materials
  - Meteorological data

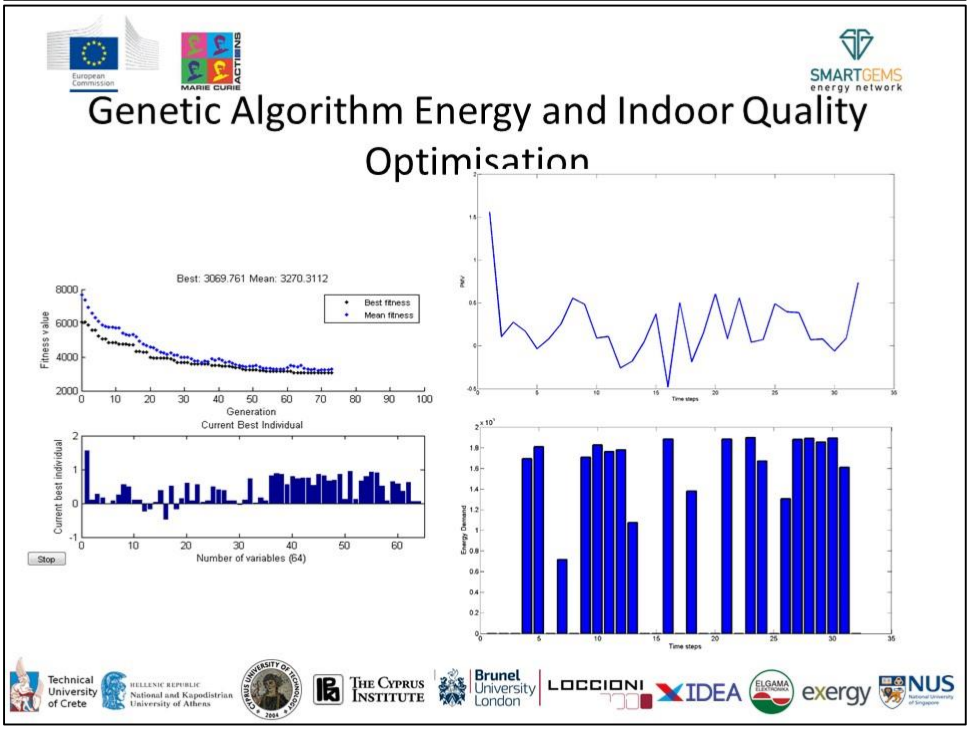




Measurements & Validation of models

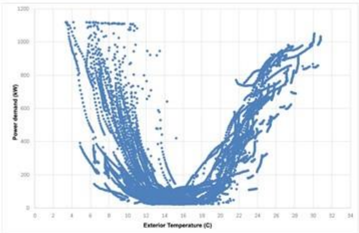
- Indoor
  - Temperature (°C)
  - Humidity (%)
  - Illuminance (lux)
  - CO_2 concentration (ppm)
  - Presence (0-1)
  - Windows / door position (0-1)
- Outdoor
  - Temperature (°C)
  - Humidity (%)
  - Solar radiation (W/m^2)


SMARTGEMS
energy network
Development of Prediction Models for the Power Demand and Exterior Conditions
Measured power demand
Predicted power demand
R-square=0.77
rmse= 7059
Power demand (W)
Time
Temperature (C)
R-square: 0.8613
RMSE:1.044
Measured temperature
Predicted temperature


SMARTGEMS
energy network
Genetic Algorithm Energy and Indoor Quality Optimisation
Best: 3069.761 Mean: 3270.3112
Best fitness
Mean fitness
Fitness value
Generation
Current Best Individual
Current best individual
Number of variables (64)
Stop
Time steps
Energy Demand

Development of HVAC and Lights control algorithms



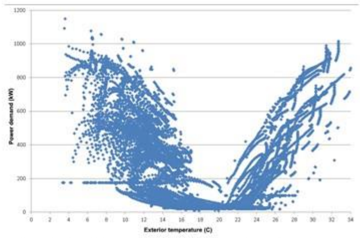


Figure 1: Left: Power demand related to the exterior temperature, before the application of the control algorithm.

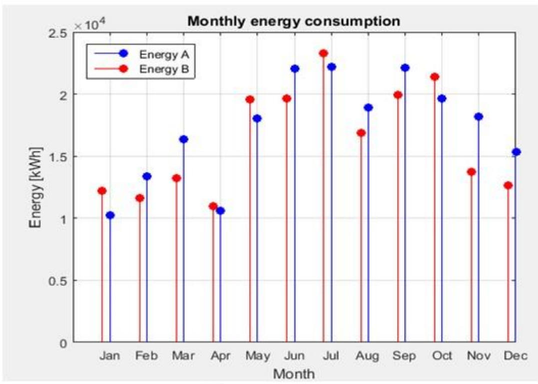
Figure 2. Right: Power demand related to the exterior temperature, after the application of the control algorithm.

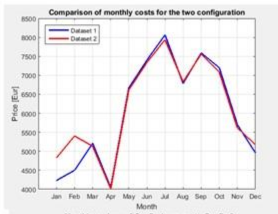
Next Steps…

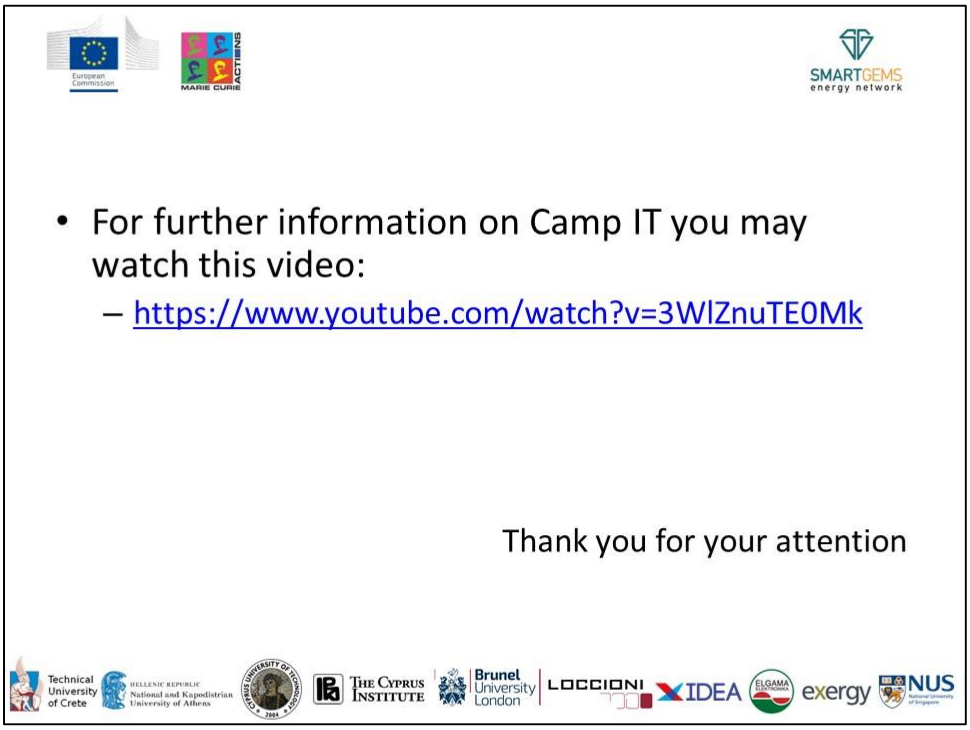
- Integration of data from smart meters (18) + 60 sensors of TUC buildings in MyLeaf
- Modelling of TUC microgrid

Development of Demand Response Framework

- Energy cost modelling according to utility billing profile for TUC has been modelled:






SMARTGEMS energy network
• For further information on Camp IT you may watch this video:
– https://www.youtube.com/watch?v=3WlZnuTE0Mk
Thank you for your attention

Annex VI: Slides of the 6th Webinar - Innovation to Zero' by UOA to the UK trainee participants of the MEnS project

This is the same as the Slides of the 2nd Webinar, organised by UoA with some introductory slides about SMART GEMS