Estimated Project Budget and Schedule

$500,000; 24 months

Proposed Partners

Power generation facilities (e.g., waste-to-energy plants; fossil fuel, natural gas and coal fired power generation facilities)

- Water treatment process vendors
- Policy makers and land use planners to rethink land use planning and funding structure for projects
- Regulators (energy, water and environment)
- Municipalities and small community users

Known Prior Research on This Topic

1. Information on waste energy in power plants – "Working Document of the National Petroleum Council Global Oil & Gas Study (July 18, 2007)"

   http://www.npc.org/Study_Topic_Papers/4-DTG-ElectricEfficiency.pdf

2. Memstill membrane distillation – a future desalination technology (Desalination 199 (2006) 175–176)

   Jan H. Hanemaaijera, Jolanda van Medevoorta, Albert E. Jansena, Chris Dotremontb, Eric van Sonsbeekb, Tao Yuanc, Luc De Ryckb

WIND

Wind Project 1

Title

Guidebook for implementation of renewable energy for desalination for small systems

Needs the Project Meets

There is currently no guidance for small systems that would like to employ wind, solar or other renewable energies when considering desalination alternatives. While information exists for large systems, there is a need for those that are off the grid. If renewable energy (RE) is to be employed on a more widespread basis for small systems, then clear, concise and tailored guidance is warranted.

Benefits of Project and Expected Outcomes

1. A better understanding of renewable energy options, challenges, and directions so that small systems can make informed decisions when undertaking a desalination project.
2. Greater rate of implementation success for small-scale RE-desalination.
3. Ultimately, higher water quality for disadvantaged and off-the-grid small communities.
4. Provides a peer-reviewed decision making tool to manage risk associated with implantation of RE-desalination.

Research Objectives

To provide guidance in planning and implementation of RE-desalination specific to small systems investigating alternatives for water supply where the energy component is off the electrical grid.

Research Approach (numbered by task)

1. Collect information on all available components associated with a RE-desalination project (including RE-collection methodology, electrical coupling and conditioning techniques, identification of suitable process equipment, water storage, and concentration disposal).
2. Describe opportunities for package systems.
3. Assess approaches to quantify of RE-resources.
4. Provide methodology to assess costs associated with both RE sources and desalination technology in terms of capital, operation and management, and total water costs.
5. Provide guidance on ownership and financing alternatives.
6. Develop criteria for go/no go decision making on RE-desalination implementation.
7. Information should be drawn from current and proposed practices around the world.
8. Describe issues associated with permitting RE-desalination for small systems.

Estimated Project Budget and Schedule

$200,000; one year

Proposed Partners

Electric Power Research Institute, Water Research Foundation, Rural Electric Association, ProDes, NCED

Known Prior Research on This Topic

Guidance has been developed for large systems via the WateReuse Research Foundation, but none specific to small systems.

Wind Project 2

Title

Which high-risk wind research projects are suitable for further exploration?

Needs the Project Meets

The group determined that there isn't a good understanding of work being done on high-risk wind energy ideas – at the university level, in government, in private industry; in the U.S. or globally. A central directory of these high-risk ideas would serve as a tool for researchers and funders to use to see what work is being done, to avoid potential duplication of efforts, and to determine what ideas are not being explored. The projects could be categorized by technology type and could serve to catalyze related but not identical projects, as well as further work on some of these potentially viable high-risk projects.

Benefits of Project and Expected Outcomes

The expected outcome would be a document that identifies and describes the various high-risk wind energy research projects and who's working on them; includes links to the researcher conducting the work/inventor proposing the idea(s). The benefit would be time savings on the part of researchers and improved knowledge about the range of wind energy projects underway, as well as greater exploration of possibly overlooked viable ideas. Could help identify knowledge gaps and future research needs.

Research Objectives

Identify the high-risk wind energy research underway in the U.S. and globally. Include universities, government, private industry; U.S. and non-U.S. organizations.

Research Approach (numbered by task)

1. Identify who is doing wind research and locate descriptions of projects
2. Assemble descriptions of the candidate research projects
3. Identify a time-frame: only active research, or include projects from previous years?
4. Assemble an assistance team to determine which projects are high risk and offer greatest potential for further exploration
5. Review the research projects to identify whether they're high risk
6. Prepare a database or spreadsheet listing projects, descriptions, lead researchers, organizations, and hyperlinks to research description/organization
7. Prepare report including information on projects
8. Assistance team reviews/approves report
9. Publish/submit final report

Estimated Project Budget and Schedule

$70,000 ($60,000, graduate or post-doc student; $10,000, assistance team review time); report published electronically

Schedule: one year

- Months 1-3: Tasks 1 through 4 (identify work underway through assembling assistance team)
- Months 4-6: Tasks 5 and 6 (review projects and decide which are high risk/high return, prepare draft database/spreadsheet of projects)
- Months 7-9: Tasks 7 and 8 (prepare report on findings; assistance team review report and provide comments)
- Months 10-12: Task 9 (finalize and publish report)

Proposed Partners

American Wind Energy Association, American Water Works Association, Electric Power Research Institute, Virginia Center for Wind Energy – James Madison University, Alternative Energy Institute – West Texas A&M

Known Prior Research on This Topic

Unknown

Wind Project 3 (project summary submitted but not described at plenary session)

Title

Hybrid wind with vertical solar for desalination

Needs the Project Meets

Wind power generation is highly variable and a hybrid system can provide a more consistent power supply. Locations for wind power generation are often not considered suitable for solar power generation. Research at the Massachusetts Institute of Technology (MIT) has demonstrated that solar power production under low light conditions can be optimized with photovoltaics mounted on vertical structures. The vertical alignment of the photovoltaics allows for power production from ambient light along with direct sunlight. Using vertical structures for wind generation can allow for solar power production in regions with low solar incidence.

Benefits of Project and Expected Outcomes

The project would provide more consistent power production to operate a desalination system and allow for solar power production to be used in regions not considered suitable for solar power.

Research Objectives

The proposed research will evaluate the ability to generate solar power using the structures required for wind power production and desalination. Vertical solar power production will be optimized for the structures to capture both direct sunlight and ambient light. The feasibility of using vertical solar power in regions not considered suitable for solar power production will be evaluated. Methods to optimize the use of power generated from a hybrid wind power/vertical solar power production for desalination will be evaluated.

Research Approach (numbered by task)

1. Vertical access wind turbines can produce power at lower wind speeds as compared to horizontal access wind turbines. These structures will be screened to determine which ones are suitable for vertical solar power production

2. The structures associated with wind production and water storage will be used to mount a vertical solar power production system. The optimal configuration of the vertical solar collection system for power production will be evaluated using a computer program developed at MIT.

3. A bench-scale system will be built and evaluated under different light and wind conditions. The alignment of the vertical solar power system will varied based on output from the computer optimization step.

4. The results from task 3 will be used to determine methods to use the power generated for a desalination facility.

5. A model will be developed to assess the feasibility of using a hybrid wind/vertical solar system for off the grid desalination of brackish water with reverse osmosis.

6. Prepare a final report with recommendations for scale-up to a field study.

Estimated Project Budget and Schedule

$100,000; one year

Proposed Partners

Department of Energy, MIT

Known Prior Research on This Topic

Existing hybrid wind/solar projects and ongoing research at MIT.

Wind Project 4

Title

Capture of more atmospheric processes in wind energy assessment approaches

Needs the Project Meets

Wind is affected by many atmospheric processes occurring not only at the wind project site but elsewhere, i.e., 10's of kilometers (e.g., clouds and elevated terrain interactions) vertically and 100's of kilometers (e.g., passing low-pressure systems) horizontally. Current wind energy assessment efforts (short period measurements of wind and small-scale CFD model application) come up so short in that they pretty much ignore the atmosphere. These limitations, resulting from untreated atmospheric processes, in developing wind/energy information will add to unknown risk for the investor and, thus, stint wide-scale growth of wind projects.

Benefits of Project and Expected Outcomes

There are quite a few benefits of employing atmospheric physics based wind energy assessment methods two of the main benefits are listed below:

Benefits:

1. Wind information is provided not only at the height(s) of actual wind turbines but also at multiple locations to cover a large area to cover wind projects

2. Wind information can be provided at a fraction of the time, i.e., a full year of wind information can be created in 30 or fewer days

3. Wind information can be produced at a fraction of the cost. For example, an 80-m wind collection effort can cost as much $80,000, compared to only $20,000 for the simulation based efforts

Expected Outcomes:

1. Accurate estimation of wind energy production for a specific year with monthly average wind speed or monthly energy production

2. Accurate capture of diurnal variation of wind energy for the year and for each month
3. Detailed and accurate estimation of long-term energy production with minimum year, average year, and maximum year; investors

Research Objectives

Test and validate atmospheric domain configuration strategies, determine effective ways to capture of all the relevant atmospheric physics without the cost of computational burden.

Research Approach (numbered by task)

1. Choose a site (an active wind project development will be desirable) with actual site wind measurements for comparing the simulation output with the site measurements for a) model validation b) simulation bias correction.
2. Set up an optimal atmospheric model domain, acquire the parallel computational resources, and complete simulations for ten years
3. Develop a wind energy assessment analysis and a report based on the simulation output and validation results

Estimated Project Budget and Schedule

$130,000; eight months

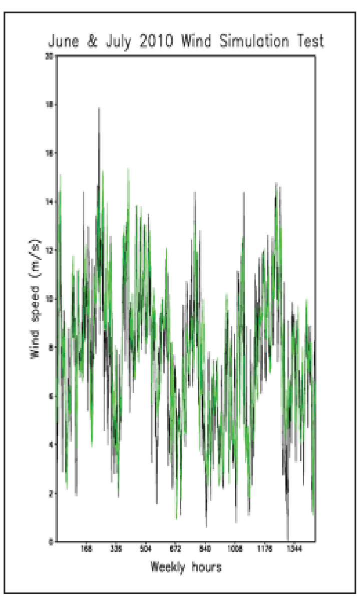
Proposed Partners

National Renewable Energy Laboratory for providing site measurements and independent validation of the simulation results

Electric Power Research Institute for providing site measurements and/or independent validation of the simulation results

Known Prior Research on This Topic

WindForces (www.windforces.com) has developed a cutting-edge atmospheric simulation technology for wind energy applications with the required atmospheric models, computational resources, etc.



WindForces is looking to develop independent validation studies based on the research already conducted.

Some comparison results for a wind project site in Oklahoma are summarized in the figure:

The simulation was conducted for a site in Oklahoma at the 56-m height. The difference as a percent for June is ~5% and July is ~1.7% and for the two month average is less than 4%.

Wind Project 5

Title

Direct use of mechanical energy from wind power for desalination

Needs the Project Meets

Wind energy conversion to electricity is inefficient and storage of highly variable electrical production is expensive. Investigations to use mechanical energy more efficiently i.e., use it directly without converting it to electricity may improve the cost effectiveness and therefore the employment of wind energy. Storage of mechanical energy could also be done more effectively than storage of electrical power. There is a need for further investigation of the concept.

Benefits of Project and Expected Outcomes

Identify technical barriers and opportunities to use mechanical energy from wind sources at small-scale brackish desalination facilities. Direct use of mechanical energy could allow for more effective wind power collection at both low and high wind speeds that cannot be captured with electrical energy. Storage of mechanical power could provide a consistent power source for a desalination system.

Research Objectives

Investigate and test the use of mechanical energy from wind turbines directly for a small brackish water desalination facilities. A key objective will be the use of a mechanical power storage system to provide a consistent power source for desalination.

Research Approach (numbered by task)

1. Literature review to identify ongoing and completed work
2. Development of a prototype for a wind power mechanical desalination system with storage of mechanical power to provide a consistent power source.
3. The prototype will be evaluated under varying wind speeds (either simulated or actual) to determine the efficiency of energy recovery and ability to store power.
4. Evaluate the data collected and prepare a final report with recommendations for a field evaluation.

Estimated Project Budget and Schedule

$200,000; two years

Proposed Partners

National Renewable Energy Laboratory, Reclamation, Department of Energy

Known Prior Research on This Topic

Considerable research has been done on the storage and use of mechanical power for pumps. This research should be applied for desalination.

Wind Project 6

Title

Grid independent green personal computer (PC) technology for energy optimization (patent-pending)

Needs the Project Meets

This technology shows the potential to significantly change the renewable energy sector for the better by offering the following three key benefits:

1. It will not require the power grid to build large scale renewable energy projects
2. Project developers will not require traditional power purchase agreements to build utility scale projects
3. The system pays for a large part of the energy storage system without increasing the cost of energy production

Benefits of Project and Expected Outcomes

This technology makes personal computers (PCs) “green” by which PCs, cloud/server clusters, etc., draw more than 90% of energy at the generation source (e.g., wind farms). PCs are accessed via internet using a PC-specific connector box unique to each PC. PC owners have control over their PCs—they can turn them on/off—as if they are residing in their homes/offices.

This technology offers wholesale energy rates to consumers that will last for the life of the renewable project and beyond. For example, a municipality with 500K personal computers, can save at least $15M per year. Depending on the location where retail rates may be higher, those savings can be as high as $60M per year.

As an example, a 100-MW wind/solar energy farm can support up to 300K personal computers and by pooling the cost of all those 300K power supply boxes, within all those PCs, an energy storage system (battery) can be fully paid for and the chaotic nature of renewable energy production stabilized, without having to increase the cost of energy production.

The technology leads to the development of highly energy efficient, grid independent, and cost-effective utility scale renewable energy projects globally. Energy efficiency results from the ability to choose sites with abundant natural resources and the ability to avoid energy losses in transmission/distribution. Grid independence results from the fact that these renewable projects no longer need the power grid as back up energy source. Cost effectiveness results from wholesale prices offered directly to the consumers.

With an estimated count of 2 billion PCs worldwide, the total energy required by these PCs may be on the order of a staggering 500GW of installed wind capacity at the 40% energy conversion efficiency.

Research Objectives

The objective is to develop a new personal computer (PC) that will use only 5-10% of grid supplied energy as opposed to 100% as it is currently. In doing so, renewable energy project development, including wind, will grow significantly.

Research Approach (numbered by task)

Fifteen (15) personal computers will be made compatible for this energy optimization technology concept so they are able to draw most of the energy (90+%) from a wind farm site. Energy consumption will be determined, using power meters, on the PC customer end as well on the energy consumption end to reach the research objectives stated above.

Estimated Project Budget and Schedule

$150,000; 12 months

Proposed Partners

M-TEC at New Mexico State University

North American Wind Research & Training Center at Mesalands Community College

Known Prior Research on This Topic

This is a patent-pending technology that is in the initial stages gathering strategic development and investment partners. Please contact James Stalker, the inventor, for further details at jrstalker@respr.com or 575-571-6354.