Digitalization as an enabler for the energy transition

PANTERA Regional Workshop

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Metody Georgiev / Technical University of Sofia

Tasos Tsitsanis / Suite 5

Rad Stanev / Technical University of Sofia

TECHNICAL UNIVERSITY OF SOFIA – R & D Sector

TECHNICAL UNIVERSITY of Sofia (TUS) is the largest higher Engineering school in Bulgaria with long years of experience in training engineers.

THE RESEARCH AND DEVELOPMENT SECTOR (**R&DS**) is a unit of the TU Sofia whose tasks are related to the organization, administration and service of the research and innovation activities under contract with the National and International research programs.

TECHNICAL UNIVERSITY OF SOFIA – R & D Sector

Laboratories working in the field of DER and digitalization

- Power system stability Laboratory (PSSL)
- Power Electronics Laboratory (PEL)
- Communications, Process Control and Energy Efficiency In Industry (CPPEIL)

Research activity

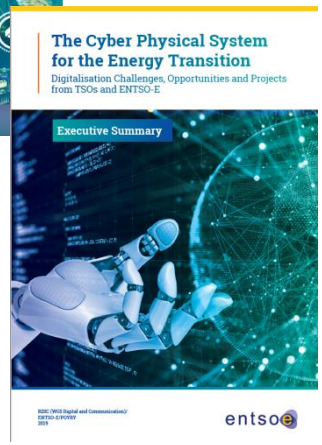
- Voltage, angular and frequency stability analysis
- Analytical and physical modeling of electrical power systems
- Power electronics converters with improved power factor
- Power systems dynamics
- EV wired and wireless charging systems
- Autonomous, micro- and minigrids
- Power generation prediction of DER
- Energy and power management systems
- Intelligent power system automation and control
- Modeling and simulation of smart grid systems and components
- Model, SIL and HIL experiments
- SCADA systems of distribution, microgrids and industry
- Energy storage systems
- Communication in power systems

Digitalization
What? / Why? / How?

Definition(s) :

Motivation :

Driving forces :



Barriers and challenges

Challenge 1 : Increased Vulnerability

Challenge 2 : Grid flexibility meet grid complexity

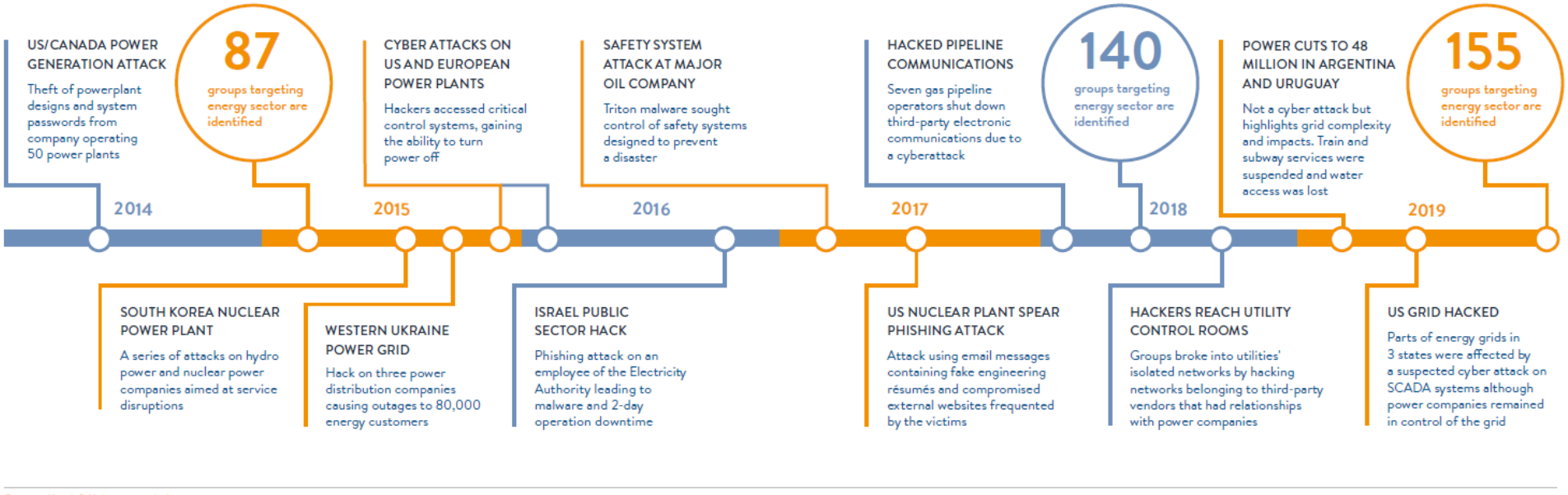
Challenge 3 : New services need new business models and trading strategies

Challenge 4 : Legal aspects: New technologies lead to new regulation needs

Challenge 5 : Interoperability with other networks /Thermal, gas, hydrogen, etc./

Challenge 1: Increased Vulnerability

- Rapid pace of innovation.
- Technological complexity.
- Data sharing and interconnectivity
- Rising cyber attacks

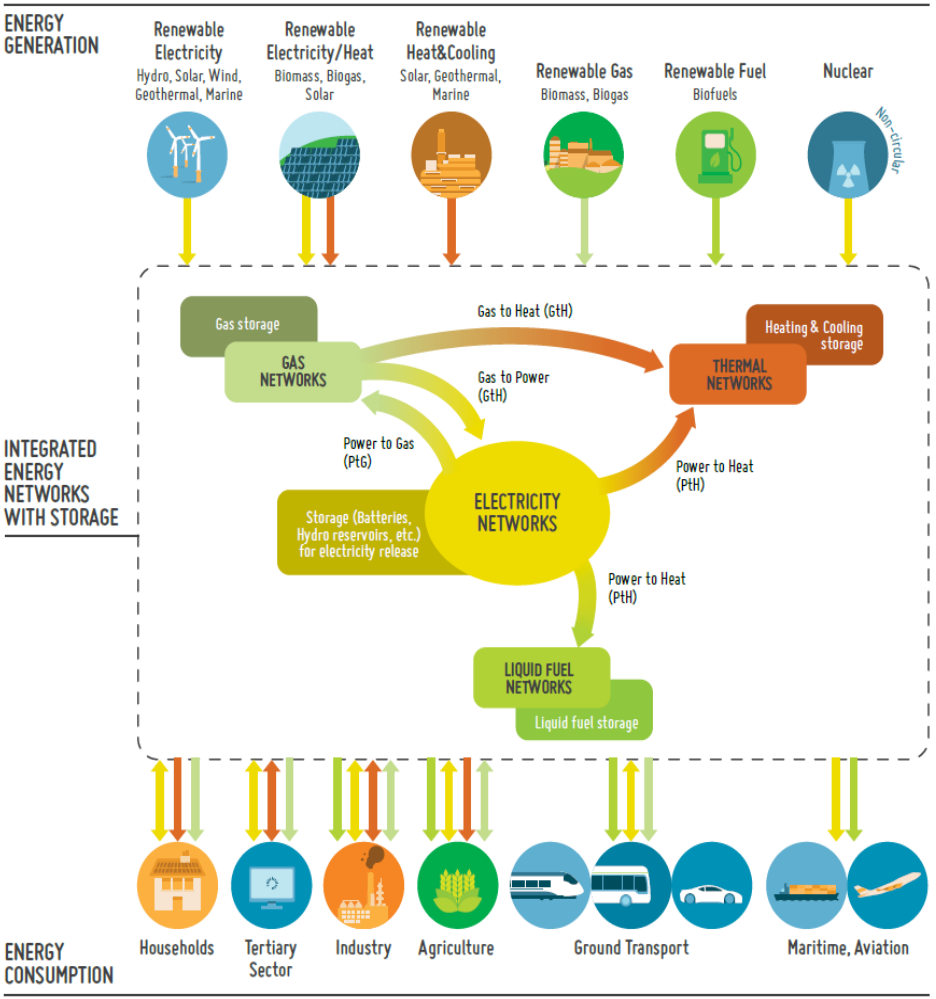


Source: World Energy Council: Cyber Challenges to the energy transition

Challenge 2: Grid flexibility meet grid complexity

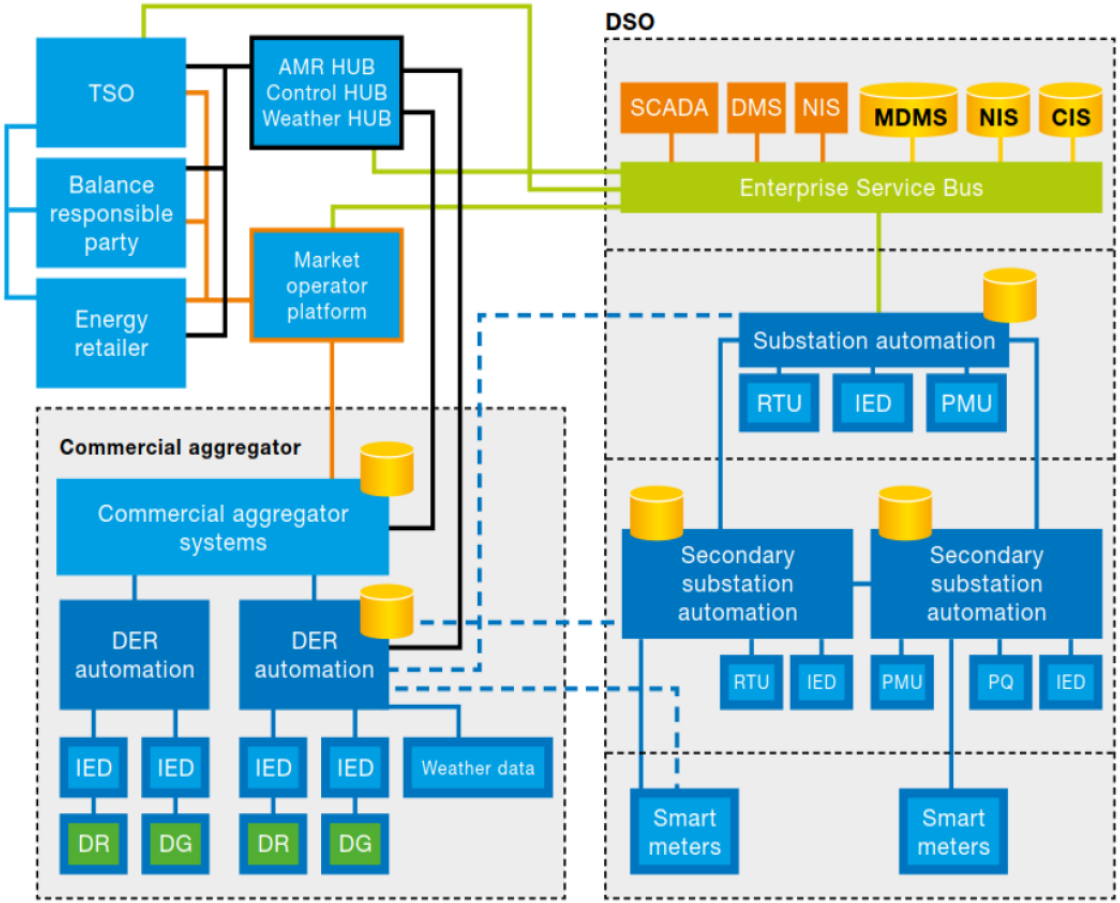
- Consumers become prosumers
- Decentralization of electricity networks - Myriads of distributed assets (generation, storage, demand, e-mobility, IoT) push controllability at the edge of the grid
- Increased number of actors
- Demand Response models become more complex
- Combining classical control signals with new ICT based control strategies
- Need for orchestration and coordination between stakeholders
- Integration of non-electrical power systems (gas and thermal)

ETIPS Net Vision 2050 Part 2
Towards Integrated Energy Systems 2050



Challenge 3: New services need new business models and trading strategies

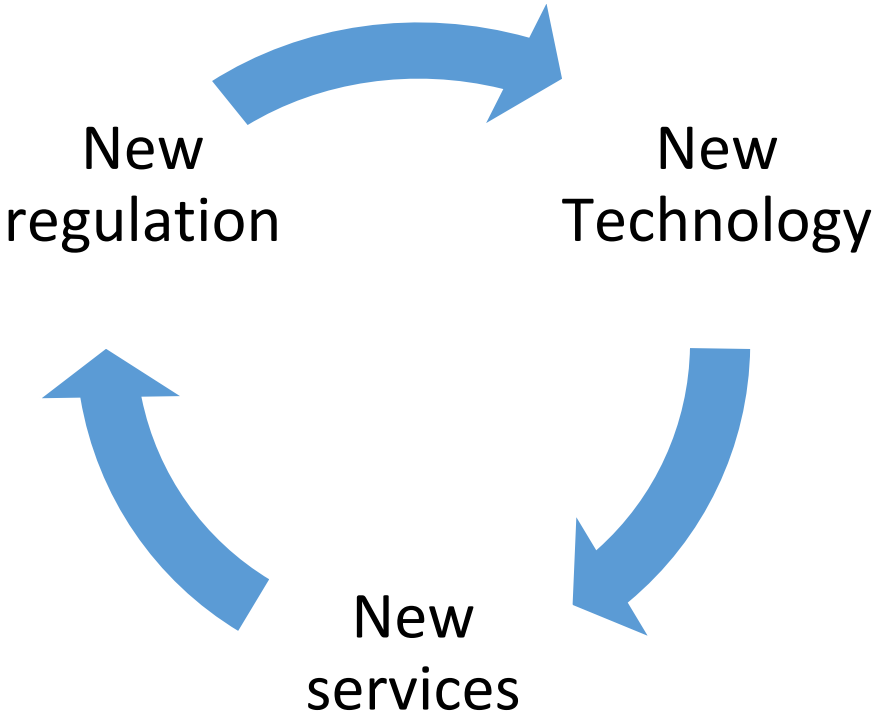
- New services are offered to the market
- New trading schemes are presented
- Prosumers aggregation, prediction, control
- Interoperability between market and technical systems (also at the data level-semantic interoperability)
- Many platforms, clouds, analyses tools leads to heavy decision making process



Challenge 4: Digitalization impact on the society

- Privacy issues concerning the data
- The customer should be convinced to grant access to the facilities.
- New jobs related to the new technologies and new needs of well trained staff are created
- New learning programs are necessary.
- Academia and schools should be involved more deeply in the process.

Challenge 5: New technologies lead to new services, new skills requirements and new regulation needs



Digitalization use cases

STAKEHOLDER	PRACTICAL USE CASE	PROJECT/FIELD TRIAL
(3.1) Power Generator	(3.1.1) Probabilistic forecasting of wind generation, extremes and optimal use in the system	Anemos/Safewind
	(3.1.2) Smart curtailment, dynamic line rating and Improved forecasting tools to maximize integration of wind	SWIFT
(3.2) Transmission & Distribution Networks	(3.2.1) Innovative Tools for Electrical System Security within Large Area	iTesla
	(3.2.2) Autonomous grid reconfiguration and forecasting in the MV grid	FP7 GRID4EU
	(3.2.3) Meter data management for network operation in the LV grid	FP7 GRID4EU
	(3.2.4) Collaborative Asset Management	SAP Asset Intelligence Network
	(3.2.5) Advanced tools and ICT servicers for Distribution System Operators	NOBEL GRID
	(3.2.6) A Platform to interface demand side management with DSO needs	SERVO
(3.3) Retailers and Aggregators	(3.3.1) Empowering SG Market Actors through Information and Communication Technologies	SmarterEMC2
	(3.3.2) IDE4L Use Cases on technical and commercial aggregators	IDE4L
(3.4) Consumers & Prosumers	(3.4.1) Dynamic pricing and Demand Response Management	Linear
	(3.4.2) Smart houses in a smart grid environment	SmartHouse/SmartGrid
	(3.4.3) Smart charging of electric vehicles	FINESCE
	(3.4.4) Neighborhood energy management	FP7 COOPERATE
(3.5) New Market Platforms	(3.5.1) Local Energy Markets	FINESCE
	(3.5.2) ICT tools for cross-border markets	eBadge
	(3.5.3) The DSO as market facilitator	FLEXCIENCY
	(3.5.4) The Universal Smart Energy Framework	USEF Foundation

Source, Digital Energy 4.0, 2016, SmartGrids, https://www.researchgate.net/publications/313904016

Digitalization recommendations

- Smart meters and IED should be strongly involved and utilized for systems control and assets management.
- Projects involving different facilities /gas, electricity and heat/ should be combined with market systems and provided as services to the customer.
- The customers (producers and/or consumers) needs to allow access to the facilities and should be aware with his requirements and benefits.
- The customers of the technology should be convinced to the technology benefits
- Cyber security systems should be improved to meet big data transfer
- Big data platforms are needed to facilitate real time AI analytics (centralized, edge) for control optimization
- Data need to become available to all involved stakeholders through trusted and secure data sharing models (enabling data trading and monetization)
- New teaching methods and programs should be developed
- New regulatory framework should be created to support new services and technology implementation.

Challenges in Resources

Do you have sufficient expertise/staff to undertake R&I activities within your organization? • Highly skilled personnel moves abroad so it is too difficult to find and engage really skillful personnel in relevant R&D activities; • Highly skilled personnel moves to work for industry and do not participate in R&I activities • Demographic crisis; • Low societal and financial respect to the energy sector in Bulgaria • Low percent of yearly graduated students in electrical power engineering • Low motivation for R&I activities in energy sector of the young people • Lack of related educational programs at middle schools
Does your organization have adequate funding to engage in R&I activities? • Limited budget available at national level; • Reduced visibility to engage in EU funded projects; • Orientation of funding towards more traditional activities (infrastructure enhancement) rather than digitalization

Challenges in Resources

How can R&I collaboration be supported? • Stronger European funding for countries with less activities (and may be less possibilities for funding) in R&I sector. • More active involvement of Academia and Research organizations in industry projects; • Focus on small scale and middle scale projects; • Providing of consulting services in R&I projects management
Which areas of Smart Grid R&I pose the biggest challenges? • Controllability of the system with large number of DER • Holistic knowledge on digital systems and analog power systems • Cybersecurity

Challenges in Governance

What are the main challenges regarding energy-related innovation governance? • Financing (may be mainly lack of information) • Lack of innovation projects management skills • Lack of collaboration between market actors for the definition of new business models and the provision of novel energy services • Knowledge exchange face the know-how protection.
Which initiatives enhance the quality of governance of the energy and innovation system? • Collaborative knowledge sharing; • Education; • Exchange of data and information.
What have been the successes or failures of those actions? • No coordination between market actors that possess their own agendas and operate in silos • No data sharing attitude between them and strong conflicts that affect their collaboration potential for an orchestrated approach in smart grid management

Challenges in Governance

To what extent is the governance of national innovation systems effective?

It is hardly to estimate the success of governance as this is a matter of investigation of figures for successful innovation projects. In Bulgaria there is several institutions which govern with innovation programs: Ministry of Energy, Ministry of Education, Ministry of Economics and Ministry of environment and water and this cause to difficulties in governance.

To what extent your country is facing the need to update the required skills and competences for a clean, fair and effective energy transition?

- Rapid growth of renewable energy (mainly solar and wind);
- Centralized large scale installations made by foreign investors (mainly);
- Power system technical issues: stability, power quality, power balancing;
- Low social acceptance to high electricity pricing (22% of the population is below the poverty line);
- High digitalization at TSO level;
- Low digitalization at DSO level.
- Investments are needed for further development of electricity grids and implementation of new technologies (smart metering and smart grids).
- Deployment of smart meters:
  - National legislation is developing slowly (i.e., the Energy Act and the Energy Efficiency Act) provide the possibility through art. 120 in the Energy Act to deploy smart meters in a cost effective manner (following the EWRC Decision of 31.07.2013)
  - Relevant protection of the personal data provision is based on art. 67, par. 6 of the Energy Efficiency Act.

Gaps in Networking

- Reduced visibility of R&I results towards external actors
- Need to promote collaborations with business and industry to increase attractiveness towards external stakeholders and achieve the involvement in EU funded projects through local consortia
- Need for national coordination towards the organization of the participation of local R&I actors in EU organized events to facilitate networking

Gaps in Regulations

Which regulatory instruments need to be adopted/amended to facilitate progress on the climate action plan roadmap?

- Adjustment of the national legal framework for new technologies (e.g. Storage and e-mobility)
- Incentives for the penetration of such new technologies
- Clear framework for independent RES and demand side aggregators participation in the market
- More favorable conditions for local energy communities establishment and remuneration of demand
- Robust framework regulating data sharing mechanisms and remuneration
- Clear regulation for data privacy and data sharing

PANTERA support

How can PANTERA project support your organisation/energy community to drive the energy sector toward carbon neutral

- Opportunity to increase visibility through collaboration and interaction with external actors through regional desks
- Promotion of success stories and use cases and increase of attractiveness to get involved in R&I activities at EU-level
- Identification of gaps in R&I in collaboration with the PANTERA teams and focus on what really matters

How can PANTERA project bridge the gaps that currently exist in R&I energy field in Europe between member states and incentivize investments in smart grids?

- Filling the gap in information about funding opportunities
- Providing proper tools for stakeholders collaboration

What are your expectations from the PANTERA project?

- Establish contacts (through collaboration) with renowned organizations that can enable further involvement in R&I activities and adequate coverage of identified gaps
- Knowledge transfer and experience sharing
- Identification of best practices that have been successfully deployed in similar contexts and collaboration establishment for the attraction of the required financing

THANK YOU FOR YOUR ATTENTION!

Metody Georgiev
Technical University of Sofia
georgievmg@tu-sofia.bg

Tasos Tsitsanis
Suite 5
tasos@suite5.eu

Rad Stanev
Technical University of Sofia
rstanev@tu-sofia.bg