Modelling measures for fast, flexible and secure decarbonization of the Baltic states

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Summary of results from Fasten project

Baltic targets for 2030

Decarbonization

- Reducing total GHGs while maintaining LULUCF sinks
- National non-ETS target, noting that EU Commission suggested higher non-ETS target
- Increasing the share of renewable electricity, heat, and transport energy

Energy security

- Reduced imports by increasing domestic generation and production
- Increased interconnectivity and flexibility
- Long-term and short-term adequacy. Short-term particularly important with electricity.

Energy efficiency

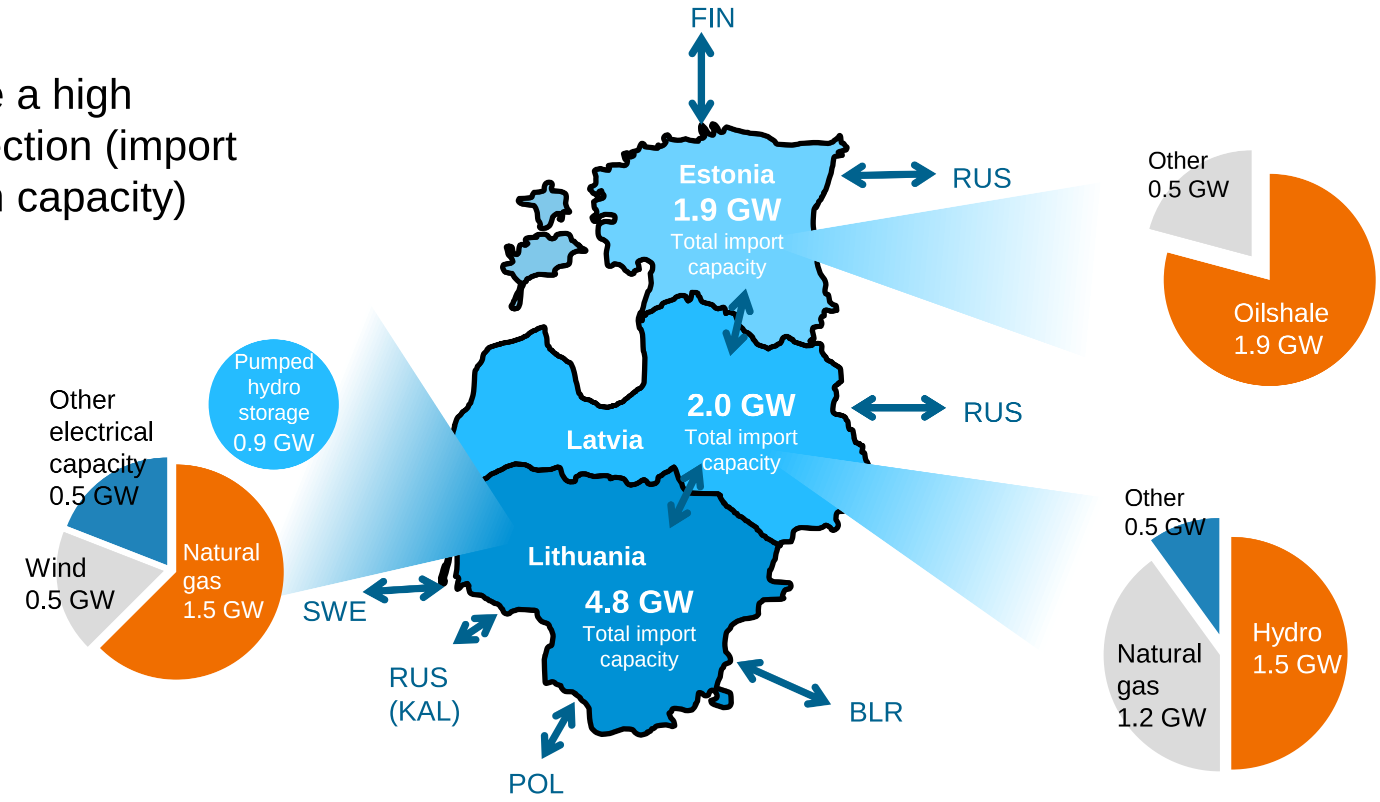
- Reduced primary and final energy use with special emphasis on energy renovations

Markets, research, innovation, competitiveness

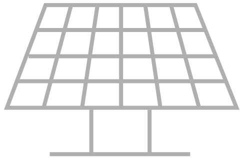
- Large range of measures and targets

Baltic power system today

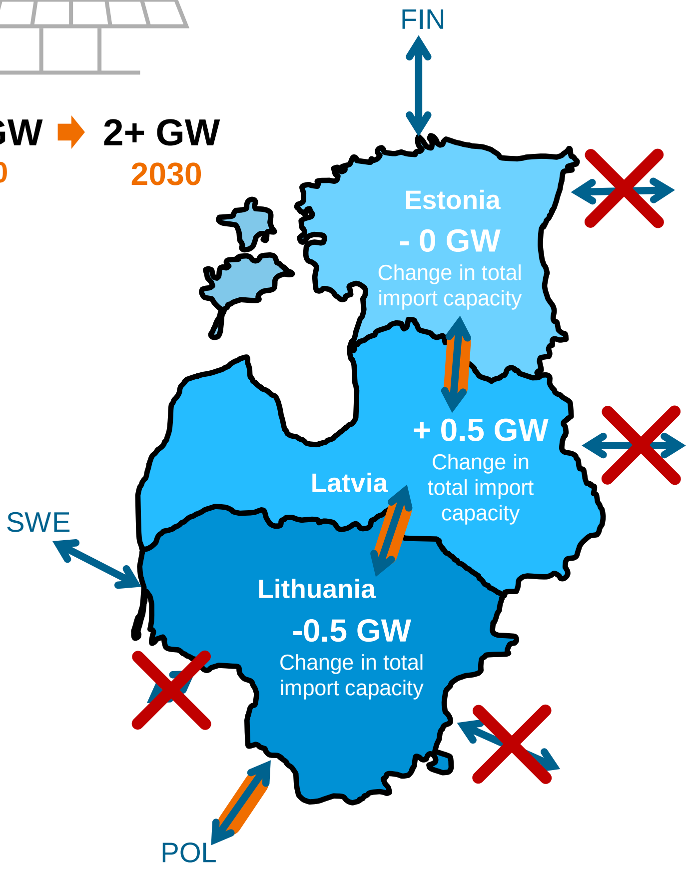
- Baltic countries have a high degree of interconnection (import capacity / generation capacity)
  - Estonia has been a net exporter of electricity on annual level, Lithuania a net importer
  - All Baltic countries have very high share of combined heat and power (CHP) generation.

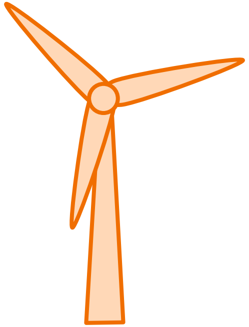


Key aspects towards 2030

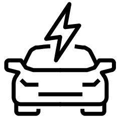


0.1 GW ➡ 2+ GW
2020 2030





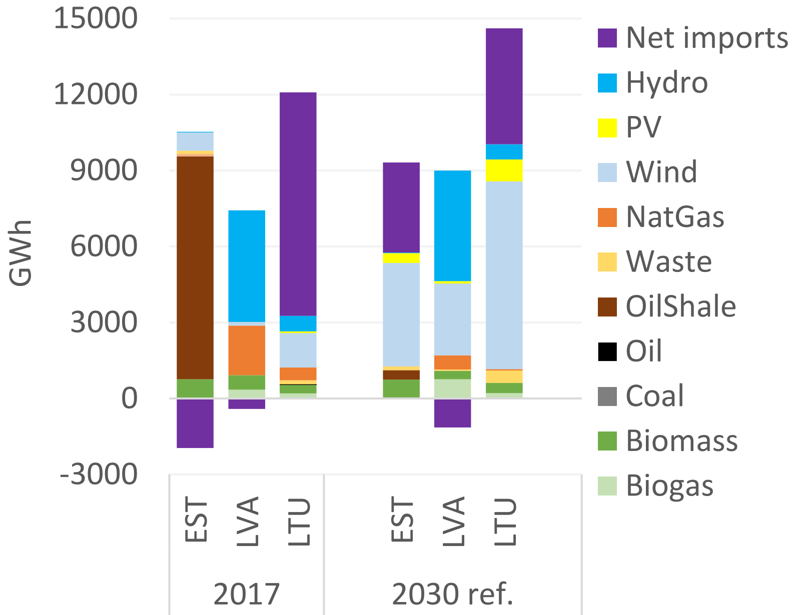
0.9 GW ➡ 4+ GW
2017 2030



~0 % of passenger km's 2017 ➡ 3+ % of passenger km's 2030

Baltic annual electricity supply towards 2030

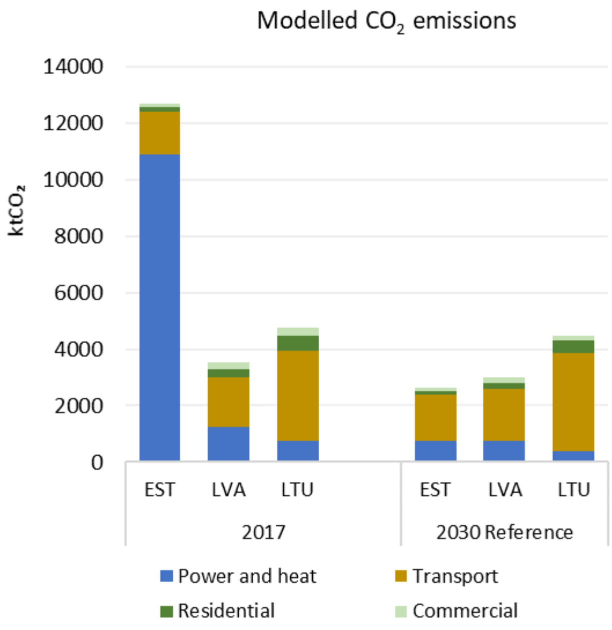
- In FasTen 2030 reference scenario
  - Domestic generation increases in Latvia and Lithuania, but reduces in Estonia
  - Wind and solar replace fossil fuels
  - As a region, Baltic countries remain dependent of imports.
- 2030 reference system is based on national plans



Increasing transport demand makes non-ETS* target difficult to achieve

- Modelled 2030 reference scenario sees a slight increase in non-ETS CO_2 emissions and final energy use due to increasing transport demands.
  - This makes overall non-ETS targets difficult to achieve
  - Reductions in the non-ETS emissions typically more difficult than in the ETS sector

**Non-ETS = sectors outside EU emission trading scheme (EU ETS). Includes for example, transport, buildings, agriculture, and small industries and power producers. Countries have individual non-ETS emission reduction targets whereas ETS target is common to all EU.*



** Transport includes only passenger vehicles

Overview of the impact of additional policies

- Impacts of additional policies beyond reference vary from country to country depending on local resources and the base level in 2030 reference system
  - Table summarizes the results for Baltic countries
- Measure can help with one target, but counteract with another
- Measures can lower costs up to a point, but eventually costs start to increase
- Deep dive to modelled additional policies and their costs are presented after the summary
- Some measures much easier to implement than others.

	Decarbonization					Energy efficiency		Energy security	Costs
	ETS CO_2	non-ETS CO_2	RES-E	RES-H	RES-T	Primary energy	Final energy	Domestic elec. Generation	system costs
Additional wind power									
Additional solar PV									
Grid batteries									?
Solar district heating									
Heat pumps, district heating									
Heat storages, district heating									?
Heat pumps, buildings									
Energy renovations									?
Transport biofuels									
Electric vehicles									?
Lower passenger volumes									?

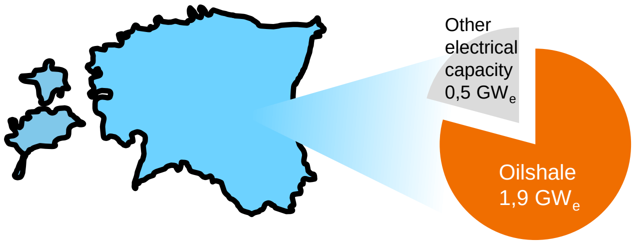
* We were not able to include costs of all policies in this analysis

** Green color signifies positive development, e.g. reducing emissions, and red color signifies negative development, e.g. increasing costs. The darker the color, the bigger the impact. See deep dive to modelled policies for further info.

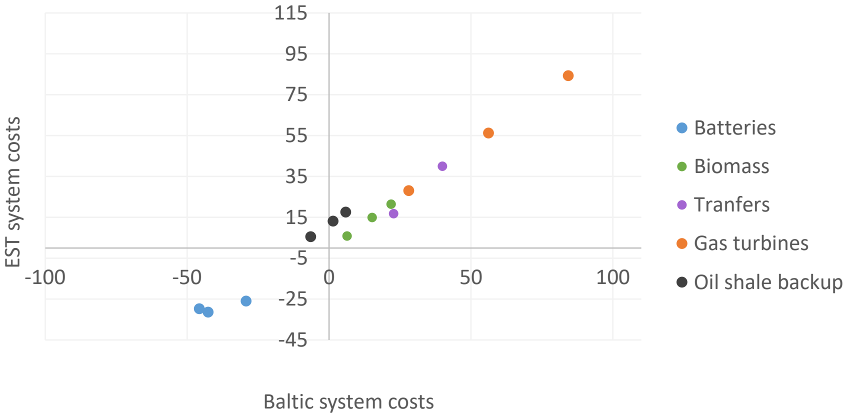
Estonia: Additional capacity needed in 2030

- Additional domestic capacity is needed to replace phased out of oil shale capacity
  - Battery electricity storages seem cost-efficient option to provide reserves and balance variable generation up to a certain capacity
  - Biomass CHP has low additional costs and would provide both fossil-free electricity and district heating
  - Keeping 1 shale oil unit as a back-up capacity could be a cheap option to preserve domestic generation capacity as energy security measure
- 200 MW battery unit included to the reference scenario and two shale oil CHP units kept as backup (400 MW)

Current capacity:

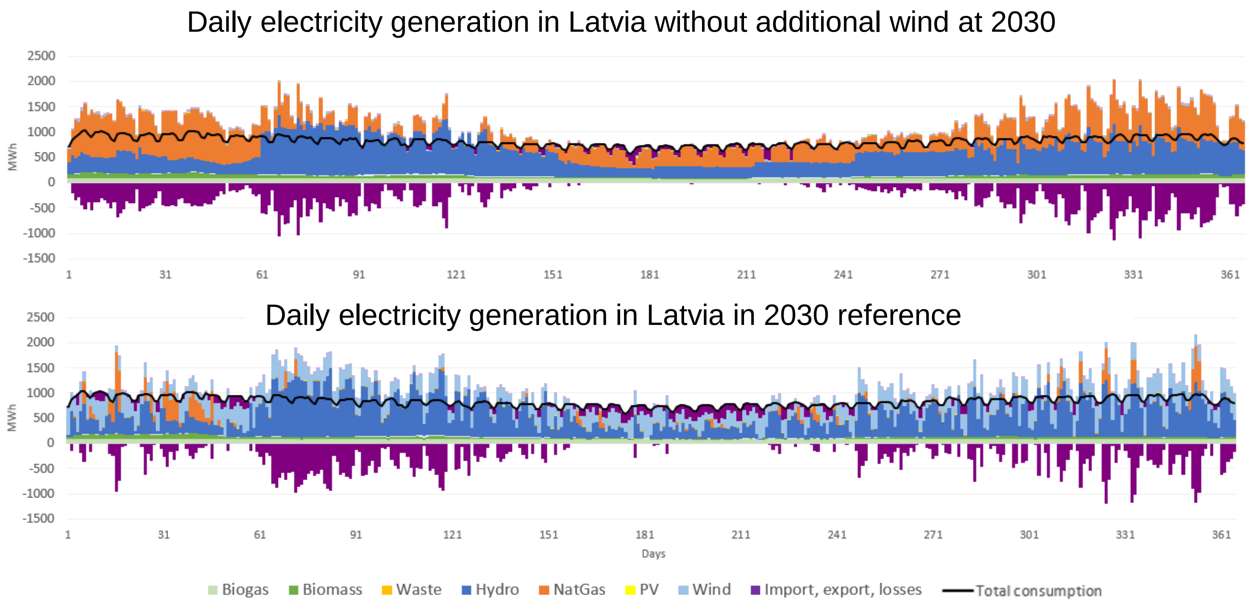


Modelled options for new capacity:



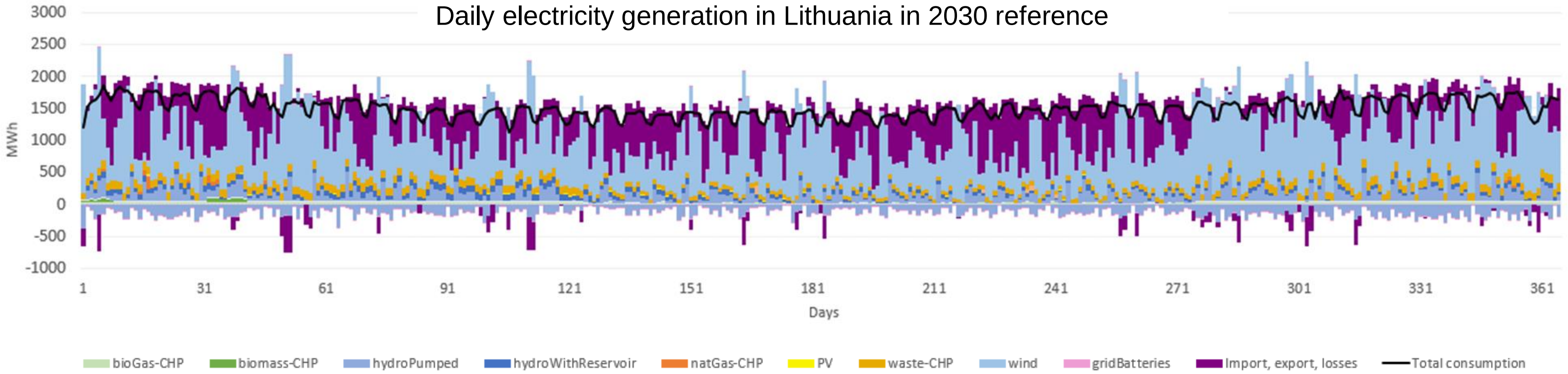
Latvia: Wind power can reduce operation hours of large CHP units

- Additional wind capacity reduces imports (especially in Estonia and Lithuania), but also the operation hours of CHPs (especially in Latvia).
- For an example, Riga’s large natural gas CHP units reduce operating hours below 1000 h/year in the 2030 reference scenario, that is not enough for commercial operation, especially in warm years.



Lithuania: Up to 80% VRE generation share in 2030

- In 2030 reference, Lithuania produces up to 80% of power generation and 55% of total power demand by variable wind and solar
- Simultaneous with the decrease of import capacity by -1,6 GW
with desynchronization from BRELL
- While our modelling does not detect significant operational issues, some could appear with more detailed grid modelling. Real-life experience on such high-VRE systems are still limited.



Summary of Baltic opportunities, benefits, and risks 2/2

National viewpoints / differences

- Estonia
  - + Significant reductions in emissions and increase in renewable generation.
  - − Decreased domestic electricity and fuel production, lack of existing balancing capacity.
- Latvia
  - + Reservoir hydro helps balancing. No electricity import dependency. Decreased reliance on imported gas. Heat pumps and solar collectors may offer benefits in capital.
  - − Reduced electricity generation in gas-fired power plants risk to commercial operation.
- Lithuania
  - + Increased domestic electricity generation and decreased reliance on imported natural gas and power. Increased utilization of Kruonis pumped hydro storage and new grid batteries.
  - − Reliance on imports/exports to balance electricity generation. Negligible electricity generation in gas-fired power plants risking commercial operations.

Regional collaboration

- Stronger synchronization with Nordic countries and Continental Europe
- Joined investments in e.g. offshore wind
- Balancing generation from variable RES
- Sharing electricity reserves and backup capacity over borders

Bigger than Baltic

- Impacts of other countries' energy policies impact electricity trade prices and availability
- Impacts of CO_2 prices
- European energy and climate targets create additional demands and limitations on decisions

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FINAL RESULTS FROM FASTEN PROJECT