Potential of wind-hydrogen (Power-to-X) energy systems in Latvia

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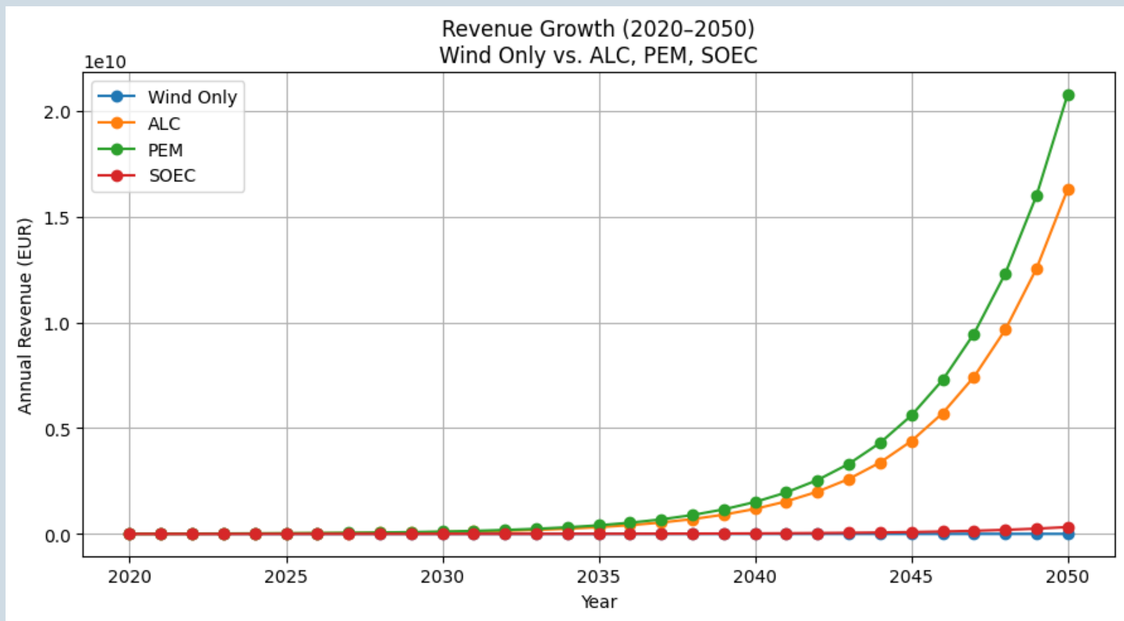
- **Scenario of Power2X technology integration shows significant profit difference from wind energy only selling case in ALK and PAME wind – hydrogen system cases.**
- **PEM technology is the best option in Latvian conditions by providing the most amount of profit and least environmental impact.**

Due to wind power problem of big amounts of produces energy during low electricity cost hours, scenario of wind energy selling during high electricity cost value and hydrogen production and selling during low electricity cost value shows was studied.



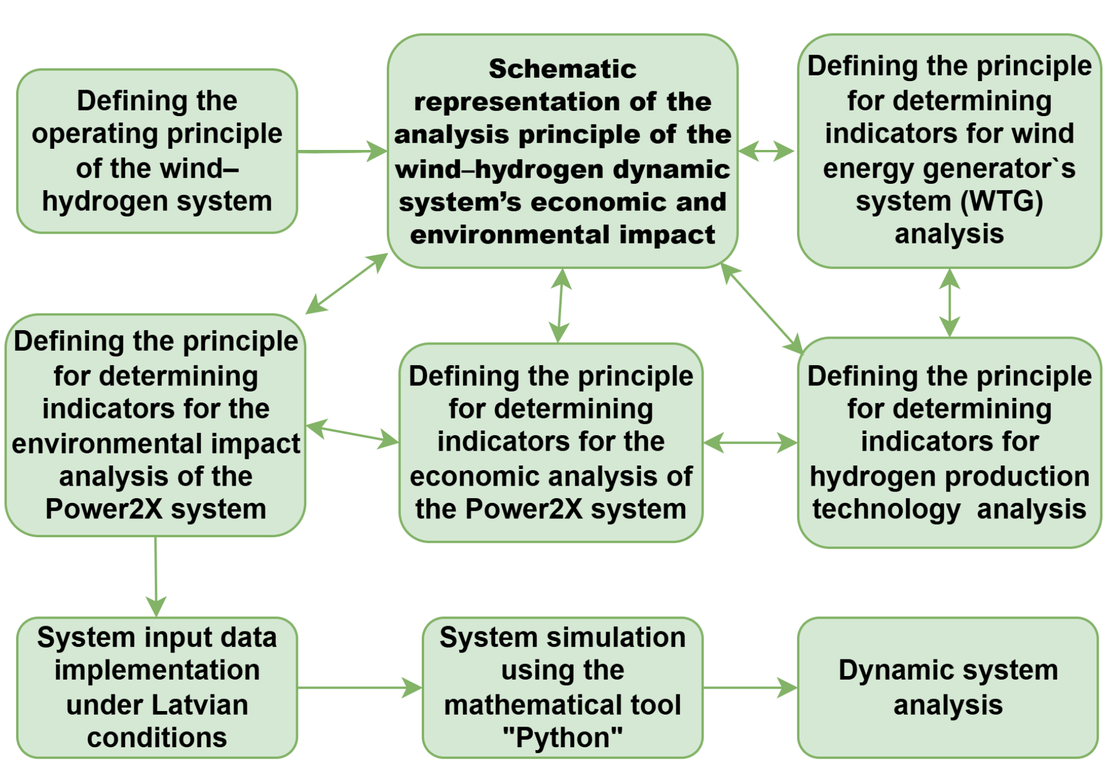
Due to PEM technology low LCOH and high profit value, it is most profitable technology. On the other hand, SOEC technology seems to have lowest profit value.
The environmental impact analysis shows that overall, the least environmental impact is showing PEM technology. SOEC technology has the most amount of environmental impact except of ODP impact, where ALC technology stands out by shoving 7.5 times bigger impact than SOEC technology.

Introduction

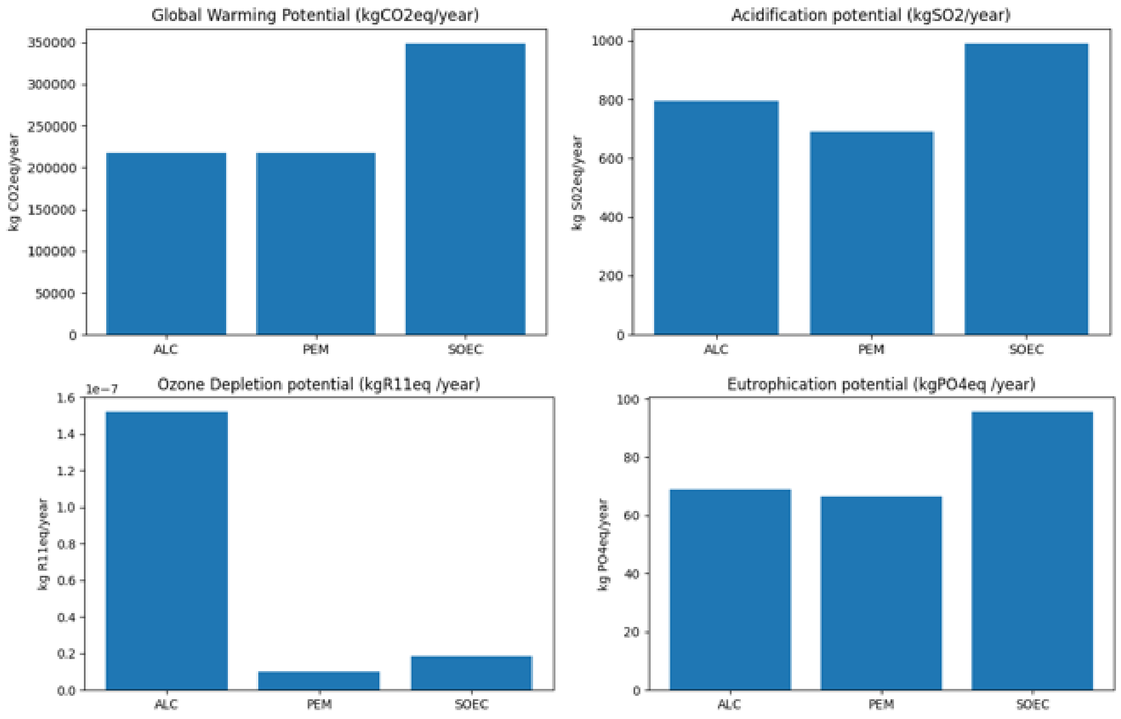
Green hydrogen is an important component from an economic, environmental, and social perspective on the path to sustainable zero-emission technologies.
In Latvia, share of wind energy is increasing, that makes questions about renewable energy storage possibilities and their rationality more popular.

This study evaluates the potential of wind-hydrogen Power2X systems in Latvia by analyzing three methods for converting wind energy into hydrogen for storage and subsequent use, using Python mathematical modelling in system dynamics analysis of wind energy generation and hydrogen production technologies.

Methodology



Results



Scenario	Total annualized costs (TAC)	Levelized cost of hydrogen or of electricity (LCOH or LCOE)	Payback period	Profit	ΔProfit
Unit	EUR/year	EUR/kg H_2	Years	EUR/year	EUR/year
Wind energy only	82 409	23.23	6.58	227 812.65	0
Wind + ALK	5 529 160	2.82	7.4	6 903 03	5 090 39
Wind + PEM	6 291 480	2.66	6.3	7 632 59	7 819 94
Wind + SOEC	10 648 906	6.02	387.97	1 23 722.95	-104 089.70

When comparing alkaline water electrolysis, proton exchange membrane electrolysis, and solid oxide electrolysis in a wind–hydrogen Power2X system from an economic justification perspective, the simulation of the proton exchange membrane electrolysis Power2X system showed the highest profit both in the short term and long term and smallest environmental impact under Latvian conditions.