PG&E Presents:

Effective R&D Paths for Promoting Wind Repowering in California

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Agenda

1) Current Landscape
   - California Repowering Outlook
   - R&D Priorities to Support Wind Repowering
2) Economic Factors
   - Tax Implications
   - Other Economic Considerations
3) Renewable Integration
4) Recommendations

Current Landscape

California Repowering Outlook

Near-term repowering efforts in California are expected to peak in the next few years

- Attempt to leverage Production Tax Credit before phase-out
- Many original 30-year QF contracts expiring mid-decade

Appetite for wind projects to accommodate repowering will likely be from more diverse counterparties than previous contract generations

- In addition to IOUs, other retail sellers may be seeking opportunities to procure from repowered projects.
- Under SB 350, RPS rules will likely change, leading to more variability and flexibility in contract arrangements.
- Commercial & Industrial customers seeking renewable resources.

Altamont Pass Wind Resource Area (APWRA) Repowering

- **Alameda County Planning Board approved the final program environmental impact report for Alameda County's portion of the APWRA in November 2014.**
  - Set framework for next 30 years of Altamont Pass wind energy repowering.
  - Also approved CUP for two wind energy repowering projects:
    - Golden Hills Wind Energy Facility.
      - Remove 775 existing wind turbines
      - Install up to 52 new 1.7 MW with nameplate capacity of 88.4 MW
    - Patterson Pass Wind Farm Repowering Project
      - Repower existing 21.8 MW windfarm, originally containing 336 sixty-five kW turbines with 8-12 turbines with a total nameplate capacity of 19.8 MW
  - Approved total buildout in excess of 400 MW. This buildout is expected to occur over four years following the EIR approval.

R&D Priorities to Support Wind Repowering

Cost Reduction

- Seek methods to achieve reductions in the lifetime cost of wind turbine technologies through integrated design approach.
- Increase performance and reliability, improve O&M effectiveness and gain manufacturing efficiencies.
- Evaluate potential capacity factor impacts at existing wind sites, given increased capacity factor of new turbines.
- Evaluate economic impacts of co-locating storage facilities with existing and new wind facilities.

Wind Energy Integration

- Develop familiarity with wind generation providing flexibility, load following and grid support in other States.
- Improve wind power forecasting capabilities.
- Incorporate grid reliability into project design.

Economic Factors

Tax Implications

- **Federal Renewable Energy Production Tax Credit was extended through 2017, followed by phase down. Ends in 2019.**
- **Consolidated Appropriations Act, 2016 – not yet interpreted by the IRS.**
- **Impact of PTC – Repower was historically eligible.**
- **Developers must maintain a continuous program of construction**
- **Wind projects that begin construction in 2016 for full value of PTC are eligible to take the PTC or the 30% Investment Tax Credit in lieu of the PTC**
- **Developers can establish that they have begun construction by:**
  - Performing physical work of a significant nature
  - Meeting 5% Safe Harbor Provisions by paying or incurring at least 5% of total eligible cost of the facility

Other Economic Considerations

- **Primary cost to repower:**
  - Capital costs
  - Annual O&M
  - Large projects benefit from economy of scale; however owners of multiple projects may have ordering economies

- **Primary expense:**
  - Debt service associated with buying & installing new turbines

- **More diverse financing options today**
  - Bank Debt (a long-standing option)
  - Tax Equity
  - Term Loan B
  - Project Bonds

- **More diverse contracting opportunities for renewable developers today than in earlier generations**

Renewable Integration

Renewable Integration Challenges

	Issue	Action
Changing Load Curve	Resources are no longer dispatched to meet total system demand. Dispatch follows Net Load	Flexible resources. Ability to ramp quickly &/or start up twice per day.
Overgeneration	Daytime over generation an issue under 33% RPS. Expect more extreme events under 50% RPS.	Dispatchability provisions in contracts. Modern turbines that ramp very quickly.
Variability	Expected change in generation within scheduling intervals.	Anticipate providing Ancillary Services including spinning reserves & Regulation.
Uncertainty	Unknown deviation of generation from forecast. Risk decreases as you move from Day-Ahead into Real-Time operation	Frequency response initiative to ensure dynamic response to frequency changes in the seconds to 1-minute after contingency

Recommendations

Recommendations

- **Cost Reduction**
  - Integrated design approach
  - Lessons learned and looking to the future

- **Wind Integration**
  - Benchmarking
  - Forecasting
  - Project design

Thank You

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