1428 South Humboldt Street
Denver, CO 80210
303-777-3341
tolsen@windtechnology.com

Advanced Energy Systems, LLC

August 28, 2018

Mission Statement: To develop clean, efficient, cost-effective energy systems and resources, and to move with society toward sustainable living on a healthy planet.

Core Business: Project management and engineering for renewable energy and energy efficiency systems including wind, solar, hydro, biomass, and demand response.

Services:

Project Management:

- Management consulting and strategic planning
- Feasibility assessment
- Economic and financial analysis
- Project planning and logistics
- Construction management
- Due diligence project review
- Mediation and arbitration

Engineering and Design:

- System design, analysis, integration, reliability, certification
- Structural engineering, loads modeling, finite element analysis
- Electrical engineering, instrumentation, test engineering
- Hybrid energy system modeling, design and installation
- Meteorological data collection and analysis
- Aerodynamic design and analysis
- Energy efficiency, steam system optimization

Project Partners: Energy project developers, financiers, engineering firms, government agencies, international agencies, utilities, rural electric associations, wind turbine manufacturers, industrial firms, communities, remote homes and businesses, policy-makers.

Principal: Timothy L Olsen, MSME, PE (CO, 29136), NABCEP Small Wind (091110-4), NABCEP Solar PV (051112-135).

Expertise: Licensed professional engineer with 25 years of experience in renewable energy system design, engineering, and project management.

Date of Inception: September 1990.

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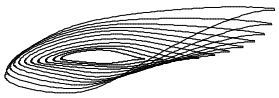
Selected Project List:

Solar/Wind System Engineering and Installation:
Saint Vrain Valley School District: 73 buildings evaluated, 2.0 MW PV in construction, 2016-present
Northern Cheyenne Tribe / eFormative Options: multifaceted EERE program development, 2017-present
Grid Alternatives: 125 kW PV aggregate, professional engineering for 30 projects, 2015-ongoing
Atlas Energy Capital: 21 MW utility-scale PV, preliminary planning and engineering, 2016-2017
Arion Energy, Denver CO, 3 MW solar installed, 1200 MW wind planned, 2012-ongoing
National Wind Technology Center/AnemErgonics, CO, install, test 4 small turbines & towers, 2009-2017
MesoAmerica Development Group, Honduras & Panama, 8 energy audits and solar feasibility, 2011-2016
Community Energy, Antonito Solar, CO, 500 kW solar PV, owner's engineer, 2014-15
Boulder County Longhorn Maintenance Facility, 48 kW solar PV, fast-track installation, 2013
Presidio Waste Water Treatment Plant, TX, 80 kW solar PV/battery, engineering & installation, 2011
Colorado Wind-for-Schools: Stratton High, Kit Carson High, Nederland High, Ponderosa High, Thorne Ecological Institute, 2.4 kW SkyStream wind turbine, engineer, stamp, & install, 2007-11
Habitat for Humanity, CO, (2) 2.0 kW solar PV systems: engineering & stamp, 2007
Mercury Café, CO, 0.8 kW wind/3.1 kW solar hybrid: engineering, stamp, & installation, 2005-2006

Windfarm Development:
Clear Creek Power: Highland Park 180 MW Windfarm, wind, layout, economics, planning, 2006-present
Indigenous To Indienous: 30 MW wind and 150 MW solar development in Kenya, 2016-present
Combined Power / HI Wind: 250 MW wind/solar/VRB model, micrositing, economics 2009-2010
Terra-Gen / Sytech: Iron Mountain, WY, 500 MW, resource assessment and project plan 2008-2010
Wind Revolutions: Multiple WY/NM, 1200 MW, wind assessment, micrositing, economics 2007-2009
Duke Energy / HTH Powershift: Campbell Hill, WY, 99 MW, wind assessment, economics 2005-2009
Korenco RE: Donbokri Wind, Jeju, Korea, 10 MW, resource assessment and project plan 2008-2009
Mesalands Community College R&D & Training Facility, GE1.5sle: wind assess, econ, RFPs 2007-2008
ArcVera-Chinook / Energy NW: Bonneville Power Authority regional wind resource survey, 2008
ArcVera-Chinook / KeyBanc: Clipper C96 Technical Due Diligence, complete 2007
Power Company of WY/Anschutz, CO: Western US wind potential and optimization survey, 2007
enXco: Peetz Table I, CO, 30 MW, planning and logistics, completed 2001, expanded 2007
ArcVera-Chinook / BP: 100-Windfarm Pre-Development Review, complete 2006
NREL / US Navy: San Clemente Island, CA, 900 kW Wind-Diesel Integration, 1998-2002

Hydropower Engineering:
Colorado Dept of Agriculture: ACRE-3 small hydropower feasibility, implementation, 2015-present
Park Family Farms, CO: 25 kW hydro plant feasibility study, grant acquisition, and engineering, 2015-17
Amec Foster Wheeler/CO Energy Office: PRV hydropower assessment and 80 kW sample case, 2016
Springville Utilities, UT: 300 kW Hobble Creek hydro plant refurbishment vs site restoration study, 2015

Wind Turbine Design:
QED Wind: SWCC certification structural analysis review and revision, 2016-18
Renewtech: SWCC certification structural analysis review and revision, 2015-17
Pika Wind: SWCC certification structural analysis review and revision, 2015
Skystream Wind Turbine: GL certification & engineering, Southwest Windpower, Inc: 2010-11
NREL: Low Windspeed Turbine Project, Advanced Blade Pitch Control, 2003-2004
GE Energy (Zond/Enron): Advanced WT Next Generation, Z40, EW750, GE1.5 RD&D, 1993-2003
NREL / Global Energy Concepts: Wind Industry O&M Cost Analysis, 2001
NREL / PS Enterprises: Advanced WT Innovative Subsystems: Flexible Rotor, 1995-2001
Early Wind Turbine Design: Carter C-300, SecondWind, Cannon Windeagle 25 & 300: 1993-1998



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MISSION

To inspire societal transformation to honor and achieve clean energy for a healthy planet.

EXPERIENCE

President and CEO, **Advanced Energy Systems, LLC**, Denver, CO 1988-Present.

Description: Develop, engineer, and integrate full spectrum of clean energy technologies, with emphasis on solar, wind, hydro, storage, and energy efficiency. Manage complex projects and partnerships with multiple teams and clients.

Clients:

GE Wind	Saint Vrain Valley School District	Grid Alternatives
Terra-Gen	Northern Cheyenne Tribe / eFormative	Chinook Wind/BP Wind
Xzeres Wind	National Renewable Energy Laboratory	City of Springville, UT
Carter Wind	Power Company of Wyoming / Anschutz	City of Presidio TX
QED Wind	Colorado Wind for Schools Program	Community Energy
Pika Wind	Freeport McMoRan Copper & Gold	Clear Creek Power
Sunstrong	MesoAmerican Development Group	AnemErgonics
KeyBanc	Colorado Department of Agriculture	Arion Energy
SeaWest	Mesalands Community College	Mercury Café
Vaisala	Duke Energy / HTH Wind	Zond Energy

Key Duties:

- Manage renewable energy projects for both project development and product execution
- Coordinate project stakeholders: utility, government, community, suppliers, permitting agencies
- Perform technical, economic, and strategic due diligence and feasibility
- Review, develop, and advocate for transformative renewable energy policies
- Assess renewable energy resources, technologies, interfaces, markets, and project economics
- Model and engineer wind/solar hybrid power management systems on utility and island grids
- Analyze and certify energy system architectures and mechanical and electrical components
- Optimize building and factory energy efficiency: lighting, motors, HVACR, steam, pumps, etc
- Optimize rotor blade aerodynamics, planform, and composite structural design
- Test, analyze, and certify structural and fatigue loads, system performance, function, and quality
- Model and analyze structural dynamics, component design, and draft specifications

Previous:

Research Engineer, **National Renewable Energy Laboratory**, National Wind Technology Center, Golden, CO 1988-1990.

- Computational algorithm design, system testing, statistical, time series and spectral analysis.

Systems Engineer, **Martin Marietta Denver Aerospace**, Littleton, CO 1986-1987.

- Space Shuttle Reevaluation Study, FMEAs, simulations, orbital mechanics.

Research Assistant, **Virginia Polytechnic Institute and State University**, (VPI&SU), Mechanical Engineering Department, Blacksburg, VA 1984-1985.

- Thesis to optimize turbo-machinery design and acoustics.

Structural Analyst, **Swales and Associates**, Greenbelt, MD 1983-1984.

- NASA Goddard project coordination, space structure design and evaluation.

EDUCATION

MS, Mechanical Engineering, **Virginia Polytechnic Institute and State University**, Blacksburg VA, 1985
BS, Mechanical Engineering, **University of Colorado**, Boulder CO, 1982
BA, Music Performance, classical guitar, **Metro State College of Denver**, CO, 1990

CERTIFICATIONS

- Professional Engineer: Colorado License #29136
- Professional Mediator: Mediation Association of Colorado
- Solar Installation: NABCEP 051112-135
- Qualified Steam Specialist: US DOE Industrial Technology Center
- Safety: MSHA 40-hr: initial 2010-01, updated 2018-02

ACTIVITIES

- WorldDenver / Denver World Affairs Council, YP Board of Advisors
- Colorado Renewable Energy Society, 2006 President, Board of Directors
- Engineers Without Borders, 2005 Co-chair, Technical Advisory Committee
- American Wind Energy Association, American Society of Mechanical Engineers
- Mediation for US Postal Service; Alternatives to Violence Project trainer

PUBLICATIONS AND PRESENTATIONS

- *Wind and Solar Energy Basics*, Presentation to multiple audiences, Denver, CO, 2009-2016.
- *Small Wind Site Assessment Guidelines*, NREL/TP-5000-63696, Golden, CO, September 2015.
- *A Preliminary Condition Assessment of the Hobble Creek Hydroelectric Plant for the City of Springville, Utah*, 2015.
- *Wind Energy Technology*, 40-hr course for Green Careers for Coloradans workforce re-training, Denver, CO, April 2011 – March 2012.
- *Solar Energy for Honduras*, Honduras is Open for Business, San Pedro Sula, November, 2012.
- *Renewable Energy Education Program*, 80-hr Colorado job re-training, Denver, CO, July, 2010.
- *Wind Energy in Colorado*, Present to Front Range Community College Earth Day, Lakewood, CO, April, 2006. *Solar Energy for Colorado*, to Denver International Airport, June, 2006.
- *Low Wind Speed Turbine Project Conceptual Design Study: Advanced Independent Pitch Control*, NREL/SR-500-36755, Golden, CO, November, 2004.
- *Wind Farmers Workshop*, Presentations in Hugo, Burlington, Akron, Holyoke, Lamar, Montrose, CO, April 2002 – October, 2004.
- *Examining the Benefits of Hybrid Systems*, IBC Wind Conference, Boston, MA, Aug 2002.
- *Home Grown Electricity: Solar and Wind Basics*, Cheyenne Botanic Gardens Forum, WY, 2001.
- *Wind Power Plant Evaluation: Naval Auxiliary Landing Field, San Clemente Island, CA*, NREL/SR-500-27527, Golden, CO, December 2000, and SR-500-24663, July 1999.
- *Wind Resource Assessment and Wind Energy System Cost Analysis: Fort Huachuca, AZ*, National Renewable Energy Lab NREL/SR-500-21121, Golden, CO, December 1997.
- *Hybrid Energy System Cost Analysis: San Nicolas Island, California*, National Renewable Energy Laboratory NREL/TP-440-21120, Golden, CO, July 1996.
- *Parametric Study of Wind Turbine Loads Using Yawdyn*, prepared for the ASME ETCE Wind Energy Symposium, New Orleans, LA, January 1994.
- *WINDATS - Wind Data Analysis Tool Set: User's Manual*, Wind Technology Division, National Renewable Energy Laboratory, Golden, CO, September 1990.
- *Atmospheric Performance of the Special-Purpose SERI Thin-Airfoil Family: Final Results*, AWEA Windpower '90 Conference, Washington, DC, August 1989 (coauthor).
- *Experimental Investigation of Unsteady Fan Flow Interaction with Downstream Struts*, Mechanical Engineering Dept thesis, VPI&SU, Blacksburg, VA, December 1985; also in *Journal of Propulsion and Power*, V3, No2, March-April 1987.