Renewables in the EU
The support towards a single energy market

EU countries reporting under Article 22(1) (b), (e) and (f) of the Renewable Energy Directive

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EU Climate and Energy Framework

- **GHG emissions**
  - 20% reduction by 2020
  - 40% reduction by 2030

- **Energy consumption**
  - 20% reduction by 2020
  - 30% reduction by 2030

- **Overall RES share**
  - 20% by 2020
  - 27% (35%) by 2030

- **RES-E share**
  - 34% by 2020
  - 50% by 2030

Timeline:
- 2000
- 2005
- 2010
- 2015
- 2020
- 2025
- 2030
Database RES policy support (2010-2014)

Electricity – Heating/Cooling – Transport

**Overall support measures** (economic, administrative, financial, regulatory) in EU countries for RES deployment

Art.22 (1) b, e, f of Directive 2009/28/EC

Support schemes, Administrative procedures, Transmission

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit support</th>
<th>Overall support</th>
</tr>
</thead>
</table>

~ 10,000 entries in the database
Key points

Support schemes → major drivers for RES-E investment in the EU

Most used schemes → Price driven schemes (feed-in-tariffs, etc)

Major policy trends → more feed-in premiums and tenders

→ mainly technology-specific support

For almost all EU countries the incentive seems high enough to cover the cost of the electricity produced
Outline

1. Progress of renewables in the EU
2. Support schemes for RES
3. Who applies what? – focus on Solar PV & Wind
4. Key Takeaways & Policy challenges

Appendix - Case studies – Germany, Italy, UK, Denmark
1. Progress of renewables in the EU
Progress of renewables in the EU, 2016

Overall RES share **17%** of Gross Final Energy Consumption

RES-E → **29.6%**

RES-H&C → **19%**

RES-T → **7.1%**
RES-E share in the EU countries
Gross Final Electricity Consumption, 2016
Share of solar PV in the EU countries
Gross Final Electricity Consumption, 2016
Share of wind in the EU countries
Gross Final Electricity Consumption, 2016
2. Support schemes for Renewables
Support Schemes for Renewables

Idea:

Cost of RES-E Generation > Market Prices

Support schemes need for to cover this difference

General requirements – EU Guidelines SWD(2013) 439 final

- Flexible and freedom of choice;
- Responsiveness to reductions of technology cost;
- Removed when RES technologies became cost competitive;
- Incentivising market instruments gradually;
- Stability of regulatory framework (to strengthen of investor confidence)
- Ensuring efficiency of RES deployment using cooperation mechanism
Support Schemes for Renewables

**Regulatory & Direct** (either focused on investment or generation)

- **Price driven:** Investment Subsidies, Feed-in Tariffs, Premiums, Tax Incentives
- **Quantity driven:** Tenders, Quotas obligation with Tradable Green Certificates (TGC)

**Regulatory & Indirect** *Environmental taxes*

**Voluntary** *Green tariffs, agreements, contribution shareholders programs*
Support Schemes for Renewables

How do they work?

Schematic representation of the support mechanism for the 4 main schemes

€/MWh

- FIT
- Market Price
- Constant FIP
- Market Price
- Sliding FIP
- Market Price
- Average Certificate Price
- Market Price

Feed-in-Tariff
Fixed Feed-in-Premium
Sliding Feed-in-Premium
Quota (TGCs)
3. Who applies what?

– focus on Solar PV & Wind
Support Schemes for RES: Who applies what?

Feed-in-tariff (FIT)
- Guaranteed access to the grid;
- Long-term purchase agreement to cover cost of RES-E generation;
- Based on cost of RE generation.

Feed-in-Premium (FIP)
Constant/Cap & Floor/Sliding

Quota obligation + TGCs
- Compulsory share of RE for consumers;
- Certificates for RES-E producers;
- Market for certificates;
- Penalties

Tendering procedures
- Maximum support level
- Quantity
FIT Average support - PV & Wind (2010-2014)

Higher average support level for solar PV compared to wind
Larger dispersion of average support level for solar PV
Interquartile range of average support – greatest for solar PV
Larger decrease of average support level for solar PV
Solar PV

Feed-in-tariff - 16
AT, BG, CZ, EL, ES, FR, HR, LT, LU, MT, PT, SI, SK, UK, HU, DE

Constant FIP - 6
CZ, DE, EE, IT, NL, SI

Sliding FIP - 3
CY, DK, NL

Green certificates – 5
BE, PL, RO, SE, UK

Auctions – FR, DE, DK, IT, CY, HR, PL, PT, SI
Average support solar PV & average baseload electricity price, 2014

Support is always above market price → "true" support
Effectiveness Indicator – Solar (2010-2014)

A clear pattern in "support schemes – deployment"

\[ \text{Eff.} = \frac{G_l n - G_l n-1}{G_l \text{target} 2020 - G_l n-1} \]

\( G_l n \) = Electricity Generation in year \( n \)
Who applies what?

Wind

Feed-in-tariff - 18
AT, BG, CZ, EL, ES, FR, HR, IE, IT, LT, LU, LV, PT, SI, SK, UK, HU, DE

Constant FIP - 5
CZ, DK, EE, NL, SI

Sliding FIP - 5
CY, DK, FI, ES, NL

Green Certificates – 6
BE, IT, PL, RO, SE, UK

Auctions – DE, ES, NL, DK, IE, HR, PL, PT, SI
| Country | AT | BG | CZ | DE | EL | ES | FR | HR | HU | IE | LT | LU | LV | PT | SI | SK | UK |
|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Min     | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| Average | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |
| Max     | 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230| 230|

**FIT - Wind, 2014**

The graph shows the wind support level in euros per MWh for various European countries in 2014. The colors represent the minimum (Min), average, and maximum (Max) support levels.
Average support Wind & average baseload electricity price, 2014

Support is always above market price → "true" support
Effectiveness Indicator – Wind (2010-2014)

No clear pattern in "support schemes – deployment"

\[ \text{Eff.} = \frac{G_{ln} - G_{ln-1}}{G_{2020} - G_{ln-1}} \]

\( G_{ln} = \text{Electricity Generation in year } n \)
Conclusion

Key takeaways & Policy challenges
Key takeaways & Policy challenges based on the literature

**Balance between budget control and investments security**
- Better performances of FIT than those of GC?
- Better integration of producers with FIP but risk of overcompensation
- Importance of strengthening investor confidence

**Balance between production and innovation**
- Technology-neutral support policies?
- The advantages of auctions

**Trends? FIT + FIP and Auctions** (EU State Aid Guidelines)
- Combination of FIT and FIP
- More market integration of producers
- Cost-effectiveness of auctions
Appendix - Case Studies

- Germany
- Italy
- UK
- Denmark
Solar PV & Wind in Germany – FIT & Tendering

FIT – introduced in 2000 (monthly degressions)

Phased-in introduction of a "direct marketing" obligation (~ sliding FIP with same rates + management premium):

- Since 1st August 2014: IC higher than 500 kW
- Since January 2016: IC higher than 100 kW
- FIT still available for IC lower than 100 kW

In June 2013, 80% onshore wind capacity and 100% offshore capacity were already using direct marketing
Solar PV & Wind in Germany – FIT & Tendering

Tendering system since 2014 (sliding FIP) for Wind

- August 2017 – 2\textsuperscript{nd} onshore tender – 1.013 MW – 42.8 €/MWh
- 3\textsuperscript{rd} round end of 2017 – target 1 GW – bidding cap 70€/MWh (unchanged)
- 4 rounds planned in 2014

PV tenders: the level of support awarded decreased

Next PV tender in 2018: 200 MW – 88.4 €/MWh ceiling
PV Feed-in scheme (>20yr)-5 incentive schemes 2005 -2013
Capacity > 1 MW    Feed-in-premium
Capacity < 1 MW    Feed-in-tariff

Feed-in scheme end 2014 - 17713 MW or 95% of PV capacity
Cumulative cost of incentives mid July 2013 – 6.7 €billion (the max annual)
After 2013 - Feed-in-tariff II & Tender scheme (DM 6/7/12)
Italy – solar PV

9.3 GW added in 2011

0.38 GW added in 2016

90% drop added values investments new PV plants 2012 -2015

2016-2020 investments new PV plans - 440 M€ annually

Source: IT progress reports on RES (2011-2015) GSE
Solar PV & wind in UK – FIT support

3 support schemes: FIT (2010), FIP (sliding), GC

FIT capacity end 2015 (commissioned) - 4010 MW

almost 20% of UK additional capacity 2010-2015

Standard PV (<4 kW – 250 kW)
Standard large PV (250 kW- 5MW)
Standalone PV (< 5MW)
min support 76.3 €/MWh – max support 172.2 €/MWh

wind (<100 kW – 5 MW)
min support 36.8 €/MWh – max support 191.6 €/MWh

Solar PV & wind in UK – FIT support

**Solar PV**
- 84% of FIT capacity
- 16% of additional RES-E capacity 2010-2015

**Wind**
- 11% of FIT capacity

### Table: Solar PV & Wind Capacity

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV capacity (MW)</td>
<td>2662</td>
<td>3374</td>
</tr>
<tr>
<td>PV installations (thousand)</td>
<td>599.4</td>
<td>755</td>
</tr>
<tr>
<td>Wind capacity (MW)</td>
<td>322.2</td>
<td>411.8</td>
</tr>
<tr>
<td>Wind installations (thousand)</td>
<td>6.6</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Wind in Denmark

**End 2013** – Constant FIP for onshore wind

**Jan 2014** – Sliding FIP with max remuneration 77.8 €/MWh

**Sliding FIP** for wind domestic turbines:
- up to 10 kW – 335 €/MWh
- up to 25 kW – 201 €/MWh

**Tendering system** for offshore wind: 5 rounds (2004 to 2014) (auctions for sliding FIP for 12 to 15 years)

<table>
<thead>
<tr>
<th>Name</th>
<th>Period</th>
<th>Capacity</th>
<th>Suppl. Gen.</th>
<th>Unit support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horns Rev 2</td>
<td>Feb. 2005</td>
<td>200 MW</td>
<td>10 TWh</td>
<td>69 €/MWh</td>
</tr>
<tr>
<td>Rødsand 2, 1\textsuperscript{st} try</td>
<td>May 2006</td>
<td>200 MW</td>
<td>10 TWh</td>
<td>67 €/MWh</td>
</tr>
<tr>
<td>Rødsand 2, 2\textsuperscript{nd} try</td>
<td>Apr. 2008</td>
<td>200 MW</td>
<td>10 TWh</td>
<td>85 €/MWh</td>
</tr>
<tr>
<td>Anholt</td>
<td>Apr. 2010</td>
<td>390-400 MW</td>
<td>20 TWh</td>
<td>141 €/MWh</td>
</tr>
</tbody>
</table>
Thank you for your attention!

Any question?