Summary and Recommendations from the Staff Workshop Entitled Challenges and Effective R&D Paths for Promoting Repowering Wind Energy

Summary and Recommendations

On February 28, 2016, California Energy Commission staff held a workshop entitled "Challenges and Effective R&D Paths for Promoting Repowering Wind Energy". The objective of the workshop was to obtain feedback from wind energy stakeholders on the challenges and effective research and development (R&D) paths for repowering wind energy in California. Feedback or suggestions gathered from stakeholders during this workshop will be used to inform and refine the grant solicitation that will be released in support of the Electric Program Investment Charge (EPIC) Second Investment Plan Funding Initiative 4.4: Upgrade California's Aging Wind Turbines: Design, Cost, and Developing Improvements That Meet Local Needs.

The workshop was organized into two parts, "Part I: Presentations of Wind Energy Experts" and "Part II: Panel Discussion with original equipment manufacturers (OEMs)."

Session I: **Challenges and Priority R&D Paths to Promote Cost-Effective Wind Repowering.** Session I was comprised of two parts, presentations and a moderated discussion with expert panelists. These panelists were from a variety of professional backgrounds including industry, utilities, operators and wind energy experts:

Moderator: Nancy Rader, California Wind Energy Association (CalWEA)

Panelists: Alex Byrne, DNV LG

Barry Gilman, Southern California Edison

Farshid Arman, Siemens Technology to Business Center

John Pappas, Pacific Gas & Electricity Company (PG&E)

Maureen Hand, National Renewable Energy Laboratory (NREL)

Thomas Smith, OGIN

Panelists provided introductory remarks and slide presentations that are also integrated in the posted workshop presentation.

Comments – Session 1:

1. California needs to repower not only to produce more energy but to preserve wind energy. Repowering is one of the few remaining opportunities for preserving and generating more wind energy in California.
2. Because of BLM wind exclusion, there are only a few areas with permission for wind energy projects. Land-use restrictions will severely restrict new CA wind development.

3. Wind energy is in disadvantages with solar energy with stiff competition from solar PV and significant tax policy disadvantages.
4. Some barriers: Prohibition of Shared Interconnection Facilities in Renewable Auction Mechanism (RAM) or RPS RFO PPA. Legacy wind projects must be able to economically operate until the complex and complicated repower can be completed. A middle ground is necessary until repower.
5. Resources are no longer dispatched to meet total system demand. Dispatch follows net load
6. Daytime over-generation is an issue under 33% RPS. Expect more extreme events under 50% RPS.
7. Expected change in generation within scheduling intervals.
8. Unknown deviation of generation from forecast. Risk decreases as you move from day-ahead into real-time operation.
9. Utilities need reliable information, signals and data from operators. It could help reduce the amount of curtailments.
10. In other countries such as Denmark and Germany, repowering projects brought to the wind sector bigger turbines and larger rotors.
11. Reduce cost of energy overall is beneficial for repowering and new projects.

<u>Suggestions from panelists – Session 1</u>:

12. Research and development to reduce cost of wind energy (capital and installation, O&M costs, foundation) and cost of repowering (additional cost of removing old infrastructure).
13. Research and development on how to implement new technology and reduce the cost of implementation (e.g. new construction methods for tall towers; new installation methods for high altitude wind). Such technology implementation may be viewed from an industrial process perspective.
14. New wind resource maps at higher hub height, for instance at around 200 meters (656 feet). Higher hub height could help improve capacity factor.
15. Research and development in more efficient wind turbines at lower hub height – considering military height restrictions and other limitations at higher elevations. The OEMs need incentives and market to come up with solutions.
16. Research and development in modern small turbines with high capacity factor. Many legacy projects are not suitable for big turbines and components when repowering. Currently, many of the repowering wind projects are small size and fragmented facilities.
17. Research and development in modern small turbines with high capacity factor to promote distributed wind energy.
18. Research and development in advanced control systems.
19. Research and development in modern turbines that ramp very quickly – wind farms that can ramp up and down quickly and efficiently and run at low output levels. Increase flexibility in wind farms.
20. Research and development in advanced material to be recycled or repurposed at the end of life.
21. Research and development in life extension, i.e. upgrading existing turbines and maximizing energy output without compromising safe operation.

22. Research and development in generic component designs that can be applied across turbine models.
23. Study on addressing the following major barriers to wind repowering: environmental permitting; new long-term PPAs required (RPS RFO or RAM); new QF contract pricing that is often too low to sustain operation; QF conversion interconnection capacity uncertainty creating more delays; and existing wind capacity that is eligible for RAM or RPS RFO contracts but economic curtailment requirements (specified capacity level reduction and duration) requires state of the art turbines with modern SCADA systems.
24. Repowering guidebook to help smaller operators get over hurdles.
25. Environmental and economic assessment of new wind turbines and specific Repowering projects.

Session II: Original Equipment Manufacturer's Perspective on Wind Repowering Panel Discussion. A moderated discussion with industry and expert panelists took place. These panelists presented the vision of OEMs on repowering wind energy in California:

Moderator: Silvia Palma-Rojas, California Energy Commission

Panelists: Brent Reardon, Siemens Wind Power Americas

Henry Shui, University of California Davis

Oliver Kijas, Senvion USA Corp.

Thomas Smith, Ogin

Questions to Panel

1. *Do we have sufficient technology needed for repowering? From your perspective, are there technological barriers or further innovations needed to better take advantage of opportunities from repowering older wind facilities?*
2. *How can we better deploy new and innovative wind technology to help repower and maximize use of California's wind resources? What is limiting the deployment of these technologies?*
3. *Are the O&M costs and capital costs the primary drivers for repowering decisions? If so, what research and development is needed to address the cost issues?*
4. *How is the end-of-life aspect of the current fleet of older wind turbine being addressed? In 20-30 years, we will have the need of repowering the "new" old fleet. Is the end-of-life perspective included in the design of the current or newer wind technology? Please provide an insight on what might be expected in the end-of-life phase of the new turbines.*

<u>Comments – Session 2</u>:

1. There is sufficient technology for repowering. It's the implementation of the technology that is the challenge and the cost to implement it.

2. There is a tremendous wind technology options but are not being taken advantage for all repowering opportunities in California. Small and fragmented farms cannot take advantage of available technology.
3. There is not enough market for big OEMs to invest in small turbines investment. Big OEMs need a big market.
4. The trend is distributed form of power. We need modern small turbines that are more efficient. Make the market much bigger and cost-competitive. To provide sufficient economic impetus to technology manufacturers, need to extend beyond California market.
5. Maximize the wind resource in California; we need to work on the height restrictions, land use restrictions, overcome the wind shadow effect.
6. It is important to look for a way to preserve the technology over the years, e.g. use of the existing infrastructure, towers, etc. in the future.
7. Partial repowering or replenishment as a bridge to promote repowering.
8. Years of SCADA data could better characterize the wind resource of a repowering site than assessments of new sites.
9. Higher aerodynamic, mechanical, and electrical efficiencies help to increase capacity factors.
10. Industry needs data from wind farms. The testing is carried out in a controlled environment.

<u>Suggestions from panelists – Session 2</u>:

1. Research and development on reducing the cost of energy.
2. Research and development to reduce O&M costs: new turbines with higher reliability.
3. Research and development on how to better implement new technology and reduce the cost of implementation of the new technology.
4. Research and development on taller turbines to reach greater winds and on mid-sized turbines.
5. Research and Development that support small wind turbine modernization that achieves a high aerodynamic efficiency (gain through aerodynamic research) and modern small turbines with high capacity factor. Many legacy projects are not suitable for big turbines and components when repowering. They are small and fragmented facilities.
6. Research and development in distributed wind to achieve cost-competitiveness.
7. Survey potential repowering sites and assess novel constraints (support Technology Readiness Level Threshold).
8. Research in new turbines offering VAR (volt-ampere reactive) support, zero voltage ride through (ZVRT), ramp control – grid support.
9. Research and development in extending useful life of wind facilities.
10. Research in improvements in grid control and integration, and storage.
11. Study on the implementation of decommissioning plans: what can be recycled, etc. and declare if there are any hazardous materials at the end of the life, etc.