Smart meters – Enabling or postponing
"Smart Energy Systems and Communities"

Dr. Mihai Sanduleac
Faculty of Power Engineering, University Politehnica of Bucharest

3rd UNI-SET Energy Clustering Event, 21-23 November 2016

Hosted by University Politehnica of Bucharest, Bucharest, Romania

Smart Metering systems in EU
An overview of the today situation

First generation in 2004-2010: mainly Italy and Scandinavian countries

Low functionality
Low standardization
Entry-level technology

Second generation (today): many EU countries, focus on France, Spain and again Italy

Higher functionality
Improvements in standardization
More mature technology

Many meters pretend to be smart !

What about integration of various solutions in "Smart Energy Systems" ?

Actual situation of Smart Meters arena – a ZOO

Existing meter integration is a nightmare !

- Multitude of protocols
- Non-standards protocols
- Secret (custom) protocols
- Standard protocols but wrong implemented
- Standard protocols are not enough standard (e.g. DLMS/COSEM)
- Data security issues in some situations
- Lack of documentation
- No communication interfaces (except IR port)

CEN-CENELEC standardization and real meters life: Improvements are definitively needed

EU legislative environment

2004/22/CE – Measuring Instruments Directive (**MID**)

M/441 Mandate 2009.04.12
Smart Metering
– Functional reference architecture for communications in **smart metering** systems
CEN/CLC/ETSI/TR 50572, Dec. 2011

M/490 Mandate 2011.03.01
Smart Grid
– "**Smart Grid** reference Architecture"
CEN/CENELEC/ETSI, Nov. 2012
→ **SGAM** Framework
CEN/CENELEC/ETSI, Nov. 2012

2012/27/EU
Directive
– **Energy efficiency** directive → Empowering citizen for efficient use of energy resources

2012/148/EU
Recommendation
– **Roll-out of smart metering** systems → Technical requirements, security, privacy

Cost Benefit Analysis – the main criterion

95/46/EC, 2009/136/EC, GDPR → Data security and privacy requirements

EU legislative environment

2012/148/EU ● **Roll-out of smart metering** systems → Technical requirements, security, privacy

10 key common minimum functionalities →

CONSUMER	• a) Provide readings directly to the consumer and/or any 3rd party • b) Update readings frequently enough to use energy saving schemes
METERING OPERATOR	• c) Allow remote reading by the operator • d) Provide 2-way communication for maintenance and control • e) Allow frequent enough readings for networking planning
COMMERCIAL ASPECTS OF SUPPLY	• f) Support advanced tariff system • g) Remote ON/OFF control supply and/or flow or power limitation
SECURITY - DATA PROTECTION	• h) Provide secure data communications • i) Fraud prevention and detection
DISTRIBUTED GENERATION	• j) Provide import/export and reactive metering

Not fully implemented in many National rollouts !!!

Drawbacks of today Smart Metering systems

Smart Metering and Smart Grid: no real synergies

Two concepts which are supposed to grow together

First Smart Meters, then Smart Grids, or Smart Grids in parallel

Smart Metering and Smart House: no real synergies

Citizen are not empowered (they do not receive in-time awareness)

Citizen feel the SM as their (big brother) spy in the house

Smart Metering and telecomm: no real synergies

They do not share communication (SM uses slow PLC instead of IP)

They alone are not helping the digital agenda and e-society (EU policies)

FP7/H2020 projects on the matter are still not making springtime

Smart Metering and energy services: no real support

Smart Metering, cyber-security and privacy: still high concerns

Cost Benefit Analysis – Official country data for Smart Metering Systems

Table 23 Costs and Benefits normalised by number of metering points

Member States already completed roll-out	Cost per Metering Point	Benefit per Metering Point
Finland	€210	NA
Italy	€94	€176
Sweden	€288	€323

Member States rolling out smart metering in ELE and GAS jointly	Cost per Metering Point	Benefit per Metering Point
Ireland	€473	€551
Netherlands	€220	€270
United Kingdom - GB	€161	€377

Member States rolling out smart metering	Cost per Metering Point	Benefit per Metering Point
Austria	€590	€654
Denmark	€225	€233
Estonia	€155	€269
France	€135	NA
Greece	€309	€436
Luxembourg	€142	€162
Malta	€77	NA
Poland	€167	€177
Romania	€99	€77
Spain	NA	NA

Member States NOT rolling out smart metering yet	Cost per Metering Point	Benefit per Metering Point
Belgium	NA	NA
Czech Republic	€766	€499
Germany	€546	€493
Latvia	€302	€18
Lithuania	€123	€82
Portugal	€99	€202
Slovak Republic	€114	€118

All: fixed functionality during lifetime

Some of today Smart Meter solutions: Low cost, BUT low functions, low benefits

Today Smart Meters rollout (2nd generation): Do they enable energy evolution / revolution ? Or they slow it and postpone it ?

Most of today Smart Meters have minimal functionalities (even not the 10 commands)

Most of today Smart Meters data goes through DSO (slow, incomplete) and block new services (from suppliers, ESCOs, Smart cities and communities)

Most of today meters do not have real-time support for Smart Grids

Most of today Smart Meters use DSO based communication (slow PLC) and do not use / share synergies with telecom advancements (towards ubiquitous public IP solutions)

Most of today Smart Meters do not empower citizen and ask for costly parallel solutions (a second meter just for monitoring the house consumption)

Today Smart Meters rollout (2nd generation): Do they enable energy evolution / revolution ? Or they slow it and postpone it ? (cont.)

Most of today Smart Meters have fixed functionalities

Most of today Smart Meters do not have support for energy services

Most of today Smart Meters are mostly for the benefit of DSO

Meters deployed today will stay in place 8 to 10 years
(usual depreciation until a new generation is changing the meter park)

Can we say that:

Today fixed-functionality SMs slow-down / postpone societal evolution towards "Smart Energy Systems" ?

University environment, as a neutral actor, supports new solutions:

Involvement of

University Politehnica of Bucharest

In the H2020 - NOBEL GRID project

Support for a new Smart Meter (3rd) generation:

The Unbundled Smart Meter

Unbundled Smart Meter (USM) concept

Support for Smart Grid
Real-time data

Support for dynamic energy markets

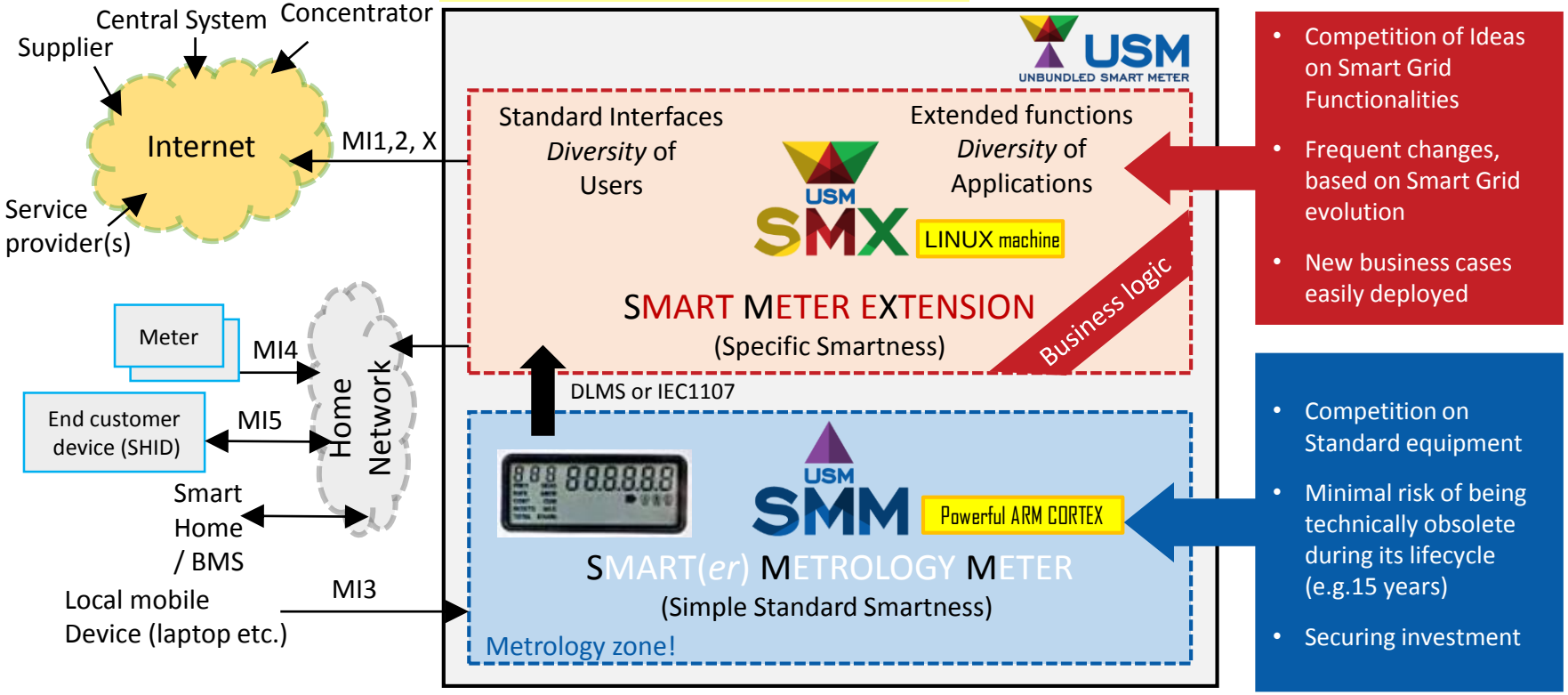
Support for Power Quality
Including harmonics

Support for production and storage control

Support for Energy services

Support for security and privacy

Support for Unknown yet ! (services of the future)



Unbundled Smart Meter (USM) connection to the energy world

DSO network
Observability
DER control
Secondary U control

Aggregators
DR response
Energy services
VPPs

Markets
Energy
Ancillary services
Balancing

Communities
Smart Cities,
Electrical cooperatives
Neighborhoods

All actors to access directly the prosumer

USM UNBUNDLED SMART METER — **Smart Meters**

Inverter to connect **DER** and **storage**

ENTSO-E new network codes support

Control

DR control

Intelligent device

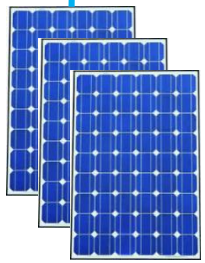
Air conditioner

DR control

Intelligent device

LED lighting

Home users
Awareness, control



PV panels (DER)

Storage

Prosumer's Smart Home environment

Cost Benefit Analysis – Unbundled Smart Meter

Table 23 Costs and Benefits normalised by number of metering points

Member States already completed roll-out	Cost per Metering Point	Benefit per Metering Point
Finland	€210	NA
Italy	€94	€176
Sweden	€288	€323

Member States rolling out smart metering in ELE and GAS jointly	Cost per Metering Point	Benefit per Metering Point
Ireland	€473	€551
Netherlands	€220	€270
United Kingdom - GB	€161	€377

Member States rolling out smart metering	Cost per Metering Point	Benefit per Metering Point
Austria	€590	€654
Denmark	€225	€233
Estonia	€155	€269
France	€135	NA
Greece	€309	€436
Luxembourg	€142	€162
Malta	€77	NA
Poland	€167	€177
Romania	€99	€77
Spain	NA	NA

Member States NOT rolling out smart metering yet	Cost per Metering Point	Benefit per Metering Point
Belgium	NA	NA
Czech Republic	€766	€499
Germany	€546	€493
Latvia	€302	€18
Lithuania	€123	€82
Portugal	€99	€202
Slovak Republic	€114	€118

Cost per metering point: € 250

Benefit per metering point: € 475

Low-medium cost, Complex functions, High benefits

Opening for new functions during lifetime

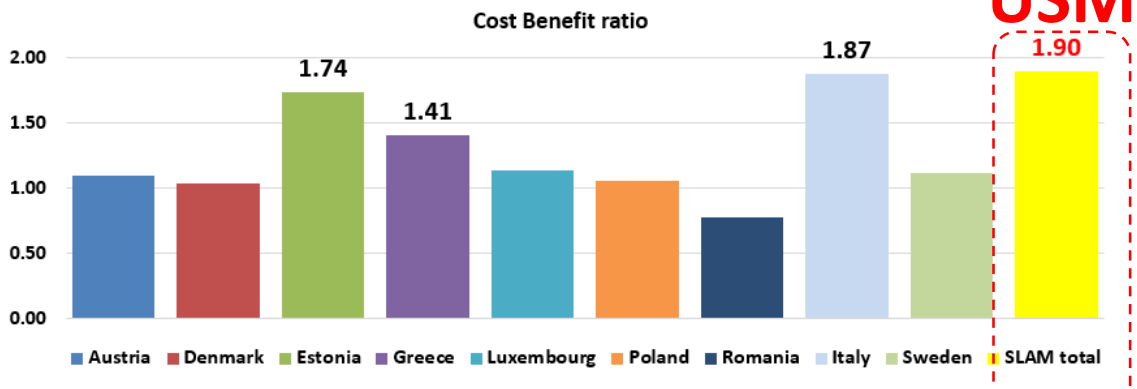
Involving all actors

All: fixed functionality during lifetime

Some of today Smart Meter solutions: Low cost, BUT low functions, low benefits

Smart meters – Enabling or postponing "Smart Energy Systems and Communities"

USM

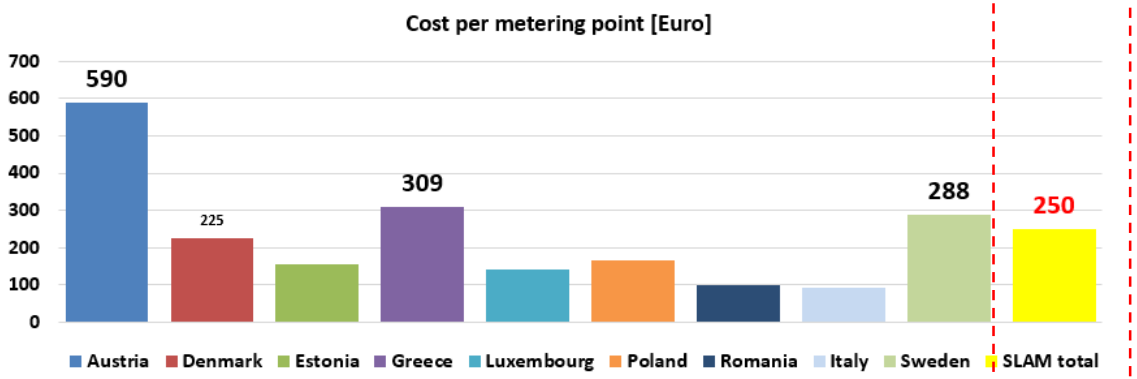


Cost Benefit ratio

Best (1st) CBA = 1.90 (USM)

Better than average (+52%)

(average CBA = 1.25)

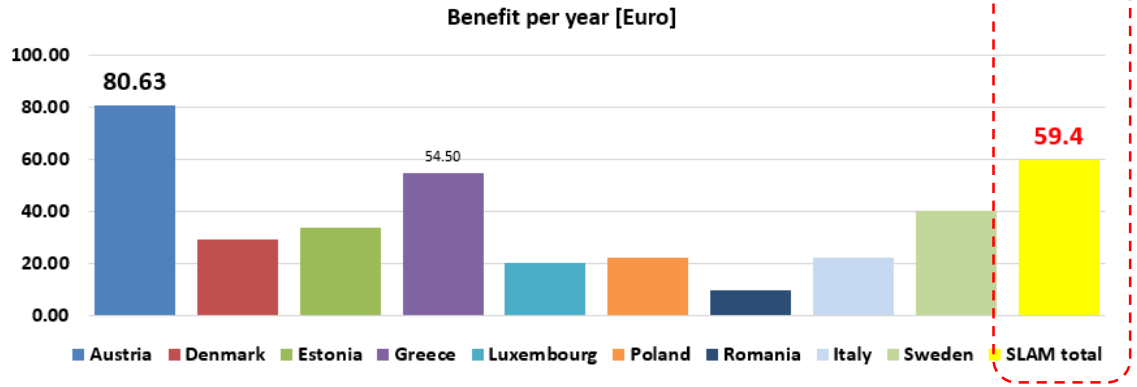


Cost per metering point

7th on price = 250 €, from 10

Higher than average (+21%)

(average = 207 €, max=590 €)



Benefit per year

2nd best benefit = 59.4 €/y

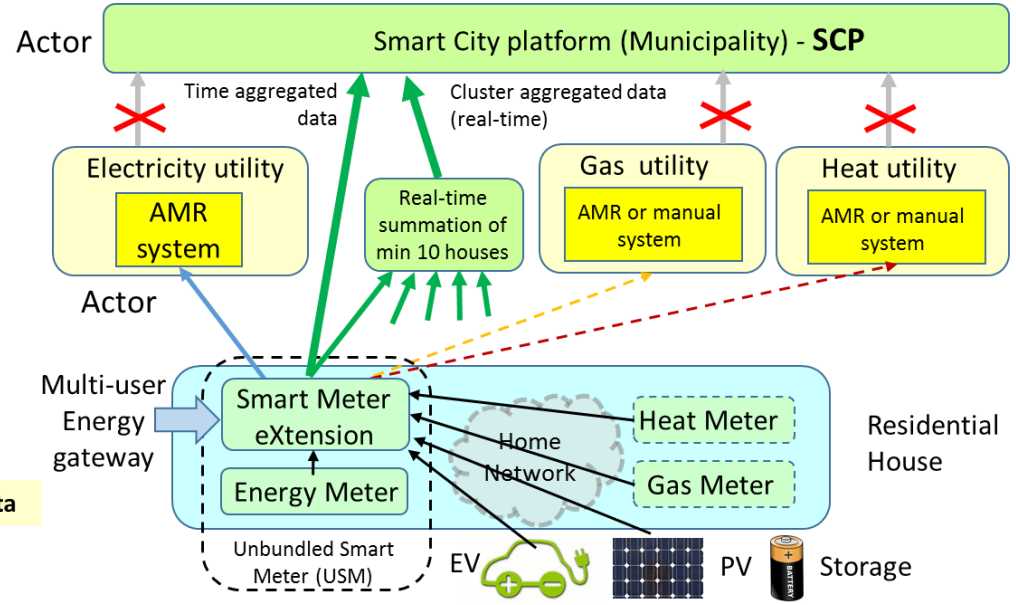
Better than average (+71%)

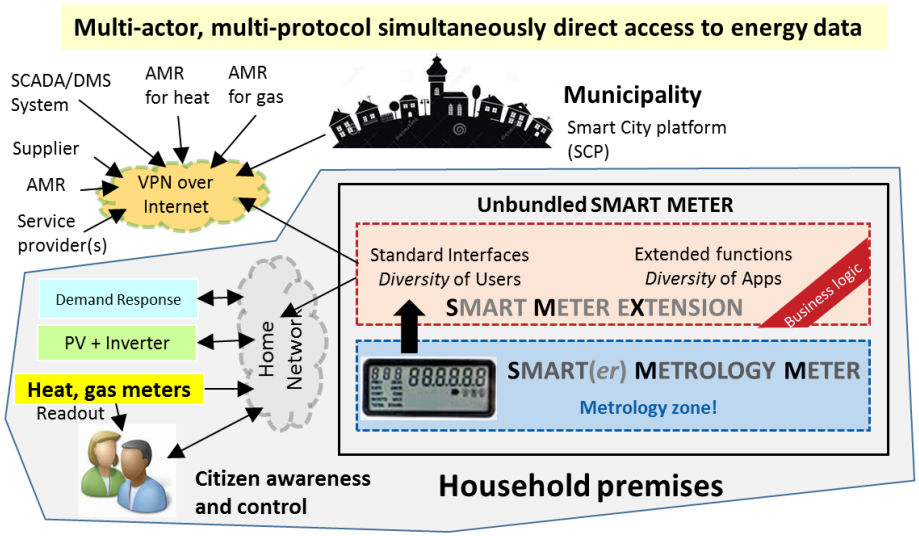
(average = 34.7 €/y)

Smart Cities and communities enabled by USM

Important shortcuts for deploying smart energy in Smart Cities:

- Privacy concerns due to rich data not wanted to be acquired through utilities AMRs
- Multi-energy streams optimization is in opposition to utilities interest
- No direct communication city to citizen





The role of Universities can be essential:

For an equilibrium of interests

For opening towards progress of society and not for a group

As a think-tank for the right technologies and architectures

For avoiding or counter-balancing bad effects (even with initial good intentions)

- Advocating effective network use with Smart Grids but finally promoting grid reinforcement !
- Wanting local resilience and efficiency but finally enforcing TSO control down to 800 W production
- Looking for citizen empowerment but giving him low support with the latest metering rollouts !

The role of Universities can be essential:

For teaching students towards citizen and societal empowerment and for giving them solutions

For promoting open-source solutions, bot HW and SW, and for enabling startups and fear market

For helping the standardization process

For contributing to proper decisions in the EU regulations e.g. for:

- Pan-European codes
- Neighborhood market rules
- Smart communities and their resilience

For enabling rather than postponing energy evolution / revolution

Thank you for your attention !

Smart meters – Enabling or postponing
"Smart Energy Systems and Communities"

Dr. Mihai Sanduleac
Faculty of Power Engineering, University Politehnica of Bucharest