Urban Renewable Power:
Natural Electric Energy Systems
In World Cities

Bil Becker, CEO - Aerotecture International, Inc.
www.aerotecture.com
R.B. Fuller elevation, plan & perspective - Towers with wind generators aloft – Chicago, 1928

’70s Alcoa Rural Darrieus Design
North American coastlines, Mississippi/Great Plains regions and Great Lakes coastlines have highest wind energy resources – approximating 9 TWs of available electricity out of a current global consumption of 1.6-1.8 TWs worldwide*

Indo-Asian coastlines and Himalayan regions (wind is not well measured there) offer more than 10 TWs of available wind electric power potential – within a current global total use of 1.6-1.8 TWs of electricity*

6 Billion people worldwide need low-cost, safe, quiet village/urban wind energy – of the world’s current use of 1.6–1.8 TWs of electricity, wind power offers 72 TWs*

*"Evaluation of Global Wind power" 2005 - C. Archer (archer@stanford.edu), and M. Z. Jacobson (jacobson@stanford.edu)


Current Large Windfarm Paradigm
Aircraft Engineers Design Giant Megawatt Windmills
Problems for Props are Opportunities for Aeroturbines

The Becker Aeroturbine

- "Enjoy s" turbulent winds
- Safe – self-regulating
- Quiet – vibration-free
- Low cost
- No powerline transmission losses
- No giant powerlines needed
- Easy integration with other sources of power
- Portable and/or architecturally design compatible
- People and Bird safe
**Aeroturbine Characteristics** | **Propeller-Type Characteristics**
---|---
Urban settings best with variable & gusting winds | Rural settings best with steady, uni-directional winds
Integrate well with rooftop solar & PV installations | Tower vibrations work against buildings and best PV installations
Produce power over a spectrum of low/midrange RPMs – do not run away – with MORE power hours/year | Produce power ONLY after spin-up to very high RPMs – running away is always a concern
Operate with low noise & low/no vibration anywhere | Operate best where noise & vibration are no problem
Require minimal/no tower supports & no anti-vibration devices | Require major structural towers & major anti-vibration devices
Mountable INSIDE towers or ON other built structures – i.e., cell towers, noise barriers, water tank towers, etc. | Not easily fitted to interiors of typical structural towers – hard to fit within existing structures & buildings
Low visible rooftop profile or within other structures | Require high profile above trees & other obstructions
Require no special code/zoning/liability insurance, etc. | Require exemptions, special codes/zoning, & insurance
Falls under current rooftop PV codes & zoning | Require costly tower/noise/vibration statement systems for safe roof mounting
AeroTurbines run quietly & protect wildlife | High speed blades are noisy & kill birds
Durable systems require low maintenance & repair | High vibration systems require high maintenance & frequent repair and attention to ‘bolt loosening’
AeroTurbines aesthetically and functionally integrate well with architectural settings | Propeller systems prove difficult to integrate with architectural settings
U.S. Wind Resource Map
Note: Midwest & Great Lakes Wind Resources

Illinois Wind Resources
Lakefront high winds not shown?
Wisconsin Wind Speeds
Detailed Map Supports Distributed Windpower

Randall Museum Vertical Aeroturbine
San Francisco, CA
Diagram of Hybrid RE Elements
PV and Wind Power Systems on Single Inverter

Angel’s Nest Retreat - Aeroturbines
Create Zero Energy Resort - Taos, NM
PV’s Value Profile

**PV’s Value as a Technology That Adds Capacity**

- PV has tangible value to utilities in generating capacity.
- Regions of high ELCC do not always overlap with regions traditionally targeted for solar energy. For example, note the high ELCC values in Southern California, the central states, and the Mid-Atlantic seaboard states. The “traditional solar areas” of Florida and the arid Southwest states have lower PV ELCC values despite their greater solar intensity values, because PV output doesn’t match the loads as well in those areas.
- Areas of high PV ELCC are associated with regions that have certain characteristics:
  - Intense summer heat waves
  - High daytime commercial demand
  - Small electric-heating demand
- Isolated pockets with high PV ELCC values may exist within a region having lower PV ELCC values. For example, high-density urban areas may have a high daytime demand in the commercial sector and thus have a high ELCC value for PV.
- These new findings about PV’s ELCC should make decisions on capacity additions and demand management a little easier for U.S. utilities.
Oxford House
Zero-Energy, Manufactureable, Net+Energy Home
Aeroturbines complete well documented approach—
NOTE: square plan allows South roof orientation on ANY site.

Pfister/Uni-Solar Project
Project Type:
Solar Energy
Site:
Flemington, NJ
Solar Manufacturer:
Uni-Solar
Project Size:
40 kW
Murphy/Jahn MHL-Aeroturbines

Mercy Housing Lakefront Aeroturbines are based on 6 Years of Earlier
Mercy Housing Lakefront Site  
Clybourne & Division Sts., Chicago

Chicago Windrose - main winds from  
Southwest & Northeast
Aeroturbine ‘Pyramid’ Tube Bases
All Zinc, 98% Recycled 18 ga. Steel Tube
Computer simulation of over-streaming winds & Aeroturbines roof location

Adding a Venturi wing above the Aeroturbines (PVs could be added)
Wind and Photovoltaic Systems

Wind turbines capture wind energy with moving parts that convert wind energy into electrical energy. They have a complex design and require regular maintenance to ensure optimal performance.

Photovoltaic (PV) systems convert sunlight directly into electricity. This process is more straightforward when solar cells are exposed to light. The electricity generated by a PV system can be harnessed into an electric current to power various devices.

Combining Wind and Photovoltaic Systems

- Wind and PV systems can be integrated to provide a more reliable and consistent power supply.
- Wind and PV systems can be complementary; they can operate independently or in tandem, providing additional benefits.

Wind or Photovoltaic Interconnection Diagram

A diagram illustrating the interconnection between wind or PV systems and the electrical grid. The diagram shows the flow of electricity from the renewable energy sources to the grid, highlighting the components involved.

Code Requirements

Comments are mandatory for designing, installing, operating, and maintaining systems for wind or PV energy. These comments must be updated and recorded in accordance with the National Electrical Code and/or local codes.

Power Quality

- All power systems, including wind and PV generation systems, must adhere to safety and quality standards set by the Code.
- Appropriate sizing and planning must be considered to ensure compliance with current regulations and standards.

Loss of Grid Supply

- One of the primary safety concerns associated with independent power systems is their ability to provide power during grid outages.
- The loss of grid supply can be managed by incorporating backup systems (such as battery banks, emergency generators, etc.) to maintain continuous power delivery.

Lockable Manual Disconnect

- A manual disconnect must be accessible to allow safe disconnection of the system.
- It is essential for maintenance and emergency situations.

Advantages of Combining Wind and PV Systems

- Enhanced reliability: The combined system can provide power during periods when one of the systems is not available.
- Cost-effective: By leveraging the complementary characteristics of wind and PV systems, the overall efficiency and cost-effectiveness can be improved.

Conclusion

Combining wind and PV systems offers significant advantages in terms of reliability, efficiency, and cost-effectiveness. Proper planning and implementation are crucial to ensure a seamless integration into the electrical grid.
8 – 2000 Watt Aeroturbines, in 10-110 mph winds, will produce 24,000 kWhs/Year

Golden Gate Aeroturbines
AeroSun Highways Start with Chicago Expressway Simulation in 2007

Installed Costs/Rated Power

Costs of complete wind electric systems.