European SmartGrid Research and Challenges

Stamatis Karnouskos, Maher Chebbo
SAP

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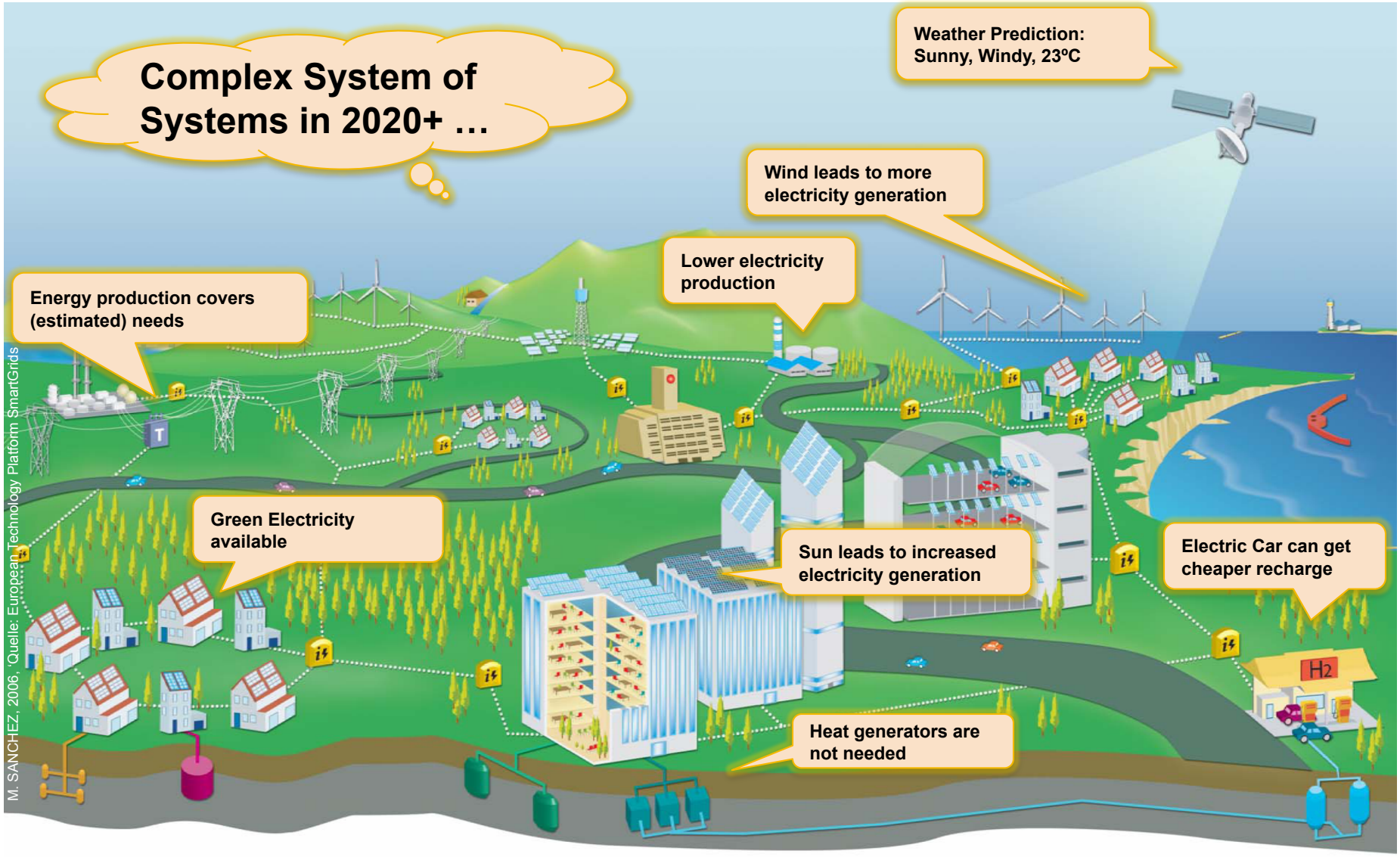
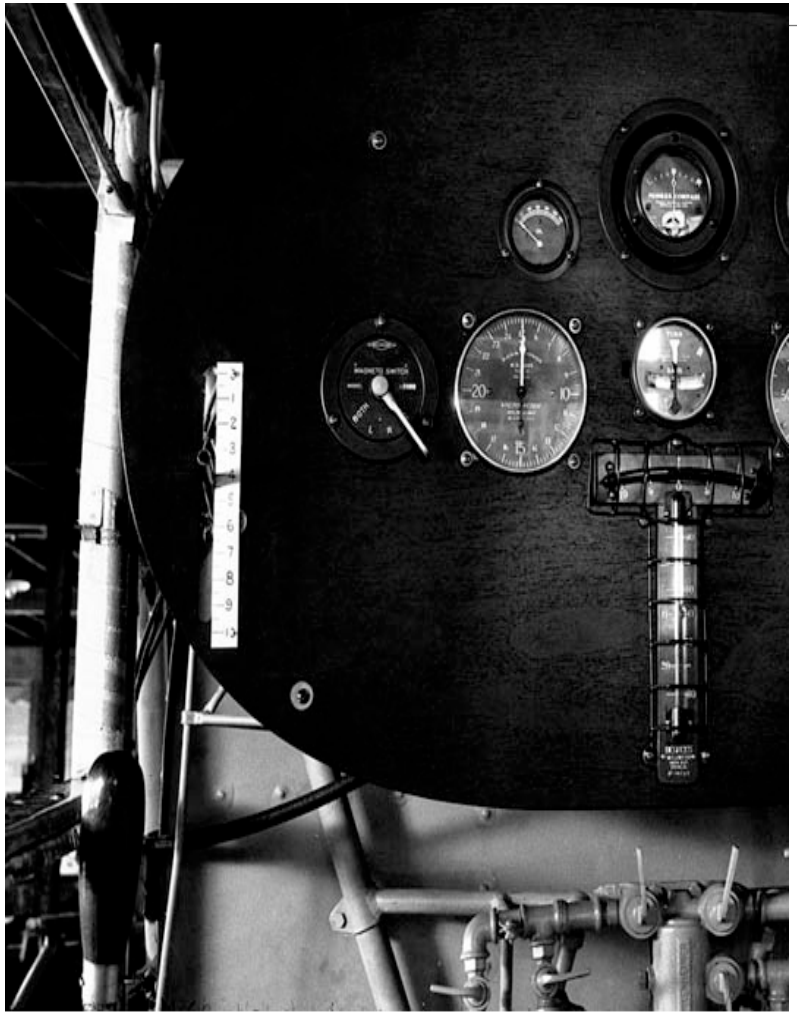
The SmartGrid City– a complex System of Systems



Smart City: Growing Complexity Management Challenges



The Spirit of St. Louis (1927)

Source: www.charleslindbergh.com

Airbus A380 (2005)

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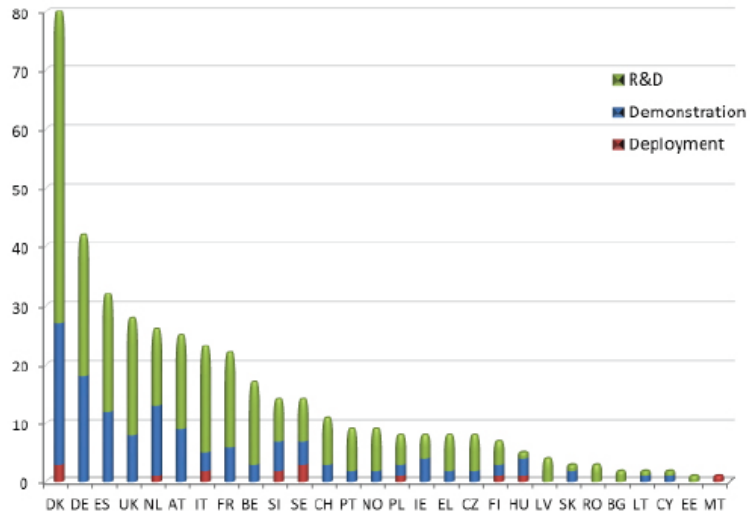
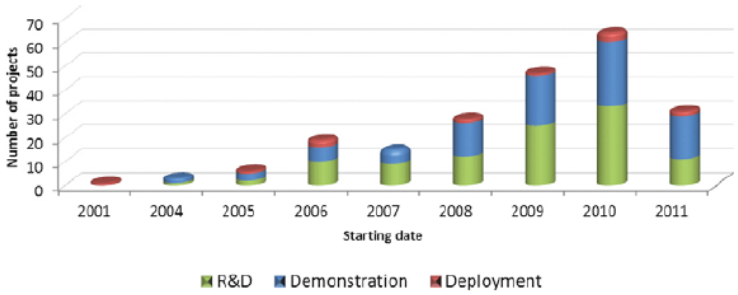
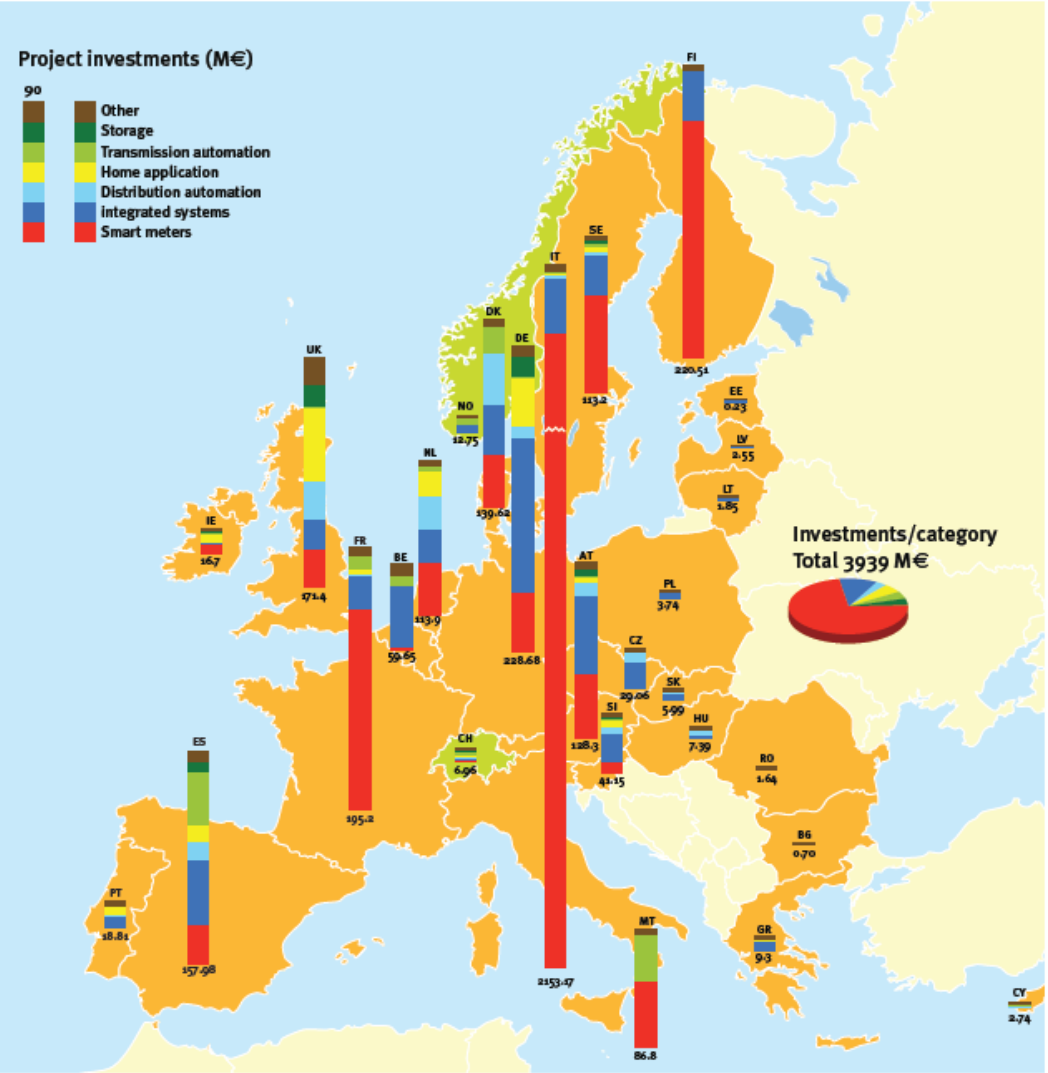
EU SmartGrid Reseach







Source: JRC European Commission, "**Smart Grid projects in Europe: lessons learned and current developments**", 2011

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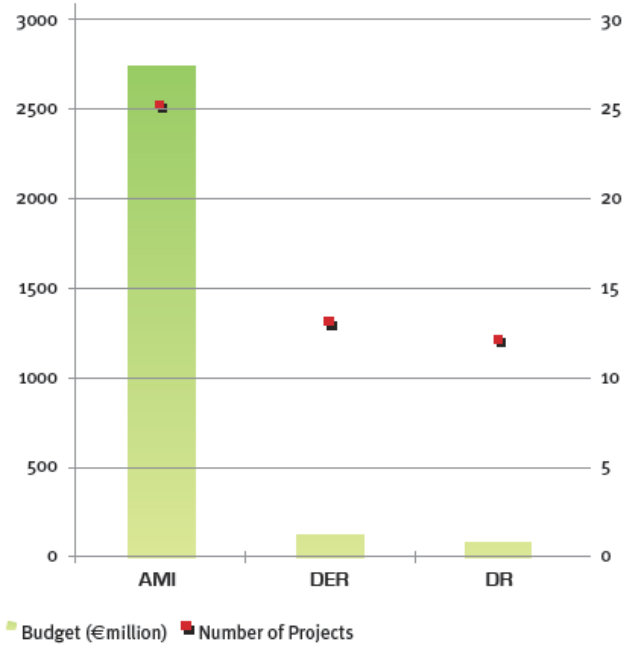
Global Smart Grid Overview

Country / Region	Forecast Smart Grid investments (€/$)	Funding for Smart Grid development (€/$)	Number of smart meters deployed and/or planned
European Union	€56 billion by 2020 [47]* *(estimated Smart Grid investments)*	€184 million (FP6 and FP7 European funding for projects in the JRC catalogue) About €200 million from European Recovery Fund, ERDF, EERA. National funding: n/a	45 million already installed (JRC catalogue,2011) 240 million by 2020 [47]
USA	$338 (€238) to 476 (€334) billion by 2030 [16] *(estimated investments for implementation of fully functional Smart Grid)*	$7 (€4.9) billion in 2009 [49]	8 million in 2011 [50] 60 million by 2020 [50]
China	$101 (€71) billion [65] *(Smart Grid technology development)*	$7.3 billion in 2009 (€5.1) [49]	360 million by 2030 [31]
South Korea	$24 (€16.8) billion by 2030 [40]] (estimated Smart Grid investments)	$824 (€580) million in 2009 [49]	500,000 in 2010, 750,000 in 2011 and 24 million by 2020
Australia	n/a	$360 (€253) million in 2009 [49]	2.4 million by 2013 in State of Victoria
India	n/a	n/a	130 million by 2020 [31]
Brazil	n/a	$204 (€143.6) million in 2009 [49]	63 million by 2020 [31]
Japan	n/a	$849 (€143.6) millions in 2009 [49]	n/a



Beyond AMI: It is time to move from the "basics" towards cross-domain sophisticated infrastructure & enterprise services and applications

Source: JRC European Commission, "**Smart Grid projects in Europe: lessons learned and current developments**", 2011

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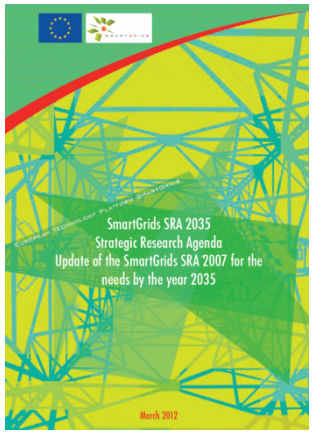
SmartGrid 2035

- Stakeholders
  - Consumers
  - Prosumers
  - Energy Retailers
  - Aggregators
  - Energy Service Companies (ESCOs)
  - Electric Appliance users
  - Electric Vehicle users
  - Generators
  - Distributed Generators
  - Storage Providers
  - Ancillary Service Providers
  - ICT equipment and systems providers
  - Telecommunications providers
  - Data processing service providers
  - Energy Equipment & Systems Manufacturers
  - Distribution System Operators (DSOs)
  - Transmission System Operators (TSOs)
  - Wholesale Electricity Market Traders
  - Policy makers, Regulators
  - Electricity Market Operators

- Challenges
  - Electro-Technologies
  - ICT (Information and Communication) Technologies
  - EEGI (European Electricity Grid Initiative) Compatibility
  - Legal frameworks, market structures
  - Socio-Economic incentives



- Priorities
  - Small- to medium-scale distributed storage systems
  - Real-time energy use / system state
  - Grid modelling technologies
  - Communication technologies
  - Security of Supply
  - Non-technological issues with direct impact on technologies

Source: European Commission, "**SmartGrids SRA 2035 Strategic Research Agenda Update of the SmartGrids SRA 2007 for the needs by the year 2035**", 2012

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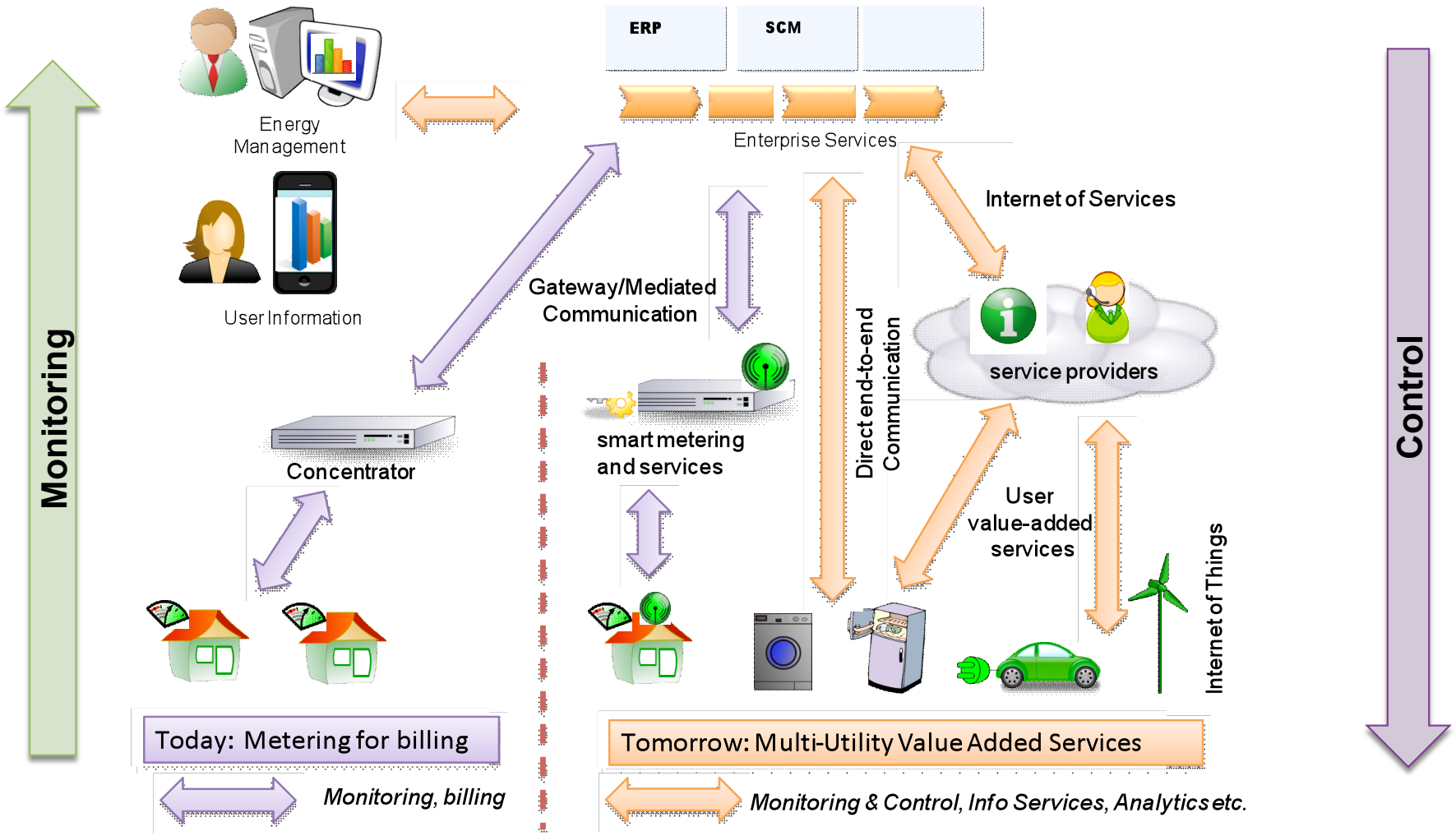
Smart Grid brings new opportunities: From Billing to a plethora of value-added services



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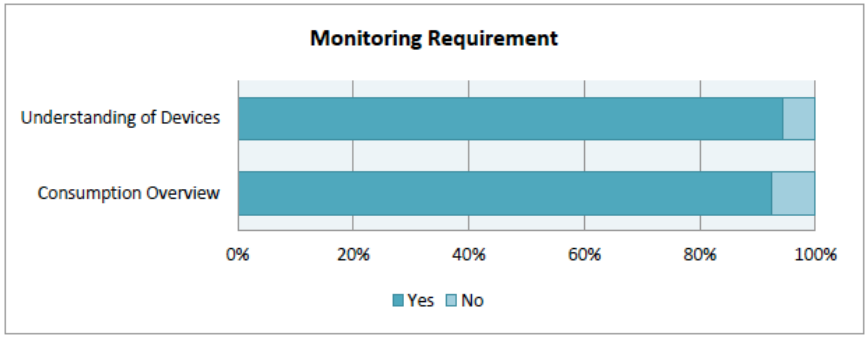
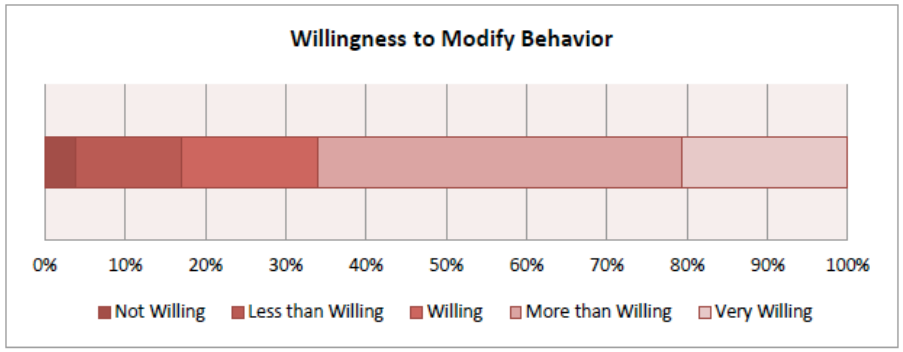
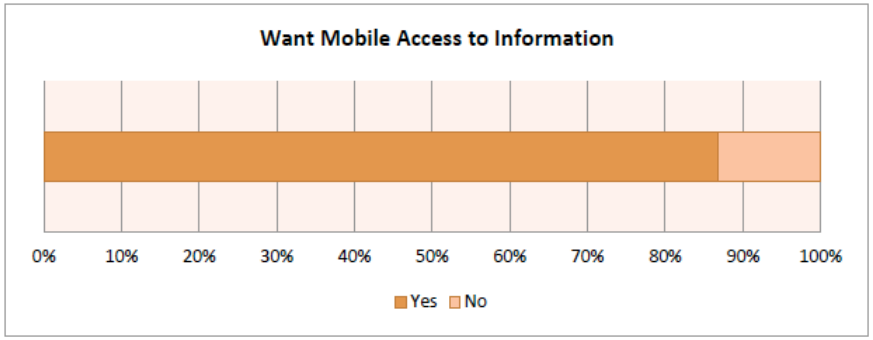
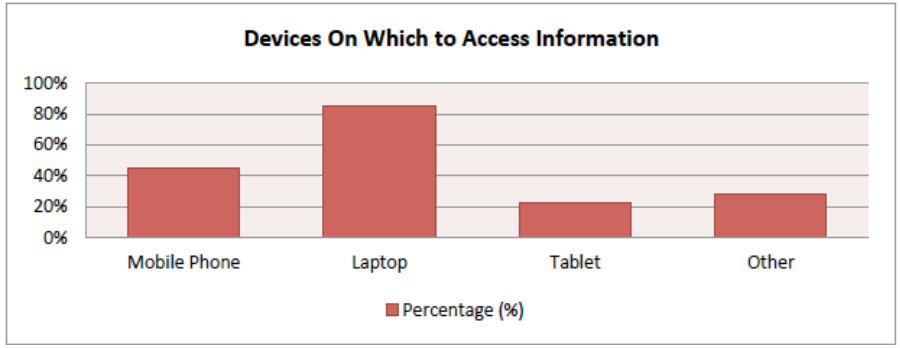
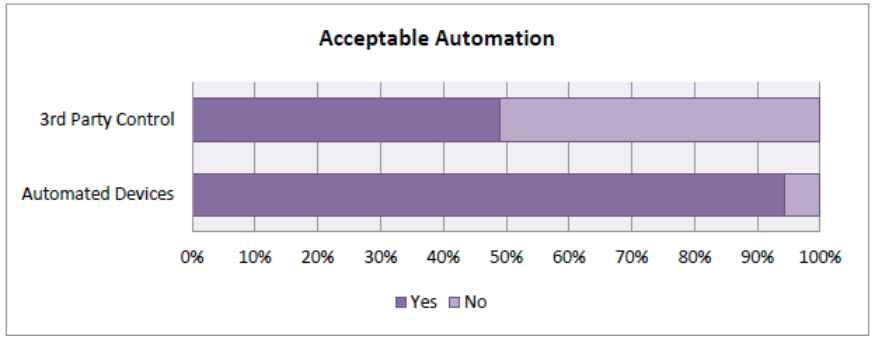
Consumer Survey

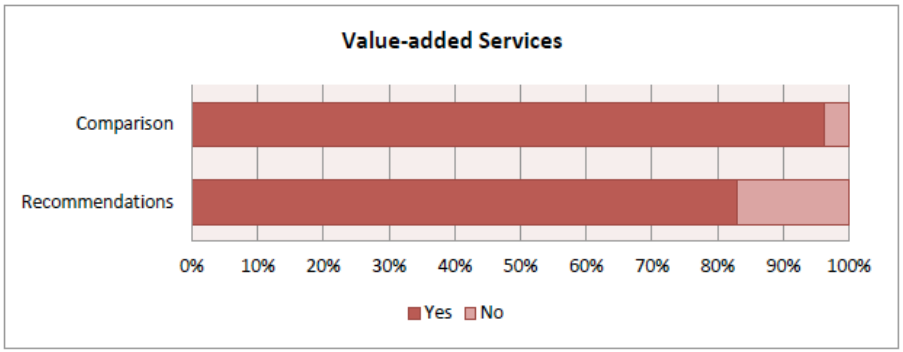












NOBEL Project, Full report to be presented in IEEE ISGT Europe 2012

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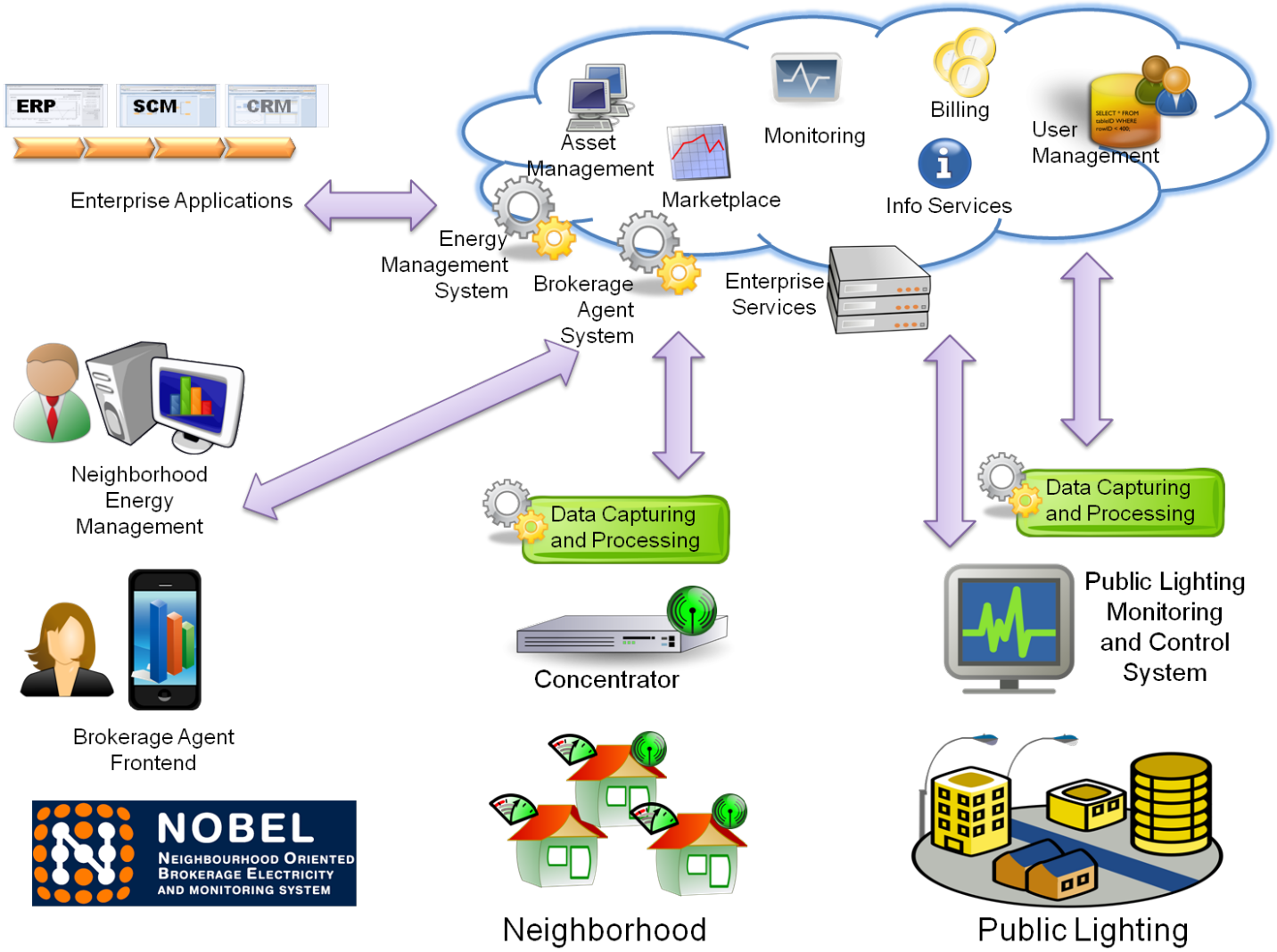
Provision of SmartGrid services for SmartGrid City neighborhoods



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Towards an Internet of Energy

Internet of Services
Novel automated services

MARKETPLACE
- Brokering of supply and demand
- Services for utilities, consumers, other market roles

Internet of Things
Networked smart devices

Generation
- Renewable and decentralized resources

Consumption
- Digital living
- Demand side management

Internet of Energy

NOBEL
Neighbourhood Oriented Brokerage Electricity and Monitoring System

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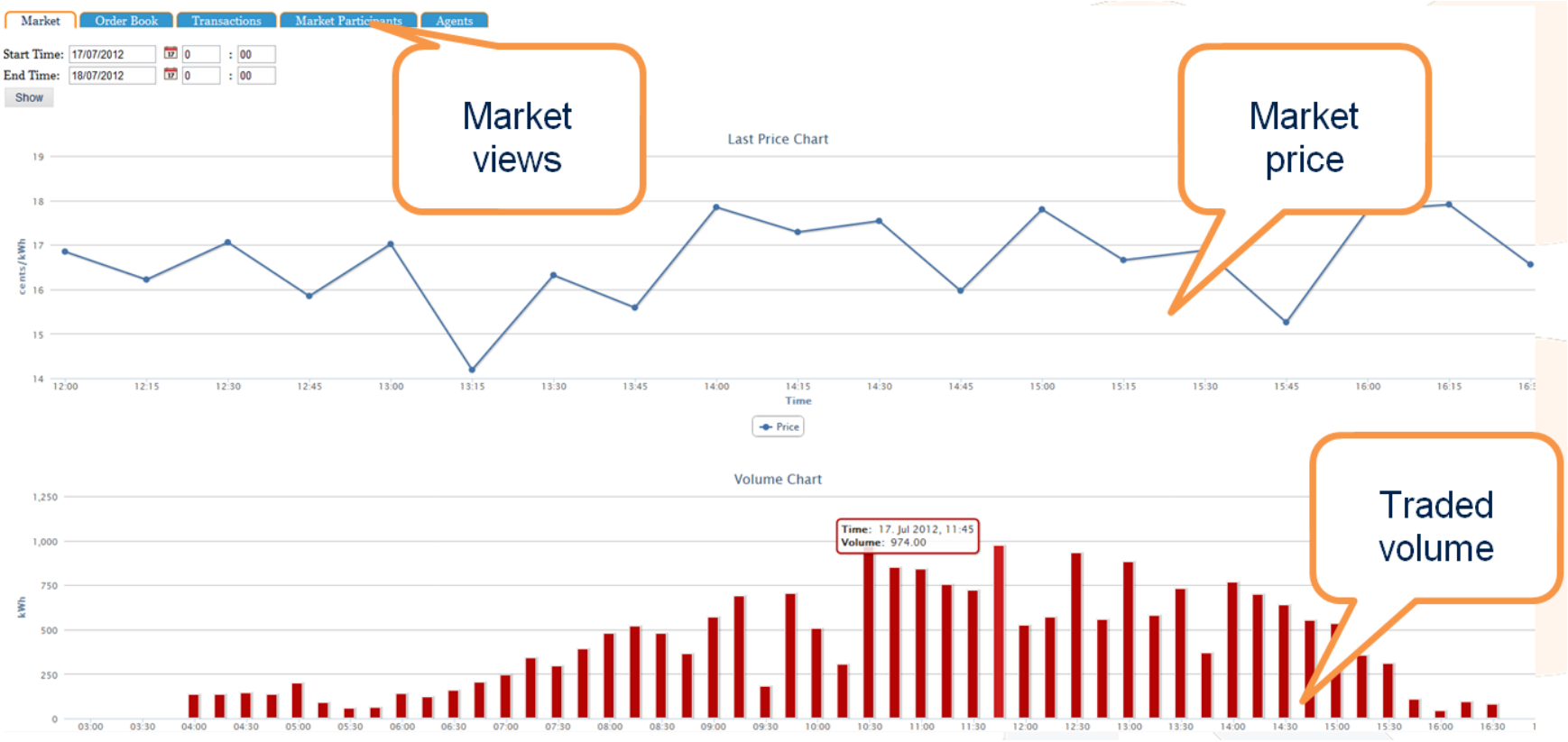
Energy Trading



NOBEL
Neighbourhood Oriented Brokerage Electricity and Monitoring System

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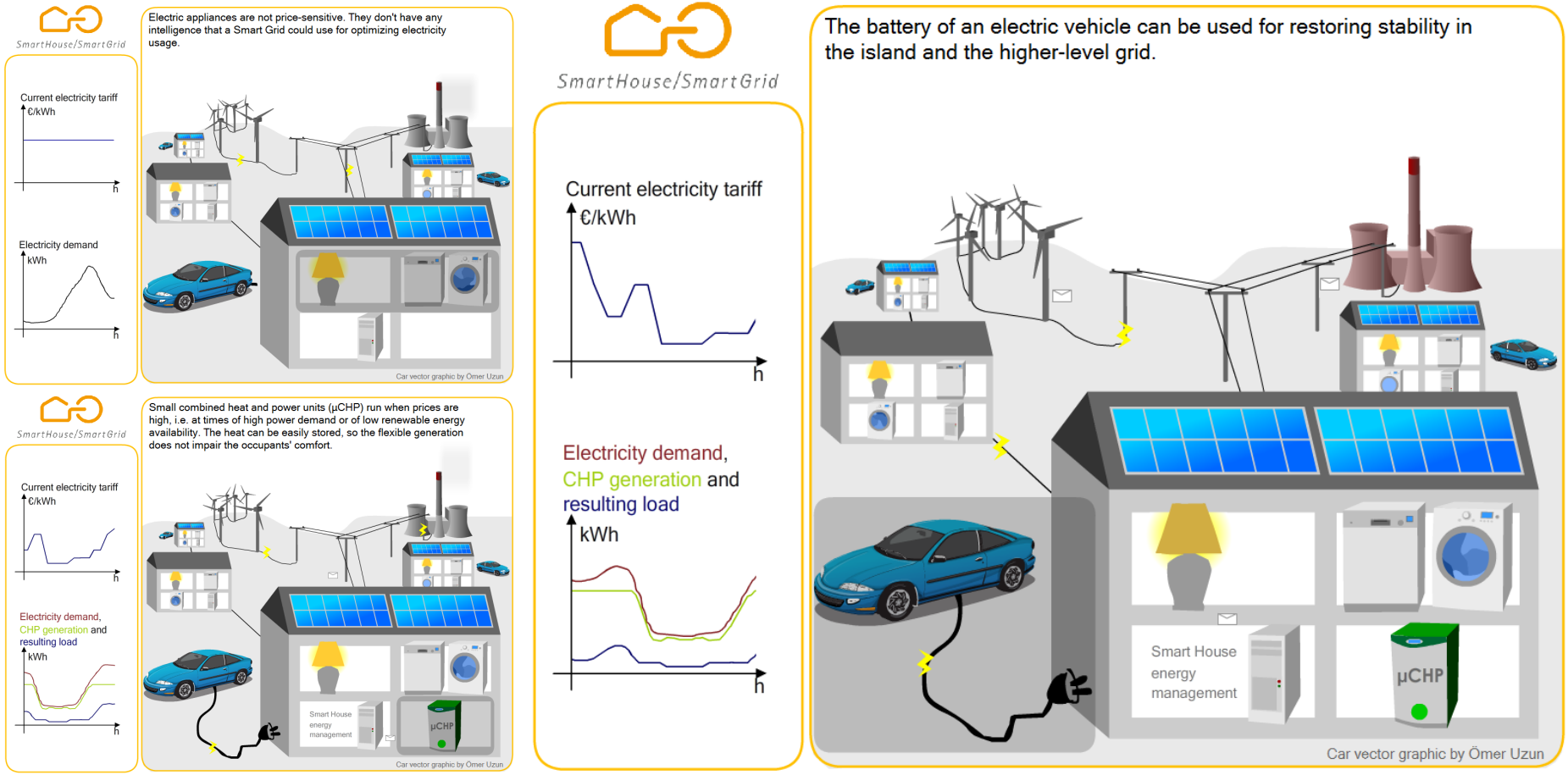
SmartHouses in a SmartGrid



http://www.smarthouse-smartgrid.eu/fileadmin/templateSHSG/docs/SHSG_Animation.swf

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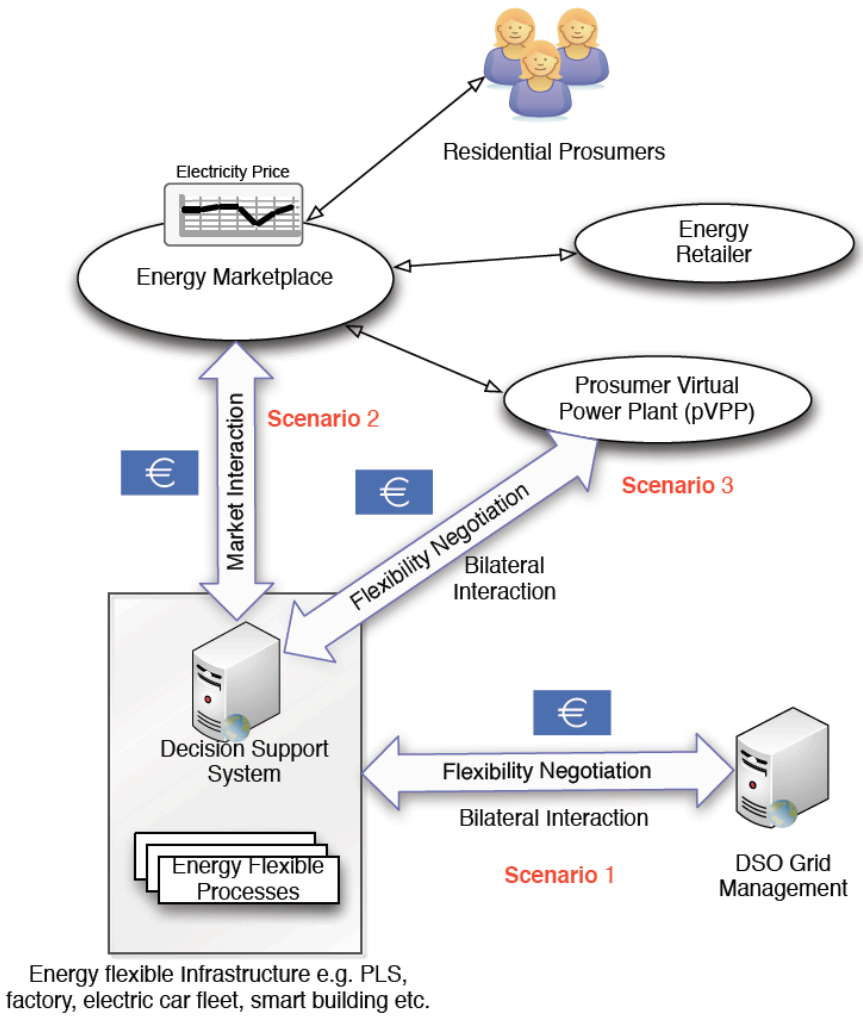
New revenue sources for Public Authorities?



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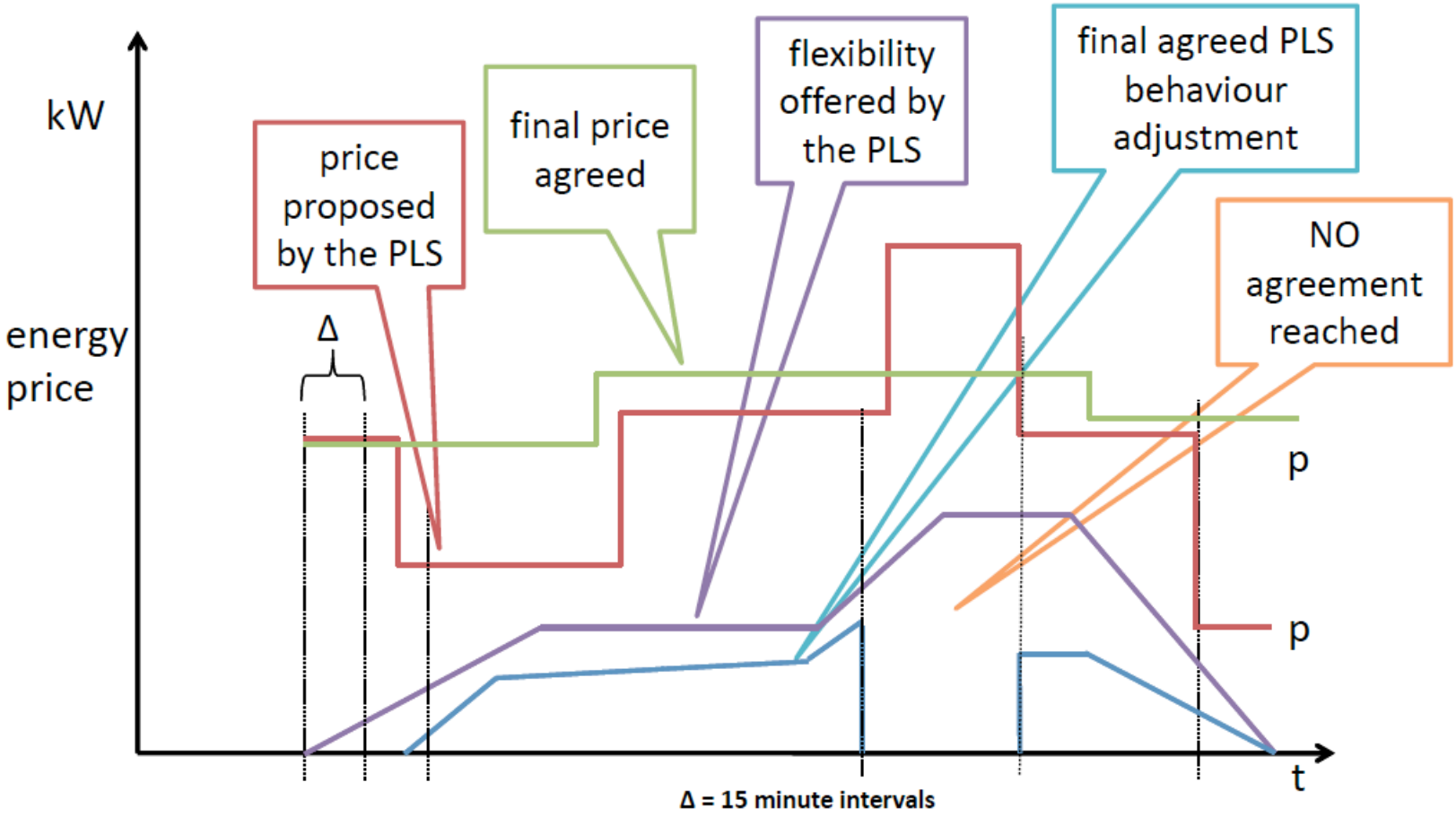
Trading of energy signature “flexibility”



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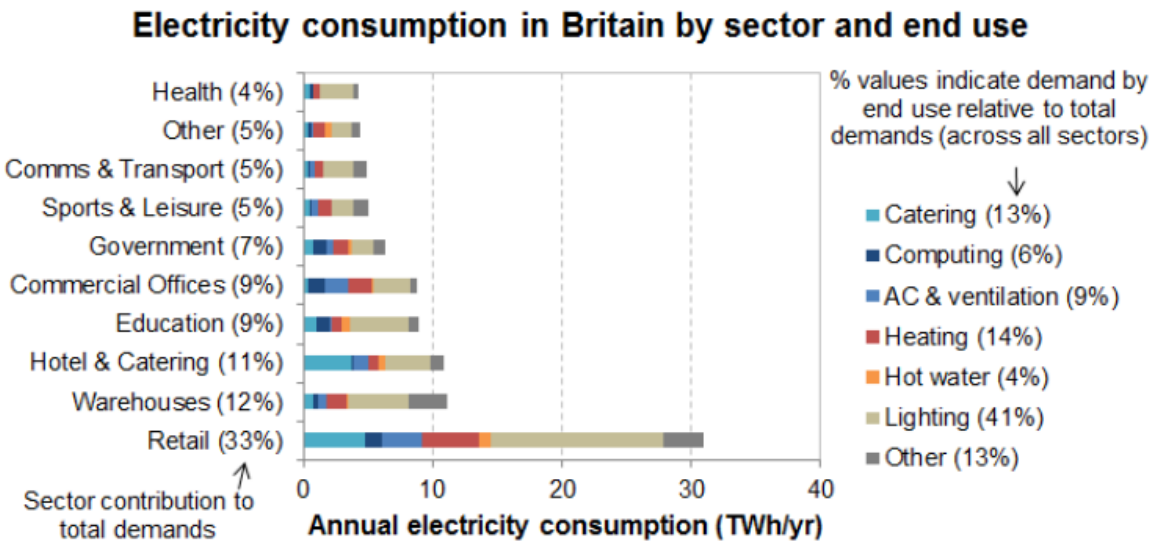
But how much flexibility is there?



Scenario	Flexibility in peak periods by sub-load (across all sub-sectors)			
	Hot water	Lighting	HVAC	Other
Conservative	25%	10%	10%	10%
Moderate	50%	20%	20%	20%
Stretch	75%	40%	30%	30%

Note: zero flexibility assumed for catering or computing sub-loads.

Source: "Demand side response in the non-domestic sector" Final report for Ofgem, July 2012

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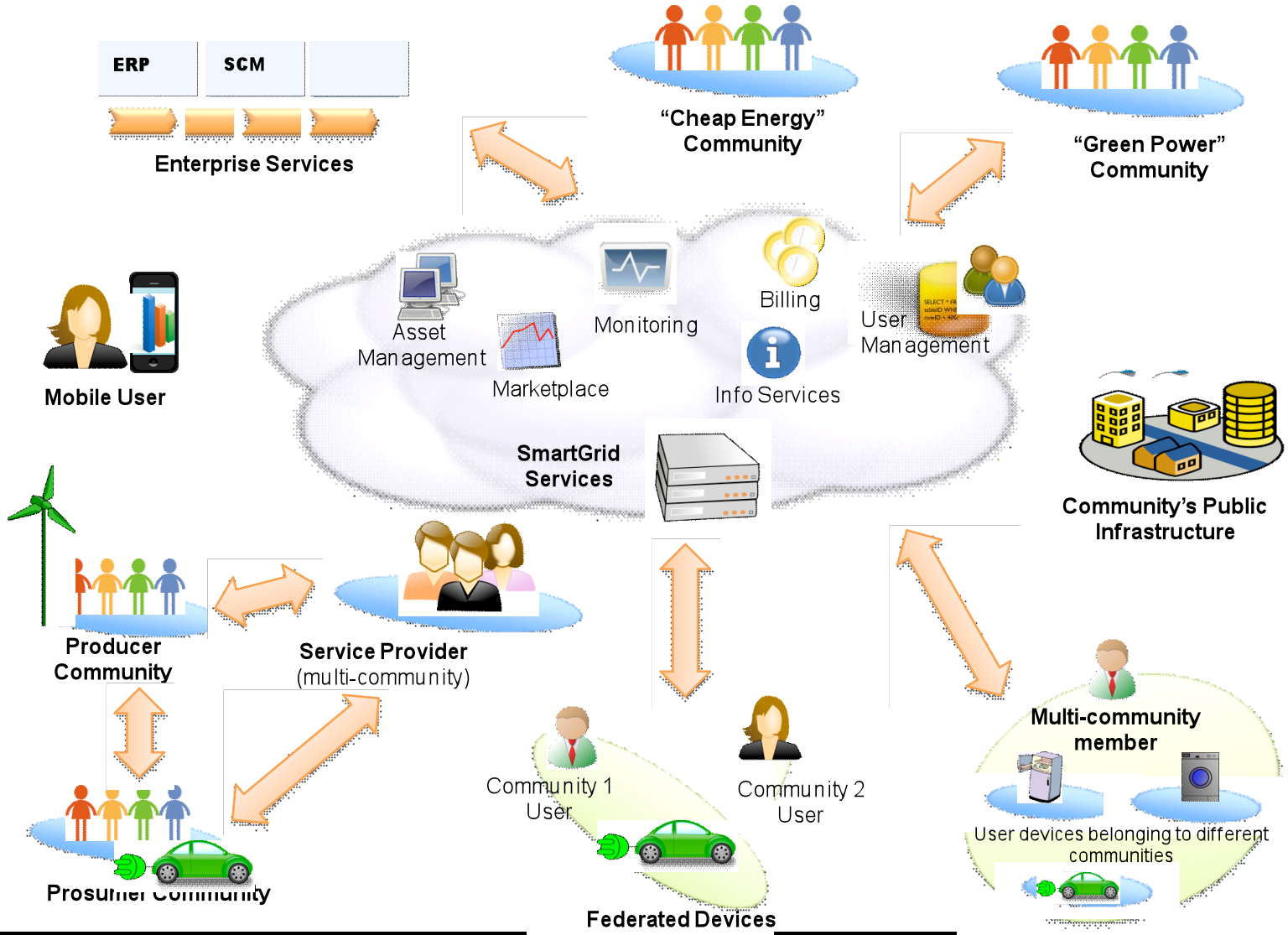
Towards prosumer Virtual Power Plants (pVPPs)



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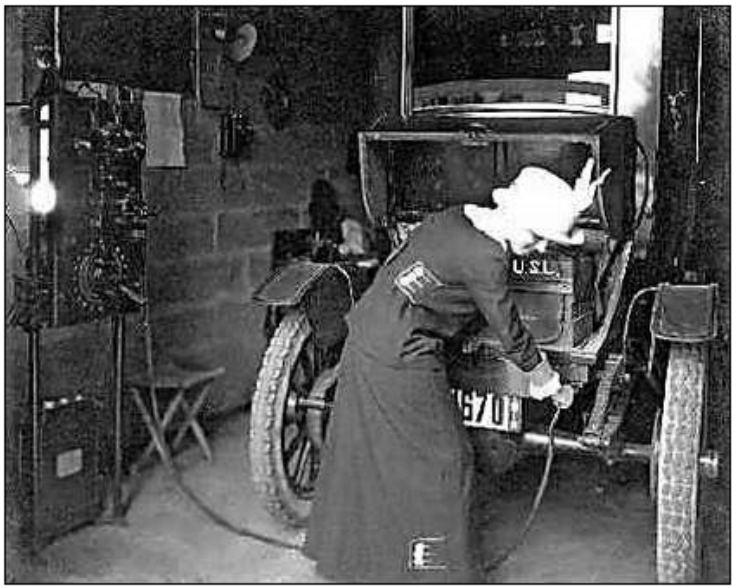
www.ict-nobel.eu

www.ict4e2b.eu

www.smarthouse-smartgrid.eu



[Source: Jan Perry/Cincinnati Post from Autobloggreen]
Electric Car - Cincinnati 1912

Contact:

Stamatis Karnouskos
SAP Research

SAP AG
Vincenz-Priessnitz-Strasse 1
D-76131 Karlsruhe,
Germany

Email: stamatis.karnouskos@sap.com

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