Power Sector: the move from the Market regime to an Hybrid regime

Adapting Institutions to SoS & Decarbonisation Objectives

Dominique FINON
Directeur de recherche émérite au CNRS

55° Séminaire d'économie d'énergie PSL
14 janvier 2022

Dans les 1990s
Libéralisation du secteur

Correction des défauts du modèle du monopole de service public
(dont propriété publique).

Croyance forte dans les vertus du marché

Croyance dans marchés bien intégrés entre systèmes,
marché day ahead,
marché infra journalier

Dispatch optimal aux bénéfices des consommmateurs

Eviter la tendance à surinvestir du monopole règlementé

Croyance dans développement optimal du mix avec les seuls signaux de prix du marché horaire

Depuis 15 ans
Le secteur électrique confronté aux enjeux du long terme

Dans les économies émergentes en croissance:
sécurité d'approvisionnement par suivi des besoins croissants

Dans les autres reconnaissanc e progressive du problème d'adéquation des capacités en pointe

Décarbonation des systèmes

Les défaillances de marché sont en partie reconnues

Reconnaissance du besoins de remèdes
- d'arrangements de long terme permettant de transférer le risque d'investissement et de subventionner en cas d'effets inattendus
- du planification

Problème de blocage instituionnel dans l'UE par culture de marché et règles de la concurrencen

Beaucoup de littérature sur des parties précises du market design en termes d' Industrial Organisation

- limiter exercice de pouvoir de marché et recommandations
  - La conception du marché day ahead, intraday,
  - Les règles d'accès au système de transport, etc;
  - Efficacité comparée de différents types de mécanisme de capacité

Mais il y a peu de littérature « holistique » sur les défauts des coordinations de court terme et long terme par le marché et les effets de fragilisation que les politiques ont sur ces coordinations, notamment la promotion des ENRi à outrance

Peu d'analyse sur la dynamique institutionnelle d'ensemble liée à la reconnaissance des market failures et des chocs politiques (parachutage des Enr intermittente à faible valeur, sortie de technologies économiques pilotables, etc.)

Les économistes ne s'engagent pas trop . Reconnaissance d'abord de l'intérêt des mécanismes de capacité et plus taridivemeent de l'importance des contrats de long terme pour la décarbonation (par P. Joskow en 2017 et de David Newbery et Pollitt en 2018)

Questions de recherche:

1. Peut-on caractériser les changements observables comme un changement de régime sectoriel , en mixant deux structures de gouvernance, la hiérarchie (la planification) et le marché,

2. L'addition de patches divers pour corriger continuement le modèle initial ne répond-elle pas finalement à une certaine logique conduisant en dynamique à un régime hybride sous la contrainte de la sécurité de fourniture et des politiques ENR?.

3. Quelle leçon en tirer?

Ne faut–il pas reconnaître explicitement le rôle clé de la **planification/programmation/pilotage,** au risque sinon de conduire à des incohérences et des inefficiences ?

Adoption d'une démarche fonctionnelle à distinguer d'une démarché normative ,

Démarche fonctionnelle est sur les facteurs déclenchants (inefficince, incohérence etc.) et prend acte des différences de réponses selon les pays (relation avec l'nvironneemtn institutionnel)

Démarche normative consiste à rechercher la meilleure conception du nouveau régime

Version centralisée à base d'enchères centralisées

Vs

version décentralisée à base d'obligations sur les fournisseurs,

avec toute un éventails de solutions pour chaque enjeu:

eg. Auctioning with technology neutrality or technology specific, etc.i

Définition Régime sectoriel : Combinaison de droits de propriétés, de structures règlementaires spécifique, d'arrangements institutionnels, de marchés organisés, et d'une structure de gouvernance publique

- Un hybride est un croisement de deux variétés ou espèces différentes
- **Plutôt que de marchés hybrides, il s'agit d'un régime hybride** qui croise deux types de coordination, la planification pour le long terme et le marché pour le dispatching économique
  - ce n'est pas « concurrence pour le marché » mêlé à « concurrence dans le marché »
  - C'est « planification » avec « concurrence de long terme » pour des marchés
- Parler de régime revient à reconnaître le rôle de la planification
- Au-delà de la connotation « soviétique », il s'agit de « smart programming » à base d'incitations à investir (subventions/dé-risquage)
  - Mais ce n'est pas planification en recherche d'optimalité
  - Politisation d'une partie des choix avec fixation d'objectifs de part d'EnR
  - Problème: éloignement du mix optimal avec prix élevé du carbone

A neo-institutionnal economics framework

The words of Joskow, (2021). From Hierarchies to Markets and Partially Back Again in Electricity: Responding to Deep Decarbonization Commitments and Security of Supply Criteria.

A first perspective (lignée North, , Levy et Spiller, Jamasb et Pollitt)

- Identification of the successive sequences for reforming a complex industry (unbundling, creation of organised markets, opening up to retail competition, privatisation)
- stages)Importance of coherence with the institutional environment, (including the soft law of competition policies)
- Explanation of the variety of reforms by historical, institutional and resource factors (water, technological resources, etc.)

The NIE functionalist perspective

Analyis of complex industry in terms of modularity (Bladwin, 2000; Glachant et Perez, 2009)

- Each module: coherent set of physical and market transactions
- Autonomy of modules and clear relations between them
- Caveat for electricity .
  - Flawed chain of imperfect modules and faulty interfaces have been inserted between monopolisitic modules and competitive activities modules
  - They explain the variety in the design of modules, and of fuzzy interfaces

A NIE functionalist perspective (following)

The efficiency of a regulatory and organisational model depends upon:

1/ Internal consistency of modules
2/Consistency between modules
3/ Coherence with the institutional environment

Divers of change come from :

- Ineffectiveness : the issue of risk management for CAPEX units
- Market failures : non internalisation of collective goods (security of supply, learning externalities, CO2 cost
- Policy shocks (RES-E parachuting beyond economic rationality)
- Acceptability (payment of the cost of RES arrangmeents by taxation)

Answers by creation of new modules

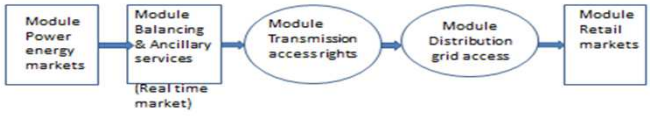
Risk of non- consistency between initial modules and new ones
- Unintended effects provoke adaptations of rules and new institutions
- Adaptation of the former ones, merging of other ones

Which consistency with institutional environment ?

- barriers to adaptation by competition policies ?

Part 1. The first wave of adjunctions under SoS objective and RES policy

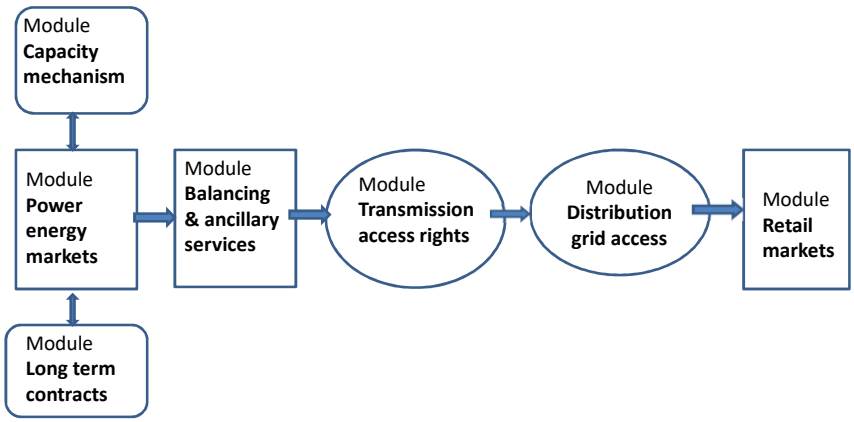
Chain of modules of liberalised electricity markets



1.1.Standard reform model

- From vertical integration and public service retail monopoly to market model
- Unbundling of competitive and natural monopoly activities (transmission and system operation; distribution)
  - Limitation of long-term producer-supplier contracts
- Energy-only market (day ahead, intraday) with no further remuneration
- The network operator relies on services offered on market mechanisms (balancing/ real time market, system services).
- Two coordination roles
  - Short-term coordination (hourly economic dispatching)
  - Long-term coordination
    - Investing in different technologies that will produce over different durations
    - Textbook: Assumption of alignment of the sum of hourly revenues of an equipment with the technology mix

1.2 To complete the market design with modules that provide long term signals and hedging



1.2.1. Addition of a long term contract module
Answer to market failures in the technology mix development

- **Risks are born by the investors**, but not by consumers ,as before in the public service monopoly regime
- Power generation technologies have different risks and returns characteristics
  - Different exposure to market risks (electricity price, fuel price, CO2 price)
  - High degree of capital intensity (CAPEX) per MWh for peak- and base- load units
- **Domination of the criteria of risk management on the criteria of NPV**
- **Uncomplete markets**
  - Poor liquidity of forward contracts markets and futures with long maturity (up to 3 years max)

Answers

- Coordination of investment through planning
- Delinking of investment from hourly power market prices

- Central auctioning of long term contracts at fixed price
  Vs
  Decentralised obligation on suppliers to contracts

Answer in emerging economies and the UK pioneer

Long-term investment decision-making, largely driven by auctioning of long-term contracts - for capacity in Colombia

- for energy in Chile and Peru,
- or for both as in Brazil.

Significant differences in the key implementation parameters

- the degree of centralisation of the arrangements, (Chili with an obligation being placed on retailers)
- the auction procurement approach (frequency, type of auctions, etc.).
- The type of contracts (physical contracts, financial contracts)and maturity

Some Important key features:

contracts are with retailers/distributors, every one with remaining retail monopoly

In hydro system (Brazil, Argentina, Columbia), auctions are based on values calculated by a system model

NB. Brazil: specific planning agency

In the British electricity market reform

- Contracts for difference (CfDs) for RES-E and low carbon technologies established with the grid NGC (compensated for the cost of the payment by)
- Long term Capacity Contracts also established with the grid

1.2.2 Addition of a Capacity Remuneration module (CRM)

Theory of peak pricing and marginal cost pricing (Boîteux, 1949, 1954; Joskow, 1987 etc.)
How to invest in peaking units with functioning during 0-100h/year ?

The doxa:

- the market is able to reflect scarcity during peak load period
- Scarcity rents able to finance the investment in peaking units (but importance of fixed cost share /MWh)

Problems:

- Unfeasibility of real time pricing with sky rocketting prices for industrial, commercial and domestic consumers
  - Problem of cognitive understanding, hedging etc.
- Unacceptability of scarcity pricing by public opinion and politicians
  (3000-10000 €/MWh during some hours instead of 40-80 €/MWh normally
- Willingness of policiy makers and regulators to guarantee a supply reliability in every situation (failure norm of 3h/year in France for instance)

Different types of CRM

Strategic reserves (payment of dedicated new or old equipment, very strict condition to produce)

Price instrument : Capacity payment related to ex post reliability of the units

Quantity instrument: decentralised obligation on suppliers to their served load + reserve margin (French mechanism)

Centralised auctioning of forward capacity contrats:
physical contracts versus financial contracts (CfDs)
One year remuneration for existing units & several y. remuneration for new units

Introduction of demand response and storage in the « capacity resources »
Better performance of quantity instrument for reaching SoS standard
(Decentralised obligation less efficient than centralised auction)
Finacial contracts more flexible and efficient
Centralised model: Paiement by uplift

Role of the TSO as planner

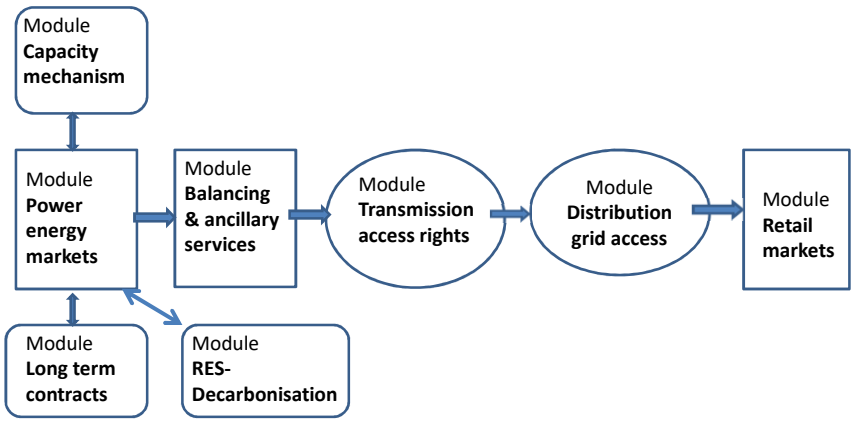
1.3. Addition of a RES-Decarbonisation module

Rationales for support mechanisms under the form of long term arrangements

1. Market failures in matter of learning process for RES-E, new nuke, CCS (no appropriation of learning-by-doing externalities and under-investment)

2. Carbon price
- Lack of long term credibility of carbon pricing by ETS
- But even with robust carbon price, disincentives to trigger low carbon investment

3. Capital intensiveness for RES-E as well as for other low carbon technologies (CCS, nuclear) with investment risks on power markets (see above)



"Triple functions of RES support mechanisms:, by long term arrangements

- To add a support for non-mature technologies
- To transfer the market risks on a public agency (in fact on consumers)
- To correct the discrepancy between the value of each VRE MWh and its LCOE ((hidden function)

The **different types of mechanisms**

- Feed-in tariffs (FIT)and assimilated
  - Guarantees of revenue per MWh produced on long term
  - Identical revenues per MWh, whatever the period of production
  - Allowed easy cost recovery
  - No balancing responsibility wiht si
- Long term contracts CfDs for flexible FIP
  - Guarantees of revenue per MWh produced on long term
  - Balancing responsibility
  - Auctioning for RES-E. (special regime for nuke in the UK)

Dominant mechanism with some virtues

- Renewables obligation on suppliers
  - Green certifcates exchanges
  - In fact additions of risks for developers (power price, green price, etc.) & high capital cost// high transactions costs
  - Need for private contracts with obligated suppliers
  - GB preferred to skip to CfDs and FITs

Again Centralized design dominates decentralized design

1.4. A Multi-Agency gouvernance

- Problems with multiples planning and decision centers:
- Ideal-type Brazilian model : a specifi planning agency working with the TSO, the regulator and the ministry

1. Government with policy objectives (RES share, etc.) and use of "out-of-makets" instruments
   Anti-economic and inefficient practices
   To be captured by interests groups and political lobbies
   Electoral pressures for short term

2. Planning : Planning agency and TSO

TSO is programming with different mid term scenarios to develop grid and check capacity adequacy

Need of a Planning agency over TSO competencies
   Need for neutrality of the planning agency, supported by sound regulatory framework
   How to escape to capture?
   Need of both short term economic dispatching model and long term programming model
      Definition optimal mix

For effectiveness of the planning : Need of consistency of the procurement mechanism with the planning process,
   RES tenders schedule, Nuke contracts, storage tenders consistent with long term policy targets

3. Regulator

Regulate transmission and distribution tariffs

- (assessment of the cost of capacity mechanism and uplift)

Overview on competition on the different market mecanisms

Could organize auctions

Assess the annual total cost of arrangements (to be paid e

4. Issue of the cost of the mechanisms when paid by a tax on conumers

The case of FIT and auctioned long term arrangements with TSO or else

Discrepancy between contractual reference price for RES/low carbon tech. and market prices

Initially payment by a tax or uplift with differentiation between households/SME and large consumers.

Increasing of the total cost of RES long term arrangements

- Cumulation of more and more arrangements

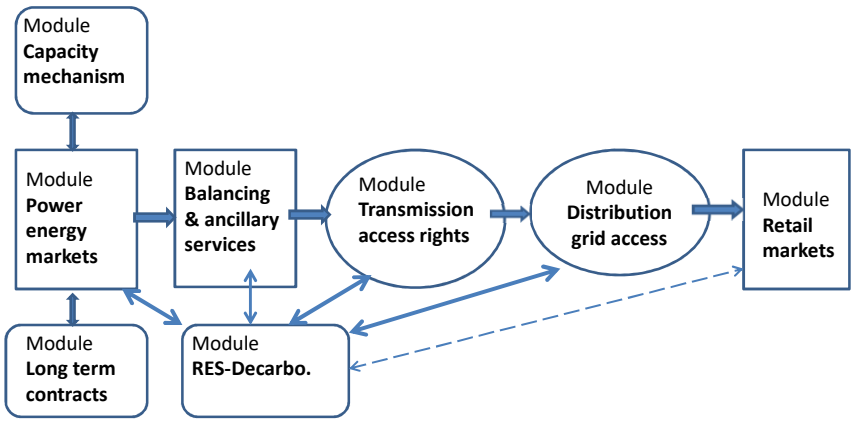
Except in the UK with cap on the expenses , no tentaive of control

Increasing acceptability problem

- Shifting of the CfD costs on the public budget (France 2017, Germany 2022)
- Financing by resources coming from fuel taxation

Part 2. Inconsistencies between old market modules and new long term modules

The need fo recurrent adjustments



2.1. Increasing disqualification of long term coordination by market

The dominance of RES-Var shifts cost structures to high shares of capital and low or even zero marginal costs.

Wind and solar have near zero marginal costs,
They dominate dispatch and push everything else off the dispatch.

With merit order effects : Decreasing value of last marginal RES capacity ot be installed
Self reliance of mechanisms for RES-E
Defintive need of long term arrangements in a low marginal cost pricing environment

Long term supply security : No more market-driven development of investment in peaking units and back up equipment

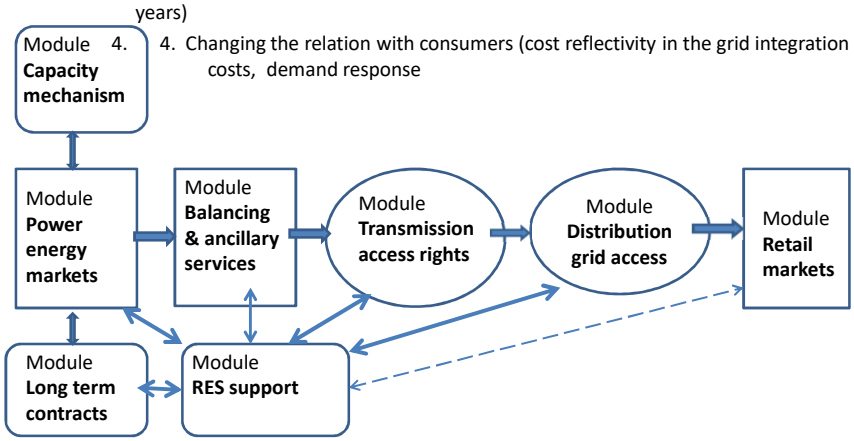
Intermittency requires investment in new fast ramping units and other flexible resources .

Need for restructured power market design

- that enables the payback of investments
- that insures capacity adequacy
- that re-adjusts flexibility remuneration in energy markets (intraday), balancing and ancillary services to trigger investment in flexible ressoruces

Correcting market design for facing Variable & Zero SMRC renewables at the central and decentralized level

1. « flexibility » markets (balancing, ancillary services, reserves)
2. « transmission rights » markets
3. Creation of decentralised markets (platforms) at the level of distribution (next10 years)
4. Changing the relation with consumers (cost reflectivity in the grid integration costs, demand response



2.2. Adaptation of the different market modules

In search of sufficient liquidity on the different products markets

- It depends in first on the responsibilisation of the VRE producers for their system externalities

Energy intraday et day aheas Market

- Short program time units (15 minutes product on intraday)
- Trading close to real time
- Large-scale geographic integration

Balancing and Ancillary Services Module

- **System service markets (tuning of reactive power, etc.)**
  - Non-discriminatory access (including the VRE)
  - *Remuneration at marginal value*
- **Balancing mechanism**
  - *cash-out pricing price at the marginal value* as in the UK , and not at the weighted average value of the bidders as in Germany and France
  - Significant portfolio effect for VREs to participate to balancing mechanism
  - Trading arrangements need to allow small participants to access aggregation benefits (after-day market, short-selling)

2.3. Adaptation of TSO and DSO modules

- Connection of the VRE units, mainly localised, **without any price signal to indicate zones behind congested transmission lines.**
- The locations of these units could generate new congestions within the transmission system.
- Locational optimisation of generation and flexible resources is made increasingly complex.
- Issue of the cost of VRE units' connection

For transmission system operators,

- Need to move from quite simple transmission tariffs to zonal or nodal tariffs
- Need to allow grid storage units
- **To balance VRE productions** with fast ramping turbines, demand response programs with industry, different types of storage (among which EV batteries) and windpower interruptibility

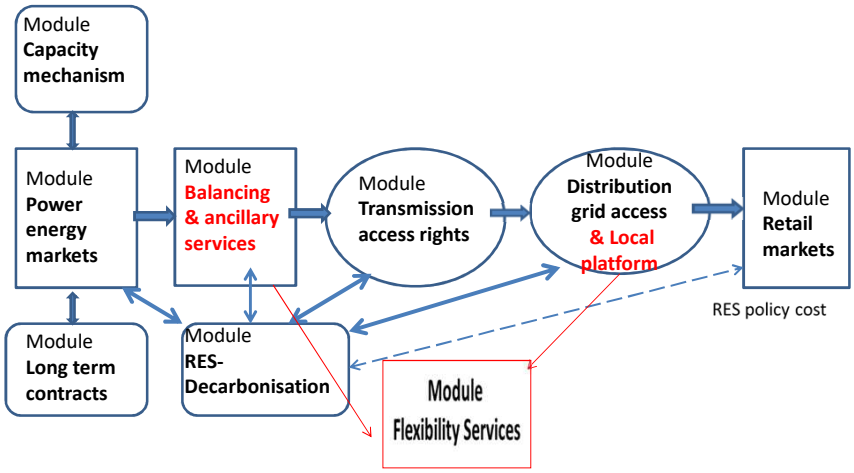
For distribution system operators,

- Locational tariffs?
- Move towards an active role in balancing the local systems (presently totally passive)
- "Smart grid" to balance Var-RES productions at the local level among which EV batteries)

Development of local flexibility platforms

- Issue of sharing balancing and system services role with the transmission grid

In search of monetization of flexilbility products of storage, demand response, fast ramping & power to gas (?)



2.4.Tensions between the RES-Decarbonisation module and the Retail Market module

Rise of prosumers and search of active demand participation

Retail markets be partly transformed in energy services markets, including prosumers .

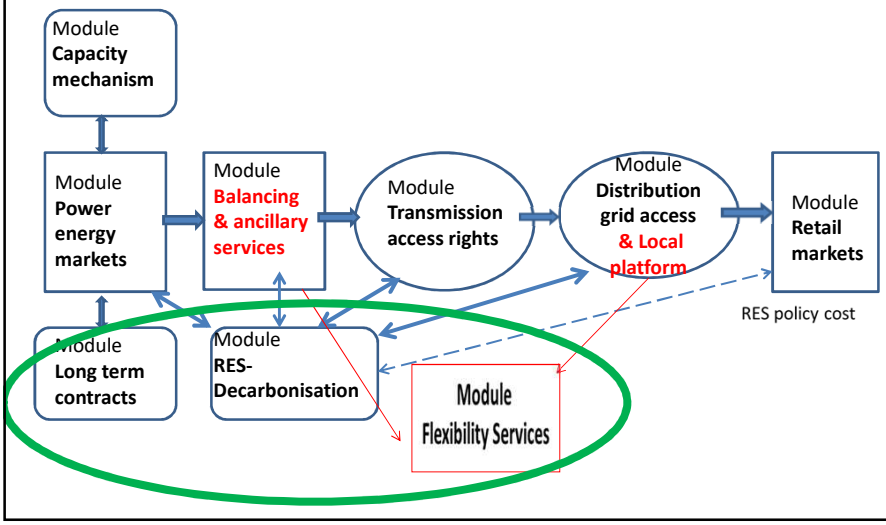
Not so simple to adapt market rules in order to make emerged new business models

- aggregators of demand response, of battery management, of home PV productions
- Participation of aggregators to energy and services markets
- Fundamental need of clear and stable rules

Need to correct inefficient designs:

- limitation of cross-subsidies from households to consumers in distribution tariffs
- Towards 100 percent of capacity share in distribution tariffs

2.3. Merger of RES-Decarbonisation module, LTC module and Flexibility Sources module



2.4. New general module: merger of **RES-Decarbonisation module, LTContracts module and Flexibility services module**

- Revenues on energy and services markets insufficient to trigger investment in flexible resources (gas turbines, battery storage, demand response, power to gas)
  - Price alignment on SRMC or opportunity cost
  - Volatility and unexpectability of prices on the payback period of equipment
  - Unexpected effects (e. g. PV effects on spread and arbitration value of pumping strorage, rivalry between flexiblity sources)
- Inclusion of every technology in a large long term module including the former RES-decarbonisation module
- Auctioning contracts for every technology
  - But difficulties to identify economic values of different services of storages
  - But difficulties to harmonize the developments of VRE capacity and flexibility sources
  - Implicit competition between the different sources of flexiblity
  - Need of both short term economic dispatching model and long term programming model

2.5. Reinforcement of the governance

- Extension of planning to different types of storage, demand response, interconnection, P to G, etc.
- Increasing role of models allowing to value the various services of flexibility for the selection of auctioned hedging contracts
- Need of narrow cross-sectoral coordination
  - E.g. green gas production via P to G is viewed as flexibility sources for the power system

- Indeed (with Green Energy package) , extension of planning and contracting /hedging mecanisms to the greening of gas sector and green hydrogen uses in industrial sectors (steel, chemicals, etc.).
  - carbon contracts for difference

Conclusion

The European contradiction beween market paradigm absolutism and occult dirigism

- Non recognition of the major role of planning and central coordination
- Clean energy package give principles to improve the EU electricy markets (focus on existing set of short term markets (spot, intraday, real time, ancillary srvices)
- But Lack of a structured and coordinated approach for planning and contracting/hedging mechanisms in order to deliver the investments required to meet the decarbonisation policy targets
- Need of narrow cross sectoral coordination and multi-level local/ central coordination

Numerous problems coming from this lack of clarification because systems integration

- No coordination of investment and retirement inside countries and between countires
- Uncoordinated mechanisms to support investment that distort the market:
  - RES tenders - national approaches with little coordination

Chain of modules of liberalised electricity markets