Sustainable Design of Small Wind Energy Systems – In the context of Nepal

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Sustainability

"A sustainable society in this context may be defined as one that "meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (UN Brundtland Report of 1987).

Sustainable Design

"Sustainable Design is a multidisciplinary approach to design engineering systems/infrastructures that incorporates knowledge from engineering and social sciences to create the best designs and fulfill the needs of sustainability"

Sustainable Design of Small Wind Energy Systems:

Design Approaches

Sustainable Design of Small Wind Energy Systems: Design Approaches

Engineering Sciences

- Materials Selection (Fatigue,damage,and fracture analysis) –cost/life/performance.
- Computer Modeling (CFD,FEA,..)
- Failure Modes & Effect Analysis
- System Design (CAD/M)
- Manufacturing techniques
- Environmental Impacts

Life Cycle Assessment (LCA)

Social Sciences

- Needs of present generation
- Needs of future generation
- Impact of technological innovations in the field of energy
- Public perception over wind energy technology.

Life Cycle Assessment: Important Tool for the Best Design

LCA: " A design optimization tool that assesses costs associated with different design options over the whole life-cycle of the wind energy system." LCA enables the designer to evaluate the "**true costs**" of the energy system at the DESIGN PHASE.

Motivation Questions for LCA: "which technology or design option is better? Why & How?" –investment cost, O&M cost, etc.

Inputs for LCA: Every component or system is considered to have a definite life; but it changes in real situations. The life and performance characteristics of the components/system yield basis for cost estimation; and search for alternatives.

“LCA Methods"

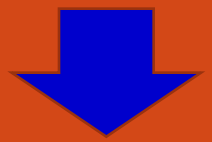
DESIGN OF WIND TURBINES, ACCESSORIES, & STRUCTURES

❖Selection of best wind turbine/ structure/materials design from a large pool of design varieties. We are more concerned with the energy cost ($/kWh) along with power cost ($/kW).

❖Computational tools such as CAD, FEA, CFD could help greatly to evaluate the technical and financial characteristics of the system over the life cycle of wind energy systems.

“Operation & Maintenance"

- Development of maintenance programs, preventive & non-preventive, at the component and system level.
- Risk Analysis of damage from lightning, wildlife, Foreign Objects.
- Component life & cost
- Lubrication: Vital
- Coatings and corrosion: Wind is abrasive
- Repair and replacement of components/parts.
- Development of Sensing, condition & trend monitoring system – helps to develop improved maintenance programs.



O & M Cost

“Cost-Benefit Analysis "

“Public and investors are more concerned to know about life, maintenance requirements, and cost- benefit **figures** of the wind energy systems over other competitive energy systems such as solar PV.”

“Conclusion"

“Need to integrate current R & D in fibre composite materials and wood ,generators,controllers,etc for creating improved design of low cost wind energy systems in Nepal.”

“The prediction based O & M programs should be developed and emphasized”

“LCA of wind energy systems may create opportunities for the larger deployment of small wind turbines in Nepal.”

THANK YOU!