Measures and instruments to encourage companies to use renewable or alternative energy technologies, in order to contribute meeting the challenge of a low carbon economy

Presentation at the 5º Congreso International de Ecoeficiencia Y Competitividad Empresarial “Hacia una Economia Baja en Carbono”

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Bogotá, September 10, 2010
• economist, Ph.D. at the University of Bielefeld
• professor at the business school of the University of Applied Sciences in Saarbruecken since 1995
• at the same time scientific head of the Institute for Future Energy Systems (IZES), a university based research institute focussing on renewable energies, energy efficiency and decentralised power generation
• author and co-author of several books and articles about liberalised electricity markets, feed-in law regulations and instruments for promoting renewable energies in the heat market.
• expert member of the Enquete commission “Sustainable energy supply” of the 14th German Bundestag
• alternate Board Member of the Agency for the Cooperation of Energy Regulators (ACER) of the European Union
My institute: the IZES

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- Energy Economy/Future Markets
  Uwe Leprich
- Test Centre TZSB
  Danjana Thels

about 30 staff members, 25 scientists
Shareholder: 70% state of Saarland, 4 regional utilities, University of the Saarland, University of Applied Sciences of the Saarland (HTW)

[Leprich, September 10 2010, Bogotá]
Selected work

Studies and research projects focusing on the

- German Energy law
- Feed-in law for electricity from renewable energies
- Renewable heat law for new buildings
- Law for electricity from cogeneration plants
- Energy Efficiency law as the national implementation of the European Energy Service Directive
- Support Mechanism for Micro CHP
- Incentive regulation scheme for electricity and gas networks

[Leprich, September 10 2010, Bogotá]
Agenda

1. The Overall Energy Situation in Germany
2. Energy Use in the Industrial Sector
3. Developments in Renewables and Energy Efficiency
4. Measures and Instruments to speed up Renewables and Energy Efficiency
5. Are there any Lessons for Colombia?

[Leprich, September 10 2010, Bogotá]
German primary energy supply 2009 (2008) by fuel (approx. 13.300 PJ)

- Oil: 34,6 (34,3)
- Gas: 21,7 (21,6)
- Hard Coal: 11,1 (12,7)
- Lignite: 11,4 (10,9)
- Nuclear: 11,1 (11,4)
- Renewables: 9,1 (8,2)
- misc.: 1,0 (0,9)

Source: AGEB 2009
German final energy consumption 2009 by sectors

Final Energy Consumption 2009

- Traffic: 29%
- Private Households: 26%
- Industry: 16%
- Small Commercial, Trade, Services: 29%

Source: UBA 2009

[Leprich, September 10 2010, Bogotá]
German electricity generation 2009 by fuel (approx. 600 TWh)

- Hard coal: 18.3%
- Gas: 12.9%
- Oil: 2.1%
- Misc.: 3.9%
- Renewables: 15.6%
- Lignite: 24.6%
- Nuclear: 22.6%

Source: BMWi 2010
[Leprich, September 10 2010, Bogotá]
Development of the greenhouse gas emissions in Germany (in Mio. t CO$_2$eq)

Source: UBA 2010

[Leprich, September 10 2010, Bogotá]
Energy related CO2 emissions in Germany

Source: DIW 2009

[Leprich, September 10 2010, Bogotá]
National targets

- 40% greenhouse gas reduction by 2020 compared to 1990
- Increase of the share of renewable energies contributing to electricity generation to at least 30% by 2020
- Increase of the share of cogeneration contributing to electricity generation to 25% by 2020
- Increase of the share of renewable energies contributing to heat consumption to 14% by 2020
- Doubling of energy productivity by 2020 compared to 1990
Germany is heading for a low carbon economy in the medium run!
1. The Overall Energy Situation in Germany

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5. Are there any Lessons for Colombia?
Who is working where in the EU economy?

Share of employees in 2003 in%

primary sector
secondary sector
tertiary sector

Quelle: OECD
Gross Added Value for different industrial sectors (%)
The German manufacturing industry is a decreasing part of the overall German economy

- The average energy costs of the German industry are in the range of 2-3% of total costs
- The German industry is not very energy intensive!
- Exceptions: aluminum melt, chlorinate elektrolysis etc.

For what purposes does the German industry use energy?
Primary energy consumption by sectors and applications

- **Lighting**
- **Mechanical Energy**
- **Industrial Heating (High Temperature)**
- **Information and Communication Techn.**
- **Space Heating (Low Temperature)**

**Source:** FfE 2009

[Leprich, September 10 2010, Bogotá]
Final energy consumption in the industry by applications and fuels

<table>
<thead>
<tr>
<th>Sector applicat.</th>
<th>coal</th>
<th>oil</th>
<th>fuel</th>
<th>gas</th>
<th>renew.</th>
<th>d.heat</th>
<th>electri.</th>
<th>sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kohle</td>
<td>In PJ</td>
<td>In %</td>
<td>In PJ</td>
<td>In %</td>
<td>In PJ</td>
<td>In %</td>
<td>In PJ</td>
<td>In %</td>
</tr>
<tr>
<td>Prozesswärme 3)</td>
<td>431</td>
<td>17,6</td>
<td>102</td>
<td>4,2</td>
<td>0</td>
<td>0,0</td>
<td>730</td>
<td>29,9</td>
</tr>
<tr>
<td>Raumwärme</td>
<td>6</td>
<td>0,2</td>
<td>53</td>
<td>2,2</td>
<td>0</td>
<td>0,0</td>
<td>103</td>
<td>4,2</td>
</tr>
<tr>
<td>Mech. Energie</td>
<td>0</td>
<td>0,0</td>
<td>3</td>
<td>0,1</td>
<td>0</td>
<td>0,0</td>
<td>9</td>
<td>0,4</td>
</tr>
<tr>
<td>Beleuchtung</td>
<td>0</td>
<td>0,0</td>
<td>0</td>
<td>0,0</td>
<td>0</td>
<td>0,0</td>
<td>0</td>
<td>0,0</td>
</tr>
<tr>
<td>IUK 5)</td>
<td>0</td>
<td>0,0</td>
<td>0</td>
<td>0,0</td>
<td>0</td>
<td>0,0</td>
<td>0</td>
<td>0,0</td>
</tr>
<tr>
<td>Insgesamt</td>
<td>437</td>
<td>17,8</td>
<td>158</td>
<td>6,5</td>
<td>0</td>
<td>0,0</td>
<td>842</td>
<td>34,5</td>
</tr>
</tbody>
</table>

Source: FFE 2009

[Leprich, September 10 2010, Bogotá]
1. The Overall Energy Situation in Germany
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5. Are there any Lessons for Colombia?
### Contribution of renewable energy sources to energy supply in Germany in 2009

<table>
<thead>
<tr>
<th>Share of renewable energy sources</th>
<th>[%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>in total final energy consumption</td>
<td>10.1</td>
</tr>
<tr>
<td>in total gross electricity consumption</td>
<td>16.1</td>
</tr>
<tr>
<td>in total heat supply</td>
<td>8.4</td>
</tr>
<tr>
<td>in total fuel consumption&lt;br&gt;1)</td>
<td>5.5</td>
</tr>
<tr>
<td>in total primary energy consumption&lt;br&gt;2)</td>
<td>8.9</td>
</tr>
</tbody>
</table>

1) Total consumption of engine fuels, excluding fuel in air traffic;
2) Source: Working Group on Energy Balances (AGEB);

Source: BMU 2010
Renewable energy sources as a share of energy supply in Germany

Source: BMU, September 10, 2010, Bogotá

[Graph showing share of renewable energy sources in energy consumption in Germany, with targets and figures for years 1998 to 2009.]

Development of electricity generation from renewable energy sources in Germany 1990 - 2009

- Hydropower
- Wind energy
- Biomass *
- Photovoltaics

Source: BMU 2010

* Solid, liquid, gaseous biomass, biogenic share of waste, landfill and sewage gas;
Electricity from geothermal energy is not presented due to the negligible quantities of electricity produced;
StrEG: Act on the Sale of Electricity to the Grid; BauGB: Construction Code; EEG: Renewable Energy Sources Act; Source: BMU-Il II 1 according to Working Group on Renewable Energies-Statistics (AGEE-Sel); Image: BMU / Christoph Eisentroth, all figures provisional
Structure of electricity supply from renewable energy sources in Germany 2009

Total: 93.5 TWh

- Wind energy: 40.4%
- Hydropower: 20.3%
- Biogenic solid fuels: 12.9%
- Biogenic liquid fuels: 1.6%
- Biogas: 10.7%
- Sewage gas: 1.1%
- Landfill gas: 1.0%
- Biogenic share of waste: 5.3%
- Photovoltaics: 6.6%

Share of biomass*: approx. 33%

*Solid, liquid, gaseous biomass, biogenic share of waste, landfill and sewage gas; Deviations in the totals are due to rounding; Source: BMU-KI III 1 according to Working Group on Renewable Energies-Statistics (AGEE-Stat); all figures provisional

Source: BMU 2010
Number of wind energy plants and installed capacity in Germany 1990 - 2009

Increase in capacity
In a mere 20 years, the yield of wind turbines has increased 100-fold. With the new 5 MW turbines, it will multiply another fivefold.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated power</td>
<td>30 kW</td>
<td>80 kW</td>
<td>250 kW</td>
<td>600 kW</td>
<td>1,500 kW</td>
<td>5,000 kW</td>
</tr>
<tr>
<td>Rotor diameter</td>
<td>15 m</td>
<td>20 m</td>
<td>30 m</td>
<td>46 m</td>
<td>70 m</td>
<td>115 m</td>
</tr>
<tr>
<td>Hub height</td>
<td>30 m</td>
<td>40 m</td>
<td>50 m</td>
<td>78 m</td>
<td>100 m</td>
<td>120 m</td>
</tr>
<tr>
<td>Annual energy yield</td>
<td>35,000 kWh</td>
<td>95,000 kWh</td>
<td>400,000 kWh</td>
<td>1,250,000 kWh</td>
<td>3,500,000 kWh</td>
<td>approx. 17,000,000 kWh</td>
</tr>
</tbody>
</table>
Repower 6 M

6,15 MW el

126 m diameter

117 m Hub height
Installed capacity and energy supply from photovoltaic installations in Germany 1990 - 2009

Source: BMU-KI III 1 according to Working Group on Renewable Energies-Statistics (AEE-Estat); Image: BMU / Bernd Müller, all figures provisional
Total turnover from renewable energy sources in Germany 2009 (investments and operation)

- Hydropower; EUR 1,420 million; 4.3%
- Wind energy; EUR 5,650 million; 16.9%
- Geothermal energy; EUR 1,003 million; 3.0%
- Biomass; EUR 11,400 million; 34.2%
- Solar energy; EUR 13,900 million; 41.8%

Total: approx. EUR 33.4 billion

Turnovers:
- Investments: approx. EUR 17.7 billion
- Operation: approx. EUR 15.7 billion

Source: BMU-KI III 1 according to the Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ISFH); all figures provisional.

Photovoltaics and solar thermal energy; 2 2 Large plants and heat pumps. Deviations in the totals are due to rounding.

Source: BMU 2010
Jobs in the renewable energy sector in Germany
2004, 2008 und 2009

Wind energy
Biomass
Solar energy
Hydropower
Geothermal energy
Public / non-profit - sector jobs

Increase: approx. 87 %

Source: BMU-KI III Projekt "Gross employment from renewable energy in Germany in the year 2009, a first estimate"; Image: BMU / Christoph Susse / transit
But don‘t forget energy efficiency – it is as important as the use of renewable energies!
“Decoupling” – efficiency at the move

Gross Added Value
Primary Energy Consumption
Gross Electricity Consumption

Source: Thöne/Fahl/Blesel 2009
Development of energy productivity

Source: Stingwagner 2009

Graph showing development of energy productivity with targets for 2020 and previous years.

Target 2020: 3.1

Source: EMWI, IIIA2

Leprich, September 10 2010, Bogotá
The Energy Conservation Supply Curve for the German industry 2020

Source: McKinsey 2007
In the industrial sector high temperature heat and electricity are usually the dominant uses of energy.

Renewable energies are mainly used for electricity generation, for fuel supply and for hot water, not for high temperature heat.

Energy efficiency in the industrial sector offers a broad range of options with very low life cycle costs.

The structural transformation of the economy from manufacturing to the service sector (tertiary sector) automatically leads to less use of energy.
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The toolbox

**Instruments**
- voluntary agreements
- financial support programmes
- innovation support programmes
- legal framework
- market-based: taxes, information, consulting, labels
Legal framework for REN and EE

- Eco Tax Law
- Energy Taxonomy Act (EnWG)
- Energy Saving Ordinance (EnEV)
- Renewable Energy Sources Act (EEG)
- Legislation for CHP, Federal Emissions Prevention, Emissions Trading
- Energy Saving Act (EnEG)
- Tendering procedures
- Command and control

ETS

Energy Consumption Labelling Law

Leprich, September 10 2010, Bogotá
Legal framework for REN and EE

ETS

- Eco Tax Law
- Energy Consumption Labelling Law
- Renewable Energy Sources Act (EEG)
- Tendering procedures
- Energy Saving Ordinance (EnEV)
- Energy Saving Act (EnEG)

REN / EE

Market based / financial

[Leprich, September 10 2010, Bogotá]
### Selected measures and instruments

<table>
<thead>
<tr>
<th>Command and Control</th>
<th>Market based</th>
<th>Else</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Ecodesign directive (EU)</td>
<td>▪ Feed-in tariff ▪ direct support schemes</td>
<td>▪ Contracting ▪ Efficiency networks</td>
</tr>
</tbody>
</table>

... if you want to avoid direct money flows

... if there is some money with the state and/or the customers

... if you have market players who can make a business out of it
a) Ecodesign Directive
The Ecodesign Directive
2009/125/EC

- The Directive establishes a framework for the setting of ecodesign requirements for energy-related products.

- “Ecodesign” aims at improving the environmental performance of products throughout their life-cycle by integration of environmental aspects in the product design, in balance with technical and economic constraints.

- Framework Directive implemented through implementing measures by Commission or self-regulation measures by industry
Commission adopted 9 implementing measures

<table>
<thead>
<tr>
<th>Ecodesign Regulation</th>
<th>Adoption</th>
<th>Saving potential per year in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1275/2008 Standby and off mode of household and office equipment</td>
<td>17.12.2008</td>
<td>35 TWh</td>
</tr>
<tr>
<td>107/2009 Simple set-top boxes</td>
<td>04.02.2009</td>
<td>6 TWh</td>
</tr>
<tr>
<td>244/2009 Non-directional household lamps</td>
<td>18.03.2009</td>
<td>37 TWh</td>
</tr>
<tr>
<td>245/2009 Street and office lighting</td>
<td>18.03.2009</td>
<td>38 TWh</td>
</tr>
<tr>
<td>278/2009 External power supplies</td>
<td>06.04.2009</td>
<td>9 TWh</td>
</tr>
<tr>
<td>640/2009 Electric motors</td>
<td>22.07.2009</td>
<td>135 TWh</td>
</tr>
<tr>
<td>641/2009 Circulators</td>
<td>22.07.2009</td>
<td>25 TWh</td>
</tr>
<tr>
<td>642/2009 Televisions</td>
<td>22.07.2009</td>
<td>26 TWh</td>
</tr>
<tr>
<td>643/2009 Household refrigerating appliances</td>
<td>22.07.2009</td>
<td>4 TWh</td>
</tr>
</tbody>
</table>

Expected savings in 2020 equal to 12% of the total annual EU electricity consumption

[Leprich, September 10 2010, Bogotá]
The problem with standards: they are often not very ambitious!
b) Feed-in tariff
Renewable Energy Sources Act, main features

- Term of the contracts: maximum 20 years
- Planning and investment reliability by guaranteed fixed prices for RE-power
- Returns of 7% taken as the basis for the calculations
- Annual decrease of the tariffs
- RE-priority for grid access, transmission and distribution
- Equalization of additional costs for electricity from RES between all grid operators and electricity suppliers; Costs paid by all consumers
- All different types of RES are considered
### Feed-in tariffs 2009

<table>
<thead>
<tr>
<th>Technology</th>
<th>Payment time [years]</th>
<th>Feed-in tariff [€cent/kWh]</th>
<th>Degression rate annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind power (onshore)</td>
<td>20</td>
<td>9.70 (...5.02)**</td>
<td>1%</td>
</tr>
<tr>
<td>Wind power (offshore)</td>
<td>20</td>
<td>15.0 (...3.5)**</td>
<td>5% as of 2015</td>
</tr>
<tr>
<td>Photovoltaics</td>
<td>20</td>
<td>31.94 –43.01</td>
<td>8% -10%</td>
</tr>
<tr>
<td>Hydro power &lt; 5 MW</td>
<td>20</td>
<td>7.65 -12.67</td>
<td>-</td>
</tr>
<tr>
<td>Large hydro &gt; 5 MW</td>
<td>15</td>
<td>3.50 -7.29</td>
<td>-</td>
</tr>
<tr>
<td>Biomass</td>
<td>20</td>
<td>7.79 -11.67</td>
<td>1%</td>
</tr>
<tr>
<td>Geothermal energy</td>
<td>20</td>
<td>10.5 –16.0</td>
<td>1%</td>
</tr>
</tbody>
</table>

* Additional bonus up to 13 €ct/kWh if renewable raw material is used

** The tariff is paid in the beginning and is reduced during the payment time to the lower level
The problem with feed-in tariffs: sometimes they do not give enough incentives to bring the costs of the technologies down
c) Contracting
The idea

Financing Model

- Guaranteed savings covers the investment value
- New, reduced costs with Performance Contracting
- Customer savings
## Saving Guarantee-Contract *

### contents

**Guaranteed performance by contractor:**

- saving and participation of the client on the saved operating costs
- investments (level and structur)
- energy-controlling-system (remote control / optimization)
- maintenance of energy saving measurements (e.g. according DIN 31051)
- user motivation indoor lighting (motivation / incentive systems e.g. in schools)
- keeping of agreements to the standards
- documentation

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* on the example of the German model contract, based on the Hesse Contracting-guideline, lighting guidelines
Saving Guarantee-Contract

**Risk sharing**

- **Risk of using**
  - carried by the owner of lighting system: in case of changing the use an adjustment of the guaranteed saving will be carried out

- **Risk of energy prices**
  - carried by the owner: protect the contractor against increasing prices and help the building owner in cases of price cutting

- **Technical risk**
  - Contractor carries the guarantee for the functioning, reliability and availability

- **Economical risk**
  - Contractor carries the whole risk of his investment

- **Ownership**
  - The saving investments installed by the Contractor will become with the installation and acceptance the property of the owner of the lighting system
d) Efficiency networks
A “Learning Energy Efficiency Network“ (LEEN) meets on a regular basis with at least 10-15 local/regional companies in order to cut energy costs with the help of external experts. The meetings are professionally organised and serve as a forum to exchange experiences.
Further targets

- grab the „low hanging fruits“ rapidly
- decrease information/transaction costs
- cut direct and indirect CO2 emissions
- increase awareness for energy efficiency within the companies
- anticipate changes in the legal framework
- local/regional companies with energy costs higher than 150,000 € per year
- companies with a high share of their energy use for non-production technologies (e.g. heating, cooling, lighting, ..)
- parts of large companies
- companies from different branches, no competitors
The problem with efficiency networks: energy is usually a low interest issue for companies
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➢ 5. Are there any Lessons for Colombia?
If standards are o.k., start with motors!

- large potential in the industry
- cost effective measure
- available technologies

Cost curve for motor systems (EU27, 2030)
If a feed-in tariff is o.k., start with

- mine gas (methane)
- sewage treatment plant gas
- landfill gas
- possibly biogas

**Article 7**

Fees paid for electricity produced from landfill gas, sewage treatment plant gas and mine gas

The fees paid for electricity from landfill gas, sewage treatment plant gas and mine gas shall be

1. at least 7.67 cents per kilowatt-hour up to and including a capacity of 500 kilowatts and
2. at least 6.65 cents per kilowatt-hour up to and including a capacity of 5 megawatts.

The fees paid for electricity from mine gas plants with a capacity of over 5 megawatts shall be 6.65 cents per kilowatt-hour.
.. could be triggered for industrial companies if it is accompanied by a certain risk guarantee from the state. Otherwise this market will not “fly” and will remain a small niche market.

A good starting point for contracting are public buildings anyway (no risk).
Efficiency networks

.. could be supported by very little means from the state or the utilities. They could benefit from experiences in Germany.

They should be accompanied by the commitment of the participating companies to apply longer payback periods to energy efficiency investments than to their usual investments in order to realise a larger part of the efficiency potential.
Final remarks

Progress towards the increasing use of renewable or alternative energy technologies in the industry heavily relies on:

- the overall spirit to go for a low carbon economy
- national overall and sector targets to fill the spirit with lives
- the implementation of effective instruments and measures to reach the targets
- the readiness of the companies to take some technical risks in order to cut energy costs in the medium and long run.
... for the sake of the planet!
Thank you very much for your attention!

Institut für ZukunftsEnergieSysteme (IZES)

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