Transition to Renewable Energy until 2030 – 2050 in the EU, Denmark, and more - The INFORSE Visions

Gunnar Boye Olesen, International Network for Sustainable Energy (INFORSE-Europe)

EU Stakeholder Seminar on Low Carbon European Energy Scenarios, 28 April 2010

The INFORSE Vision

• Phase out fossil fuel and nuclear power
• Provide everybody with basic energy needs
INFORSE Sustainable Energy Visions

- Global Vision
- Vision for EU-27
  - Bulgaria
  - Denmark
  - Hungary
  - Latvia
  - Lithuania
  - Romania
  - Slovakia
- UK Zero Carbon Britain
  - Belarus
  - Russia
  - Ukraine
We need to limit global climate change to 2°C (or better 1.5°C)

Only than can we avoid catastrophes for nature and humanity.

In spite of recent press there has been very broad scientific consensus on this for several years.

It is expressed in the IPCC 4th Assessment report (2007) and stronger emphasized in later studies.
Climate Sensitivity: How much will global temperature increase with a doubling of atmospheric greenhouse gases?

According to Meinshausen, Hare a.o. PIK, Nature, April 2009
1: IPCC 4, 2007
4: World Energy Council 2007
16: Meinshausen et.al. 2008

http://www.pik-potsdam.de/members/mmalte
The risk to exceed 2'C global warming depending on CO\textsubscript{2} emissions 2000 – 2049 (The Climate Budget)
Climate budget

CO2 emission budget 2000 - 2049

Gigaton CO2

<table>
<thead>
<tr>
<th>Probability of staying below 2°C</th>
<th>80%</th>
<th>75%</th>
<th>66%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions 2010-2049</td>
<td>636</td>
<td>750</td>
<td>906</td>
<td>1187</td>
</tr>
<tr>
<td>Emissions 2000 - 2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pathway

Global CO2 emissions to keep below 2°C
EU's Challenges in a Global Development Rights Framework

http://www.ecoequity.org
The Global Vision

Supply minus demand (W/m²)

-0.1 to 0.5
-0.05 to 0.1
-0.01 to 0.05
-0.005 to 0.01
-0.0001 to 0.005
-0.005 to -0.0001
-0.01 to -0.005
-0.05 to -0.01
-0.1 to -0.05
-0.5 to -0.1
-1 to -0.5
-2 to -1
-10 to -2
all others

Prof. Bent Sørensen, 100% Renewable Energy Scenario, Low Energy Consumption Scen. 1999
EU-27 Sustainable Energy Vision

Methodology of the study:
- Energy balances per decade for EU-15, EU-12 and selected countries
- Trends from decade to decade based on realised examples and studies/documentation
- Based on energy service level trends, not GDP
- Based on low growth/sustainable development

Targets & guidelines:
- Above 95% reduction by 2050 (98%),
- Fast application of known solutions to 2020 and 2030
- Sustainability issues addressed (biomass, biofuels)
- No net import or export over longer periods
EU-27 Sustainable Energy Vision

Demand side:
- Modest increase in energy services (sufficiency/sust.)
- Less road transport in EU-15 (sufficiency, environm.)
- Large increase in energy efficiency, factor 4 in end-use sectors when possible until 2050
- Transition to electric and hydrogen transport, 97%

Supply side:
- Efficient energy supply with combined heat and power (CHP), smarter and more efficient grids
- Rapid development of renewable energy
- Phase out of nuclear until 2025, no CCS
Renewable Energy Supply - EU27

Renewable Energy Supply, EU27

- Solar PV
- Solar heat
- Windpower
- Bio-fuel, liquid
- Energy Forest
- Biomass
- Geothermal
- Hydro

Years:
- 2000
- 2010
- 2020
- 2030
- 2040
- 2050

Units:
- PJ
Is the Biomass Use Sustainable?

EU-27 Biomass potential/use 2050 (PJ)

* EU-15 figures up-scaled with 20% to EU-27
** DK figures up-scaled with population ratio to EU-27
Energy Efficiency Increases

Small development until 2010
Factor 4 for personal cars, industry, until 2050
55% for space heating, until 2050
40% for railways, 60% for road freight until 2050
Energy Service Developments
Increase in Energy Sector Efficiency

Power(CHP) plant efficiency, EU-15

Power(CHP) plant efficiency, EU-new
Electricity

Electricity Divided in Supply, EU-27

- Nuclear
- Fossils
- Solar PV
- Wind
- Biomass
- Hydro

PJ

2000 2010 2020 2030 2040 2050
Primary Energy

Total Primary Energy Supply, EU-27

- Nuclear
- Natural gas
- Oil products
- Coal & waste
- Biomass
- Other RE

25%
EU CO2 emissions from energy - mill. tons
INFORSE Vision
Vision for Denmark (OVE) 2030

- Strong growth in windpower, sust. biomass
- Reduce specific building consumption 39% to '30
- Reduce specific electricity use, industry 42% to '30
- Flexible energy: district heating, heat pumps, electric cars and hydrogen
- Sustainable transport system, 80% more efficient
- No new international power lines
Danish Primary Energy Supply

- Coal and waste
- Olie
- Naturgas
- Biomasse
- Vind, sol, bølger, geotermi

District Heating = 70% of Heat

District Heat Supply, Denmark (PJ)

- Heat pumps
- Solar heating
- Geothermal
- Bio-CHP
- Bio-heat
- Waste
- Gas-CHP
- Gas-heat
- Coal+oil-CHP
- Coal+oil-heat
<table>
<thead>
<tr>
<th>Year</th>
<th>CO₂ Emissions (t/capita)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010 – 2049</td>
<td>2</td>
</tr>
</tbody>
</table>

In total 2 t/capita per year in average 2010 – 2049 = sustainable level
DK System in balance in 2030

- Hourly balances made with Energy Plan programme
- 1% unused windpower
- Existing import/export lines

RES12 = Wind
RE34 = wave+PV
CHP incl. geothermal
ZeroCarbonBritain
Scenario for UK
Up to 50% reduction in energy use
Transition to electric transport
Phase out of fossil fuels in 20 years
Suggested measures, including personal CO2 allowances
Gas price: 350 USD/1000m3
Coal price: 100 USD/ton
Biomass price: 12€/MWh (7Lat/m3)
Uran price: 100 USD/pund

Operating hours: 5500 h/year
(biogas 8000, wind 2000)
Heat selling price: 30€/MWh (21Lat)/MWh
Thank you

See
www.inforse.org/europe