



Market Assessment Methodology for Small Wind in the Developing World

Alfred Alsop,
Wind and Marine Energy Systems CDT



Industrial Partner: Wind Empowerment

- Wind Empowerment is an international network of practitioners, researchers and stakeholders in small scale wind power and rural electrification.
- My involvement with this research stems from working with the Market Assessment Working Group (MAWG) in 2016.
- Before my involvement, the MAWG has carried out Market Assessment studies in Nicaragua, Ethiopia and Malawi. It is the methodology used in these assessments that my research builds upon

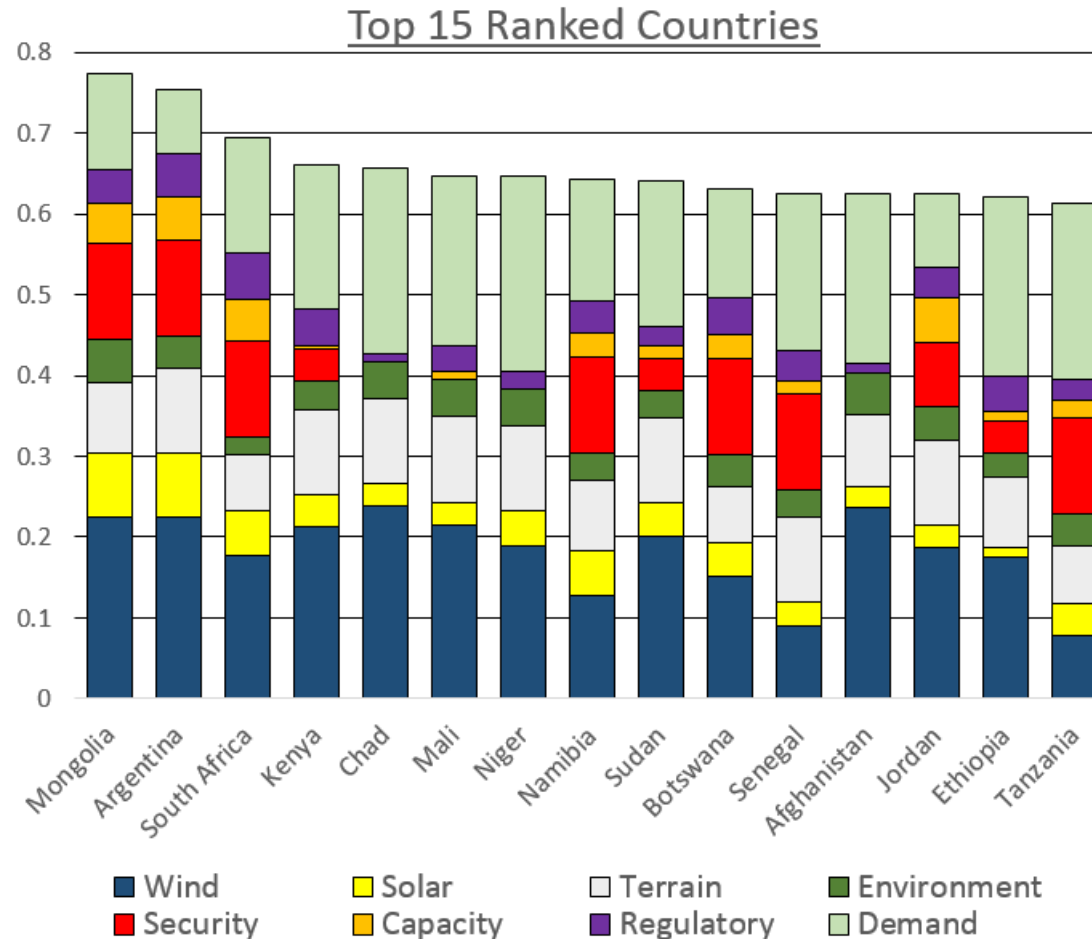


Structure of Research Tasks

- Literature Review of previous small wind implementation and research projects ✓
- Multi-criteria decision analysis based Global Market Assessment ✓
- Development of GIS based techno-economic optimisation model for use in National Market Assessments ✓
- Case Study of National Market Assessment Methodology (Nepal, Malawi) ✓
- Fine tuning Methodology with focus on providing actionable recommendations and priority actions for decision makers and stakeholders ...

Global Market Assessment

- Deciding on a series of 'indicators' to define the enabling environment for small wind, that can be applied to every country in the world.
- Scores based on data, indicator weights based on expert opinion.
- Results highlight a list of countries ranked by suitability for off-grid, small scale wind turbine installations



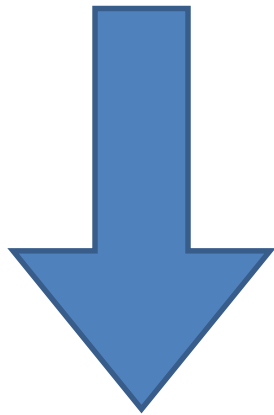
National Market Assessment Methodology

The national market assessment methodology can be broadly split into three categories

- Learning from existing initiatives
 - Literature/policy reviews
 - Critical analysis of similar historical projects
 - Expert interviews
- Techno-economic modelling
 - Identify system capital and operational costs
 - Map geographical viability, dependent on geographically varying factors
 - Calculate market potential in terms of end-users served and associated costs
- Mapping the product ecosystem
 - Consider ability/willingness to pay of end-users
 - Compare competing technologies with respect to social/cultural factors and practices that might influence the preference
 - Highlight necessary actions/conditions for the uptake of the technology based on gathered/modelled information.

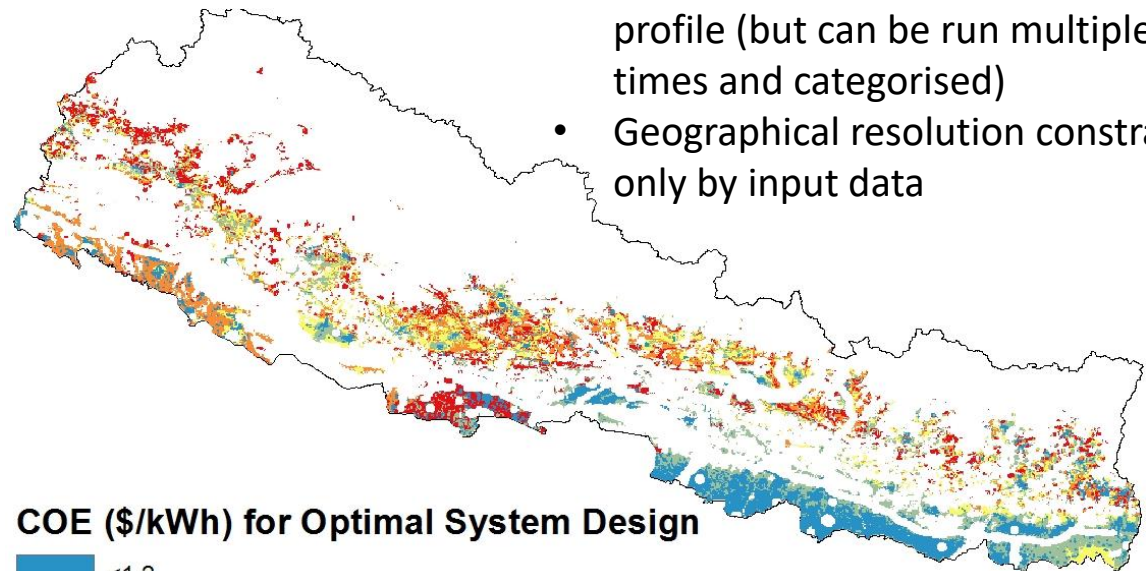
GIS based Techno-economic modelling

Input maps for renewable resources, fuel costs, maintenance costs etc, component cost/financial data



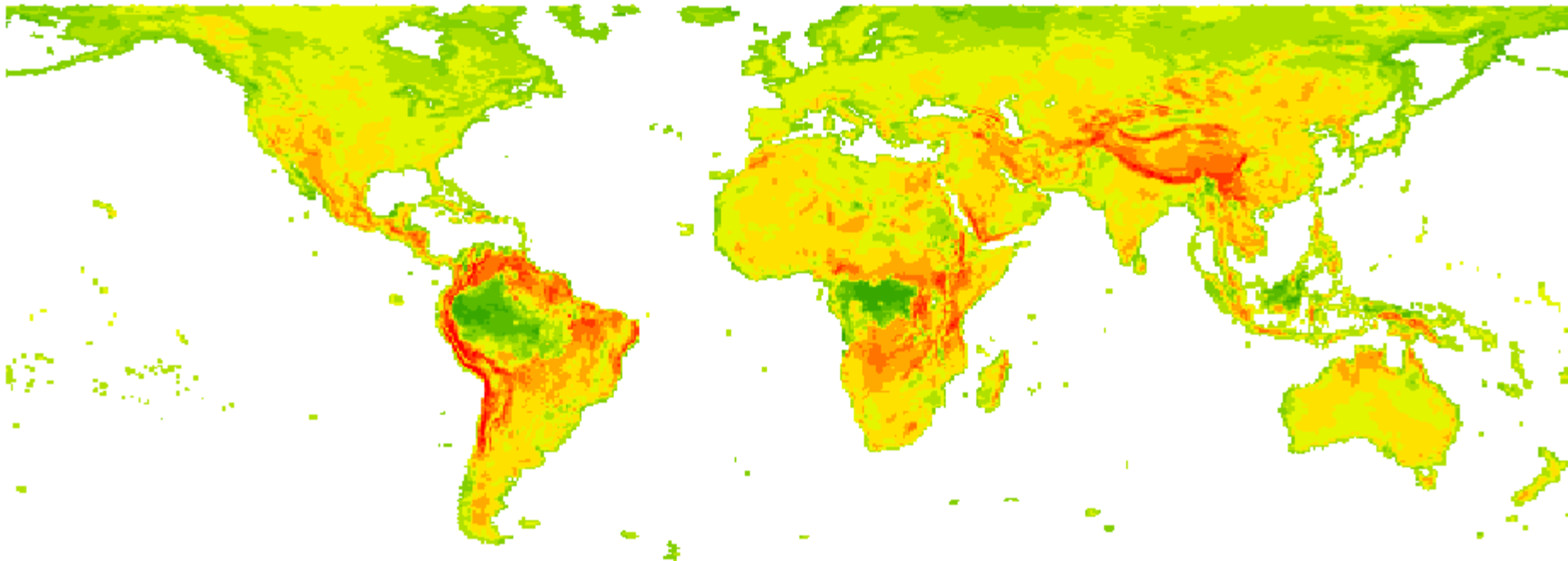
- Coded in python, can be used with any optimisation, any GIS software.
- Optimises based on LCOE
- Agnostic towards generation type
- Assumes single system size/demand profile (but can be run multiple times and categorised)
- Geographical resolution constrained only by input data

Output maps for optimised system design, fuel consumption, renewable fraction, CAPEX, OPEX, LCOE



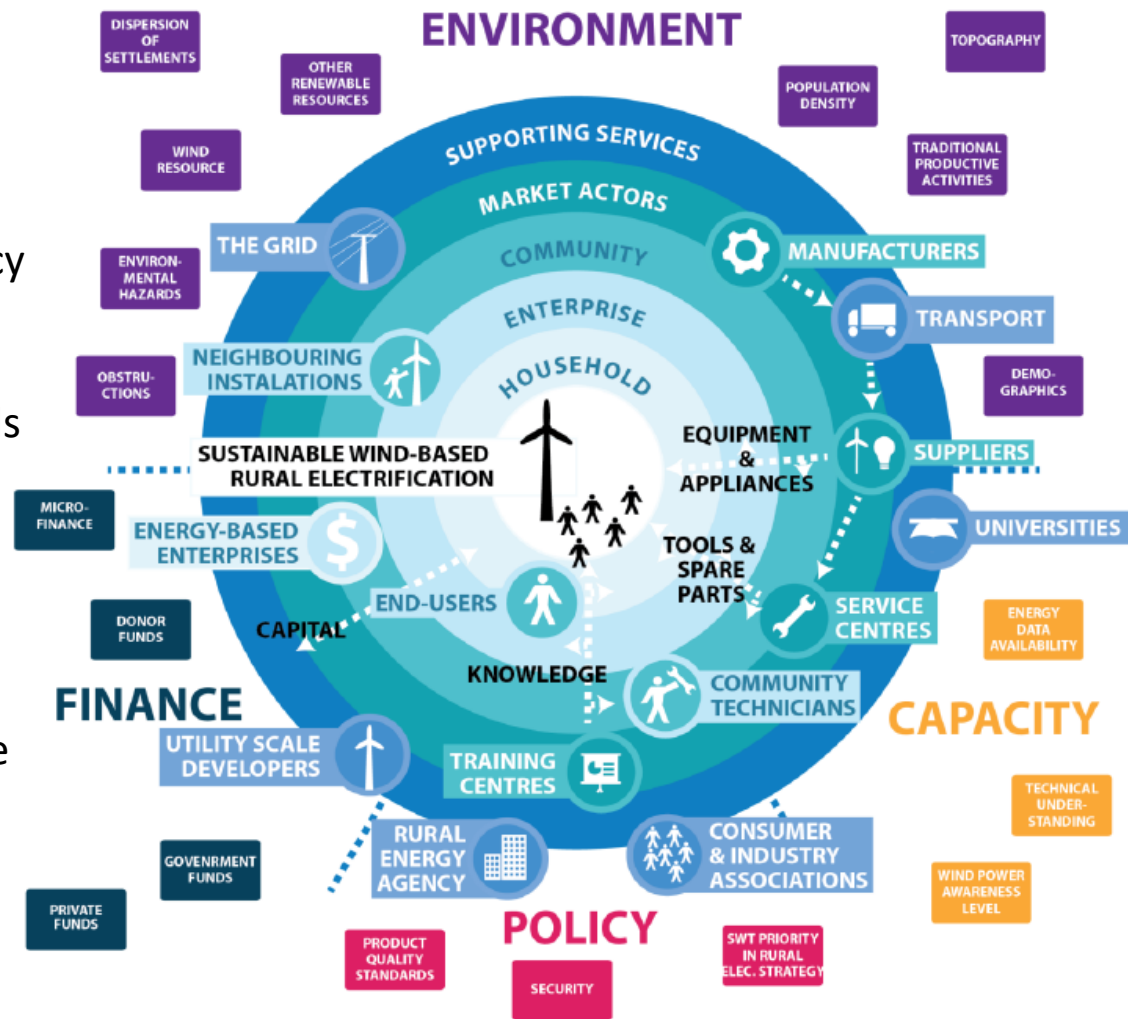
Wind – Solar Complementarity Map

- Hybrid mini-grids (Wind and Solar) can add value, if solar and wind resources peak at opposite times of the day, reduce battery storage requirements – this is the complementary case.
- In the non-complementary case, the resources peak at the same time, there is a greater need for battery storage, and wind and solar technologies compete, rather than complement.
- This map is based on hourly measured solar resource and wind-speeds from the MERRA-2 dataset from NASA. Green areas indicate high complementarity, red areas indicate low complementarity.



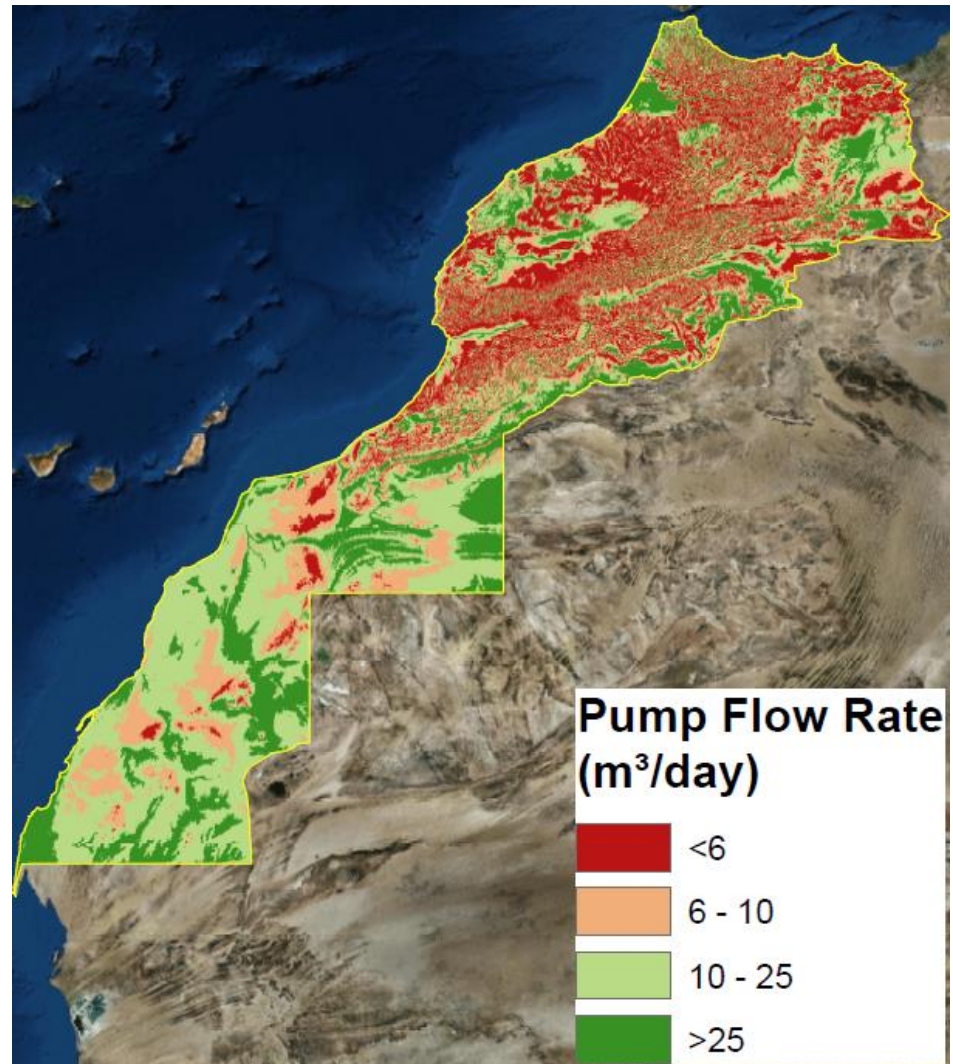
Expert Elicitation and Decision Analysis

- Decisions rarely only made on the basis of cost alone.
- Range of stakeholders (engineers, system operators, end-users, policy makers etc.)
- Entire enabling environment needs to be considered.
- Need to elicit and aggregate the perceptions of key stakeholders from different areas in order to build up an accurate picture of the sector and inform recommendations for future action.



Other applications..

- The Market assessment methodology is technology agnostic – it can be applied to any generation technology without significant modification.
- It has also been used for Solar-Diesel hybrid mini-grid systems in Malawi, and to a lesser extent the mapping methodology has been applied to water pumping small wind turbines in India, Morocco and Argentina.
- The methodology is broadly applicable to any product, in any context.



Next Steps

- Refining the national market assessment methodology, adding more decision analysis elements with a focus on providing actionable recommendations and priority actions for decision makers and stakeholders
- Working to make the methodology as open source and replicable as possible, to provide a tested market assessment methodology to small wind actors across the world.
- Establish a decision process, identifying key stakeholders and required information throughout an off-grid small wind planning process.

Thanks for your attention!

Any Questions?

Alfred Alsop

alfred.alsop@strath.ac.uk

windempowerment.org