Renewable fuels – A comparative assessment from economic, energetic and ecological point-of-view up to 2050 in EU countries

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1. Introduction

GREENHOUSE GAS EMISSIONS EU-27

- Energy sector: 40%
- Industry: 16%
- Service: 4%
- Residential: 11%
- Others: 4%
- Railways: 0%
- Ships: 1%
- Other: 0%
- Civic Aviation: 1%

Transport: 25%

Road transport: 23%

TOTAL ENERGY 2007:
4000 Mio tons CO2_equ
2. Method of approach

The energy chain for providing the service mobility

- **Well-to-Tank (WTT)**
- **Tank-to-Wheel (TTW)**
- **Well-to-Wheel (WTW)**

**Renewable energy sources** → **Fuel** → **Mobility** → **Car**

The energy chain for providing the service mobility
3. Environmental assessment

Comparison of specific WTW CO2-emissions in 2010.
3. Environmental assessment

Comparison of specific WTW CO2-emissions in 2050
Renewable (RE) and fossil (FF) energy shares in the whole WTW energy service provision chain in 2010 for gasoline versus renewable fuels
3. Environmental assessment

Renewable (RE) and fossil (FE) energy shares in the whole WTW energy service provision chain in 2050 for gasoline versus renewable fuels
4. Economic assessment

Transport service fuel costs in 2010 per 100 km
4. Economic assessment

Transport service fuel costs in 2050 per 100 km
4. Economic assessment

Total specific costs of transport in 2010 per 100 km
3. Economic assessment

Total specific costs of transport in 2050 per 100 km
4. Economic assessment

Comparison of specific CO2 emissions and costs of mobility with different fuels in 2010
Comparison of specific CO2 emissions and costs of mobility with different fuels in 2050
5. Conclusions

• **1st generation biofuels**
  – The environmental performance of 1st generation biofuels is currently rather modest. The economic prospects for the 1st generation biofuels could be much better with the implementation of CO₂ based tax system. Moreover, their potentials are very restricted especially due to limited crops areas;

• **2nd generation biofuels**
  – There are much higher expectations from 2nd generation biofuels which could – in a favourable case – enter the market between 2020 and 2030. The major advantage of the 2nd generation biofuels is that they can be produced from different lignocellulosic materials, which are not in competition with a food production. These advanced biofuels have significantly better ecological and energetic life-cycle performance in comparison to the 1st generation;
5. Conclusions

- **Hydrogen and electricity from RES**
  - In 2010 and 2050 electricity is slightly favorable from ecological point-of-view given the same RES. Most favorable are wind and hydro followed by PV and biomass;
  - Despite very good CO$_2$ balances of hydrogen from renewable energy sources, use of hydrogen in a passenger cars will not become competitive before 2050 due to high capital costs;
  - Similar as with hydrogen, electricity from renewable energy sources will remain an expensive option for mobility.
Thank you!
Promotion systems for electricity generation from renewable energy sources revisited - an update on lessons learned from EU countries

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1. Introduction

2. Historical developments

3. Success of strategies

4. Conclusions
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

1997: 12%
2009: 17%

Electricity generation [TWh/a]

Large-scale hydro
Small-scale hydro
'New' RES-E excl. hydro
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!
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 for different years and countries.](image-url)
SUPPORT LEVELS: COMPARISON

TRADABLE CERTIFICATES

FEED-IN TARIFFS
EFFECTIVENESS VS COSTS

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

Figures excl. PV, Figures for 2009/10 preliminary
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

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

The graph shows the relationship between the supply curve and different energy sources, including biomass, with specific costs and investment subsidies for wind. The Quota indicates the quota for energy production.
PRICES OF CERTIFICATES IN SWEDEN

TGCs issued

TGCs redeemed

TWh/yr

2003 2004 2005 2006 2007 2008 2009 2010
4. CONCLUSIONS (1)

• There should be a clear focus on NEW capacities!
• To ensure significant RES deployment in the long-term, it is essential to promote a broad portfolio of different technologies.
• A well-designed FIT provides RES 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!

requirements -> lower costs for society.
4. CONCLUSIONS (2)

• Promoting RES in EU successful? Yes, but increase in energy consumption outweighed …

• Trading certificates in Sweden successful due to very specific favourable conditions (“Long”)

• 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!
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