Promotion systems for electricity from renewable energy sources – Lessons learned from EU countries

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1. Introduction
2. Historical developments
3. Success of strategies
4. The success story of PV
5. Effects on electricity markets
6. Conclusions
1 INTRODUCTION

CORE MOTIVATION:
Policy targets for an INCREASE of RES-E!

e.g. 2020/20/20/20 targets

RES-E directive: increase share of RES-E from 12% 1997 to 22% in 2010)
2. HISTORY

RES-E EU-27

Electricity generation [TWh/a]

1997: 12%

2009: 17%
ELECTRICITY GENERATION FROM „NEW“ RENEWABLES IN EUROPE

1997: 1%

2009: 7%
REMARK ON RES – DEPLOYMENT IN THE EU-COUNTRIES

• Since about 1997 triggered by EU-directives and EU initiatives

• Yet, specific country success stories very strongly related to national policies design!
3. SUCCESS OF STRATEGIES
SUCCESS CRITERIA FOR STRATEGIES

Major objectives:

• increase the amount of electricity from renewables and
• reduce costs!

Costs (EUR/ kW)

MW /Number of plants

Major objectives:

=efficiency

=effectiveness
PRICES OF CERTIFICATES

Italy, UK; Belgium: Continuous high level!

Sweden: Shortage in banked certificates!
LEVEL OF FEED-IN TARIFFS

![Graph showing the level of feed-in tariffs from 2002 to 2010 for AT, DE, and ES.](image-url)
SUPPORT LEVELS: COMPARISON

TRADABLE CERTIFICATES

FEED-IN TARIFFS

Value of certificate (c/kWh)

Sweden UK Belgium (average) Italy Poland Romania
EFFECTIVENESS VS COSTS

Av. 2003-2007 ---> Av. 2006-2010

Figures excl. PV, Figures for 2009/10 preliminary

Support (c/kWh)

kWh/cap/yr

AT  DE  ES  PT  CZ  BE  IT  UK  SE  PL  FR
METHOD OF APPROACH: STATIC COST RESOURCE CURVES

- Cheapest capacities: e.g. biomass cofiring
- More expensive capacities: e.g. small Hydro, Wind
- Predicted costs
- Uncertainty

EUR/kWh vs kWh
HOW FEED-IN TARIFFS WORK

Costs

$P_{\text{Fix}}$

$Q_{\text{Out}}$

EURO/ kWh vs. kWh
Total costs for customers

(PREMIUM) FEED-IN TARIFFS

Total costs =

Producer surplus +

Additional generation costs

EURO/kWh

Market price kWh

Target kWh

Cost curve

$P_{FIT.A}$ $P_{FIT.B}$ $P_{FIT.C}$
HOW QUOTA-BASED TRADABLE GO - CERTIFICATES WORK

EURO/kWh

P_{Zert}?

Costs

kWh

QUOTA
Total costs for customers

TRADABLE GO CERTIFICATES

Total costs = Producer surplus + Additional generation costs

Total costs for customers
TRADABLE GREEN CERTIFICATES

EURO/kWh

Producer surplus

Extra generation costs
risk premium!!!

Minimal Monetary generation costs

Market price

Total costs

kWh

Quota/Target
THE SHAPE OF THE COST CURVE EU - 27

Additional generation costs

Producer surplus

Marginal cost for RES-E

Electricity market price

Required RES-E deployment

Total costs

Additional (up to 2020) realisable potential for RES-E [TWh]

Cost-resource curve (RES-E in the EU27)
THE CASE OF SWEDEN
CONCLUSIONS (1)

• To ensure significant RES-E deployment in the long-term, it is essential to promote a broad portfolio of different technologies.

• A well-designed FIT provides RES-E deployment fastest and at lowest costs.

• Strategies with lower (financial) risk > less profit requirements > lower costs for society.

IMPROVE/OPTIMIZE THE CURRENT SYSTEMS BEFORE HARMONISING OR IMPLEMENTING MAJOR CHANGES!

• A European-wide trading system would lead to a much higher burden for European citizens than a comparable FIT for meeting the 2020/20%RES target!
4. THE SUCCESS STORY OF PHOTOVOLTAIC DEPLOYMENT (IN GERMANY)
PV increases in recent years in Europe

- Germany
- Italy
- Spain
- Czech Republic

MW/year

2005 2006 2007 2008 2009 2010 2011 2012
Total installed capacity 2011: 27.7 GW
(compared to 16.6 GW in 2010)

Source: EPIA (2012)
Costs of and FIT for PV

Costs

FIT Germany

- Germany
- Costs Germany

Cent/kWh

2005 2006 2007 2008 2009 2010 2011 2012
PV: cumulative development in Central Europe

In Germany in 2011/2012: PV contributes at peak production times to about 25% of load!
SINCE 2000: INVESTMENTS MAINLY IN RENEWABLES!

2020: ca. 25000 MW PV
5. EFFECTS OF PROMOTING RES-E ON ELECTRICITY MARKETS
LONG-TERM MARGINAL COSTS

Cheapest:
1. Nat. Gas
2. Nuclear
3. Wind

Costs (EUR/MWh)

Capital costs
Operation/Fuel costs
CO2 costs
SHORT-TERM MARGINAL COSTS

Cheapest:

1. Nuclear
2. Wind
3. Nat. gas

Costs (EUR/MWh)

Operation/Fuel costs

CO2 costs
Long-term vs short-term marginal costs

Marginal generation costs [cents/kWh]

Total costs = long-term marginal costs

$p_{\text{gas}} = 30$ cents/m$^3$

$p_{\text{gas}} = 18$ cents/m$^3$

short-term marginal costs
ON-PEAK NICE SUMMER DAY: PRICE = SHORT-TERM MARGINAL COSTS

What happens, if PV capacity will double?
IMPACT OF PV ON THE ELECTRICITY MARKET PRICE IN GERMANY

Photovoltaics

On-peak time: Low electricity prices!

Spot market price electricity Germany
Supply and Demand

RES Production

> Demand

Electricity price = 0
(or negative)

< Demand

Electricity price = high!
PV costs vs household electricity price in Germany
Share on household electricity prices

- Capital costs
- Operation & Labour costs
- Fuel costs
- Profits of companies

Electricity prices of households

1983 to 2006
Structure household electricity prices

Household electricity price structures 1980 - 2012 - 2030

- Fuel costs decrease
- Capital costs increase

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<td>Capital costs production</td>
<td>5</td>
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<td>Fuel costs</td>
<td>10</td>
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<td>Operation costs grid &amp; storages</td>
<td>5</td>
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</tr>
<tr>
<td>Profits</td>
<td>2</td>
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Legend:
- Capital costs production
- Fuel costs
- Operation costs grid & storages
- Profits
- Tax
- Capital costs grid & storages
- Operation costs production
- RE-fee
- Distribution
Share on household electricity prices

Electricity prices of households

Non-regulated share

Regulated share

[1983] [2006] [2030]
[c/kWh]
6. Conclusions

(i) well-designed (dynamic) Feed-in tariff $\rightarrow$ certain deployment of PV fastest and at lowest costs for society $\rightarrow$ correct dynamic design!

(ii) “Overheating” destroyed other markets (Czech Republic, Spain, Italy(?));

(iii) Loming “grid-parity” for PV? $\rightarrow$ change to investment subsidies?

(v) New market design will emerge

(vi) New pricing mechanisms for end users

(vii) Regulated share on electricity prices will increase
INTERESTED IN FURTHER INFORMATION?

- Download reports from: www.eeg.tuwien.ac.at
- E-Mail to: Reinhard.Haas@tuwien.ac.at
THE CASE OF SWEDEN

Major characteristics:

* since 2002: quota-based system of Tradable Certificates
* also „old“ capacity allowed to fulfill quota
* additional investment subs. for wind!
SWEDEN: IMPACT OF INVESTMENT SUBSIDIES

Energy Economics Group

[Graph showing costs (Supply curve) for wind, investment subsidies for wind, and quota for Biomass.

- Wind Loc. A
- Wind Loc. B
- Costs (Supply curve)
- Invest. Subsidies for wind
- Quota

P_{\text{cert\_th}}

P_{\text{cert\_act}}

[Biomass]

[cent/kWh]

[GWh/year]
PRICES OF CERTIFICATES IN SWEDEN
Costs of PV in next years (EUR/kWp)

Increased competition due to modules from China

Market clearing

Over capacities