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# Digitalization of electricity sector... An introduction

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I was born analogic, not digital



# Analogic world / Digital world...

- --- Analogic (roughly) ---
- **Each type of data and device:** a particular coding, storing, access, etc
- **Only men are universal go-between:** via specialization of tasks & labour
- --- Digital (as roughly) ---
- **All data in a similar code permitting:** storing, transmitting, aggregating, disaggregating, checking, injecting into programs for analysis & decision
- **Instructions for devices too:** Thanks A. Turing, computers & smart devices have storable & replaceable programs expressed in codes similar to data
- **Universal compatibility & universal access are doable:** Data, devices, humans can be deeply intertwined

# *1st wave of electricity digitalisation...*

## *Opening wholesale markets, 30 years ago*

- **Before elec.:** Markets for stocks, bonds, currency; Markets for commodities – much more convenient & more informative  
New-York, Chicago got mainframes, private lines & terminals, stopped being cooperatives of traders: Traceability guarantees
- **1<sup>st</sup> Step:** UK Electricity Pool (1 April 1990) took “Plants Merit Order Program” of integrated utility, made it “Open Merit Order” fed by each plant bids  
1996, NordPool; 1997, PJM, California wholesale markets
- **2<sup>nd</sup> Step:** Transmission equips with new ITC to manage the system & implement market decisions  
**Joint Wave (Wholesale Markets) <:> (Smart Grids 1.0)**

# 2<sup>nd</sup> wave of digitalization too is a twinning...

- 2 Big Bangs (Decentralization) + (Digitalization)

## 1- Decentralizing “Big Bang”.

**Generation new technology** : Wind mills by MW - PV Panels by KW

Pushed by decarbonisation: EU, Maryland, California. Or not: State of Texas.

New wave in Chile, Mexico. Etc.

“Utility scale Wind & Solar” can be very cheap, can beat coal: India; or gas: US

(And more to come: V. Sivaram -2018- *Taming the Sun. Innovations to Harness Solar Energy & Power the Planet*)

**Storage revolution** (on the top) growing, challenging system operation

## 2- Digitalization is parallel “Big Bang”.

**1st wave** digitalization (“mainframes”, smart grids 1.0) supported wholesale market

**2nd wave** digitalization (+ new smart grids 2.0) supports new decentralization shift

(S. Vadari -2018- *Smart Grid Redefined. Transformation of the Electric Utility*)

**Consumer technology shift**: Aggregation. Multiple small consumption units are gathered, & become new offer entering wholesale market as “virtual units”

## Why are Decentralization & Digitalization so twins?

**1/ Decentralization** changes size & scope of assets;  
then their operation, & the decision making

**New Ownership structure for assets** <:> New Operation rules for assets  
<:> New Governance structure for industry

**2/ Digitalization** changes information, control, decision making;  
then operation of assets, services they deliver > new decision making:

**New Technology frame** <:Information, Control, & Decision Making:>  
New Operation Rules & New Services <:> New Governance structure

## 1/ Decentralization has two children

\*End of single centralized Utilities; substituting multiple players

\*\*End of single centralized System Operation; substituting multiple levels of control & optimization (micro-grids; distribution grids; transmission grids)

## 2/ Digitalization too has two children

\*Arrangements outside traditional Electricity Sector regulation (as Aggregators playing with consumption, hence “Behind the Meter”)

\*\*Coordination of new ‘digitalized’ tasks within Electricity Delivery Loop

>Remember 1<sup>st</sup> wave: Coordinating Transmission & Wholesale

>2<sup>nd</sup> wave > Amazon “Delivery Loop” = coordinating “Distribution Grid Platform” with new actions

prosumers + prosumagers + all other Behind the Meter entering the El.system

# Interactions between twins: Decentralization - Digitalization



## Decentralization opens two streams of changes

### 1\* **Distributed Generation** expands

with new “**Utility Scale Renewables**”,

+ distributed **Prosumers** (PV or Wind PPAs)

+ **Prosumagers** (Storage)

+ other “**Behind the Meter**” (electric Cars; smart buildings)

### 2\*\* While **Aggregators & Platforms (2-sided markets)**

offer new ways of coordinating decentralized units

Down to “**Sharing Economy**” Platforms = **Peer2Peer**

## Digitalization favors two streams of changes

### 1/ **Playing from outside Traditional Sector:**

Fleets of “*Behind the Meter*” devices” can be gathered & controlled to be managed as system smart assets

>think electric car fleets; or “*zero net consumption*” buildings

### 2/ **New ways of coordinating all decentralized units:**

thanks to Agregators & Platforms **P2P**;

down to **Blockchain** networks

>Blockchain network is **P2P** with NO intermediary, NO UBER between Peer-2-Peer

### 3/ **BUT WITHIN “Amazon Delivery Loop”** constraint

It is the needed / desired “**Distribution Grid Platform**”

>Ignacio Perez-Arriaga “**Utility of the Future**” when perfectly set up (MIT Report 2016)

>>New York “**Distribution Platform**” project (Sioshansi Fereidoon 2017; 2019)

## *Decentralization & Digitalization* can only strongly interact

### **1/ Because they have similar wings of change**

> “Behind the Meter” targets of “smart assets”

>> **Aggregators & Platforms P2P** offering entry to the “El. Amazon Loop”  
delivery constraint

### **2/ Because both 2Ds (Decentralization & Digitalization) touch upon tasks, assets, operation, apps, integrators, platforms**

> **Up to Governance**

with new types of players, as

\*Communities of Peers

\*\*Clubs of Partners

\*\*\*Smart Local Authorities

## Conclusions: key challenges for industry, consumers & prosumers, and regulators

- 1> New Coordination Tasks:** Beyond “Utility”+ “Behind the Meter” activities + interactions Transmission/Distribution
  
- 2> New Incentive Regulation:** to favour structural business innovations & new business models <through> incentive Regulatory Frames
  
- 3> New Protections needed:**
  - a)** protect individual privacy - from abuse of digital power (typical: EU new regulation; but)
  - b)** protect all industry chain - from piracy & organized crime
  - c)** protect system bones, assets & all hardware - from extreme natural events, as forest fire, flood, tornado...



**Muchas Gracias!**

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