SEERMAP: Modelling results and conclusions

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## The SEERMAP project

<table>
<thead>
<tr>
<th>Project title</th>
<th>South East European Electricity Roadmap</th>
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<tbody>
<tr>
<td>Region of implementation</td>
<td>Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, Macedonia, Serbia, Romania, Bulgaria, Greece</td>
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<td>Consortium Partners</td>
<td>REKK, TU Wien, OG Research, EKC</td>
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<td>Project cycle</td>
<td>July 2016 to October 2017</td>
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<td>Donors</td>
<td>Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management</td>
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<td>European Climate Foundation</td>
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<tr>
<td>Web</td>
<td><a href="http://www.seermap.rekk.hu">www.seermap.rekk.hu</a></td>
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# Our partners

<table>
<thead>
<tr>
<th>Country</th>
<th>Name of the Partner</th>
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<tbody>
<tr>
<td>Albania</td>
<td>POLIS University, Co-Plan</td>
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<td>Bosnia and Herzegovina</td>
<td>ENOVA</td>
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<td>Bulgaria</td>
<td>CSD</td>
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<td>Greece</td>
<td>FACETS</td>
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<td>Kosovo*</td>
<td>INDEP</td>
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<td>FYR of Macedonia</td>
<td>MACEF</td>
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<td>Montenegro</td>
<td>IPER</td>
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<td>Romania</td>
<td>EPG</td>
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<td>Serbia</td>
<td>RES Foundation</td>
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<td>Organisational Partner</td>
<td>ERRA</td>
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Our goals

Modelling

• Analyse the impact of the transition to a low carbon and energy secure pathway the electricity sector until 2050 in line with EU 2050 Roadmap
• Develop of a Long Term Electricity Roadmap for the SEE region and effectively distribute the findings to the high level decision-makers - Promote a regional integration scenario

Dialogue and capacity building

• Build up capacities – in the form of training courses - amongst policy makers, TSO members, energy regulators and local think tanks in the field of renewable energy deployment and transmission network planning issues
• Build up a network of regional think tanks capable of contributing to the debate on the long term decarbonisation pathways in the SEE region
• Trigger discussions on electricity scenarios at a national level in the region
Models applied and interlinkages
European Electricity Market Model (EEMM)

- 40 countries (ENTSO-E + neighbours)
- Around 3400 power plant blocks
- 104 interconnectors between countries

Partial equilibrium model in which homogeneous product is traded across neighboring markets

- Competitive behaviour in production and trade
- Constrained capacity limits on cross border networks, power flows on an interconnector are limited by NTC.
Three scenarios
# The assumptions behind the scenarios

<table>
<thead>
<tr>
<th></th>
<th>No Target</th>
<th>Delayed</th>
<th>Decarbonization</th>
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<tbody>
<tr>
<td><strong>CO₂ target</strong></td>
<td>No target</td>
<td>94% reduction</td>
<td>94% reduction</td>
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<tr>
<td><strong>Fossil plants</strong></td>
<td>National plans: all PPs</td>
<td>National plans: all PPs</td>
<td>National plans: only PPs with FID</td>
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<tr>
<td><strong>SEERMAP RES target</strong></td>
<td>Phase out of support after 2025</td>
<td>Continuation of current policies till 2035 and than high uptake</td>
<td>More ambitious RES deployment from 2020 to reach the 2050 target</td>
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<td><strong>Shared assumptions</strong></td>
<td>demand, CO₂ and fossil fuel prices, gas infrastructure, WACC, NTCs</td>
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**SEERMAP**
South East Europe Electricity Roadmap
MODELLING RESULTS FOR THE SEERMAP REGION
Installed capacity

- Gradual phase out of fossil capacities
- Role of natural gas is uncertain: bridging role in 'decarbonisation' and 'delayed' scenario, where gas is crowded out from the market, and more permanent role in the 'no target'
- Dynamic uptake of RES technologies, especially wind and solar – including the 'no target' scenario
Gross electricity mix

- Coal based generation disappears from electricity mix
- Gas consumption peaks in 2030-2040, and downward trend afterwards.
- Trade position of the region slightly deteriorates
- RES domination in the generation mix after 2030
Gross electricity mix by country in 2050

- Intermittent RES dominated countries: GR, RO
- Hydro domination in: AL, BA, ME, MK, RS
- RES shares above 100% in AL and ME
- Significant import in RS and BG; Exporting countries: AL, BA and ME
Natural gas consumption in electricity generation

- Bridging role of natural gas in all scenarios
- In 'delayed' and 'decarbonisation' scenario gas based generation is crowded out from the market by 2050
- GR, RO and BG are the large gas consumers. In WB6 AL, MK and RS show the highest increase
Utilisation rate of conventional power plants

- Sharp decrease in gas and coal utilisation rates after 2040. Coal rates fall below economically sustainable levels.
- Gas takes over coal generation with increasing rates in 2030-2040.
- Even nuclear utilisation reduces in 2050 due to high RES penetration.
CO₂ emissions

- Sharp CO₂ reductions in the region: over 98% in the 'decarbonisation' scenario,
- Even the 'no target' scenario reaches 90% reduction rate by 2050
- Higher reduction rates than EU average – SEERMAP region can contribute to the reduction target efficiently

SEERMAP: left hand axis, EU28+WB6: right hand axis
Fossil and RES investment cost

- All scenarios require dynamic investment uptake in the region.
- RES investment costs dominate the post 2020 period
Magnitude of wholesale price and RES support

- Increasing wholesale price level over the period, reaching above 80 €/MWh by 2050
- Low variable costs of RES reduces wholesale prices by 2050 compared to 'no target'
- RES support need reduces and become minor by 2050
- In 'delayed' scenario sharp increase of support need in 2041-2050
System /generation adequacy in the SEERMAP region

- Both system and generation adequacy values are positive
- Generation adequacy deteriorates, while system adequacy improves after 2040

DEFINITIONS:
- **Generation adequacy**: ability to cover peak demand with domestic generation (Zero value means capacities equal to peak load)
- **System adequacy**: Ability to cover peak demand with domestic capacity plus Net Transfer Capacity (NTC)
Negative generation adequacy (generation below peak load) in: AL, KO*, RS.

Cost of improving generation adequacy: between 30-200 m€/year to reach zero generation adequacy level.

'Delayed' and 'no target' scenarios also present generation adequacy problems in: AL, BG, KO*, RS.
Network congestions in 2030

- Several contingencies are identified by the network model in the decarbonisation target scenarios in all countries.
- The cost of solving these problems at the transmission network level are estimated to be below 200 m€ in all scenarios in 2030 and 2050 (excluding Greece, where exogenous assessment was used).
- These costs are additional to TYNDP development costs.)
Network congestions in 2030-Greece

- Greek TSO study is used.
- Development cost estimation is at 1800 m€, but including transmission and distribution level.
- Significant part is due to the connections of islands.
Macroeconomic results: % of household electricity expenditure in HH income

- Macroeconomic assessment was carried out to check impacts on GDP, employment, household expenditure, external and fiscal balance.
- GDP and employment shows slight improvement, while affordability slightly reduces at regional level. In some countries, affordability deteriorates significantly.
- Decarbonisation has lowest HH expenditure in the long term.
Stranded costs of power generation

- Stranded cost of underutilised gas and coal assets applies in most countries in the 'no target' and 'delayed' scenarios, ranging between 2-8 €/MWh (over a 10 year period)
- The lower investment level of coal/lignite and gas based capacities in the 'decarbonisation' scenarios help to reduce, or eliminate these stranded costs
## Conclusions 1

### Market integration

- Introduction of competitive market is a key driver for the SEE electricity sector: support RES deployment, price equalisation.
- No need for massive cross border capacity increase, rather functioning market institutions.

### Natural gas

- Role of gas is transitionary in electricity generation:
  - in the ‘no target’ scenario it peaks at 2040
  - in the ‘delayed’ and ‘decarbonisation’ scenarios it is fully replaced by RES by 2050

### Coal

- Gradual elimination of coal capacity and production in all scenarios
- Very low utilization from 2040 onwards (below 20% - closure)
- Stranded cost in these assets ranges between 2-8 €/MWh
Conclusions 2

Security of supply

- The 'new' domestic resource: RES replaces coal/lignite based generation
- The substitution however results in significant electricity import in many WB6 countries (MK and RS) but dynamic RES deployment supports self-sufficiency
- System adequacy remains high in all scenarios, although generation adequacy deteriorates

RES deployment

- RES deployment increases in all scenarios, even without support significant growth after 2040
- RES support level reduction helped by increased wholesale prices and reducing technology costs
## Conclusions 3

### Price evolution
- Setting a decarbonisation target does not lead to higher prices: quasi identical wholesale electricity price increase across scenarios (from 35 EUR/MWh to 80-90 EUR/MWh)
- SEERMAP region remains a single price zone

### Carbon Emissions
- The SEERMAP region offers relatively cheap decarbonisation options: SEERMAP region is 99% compared to the 94% of EU
- Significant reduction even in the 'no target' scenario.
- Future carbon price is key determinant of the generation portfolio and the cost of transition

### Macro-economic impacts
- Macroeconomic impacts show small impact of decarbonisation, mostly in positive direction,
- Affordability emerges as issue in several countries: BIH, BG, ME, MK, RO
Policy conclusions

• The high penetration of renewables in all scenarios suggests that energy policy, both at the national and regional level, should focus on enabling RES integration

• National energy policy will have less influence on the future generation mix – it will be driven by market forces

• EU and regional level policies should be incorporated in national energy planning

• Stranded costs should be carefully considered in fossil generation and gas network investment decisions

• Household electricity expenditure increase significantly in some countries, it may require new policy approach

• Regional cooperation helps to handle SoS issues and reduce costs of decarbonisation