REGIONAL COOPERATION IN THE WESTERN BALKANS: BENEFITS OF A TRANSNATIONAL APPROACH

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Opportunities and challenges of the European Energy Union – Energy Efficiency and Renewable Energy in Croatia

Meeting Room Ivan Mažuranić, Croatian Parliament, Zagreb
31 March 2017, 09:30 – 12:30
How to Make New Croatian Energy Strategy?

**Geothermal**
125 MWe, 295 GWh, 2014

**Hydropower**
2200 MW, 9000 GWh, 2014

**Biomass**
( agriculture and forests )
56 MWe, 388 GWh, 2016
515 MWt, 12600 GWh, 2014

**Solar Energy**
50 MWe, 61 GWh, 2016
113 MWt, 107 GWh, 2014

**Wind Energy**
412 MW, 1018 GWh, 2016
How to make new Croatian energy strategy?

- 5D approach
- Decentralization
- Diversification
- Decarbonization
- Decoupling
- Deregulation
5D IN THE DANISH ENERGY TRANSITION?
DENMARK ➔ SEE ➔ THE WESTERN BALKANS
100% RES ISLANDS

Average wind velocity [m/s]

<table>
<thead>
<tr>
<th>Island</th>
<th>Scenario/year</th>
<th>Manufacturing and Installation (person years)</th>
<th>O&amp;M and Service (Jobs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mljet</td>
<td>100% RES 2015</td>
<td>216</td>
<td>11</td>
</tr>
<tr>
<td>Losinj</td>
<td>100% RES (80% RES PTV) 2025</td>
<td>3987</td>
<td>520</td>
</tr>
<tr>
<td>Unije</td>
<td>100% RES 2030</td>
<td>95</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>4299</td>
<td>537</td>
</tr>
</tbody>
</table>

Supplaying demand [GWh]

- Mljet: 2,96
- Losinj: 1,69
- Unije: 2,36
- Diesel: 3,53
- grid: 0,83
- fuel cell: 2,12
- solar: 1,18
- wind: 0

2006 2010 2015

Island Scenario / year Manufacturing and Installation (person years) O&M and Service (Jobs)

Mljet 100% RES 2015 216 11
Losinj 100% RES (80% RES PTV) 2025 3987 520
Unije 100% RES 2030 95 6
TOTAL 4299 537

Supplaying demand [GWh]
100% RES CITIES AND COUNTIES

KWh

- Proizvodnja VE*
- Proizvodnja HE
- Lastovo
- Mljet
- Blato
- Smokvica
- Vela Luka
- Korčula
- Konavle
- Župa dubrovačka
- Ston
- Potrošnja DU-NE županija

100% RES CROATIA!
A 100% renewable energy system in the year 2050: The case of Macedonia

Boris Ćosić 1, Goran Krajačić 2, Neven Duić 2

http://dx.doi.org/10.1016/j.energy.2012.06.078
100% RES energy system in The South East Europe (Balkans)?

- 11 countries (65.5 mil. ppl)
- 765,884 km² (17% EU)
- 85.5 people/km² (113 ppl/km² EU)
- 8.9% of Europe’s total population
- Average age: 39.8 (42.2 EU-28)
- Urban population: 59 % (72.4% EU-28)
- GDP per capita: 9,922 $ (Slovenia: 23,962; Kosovo: 3,877 $)
- Efficiency increase
- Increase of DH
- Individual HP, solar thermal and biomass boilers
- Industrial CHPs
- Waste heat
- Electrification of industry
- Massive electrification of transport sector (V2G)
- Synthetic fuels as a last resort (CO2 hydrogenation)
SUPPLY SIDE

- PV: 65 GW
- Wind: 50 GW
- CSP: 11 GW
- Dammed hydro: from 18.8 to 23.5 GW
- Large-scale HPs: 1.5 GW
- Solar thermal with energy storage in DH: 13.3 %
- Seasonal thermal energy storage: 230 GWh
- Waste incineration plants: 0.96 GWe
- Geothermal plants: 1.25 GWe
- Geothermal heating plants: 7.5 GW
- River hydro, pumped-hydro 2 GW, 1000 GWh
- Decomission of nuclear PPs
- Reduction in thermal power plants capacity to 24.7 GW
Energy systems SEE 2012 – 2050?

Energy systems: 2012 vs. 2050

Electricity generation mix in 2050 [TWh]
## Economic and Technical Indicators

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>PES [TWh]</td>
<td>1,426</td>
<td>702.86</td>
</tr>
<tr>
<td>CO$_2$ emissions [Mt]</td>
<td>332</td>
<td>0</td>
</tr>
<tr>
<td>CEEP [TWh]</td>
<td>0</td>
<td>15.64</td>
</tr>
<tr>
<td>Total annual socio-economic cost [MEUR]</td>
<td>63,903</td>
<td>44,415</td>
</tr>
</tbody>
</table>

Sustainable use of biomass (785 PJ in the year 2050)!
FAST – METHOD FOR FLEXIBILITY ASSESSMENT

Step 1: identify flexible resource

- Dispatchable plant
- Storage
- Interconnection
- Demand side

Step 2: how much of that flexible resources is available?

Optimise availability of existing flexible resource. If necessary, deploy additional.

Step 3: What is the net flexibility need?

Existing flexibility needs (demand, contingencies)

Step 4: Compare need with available resources

Optimise availability of existing flexible resource. If necessary, deploy additional.

The power area context

Additional flexibility needs from variable renewables

Smoothing through geographical and VRE technology spread (assuming a strong grid)
FLEXIBILITY GAP

Two methods for decreasing the flexibility gap in national energy systems

Ilija Batas Bjelić, Nikola Rajaković, Goran Krajačić, Neven Duić

http://dx.doi.org/10.1016/j.energy.2016.07.151
Regional cooperation (NORD POOL) and Deregulation
CREATING A REGIONAL ELECTRICITY MARKET IN THE WESTERN BALKANS?

Spot Market Development

Cross-border Balancing

Energy Community

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CONCLUSIONS

- It is possible to build 100% RES of the Southeast Europe
- Significant integration of different energy subsectors is needed in order to integrate high share of intermittent RES
- Biomass consumption is sustainable
- Thermal and gas storage need to be maximally utilized, as well as V2G concept for providing flexibility and energy storage
- Many coordinated steps are needed in order to reach zero carbon energy system
- Strategies and actions must be identified, planned and coordinated on EU, macroregional, national, regional, city and local levels
THANK YOU FOR YOUR ATTENTION!

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Zero carbon energy system of South East Europe in 2050

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CROATIAN ENERGY TRANSITION

4dh
STRATEGO
CoolHeating

BEAST
HRE
Bin2Grid

AGROCYCLE
fosterREG
PlanHeat