

Life cycle assessment of the solar panels and small urban wind turbines, parts of the Energy Wall

Based on the Kyoto protocol targets and Paris agreement and due to climate change, the Dutch government and municipalities plan to increase the share of renewable electricity generation. In addition, wind and solar energy systems show great potential worldwide and the Dutch government plans on implementing them to achieve their sustainability targets. Thus, TU Delft developed the Energy Wall; the Energy Wall is a large scale conceptual framework for combining solar panels, small urban wind turbines, a smart grid (DC operated), fine dust mitigation devices LED lighting and hydrogen fuel for scooters. This way the urban wind turbines and solar panels can be used to generate electricity for near-road applications, such as street lighting and electric and/or hydrogen vehicle charging. The structural integration of wind turbines on noise barriers (the “wall”) at highways is a way to significantly reduce the total cost of such a system. The noise barrier can provide the tower and foundation for the urban wind turbines which comprises 30% of the total system cost, the foundation for the solar panels and it can act as a flow augmentation device for the wind turbine performance.

Sustainable development is the international community’s most urgent priority, and the core aim of the post-2015 development agenda of United Nations. Sustainable development consists of three pillars, economic, social and environmental. Among the three pillars, the Life Cycle Assessment (LCA) is a methodology and tool for modelling the environmental performance of products, systems and services. In addition, LCA identifies hot-spots and bottlenecks for possible improvements. The methodology is standardized by the ISO and it has become very popular the last decade because its results can be presented and understood from decision-makers people with a moderate technical background.

TU Delft under the STW research fund is in collaboration with the Province of Zuid-Holland a consortium of companies and the Green Village in order to design and test such a system. An experimental set-up of the “Energy Wall” has been realized in the intersection of A13-N470 highways of Netherlands (next to TU Delft).

In this MSc. graduation project the aim is to investigate the environmental performances of the solar panels and small urban wind turbines, parts of the Energy Wall. The environmental impacts under focus are the climate change, acidification eutrophication and particle emissions. Main research questions are:

- Does the integration of the small urban wind turbines at the noise barrier offer greater environmental benefits than large scale wind turbines for the analyzed environmental impacts?
- Does the integration of the solar panels at the noise barrier offer greater environmental benefits than large scale solar panels for the analyzed environmental impacts?
- Which is the aggregated environmental performance of integrated solar panels and small urban wind turbines?
- Which are the hot-spots of such LCA systems that can be improved and influence the results significantly?
- Are there any bottlenecks in the supply chains?

The MSc. Graduation topic will include modelling via the LCA software SimaPro. The LCA system boundaries will be cradle-to-grave; i.e. from the production of all the used materials, to the final

disposal of the solar panels and wind turbines. The final deliverable will be a report that and the student will have to present his/her work in the group.

Further reading:

- Nikolaos Chrysochoidis-Antsos and Ad van Wijk. (2017). [Wind speed measurements above a noise barrier next to a highway for urban wind turbine installations.](#)
- Dighe, V. (2016). [Ducted wind turbines: A potential energy shaper.](#) Leonardo times, 2016(3), 40-41.
- Tsalidis, G.A., Discha, F.E., Korevaar, G. et al. Int J Energy Environ Eng (2017) 8: 175. <https://doi.org/10.1007/s40095-017-0242-8>
- Province Zuid-Holland, <https://www.zuid-holland.nl/>

Start date	Continuous
Location	Internal
Theme	Life cycle assessment
Specialisation - Electives package	LCA Practice & Reporting (Leiden University, CML), Analytical Methodologies and Tools (Leiden University, CML), Materials and Ecological Engineering, Climate proof sustainable renovation: energy use, environmental impact, health and comfort, life-cycle cost Ethics and Impacts of Global Interventions
Section	E&I
Program	MSc Industrial ecology
Methods	Environmental life cycle assessment (LCA) modelling
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