



**DG or how new generation schemes  
affect to the network.**

**One Spanish distributor's point of view.**

**INTERNATIONAL CONFERENCE ON RENEWABLE  
ENERGIES AND POWER QUALITY (ICREPO'07)**

Sevilla 28-30th March, 2007



- My apologies.
- My background.
- My position.
- My intention.
- If any, questions at the end, please.

1. Introduction.
2. Legal framework: State regulation vs. regional regulation.
3. Exploitation point of view.
  - Operation distribution networks effects.
  - Quality of supply: Continuity, wave shape keeping. Responsibilities.
  - Losses.
4. Planning point of view.
  - Cost-reflective development and nodal prices.
5. Supply point of view.
  - Deviations & Market.
6. Concerning & most worries.
7. Opportunities.
8. Summary.

1. Introduction.

## 1. Introduction (1/5)

### 1. My company: Endesa.

- Leader in ensuring the coverage of electricity demand in Spain.
- Leader in sustainable development (DJ Sustainability indexes)
  - Economic aspects
  - Environmental aspects
  - Social aspects



## 1. Introduction (2/5)

### 2. How do we understand DG? What is it ?

(DG → DER → VPP): Concept evolution.

DG = electricity can be produced at customer's scale with good levels of electrical efficiency.

The electrical generation « scale effect » continuously diminishes: gas engines, microturbines, fuel cells, Stirling engines. Local use of waste heat (CHP)— very often in industrial uses, not as usual in domestic consumers in Spain.

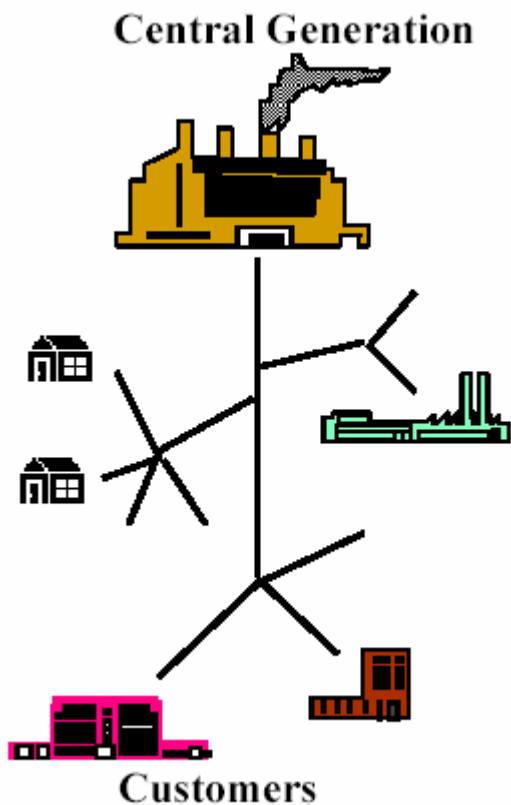
DER (Distributed Energy Resources) = DG (CHP)+energy storage +power quality eqt. + ...

VPP (Virtual Power Plant) = DR supply + Energy management system + Intelligent communication systems...

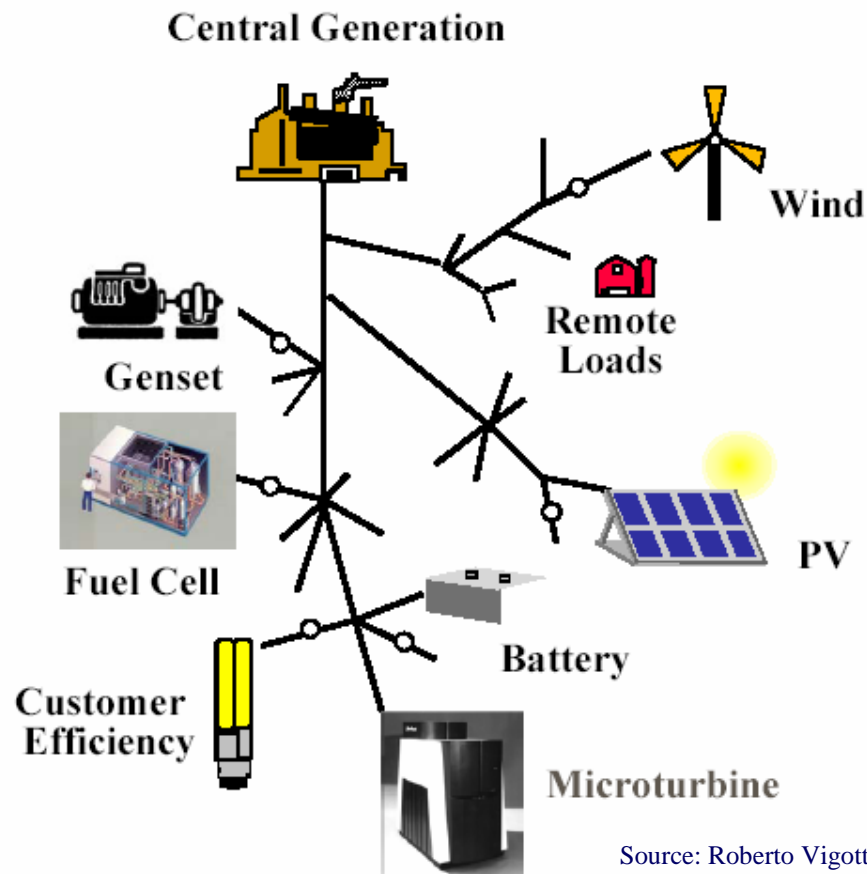
## 1. Introduction (3/5)

3. How can all these generation evolve? What is the “electric environment” this generation need?

### Today's central utility



### Tomorrow's distributed utility.



Source: Roberto Vigotti - Enel

## 1. Introduction (4/5)

### 4. We must pay attention to the grid as well !!.

- The similarity to other business:

“Yesterday, we used to run over the very simplest roads to put into relation producers and consumers. Now we need more and more motorways”.

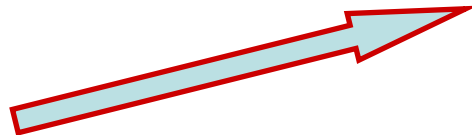
(Lorry Drivers Association)

- Electricity networks are essential to:

- Deliver electricity to users
- Balance supply and demand

- Electricity networks should be:

- Sufficient
- Cheap
- Efficient
- Reliable
- Safe



- More and more requirements are needed from the network...

**Who should pay for that?**

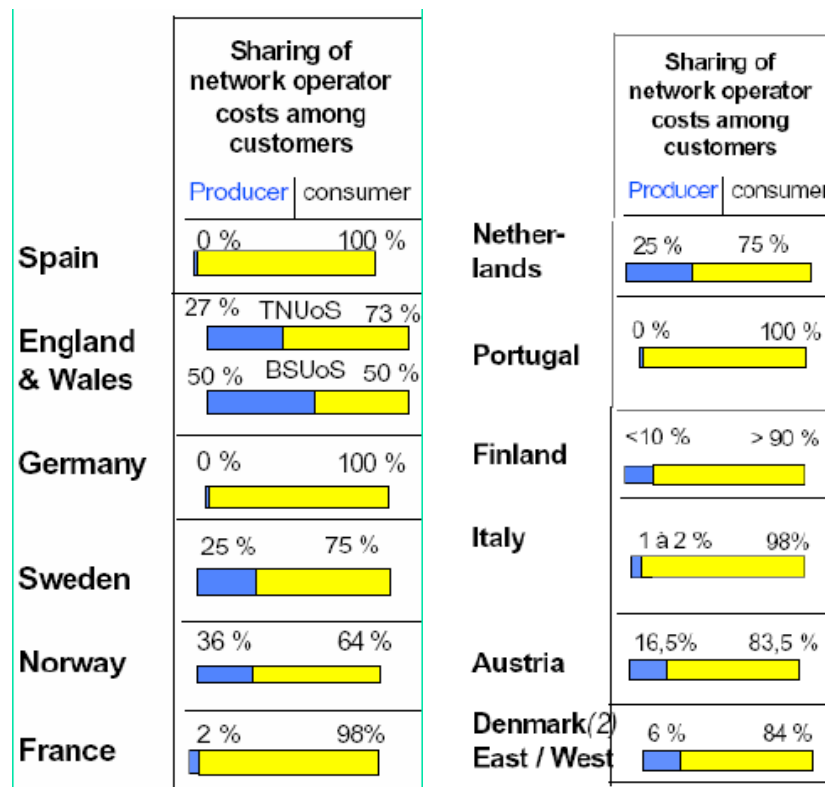


## 1. Introduction (5/5)

### 5. Sharing network charges

- There can be two components of network charges: G-paid by generators and L-paid by loads.

#### European lanscape:



Although...European Commission's opinion.

2. Legal framework: State regulation vs. regional regulation.

## 2. Legal framework: State reg. vs. regional reg. (1/5)

- A. Legal state framework in Spain for access and connection new generation to the net.
- OM 1985, 5th sept. Administrative and technical rules for connection to the network hydroelectric power plants until 5.000 KVA and electrical cogeneration.
    - ⚡ Very general voltage conditions.
    - ⚡ Power generation limits for LV connections depending on excitation of generator.
    - ⚡ Ground conditions and galvanic isolation.
    - ⚡ Special conditions for active and reactive energy metering.
    - ⚡ Protection conditions to guarantee safe network operation
  - RD 1663/2000 for photovoltaic generators connection to LV network.
    - ⚡ More specific connection conditions.
    - ⚡ PV generator will never work without network voltage.
    - ⚡ Maximum 5% voltage variation in connection and disconnection PV plant.

## 2. Legal framework: State reg. vs. regional reg. (2/5)

- A. Legal state framework in Spain for access and connection new generation to the net.
- RD 1955/2000 for transmission, distribution and supply rules and authorization rules.
    - ⚡ The most important set of administratives and technical rules in Spanish electrical regulation.
  - RD 436/2004 legal and economical regime system for SR electric production.
    - ⚡ Basically fulfilment of technical connection requirements.
    - ⚡ Power factor equal to 1
    - ⚡ Don't have to forecast their production, don't participate in ancillary services and don't have to pay for them.
    - ⚡ Alternative of a full access to the wholesale market is now offered through economic incentives, and an economic incentive to cope with dips, specifically for wind farms.
    - ⚡ As well as modulated reactive energy incentive.
    - ⚡ Participation in all the electrical markets: Full assumption of deviation costs.

## 2. Legal framework: State reg. vs. regional reg. (3/5)

- B. Legal regional framework in Spain for access and connection new generation to the net.
- Regional promotion of renewables from E4 Plan.
  - Mainly referred to the Photovoltaic Power Plants and Eolic PP as well.
    - ⚡ Most of the times, the rules set out the distributor carries on the evacuation installation which is not technically necessary and could overload the tariff. At the end, this "taken care cost" should be all the customer paid for!. But, actually customer aren't paying for it. It's distributor who is it.
  - Technical and administrative conditions.
    - ⚡ To acquire SR condition, some Regional Administration (CC.AA.) have chosen a tender procedure (Canary Island) instead of an authorization procedure.
    - ⚡ Success depends on the local authorities as well.

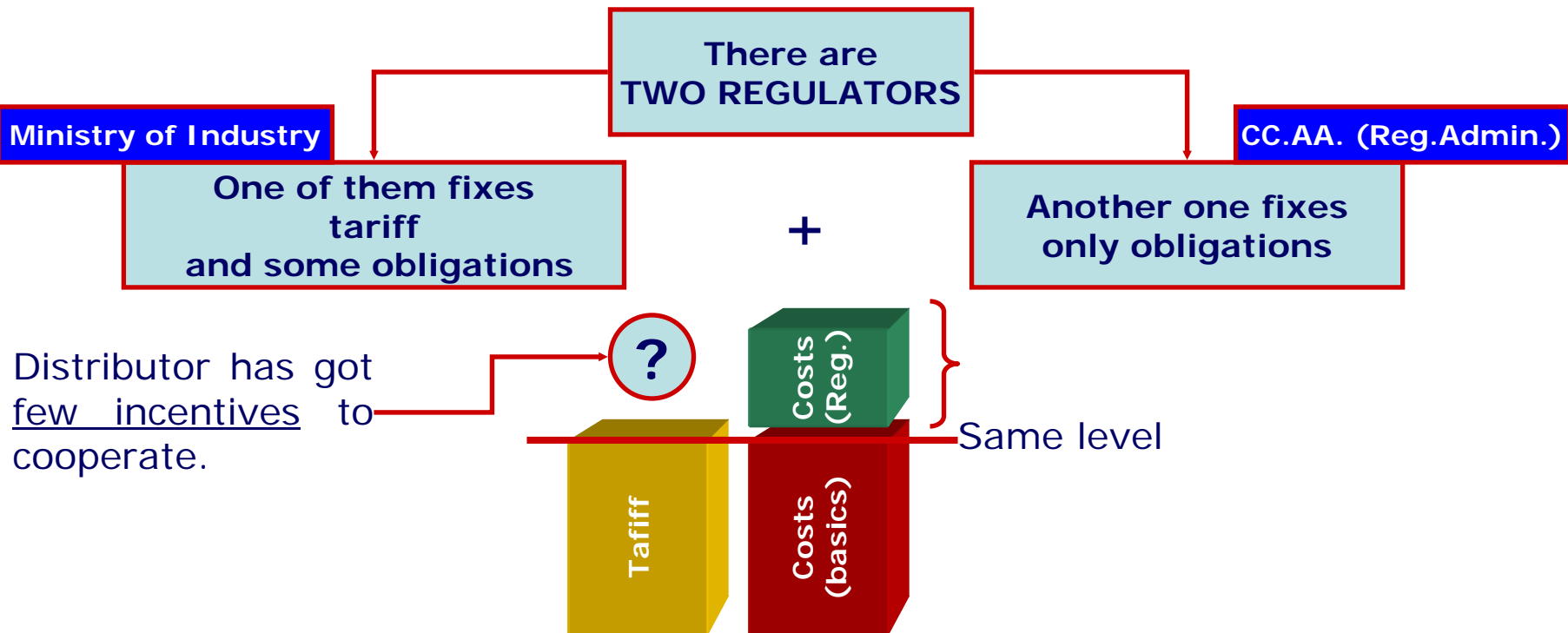
## 2. Legal framework: State reg. vs. regional reg. (4/5)

### C. Legal Panorama:

- Connections standards: There is a specific standards, mainly for photovoltaics (<100 kVA) connected to LV network since 2000, and many particular administrative topics to take into account from regional regulation.
- Network integration:
  - ⚡ No location signals.
  - ⚡ No local integration.
  - ⚡ Hard connection standards.
  - ⚡ Long and difficult administrative processes, many authorities involved into.
  - ⚡ Not adapted network connection standards for high penetration of DG.
  - ⚡ Problems to evacuate the energy depending on areas.

## 2. Legal framework: State reg. vs. regional reg. (5/5)

### C. Legal Panorama (summing up):

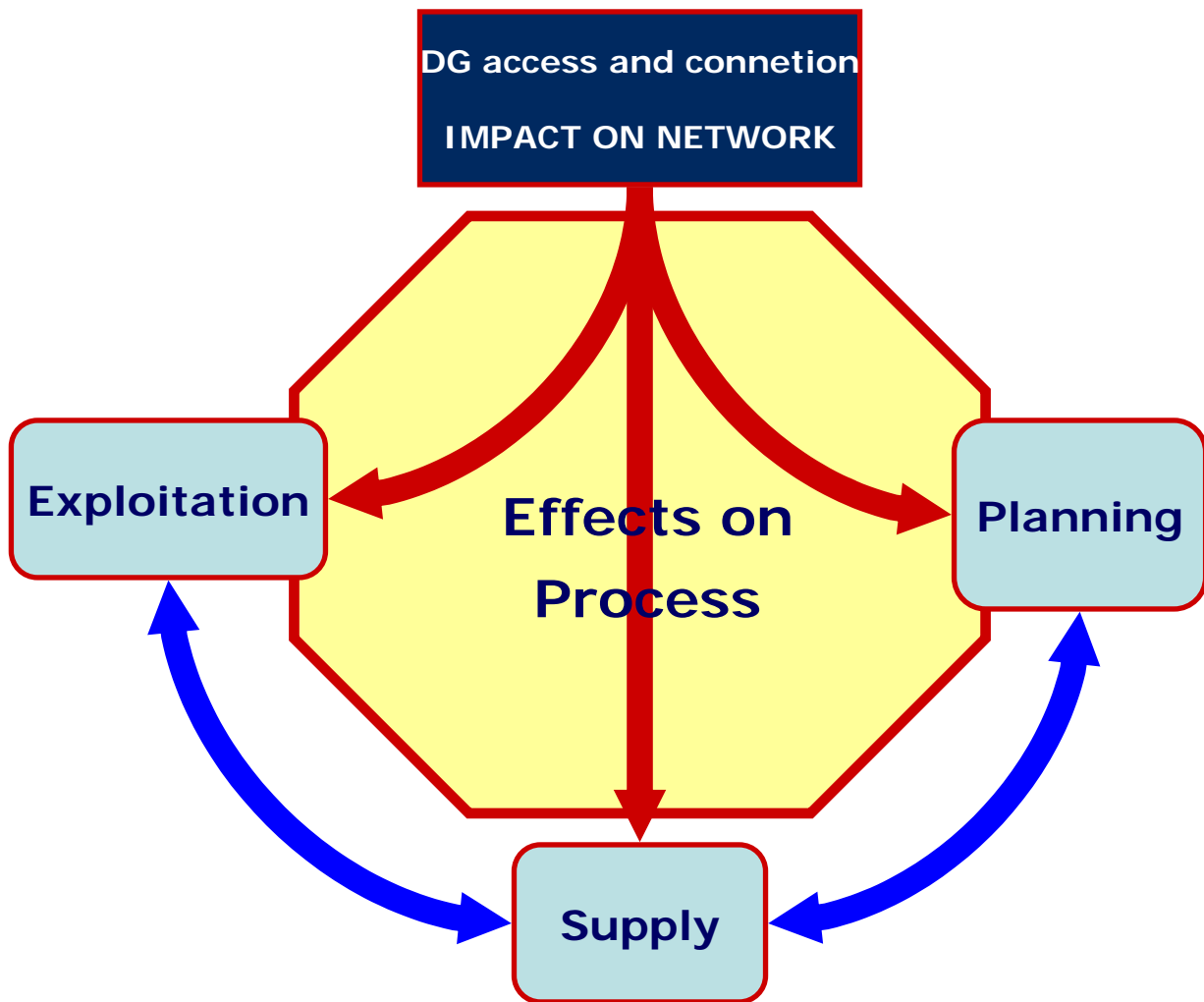


- Clear asymmetry** between obligations (cost) and revenues from tariff incomes.
  - ⚡ CNE has recently recognized that all new regulation (new duties) must reflect impact in costs and a way to revenue them.

3. Exploitation point of view.
  - Operation distribution networks effects.
  - Quality of supply: Continuity, wave shape keeping. Responsibilities.
  - Losses



- New generation access and connection to the network: effects on **process**.



### 3. Exploitation point of view (1/4)

#### A. Operation distribution networks effects.

##### The benefits:

- Operational cost saving.
- ⚡ DG may help to reduce time after outage
- Congestion relief
- ⚡ Sometimes, DG may relief network, very punctually.
- Peak load reduction and balancing of supply and demand
- ⚡ DG as a mechanism of DSM.

##### The difficulties:

- ⚡ DG needs a bigger effort to coordinate agents
- ⚡ Everytime distributor has to ensure that network keeps as less congested as he could.
- ⚡ DG is not engaged in its production's guarantee.

### 3. Exploitation point of view (2/4)

#### A. Operation distribution networks effects. Other effects.

- Personal and infrastructural risks.
- Management difficulties.
- Right direction of the energy power in substation switchgear.
- Non-quality points detection difficulties.
- Variable shortcircuit power along the lines.
- Monitoring and reporting SR difficulties.
- Variable profile of voltage level along the grid.
- Neutral disbalancing in substations.

### 3. Exploitation point of view (3/4)

#### B. Quality of supply: Continuity, wave shape keeping. Responsibilities.

- Monitoring and reporting SR difficulties. Number controlled points increasing.
- Variable profile of voltage level along the grid.
- Total harmonic distortion increasing.
- Isolated microgrid risk (island's grid working)
- Responsibilities. Who's polluting (EMC rules)? Who has to pay for it?

Armónicos impares no multiples de 3		Armónicos impares multiplos de 3		Armónicos pares	
Orden n	TASA Armónicos %	Orden n	TASA Armónicos %	Orden n	TASA Armónicos %
5	5	3	4	2	1,6
7	4	9	1,2	4	1
11	3	15	0,3	6	0,5
13	2,5	21	0,2	8	0,4
17	1,6	>21	0,2	10	0,4
19	1,2			12	0,2
23	1,2			>12	0,2
25	1,2				
>25	0,2+0,5(25/n)				

Tasa de distorsión armónica total admisible: 6,5%

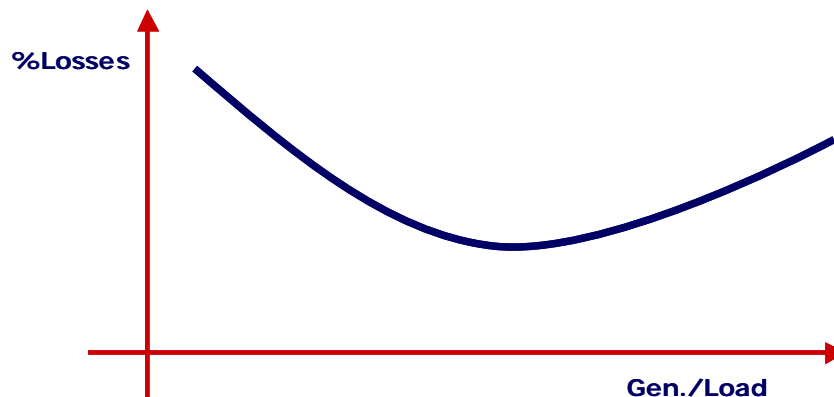
### 3. Exploitation point of view (4/4)

#### C. Losses.

- It's not true that an increasing of DG always improves the losses level for the system:
  - ➔ It depends on how DG is placed in relation to the energy consumption.

It's usual "to concentrate" DG: not so dispersed generation !  
SR is not DG: SR is been placed far away from consumption.

- ➔ Increasing evacuation capacity of the net: system costs.
- ➔ Increasing level of losses. Who's responsible for that?



- Losses.
- 4. Planning point of view.
  - Cost-reflective development and nodal prices.

## 4. Planning point of view (1/3)

### A. Derived advantages of DG in Planning Process.

#### The benefits:

- Distribution and transmisión capacity cost deferral.
- ⚡ Saving funds mechanism
- Environmental and social footprint.
- ⚡ Less landscape impact
- ⚡ Less fauna impact.
- ⚡ Reduced air emissions (CO<sub>2</sub>)
- ⚡ Disposable soil increasing.

#### The difficulties:

- ⚡ Difficulties in budgetting for new capacities.

## 4. Planning point of view (2/3)

### B. Difficulties in planning. Cost increasing effects.

- Difficulties in determine what the demand increasing will be like.
- Complex simulation to afford new forecast loads.
- Variable shortcircuit power along the lines.
- Variable profile of voltage level along the grid.
- Monitoring and reporting SR difficulties.

### C. Cost-refletive development and nodal prices

- Network planning will be compare against a network static model each four years (regulatory period).
- There has to be sent a signal to place generators efficiently.



## 4. Planning point of view (3/3)

### D. Cost of DG networks

- Administrative costs.
- Connection costs.
- Metering costs.
- Local network reinforcement costs.
- Re-thinking planning network costs.
- Stranded cost of distribution network.

5. Supply point of view.
  - Deviations & Market.

## 5. Supply point of view (1/1)

The system operation troubles:

- Daily schedule power flows.
- Daily deviations from schedule.
- Hourly deviations from schedule.

$$\text{Mismatch} = \frac{P_{gen} - P_{load}}{P_{gen}}$$

- ⚡ Mismatch is small on transmission system—traditional concern for power system operation.
- ⚡ Mismatch is relatively larger within distribution system, with distributed generation.

### ➔ Local frequency instabilities

- Two control problems:
  - a) Transmission: power mismatch, system frequency drift is historically centrally controlled. Now, new independent owned DG wants to operate independently.
  - b) Distribution: Local and fast frequency and voltage deviations could cause instabilities.

### ➔ Economic penalties for wrong forecast.

- Distributor has to estimate its own demand from:
  - a) Demand of traders.
  - b) Supply of (some) generators.

### ➔ Ancillary services (voltage regulation in T&D limits, margins,...) non-fulfilment.

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6. Concerning & most worries.

## 6. Concerning & most worries (1/2)

### A. Connection standards:

- A connection standard adapted to the new reality and new requirements are urgently needed (actual one is out of fashion). Only LV-Solar PV has its own standard !.
- Better technical integración has to be reached for allowing higher penetration:
  - ⚡ Reactive power control has to be enhanced.
  - ⚡ Wind turbines/farm dips resistance has to be improved and generalized.
  - ⚡ Frequency power control has been enhanced through market participation.
- Very complex authoritative processes involved. Administrations seem not be able to solve the request rise.
- Better definition of costs that each part has obliged to support. Symmetrical treatment for transmission and distribution network.

## 6. Concerning & most worries (2/2)

- B. Premium to the SR are now needed but, actually they could be in the tariff deficit root which is underpinning by distributors in the revenue caps scheme.
- SR premium costs were increasing and it is expected to increase in the future → Energy Package of EU. → Different/better mechanisms of financing them are needed.
  - Today, this premium is nearly 10% of total electric system cost.
  - Customers have accepted this cost because:
    - ⚡ Perhaps, they aren't aware of it.
    - ⚡ The supply tariff stress has gone down for the last 10 years in real terms.
  - Market access for DG, Energy Efficiency and DSM
    - ⚡ It is not developed for smaller generators but it should be.

7. Opportunities.

## 7. Opportunities.(1/1)

### A. New Energy Act to bring into force the Directive

- Distributed Generation as a new way to boost a diversified portfolio of clean, efficient and low-emission energy technologies and with regard to the source and the security of supply.

### B. New Executive Energy Order for Special Regime

- The best moment to develop a transparent relationship framework for DG.
- ⚡ Efficient open market mechanisms for promotion.



8. Summary.

Summary. Basic ideas to keep it:

- DG is an opportunity to boost energy sector.
- Agreement needed in sector for new regulation.
- The new regulation has to work to reflect costs.
- Mandatory quality targets.
- Common administrative and technical standards.

Thank you very much  
for your attention !!



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(for questions, for comments...)

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