

R&D  
**NESTER**

## Inovação na Energia

**Nuno Souza e Silva, Managing Director – R&D Nester**

ConVERSE, 11 de Maio 2018

## ***Presentation Content***

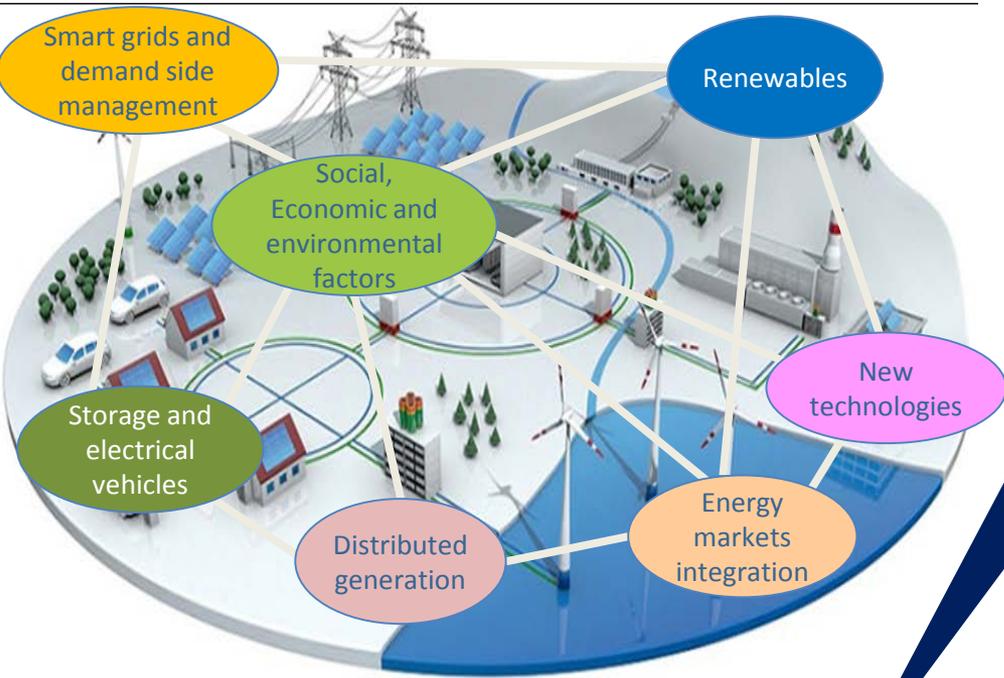
- Network and System Operator goals
- Why the need for Innovation?
- Support for Innovation
- Innovation work being developed

# 3 key goals in current National and Regional Energy Policies

Security of Supply (SoS), Competitiveness and Sustainability



In a fast changing energy paradigm...

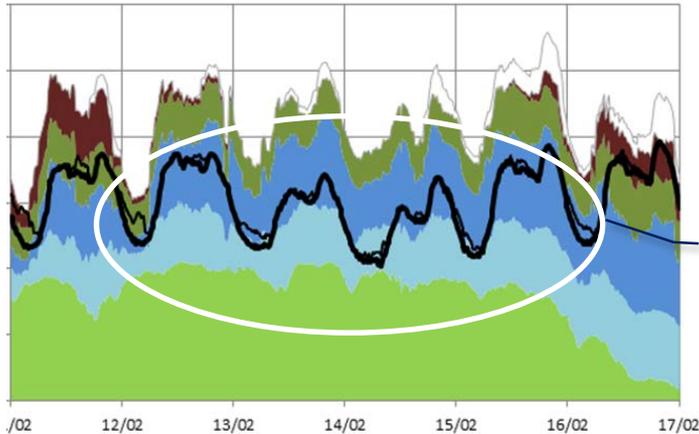


... 3 major goals prevail in every Energy Policy

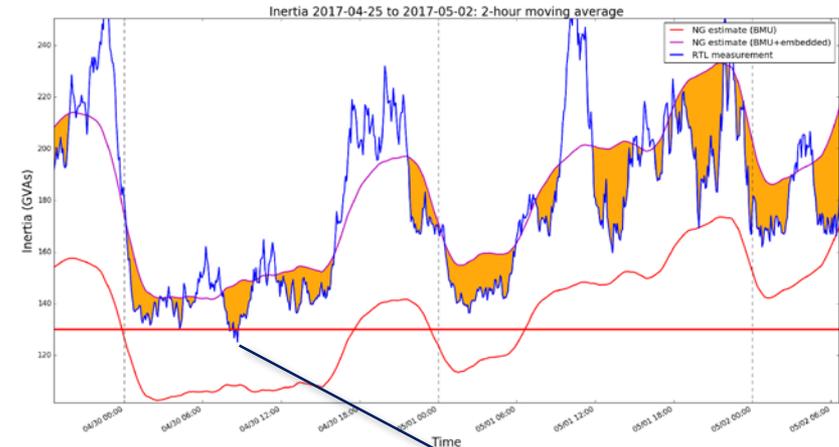


# Why the need for innovation?

## Some technical drivers:

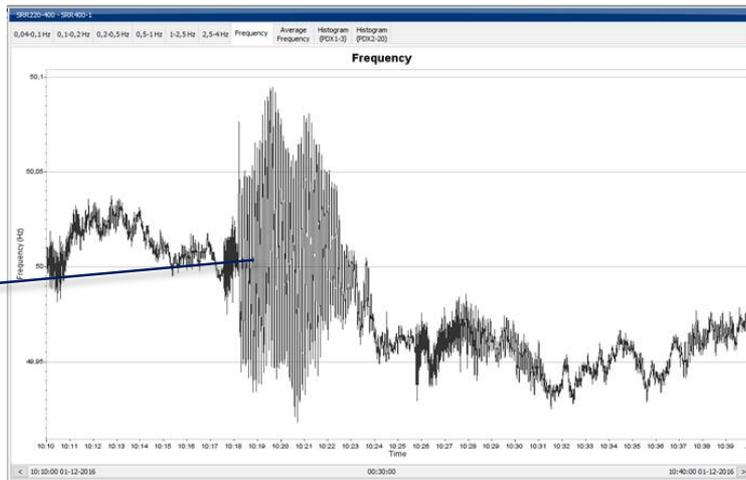


4 consecutive days of 100% renewables generation



inertia in the system below the minimum

- Increased % of renewables
- Increased electronics in the system
- Reduced inertia in the system
- Increased generation from consumers
- Inversion of energy flows
- Digitalization of communication and processes
- New technological assets in the system
- Integration into regional markets
- Integration energy vectors
- ...



frequency oscillations in the network

- Besides technical, drivers can be also economical, political, societal (stimulate new business models, players, efficiency, services for end users, ...)

# Why the need for innovation?



## Implementation of the Third Energy Package

### OBLIGATION

Article 8 (5) of Regulation 714/2009:

*“The annual work programme....shall contain ...**Research and Development activities...**”*

### FINANCIAL ELIGIBILITY

Article 37 (8) of Directive EC 2009/72:

*“... approving the tariffs ensure that transmission and distribution system operators are granted appropriate incentive ... support the related **research activities** ...*

PROJECT THOR  
Regulatory Funding of  
Transmission System Research  
and Development in ENTSO-E  
Countries  
WHITE PAPER

Per Agrell  
Daniele Benintendi

FINAL  
2013-04-12

## Incentives for Innovation – the TSO perspective

entsoe

White Paper

February 2018

### Contents

- 1) Scope and objectives
- 2) Challenges, barriers and the need of incentives
- 3) State of the art of type of innovation incentives
- 4) Considerations on the various incentive mechanisms
- 5) Portfolio of incentives options
- 6) Key Messages
- 7) Conclusions and recommendations
- 8) Appendix 1 Survey on current practices in Europe
- Appendix 2 Summary of previous RDIC studies
- Appendix 3 Literature references

- Need for innovation widely recognized internationally



“The TSO Energinet has to **ensure sufficient R&I activities necessary for the future** efficient and environmentally friendly transmission and distribution of electrical power (extract from the Law of Electrical Power Supply).”

“R&I costs of Energinet are covered partly as OPEX, partly as CAPEX and partly by external funding.”

“The 17.5 M€ was a Public Service Obligation, **financed by the tariff** and is simply distributed on the yearly consumption of kWh (all electricity consumers contributed 0.004 DKK/kWh).”

Recently, the regulation on R&D activities has evolved with a specific part for regulated grid tariff dedicated to R&D. This part is detailed in the regulatory framework and foresees a dedicated 4 year budget for the regulatory period. Through this regulation, the French regulator (CRE) “**gives RTE the means in order to launch and realize R&D and innovation projects which are necessary for the building of future electric grids**”. It guarantees the absence of barriers coming from the tariff to launch such projects. For the period 2017-2020, 142 million Euros are dedicated **in the regulated grid tariff** to RTE R&D activities.



In the present configuration, R&D in power systems is mostly entrusted to few public specialized bodies, which are **paid by the tariff** through a specific component (€cents per kWh) which has remained rather constant along the years.

- Heterogeneous mechanisms to support innovation



The yardstick regulation creates an environment where TSOs are incentivised to perform better, both in the short and the long run. Costs for innovation are included in the total costs (totex) of the sector and are remunerated to the TSO through the yardstick approach. In this way, the TSO can find their own balance in their degree of innovation and are able to optimise their choices.

Costs for R&D are treated as pass-through costs when they fulfill certain conditions, in order to avoid short term disincentives (~7 Million in 2016). It must represent a maximum of 0.3 % of the TSO's regulatory asset base.



There are two main mechanisms. Network Innovation Allowance (NIA) and Network Innovation Competition (NIC). Up to 0.7% of the allowed revenue under the NIA mechanism can be accessed. The NIC gives National Grid access to bid for a share of up to £ 30 M for large scale demonstration projects

- Heterogeneous mechanisms to support innovation. Not all countries provide incentives or support innovation explicitly.

- Innovations aiming at reducing total system cost, reduce risk of operation, increase security of supply, allow increased penetration of renewables



- Benefits for energy system and consumer

- Innovations aiming at reducing total system cost, reduce risk of operation, increase security of supply, allow increased penetration of renewables



## NETWORK PLANNING INTEGRATING DISPERSED ENERGY RESOURCES

**The challenge:** the new energy paradigm towards a decarbonized system has result on increasing levels of renewables in energy networks. Energy storage is seen as a valuable support for network operators to keep the energy infrastructure secure, reliable and flexible allowing the energy market to work without restrictions.

**HOW WE ADDRESS THE CHALLENGE OF PLANNING ENERGY STORAGE**

R&D Nester developed a new multi-attribute methodology for network planning integrating new flexible resources, such as energy storage. Through the collection of time-series from demand and supply, network models and the definition of several scenarios for the system evolution, we are able to analyse the system's flexibility. Afterwards, based on the flexibility assessment results, an especially designed algorithm is employed to search for the solution the best combines the site and size (power & energy) of the storage solution, taking into consideration technical and economic aspects of the problem (multi-objective). It also allows the comparison of the traditional network reinforcements against energy storage solutions, providing close support to the decision making process. This tool was successfully applied to a large scale transmission network of an European TSO.



**Reference Publications**  
 "Planning Energy Storage in Transmission Networks", IEEE IAS 2014, USA  
 "Sizing and Siting Smartest Energy Storage in Power Transmission Networks", IEEE IAS 2014, USA

**Contact us**  
 Phone: 351 210 001 300  
 E-mail: info@rdnester.com  
 Website: www.rdnester.com  
 Address: Rua Cidade de Goa, 4B  
 2685-038 Sacavém - Portugal

Follow us on   




## IEC61850 SPECIFICATION, CONFIGURATION, SIMULATION AND TESTING

**The challenge:** Multiple communication protocols currently exist in the area of electric system substation automation, which are often not compatible with each other. The IEC61850 Standard for the design of electrical substations protection, automation and control (PAC) system addresses many crucial aspects of Transmission and Distribution System Operators (T/DSO) communications, data modeling and engineering in order to reach seamless interoperability of different vendors' subsystems within the T/DSO system management architecture. However, presently, the communication networks have an essential importance on the performance of the PAC system, so they must be carefully designed.

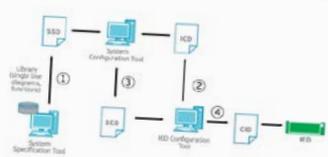
**HOW WE ADDRESS THE CHALLENGE**

R&D Nester developed an engineering approach that brings efficiency to the specification and configuration of automation (PAC) systems. Furthermore, it makes it easier to kick-off IEC61850 implementation. By appropriate use of the ICD, SCD, CID and SSD files, a top-down engineering process for system specification and configuration is developed.

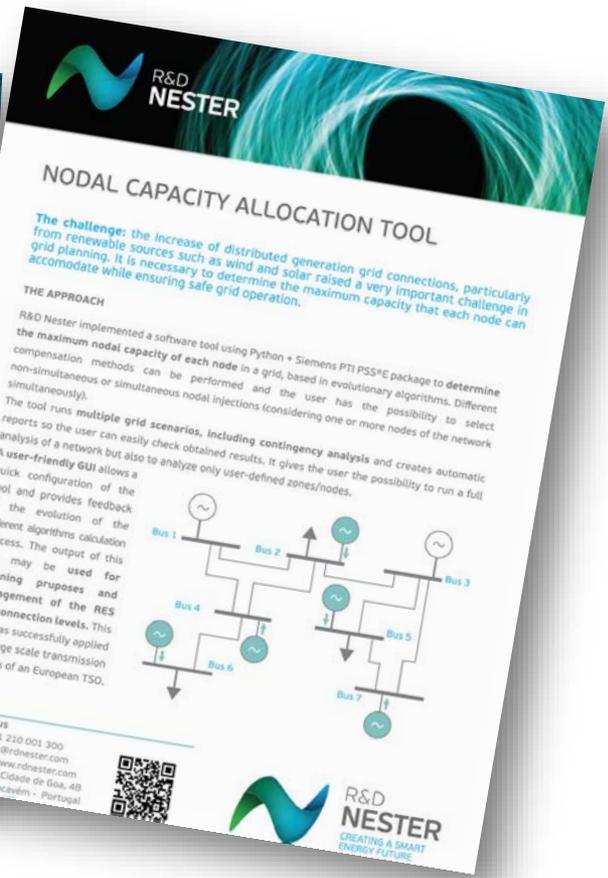
The process takes into consideration the following aspects: (i) full use of the IEC 61850 international standard, using a strategy specification and configuration tool, (ii) a new architecture, in which control and automation are no longer separate subsystems, (iii) use of process bus, (iv) study of the communication network, so its design prevents traffic congestion and considers redundancy and (v) use of an adequate time synchronization protocol.

Process level devices such as Circuit Breaker Controller (CBC), Merging Unit (MU), Intelligent Unit of the Disconnect Switch (IDS), Power Transformer Controller (PTC) and Power Transformer Monitoring Device (PMTD) are addressed.

For this purpose, R&D Nester specified and built a real-time simulation laboratory, which includes: (i) a Real Time Power System Simulator (RTPS) platform, compatible with IEC 61850, (ii) open-loop test devices, (iii) communication network real-time simulator, load generator and link impairment device, (iv) precision time protocol (PTP) analyzer and (v) IEC 61850 conformance analyzer. The laboratory provides tools for PAC systems specification, configuration and testing based on IEC 61850.



**Library** (Library Usage File, Programs, Hardware) → **System Configuration Tool** → **ICD** → **ICD Configuration Tool** → **SSD** → **SSD Configuration Tool** → **CID** → **SSD**



## NODAL CAPACITY ALLOCATION TOOL

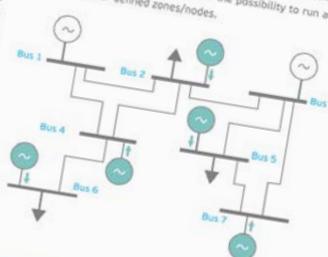
**The challenge:** the increase of distributed generation grid connections, particularly from renewable sources such as wind and solar raised a very important challenge in accommodate while ensuring safe grid operation.

**THE APPROACH**

R&D Nester implemented a software tool using Python + Siemens PTI PSS+E package to determine the maximum nodal capacity of each node in a grid, based in evolutionary algorithms. Different compensation methods can be performed and the user has the possibility to select non-simultaneous or simultaneous nodal injections (considering one or more nodes of the network simultaneously).

The tool runs multiple grid scenarios, including contingency analysis and creates automatic reports so the user can easily check obtained results. It gives the user the possibility to run a full analysis of a network but also to analyze only user-defined zones/nodes.

A user-friendly GUI allows a quick configuration of the tool and provides feedback of the evolution of the different algorithms calculation process. The output of this tool may be used for planning purposes and management of the RES grid connection levels. This tool was successfully applied to a large scale transmission network of an European TSO.



**Contact us**  
 Phone: 351 210 001 300  
 E-mail: info@rdnester.com  
 Website: www.rdnester.com  
 Address: Rua Cidade de Goa, 4B  
 2685-038 Sacavém - Portugal

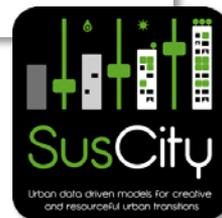


- Benefits for energy system and consumer

- Innovations aiming at reducing total system cost, reduce risk of operation, increase security of supply, allow increased penetration of renewables



Consortium with partners from  
Portugal, Spain, France, UK



Global Energy Interconnection  
Development and Cooperation Organization  
全球能源互联网发展合作组织

- Benefits for energy system and consumer

- Innovations aiming at reducing total system cost, reduce risk of operation, increase security of supply, allow increased penetration of renewables

**BIG DATA OCEAN**  
Consortium with partners from Portugal, Greece, Germany, UK, Italy, Cyprus, Israel



**FLEXITRANSTORE**  
Consortium with partners from Belgium, Greece, Portugal, Bulgaria, Cyprus, Hungary, Spain, Germany, France, Ireland, Slovenia, Croatia, Turkey



An Integrated Platform for Increased FLEXibility in smart TRANSMission grids with STORage Entities and large penetration of Renewable Energy Sources (**FLEXITRANSTORE**)



**TDX-ASSIST**  
Consortium with partners from UK, France, Germany, Portugal, Belgium, Slovenia



Coordination of Transmission and Distribution data eXchanges for renewables integration in the European marketplace through Advanced, Scalable and Secure ICT Systems and Tools (**TDX-ASSIST**)

**OSMOSE**  
Consortium with partners from France, Spain, Italy, Slovenia, Belgium, Serbia, Switzerland, Germany



Optimal System-Mix Of flexibility Solutions for European electricity (**OSMOSE**)



- Benefits for energy system and consumer

- Innovations aiming at reducing total system cost, reduce risk of operation, increase security of supply, allow increased penetration of renewables

## *Participation and membership in selected international organizations and fora*

*Allows state-of-the-art information, networking and potential funding*



*WG1 - Reliable, Economic and Efficient Smart Grid Systems  
WG4 - Digitalization of the electricity system and Customer participation  
WG5 - Innovation Implementation in the Business Environment*

- Benefits for energy system and consumer

# Innovation work being developed

Some more real examples



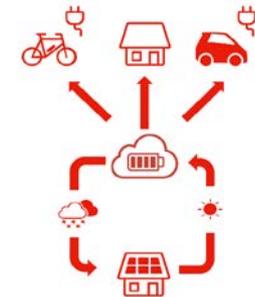
- Contributing to decarbonization, benefiting from digitalization, improving the customer experience, contributing to security of supply

## NEC to supply 20MW ESS to Ørsted for grid stabilization

Published on: May 3, 2018 11:23 am By: Jade Beevor



Danish renewable energy firm Ørsted, formally known as Dong Energy, announced on April 25 it is to install a 20MW lithium ion energy storage system in the UK after signing a deal with NEC Energy Solutions, a wholly owned subsidiary of NEC Corporation.

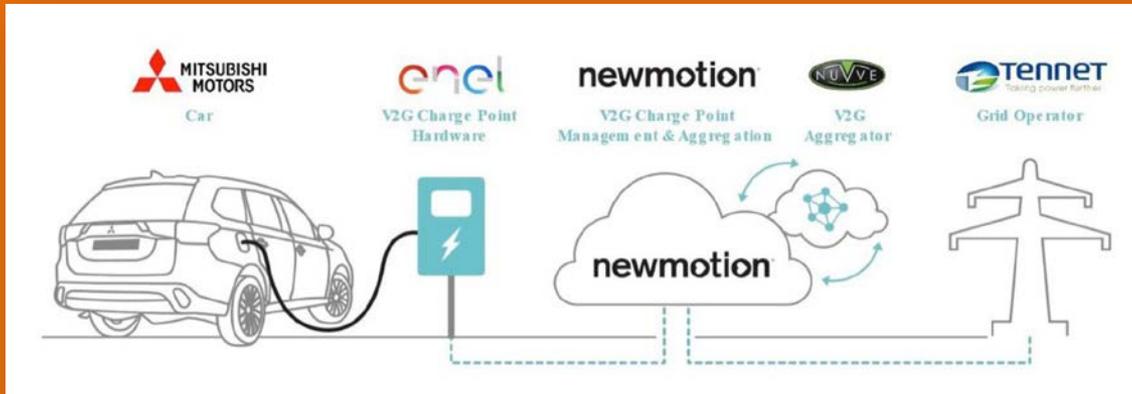


**Use 100% of your solar power with the E.ON SolarCloud!**

# Innovation work being developed

Some more real examples

- Contributing to decarbonization, benefiting from digitalization, improving the customer experience, contributing to security of supply



DEEP DIVE

## How utility pilot programs are driving renewable energy integration

SCE and APS want to use electric vehicles, water heaters and demand response to help add more wind and solar to the grid.

## 50MW of Enhanced Frequency Response batteries go online in Britain from VLC Energy



VLC Energy has completed the 40MW Glassenbury project (pictured) and a 10MW battery park at Cleator to fulfil two EFR contracts won in August 2016. Image: VLC Energy.



# CREATING A SMART ENERGY FUTURE