European Union Renewable Energy policy and lessons on bioenergy through the implementation of the NREAPs (National Renewable Energy Action Plans)

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IEA-FAO-IRENA Bioenergy
Who are we?

Institute for Energy and Transport
1 of the 7 scientific institutes of the JRC

Our mission: “provide support to Community policies and technology innovation to ensure sustainable, safe, secure and efficient energy production, distribution and use and to foster sustainable and efficient transport in Europe”

Main activities:
- Renewable energies
- Sustainable & safe nuclear energy
- Energy techno/economic assessment
- Hydrogen and fuel cells
- Clean fossil fuel
- Energy efficiency
- Security of energy supply
- Sustainable transport

As a Directorate-General of the European Commission, the JRC provides customer driven scientific and technical support for the conception, development, implementation and monitoring of European Union policies.
Energy and Climate Challenges

Keep global warming below 2°C, in comparison with 1990
- reduce GHG emissions by 20% by 2020
- reduce GHG emissions by 80 to 95% by 2050

The 2020 targets:
- decrease energy consumption by 20%
- increase the share of renewables to 20%
  10% renewable energy in transport

Low-carbon economy by 2050
- Several decarbonisation scenarios for the period until 2050
  Energy Roadmap 2050

EU 80% dependent on fossil fuels
A critical challenge: from 80% dependency on fossil fuels to
80% reduction in GHG emissions in 40 years
National Targets overall RES EU 28

Source: Annex I, Directive 2009/2/EC
NREAP analysis - renewable energy

RES 2020 target level: ~ 250 Mtoe
Bioenergy contribution: ~ 140 Mtoe

Renewable final energy consumption in the EU

Final renewable energy consumption in 2005
- biofuels 3.1%
- hydro 29.7%
- geothermal 0.5%
- solar 0.8%
- heat pumps 0.5%
- wind 6.0%
- biomass 59.3%

Final renewable energy consumption in 2020
- biofuels 12.1%
- hydro 13.0%
- geothermal 1.1%
- solar 6.2%
- heat pumps 4.8%
- wind 17.4%
- biomass 45.1%
- tide, wave, ocean 0.2%
NREAPs - Some examples

Renewable final energy consumption in Germany

Renewable final energy consumption in Italy

Renewable final energy consumption in France

Renewable final energy consumption in the UK
Bioenergy 2012 and 2020

Source: 2013 progress reports and NREAPs
DE - bioenergie.fnr.de
Bioelectricity EU 28, years 2012 and 2020

Source: 2013 progress reports and NREAPs
DE - bioenergie.fnr.de
Bioheat in EU 28
2012 and 2020

Source: 2013 progress reports and NREAPs
DE - bioenergie.fnr.de
Biofuels in EU 28, years 2012 and 2020

Source: 2013 progress reports and NREAPs
de-bioenergie.fnr.de
Deviation from NREAP bioenergy -2012

Source: 2013 progress reports and NREAPs
DE - bioenergie.fnr.de
Progress in bioenergy – EU 28

**Bioelectricity** 13 MS (BG, IE, EL, ES, FR, LT, LU, HU, NL, AT, RO, SI and SE) missed the 2012 NREAPs planned value

**Bioheat** 8 MS (CZ, IE, FR, CY, MT, NL, PT and SE) missed the 2012 NREAPs planned value

**Biofuels** Only Italy, Austria and Sweden exceeded the 2012 NREAPs planned value

**Total bioenergy** 11 MS (CZ, IE, EL, ES, FR, CY, MT, NL, PT, SE and UK) missed the 2012 NREAPs planned value

In 2012
Estonia exceeded 2020 target for bioelectricity
Estonia, Austria and Slovenia exceeded 2020 targets for bioheat
NREAPs – Biomass domestic supply

- expected bioenergy production—solid biomass, biogas, bioliquids
- conversion technologies
- domestic supply and import
- feedstock mix

- better mobilisation
- energy crops
- imports from abroad

Is there enough biomass to reach these targets?
Sustainable collectable wood from 9545 t/year to a maximum of 12192 t/year
GIS-based assessment of EU crop residues

Straw production
- crop production, area and yields
- residue to yield ratios

Collectable straw
- residue available for energy

Suitability map for localization of power plants
Main areas with important available straw resources

Actual production
- crop production, area and yields
- residue to yield ratios

Environmental constraints
- organic matter content
- sensitivity to erosion
  >> sustainable removal rates

Competitive use
Straw available for energy production

Environmental constraints
- organic matter content
- sensitivity to erosion

Assessment of the availability of agricultural crop residues in the European Union: Potential and limitations for bioenergy use
Nicole Scarlat, Milan Martino, Jean-François Dallemand

Straw density
Localization of straw-based power plants

**Optimized allocation**
- 808 plants – 100 kt straw/year
- 81.7% straw used

Looks for the most dense straw areas and exploits them in decreasing density order

**Randomized allocation**
- 834-852 plants - 100 kt straw/year
- 84.4–86% straw used

Randomly chosen points where there is enough straw to set up a plant
Sustainability of residues collection - soil carbon preservation

Collection “standard” 2010-2020

Collection “standard” 2010-2050
Assessment of energy theoretical potential from Municipal Solid Waste (MSW) in Africa (LFG = Land Fill Gas)
Aim: to address the challenges and opportunities of bioenergy in the Danube Region through activities of Scientific/Technical Networking + Joint Projects of Research & Development

Proposed activities
- Statistical assessment of Bioenergy status & Progress in Danube Countries
- Assessment of forest biomass potential for energy
- Assessment of agricultural crop residues availability
- Local use of Biomass feedstock for biogas and bio-Heat
- Public support schemes & Funding mechanisms for bioenergy
Expected growth of bioenergy in Danube Region

In 2020 bioenergy is expected to cover 57.8% of total RES in EU Danube Countries

Source: Bi-annual progress reports and NREAPs
DE- bioenergie.fnr.de
Bioheat in EU DC's
Current (2012) and expected development

74.1% of total bioenergy
decrease by 0.7% 2010-2012

2020
63.4% of total bioenergy

Source: Bi-annual progress reports and NREAPs
DE- bioenergie.fnr.de
Bioelectricity in EU DC's Current(2012) and expected development

11.7% of total bioenergy
Increased by 18.5% 2010-2012

2020
15% of total bioenergy

Source: Bi-annual progress reports and NREAPs
DE- bioenergie.fnr.de
Monitoring Bioenergy development

- Sectoral analysis of bioenergy development
- RES and bioenergy targets and perspectives
- Assessing biomass demand vs. potential
- Addressing sustainability

Possible impact of 2020 bioenergy targets on European Union land use. A scenario-based assessment from national renewable energy action plans proposals
Nicola Scarlat *, Jean-François Dallemmand, Manjola Banja

Extending the EU Renewable Energy Directive sustainability criteria to solid bioenergy from forests
Uwe R. Fritsche, Leire Irizarie, Johnny de Jong, Alessandro Agostini and Nicola Scarlat

Bioenergy production and use in Italy: Recent developments, perspectives and potential
N. Scarlat *, J.F. Dallemmand *, V. Motola *, F. Monforti-Ferrario *

Recent developments of biofuels/bioenergy sustainability certification: A global overview
Nicola Scarlat *, Jean-François Dallemmand

wheat, barley, oat, rye, maize, rapeseed, rice and sunflower
Energy potential of crop residues

Danube River Basin
Agricultural crop residues
Straw production [kilotonnes]

<table>
<thead>
<tr>
<th></th>
<th>production (kt)</th>
<th>collection (kt)</th>
<th>available (kt)</th>
<th>energy potential (ktoe)</th>
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<tbody>
<tr>
<td>DC</td>
<td>179,251</td>
<td>78,790</td>
<td>72,352</td>
<td>30,242</td>
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<tr>
<td>EU28</td>
<td>286,718</td>
<td>122,668</td>
<td>101,486</td>
<td>42,419</td>
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Three scenarios defined:
- low mobilisation
- medium mobilisation
- high mobilisation

Technical & environmental constraints
Three levels of protection
Biogas Potential from Pig Manure
Energy from waste
Case study: Croatia

Current situation
- there are 310 landfill sites
  - 137 active
  - 8 active for industrial waste
  - 94 closed
- waste was removed from 71 sites
- no existing landfill gas recovery
- 3 projects of future landfill gas plants (4.65MWel in total)

JRC's research activities
- Assessment of the potential of landfill gas utilisation for each location
- Calculation of potentials of waste utilisation in incineration plants
Energy from waste
Case study: Croatia

Spatial analysis

- Electricity production from landfill gas recovery systems
- IPCC landfill gas generation model
- Major landfill sites considered
Scientific/Technical Networking

Extending RES *sustainability criteria to solid and gaseous biomass*, The Hague, Uppsala, Toronto, 2012 - JRC, IEA, INAS, NL Agency

Agro-environmental impact of biofuels and bioenergy (EUROCLIMA), UNICAMP/CTBE Campinas, Brazil, 2011.

Greenhouse gas emissions from biofuels and bioenergy (EUROCLIMA), INTA, Buenos Aires, Argentina, 2011.

The effects of **increased demand for biofuel feedstocks** on the world agricultural markets and areas, Ispra, 2010.


Direct and indirect impact of biofuel policies on **tropical deforestation in Malaysia**, MPOC, Kuala Lumpur, Malaysia, 2008.

**Sustainable Bioenergy Cropping Systems** for the Mediterranean, Madrid 2006 - JRC, EEA, CENER, CIEMAT.

**Cereal straw resources for bioenergy** in the European Union, 2006, Pamplona, - CENER.

**Cereals straw and agricultural residues for bioenergy in New Member States and Candidate Countries**, 2007, - Novi Sad.

Biomass resource assessment for biofuels/bioenergy and **competition with other biomass uses**, Eberswalde University/EEA, Eberswalde, Germany, 2009.


EU Forest-based biomass for energy: **cost supply relations and constraints**, Metla/EFI, 2007, Joensuu
Lessons learnt on Bioenergy and National Renewable Energy Action Plans

- Importance of communication (Markets, media & science), different time frames for Science & Policy
- Importance of statistical data bases on multiple uses of biomass and different sectors, bioenergy & bio based or green economy
- Importance of stability of policy framework including public support schemes at long term, example of biofuels 10%, 5%, 7% ?
- Biomass/Bioenergy sustainability certification before, better than after
- Integration of Bioenergy & Water Action Plans
- Specification of policy drivers
- National policies
- Difficulty to quantify ILUC and indirect impacts
- Policy coherence based on different scientific input
- Difference between Resource availability & Resource mobilisation