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STUDIES

FSR ENERGY
Florence School of Regulation

4 waves of Regulation's... challenges & tools...

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To stay young... for ever!



Regulation: a Lego to play...

- -- -- -- -- Two Big Classics of Public Regulation -- -- -- --
- **1st Layer:** To submit (Natural Monopolies) to Social Welfare
- **2nd Layer:** To implement Political Economy of (Universal Service)
- -- -- -- -- Two Revolutions of Public Regulation:
Industry Structure, Technology, Market Arrangements -- -- -- --
- **3rd Layer:** To coordinate (Unbundled Grids) & (Market Design)
- **4th Layer:** To innovate with (Decentralization) + (Digitalization)

Regulation: a Lego to play...

- **1st Layer:** To submit (Natural Monopolies) to Social Welfare
- --- 1880' & 1900' (Railways) --- 1930' & 40' (Electricity)
- **2nd Layer:** To implement Political Economy of (Universal Service)
- --- Two Revolutions of Public Regulation:
Industry Structure, Technology, Market Arrangements ---
- --- 1980' & 1990'
- **3rd Layer:** To coordinate (Unbundled Grids) & (Market Design)
- --- 2010'
- **4th Layer:** To innovate with (Decentralization) + (Digitalization)

Regulation: a Lego to play...

- **1st Layer: Social Welfare with natural monopolies**

1- Monopoly of essential facility: as a bridge on a river.

2- Utility for society is usage, then pricing. Monopoly price not good for society.

3- Society will price better: fair price for owner & fair price for users.

Average Price? Marginal Price? Recovery of Fixed costs? >>

Regulated cost of service.

France Railways: discrimination pricing. 1 price for flowers; 1 price for coal. 1 price for 3d Class, for 2nd Class, for 1st Class

Regulation: a Lego to play...

- **2nd Layer: Political Economy of Universal Service**

- 1- Investments: where to put bridges & rails? > *Universal Service*
- 2- Price discrimination: why to discriminate? > *Postal Stamp*
- 3- Postal stamp is average pricing > *Social tariffs*
- 4- Quality of service: why to discriminate? > *Universal Quality*
- 5- *Further Technology choice & innovation >How compatible with Universal Service & Postal Stamp?*

Regulation: a Lego to play...

- **3rd Layer: Coordinating (Unbundled Grids) & (Market Design)**

1- To do Unbundling “*Infrastructure facility*” from “*Final services*”

➤ Unbundled grids (~ / ~) > Independent Market

2- To do Unbundling “*Regulation*” from “*Political economy*”

➤ Independent regulators (~ / ~)

3- Then one can go to “*Incentive Regulation*”

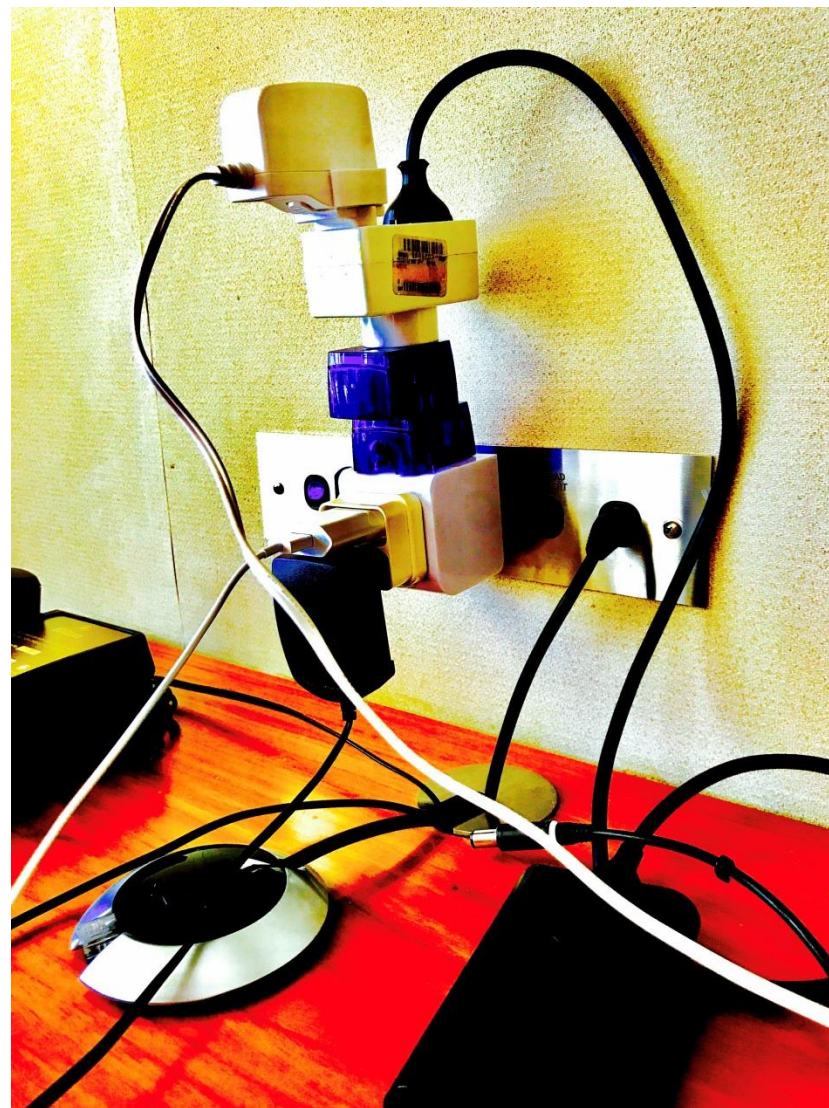
➤ and faced its “*seams*”: the ***coordination issue***.

What's coordination
issue?

*“Essential facility / Final
service”*

My hotel room in
Australia: Access is not
only pricing > *Transaction
Costs*

Lovely 😊 Aussie 😊
plugs... seen by a
continental EU visitor



What's coordination issue?
“Essential facility / Final service”

My hotel room in Washington:
Access is not only pricing >
Transaction Costs

Lovely 😊 NorteAmericana 😊
plugs... seen by a continental
EU visitor



with essential, proper digital infrastructures
the full story. Digitalisation also entails the
implementation of "smart infrastructures internal to

wholesale markets, as the power Pool in Britain or
PJM in the US and their effective combination with
system operation.

What's coordination issue?

“Essential facility / Final service”

My hotel room in New Delhi:

Access is not only pricing >

Transaction Costs

Lovely 😊 NorteAmericana 😊

plugs... seen by a continental

EU visitor

Regulation: a Lego to play...

- **3rd Layer: Coordinating (Unbundled Grids) & (Market Design)**

3- We did go to *“Incentive Regulation”*, and faced its *“seams”*

4- Rules for Infrastructures interact with “Market for final services” via **“System Operation”** > *Grid Codes (Capacity calc. & allocation, Congestion man., Balancing)*

5- “System operation neutrality” is “market design” sensitive: “Zonal” vs “Nodal

6- Revenge of Ronald Coase & Oliver Williamson: Markets need “infrastructures for transaction”- Market Transaction <**calls for**> Industry Coordination

7- Regulation still needed BUT very far from ‘Natural Monopoly Pricing’ + ‘Universal Service’ > another type of rules needed

> Need regulation to make market work on the basis of “system operation”.

In the EU >> EU Market Design is implemented via Network Codes

Regulation: a Lego to play...

- **4th Layer: Innovating with two Big Bangs (Decentralization) + (Digitalization)**

1- **Decentralizing** “Big Bang”.

New Generation technology shift: (**1st**: French nuclear plant 1,700MW - Coal Plant 500/1,000MW - CCGT 300MW) ~/~ (**2nd**: Wind mills by MW - PV Panels by KW)

This can be pushed by decarbonisation (new public policy) > (new kind of Regulation): EU, Maryland, California. Or not: State of Texas, Chile, Mexico. Etc.

“Utility Wind & Solar” becoming 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*)

Consumption technology shift: Aggregation. Multiple small consumption units are gathered, & become new offer which enters wholesale market as “virtual units”

Storage revolution (in between) started, growing, challenging system operation

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

1st wave digitalization (“mainframes”, smart meters) supported wholesale market

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

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

Why Decentralization & Digitalization are twins...

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

New Ownership structure <:> 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 brings two children

*End of single centralized Utilities; substituting multiple players

**End of single centralized System Operation; substituting multiple levels of control & optimization

2/ Digitalization brings two children

*Setting rules outside traditional Electricity Sector regulation (as Aggregators playing with “Behind the Meter”)

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

>Remember 1st wave: Coordinating Transmission & Wholesale

>2nd wave > Amazon “Delivery Loop”

= the “Distribution Grid Platform”

which is where *prosumers* + *prosumagers* + all other *Behind the Meter* enter the El.system

1/ Decentralization has two focal points

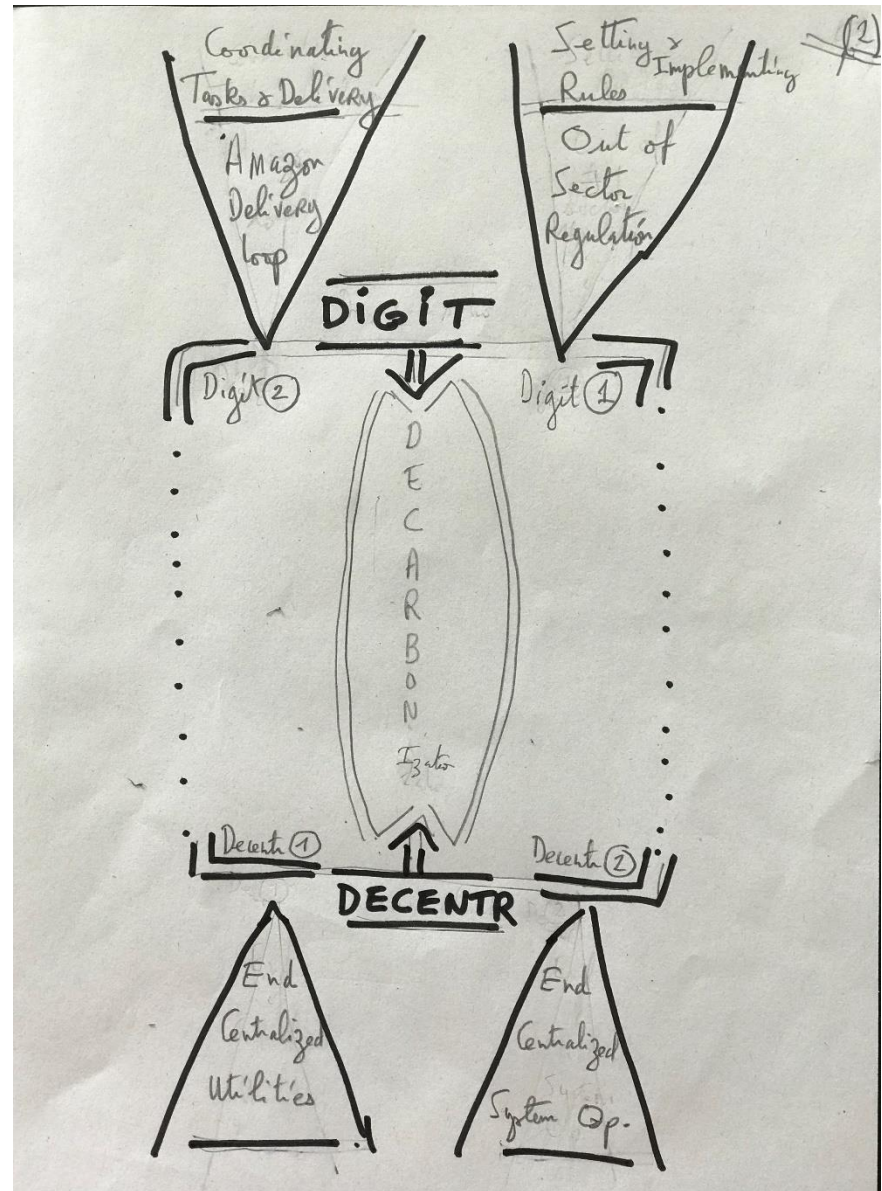
*Ending centralized Utilities

**Ending centralized System Operation

2/ Digitalization has two focal points

*Setting rules outside El. Sector regulation

**Coordinating digital tasks with El. Delivery loop (Amazon "Delivery Loop" = Distribution Grid Platform)



Interactions between twins: Decentralization - Digitalization

Decentralization opens two streams of changes

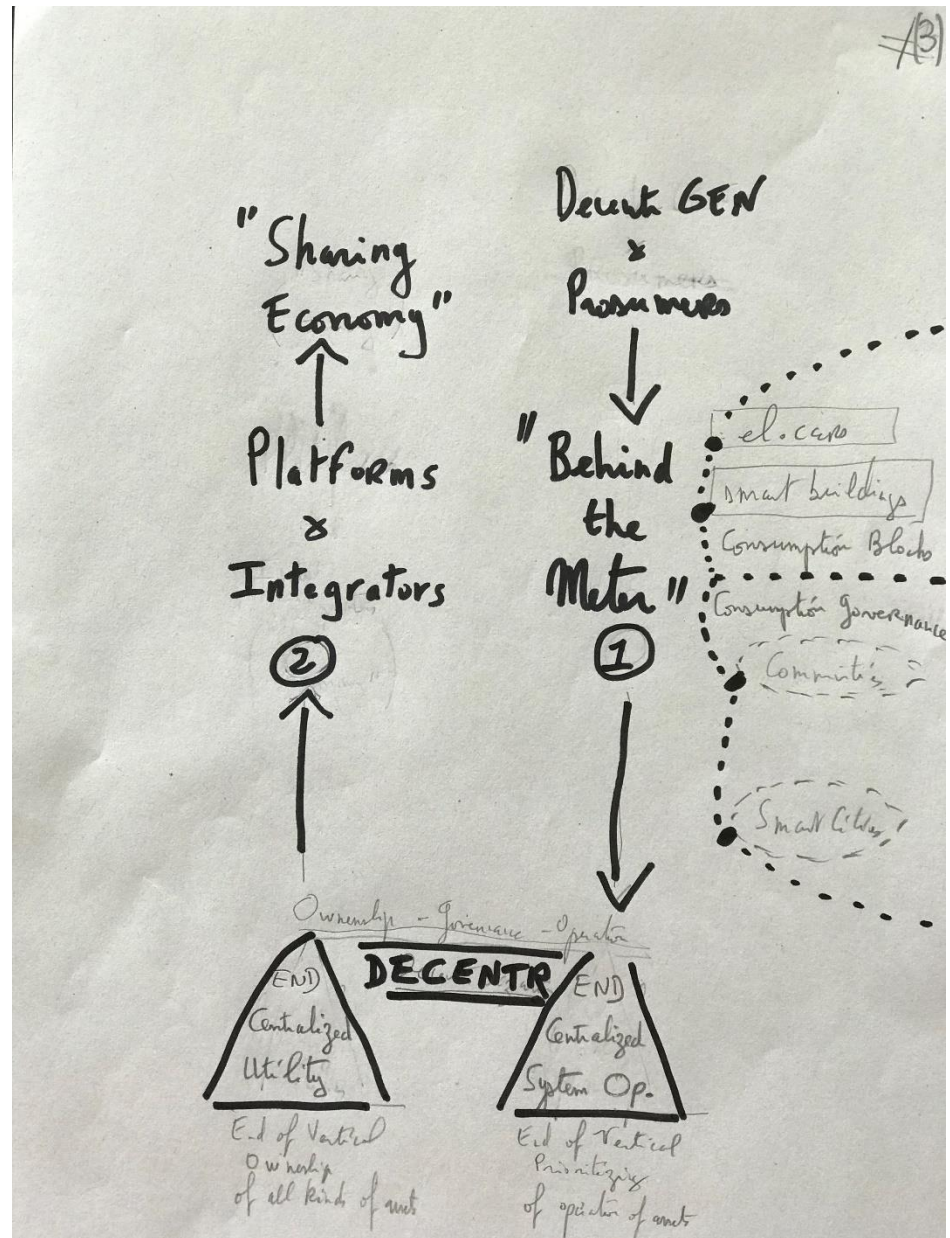
1* **Distributed Generation** expands,
with new “**Utility Scale Renewables**”,
down to distributed **Prosumers** (PV or Wind PPAs), **Prosumagers** (Storage),
& other “**Behind the Meter**” (electric Cars; smart buildings)

2* **Aggregators & Platforms (2-sided markets)**
offer new ways of coordinating decentralized units
(Down to “**Sharing Economy**” Platforms = **Peer2Peer**)

Decentralization supports two streams of changes

1* **Distributed Generation** expands to distributed **Prosumers** (PV or Wind PPAs), **Prosumagers** (Storage), & more "**Behind the Meter**" (electric Cars; smart buildings)

2* **Platforms & Integrators** offer new ways of coordinating the decentralized units, down to "**Sharing Economy**"
Platforms (**P2P**)



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 decentralized units,**

thanks to Agregators & Platforms **P2P**;
down to **Blockchain** networks (a Blockchain network is **P2P** with NO intermediary, with NO UBER between Peer-2-Peer).

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

It is the needed / desired “Distribution Grid Platform”

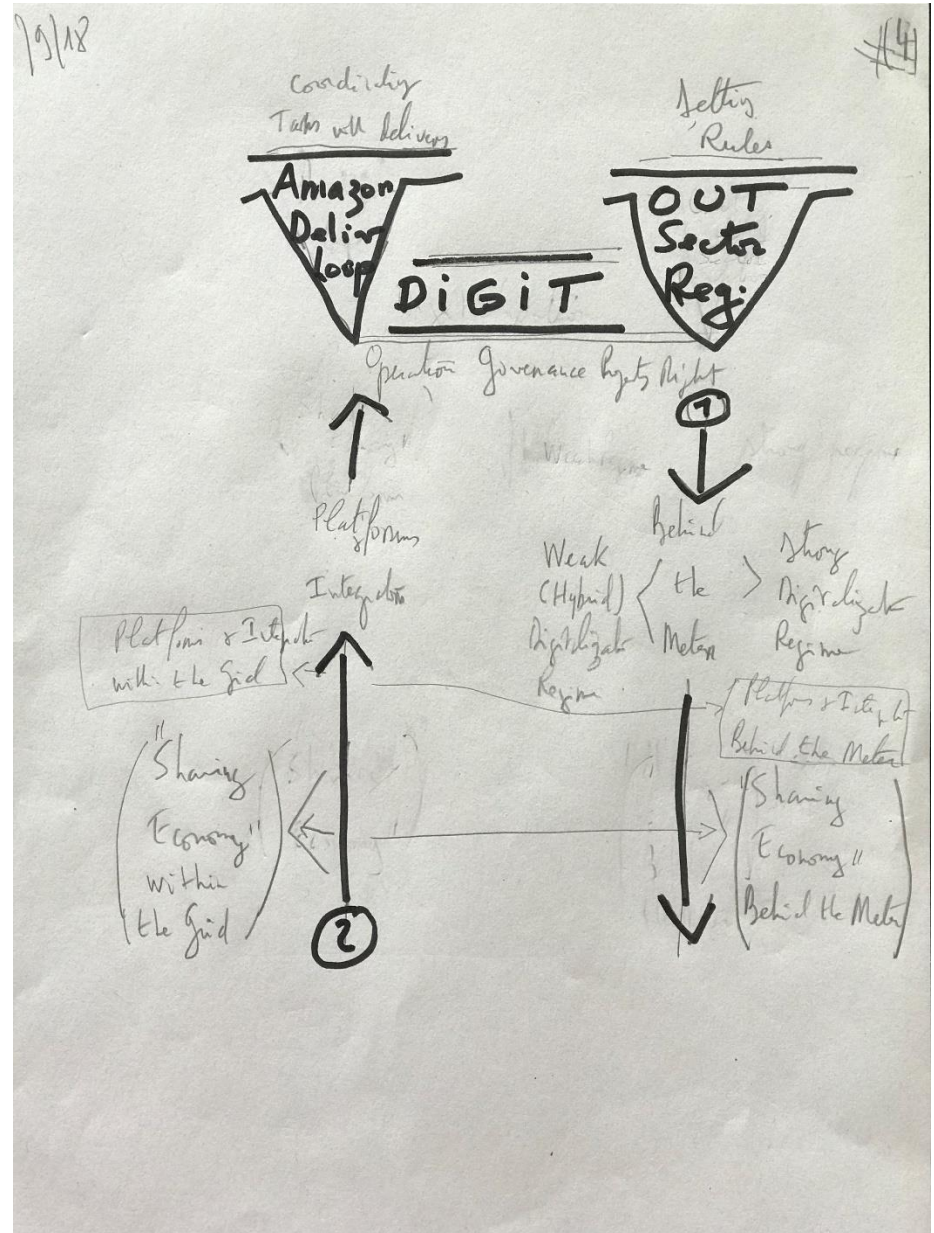
– the Ignacio Perez-Arriaga “Utility of the Future” when perfectly set up (MIT Report 2016); or New York “Distribution Platform” project (Sioshansi Fereidoon 2017; 2019)

Digitalization favours two streams of changes

***Out of Sector** gathering the “Behind the Meter devices” to manage them as smart assets (think electric car fleets)

****Agregators & Platforms** offer new ways of coordinating the decentralized, Down to Blockchain networks (NO intermediary, NO UBER between Peer2Peer)

***But “**Amazon Delivery Loop**” constraint (*Distribution Grid Platform*)



Decentralization & Digitalization strongly interact

1/ Because they have similar streams of changes

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

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

2/ 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

Decentralization & Digitalization strongly interact

Because they have two similar streams of changes

*The “**Behind the Meter**”

targets of smart assets

**Platforms & Integrators

facing the “**El. Amazon Loop**”
delivery constraint

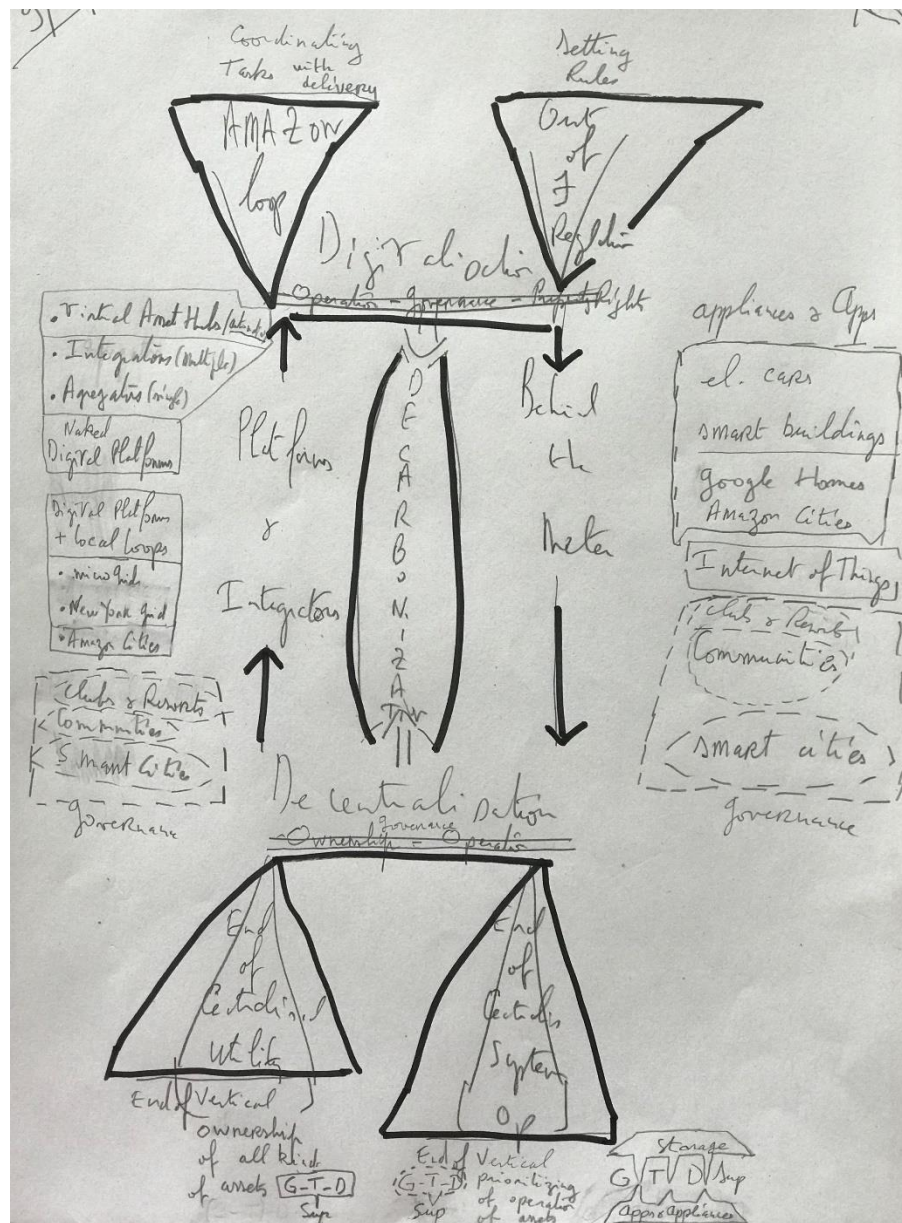
They touch upon tasks, assets, operation, apps, integrators, platforms

>> Up to Governance:

*Communities of Peers

**Clubs of Partners

***Smart Local Authorities



3/ Conclusions: a lot of challenges for industry, industry regulation, and regulators

<:> New Coordination Tasks

Beyond “Utility regulation”

+ “Behind the Meter” activities

<:> New Incentive Regulation:

needed to favour structural business innovations

Innovation Business Models <through> Regulatory Frames



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