

Energy Sector Profile

The Services, Technologies and Economics (STEcon) group of AUEB (previously known as *Network Economics and Services Group - NES*) was founded in 1999 by Prof. Costas Courcoubetis, co-author of “Pricing Communication Networks: Economics, Technology and Modeling” (Wiley, 2003), and Prof. George D. Stamoulis, who is now the head of the group.

The group comprises members with **multidisciplinary scientific expertise** and specializes in the combination of **technology and economics**. We investigate, develop, and evaluate: economic models and business plans, economic mechanisms (such as pricing schemes, SLAs, incentives and auctions) and other incentives-based mechanisms (such as performance differentiation, gamification, and reputation) for demand side management in smart energy grids and for the allocation, management and trading of network, cloud, CDN and IoT services and resources. Emphasis is placed on the theoretical and simulative evaluation of such mechanisms, and on the technologies and data necessary for enabling their **implementation in real systems**.

Some facts about us:

- Head: Prof. G.D.Stamoulis
- Faculty members: C.Courcoubetis (SUTD), I.Koutsopoulos (AUEB), A.Dimakis (AUEB)
- **7** Postdoctoral researchers
- **7** Ph.D. researchers
- Broad international collaborations
- **12+** major projects completed since 2007, with **3+ million Euros** funding
- Interdisciplinary expertise: ICT, Economics, and Electrical Engineering

The STEcon (previously NES) group during the last 10 years has participated in a broad set of successfully completed innovative EU-funded projects in the area of Energy and Smart Grids (presented below), Cloud Computing (*ASCETIC, BEinGRID, GridEcon*), in architecting the Future Internet and Telecommunication Networks (*SmartenIT, OPTET, PURSUIT, Trilogy, SmoothIT, ETICS*), and in the area of IoT (INCEPTION co-funded by the EU and the Greek government). Trilogy, especially, received the *Future Internet Award in FIA 2011* for developing new solutions for the control architecture of the Internet, combining for the first time Network Theory with Economics. The group was also member of the Networks of Excellence *EuroNGI, EuroFGI* and *EuroNF*, which comprised the top research organizations in Europe on the design and engineering of future Internet and has also offered its techno-economic expertise in the community of Future Internet researchers through the Coordination Action SESERV.

The EU-funded projects below performed cutting edge multidisciplinary research in Smart Grids:

WiseGrid (Nov. 2016 – Apr. 2020): the project puts in the market a set of solutions and technologies that increase the smartness, stability and security of an open, consumer-centric European energy grid, with an enhanced use of storage technologies and a highly increased share of renewables.

Nobel Grid (Jan. 2015 – Jun. 2018): provides advanced tools and ICT services to all actors in the Smart Grid and in the retail electricity market to attain benefits from demand response, lower prices, more secure and stable grids and a cleaner mix of electricity in the presence of renewables and prosumers.

ChArGED (Mar. 2016 – Feb.2019): addresses the energy consumption in public buildings and proposes a gamification human-centric approach using IoT to facilitate energy efficiency and incite users to avoid waste of energy.

OPTi (Mar. 2015 – Apr. 2018): the project develops tools and techniques for modelling and optimizing existing and future district heating and cooling networks, studying among others automated demand response (ADR) programs with users being incentivized to sign ADR contracts

Wattalyst (Nov. 2011 – Dec. 2014): the project analysed, designed and implemented efficient Demand response (DR) programs for electricity, whereby users were appropriately incentivized to reduce their peak consumption when needed.

In the context of these projects STEcon has produced and evaluated in real life contexts several scientific and technological outcomes, a selection of which is presented below. More details, including downloadable links of demos and presentations can be found in: <http://stecon.cs.aueb.gr/research/energy-environment/>.

Demand Response (DR) optimal targeting and optimisation tools

Our group developed methodologies for designing incentive-based Demand Response (DR) programs and for Automated DR (ADR) contracts. In particular, two different approaches were developed and evaluated in a prototype tool targeted to utility companies with the collaboration of IBM India. In the first one, for each consumer the modification of the optimal consumption schedule in the case of DR participation is modelled, which leads to the estimation of the minimum incentives necessary for the consumer to participate in DR. In our second approach, each consumer is assumed to act rationally by choosing the consumption schedule that maximises her total Net Benefit and a user utility model is derived, again employed for the estimation of DR incentives and for the selection of the optimal subset of consumers to be targeted for DR. Both approaches are applicable for a variety of sources of energy including from Distributed Resources (renewables etc.).

Price-based energy demand flexibility profiling tool

The Price Based Flexibility Profiling tool is part of the Nobel Grid suite of tools for Demand-side Management. The tool produces a profile for each customer, reflecting real-time demand flexibility as a function of multiple parameters, such as environmental context/ conditions, energy retail prices at peak and off-peak periods and individual/group preferences. These profiles can be used for calculating the flexibility obtained by each endpoint for any price and outdoor temperature during the peak and off-peak periods, as well as, for calculating incentive-compatible rewards to participants on the basis of concepts of economic theory.

Key research areas in the Energy area:

- Utility-based user demand modelling
- Price-based demand profiling
- Behavioural economics
- Design of incentive compatible contracts for Automated/Manual DR campaigns
- Business model evaluation
- Economic/Societal Cost Benefit Analysis
- Auction mechanisms and bidding strategies

Cost Benefit and Business modelling analysis tool for Smart Grid actors

A novel methodology for business modelling and a related software tool have been developed on the basis of well-known approaches such as value network analysis and business model canvas. The tool allows the user to model value networks of multiple actors and roles, aiming at evaluating: a) business models enabled by innovative smart grid technologies (e.g., those developed by H2020 EU-funded projects, off-the-shelf products/services), b) the replication and upscaling of technologies to new regions/markets, and c) the Cost-Benefit for the society as a whole in accordance to EU guidelines. The tool is extensible and already used for specifying and evaluating the market potential of the Smart Grid technologies and the resulting interactions among the market players, namely DSOs, Aggregators, Retailers and Prosumers. Once adequately evaluated, the tool will be publicly released to the energy community. The beta version can be downloaded from this link: <http://nobelgrid.eu/business-model-evaluation/>.

Moreover, **Selected Recent Publications** of our team members can be found here:

<http://stecon.cs.aueb.gr/publications/by-application-area/#Energy%20&%20Environment>.