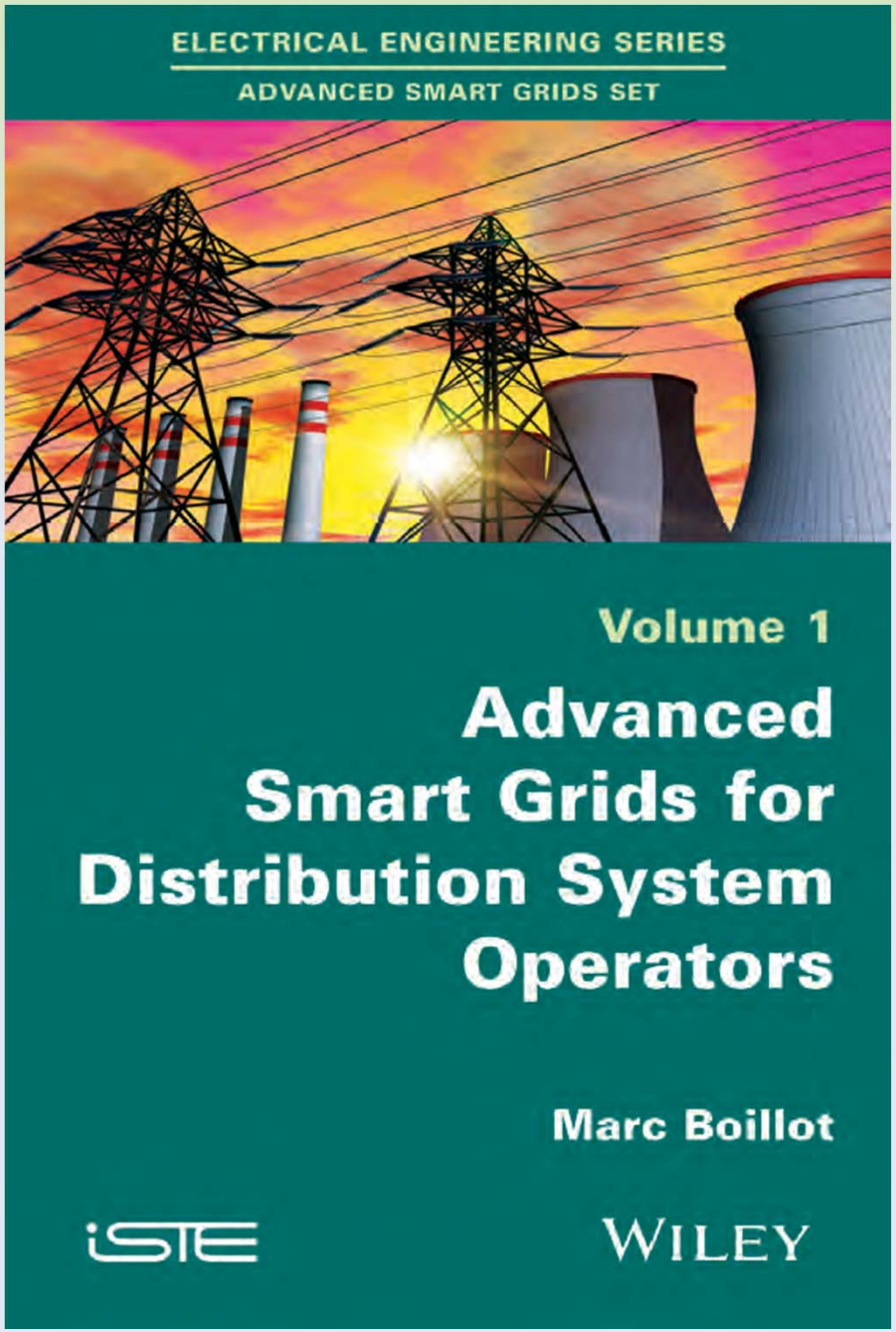


Presentation to USEA

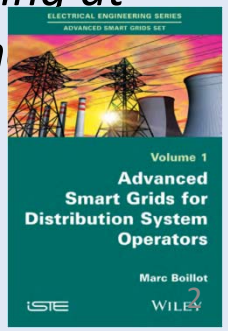
January 15th, 2015

Summary

- Distribution System Operators (DSOs) are key players in energy transition and with the help of Advanced Smart Grids they will be able to better take advantage of existing distribution networks.
- Energy transition is underway in many regions of the world. This is a real challenge for electric systems and a paradigm shift for existing distribution networks. With the help of “advanced” smart technologies,
- DSOs will have a central role in the integration of renewable generation, electric vehicles and demand response programs. Smart Grids are a means for DSOs to ensure the quality and security of the power supply.
- This book proposes a singular approach based on practical experience from DSOs, which will complement the generally academic focus of previous books written on the subject of Smart Grids.

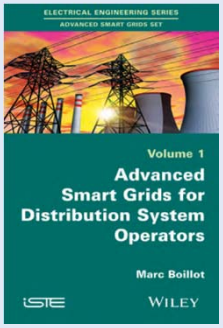
This book is precisely targeting the changes that are rapidly occurring at the distribution level and the role of DSOs in the development of th grid concept”

Miroslav Begovic, IEEE, President of Power and Energy Society



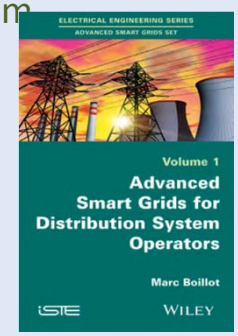
ERDF a major player

- **The largest DSO in Europe :**
  - **35 million customers, 95% of the territory, 1.3 million km of lines, 35000 employees**
  - **Sales : 13 billion euros, Investment : 3,5 billion euros**
  - **R&D, innovation, technology, automation**
- **European Energy Market Reform**
  - **Separation of T&D : neutral and non discriminatory, equal access**
  - **Generation and supply become a market**
  - **Creation of a separate entity : ERDF (2008)**
- **3 x 20 by 2020**
  - **20% CO2 reduction/1990**
  - **20% RES**
  - **20% energy efficiency**



What are Smart Grids ?

- **Above all, smart grids remain grids!**
- **Systems** obtained by superposing information and telecomunication networks on electric power networks
- **Purpose** : integrate intermittent RES and EV in the best safety conditions, while minimizing investments
- **Mature Technologies** : sensors, smart meters, information transmission and exchange devices, real time analysis, softwares, automation etc.
- **Challenge** : modernize low voltage networks as has been previously done for medium voltage networks (improving quality of service, lowering outage time for customers)



Smart Grids are not an option but a necessity to tackle the energy transition

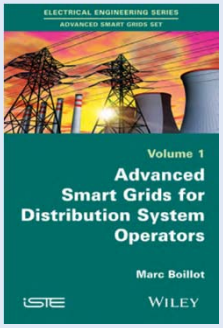
- **Yesterday :** radial flow from centralized power plants to end consumers

- **Tomorrow**: manage more complex interlinked networks mixing generartion and demand with much higher variations and reverse flows from distribution to transmission networks

- **New market players** : load curtailers, VPP operators, aggregators etc.

- **The basic principles of electric systems have not changed** : electricity must be produced at the same time it is consumed. Voltage and frequency levels must be kept within precribed limits .

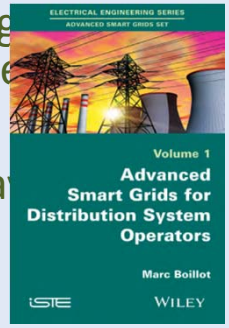
- **Smart Grids are are a necessity** : electricity networks will need to be more reactive and flexible to ensure security and stability of the system



DSOs play a central role in the deployment of Smart Grids

➢ **Act as enablers and facilitators of the market**

- **Test and try new solutions** : lab, field tests, pilot projects
- Ensure uniformed and **harmonized deployment of SG and smart meters**
- Enable the **deployment of new services** (prediction of outages, prediction of RES production, predictive maintenance)
- Contribute to the **operation and control of new flexibilities** (storag peak shaving programs, management of capacity, dynamic tariffs, e
- **Provide data** to customers, energy suppliers and other market pla

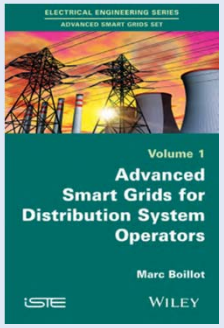


But DSOs should not bear alone all the costs of the energy transition for the benefit of all

- **The regulator should define the principles for allocating costs** to the players who benefit from the investment (cf Telecom industry)

- **Examples**
  - Connections to the distribution network and re inforcements
  - Metering infrastructure
  - Flexibility devices

- **Challenge** :
  - split equitably the costs between all players according to their expected benefits
  - Auto consumption tends to reduce the power flows thus revenues of the DSO. The structure of the rates should reflect this (higher fixed costs)



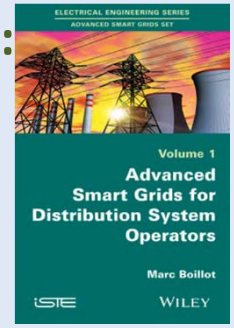
More RES means more distribution networks

- **Connections of RES to the network** (often reinforcement to allow RES to produce at full capacity)

- **Despite wind and sun regimes or consumtion fluctuations,** the network should be capable to ensure supply of maximum demand to customers

- **The electric distribution network plays the role of « mutual insurance » and « back-up » power**

- **The DSO ensures the continuity of voltage level at the local scale :** an excess of RES raises the voltage level, to much demand results in lower voltage (ex : charging of EV). outside of legal limits, customer devices as well as network equipment can suffer damages in excessive voltage elevation. Harmonics pollution.



Focus on flexibility options

➢**Flexibility** : modification of generation injection or consumption patters in reaction to an external signal in order to provide a service within the energy system

➢To limit the increase of network load and the raise of the peak, **DSOs needs to implement flexibilities to defer certain network reinforcements**

➢**DSO needs :** active power reserves, active demand, power flow control and network congestion solutions, voltage control and reactive power compensation

➢**Emergency situations :** increase reactive power injection, reduce loads, start new generation units, block transformer tap changers at HV/MV substations

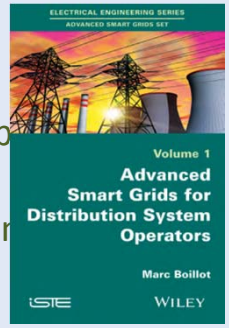
➢**Merit order** : calculation of the value created ; the flexibility source will remain active while its cost is less than the flexibility value for the DSO

➢**Lessons learned from international business cases :**

•Germany : EWE experimentation on local market to allow generators to valorize their p

•UK (ENWL) : load shaving program to reduce the load by 2-5 MW

•USA (PJM, Comed): load shaving programs to defer investments into primary substation



The necessary engagement of end-customers

- **Incentives and technogies are needed**

- **It is crucial for demand-side flexibility to workeffectively and deliver its full benefits**

- **From Passive techniques :** the customer has little to no control (no opt in or opt out possibilities)

- **To more active techniques :** hands on to determine the program the customer wants to participate in

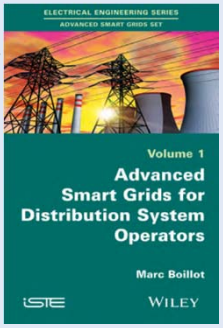
- **Isgan Case book on DSM** :

•custmers accept to change their habits but do not tolerate service degradation

•The customer often need to be guaranteed that they will not loose money nor quality of supply

•Managing customer needs is paramont in any demo project

•Clear rules on the ownership and protection of their data should be defined



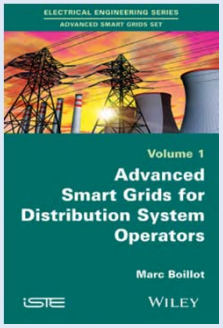
DSOs have a long experience in data management

- **Collecting, validating, managing, providing data** to manage their own network as well as giving support to market activities

- **Activities under regulatory supervision and guided by cost efficiency processes :** Consumer billing, settlement process in energy markets, supplier switching, allocation and reconciliation, energy forcecasting, support of DSO process etc.

- **Skills and know-how** to manage supplier's perimeters, able to also manage flexibility perimeter and ensure non discriminatory access

- **DSOs guarantee reliable and fair markets** within the system



A pragmatic approach based on « use cases »

- **Methodology :** equip SG projects in regard to the creation of business processes and the IT functions that support these changes.This is a method that begins with a strategic framework but grows on the feedback issued from the projects.

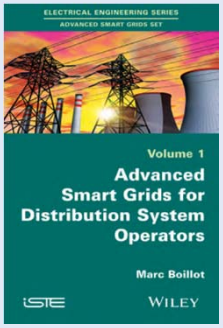
- **Examples of scenarios :** optimization of RES connections, forecast management of RES generation, voltage setting etc.)

- **Need to specify :** Equipment, solutions, KPI

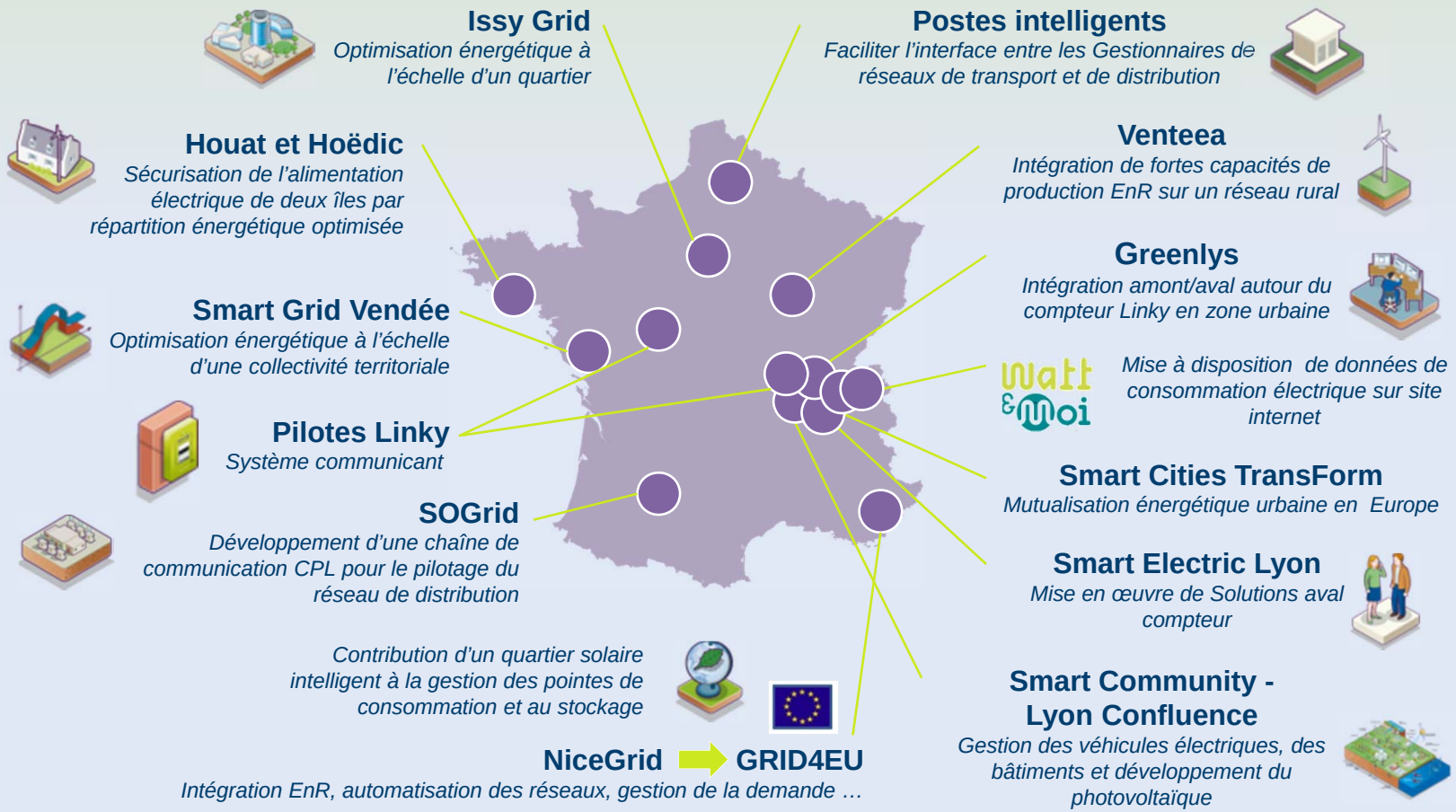
- **Advantages** : capitalizing the feedback issued from SG projects, anticipating the impact on the work-flow and the competences of the DSOs

- **Pioneer** : SCE, EPRI (Intelligrid Program)

- **The Grid4EU project** : 6 demos in France (NiceGrid), Italy, Spain, Germany, Sweeden,Czek Republik, coordinated by ERDF, funded by the EU



ERDF pilot projects



Issy Grid
Optimisation énergétique à l'échelle d'un quartier

Houat et Hoëdic
Sécurisation de l'alimentation électrique de deux îles par répartition énergétique optimisée

Smart Grid Vendée
Optimisation énergétique à l'échelle d'une collectivité territoriale

Pilotes Linky
Système communicant

SOGrid
Développement d'une chaîne de communication CPL pour le pilotage du réseau de distribution

Contribution d'un quartier solaire intelligent à la gestion des pointes de consommation et au stockage

NiceGrid ➡ **GRID4EU**
Intégration EnR, automatisation des réseaux, gestion de la demande …

Postes intelligents
Faciliter l'interface entre les Gestionnaires de réseaux de transport et de distribution

Venteea
Intégration de fortes capacités de production EnR sur un réseau rural

Greenlys
Intégration amont/aval autour du compteur Linky en zone urbaine

Watt & Moi
Mise à disposition de données de consommation électrique sur site internet

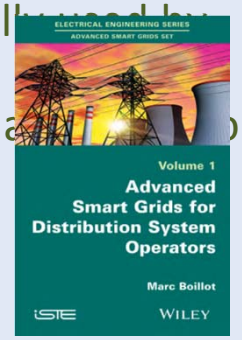
Smart Cities TransForm
Mutualisation énergétique urbaine en Europe

Smart Electric Lyon
Mise en œuvre de Solutions aval compteur

Smart Community - Lyon Confluence
Gestion des véhicules électriques, des bâtiments et développement du photovoltaïque

Smart Metering : a core activity of DSOs

- **Part of the physical grid infrastructure : domain of the DSO**
- **Functions : accurately reflect consumption, provide information to the actual time of use**
- **Tool to enhance competition on retail markets and foster energy efficiency**
- **Contribute to the optimisation of network management :** larger integration of RES**,** better fault identification and localisation thus ensuring faster intervention and lower outage duration, detailed monitoring of power quality (less complains), increased capacity to act remotely, forecast constraints on networks, better observation and control capabilities
- **Integrated approach:** meters, concentrators and IT (head-end systems) generally used by small ore medium DSOs
- **Modular approach** : several equipment manufacturers , interoperability, need a multi-vendor of IT solutions for the head-end system, generally used by large DSOs



G3-PLC is a mature standart

➢**PLC communication** uses a higher frequency, low-energy signal superimposed on the electric current at 50Hz. It can be transmitted through MV and LV meters, as well asdownstream the meters.

➢**The PLC signal** enables transmission of information over the entire distribution network

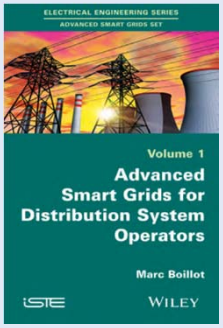
➢**G3-PLC : a technology that offers a balance** between high data rate, robustness, security, quality of service, low infrastructure costs

➢Europe is moving on : **ERDF has made an announcement for 32 million meters with G3-PLC**, there are several projects in Belgium, Luxemburg, Austria etc.

➢**Asia is the fastest growing market for SG applications and communications technologies that works well in noisy environments.** Japan has announced the acceleration of its smart meter program with the G3 technology for high rise buildings. Many other Asian countries have pilot projects : Taiwan, Korea, Malaysia

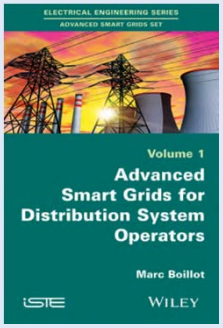
➢**The G3-PLC Alliance** :

- standardisation (ITU, IEEE) of the technology, and promotion worldwide
- More than 50 members



A necessary evolution of jobs and skills of the DSOs

- **Operation and maintenance of the network of the future**
- **Making forcasts : consumption and generation forecast scenarios**
- **Managing telecom and IT infrastructures :** supervision, operation, maintenance, smart equipment (meters, automation, sensors etc.)
- **Operation of the local electric system :** analysis/forecast of the constraints of the network, forecast management in relation to planning and operation, taking into account load shaving programms, activation of flexibility levers
- **Management of the relations between the players of the energy system :** TSO, aggregators, suppliers, customers
- **Big Data management :** formatting treatment, publication, integration of market mecanisms, protection etc.



Conclusion

- **A smart bubble?**

  - It is in fact essential from the get-go that **the customer can benefit** from new services offered by Smart Grids

  - Despite the ongoing experiments and the pilot projects, the technical feasibility of devices for controlling household appliances and large- scale residential **shedding remains to be proven**

- **Or a genuine industrial opportunity ?**

  - **The Smart Grids represent a successfully industrial opportunity**: many technologies are mature, many innovations are incoming

  - The expected benefit of Smart Grids will be easier to obtain if the outfitting is made globally at **the scale of a State or of a region**

  - **Smart Grids will reinforce spectacularly the attractiveness of the DSO** by mobilizing intellectual resources essential to the success of this transformation