MARKET FOR RENEWABLE ENERGY

Power Market Study Tour- 2014

Amsterdam, July 16th

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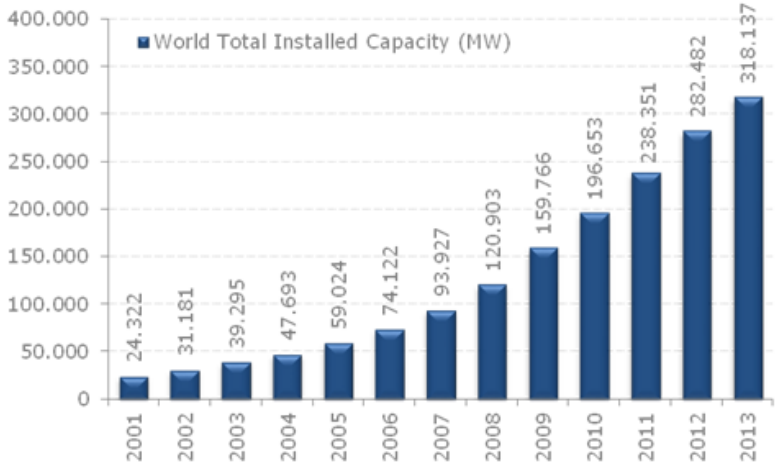
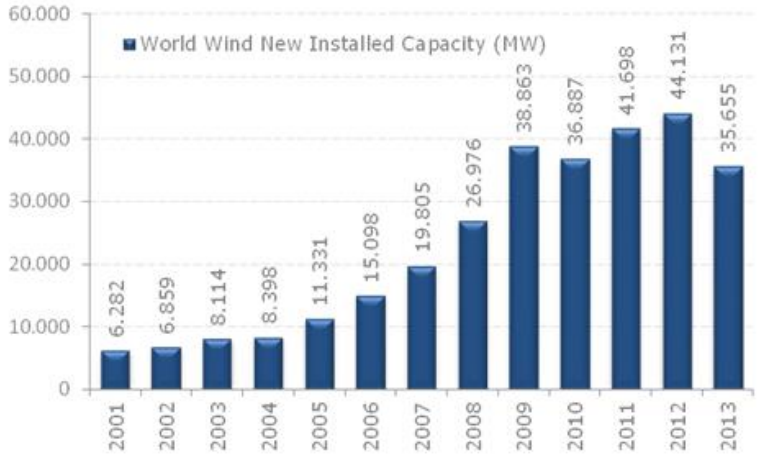
Introduction. Wind Installed Capacity

- Total Global Wind Capacity by the end of 2013 (31/12/2013): **318.137 MW.**
  - **35.655 MW** (Δ 12,2%) of wind capacity were installed across the world (19,2% less than 2012 figures).





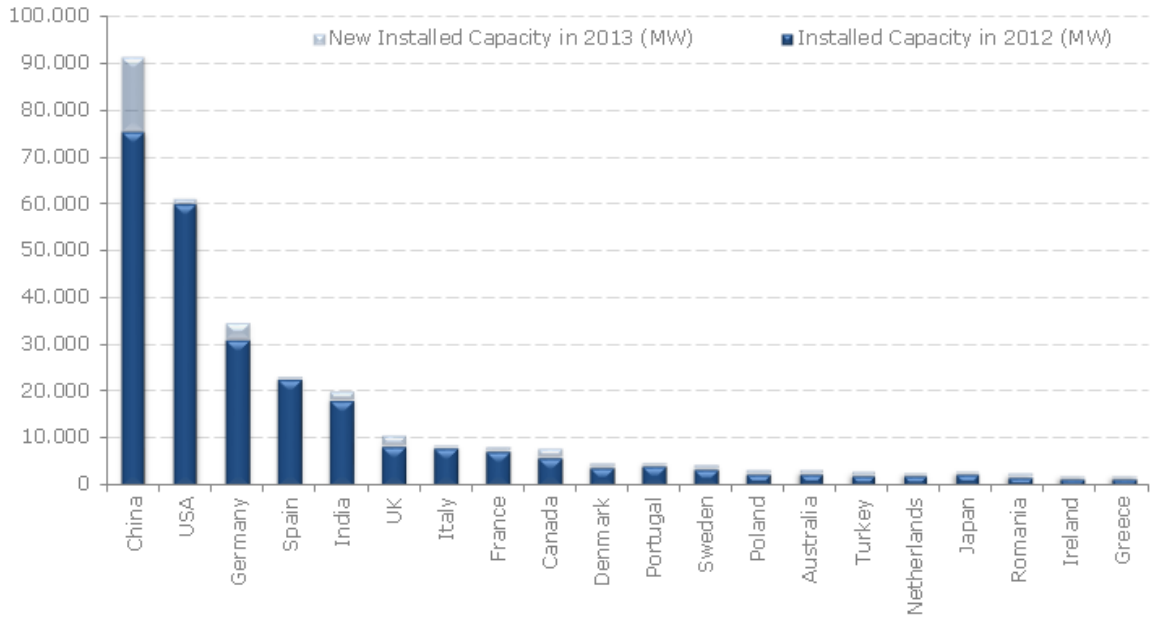
- Average growth path – last 5 years: 39.447 MW

- This shows that the energy sector is progressively moving away from conventional generation technologies towards a renewable energy scenario. **Wind power was the leading technology in terms of new installation accounting for 32%** (11,2 GW) of the new installations in 2013, followed by solar PV with a 31% (11 GW) and gas with a 21% (7,5 GW).

- **Support mechanisms to renewables energies have played an important role in deploying wind power**. 2013 showed the negative impact of regulatory and political uncertainty for new wind installations. The support level for onshore wind broadly varies by country. The predominant mechanisms to support wind now are feed-in tariffs (FITs) and tradable Green Certificates.

- The drop of the global wind energy market in 2013 is largely attributed to the US market collapse that started at the beginning of the year. The reason was the late extension of the federal Production Tax Credit (PTC).

Introduction. Wind Installed Capacity



- **China was the largest market in 2013, with a new installed capacity of 16.100 MW**. Germany was the second country in terms of new installed capacity, adding 3.238 MW in 2013 . UK came in third place with 1.883 MW, followed by India with 1.729 MW and Canada with 1.599 MW.

- At the end of 2013 the global cumulative installed capacity reached 318 GW, led by China (91 GW), USA (61 GW), Germany (34 GW), Spain (23 GW) and India (20 GW). **The five leading countries account for a share of 76,5% of the global wind capacity.**

- **Germany remains the EU country with the largest installed capacity followed by Spain, the UK and Italy. 15 Member States have more than 1GW of installed capacity,** including two new Member States: Poland and Romania (both had record years installing around 8% of the EU's annual capacity).

Promotion of RES in **Europe**

The **Directive 2009/28/EC** of the European Parliament establishes a common framework for the use of the energy from renewable sources in order to limit the greenhouse gas emissions and to promote a cleaner transport through the definition of National Action Plans.

National Target and Measures	**Each Member State has a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. This target is in line with the overall 20 – 20 – 20 goal for the Community.**
National Renewable Energy Action Plans	**Member States have to establish National Action Plans in order to set the share of energy from renewable energy sources consumed in the production of electricity, transport and heating in 2020.** **These plans will also establish procedures for the reform of planning and pricing schemes, access to electricity networks and promoting energy from renewable sources.**
Cooperation between Members	Member States can exchange an amount of energy from renewable sources using a statistical transfer, and set up joint projects concerning the production of electricity and heating from renewable sources.
Guarantee of Origin	Each Member State must be able to guarantee the origin of electricity, heating and cooling produced from renewable energy sources. The information contained in these guarantees of origin is normalized and should be recognized in all Member States.
Access to and Operation of the grids	**Member States should build the necessary infrastructures for energy from renewable sources in the transport sector.** **Ensure that operator guarantee the transport and distribution of electricity from RES** **Provide priority access to this type or energy.**

Retribution Scheme: **Spain**

- 102.395 MW of installed capacity (2013).
  - Thermal: 36,14%
  - Renewable: 38,88%
    - Wind: 57,50%
    - Solar PV: 11,13%

- At the end of 2013, Spain had **22.959 MW installed of wind capacity** that it´s able to **cover around 21% of its demand**. It´s the fourth country, after China ,US and Germany with the highest wind capacity installed.

- RES targets defined through the 2009/28/EC Directive.
  - **38,1 % of total electricity demand in 2020** should be covered with renewables.
    - Wind: 35.000 MW
    - Solar PV:7.250 MW

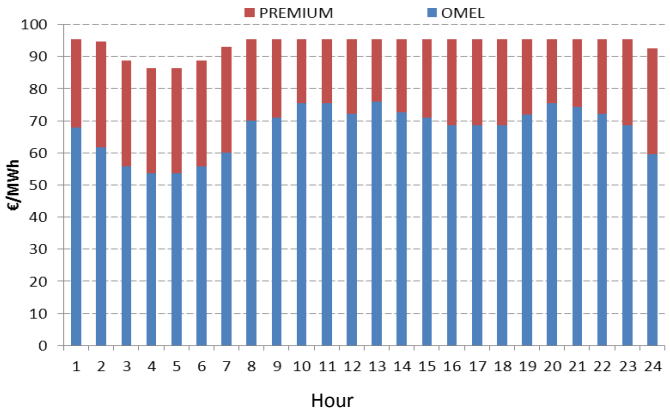
- The **promotion of renewable was done through a Feed In Tariff (FIT) / Market + Premium mechanism** regulated by RD 435 and 661.

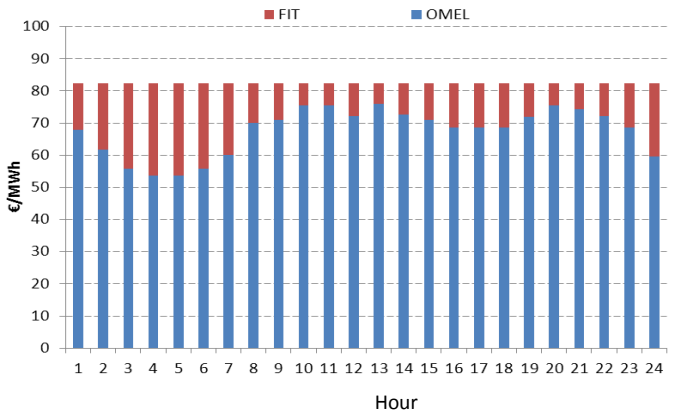
- Regardless on the sale option selected, **every producer should sell the electricity output through the spot market (OMIE Spain)**. Subject to market rules.

- Recent regulatory changes, applicable from July 2013, have removed the FIT/ FIT + Premium for new installations and a retroactive change applied for already installed facilities which set the economic return based on an IRR (internal rate of return) set by the Government (7,4%).

Retribution Scheme: **Spain**

- The economic retribution for renewable energy producers during 2012 was regulated by the Royal Decree 661/07 offer two offtake scheme options:
  - **Market + Premium**. Remuneration is based on the marginal hourly price. It considers a floor and cap price. Floor, Price and Premium are annually escalated based on CPI minus X %.
    - Cap: 95,5 €/MWh. Floor: 80,1 €/MWh. Premium: 32,9 €/MWh
      - If Market + Premium < Floor; Floor
      - If Market + Premium > Floor and < Cap; Market + Premium
      - If Market + Premium > Cap; Cap
      - If Market > Cap; Market
  - **FIT.** Fixed price, for all time periods, annually escalated based on CPI minus X %. (2012: 82,3 €/MWh)

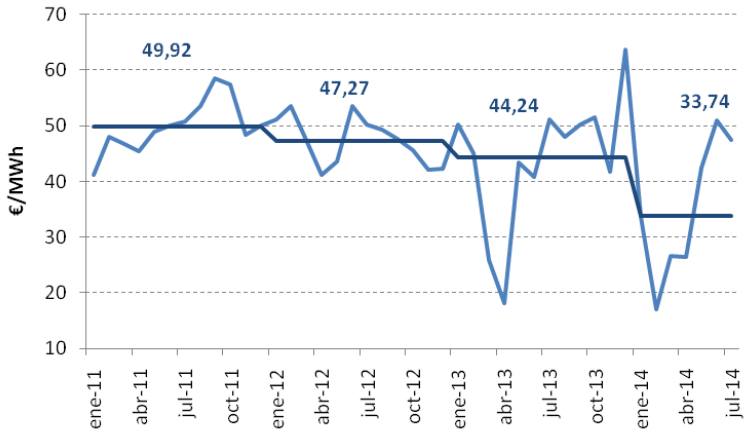




Retribution Scheme: **Spain**

- This retribution scheme is not longer valid from 2013 due to several regulatory changes:
  - Renewable producers that have already achieved a certain IRR (7,4%) will receive just the hourly market price. The IRR is set by the Government.
  - For those producers that **have not yet achieved the IRR, will receive an economic support from the Government until they reach it, once they reach it they will receive the hourly market price from the Government**, they will just receive the market price.
  - This new regulatory regime is applicable to new wind farms as well.

Historical Monthly/Annual Price – OMIE - Spain



Source: OMIE

Retribution Scheme: **Portugal**

- 18.546 MW of installed capacity (2012).
  - Thermal: 42,37%
  - Renewable (excl. hydro): 29,38%
    - Wind: 76,96%
    - Solar PV: 4,03%

- At the end of 2013, Portugal had **4.724 MW installed of wind capacity** that it´s able to **cover around 18% of its demand**. It´s the eleventh country, after China ,US, Germany, Spain, India, UK, Italy, France, Canada and Demark with the highest wind capacity installed.

- RES targets defined through the 2009/28/EC Directive.
  - **55,2% of total electricity demand in 2020** should be covered with renewables.
    - Wind: 6.875 MW
    - Solar PV: 1.500 MW

- A review of the Renewable National Action Plan, published in April 2013, established **no new renewable concessions at least until 2014** and a reduction in the estimated installed capacity by 2020.
  - Wind:5.300 MW
  - Solar PV: 670

- **Initially the promotion of renewable was done through a Feed In Tariff mechanism** based on a formula which take into accounts the total of hours produce during the year among other variables.

- **Once the FIT period ends they producers will sell their output into the spot market** , so they will be subject to market rules.

Retribution Scheme: **Portugal**

- The promotion of renewables is done through a Feed In Tariff mechanism. Wind.
  - COD before February 2006 (Legislative Decree 339-C-2001) **FiT defined on a monthly basis through a polynomial formula** which takes into account different variables as: fixed costs, greenhouse gas avoided, price index etc… so as a brief summary the FiT will be reduced as the net equivalent hours increase.

$$VRD = K \times [\, PF + PV + PA \times Z \,] \times Inflação \times perdas$$

    - FIT price level will be between 100 -90 €/MWh based on wind resource
    - **Period: 15 years from COD**. Once the periods ends, facilities will receive the market price.

  - COD after February 2006(Legislative Decree 225/2007). Same formula, different coefficients.
    - FIT is not linked to the cumulative number of hours produced. Z value is constant: 4,6. Current price level: 75 – 90 €/MWh).

- In 2012, Portugal published the Decree 25/ 2012 which suspends concession of new connection points to the grid, this applies to all renewable installations.

- **Wind energy sector and Portuguese Government reached an agreement for the extension of the FIT period (15 years)** offering to the producers the option to extend the period **to 20 – 22 years in return of an annual payment** by the producers. This option is only applicable to wind farms with COD before February 2006.

- The Government proposed **4 alternative tariff schemes to be elected** by each of the wind developers, providing
  - alternative cap and floor prices applicable to market prices (OMIE – Portugal);
  - alternative durations to the new scheme; and consequently
  - alternative levels of investment (on a MW basis)

Retribution Scheme: **Portugal**

- Portugal FIT formula applicable is the following:

$$VRD = K \times [\, PF + PV + PA \times Z \,] \times Inflação \times perdas$$

Where:

VRD: Monthly Payment

K: Modulation factor. For every project K = 1.

PF (Parcela Fixa): Fixed Payment

$$PF = PF(U)_{ref} \times COEF \times POT_{med}$$

$$PF(U)_{ref} = 5.4369\ € / kW = 5\,436.9\ € / MW$$

$$COEF = ECR / (576^* \times POT) \qquad ECR = \text{Monthly Production}$$

$$POT_{med} = \min \{ POT ; [ECR / (24 \times 30)] \} \qquad ^* 576 = 0.80 \times 24 \times 30$$

PV (Parcela Variavel): Variable Payment

$$PV = PV(U)_{ref} \times ECR$$

$$PV(U)_{ref} = 0.0249\ € / kWh = 24.9\ € / MWh$$

$$ECR = \text{Monthly Production}$$

PA (Parcela Ambiental): Environmental Payment

$$PA = ECE(U)_{ref} \times CCR_{ref} \times ECR$$

$$ECE(U)_{ref} = 0.000075\ € / g\ CO_2 = 75\ € / t\ CO_2$$

$$CCR_{ref} = 370\ g\ CO_2 / kWh = 0.37\ t\ CO_2 / MWh$$

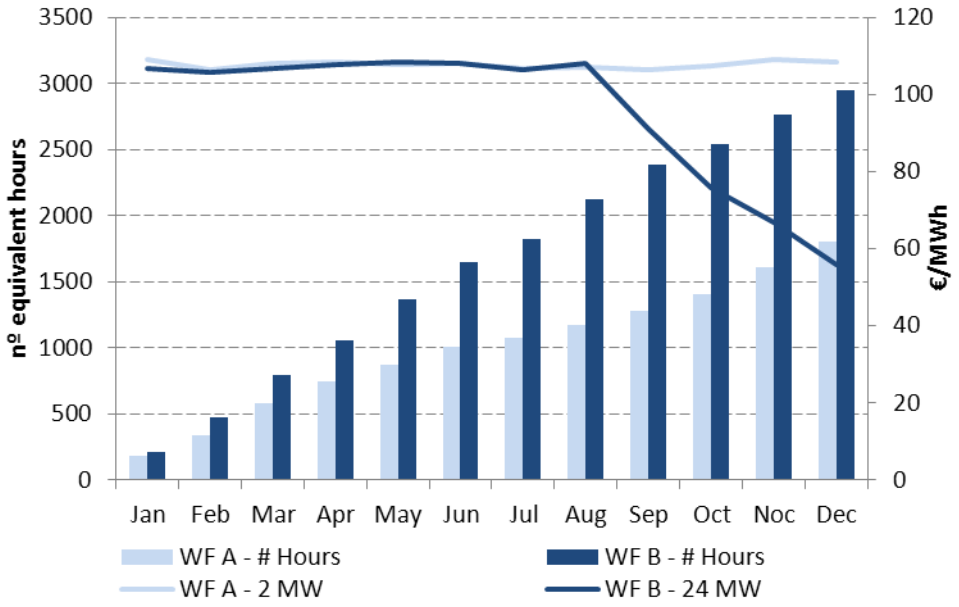
$$ECE(U)_{ref} \times CCR_{ref} = 75\ € / t\ CO_2 \times 0.37\ t\ CO_2 / MWh = 27.75 / MWh$$

$$ECR = \text{Monthly Production}$$

Retribution Scheme: **Portugal**

- **Inflaçao** (CPI): IPC_{m-1} / IPC_{ref} where the IPC ref applicable:
  - Wind farms and Solar PV under Decreto-Lei n.º 339-C/2001: December 1998
  - Wind farms under Decreto-Lei n.º 225/2007: COD

- **Perdas** (Losses):1/(1-LEV) where LEV:
  - < 5 MW: 0,035
  - >= 5 MW: 0,015



- **Z Coefficient for wind farms:**

Z DL 339 C/01	# hours	Z DL 225/07
1,70	0-2.000	4,60
1,30	2.000-2.200	
0,95	2.200-2.400	
0,65	2.400-2.600	
0,40	2.600-8.760	

- **Z Coefficient for Solar PV**

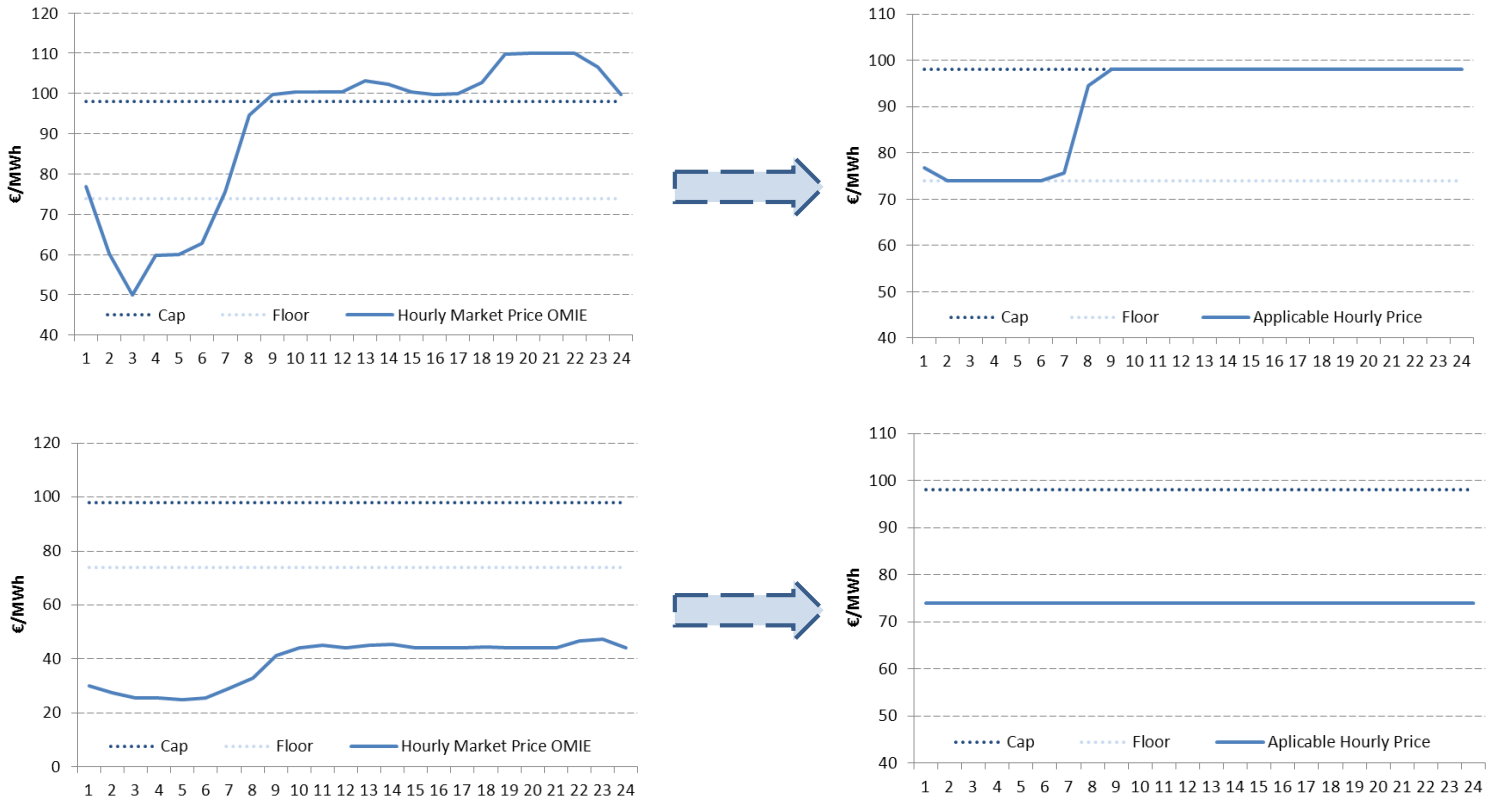
Z DL 339-C/01
6,55

Retribution Scheme: **Portugal**

Regime	FLOOR	CAP	N	PAG_{min}
A	74 €$_{2020}$/MWh	98 €$_{2020}$/MWh	5	5000 €/MW
B	74 €$_{2020}$/MWh	98 €$_{2020}$/MWh	7	5800 €/MW
C	60 €$_{2020}$/MWh	não existente	5	5000 €/MW
D	60 €$_{2020}$/MWh	não existente	7	5800 €/MW

- **Cap and floor prices applies on monthly basis**
  - Average Monthly Market Price < Floor: Floor
  - Cap > Market Price > Floor: Average Monthly Market Price
  - Average Monthly Market Price > Cap: Cap

- Once the additional periods have been completed, facilities will just receive the market price. (OMIE – Portugal).



Retribution Scheme: **Italy**

- 128.134 MW of installed capacity (2012).
  - Thermal: 59,92%
  - Renewable (excl. hydro): 22,72%
    - Wind: 27,88%
    - Solar PV: 56,40%

- At the end of 2013, Italy had **8.552 MW installed of wind capacity** that **it´s able to cover around 3% of its demand**. It´s the seventh country, after China,US, Germany, Spain, India and UK, with the highest wind capacity installed.

- RES targets defined through the 2009/28/EC Directive.
  - **26,39% of total electricity demand in 2020** should be covered with renewables.
    - Wind: 12.680 MW
    - Solar PV: 8.000 MW

- The **promotion of renewables is done through** different Renewable Energy Decrees, initially was a **Green Certificate mechanism** while the **latest Decree introduced an auction mechanism** that applied for new installations from January 2013.

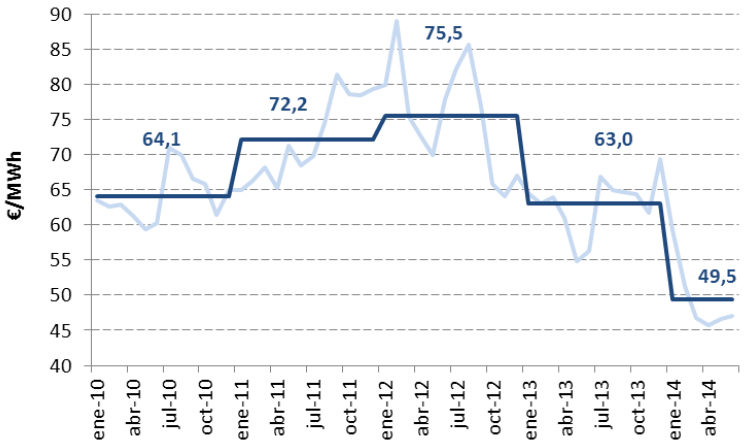
- Renewable producers, before January 2013, sell their output into the spot market (GME – Gestore Mercati Energetici) and receive the hourly spot price plus **Green Certificates for 15 years from COD (1 MWh = 1 GC)**. The sale into the spot market is done through an intermediary: GSE (Gestore Servici Energetici).

- **GSE has the obligation of buying all green certificates unsold at a regulated price. The price is set through the following formula: 0,78 x(180-PUN).**

Retribution Scheme: **Italy**

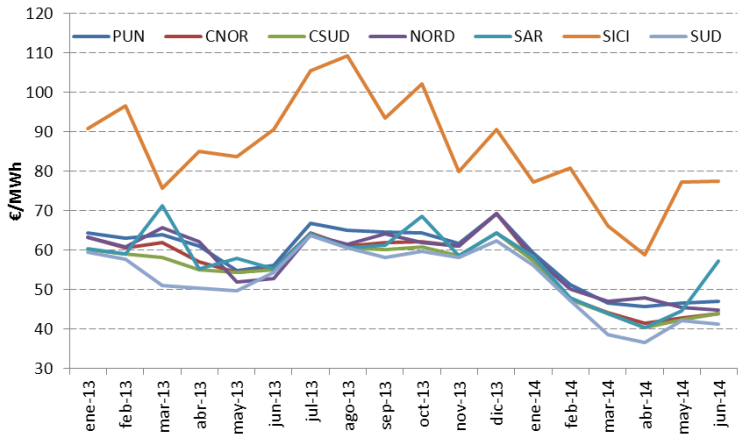
- PUN: National Price. Annual average of the 6 zonal market prices in Italy (North, Central Northern, South, Central Southern, Sicili and Sardegna).

Historical Monthly/Annual PUN Price (01/10 – 07/14)



Source: GME

Historical Monthly Zonal Power Prices (01/10 – 07/14)



Source: GME

- **From 2016 onwards, green certificates scheme will be converted into a Feed In Premium scheme. The premium will be calculated based on the same formula used to calculate the price of the green certificates unsold.**

- From 2013: Auction mechanism. For wind, there is a annual quota of 500 MW applicable to the period 2013 – 2015,
  - **Period: 20 years**
  - Wind farms with an installed capacity higher than 5 MW can participate into the auction,
  - Requirement: Bid bond equal to 5 of the construction costs.
  - Results of the first Auction: 117 €/MWh – 442 MW.

Retribution Scheme: **Poland**

- 37.907 MW of installed capacity (2011).
  - Thermal: 89,09%
  - Renewable (excl. hydro): 5,37%
    - Wind: 79,33%
    - Solar PV: 0%

- At the end of 2013, Poland had **3.390 MW installed of wind capacity** that it´s able to **cover around 4% of its demand**. It´s the 13th country, after China and US, with the highest wind capacity installed.

- RES targets defined through the 2009/28/EC Directive.
  - **19,13% of total electricity demand in 2020** should be covered with renewables.
    - Wind: 6.650 MW
    - Solar PV: 3 MW

- **The promotion of renewables is done through a green certificates mechanism. (1 GC = 1 MWh).** RES producers will be eligible to receive green certificates for a period of 15 years.

- Renewable producers have **two options to sell their electricity:**
  - Spot market (POLPX)
  - Regulated distributor who has the **obligation of buying the electricity at a regulated price** being the regulated price the **annual average of the spot market of previous calendar year**.

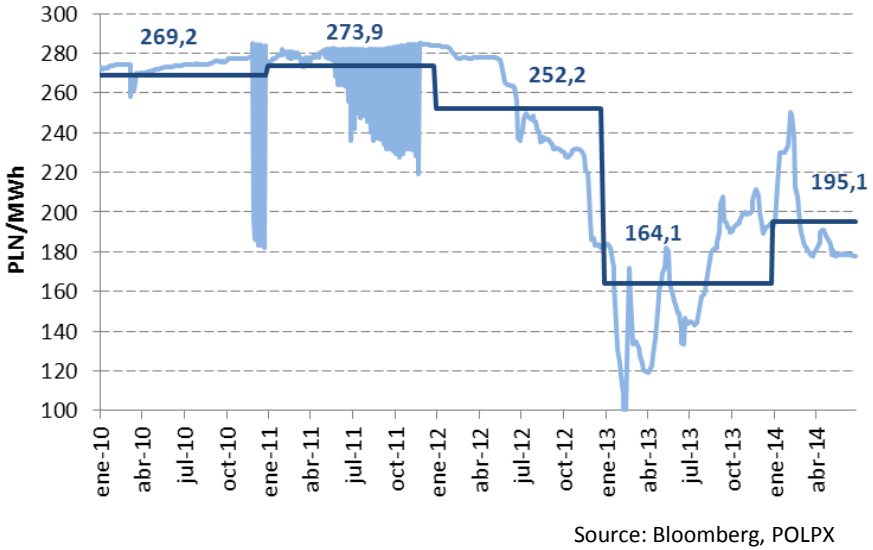
- Most of the producers chose the second option due to they have guaranteed the sale of electricity and because they are not subject to volatility coming from the spot market.

Retribution Scheme: **Poland**

- **Green Certificates market have shown to be very sensitive to regulatory changes**. During the last 2 – 3 years Poland have been through a regulatory change affecting renewables. **The uncertainty during these years have affected the prices**.

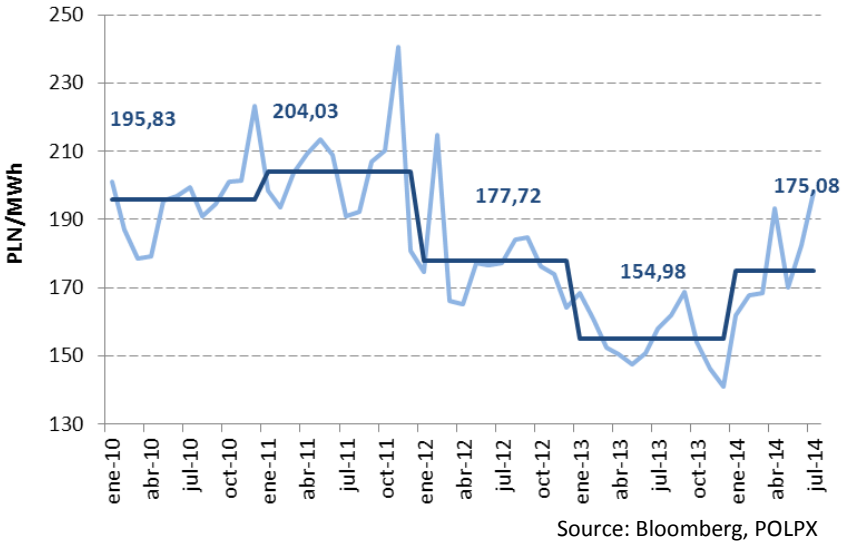
- RES producers tries to sign a bundled PPA which includes the price of the electricity and green certificates so they look for securing the sale of electricity and green certificates.

Green Certificate – Historical Prices (Jan'10 – Jul'14)



Source: Bloomberg, POLPX

Electricity – Historical Prices (Jan'10 – Jul'14)



Source: Bloomberg, POLPX

- Final Price: Electricity (Annual Average of Spot Market)+Green Certificates.

Retribution Scheme: **Germany**

- 174.238 MW of installed capacity (2012).
  - Thermal: 51,87%
  - Renewable (excl. hydro): 39,95%
    - Wind: 43,12%
    - Solar PV: 46,70%

- At the end of 2013, Germany had **34.250 MW installed of wind capacity** that it´s able to **cover around 10% of its demand**. **It´s the third country, after China and US, with the highest wind capacity installed.**

- RES targets defined through the 2009/28/EC Directive.
  - **35% of total electricity demand in 2020** should be covered with renewables.
    - Wind: 45.750 MW
    - Solar PV: 51.753 MW

- **The promotion of renewables is done through the Renewable Energy Sources Act** (*EEG - Erneuerbare-Energien-Gesetz*)
  - **Priority access for renewables to the grid.**
  - **Obligation to grid operators to purchase the electricity produced from renewable energy sources.**
  - **FiT established for 20 years (differentiated by source, size and COD).**
    - 2013 Wind FiT: 88 €/MWh for the first 5 years, 48 €/MWh for the remaining 15 years.
    - Tariff price level is reduced 1,5% p.a. for new installations. E.g. 2015 COD will have a FIT of 85,38 €/MWh.
    - Tariffs are not subject to indexation
  - Revision every three to four years.

Retribution Scheme: **Germany**

- **After the nuclear disaster of Fukushima, Germany decided to move away from nuclear and increase the promotion of renewables**. All nuclear plants should be closed by 2022 (Current nuclear capacity: around 12.000 MW).

- In 2012, the EEG was amended to introduce a **Market Premium Model, that offers the option to RES producers to sell their output directly in the spot market and get a premium over the FIT.**

- The goal of the market premium is to **increase the participation of new and existing renewables energy generators in the market (EPEX Spot).**

- Renewable energy producers have the same degree of responsibility as operators of conventional power plants: sell their electricity themselves or with the aid of electricity traders on the competitive market, make their own forecasts and be responsible for the costs of balancing energy if they divert from their forecasts.

- How it works?
  - Renewable energy producers **sell their output into the spot market (EPEX Spot – Germany) and receive the hourly market price.**
  - The **Market Premium will be calculated on a monthly basis** as follows:
    - (FIT project – Reference Price). So the FIT price level is secured.
      - **Reference Price: Weighted wind average price (taking into account all wind projects in Germany).**

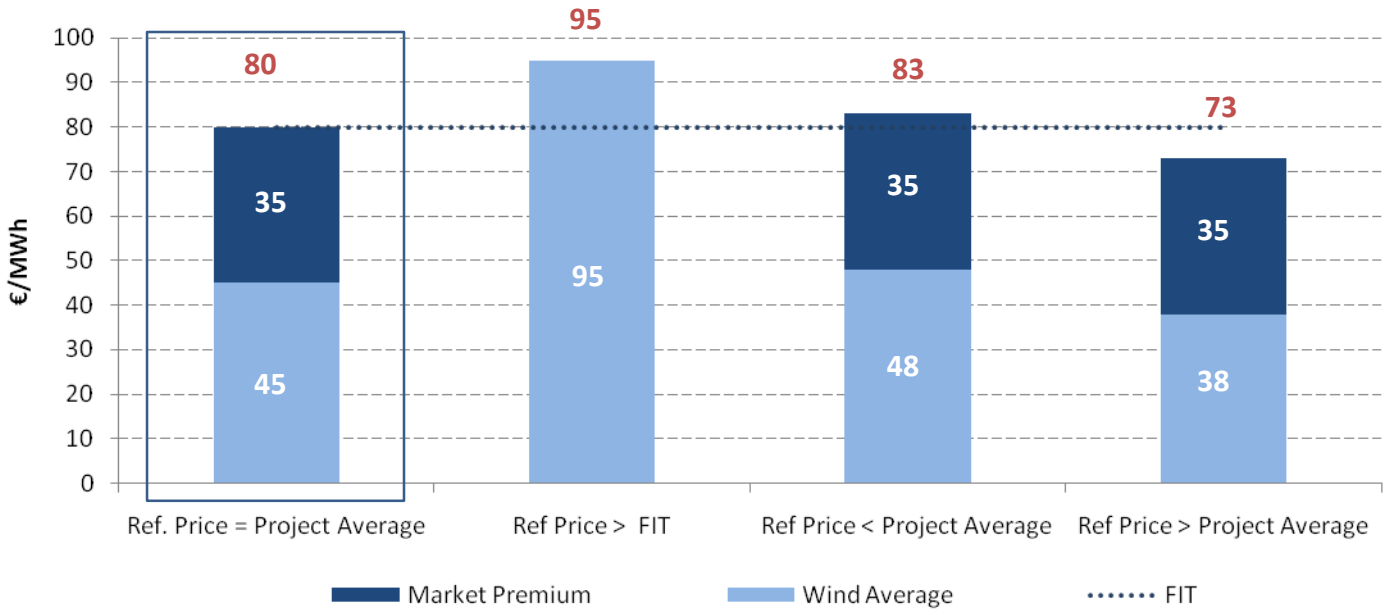
- Additionally to the Market Premium, the renewable energy producers will receive:
  - The **Management Premium**. The value of the management premium is **to cover the costs associated to sell their output in the spot markets** (fees, forecasting, unbalancing charges…). 2013: 1€/MWh., from 2014 onwards 0,85 €/MWh.
  - The **Remote Control Bonus**: which allows traders to curtail the production in scenarios of negative market prices. (Epex Spot: Cap: +3.000 €/MWh Floor: -500 €/MWh.

Retribution Scheme: **Germany**

- According to the latest figures from transmission system operators almost half of electricity from renewable sources is sold by producers directly on the electricity exchange and is thus fully integrated into the wholesale electricity market.

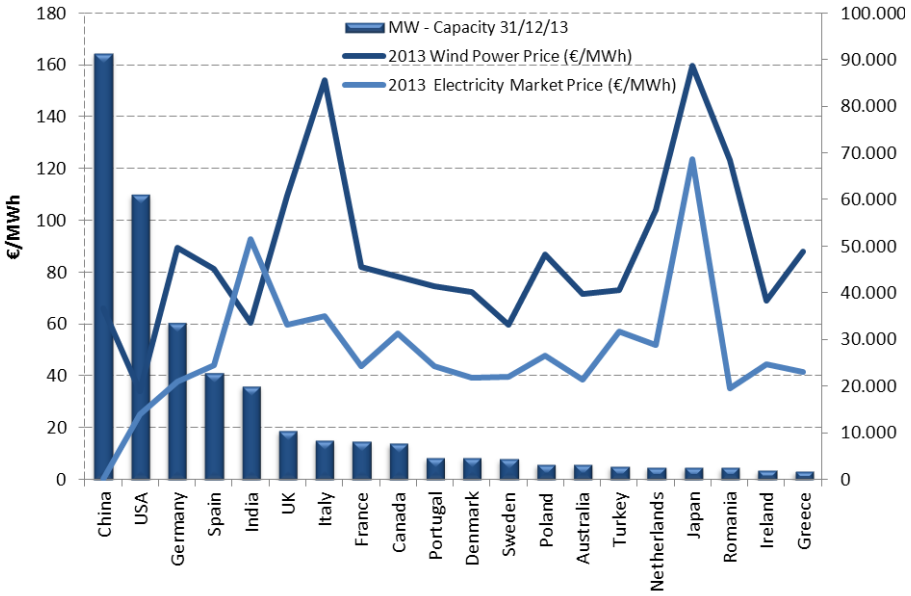
- There is a risk related coming from the price difference between:
  1. The weighted average of the project.
  2. The weighted average price of all wind projects in Germany. Reference Price.

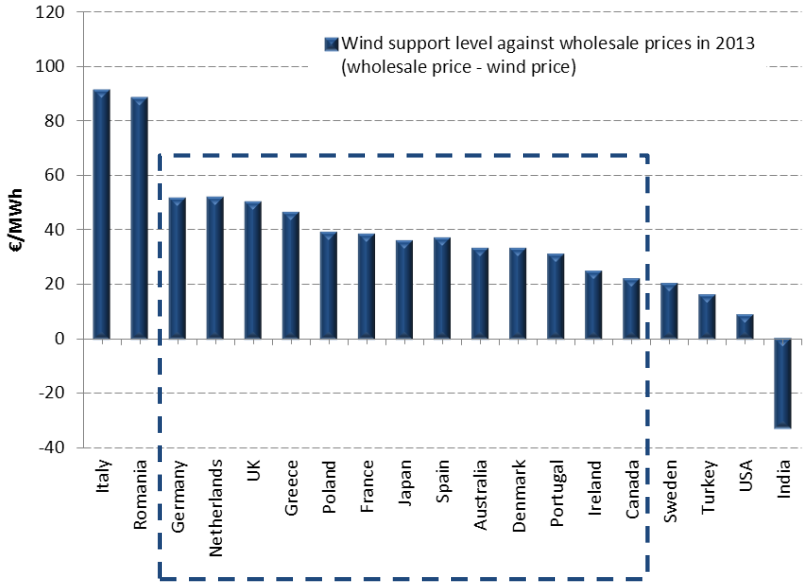
- The Market Premium will be calculated based on (2) instead of (1). (1) could be higher or lower than (2). The risk will be when (1) is lower than (2) because Market Premium will be paid from (2) price level.



- Market Premium can be zero if power prices are high enough to cover the FIT price level.

Level of Support – Wind – 2013





- The support level for onshore wind broadly varies by country. The predominant mechanisms to support wind now are feed-in tariffs (FITs) and tradable Green Certificates.
- **Japan (159 €/MWh) with a very generous FIT, was the country where the wind projects get the highest price,** followed by Italy (154 €/MWh) and Romania (123 €/MWh).
- Italy, with a support mechanism based on green certificates, was the country with the highest support level against the market wholesale prices (91,29 €/MWh).
- Most countries showed a wind price higher than the wholesale price. **The average wind support in 2013 oscillated between 30–55 €/MWh above the wholesale market price of electricity.**

Retribution Scheme: **Conclusions**

- Based on current supporting schemes for renewable:

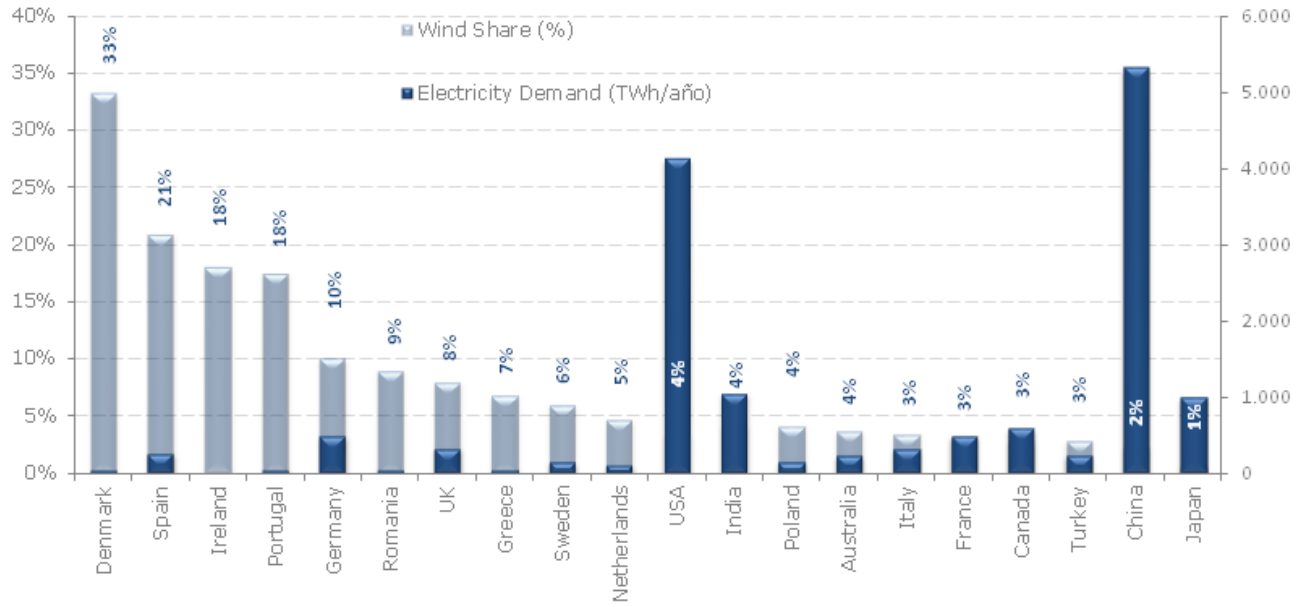
  - **Long Term Price Signal.**
    - Bankable. Easy to get finance.
    - Attractive to investors.
    - **Average Term: 15 – 20 years.**

  - **Broken by Technology**.
    - Not all technologies have the same cost so the price level must be different based on the technology.
    - Economic conditions: term, indexations etc…should be equal for all technologies.

  - **In line with RES targets.**
    - Retribution scheme it´s the key element to reach renewable energy goals based on a renewable energy plan.

  - Combination with conventional technologies.

Wind Share



- **The wind power capacity installed by the end of 2013 in the EU**, would produce in a normal wind year 257 TWh of electricity, representing **8% of the EU's electricity consumption** (a 14% more than the year before).

- **Denmark (33%) and Spain (21%) remain as the countries with the highest penetration of wind power in electricity consumption.**

- Market and System operators, have had to accommodate their rules in order to increase the integration and participation of renewable energies into the grid.

Characteristics of selling RES production into the spot markets

- Due to the extraordinary growth of renewables around the world ,**market and system operators, have had to accommodate their rules in order to increase the integration and participation of renewable energies into the grid**.

- Most of the procedures were designed when the **fuel mix was dominated by conventional technologies**. Each market and system operator have their own requirements based on the energy sector (Market) structure / maturity.

- For those producers that need to sell their output in the system: Spain, Italy, Germany…

- **From the view of a Market Operator.**
  - Economic Offers:
    - The economic offer submitted to the market operator must be based on variable costs. Variable costs for renewables is 0 €/MWh due to the fuel is free so their economic offer would be 0 €/MWh.

    - Depends on market floor prices the economic offer could be more or less complex.
      - Less Complexity: Spot markets with positive floor prices. Normally 0 €/MWh. In this case renewable producers will act as price takers.

      - More Complexity: Markets with negative prices (willing to pay to generate). In this market the offer can be more complex.

        - » Example: use the incomes received from other attributes than the energy to set the economic offer. So if a wind farm receives REC and the REC price is 3 €/MWh it will be able to offer up tp -3 $/MWh in order to match.

Characteristics of selling RES production into the spot markets

- **From the view of a Market Operator.**
  - Intraday Markets:
    - **Day Ahead forecast**. Every producer have to submit an offer (volume, price) for the next 24 hours the day before.
      - Commonly, the basis forecast requested is for day D+1 (one day before the delivery day): including energy schedule for the 24h of D+1. Some other markets/TSO request longer timeframes for example: scheduled production for the next 7 days on a hourly basis
      - Energy **Forecast is one of the most common requirements implemented by markets and TSO in order to facilitate the integration of RES into the grid**. This is mainly due to the fact it **helps the TSO to estimate how much of their energy mix will be coming from an intermittent resource in the short term**.
      - Energy forecast is prepared based on resource, which is mainly coming from meteorological prediction /statistical models combined with other information like wind farm availability.
      - **The forecast will be more accurate at shorter timeframe than further timeframes. There are significant improvements in forecast accuracy as the time horizon decreases.**

Characteristics of selling RES production into the spot markets

- **From the view of a Market Operator.**
  - **Intraday Markets:**
    - Intraday Markets allow market participants to sell or buy the energy above or below their original schedules.
    - A key issue on forecasting is to **have the possibility to update the schedule** submitted on the Day Ahead during the Delivery Day to **reflect wind resource changes or wind farm availability**. This is commonly called Intraday Markets.
    - Around Europe there are mainly 2 types of intraday markets:
      - » Continuous intraday market like EPEX spot. Price set by Bid/Offers. No matching process.
      - » Several intraday sessions with detailed timeframes like OMIE (Spain) or GME (Italy). Intraday price is set using the same matching process as the one used in the Day Ahead Market.
        - Example: 6 Intraday Sessions in OMIE

	SESSION 1º	SESSION 2ª	SESSION 3ª	SESSION 4ª	SESSION 5ª	SESSION 6ª
Session Opening	17:00	21:00	01:00	04:00	08:00	12:00
Session Closing	18:45	21:45	01:45	04:45	08:45	12:45
Matching Results	19:30	22:30	02:30	05:30	09:30	13:30
Reception of Breakdowns	19:50	22:50	02:50	05:50	09:50	13:50
Publication PHF	20:45	23:45	03:45	06:45	10:45	14:45
Schedule Horizon (Hourly periods)	27 horas (22-24)	24 horas (1-24)	20 horas (5-24)	17 horas (8-24)	13 horas (12-24)	9 horas (16-24)

Characteristics of selling RES production into the spot markets

- From the view of a **System Operator.**
  - The most common requirements implemented by markets and TSO in order **to facilitate the integration of RES into the grid is the forecasting**. This is mainly due to the fact it helps the TSO **to estimate how much of their energy mix will be coming from an intermittent resource in the short term**.

  - **Unbalancing Penalties. Applicable to the difference between the forecast and real production.**
  - Not all market apply unbalancing penalties to renewable producers however all conventional producers are subject to them. Spain, Poland, Germany, France etc… apply unbalancing penalties to renewable producers. Italy is in the middle of the process of implementation.
    - Example: If D+1 forecast from a renewable producer for a given hour is 100 MW and in real time is only able to provide 50 MW (suddenly loss of 50 MW), they SO need to call other producer to be able to supply the 50 MW missing and that have an associated cost.
    - There are mainly two types of unbalancing prices:
      - Dual Price: Spain or Italy.
      - Single Price: Germany.
    - Basic Concepts:
      - If the producer is deviated and that deviation helps the system: Benefit (dual price)
      - If the producer is deviated and the deviation makes worse the balance (supply demand) of the system: Penalty
      - Unbalancing price is normally coming from the cost of correcting the deviations

Characteristics of selling RES production into the spot markets

- When TSO/markets decide to **introduce the forecasting process it goes together with measures which try to help the market participants/facility** to familiarize and get involved in the forecasting process.
  - **Franchise**. They allow a certain volume, (in terms of %), not subject to penalties.
  - **Economic Incentives**. In an early stage, forecast submittal is voluntary so to incentivize producers to start preparing the forecast and markets/TSOs to introduce an economic premium.
  - **Testing period**: Countries where initially renewable producers were not obligated to submit the forecast and it´s implemented later, usually introduce a testing period to set of around one year in order to give time enough to be familiar with the new process. Sometimes this testing period includes a premium to incentive the participation and to cover the cost associated with the forecasting process. Examples: Italy, Germany…

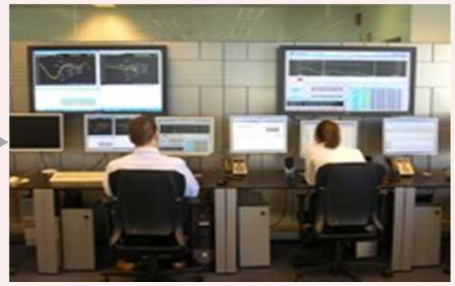
Characteristics of selling RES production into the spot markets

- Coordination between producers and system operators:
- System operators and renewable energy generators have to have common tools to coordinate actions in order to manage the integration of renewable into the grid. **These tools help to have an efficient communication between grid operators and renewable energy generator to ensure they are integrating into the grid the maximum volume of renewable energy under secure conditions.**
- For example in Spain the **Spanish TSO: Red Eléctrica de España (REE) have created a Control Center focused on renewable energies called: CECRE (Centro de Control de Energías Renovables** (Renewable Energy Control Center). This is done in order to **foresee the operating measures** that should be applied in each case, so that the system returns to a safe condition.
  - Ability to anticipate possible incidents in the system due to sudden losses in wind power generation.
  - Diagnoses and assessments are carried out in real time due to the effects that hypothetical voltage dips would have on the system.
- **All the generation coming from renewable energy producers set up in Spain are managed and controlled by CECRE**. CECRE is an operation unit integrated into the Electrical Control Center (CECOEL). CECRE is the **sole interlocutor in real time between CCOEL and each of the authorized generation control center, to which the wind farms are connected.**

Characteristics of selling RES production into the spot markets

RES Facilities (Producers)

Energy Management – OMEL



Day Ahead
Intra Day
Markets

Aggregated Schedule

Schedule Disclosure (Nomination)

Adjustment Services
Markets

CECOER – REE

Daily submission of
Hourly Schedule for D+1
(Availability, Constrains …)
24 x 7

Curtailments and
Technical Constrains
Communication

CECRE

Forecast Supplier.

Hourly forecast updates.
Submission of forecasted production based on weather
(meteorological models + historical production)

Characteristics of selling RES production. Conclusions

- **Statistical models** used to prepare the forecast have to be **frequently updated and calibrated to reflect the changes registered into the wind profile**. Wind profile is more volatile on the short term.

- **Monitor deviation figures frequently**, even without penal implications in order to identify potential improvements.

- Deviations are calculated based on the following formula (Real Production – Schedule)/Real Production. Likely deviation increases during the summer season due to a lower production and decreases during the winter due it´s the windy season for example in Spain. The wind profile has a big influence on the calculations so these numbers can be different in other countries.

- **Work closely with System Operators to develop together new procedures adapted to RE characteristics**, different from conventional ones. Special focus on short term flexibility (intraday).

- Encourage, in coordination with TSOs, **a progressive transition towards deviation penalties systems** (If applicable).

- Monitor TSO best practices, and demand proper system operation with minimizing balancing costs**. An accurate and reliable wind power generation forecast is crucial in order to minimize the wind farm's imbalance costs**.

Certificates Mechanism in Europe

How it works?

- The mechanism of green certificates **is a form of incentives for the production of electricity from renewable sources.**
- This mechanism is **based on the mandatory rule that producers of electricity generated from non-renewable sources/retailers, must generate/buy a share of electricity produced by plants using renewable sources.**
- The **requirement may also be satisfied through the purchase of GC,** corresponding to the amount due, proving the generation of electricity from renewable sources carried out by any other producer.
- Renewable producers are eligible to receive tradable green certificates linked to its production.
- Mainly there are two ways to set the green certificate value based on the technology (wind, solar..)

1. **Standard Green Certificate**.
   - To calculate the number of green certificates there will be a factor to apply. So for example wind farms will receive 1 GC per 1 MWh produced and solar PV will receive 2 GC per MWh.
   - These certificate have a single value applicable for all technologies.
   - Example: Poland, Italy

2. **Green Certificates classes.**
   - For all technologies 1 MWh = 1 Green Certificate. The value of the certificate will vary by technology (different quotations).
   - Example:

Certificates Mechanism in Europe: Italy

ITALY

- Renewable energy producers will be eligible to receive green certificates for a **period of 15 years.**
- Eligible entities**: Producers and importers of electricity generated from non-renewable sources,** must annually introduce into the national electricity system a minimum share of electricity produced by plants using renewable sources.
- **A multiplicative factor must be applied to calculate the number of green certificates** generated by technology.

	Source	Multiplicative Factor
1	Wind (plants with a capacity of more than 200 kW)	1.00
1 bis	Off-shore wind	1.50
3	Geothermal	0.90
4	Waves and tides	1.80
5	Hydro (other than the one indicated in the previous point)	1.00
6	Biodegradable waste and biomass (other than the one indicated in the following point)*	1.30
7	Biomass and biogases obtained from agriculture, animal husbandry and forestry on a short supply-line basis	1.80
8	Landfill gas, sewage treatment plant gas and biogases (other than the ones indicated in the previous point)	0.80

- GSE has the obligation to buy the unsold green certificates of every year. The price is regulated through a formula linked to the national electricity price (PUN).

	GSE - GC price €/MWh
2012	80,34
2013	89,28

0,78 x (180 – PUN)

Certificates Mechanism in Europe: Conclusions

- Establish a regulatory framework **to guarantee a strong demand**. Liquidity
  - Identify **who will be the eligible entities.** Conventional producers, retailers etc…
  - Set an **annual percentage of renewable** energy in line with the country renewable energy goal (percentage that renewable energy must cover over demand)

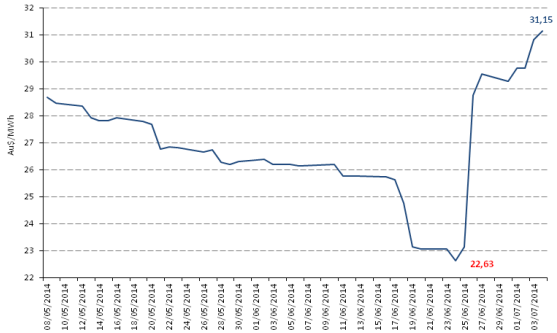
- Green Certificate markets are **sensitive to regulatory changes**, specially the price, which usually reflect those changes quickly. Example: Poland or Australia . To establish a cap and floor price could help to keep price in a certain price level..

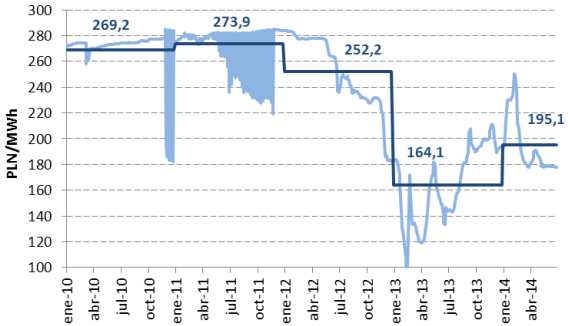
- To reinforce the action from eligible entities an **economic penalty must apply for those entities that do not reach the annual goal**. Penalty value must be linked to market prices.

- Supply Demand Balance. Example:
  - Poland

  - Australia:
    - Household solar PV had the option to receive the GC that the facility will produce during its whole lifetime, this made to have very high number of green certificates in the market what depressed the market value. Solution: Split the certificates into Small and Large scale GC.
    - Despite of splitting the markets, what helped, later regulatory changes have brought a level of uncertainty that hit the price again.

- **Reinforce the green certificate mechanism with other measures like: fiscal incentives like PTC** (Production Tax Credit) in US.





Certificates Mechanism in Europe

National Target and Measures	Each Member State has a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. This target is in line with the overall 20 – 20 – 20 goal for the Community.
National Renewable Energy Action Plans	Member States have to establish National Action Plans in order to set the share of energy from renewable energy sources consumed in the production of electricity, transport and heating in 2020. These plans will also establish procedures for the reform of planning and pricing schemes, access to electricity networks and promoting energy from renewable sources.
Cooperation between Members	Member States can exchange an amount of energy from renewable sources using a statistical transfer, and set up joint projects concerning the production of electricity and heating from renewable sources.
Guarantee of Origin	**Each Member State must be able to guarantee the origin of electricity, heating and cooling produced from renewable energy sources.** **The information contained in these guarantees of origin is normalized and should be recognized in all Member States.**
Access to and Operation of the grids	Member States should build the necessary infrastructures for energy from renewable sources in the transport sector. Ensure that operator guarantee the transport and distribution of electricity from RES Provide priority access to this type or energy.

Certificates Mechanism in Europe: GoO

Guarantee of Origin.

- **Each Member State must be able to guarantee the origin of electricity**, heating and cooling produced from renewable energy sources.

- The information contained in these guarantees of origin is normalized and **should be recognized in all Member States**. GO: an electronic document which identifies, for a MWh of electricity:
  - Fuel used
  - Technology

- **Standardized product to works across Europe** that tell people/companies **where their electricity comes from**. It allows consumers to choose what sort of electricity they get.

- AIB is the company in charge of managing the European Energy Certificate System (EECS) which offers a framework for creating and transferring electronic documents (EECS Certificates). **For each megawatt-hour of energy, EECS certifies the quality of its source and/or the method of its production.** Not all Member States have signed an agreement with AIB so they are having issues with other countries accepting their GoOs.

- GoOs are **valid for a period of 1 year from the issuance date**.

- **Traded separately from electricity**. GoOs are mainly traded through bilateral contracts (spot/forward) although EEX (European Energy Exchange) have recently launched a future markets for some classes of GoOs (hydro, wind…). EEX requirement: GoOs must be coming from countries with a signed agreement with AIB.

- **Exporting GoO are not compatible with FIT, Feed in Premium or Green Certificates** due to it is considered double accounting. If a renewable producers ask for GoO to export due to an economic transaction, that volume of energy will be exempt to receive the supporting scheme of its country.

- Current GoO price level is really low: 0,10 -0,40 €/MWh.