



**Integration of Renewable Resources Program (IRRP)**  
**- High-Level Program Plan -**

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Purpose

The purpose of this document is to provide an initial high-level scoping and program plan for the CAISO's larger 2008-2011 Business Plan initiative regarding the successful Integration of Renewable Resources. The program plan will be further developed once a program manager is identified and an implementation team is in place. It is assumed that detailed project-specific work plans will be developed for each of the matters identified herein. In addition, it is assumed that each responsible Business Unit will incorporate the identified projects in their 2008 and beyond Business Plans and related budget and resource commitments.

Program Plan Construction

For purposes of developing and aligning each CAISO's Business Unit's work plan for the 2008-2011 time period, the draft program plan identifies the major "Tracks," related projects, and makes appropriate Business Unit assignments.

The program plan includes the following Tracks:

**Proposed Program Tracks**

- Track 1** - Develop Operational Tools
- Track 2** - Identify and Develop CPUC Rule and CAISO Tariff Changes and Other Regional Agreements
- Track 3** - Perform Required Studies
- Track 4** - Market Product Assessment and Development
- Track 5** - Changes to Large Generator Interconnection and Transmission Planning Processes

In total, the proposed Renewable Resource Integration Program is comprised of 5 Tracks with 13 related major Projects.

Background

In November, 2007, the CAISO published its report entitled, "Integration of Renewable Resources Report, Transmission and Operating Issues and Recommendations For Integrating Renewable Resources on the CAISO Controlled Grid" (Renewable Resources Report or Report). The CAISO initiated the study and

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resulting report to ensure that the operation and design of the transmission grid fully supports California’s established standards with respect to the development and integration of renewable resources.

The following recommendations (by overarching Task) were included in the Renewable Resources Report:

- Tasks Identified in Report**
- Task 1:* Develop new Ramp Forecasting and planning tool for real time operations;
  - Task 2:* Over Generation Problems;
  - Task 3:* Improve accuracy of Day-Ahead Energy Forecasts for wind generators;
  - Task 4:* Improve accuracy of Same Day Energy Forecasts for wind generators;
  - Task 5:* Develop new graphical displays for Real-Time Operators so they can anticipate Wind Generation Forecasted Production;
  - Task 6:* Link Renewables forecasting with MRTU;
  - Task 7:* Scheduling/Managing Imports and Exports of Renewables;
  - Task 8:* Impact on Resource Adequacy;
  - Task 9:* Modeling of Wind Generation Facilities; and
  - Task 10:* Changes to PIRP II for Hour-Ahead forecasting and scheduling.

In addition, for purposes of scoping and developing a high-level work plan for the renewable resources integration effort, the following additional Tasks have been identified. While not explicitly identified as major “recommendations” in the Report, these tasks were identified and discussed in the Report.

- Additional Required Tasks**
- Task 11:* Assess and Develop Market Products and Mechanisms Necessary to Support Renewable Resource Mechanism;
  - Task 12:* Implement Necessary Changes to CAISO’s Large Generator Interconnection Process; and
  - Task 13:* Implement Necessary Changes to CAISO’s Transmission Planning Process and Studies.

The following sections provide an overview of the major program tracks and associated projects. Further analysis is required regarding the scope, confirmation and resource commitments necessary to complete the identified projects and

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program objectives. The CAISO will work with interested stakeholders to develop a more refined program plan.

**TRACK 1: Develop Operational Tools**

**Project #1 – Create New Wind Forecasting Capability**

**Tasks Identified in Report**

- Task 3:** Improve Accuracy of Day-Ahead Energy Forecasts for Wind Generators.
- Task 4:** Improve Accuracy of Same Day Energy Forecasts for Wind Generators.
- Task 6:** Link Renewables forecasting with MRTU.
- Task 10:** Changes to PIRP for Hour-Ahead forecasting and scheduling.

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) Implement a state-of-the-art wind forecasting service for all wind generator energy production within the CAISO Control Area. This includes Day-Ahead, Hour-Ahead, and Real Time wind generation forecasts. These forecasts will be crucial for the unit commitment, scheduling, and dispatch processes in the Day-Ahead, Hour-Ahead and Real-Time timeframes. (Report at p. 9).
- 2) Incorporate the Day and Hour-Ahead wind generation forecasts (block energy schedules) into the CAISO's and SC's scheduling processes. The Day and Hour-Ahead schedules must be based on the forecasted wind generation values.
- 3) Integrate the Real Time wind generation forecast (average wind generation for 5-minute dispatch levels) with the Real Time unit commitment and MRTU dispatching applications.

In addition, as part of this effort, it is appropriate to determine the extent to which the CAISO efforts toward enhancing its renewable resource forecasting capability can build off of and/or utilize current forecasting capability of investor owned utilities for Qualifying Facilities.



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CAISO will also investigate changes to the current PIRP program that prevent resources that incorporate storage technology from participating in PIRP.

**Project #2 – Develop Ramp Forecasting Tool and Related Graphical Displays**

**Tasks Identified in Report**

*Task 1: Develop new Ramp Forecasting and planning tool for real time operations*

*Task 5: Develop new graphical displays for Real-Time Operators so they can anticipate Wind Generation Forecasted Production*

**Scope:** The following Report recommendations need to be addressed as part of project effort: Develop a new ramp forecasting tool to help system operators anticipate large energy ramps, both up and down, on the system. The longer the lead time for forecasting a large ramp, the more options the operators have to mitigate the impact of the ramp.

**TRACK 2: Identify and develop CPUC Rule and CAISO Tariff Changes and Other Regional Agreements**

**Project # 3 – Develop Tariff Rules and Agreements Necessary to Address Over-Generation Problem**

**Tasks Identified in Report**

*Task 2: Over Generation Problems*

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) Implement a procedure where the CAISO Dispatcher can send dispatch notices to wind generation operators and require them to implement pro-rata cuts in their energy production. During over generation periods, when dispatchable generation plants are already operating at their minimum levels, the CAISO needs to have an ability to curtail wind generation on an as needed basis. (Report at p.10).
- 2) For California to meet the 20% RPS goal, the CAISO will have to import some of the renewable energy from adjacent control areas. New rules and procedures will be needed to lower the barriers for import and export

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of intermittent resources between control areas. Coordinated transmission plans as well as coordinated energy scheduling and operating practices will be key to success (Report at p.15).

The scope of this project will need to clearly state the nature of the CAISO's operational challenges (e.g., energy problem, ramping problem, etc.) and will need to reaffirm appropriate minimum import levels and other operating assumptions in view of the potential for displacement of on start dispatchable capacity by renewable resources .

In addition, as part of this effort it is necessary and appropriate to examine and update the CAISO's Over-Generation Protocols and to determine applicable CAISO market rules and protocols to determine if the identified over-generation issues can be addressed through market mechanisms. Specifically, the CAISO and stakeholders must assess what market mechanisms may be appropriate to ensure that resources responding to decremental dispatch can be made whole. Such mechanisms could include an increase (lowering) of the -\$30/MWh price cap in place in the CAISO's markets in order to provide further incentives for supply resources to reduce their operating output during periods of over-generation on the CAISO system.

Finally, in light of ongoing efforts to develop long-term contracts for Qualifying Facilities transitioning off of their current contracts, the CAISO and stakeholders should assess whether it is appropriate to develop and apply contract terms that provide the capability for these QF resources to respond to CAISO dispatch instructions, especially during periods when over-generation conditions exist on the system.

**Project # 4 – Identify and Develop NERC/WECC and CAISO Tariff Rules to Facilitate Interchange Scheduling of Renewable Resources**

**Tasks Identified in Report**

**Task 7:** Scheduling/Managing Imports and Exports of Renewables.

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) For California to meet the 20% RPS goal, the CAISO will have to import some of the renewable energy from adjacent control areas. New rules and procedures will be needed to lower the barriers for import and export of intermittent resources between control areas. Coordinated transmission line reservations as well as coordinated energy scheduling and operating practices will be key to success (Report at p.15).



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- 2) CEC Report concludes that the current practice of block hourly import and export schedules between balancing authorities may have to change to more frequent changes in schedules to accommodate the variability of renewable resources. This change may take some time to implement on a WECC-wide basis but it could be tested and implemented between any areas that wanted to make the change. (Report at p.19).
- 3) Imports of large amounts of renewable energy will be necessary for the IOU's to meet the RPS goals. The import of intermittent resources such as wind and solar will increase the amount regulation required in the CAISO area. The issue will be who should pay for this increase in the amount of regulation and operating reserves.

In addition, the project should examine tariff and scheduling rules to provide sufficient flexibility to take advantage of the West's geographic and electrical diversity and determine what standard or new energy products can best satisfy the import/export/sale of renewable resources.

**Project # 5 - Identify and Develop Necessary Resource Adequacy Rules to Support Reliable Integration of Renewable Resources**

**Tasks Identified in Report**

**Task 8:** Impact on Resource Adequacy

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) Include changes in Resource Adequacy standard to require more generation with faster and more durable ramping capabilities that will be required to meet future ramp requirements.
- 2) Encourage the development of new energy storage technology that facilitates the storage of off peak wind generation energy for delivery during on-peak periods. (Report at p. 8);
- 3) Include changes in Resource Adequacy standards to require more generation with faster and more durable ramping capabilities that will be required to meet future ramp requirements. (Report at p.8).
- 4) Include changes in Resource Adequacy standard to require additional quick start units that will be required to accommodate Hour-Ahead forecasting errors and intra-hour wind variations. (Report at p.8).



### **TRACK 3: Perform Required Studies**

The CAISO study specifically identified the need to complete the following five technical studies. The CAISO also recognizes the need to provide both regulators and the market at large the CAISO's specific operating requirements. The CAISO will endeavor to complete an over-arching assessment and identification of its operating requirements, stated in terms of requirements (be they installed/operating capacity, regulation capacity, ramping capacity, etc.) per 1000 MW of new renewable resource capacity. The study should include the effects of displacement of resources by renewables, changes in unit commitment and the potential effects of retirement of once-through cooling resources.

Additionally, CAISO will evaluate the impact of new incoming technologies on the requirements for new transmission, operational capacity and other issues.

In addition, the CAISO acknowledges that stakeholders have previously recommended that additional analysis and studies may be needed to address specific issues such as: 1) the benefits of co-location of wind and solar resources and how such benefits can be incorporated in the Locally Constrained Resource Interconnection and RETI efforts; 2) the integration and co-location of geothermal and biomass facilities near solar and other intermittent resources

#### **Project # 6 - Additional Planning Studies to integrate Tehachapi's Wind Generation**

##### **Task Identified in Report**

##### **Task 9: Modeling of Wind Generation Facilities**

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) In the event that plants are Type 1 or 2, (no dynamic reactive capability) additional studies to determine appropriate additional external dynamic reactive support;





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- 2) Re-evaluate the optimal *size* and *location* for the dynamic reactive support (SVCs) that were proposed in the Tehachapi Transmission Project Plan. (Report at p. 6, p27) (See also Track 3 above);
- 3) Analyze best solution for improving the nose point of the Q-V analysis for critical 500-kV buses (series compensation and reduction of proposed shunt compensation (Report at p.6, p27). (See also Track 3 above)

**Project # 7 - Integrating Solar Generation Facilities with Load and Wind Generation**

**Task Identified in Report**

**Task 9:** Modeling of Wind Generation Facilities

**Scope:** Analyze the impact of solar power intermittency with load and wind generation intermittency (Report at p. 8, p.61).

- 1) Work with the WECC Modeling and Validating Workgroup to develop models for Concentrated Solar Generation Facilities for use in load flow, transient stability and production costing programs.
- 2) Develop a transmission plan for interconnecting large concentrations of solar facilities (Mohave area?)

**Project # 8 - Analyze the Integration of Storage Facilities**

**Task Identified in Report**

**Task 9:** Modeling of Wind Generation Facilities

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) Work with DOE and the CEC to follow research in storage technology and to provide opportunities for testing and evaluating new storage technology in California (Report at p8, p.61).
- 2) Hold Stakeholder meetings on storage technology, projected costs and benefits, potential market solutions that encourage the deployment of





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storage facilities and provide a market based compensation for the facilities based on the benefits they provide.

**Project #9 - Sharing ACE due to Intermittent Resources between CAISO and BPA**

**Task Identified in Report**

**Task 9:** Modeling of Wind generation Facilities

**Scope:** Evaluate the benefits of participating in a wider-area ACE sharing or Wider Area Energy Management system between the Bonneville Power Administration and the CAISO. (Report at p.8, p.61).

- 1) Help to cope with intermittent resources by recycling the excess energy, controlling dispatchable load and distributed generation, and exchanging the excess energy between the BPA and CAISO Control Areas action with CEC and other state entities.
- 2) Develop principles, algorithms, market integration rules, functional design and technical specification for such a system.
- 3) Provide a cost-benefit analysis and business model for an investment-based practical deployment of system.



**Project #10 - Analyze the Benefits of Fast Regulation and Wind Integration**

**Task Identified in Report**

**Task 9:** Modeling of Wind generation Facilities

**Scope:** Evaluate a methodology to assess the relative value of the existing and new generation resources used for regulation and load following. (Report at p.8, p.61).

- 1) Assess based on physical characteristics the ability of resources to quickly change their output following CAISO EMS signals.
- 2) Evaluate what power is worth on different time scales (from sub-seconds and seconds to minutes and hours).
- 3) Analyze the benefits of new regulation resources to provide effective compliance with the new mandatory NERC Control Performance Standards.

**TRACK 4: Market Product Assessment and Development**

**Project # 11 - Develop Market Products and Mechanisms Necessary to Support Renewable Resource Mechanism**

**Tasks Identified in Report**

**Task 11** Develop Market Products and Mechanisms Necessary to Support Renewable Resource Mechanism

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) Integrating 20% renewables in the CAISO Control Area is operationally feasible, however, the requirement is expected to increase the three-hour morning ramp by 926 MW to 1529 MW and the three-hour evening ramp by 427 MW to 984 MW depending on the season. (Report at p.46).
- 2) The CAISO regulation capacity requirements will increase noticeably during certain hour ranges (regulation requirements will decrease with better forecasts) (report at p.47).



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- 3) The CAISO regulation ramping capacity requirements are expected to increase by about +/- 10 MW/min. to +/-25 MW/min. These increases will affect AGC ramps up to five minutes long. (report at p.47).
- 4) The CAISO will also require a significant increase in the supplemental energy stack to meet intra-hour load following needs. The increase is explained by the fact that the Hour-Ahead wind generation forecast error becomes comparable with the Hour-Ahead load forecast error. Load following requirements will decrease with better forecasts. (report at p.47).
- 5) The CAISO maximum load following ramping requirements are expected to increase by about +/- 30 MW/min. to +/-40 MW/min. These increases will affect ADS ramps up to 20-30 minutes long. (report at p.47).
- 6) Include changes in Resource Adequacy standard to require more generation with faster and more durable ramping capabilities that will be required to meet future ramp requirements.
- 7) Encourage the development of new energy storage technology that facilitates the storage of off peak wind generation energy for delivery during on-peak periods. (Report at p. 10);
- 8) Include changes in Resource Adequacy standards to require more generation with faster and more durable ramping capabilities that will be required to meet future ramp requirements. (Report at p.10).
- 9) Include changes in Resource Adequacy standard to require additional quick start units that will be required to accommodate Hour-Ahead forecasting errors and intra-hour wind variations. (Report at p.10).
- 10) Investigate incentives and/or mechanisms for encouraging and taking advantage of the capabilities of advanced wind and other renewable technologies to provide dispatchability related services similar to existing ancillary service products.

**TRACK 5: Changes to Large Generator Interconnection and Transmission Planning Processes**

**Project # 12 - Identify and develop Necessary Changes to CAISO's Large Generator Interconnection Process**

**Tasks Identified in Report**

**Task 12:** Implement Necessary Changes to CAISO's Large Generator Interconnection Process; and Interconnection of Renewable Resources



**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) Ensure that all new wind generation plants meet WECC Low Voltage Ride Through (LVRT) requirements (Report at p.8, p.24));
- 2) Ensure that majority of new wind plants are Type 3 or 4 and thus capable of providing dynamic reactive support (Report at p.8, p.23). [In the event that plants are Type 1 or 2, (no dynamic reactive capability) additional studies to determine appropriate additional external dynamic reactive support, see Track 3 above];
- 3) The CAISO may consider requiring that a minimum portion of the required power factor range be dynamic for each new plant. (Report at p.24)
- 4) Re-evaluate the optimal size for the dynamic reactive support (SVCs) that were proposed in the Tehachapi Transmission Project Plan (Report at p.8). (See also Track 3 above);
- 5) Analyze best solution for improving the nose point of the Q-V analysis for critical 500-kV buses (series compensation and reduction of proposed shunt compensation (Report @ p.8). (See also Track 3 above)
- 6) Change the CAISO generator interconnection standards to require compliance of all intermittent resources with the interconnection rules established for the Participating Intermittent Resources Program (PIRP). These rules include real-time meteorological data (and meteorological towers) and DPG telemetry systems to communicate the 4-second data meteorological and production data from wind parks to the CAISO. This data needs to be integrated into the CAISO's forecasting software. (Report at p.9).
- 7) Consider means to improve the legitimacy and timeliness of the interconnection queue, including:
  - Require site control;
  - On-line dates must be within five-years;
  - Require higher deposits and for each study;
  - Force clustering;
  - Require strict technical data;
  - Third-party economic reality checks;
  - Allow projects in transmission rich areas and that have no system impacts to move forward;



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- Allow greater CAISO control of study timelines with possible penalties for PTOs (others) for missing deadlines;
- Remove Commercial on-line extension option;
- Require wind developers to submit technical information.

(Report at p.30)



**Project # 13 - Identify and Develop Necessary Changes to CAISO's  
Transmission Planning and Study Process**

**Tasks Identified in Report**

**Task 13:** Implement Necessary Changes to CAISO's Transmission Planning Process and Studies.

**Scope:** The following Report recommendations need to be addressed as part of project effort:

- 1) Based on studies completed as part of Track 3 efforts, ensure that Transmission Planning Studies appropriate assess and reflect impact of renewable resources on system studies.
- 2) Working through WECC TEPC and California Sub-regional Planning Group forums, develop regional approach to developing inter-regional transmission facilities needed to support (deliver) renewable resources.
- 3) Work with the CEC to identify and prioritize areas with significant renewable resources potential.

Critical Dependencies

There are a number of key CAISO and broader State initiatives that are linked to the Integration of Renewable Resources Program. In order to maximize the efficient deployment and use of both CAISO and stakeholder resources, it is important to identify common deliverables and align these related efforts. At present, the CAISO has identified the following initiatives as being related to the IRRP:

- 1) Demand Response;
- 2) Long-term Resource Adequacy (Capacity Markets) ;
- 3) Green House Gas Emissions Reduction;
- 4) Once-Through Cooling Regulations.

In addition, the IRRP must be aligned with and complement ongoing efforts such as the California Energy Commission's Integrated Energy Policy Report (IEPR) and the North American Electric Reliability Corporation's (NERC's) and the Western Electricity Coordinating Council's (WECC's) efforts to further develop National/Regional Electric Reliability Standards – including standards related to the reliable integration of renewable resources and the Renewable Energy Transmission Initiative.