



Key factors of feed-in tariff systems, best practices of design options and comparison to other alternatives

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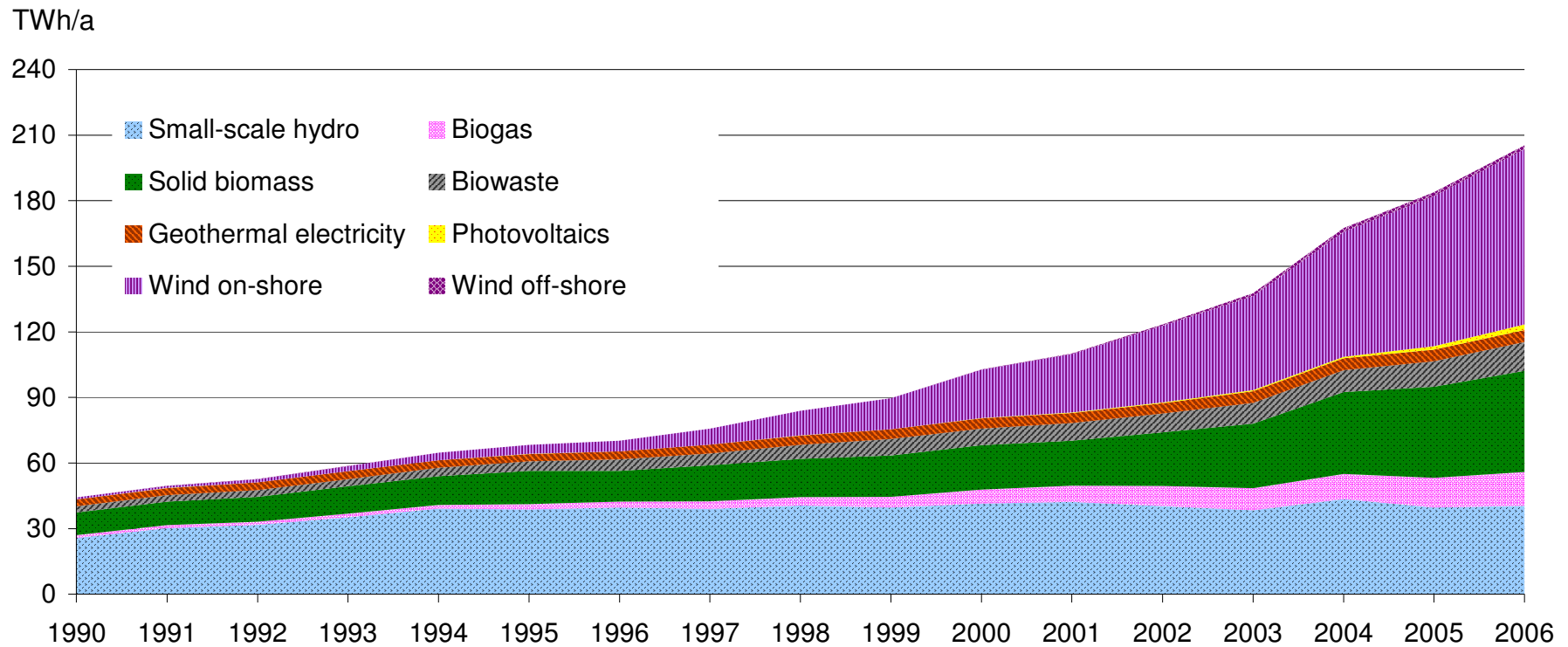
Outline

- Present status and historical development of RES-E penetration
- Support schemes for RES-E
- Feed-in tariff design options
 - ▶ Tariff level
 - ▶ Stepped tariffs
 - ▶ Tariff degression
 - ▶ Premium tariffs
 - ▶ Extra premiums for innovative features
- Conclusion



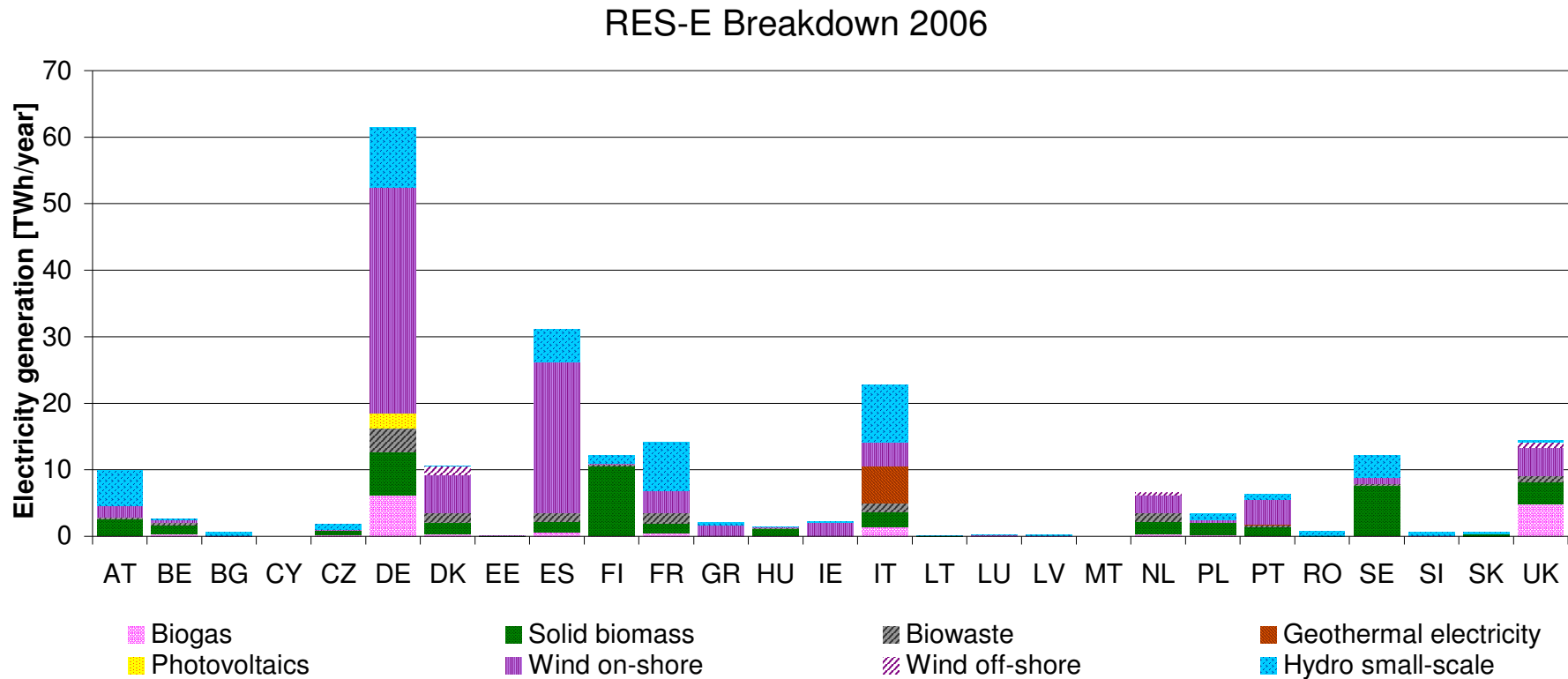
Present status and historical development of RES-E in the EU

RES-E penetration in the EU-27 excluding large-scale hydro [TWh/y]



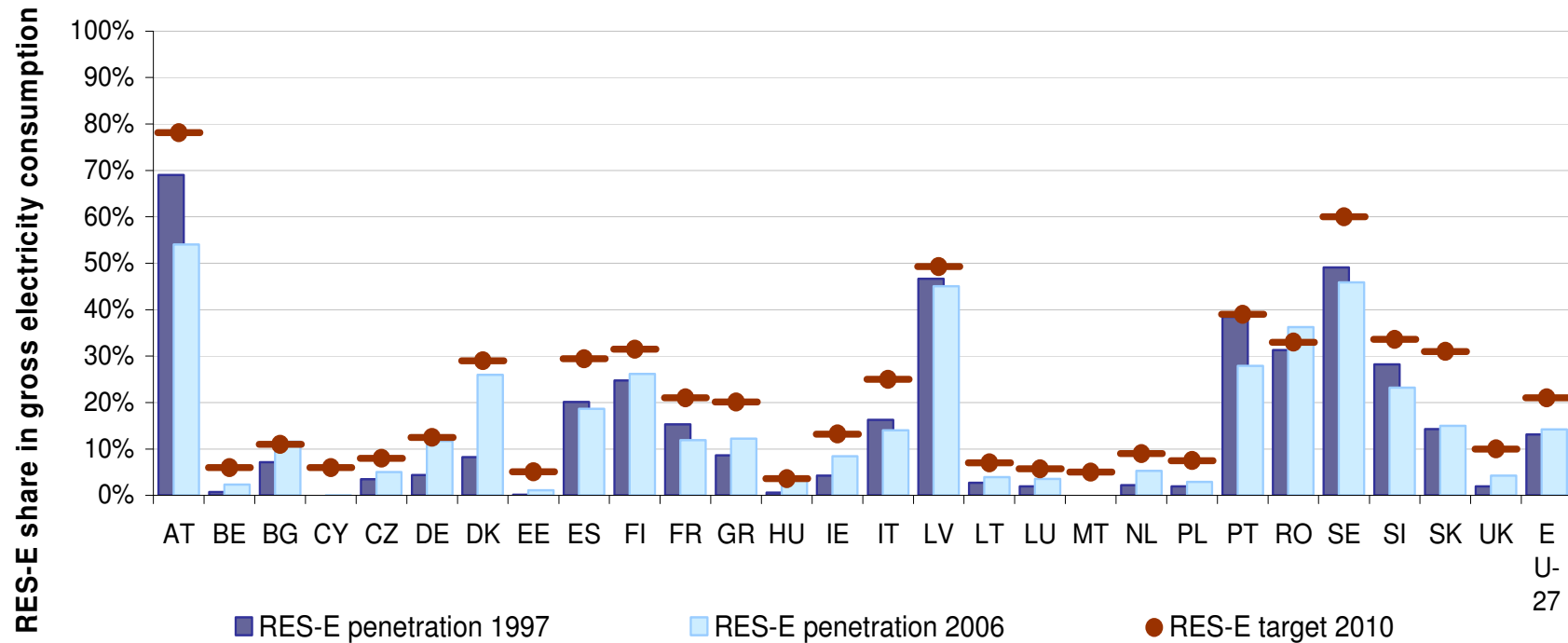
Present status and historical development of RES-E in the EU

Breakdown of RES-E generation in the EU-27 Member States in 2006



Present status and historical development of RES-E in the EU

RES-E share in gross electricity consumption in the EU-27 Member States



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Support schemes for RES-E

1. Feed-in tariffs (FIT)

- ▶ Renewable electricity can be fed into the grid at a guaranteed tariff for a determined period of time
- ▶ The electricity output depends on the support level → price-based
- ▶ FITs may also consist of premium tariffs paid in addition to the market price (e.g. in Spain) → stronger market orientation

2. Quota obligation with tradable green certificates (TGC)

- ▶ Determination of quota target
- ▶ Renewable electricity is sold at the market electricity price
- ▶ Additional revenue from selling TGCs
- ▶ Certificate price depends on predefined quota target and is determined on the market → quantity-based



Support schemes for RES-E

3. Tender procedures

- ▶ A predefined target of additional capacity or generation is set
- ▶ In a bidding round projects with the lowest generation costs can obtain financial support i.e. in form of long-term feed-in tariffs → quantity-based

4. Fiscal incentives/investment grants

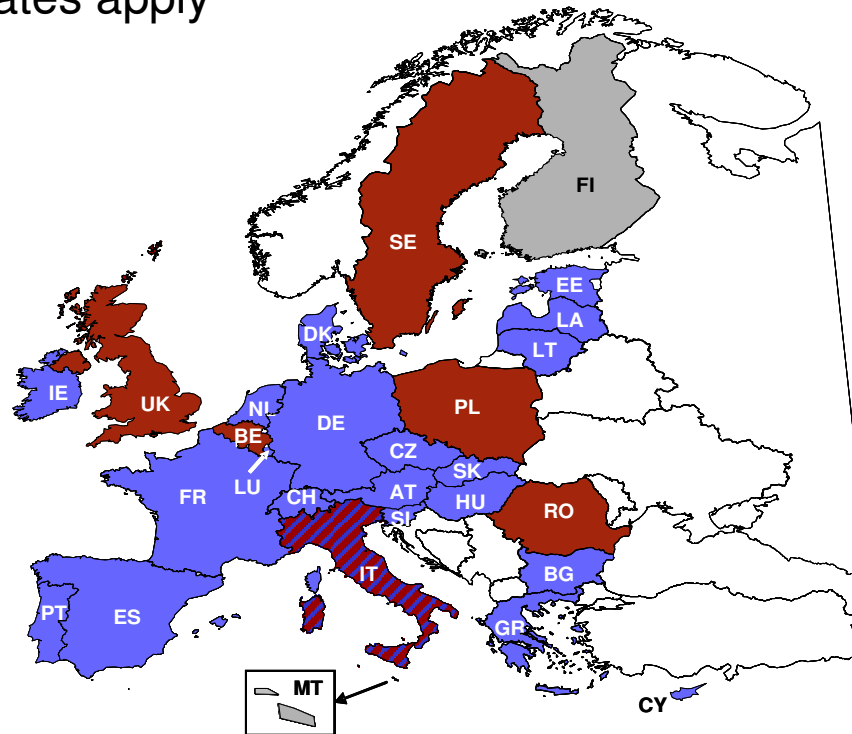
- ▶ Tax incentive: Reduction or exemption of tax payment → price-based
- ▶ Investment grants: Reduction of capital costs → price-based

Price-based mechanisms	Quantity-based mechanisms
<ul style="list-style-type: none">• Feed-in tariff• Fiscal incentives• Investment grants	<ul style="list-style-type: none">• Quota/TGC• Tender schemes



Support schemes for RES-E

Currently 20 Member States apply feed-in tariffs



- Feed-in tariff
- Quota/ TGC
- Tax incentives/ Investment grants



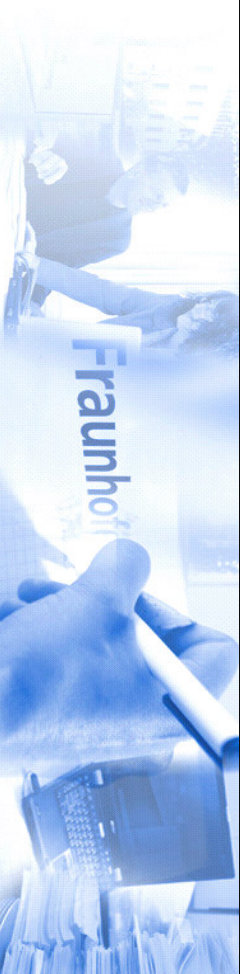
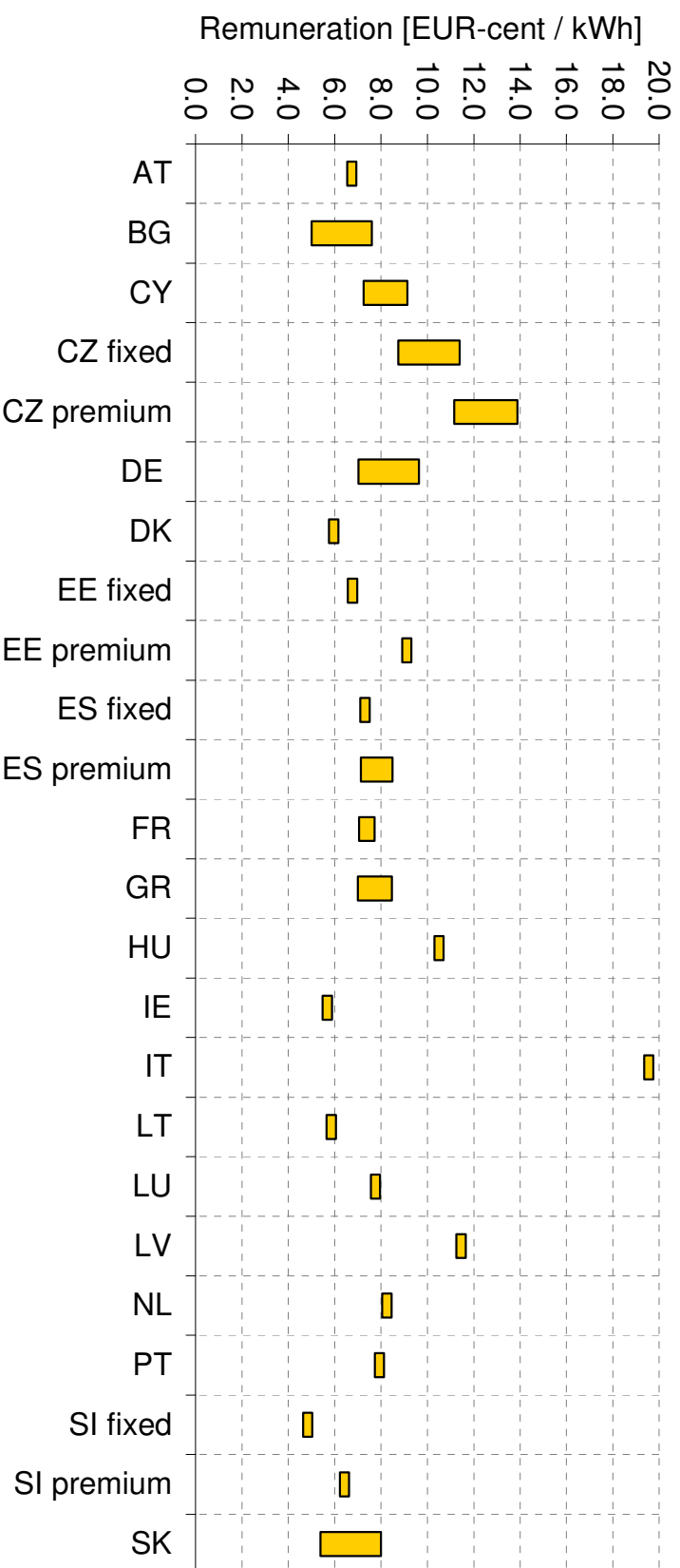
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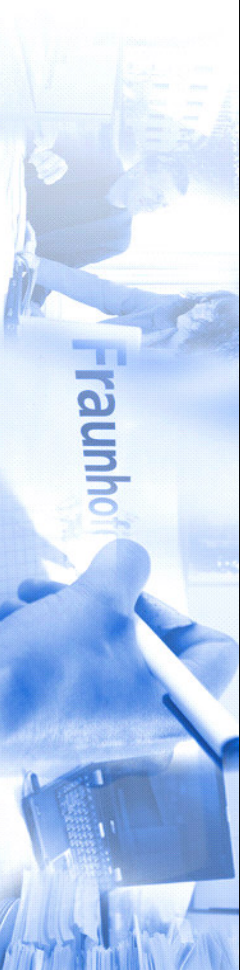
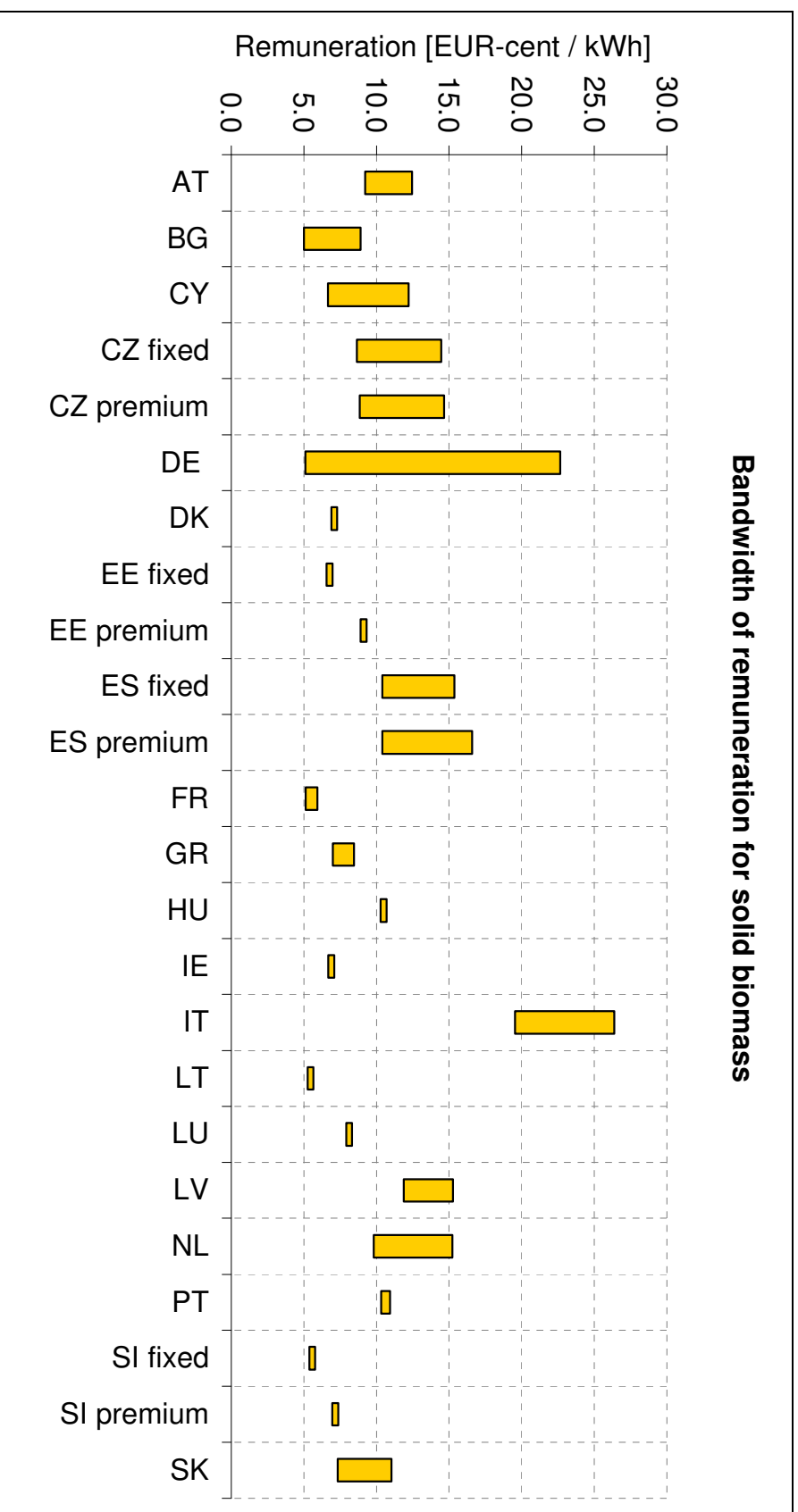
Tariff levels 2008/2009

Bandwidth of remuneration for wind power onshore



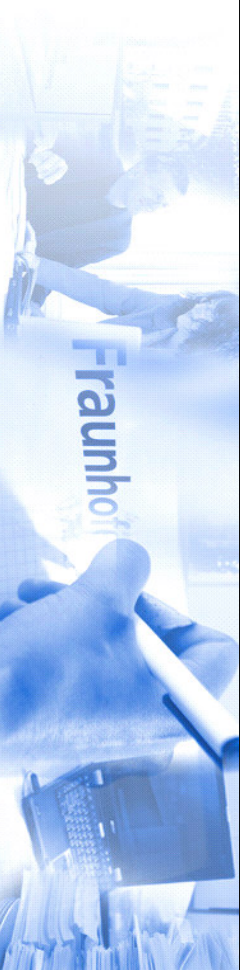
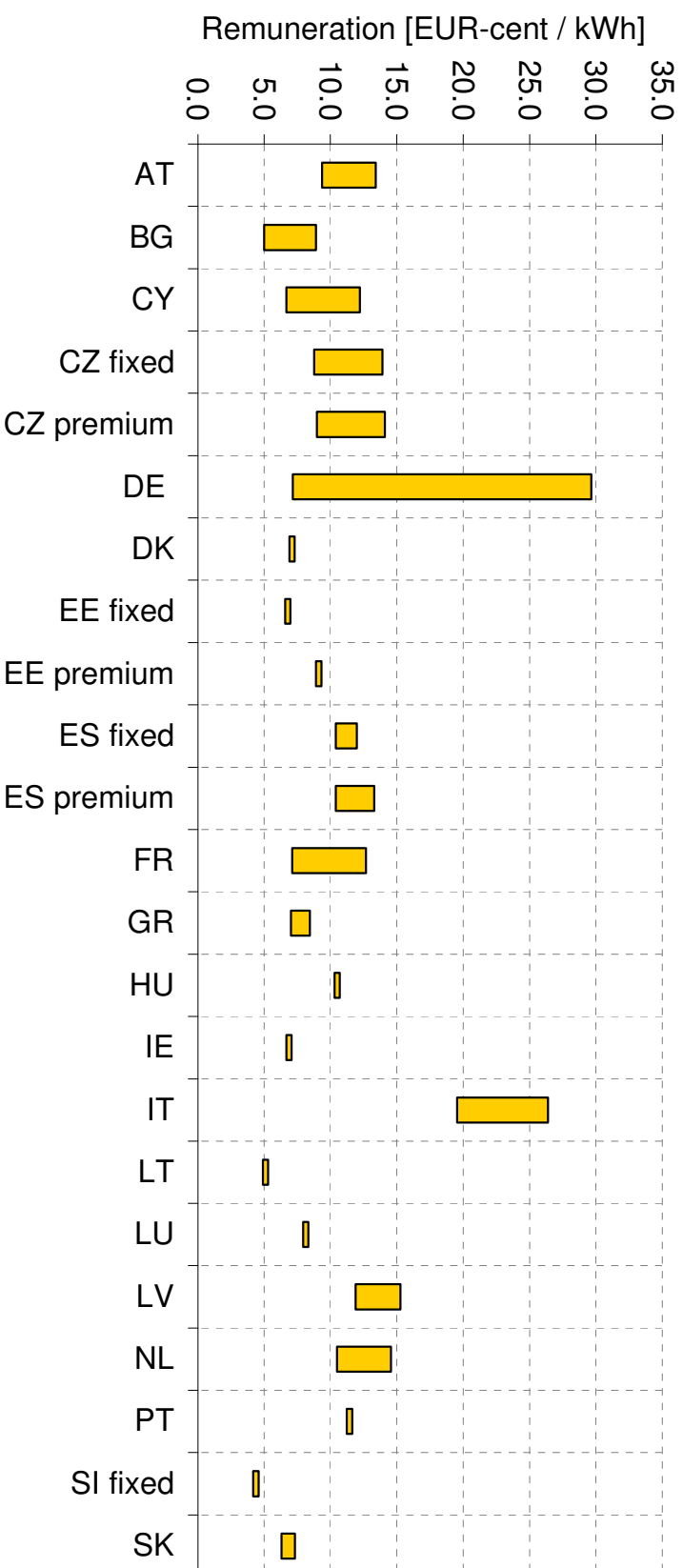
Tariff levels 2008/2009

Bandwidth of remuneration for solid biomass



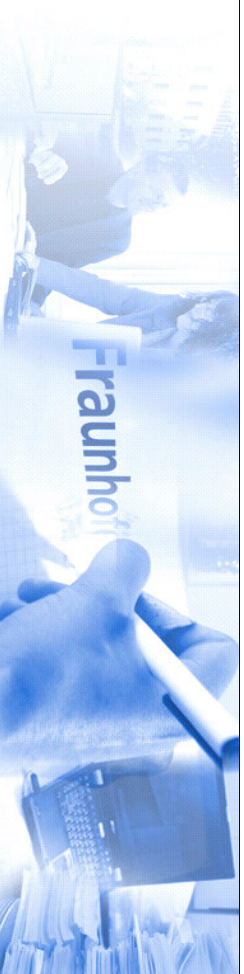
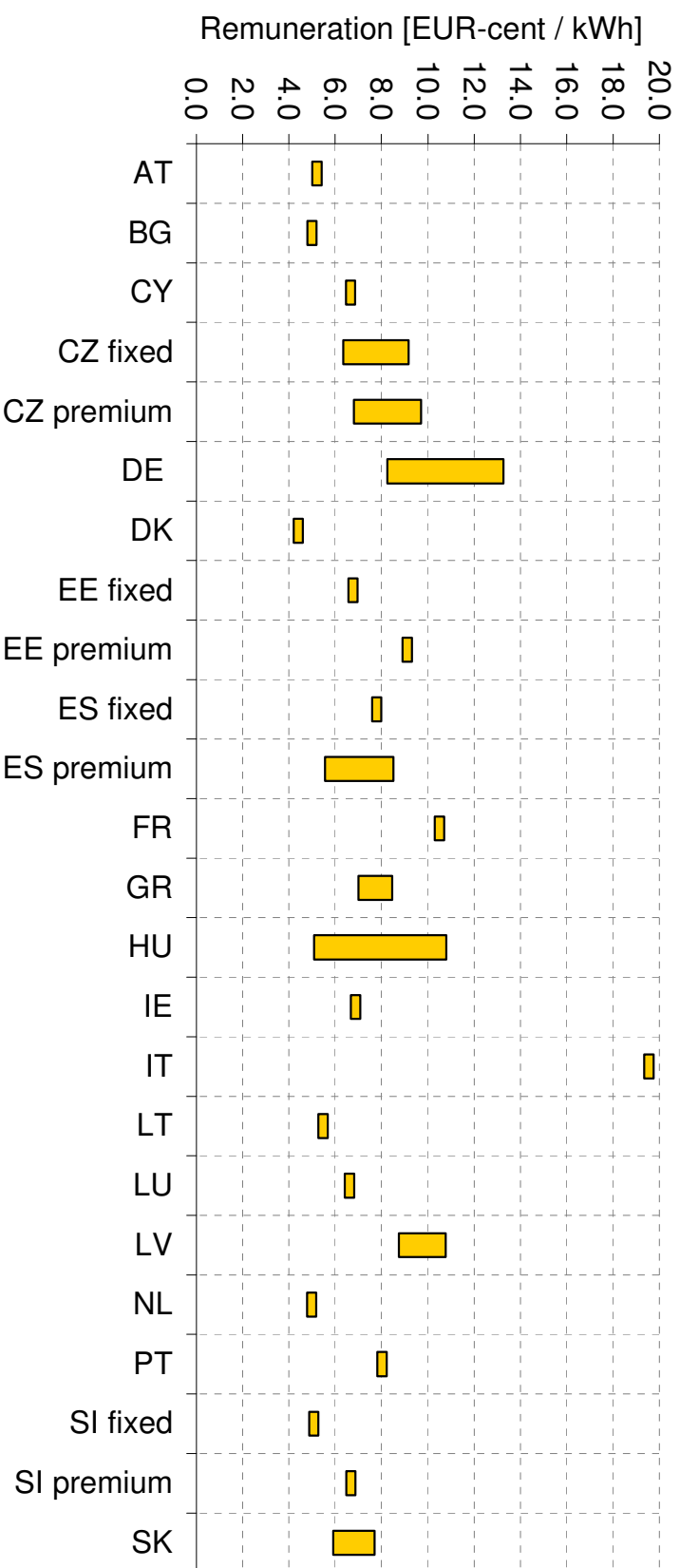
Tariff levels 2008/2009

Bandwidth of remuneration for biogas

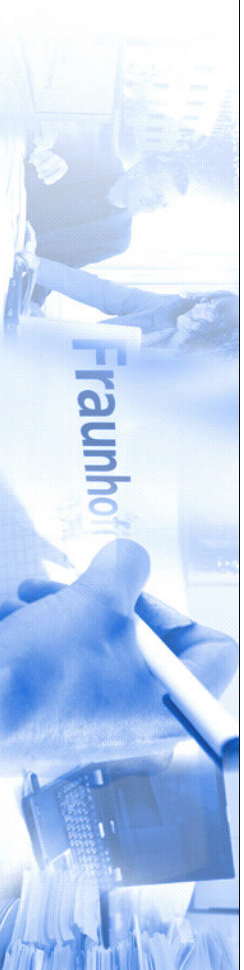
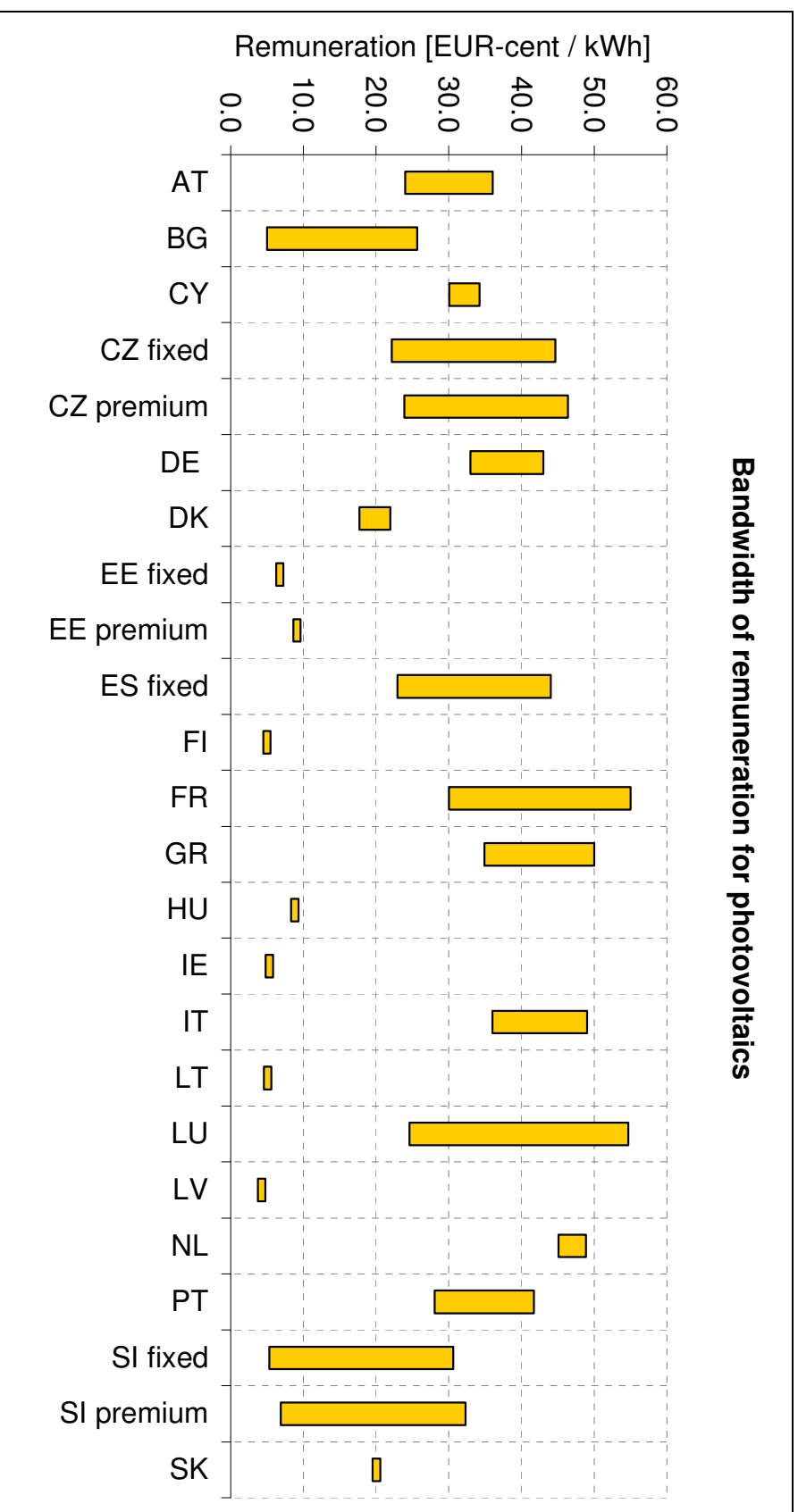


Tariff levels 2008/2009

Bandwidth of remuneration for small-scale hydropower



Tariff levels 2008/2009

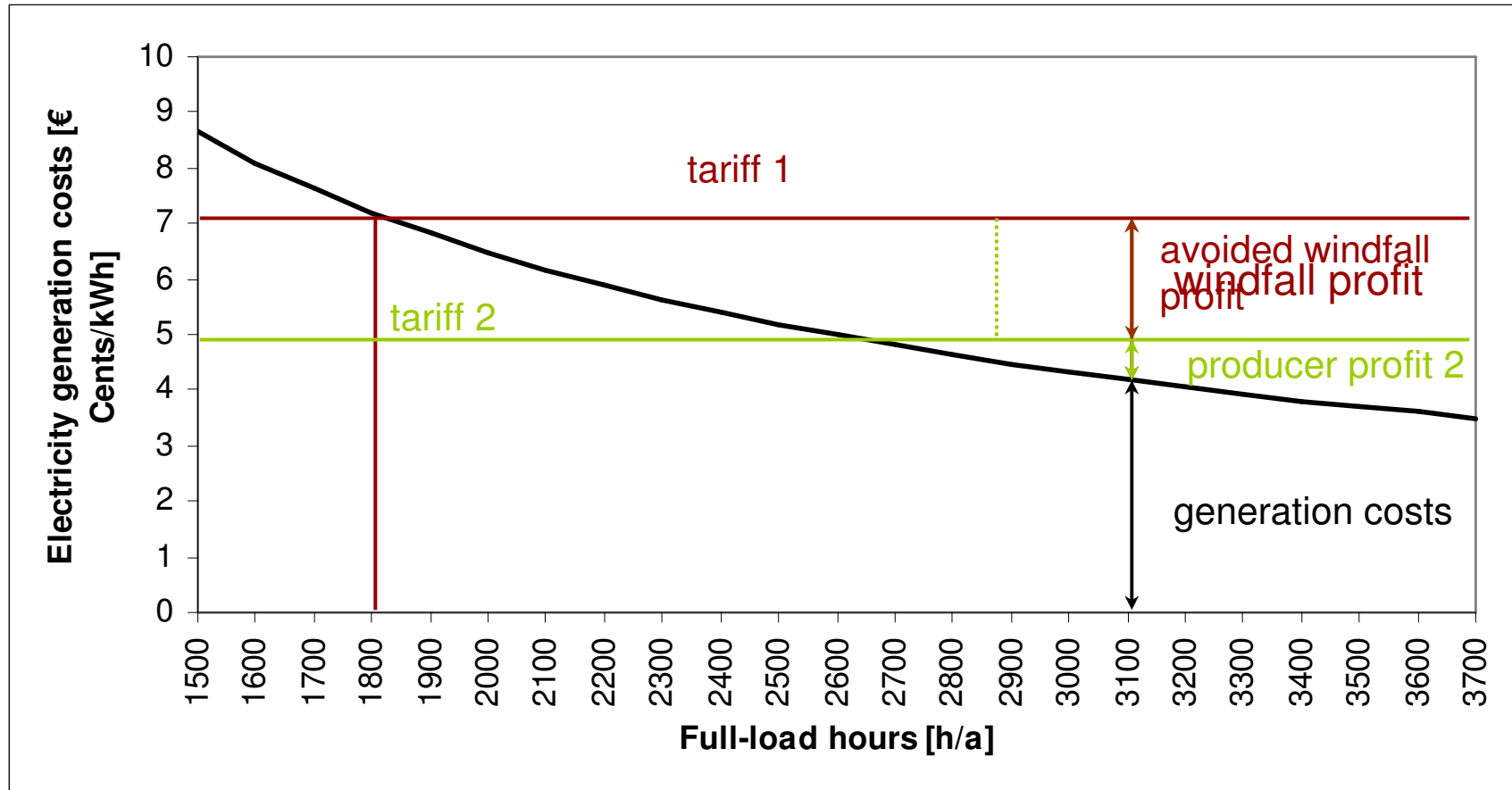


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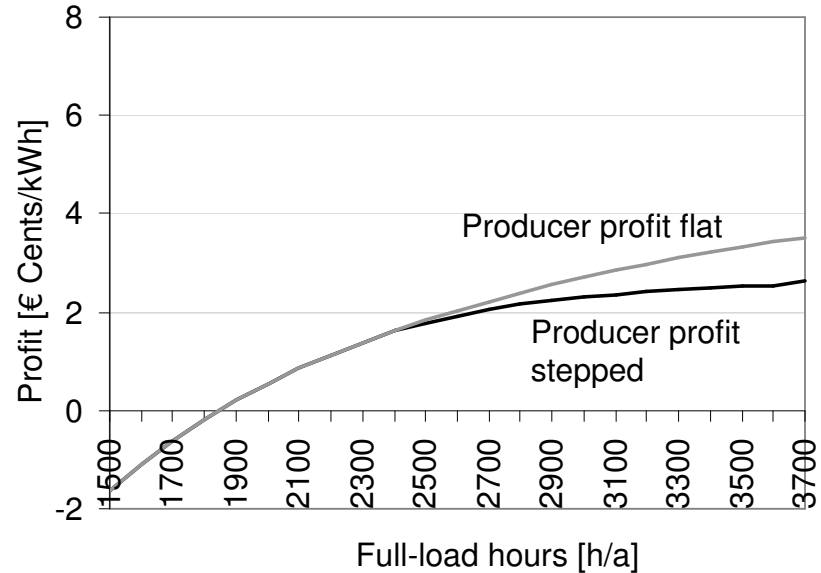
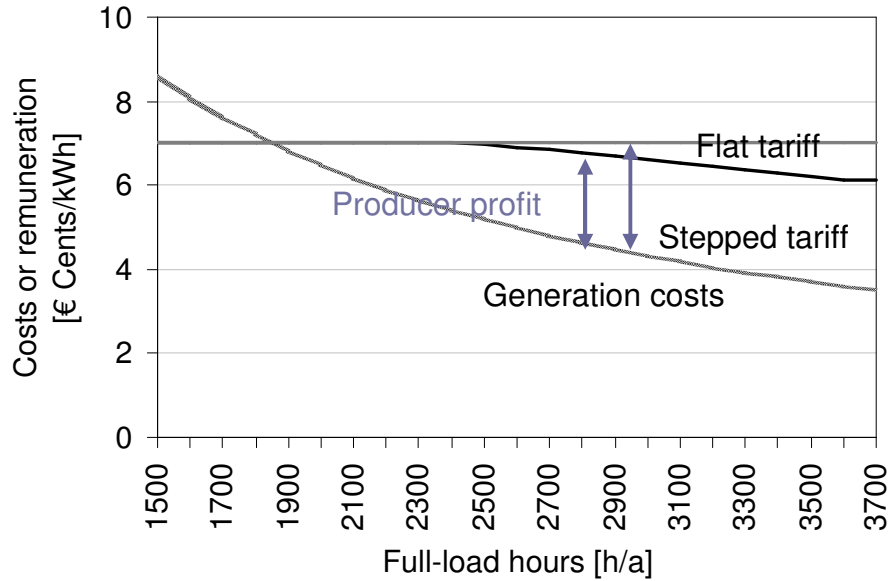


Stepped tariff design



Stepped tariffs – Level depending on local conditions

Case study France



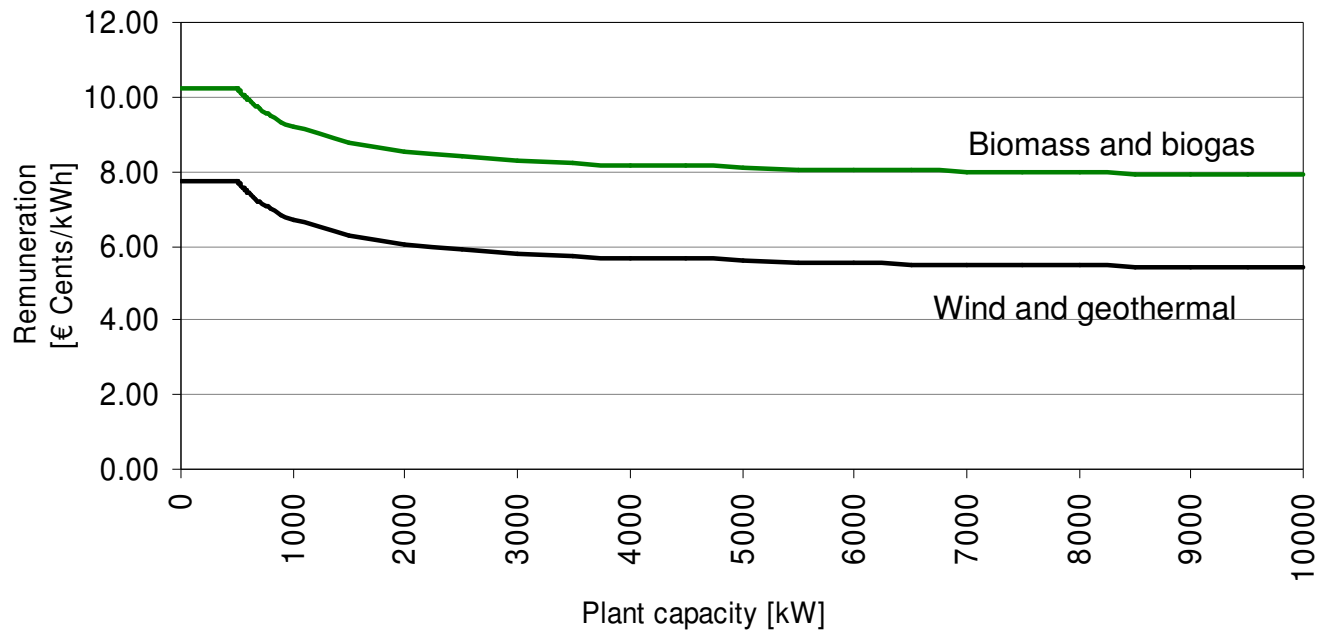
Support for onshore wind energy in France:

- 8.2 € Cents/kWh for 10 years
- Between 2.8 and 8.2 € Cents/kWh for the remaining 5 years (depending on the electricity yield during the first 10 years)



Stepped tariffs – Level depending on plant size

Case study Luxembourg



$$M = \left(1.95 + \left(\frac{500}{P} \right)^{0.75} \right) \times 2.63$$

M: Remuneration per kWh
P: Plant capacity in kW



Stepped tariffs

Tariff level depending on fuel type

- Electricity generation costs may vary due to the type of biomass or biogas used
- Biomass grown with the purpose of electricity generation has a higher price than certain wastes or residues
- Electricity from landfill and sewage gas is remunerated with a lower tariff in some countries
- When waste with a large biogenic fraction is burnt, electricity and heat can be generated
- Applied for example in Austria, Germany, Spain and Portugal



Stepped tariffs

Support for electricity from biomass in Germany in 2009

Plant capacity	Pure solid biomass	Premium for untreated biomass	CHP premium	Premium for innovative technologies
≤ 150 kW	11.67	6.0	3.0	2.0
150 kW - 500 kW	9.18	6.0	3.0	2.0
500 kW - 5 MW	8.25	4.0	3.0	2.0
5 MW - 20 MW	7.79	-	3.0	-

- **Exceptions:**
 - ▶ Combustion of waste wood: 3.78 € Cents/kWh
 - ▶ Combustion of wood (500 kW - 5 MW): Tariff level is increased by 2.5 € Cents/kWh (Premium for untreated biomass is not applicable)
 - ▶ Landfill and sewage gas: 7.44 € Cents/kWh (≤ 500 kW); 6.45 € Cents/kWh (500 kW – 5 MW)
- **Examples for innovative technologies:**
 - ▶ Fuel cells, Organic Rankine plants, Kalina Cycle technologies and Stirling engines



Stepped tariffs – Evaluation

Advantages:

- Differences in power generation costs can be taken into account
- Risk of over-compensating very efficient plants is minimized
- Costs for consumer of RES-E support are reduced
- Not only the current contribution of a technology to policy targets is supported, but also its future potential (e.g. offshore wind turbines)

Disadvantages:

- May lead to high administrative complexity
- Many different tariff levels may reduce transparency
- Overall efficiency of the system may be decreased (if tariffs for small plants are significantly higher than for larger plants, it could be profitable to construct two small plants instead of a large one)



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Tariff degression

Tariff degression:

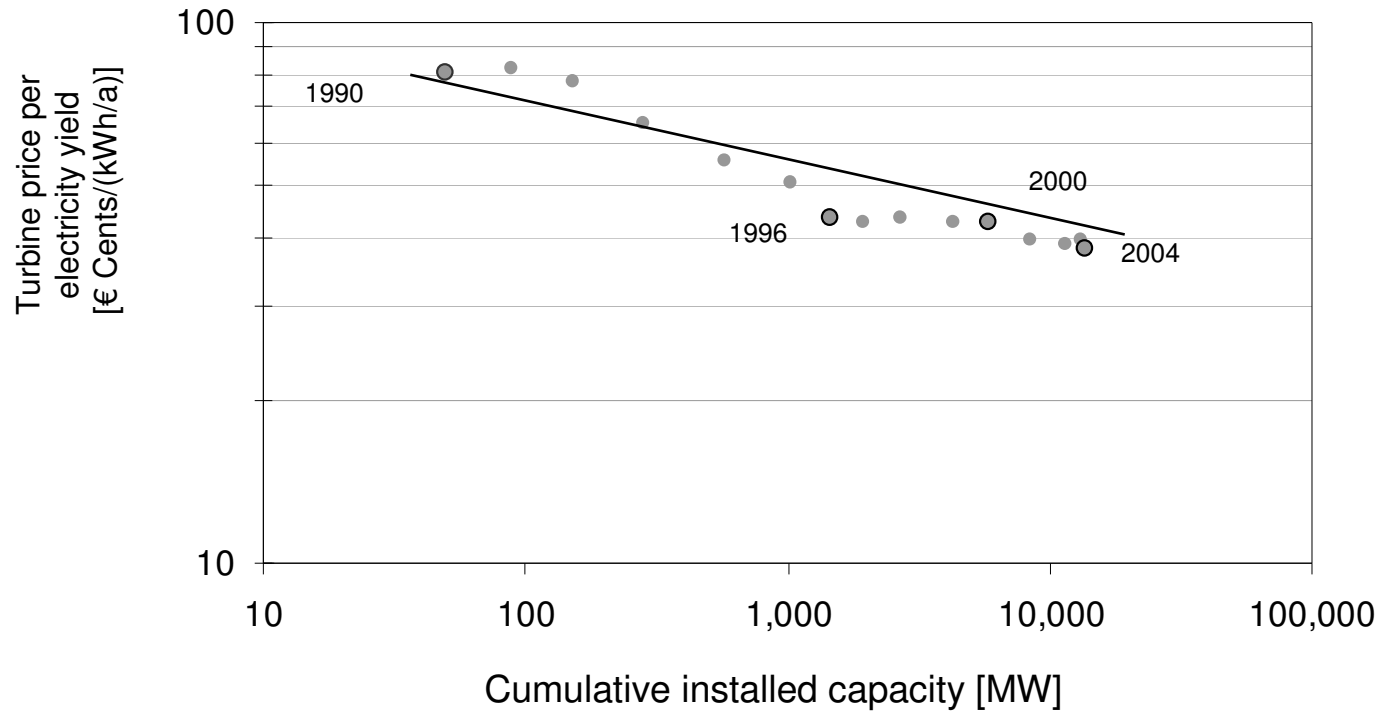
- Annual reduction of the tariff level for new power plants
- Ideally cost reductions due to the experience curve effect are reflected
- Main reasons for the cost reductions:
 - ▶ Learning process
 - ▶ Economies of scale
 - ▶ Technical progress
 - ▶ Rationalization

Applied in Germany (between 1% and 10% depending on the technology), France (2% for wind turbines) and Italy (2% for PV devices)



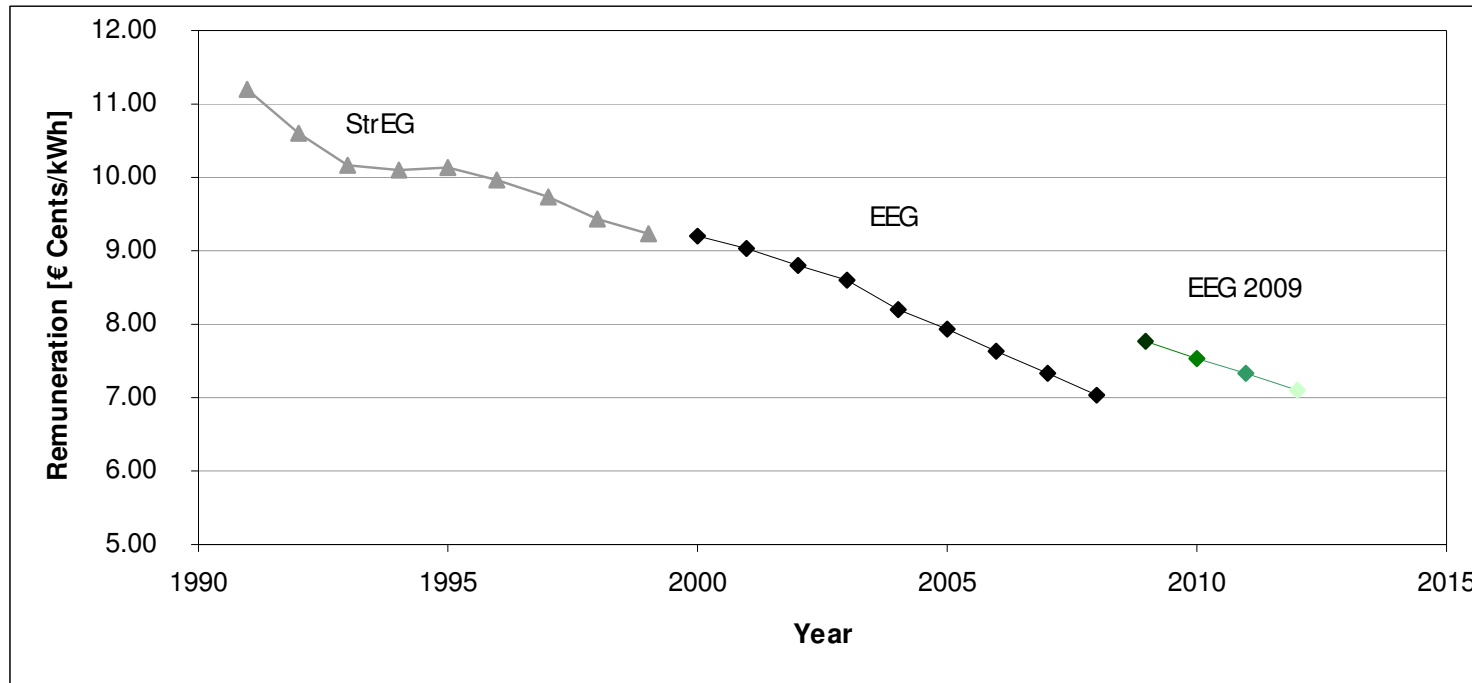
Tariff degression – Case study Germany

Experience curve for onshore wind energy



Tariff degression – Case study Germany

Remuneration for onshore wind turbines



Tariff degression – Case study Germany

Flexible degression

- From 2009 on degression for photovoltaics tariffs will be flexible
- If the overall newly installed capacity exceeds a certain amount, the degression is increased by 1%
- In turn, if the newly installed capacity is too low, the degression is decreased by 1%
- Automatic, quantity-based and transparent revision of degression



Tariff degression - Evaluation

Advantages:

- Investment security
- Incentives to build plants early
- Incentive for technological improvements
- Lower producer profit and lower costs for RES-E support

Disadvantages:

- A fixed degression rate may reduce the flexibility of a system
- Changes in input prices or plant designs are difficult to predict



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Premium tariff design

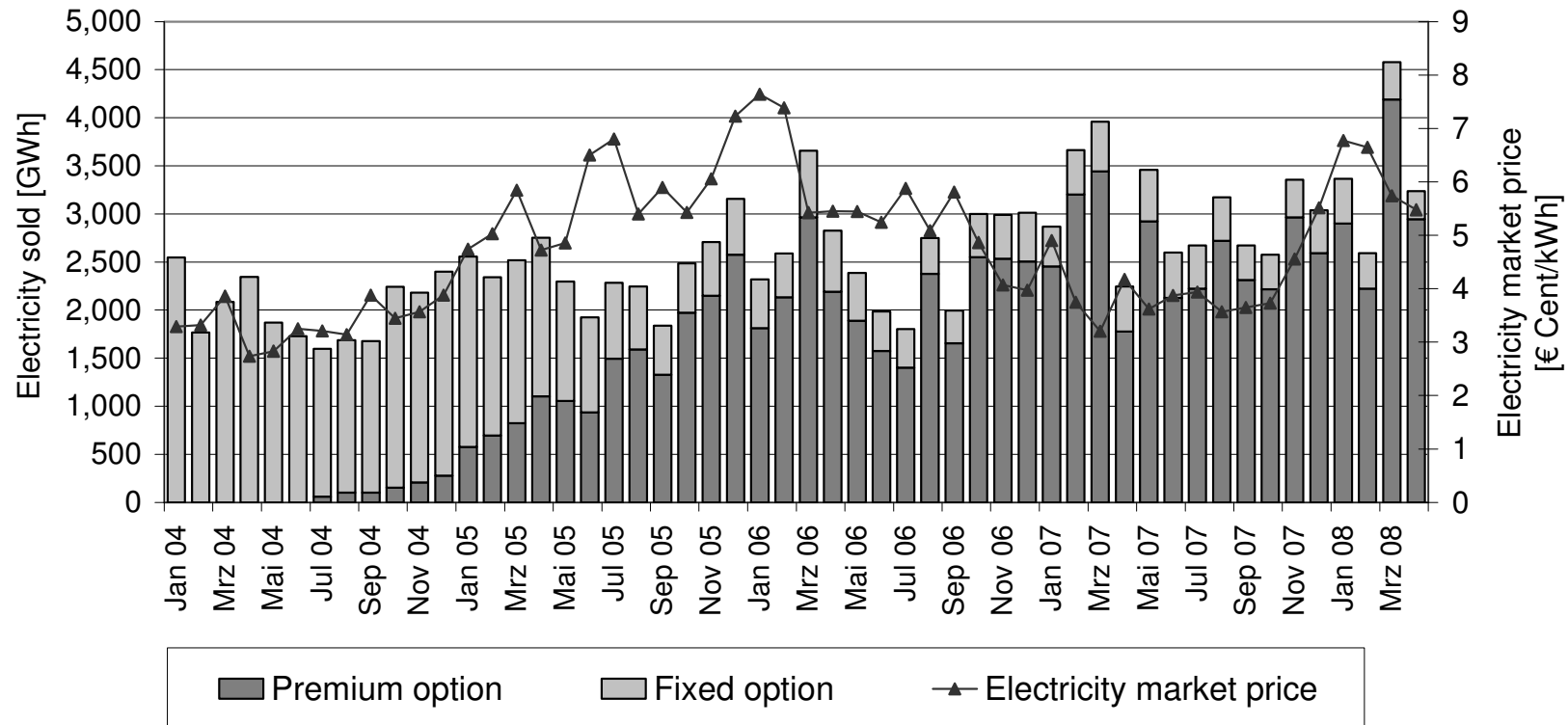
Premium tariff:

- RES-E is sold directly on the market
- Premium is paid on top of the market price
- Typically no purchase obligation is provided

Currently applied in Spain, the Czech Republic, Slovenia, Estonia, the Netherlands and Denmark (for onshore wind energy) as an alternative to the fixed tariff design



Premium tariff design – Case study Spain

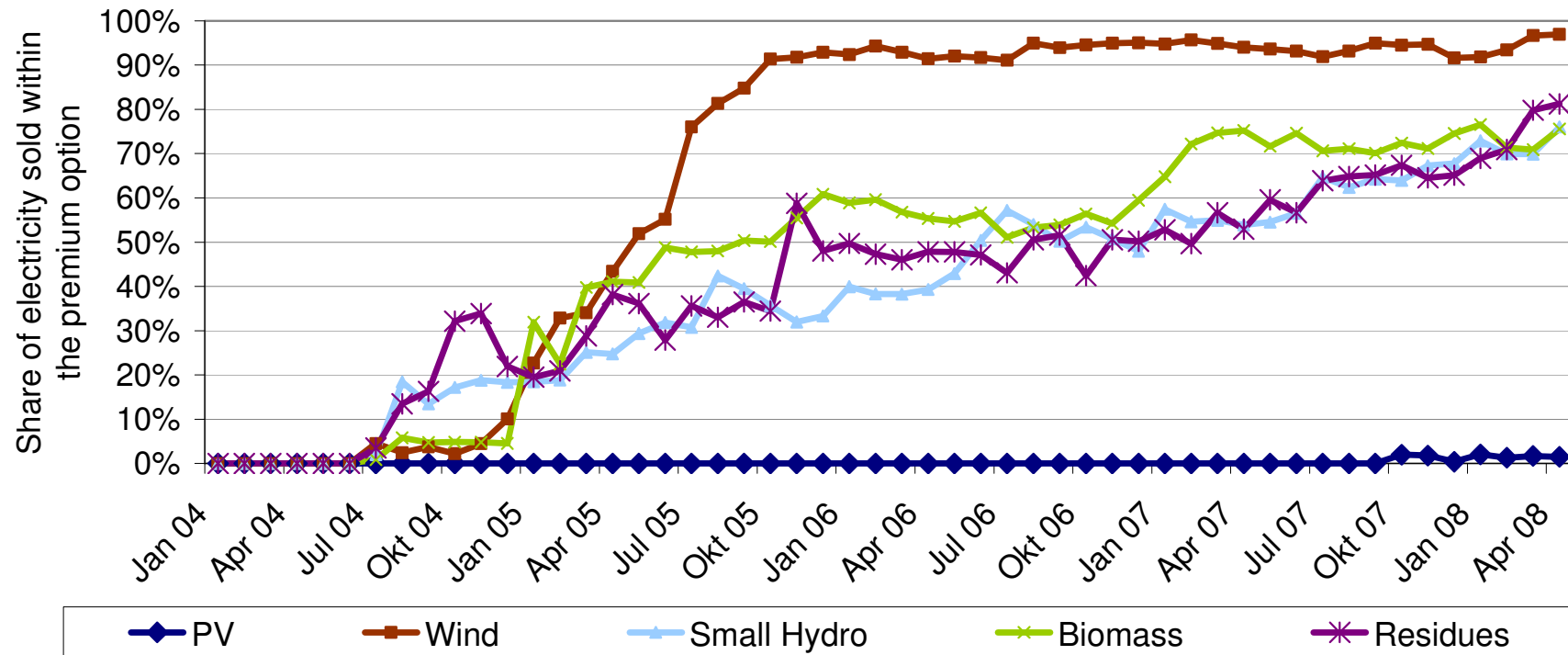


Producers choosing the premium option increased from 0% in June 2004 to 91% in April 2008

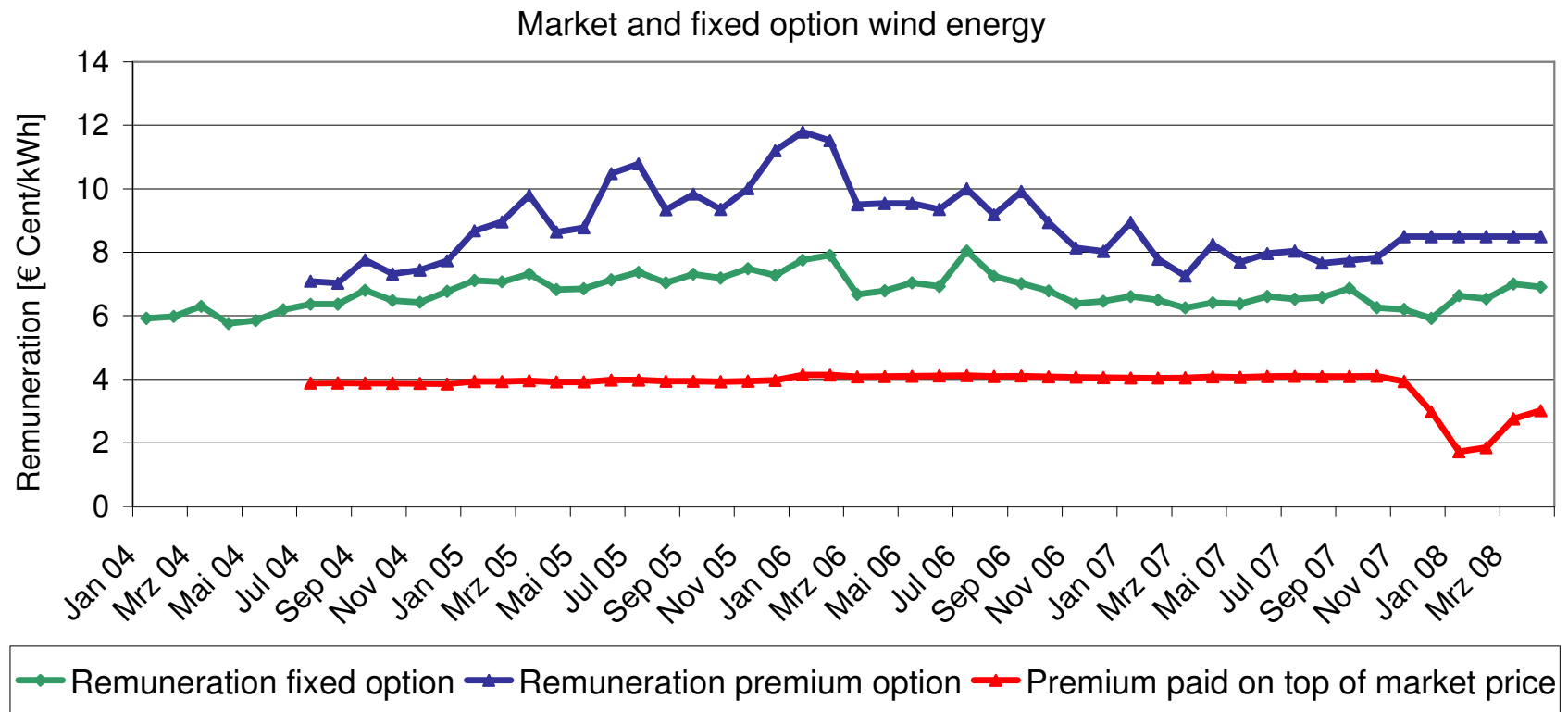


Premium tariff design – Case study Spain

Share of producers choosing the premium option increased in all technologies

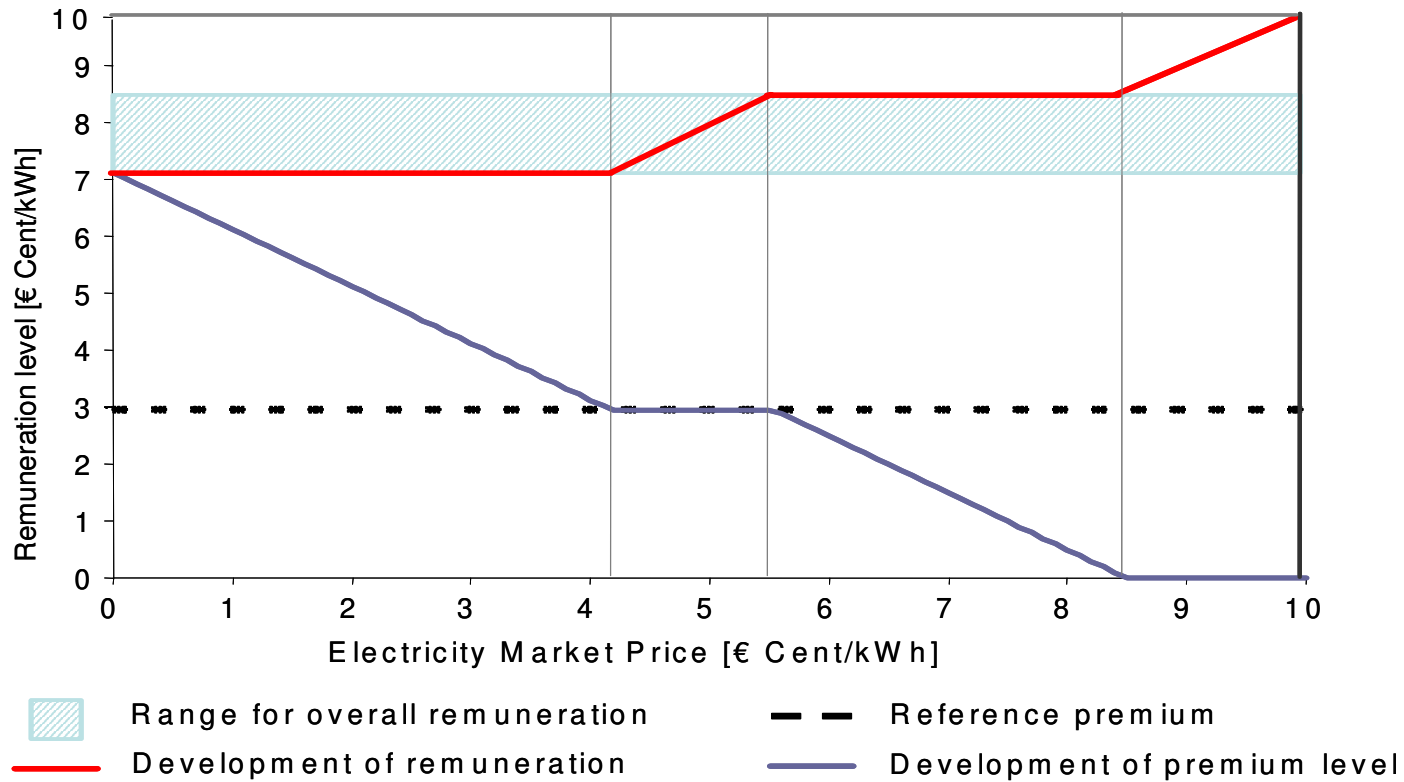


Premium tariff design – Case study Spain



Premium tariff design – Case study Spain

Floor and cap prices set a fixed range of the overall remuneration



Premium option - Evaluation

Advantages:

- Higher compatibility with liberalised electricity markets
- The market price for electricity sets a signal for RES-E dispatching, without exceeding the producers ability to react to it

Disadvantages:

- Causes typically higher costs for consumers due to additional market risks to be borne by RES-E suppliers
- Less investment security therefore higher risk premium
- Wind and solar energy can hardly be controlled



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Extra premiums for innovative features

Additional premiums are paid for:

- Technologically innovative power plant design
 - ▶ Energy efficient power plants (FR)
 - ▶ Building integrated PV devices (DE, FR)
 - ▶ Regular production during winter time (hydro power FR)
 - ▶ Premium for methanisation of biogas (FR)
- Repowering of wind turbines (DK, DE)
- Electricity generation during times of high demand (SI, HU)



Extra premiums for innovative features

France:

- Extra premiums, if certain conditions are fulfilled

Technology	Conditions	Level of premium [€ Cents/kWh]
Biomass	energy efficiency	0 – 1.2
Biogas, geothermal	energy efficiency	0 – 3.0
Biogas with methanisation	extra premium for methanisation	2.0
PV energy	building integrated plants	25.0
Hydro power	extra premium for regularity of production during winter time	0 – 1.52



Extra premiums for repowering

Repowering:

- Old power plants are replaced by modern more efficient ones, usually with a higher capacity
- This concept is especially important for wind power
- It is not only important to support turbines in new locations, with increasing capacity repowering is an option to exploit higher potentials

Revised conditions for getting the repowering bonus in Germany:

- New plant has to have at least twice the capacity of the old
- The remaining time of higher starting remuneration of the old plant is transferred to the new one



Extra premiums for demand orientation in Slovenia

RES-E producers can decide to receive different FITs according to the time of day or the season of the year (70 – 140% of normal tariff level)

	Higher daily tariff (HDT)	Lower daily tariff (LDT)
High season (Dec, Jan, Feb)	1.40	1.00
Middle season (Mar, Apr, Oct, Nov)	1.20	0.85
Low season (May – Sept)	1.00	0.70

HDT: Mon – Sat, 6:00 – 13:00 and 16:00 – 22:00 o'clock (when winter time is used)
Mon – Sat, 7:00 – 14:00 and 17:00 – 23:00 o'clock (when summer time is used)

LDT: Mon – Sat, 22:00 – 6:00 and 13:00 – 16:00 o'clock (when winter time is used)
Mon – Sat, 23:00 – 7:00 and 14:00 – 17:00 o'clock (when summer time is used)



Premium for consumption of self produced electricity - Germany

New option: Split tariff structure for small PV plants starting 2009

- Electricity fed into the grid receives 43.01 € cents/kWh
- Self-consumed electricity receives 18 € cents/kWh less (25.01 € cents/kWh)
- The difference of 2 € cents between the retail price (~ 20 € cents/kWh) and the lower remuneration sets an incentive to consume electricity when the PV plant produces

This approach helps to decrease grid load and promotes awareness for energy consumption



Extra premiums - Evaluation

Advantages:

- Possibility to influence RES-E producers in their behaviour
- Provides incentives to use the most advanced and efficient technologies
- Provides incentives to feed electricity into the grid in times of peak demand

Disadvantages:

- Extra premiums cause additional administrative complexity
- RES-E generators might not be able to influence the time of electricity generation (solar and wind energy)



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Conclusion

Applying a well designed system of feed-in tariffs...

- supports technology-specific and with respect to the future potential of the technologies
- is cost efficient and avoids windfall profits
- can give incentives to RES-E producers to participate in the liberalised power markets
- sets targets for technological progress
- can be adjusted to changes in the market situations



Finish

Thank you for your attention!

Questions and remarks?

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