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 -- -- -- --

- 3nd 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'**
- **3nd 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 goo
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 pric
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…

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

1- d } } h v µ v *Infrastructure facility* _ (Œ *Final services* _

➢ Unbundled grids (~ / ~) > Independent Market

2- d } } h v µ v *Regulation* _ (Œ *Political economy* _

➢ Independent regulators (~ / ~)

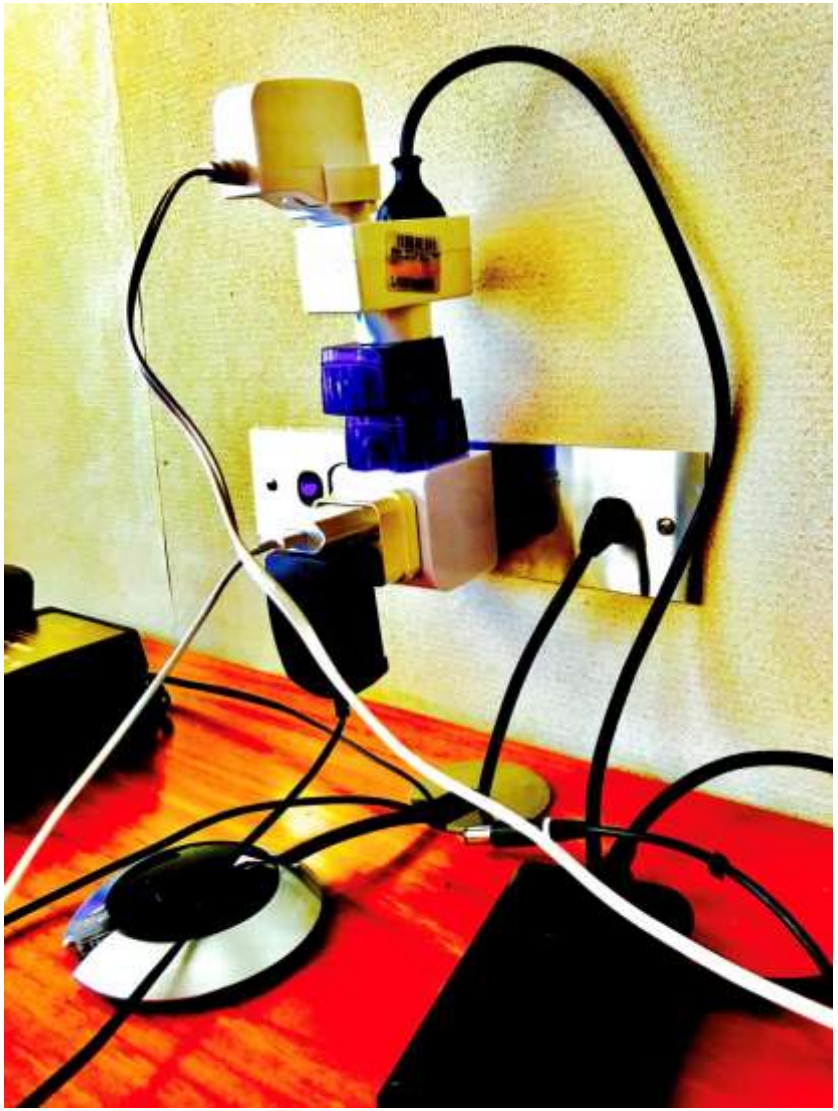
3- d Z v } v v *Incentive Regulation* _

➢ v (*schemes* _ W ***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

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…

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

3- t] P } *Incentive Regulation* _ U v (*seams*] š • ^

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

5- ^ ^ Ç • š u } ‰ neutrality } v] • ^ u Œ l š • v ••]]] š] À W ^ • } v o _

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

7- Regulation still needed h d À Œ Ç (Œ (Œ } u Z E š µ Œ o D } v Z h v] À Œ • o ^ Œ À] [E v } š Z Œ š Ç ‰ } (Œ µ o • v E E Œ P µ o š] } v š } u l u Œ l š System operation } v š } Z X •] •

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** ^] P v P _ X

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 Regulati
EU, Maryland, California Or not State of Texas, Chile, Mexico. Etc.

^ Utility t] v ~ ^ } o Œ _ } u] v P À Œ Ç Z ‰ U v š } o

(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
P š Z Œ U ~ } u v Á } ((Œ Á Z] Z v š Œ • Á Z } o • o

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

2- **Digitalization**] • ‰ Œ o o o ^] P v P _ X

1st wave] P] š o] Ì š] } v ~ ^ u] v (Œ u • _ U • u wholesale market Œ • • • µ

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 Á] š Z^ *Behind the Meter* _ •

** *Coordination of new 'digitalized' tasks* within *Electricity Delivery Loop*

>Remember 1st wave: Coordinating Transmission & Wholesale

>2nd wave> *Amazon "Delivery Loop"*

= š Z^ *Distribution Grid Platform* _

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

1/ Decentralization has two focal points

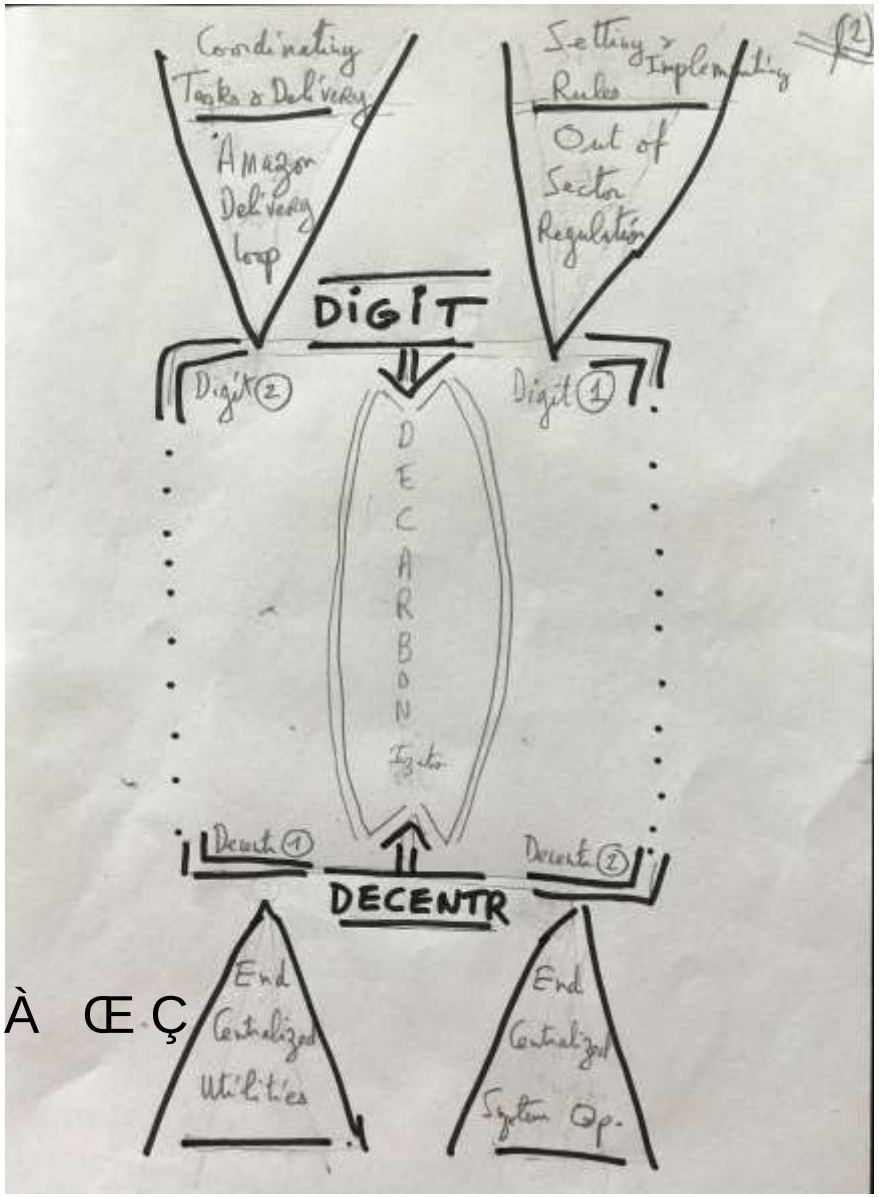
*Ending *<u>centralized Utilities</u>*

**Ending *<u>centralized System Operation</u>*

2/ Digitalization has two focal points

*Setting *<u>rules outside El. Sector</u>* regulation

**Coordinating digital tasks with *<u>El. Delivery loop</u>* ~ u Ì } v ^ o] À Œ Ç > } } ‰ Distribution Grid Platform)



Interactions between twins: Decentralization - Digitalization

Decentralization opens two streams of changes

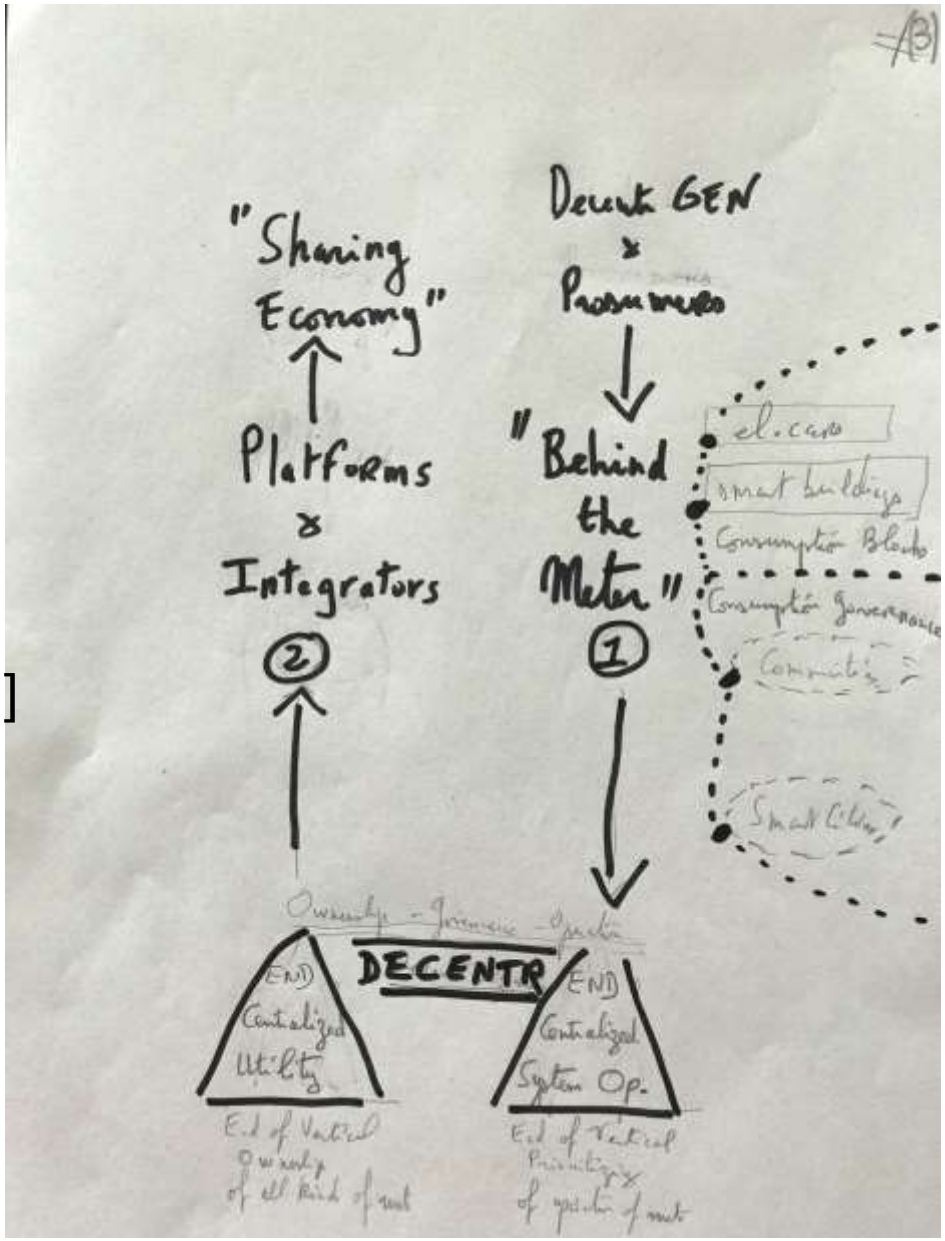
1* **Distributed Generation** expands,
with v Á **Utility Scale Renewables** _ U
down to distributed **Prosumers** (PV or Wind PPAs), **Prosumagers** (Storage),
& other ***Behind the Meter*** _ ~ o š Œ] Œ • V • u Œ š µ] o] v

2* **Aggregators & Platforms (2-sided markets)**
offer new ways of coordinating decentralized units
(} Á v š ***Sharing Economy*** _ Platforms = ***Peer2Peer***)

Decentralization suportstwo streams of changes

1*__**Distributed Generation**__ expands to distributed **Prosumers** (PV or Wind PPAs), **Prosumagers** (Storage), & more ***Behind the Meter*** _ ~ o š Œ] Cars; smart buildings)

2*__**Platforms & Integrators**__ offer new ways of coordinating the decentralized units, down š } ***Sharing Economy*** _ Platforms (***P2P***)



Digitalization favors two streams of changes

1/ **Playing from outside Traditional Sector:**
& o š • *Behind the Meter* À] can be gathered & controlled to be managed as system smart assets
(think electric car fleets; } Œ *zero net consumption* _ µ] o] v P • •

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).

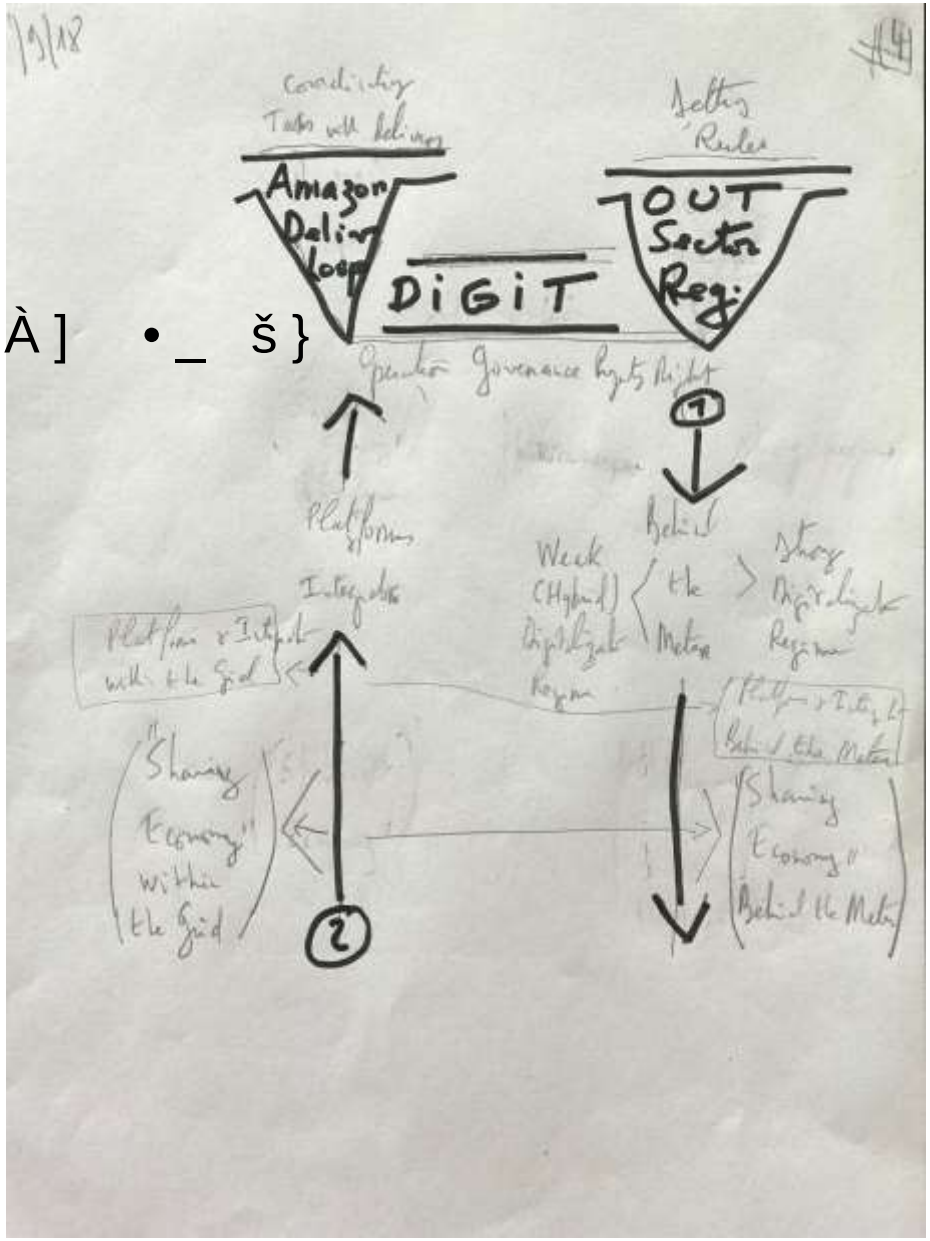
3/ **BUT WITHIN** ^ **Amazon Delivery Loop** _ } v • š Œ] v š
/ š] • š Z v l •] Œ ^] • š Œ] µ š] } v ' Œ] W o š
– the Ignacio Perez-Arriaga "Utility of the Future" when perfectly set up (MIT Report 2016); or New York "Distribution Platform" project (Sioshansi Fereidoon 2017; 2019)

Digitalization favours two streams of changes

* **Out of Sector** gathering the ^ Z] v š Z D š Œ À] • _ š } manage them as smart assets (think electric car fleets)

** **Agregators & Platforms offer new ways of coordinating the decentralized**, Downto Blockchaimetworks (NO intermediary, NO UBER between Peer2Peer)

Ž Ž Ž **Amazon Delivery Loop** _ } v • š Œ] v š (*Distribution Grid Platform*)



***Decentralization & Digitalization* strongly interact**

1/ Because they have similar streams of changes
>* ^**Behind the Meter** _targetsof ^ • u Œ š • • š • _
>>**Aggregators** & **Platforms P2P** } ((Œ] v P v š Œ E Ş } Z **Amazon Loop** _^
delivery constraint

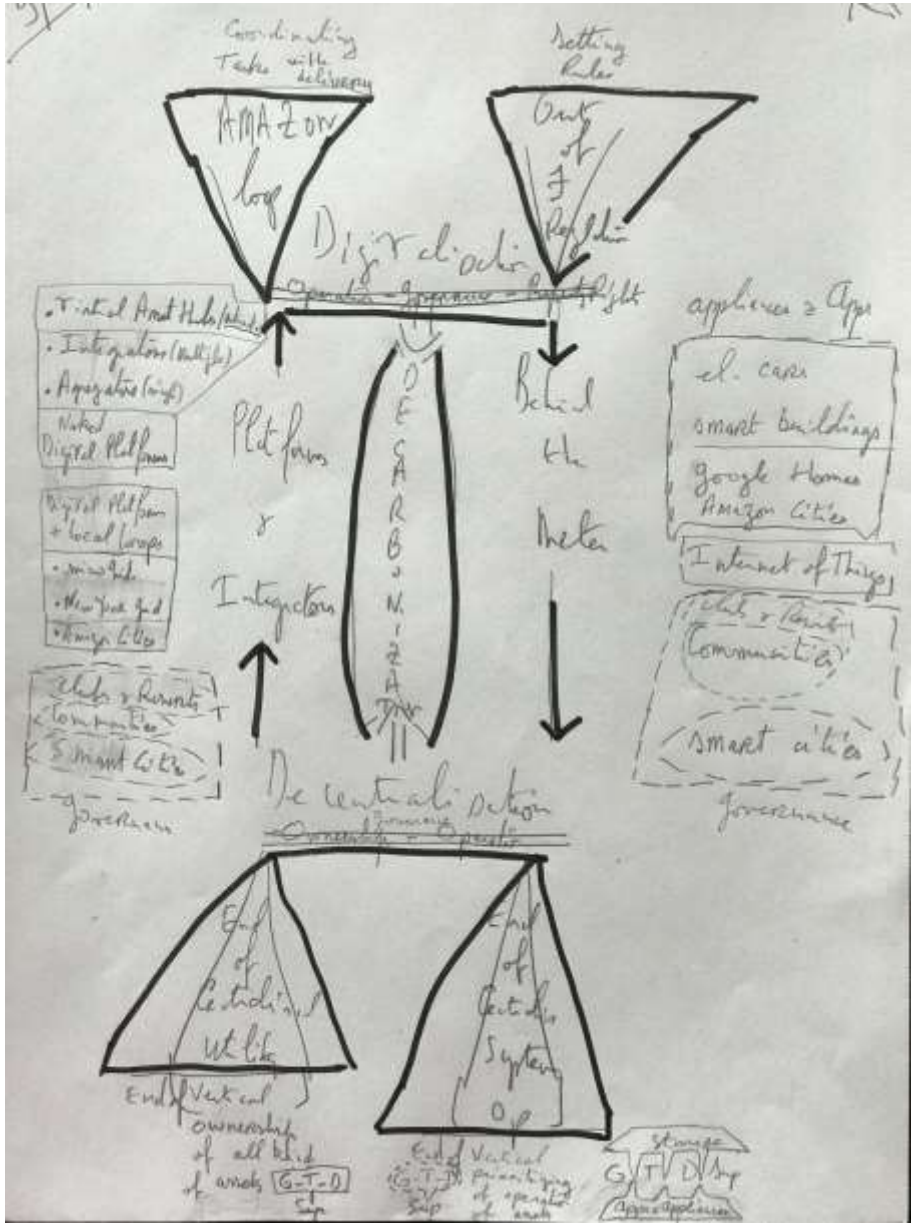
2/ Both 2Ds (Decentralization & Digitalization)
touch upon tasks, assets, operation, apps, integrators, platforms
> >***<u>Up to Governance</u>***
with new types of players, as

*Communities of Peers
**Clubs of Partners
***Smart Local Authorities

Decentralization &
Digitalization strongly interact

Because they have two similar streams of changes
Ž d Z **Behind the Meter** _ targets of smart assets
**Platforms & Integrators
( ] v P **S.Z Amazon Loop** _ delivery constraint

They touch upon tasks, assets, operation, apps, integrators, platforms
> > ***<u>Up to Governance</u>***:
*Communities of Peers
**Clubs of Partners
***Smart Local Authorities



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

<:> New <u>Coordination Tasks</u>

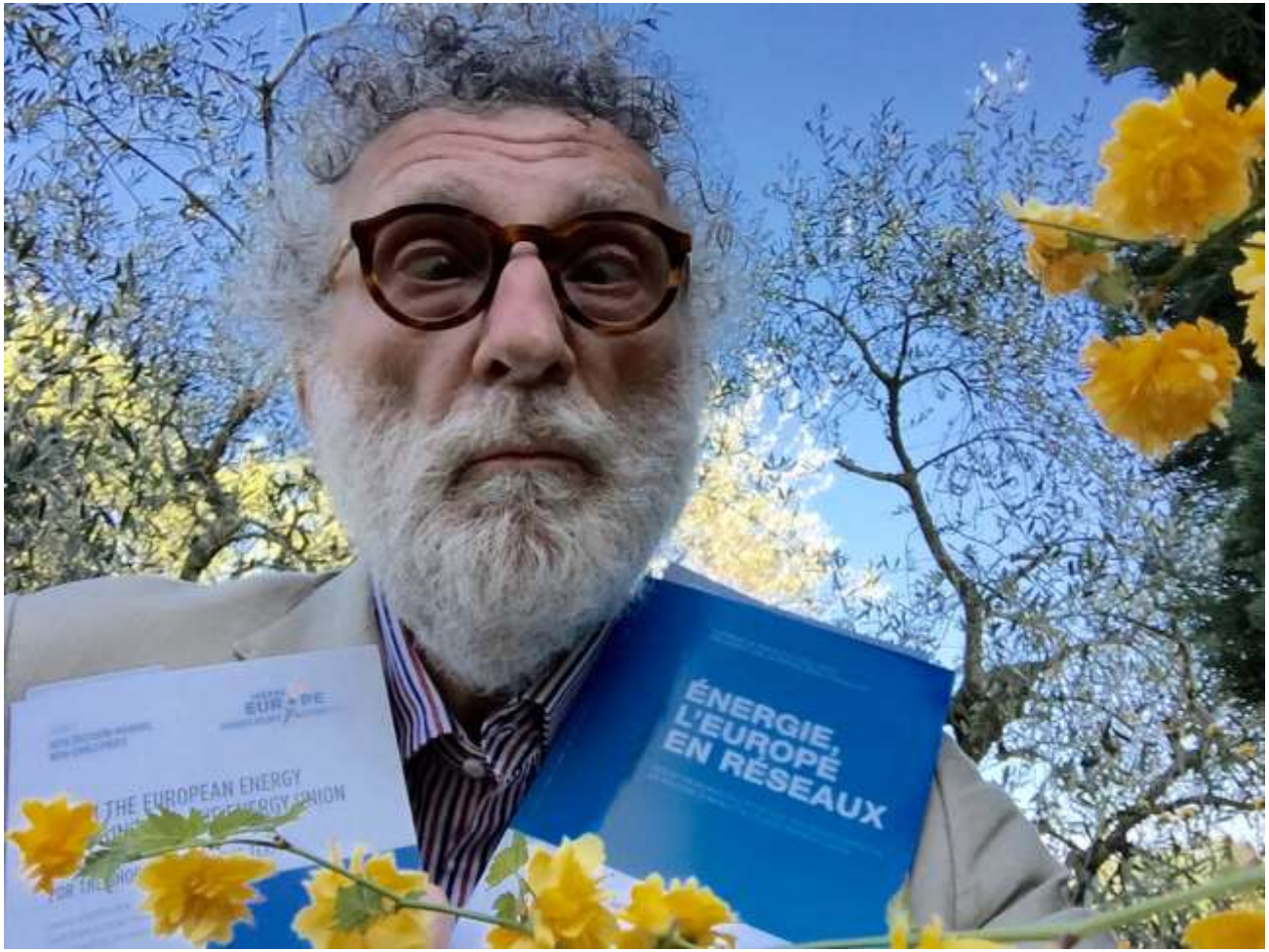
Beyond "Utilility regulation"

+ "Behind the Meter" activities

<:> New <u>Incentive Regulation</u>:

needed to favour <u>structural</u> business innovations

Innovation Business Models <through> Regulatory Frames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