EU Climate and Energy Policy beyond 2020: How Many Targets and Instruments Are Necessary?

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Outline

- Introduction
- Rationales for renewables targets
- Model
- Results
- Conclusion
EU Targets 2020 and 2030

Greenhouse gas emissions (GHG) compared to 1990
- 20%  
allocated amongst Member States
- 40%  
allocated amongst Member States

Share of renewables energy sources (RES) in total energy consumption
+ 20%  
allocated amongst Member States
+ 27%  

Reduction in energy consumption compared to projections
- 20%  

➡️ Justification: Additional targets impair the cost-effectiveness of GHG mitigation
## Contributions of our Paper

**Literature …**

- discusses the **welfare loss** of an additional RES policy in a **first-best** setting with a **GHG externality** only …
- for **2020** targets …
- using **optimization** models.

(Bernard and Vielle, 2009; Boeters and Koornneef, 2011; Böhringer et al., 2009a,b; Capros et al., 2008; Kretschmer et al., 2009; Tol, 2012)

**Our paper …**

- discusses the **costs and benefits** of an additional RES policy in a **second-best** setting with **multiple market** and **policy failures** …
- for **2030** targets …
- using **theoretical** analysis and an **econometric** decision-making model.
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Rationales for Renewables Targets and Instruments in the Electricity Sector

- **Objectives**: Targets
- **Instruments**: Efficiency rationales, Second-best rationales, First-best rationale, Rationales beyond efficiency
- **Market failure**: GHG emissions externality, Other environ. externalities, Externalities of fossil fuel imports, Technology market failures
- **Climate change mitigation**: GHG emissions externality, Other environ. externalities, Security of energy supply, Technology development
- **Environ. and resource conservation**: GHG emissions externality, Other environ. externalities, Security of energy supply, Technology development
- **Security of energy supply**: GHG emissions externality, Other environ. externalities, Security of energy supply, Technology development
- **Promotion of green growth and jobs**: GHG emissions externality, Other environ. externalities, Security of energy supply, Technology development
- **Democratic energy supply**: GHG emissions externality, Other environ. externalities, Security of energy supply, Technology development

- **Rationales strengthened by path dependencies and lock-ins** (Unruh 2000, Kalkuhl et al. 2012)
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Energy-Environment-Economy Model at the Global level (E3MG)

- Econometric model
- 22 world regions (focus here on EU)
- 42 economic sectors
- Endogenous tech. change
FTT: Power Model

Integration of FTT: Power with E3MG model

- Simulation model of tech. diffusion
- 24 technologies
- 21 E3MG regions
- Dynamics: LBD, costs of natural resources, etc.
Basic Assumptions and Inputs

- Climate policies non-EU: no action beyond existing policies
- EU ETS
  - Allowance allocation: Auctioning (electricity sector), free of charge (otherwise)
  - No borrowing, but banking
  - Revenue recycling: lump-sum to households (increases wealth but not direct consumption levels, sensitivity analysis available)
  - Offsets (CDM/JI) allowed to certain extent
  - Coverage: as of 2009, excluding aviation
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## Policy Scenarios

- Baseline scenario S0: PRIMES 2009 projections + IEA World Energy Outlook
- Targets under consideration derived from Knopf et al. (2013)

<table>
<thead>
<tr>
<th>Targets</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG target</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ETS cap (MtCO₂)</td>
<td>1136</td>
<td>626</td>
<td>1136</td>
<td>1136</td>
</tr>
<tr>
<td>RES target</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>RES-E share</td>
<td>32</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instruments</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU ETS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CO₂ price (€/CO₂)</td>
<td>100</td>
<td>440</td>
<td>53</td>
<td>41</td>
</tr>
<tr>
<td>RES-E support</td>
<td>No</td>
<td>No</td>
<td>Tech. neutral</td>
<td>Tech. specific</td>
</tr>
<tr>
<td>Average RES subsidy (€/MWh)</td>
<td>-</td>
<td>-</td>
<td>16.00</td>
<td>24.50</td>
</tr>
</tbody>
</table>

Exogenously set values
Costs of an Additional RES Target

Macro-Economic Outcomes

- Effects generally small and even positive
- Reasons:
  - Small share of ETS sectors in GDP
  - Small share of energy and CO\textsubscript{2} costs in total costs of manufacturers
  - Unemployed resources

<table>
<thead>
<tr>
<th>% change compared to baseline</th>
<th>GDP</th>
<th>Investment</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (CO2/ETS only)</td>
<td>-0.30</td>
<td>-0.32</td>
<td>-0.06</td>
</tr>
<tr>
<td>S3 (CO2 and RES-E1)</td>
<td>-0.25</td>
<td>0.08</td>
<td>-0.06</td>
</tr>
</tbody>
</table>
Costs of an Additional RES Target
Average Levelized Costs of Electricity

[in €/MWh, 2010 prices]

<table>
<thead>
<tr>
<th></th>
<th>Average LCOE, excluding carbon costs and RES-E subsidies</th>
<th>Average LCOE, including carbon costs</th>
<th>Average LCOE, including carbon costs and RES-E subsidies</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (CO2/ETS only)</td>
<td>69</td>
<td>86</td>
<td>85</td>
</tr>
<tr>
<td>S3 (CO2 and RES-E1)</td>
<td>76</td>
<td>85</td>
<td>69</td>
</tr>
</tbody>
</table>
Benefits of an Additional RES Target
Second-Best Means for CO₂ Mitigation?

- ETS sector emissions driven by ETS only
- Non-ETS emissions may be affected

<table>
<thead>
<tr>
<th></th>
<th>EU ETS</th>
<th>Non-EU ETS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (CO₂/ETS only)</td>
<td>-24.9</td>
<td>-2.6</td>
<td>-11.1</td>
</tr>
<tr>
<td>S3 (CO₂ and RES-E1)</td>
<td>-24.9</td>
<td>-2.2</td>
<td>-10.8</td>
</tr>
</tbody>
</table>
Benefits of an Additional RES Target
Second-Best Means for CO$_2$ Mitigation?

- Additional RES target brings down CO$_2$ price if addressed by additional RES instrument.
- Makes attainment of CO$_2$ target more likely from a politico-economy perspective (Gawel et al. 2014).

![Graph showing CO$_2$ price trends up to 2030 for different scenarios.](image-url)

<table>
<thead>
<tr>
<th>Year</th>
<th>S1 (CO2/ETS only)</th>
<th>S3 (CO2 and RES-E1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>2020</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>2025</td>
<td>44</td>
<td>30</td>
</tr>
<tr>
<td>2030</td>
<td>100</td>
<td>53</td>
</tr>
</tbody>
</table>
Benefits of an Additional RES Target
Second-Best Means for Environmental Protection?

- Ambiguous effects
  - Nuclear is further reduced
  - Coal increases, gas decreases

- Explanations:
  - Reduced elec. consumption
  - „Green serves the dirtiest“

<table>
<thead>
<tr>
<th></th>
<th>Nuclear</th>
<th>Coal</th>
<th>CCGT</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (CO2/ETS only)</td>
<td>7</td>
<td>-163</td>
<td>-186</td>
</tr>
<tr>
<td>S3 (CO2 and RES-E1)</td>
<td>-199</td>
<td>-152</td>
<td>-346</td>
</tr>
</tbody>
</table>
Benefits of an Additional RES Target
Second-Best Means for Energy Security?

- Additional RES target may even increase fuel imports
- But most likely only coal imports increase while gas imports decrease
- Positive for security of supply since gas is often imported from politically sensitive regions

<table>
<thead>
<tr>
<th></th>
<th>GDP</th>
<th>Investment</th>
<th>Employment</th>
<th>Consumer prices</th>
<th>EU imports of fossil fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (CO2/ETS only)</td>
<td>-0.30</td>
<td>-0.32</td>
<td>-0.06</td>
<td>0.48</td>
<td>-1.92</td>
</tr>
<tr>
<td>S3 (CO2 and RES-E1)</td>
<td>-0.25</td>
<td>0.08</td>
<td>-0.06</td>
<td>0.57</td>
<td>-1.12</td>
</tr>
</tbody>
</table>
Benefits of an Additional RES Target
Beyond Efficiency: Changes in Employment

EU sectoral employment 2030 (absolute differences from baseline)

- RES target hardly with positive effects on sectoral employment
- weak „green job“ benefits

<table>
<thead>
<tr>
<th></th>
<th>Agriculture</th>
<th>Utilities mining</th>
<th>Manuf. industry</th>
<th>Construction</th>
<th>Distrib. and retails</th>
<th>Transport</th>
<th>Busin. services</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 (CO2/ETS only)</td>
<td>-2,7</td>
<td>-54,6</td>
<td>1,6</td>
<td>-11,6</td>
<td>-16,8</td>
<td>0,1</td>
<td>-47,3</td>
</tr>
<tr>
<td>S3 (CO2 and RES-E1)</td>
<td>0,4</td>
<td>-53,6</td>
<td>-4,1</td>
<td>6,2</td>
<td>-28,5</td>
<td>1,1</td>
<td>-50,0</td>
</tr>
</tbody>
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Conclusions

- There are multiple possible rationales for implementing RES targets and instruments in addition to GHG targets and instruments in the EU.

- Quantitative assessment confirms several but not all second-best benefits.

- The economic assessment is constrained by uncertainties und hinges on individual preferences of the decision maker.

- Therefore, the eventual decision can only be taken politically.
Thank you!