Research project

District Information Modeling and Management for Energy Reduction (DIMMER)

ICT is recognized as being a key player against climate change: Pervasive sensors and actuators can efficiently control the whole energy chain (Smart Thermal/Electricity Grid). On the other side, advances on *3D modeling*, *visualization* and *interaction* technologies enable *user profiling* and *real-time feedback* to promote energy efficient behaviors. To unlock the potentiality of these technologies, the DIMMER project focuses on:
- Interoperability of district energy production/consumption, environmental conditions and user feedback data;
- Exploitation of effective visual and web-based interfaces to provide pervasive and real-time feedback about energy impact of user behaviors;
- Enabling new business models for energy traders and prosumers exploiting user energy profiling;
- Integration of Building Information Models (BIM) with real-time data and their extension at the district level.
The DIMMER system integrates BIM and district level 3D models with real-time data from sensors and user feedback to analyze and correlate buildings utilization and provide real-time feedback about energy-related behaviors. It allows open access with personal devices and A/R visualization of energy-related information to client applications for energy and cost-analysis, tariff planning and evaluation, failure identification and maintenance, energy information sharing. In order to validate the DIMMER innovative system, both *public (university campuses, schools)* and *private* buildings included in mixed-up (*mixité*) urban districts are considered in two different cities in the North and South Europe. The expected results are a consistent reduction in both energy consume and CO2 emissions by enabling a more efficient energy distribution policies, according to the real characteristics of district buildings and inhabitants as well as a more efficient utilization and maintenance of the energy distribution network, based on social behavior and users attitudes and demand.

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The University of Torino tasks

Social behaviour analysis and user awareness
ICT can help changing behaviour at the level of final users. Aware that information and real-time information is able to influence and change around the 20% of energy consumption behaviour at household level, ICTs are positively involved in transforming everyday practices of energy consumption. The objective of the project is to experiment a co-designing approach to adapt the existing information platform

to householders needs in order to facilitate their habit changing. The co-design approach oriented to consumer practices asks for innovative solutions to stimulate behavioural changes among specific groups. The project's contribution is to mobilise and revitalise these groups to reach more efficient models of energy consumption.
People living in the districts used as demonstrator have the competence and consumer culture to make the best use of technical innovation and participate in co-design activities to develope new user-friendly technologies.
So, the DIMMER project will make use this bottom-up approach involving final energy users, experts and designers in order to develop new and innovative tools and solutions (e.g. local platforms for neighbourhood).

User/social profiling and visualization and feedback
The main objectives of this WP are to create tools to involve users into interaction with the DIMMER system and to create ambient awareness of the energy status of public space in several ways. The best ways to change people energy consumption behaviour will be also evaluated. It is worth observing that different categories of users exist: energy manager, people daily working in the buildings (e.g. employees) and other people daily or occasionally present in the district according to its function.
Each category of users is naturally associated with different subsystems and they can interact with them at different level. For instance, due to his/her intrinsic position, the energy manager is able to operate more actively on the many subsystems and thus can directly control them. On the contrary, reduced or null interaction is expected by people occasionally frequenting the buildings and relevant surrounding spaces (e.g. customers, citizens in public administration offices). In the middle, regular users of public spaces (e.g. employees, regular travellers) that every day access the same building are probably characterized by wider possibility to interact with these subsystems (e.g., they could adapt their behaviour to reduce energy consumption and set the desired level of heating or air conditioning in their own space, this resulting in a local-only control on the temperature).
Moreover, each person belonging to temporarily different "subsystems" makes use of energy in different ways, according to its tasks, work and function. The way each person uses energy and information coming from ICT changes according to time and space frames of their activities and/or practices. These can be potential barriers to changes in the use of energy and energy consumption practices.
Probably, the difference in time and space of practices performed by individuals shapes their idea, e.g., of heating and cooling comfort and energy using. Since temporal and spatial aspects are particularly interesting in relation to the use of ICT in everyday life, the project will try to face these different "time and space structures" through the development of the following two actions:
1. Defining the principal "time and space patterns" of every type of final energy user;
2. Adapting ICT interface to inform in real time the different categories and suggesting the best actions to do to reach a confortable situation related to what they are doing.
This WP concerns aspects on how regular users and also people occasionally frequenting the district could be attracted to monitor the energy status of the public

space with the use of ambient energy awareness components and services running on public displays or other HMI solutions. Also more subtle ways of providing ambient feedback about the environmental health status of the public space will be subject to research for the integration of micro devices into cycles and bus, or street furniture.

This WP will provide the contents for the public energy awareness community web portal developed in WP3 to interact with the DIMMER system that will provide mobile access on smart phones as well as on large public displays. As the portal will offer opportunities to inform users about the current energy consumption,

e.g. small instructive e-learning units or competitions on how to reduce energy consumption, to detail results based on sociological study and communication strategies is an essential point of this WP.

This WP will lead to face the so-called "rebound effect", which is often connected with technical innovation processes. A decreased energy consumption could lead to changes in many aspects, not only on those merely related to the energy consumption level. When an increased energy efficiency is accompanied by costs reduction a rebound effect could be expected. Even in the case of high levels of saturation of the demand for household energy services a rebound effect could occur as a result of the fact that – for ecologically oriented consumers – the perception of their being "green" is altered, leading to a diminished attention paid to the environmental impacts deriving from the use of other resources (e.g. in the extraction and production phases) and from the use of other products. As a result of the fact that being "green" is not only the effect of a deliberate individual (or familiar) strategy, but the result of a top-down programme, will distinction strategies based on environmental aspects change? We could for example imagine the emergence of reactions to best-way standardisation pressures. Moreover, as the definition of what wastes and bad energy habits are is the result of a social process, will users accept or will they contrast the definitions of the technical expertise involved in it? Our proposal is about the data received from sensors to be accompanied by a sociological analysis of the changes occurring in other spheres, outside buildings and behind the energy use.