

Five-Year Strategic Plan

2011-2015



California ISO
Your Link to Power

Striking the Balance

December 15, 2010

Table of Contents

Mission	1
Vision	1
Core Values	1
1. Introduction	2
2. The ISO Challenge	5
2.1 Reliability	5
2.2 Market Efficiency	7
2.3 Renewable Integration.....	7
2.4 Environmental Regulation & Policy	9
2.5 Emerging Technology.....	10
3. Vision for 2020.....	11
4. 2011-2015 Strategy.....	14
4.1 Reliable Operation.....	15
4.2 Market.....	17
4.3 Infrastructure	21
4.4 Organization	25
5. Conclusion	32

Exhibits

Figure 1: California Renewable Pipeline.....	6
Figure 2: California Planned Transmission Upgrades	8
Figure 3: Consumer Decision	12
Figure 4: California Solar Initiative — Installed Projects by Sector and Geographic Location....	13
Figure 5: Plug-in Electric Vehicle Projected Concentrations.....	22
Figure 6: Renewable Production July 2009 Day.....	24

Mission

For the benefit of our customers, we:

- Operate the grid reliably and efficiently
- Provide fair and open transmission access
- Promote environmental stewardship
- Facilitate effective markets and promote infrastructure development

All through the provision of timely and accurate information.

Vision

California ISO strives to be a world-class electric transmission organization built around a globally recognized and inspired team providing cost-effective and reliable service, well-balanced and transparent energy market mechanisms and high-quality information for the benefit of our customers.

Core Values

Integrity

- We are honest, ethical and trustworthy with each other and stakeholders in all business dealings, reflecting the highest professional standards.

Teamwork

- We strive for one common vision and are inspired by working together, with clear points of accountability to be a world-class organization in meeting corporate objectives and serving our customers.

Excellence and Innovation

- We earn customer trust based on our understanding of needs, implications of decisions, quality, competence, innovation and discipline in our business dealings.

People Focus

- We value diversity, promote employee development, support work/life balance and foster an invigorating and fulfilling work environment.

Open Communication

- We seek diverse ideas and opinions, value transparency, foster teamwork, promote “thought leadership” and openly share information both internally and externally.

1. Introduction

The ISO vision for 2020 and beyond drives our strategies for the next five years. During this time, the ISO will work with others in the industry to strike the balance between achieving the state's clean energy goals and maintaining reliability, efficiency and affordability — a theme carried throughout this 2011-2015 Five-Year Strategic Plan.

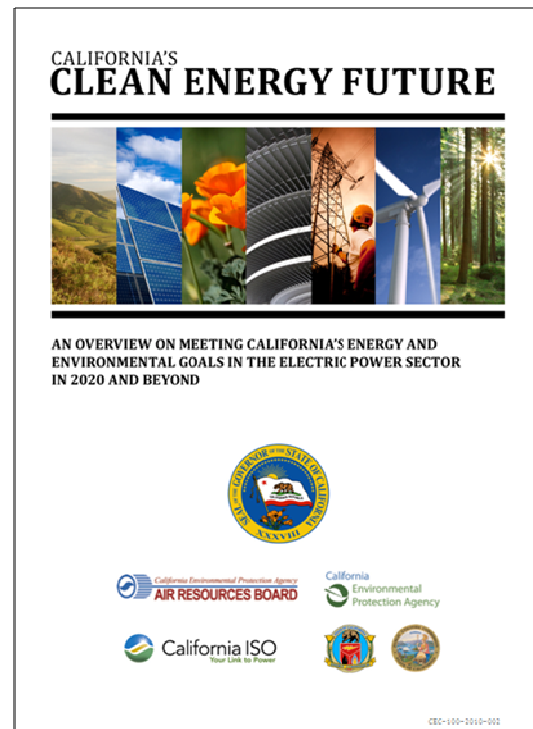
The ISO embraces California's clean energy goals and requirements, including:

- Reducing statewide greenhouse gas emissions to 1990 levels by 2020 and to 20 percent of 1990 levels by 2050
- Providing 33 percent of electricity demand in 2020 from renewable resources
- Meeting 20 percent of the state's renewable energy targets by biomass or biogas
- Complying with once-through cooling requirements
- Addressing limitations on regional air emissions credits
- Adhering to California's Loading Order, with energy efficiency and demand response as the highest-ranking resources.

The theme of the 2011-2015 Five-Year Strategic Plan is *Striking the Balance*. The electric industry has always been charged with balancing the level of service and reliability against cost. The economic downturn and increased awareness of the costs associated with integrating high levels of renewable resources have increased the focus on balancing these considerations. Thus, the theme *Striking the Balance* may not be new in concept but it now carries a new dimension and scale of complexity.

The ISO developed a strategic framework last year to coordinate all of its strategic initiatives and fill the identified gaps for achieving its goals. The results were valuable and serve as building blocks for this year's strategic plan. Recent achievements help set a solid foundation for the ISO to further refine its strategy include the following:

Establishing a Common Vision for California's Clean Energy Future — In an unprecedented collaboration, the California Environmental Protection Agency, California Air Resources Board, California Energy Commission, the California Public Utilities Commission, and California ISO developed California's Clean Energy Future to implement the state energy policies. This joint vision for the state's future is to ensure efficiency and timeliness of the collective and respective actions.¹ This historic initiative provided a clear set of goals as the basis for the renewed strategic plan as explained through the rest of the document. Therefore, different from previous strategic plans, assumptions for this one are based on a widely shared vision and goals among all the energy agencies of the state.



Enhancing Market Performance and Design —

The new ISO market has demonstrated it can serve as the solid and necessary foundation for efficient and reliable operations. Price corrections and exceptional dispatch have been reduced and the ISO has achieved success in expediting settlement statements while maintaining its commitment to accuracy. The ISO has implemented new design elements that support California's Loading Order by facilitating new products in the market, including proxy demand response, scarcity pricing and expanded opportunities for non-generation resources to provide ancillary services.

Developing a Comprehensive Transmission Plan for a 33% Renewable Electricity Standard —

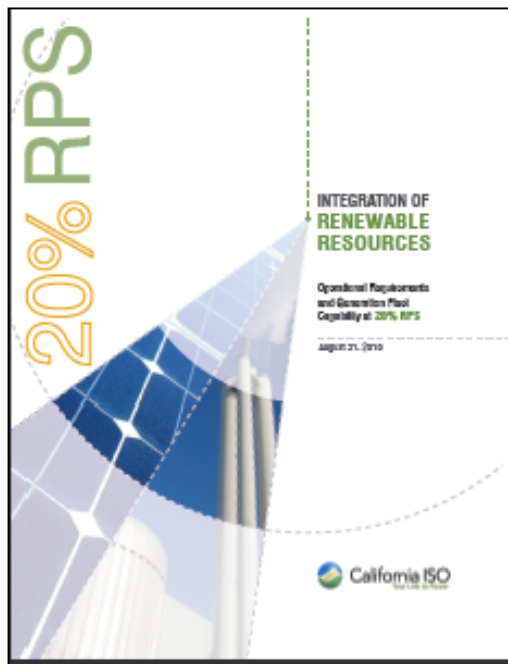
This past year, the ISO developed a long-term transmission plan, using as a key input the results from the a statewide California Transmission Planning Group formed in 2009. The collaborative planning effort reflects the needs of all load-serving entities in meeting the state's policy objectives while minimizing the overall transmission system footprint.

Approving a Critical Mass of Transmission Upgrades — The ISO has approved transmission projects that are sufficient as a foundation for the 33 percent renewable target. Many of these identified transmission projects are also approved by the CPUC and some are either ready to start construction or well into construction phases — a very important recent development in California.

¹ California's Clean Energy Future, September 2010.

Establishing a New State-of-the-Art Control Center — The new ISO control center will include the first renewable desk in the nation to ensure the reliable operation of the grid with enhanced forecasting, monitoring and dispatching tools. In addition, the new control center technology includes enhanced tools for situational awareness to enhance the capability of dealing with the challenges of the new intermittent resources.

Completing a Comprehensive Study on the Operational Requirements for a 20% Renewables Portfolio Standard — The ISO has completed its study of operational requirements needed to accommodate the 20 percent Renewables Portfolio Standard. It will play a critical role specifying the operational requirements and protocols for increasing renewable resource participation in meeting control area load while maintaining reliability. The ISO has begun implementing changes in its systems and operating procedures, including appropriate engagement with stakeholders in the change process.



Advancing Renewable Energy Projects Seeking ARRA Funding — The ISO worked in collaboration with the Governor’s office, state agencies, developers and transmission owners to pave the way for projects that qualify for funding through the American Recovery and Reinvestment Act to be on schedule for the opportunity to bring jobs and federal dollars to California.

State initiatives call for specific targets for distributed generation, demand reduction, demand response, storage technology, and other technologies. Whether or not these resources develop has a significant impact on future needs, making a highly sophisticated approach necessary to ensure readiness for the future as it unfolds. Thus, a sound strategy must maintain flexibility to:

The ISO will maintain flexibility as a strategy for dealing with uncertainty.

- Minimize the risk of adversely impacting reliability and market efficiency should any one or a combination of the goals not materialize,
- Minimize the amount of stranded investment should the targets be exceeded, and

- Stay ahead enough to be ready to accommodate the evolution but not so far ahead to risk being misdirected. A balanced strategy is neither “wait and see” nor full readiness far in advance of a highly uncertain future.

The renewables pipeline is signaling a shift from wind to solar development.

Changes in the mix of planned renewable resources development and the need to include demand response highlight the need for the market to remain efficient and robust across a wide range of future scenarios. As an example, designing a market based on the assumption that liquidity will be largely achieved from demand response may result in a failing market if demand does not respond as much as thought and the generation fleet is scaled down at the same time. The ISO will have to ensure that sufficient flexibility in resources is available to manage this contingency.

While reaching a solution on a particular issue is an accomplishment on its own, the understanding and experience gained from it often opens the gate for new issues. Thus, the ISO and the industry find itself in a sustained state of managing change. It is challenging but exciting, creating a new paradigm of embracing the changes.

The ISO stated last year that the next five years will be a critical foundation for the decades to come. The first year has passed with the ISO completing the initiatives needed to provide the foundation for next steps. The 2011-2015 Five-Year Strategic Plan builds upon these significant accomplishments to continue to lay the foundation for the transition to a low carbon energy future.

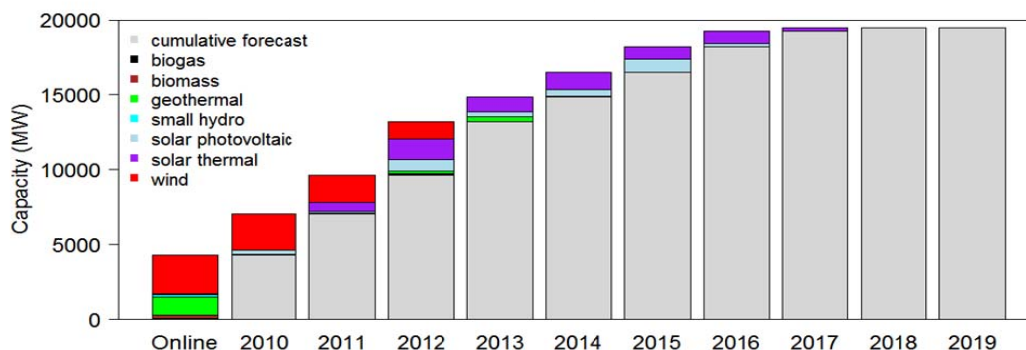
2. The ISO Challenge

Operating the system, developing efficient markets that provide the right signals to important resources and bringing new renewable resources onto the system at unprecedented levels create many challenges associated with striking the balance between reliability and cost.

2.1 Reliability

The primary responsibility of the ISO is to operate the grid reliably and efficiently. Uncertainties about the renewable resource mix present challenges that will impact planning, markets and operations. As Figure 1 displays, there is currently more utility scale solar thermal in the pipeline in California than wind. Changes in economics or environmental policies could alter this picture again — so the ISO must remain flexible as the resource mix evolves.

Figure 1: California Renewable Pipeline



Source: CEC Contract Database (Updated 9/13/10)

One of the key factors in renewables integration is planning for backup generation and other means to maintain reliability in the face of renewable intermittency. Other locales with high renewable production report that they require 1 megawatt (MW) of conventional generation to back up 1 MW of renewable generation.² Additionally, above normal levels of spinning and quick start reserves may be required operationally.

In addition to conventional units, automated demand response, smart charging of electric vehicles and high performance storage have the potential to play a critical role in effectively integrating renewable resources. In particular, the ISO recognizes that automated demand response may be well suited to provide backup requirements more cost-effectively than conventional generation or storage applications. However, the operational and economic aspects of automated demand response need to be more fully developed prior to widespread deployment as a resource. Until these new technologies materialize at significant levels, the ISO will need to rely primarily on the conventional resource fleet for renewable integration and therefore, it is critical that conventional resources remain commercially viable as the market evolves with increasing penetrations of renewable resources.

Some conventional units will experience revenue shortfall due to loading order changes and increased renewable production. Ensuring that the state portfolio maintains sufficient conventional units available for back up and operations will require development of new market products or other means of ensuring their financial viability.

² Cailliau, Foresti, and Mrinez Villar, "Winds of Change," IEEE Power & Energy September 2010

2.2 Market Efficiency

A well-designed wholesale energy spot market provides efficient utilization of resources, opportunities for innovation and signals for new investment. Moreover, the market design must function well regardless of how the generation mix, environmental policies and regulations evolve over time. Ultimately, the largest gains in market efficiency will come from having a significant share of total demand actively responding to wholesale market prices. For this to happen, it is critically important that the retail rate structure properly reflects real-time wholesale rates.

2.3 Renewable Integration

The ISO has a responsibility to provide information to policymakers and stakeholders regarding the market and reliability impacts of policy choices. The 20 percent RPS study conducted by the ISO in 2010 illuminated the operational, reliability, and economic issues associated with managing renewable resource variability and ramping requirements. In 2011, the ISO will complete a 33 percent renewables study that will serve as a baseline for planning market products and ancillary requirements for different renewable resource scenarios.

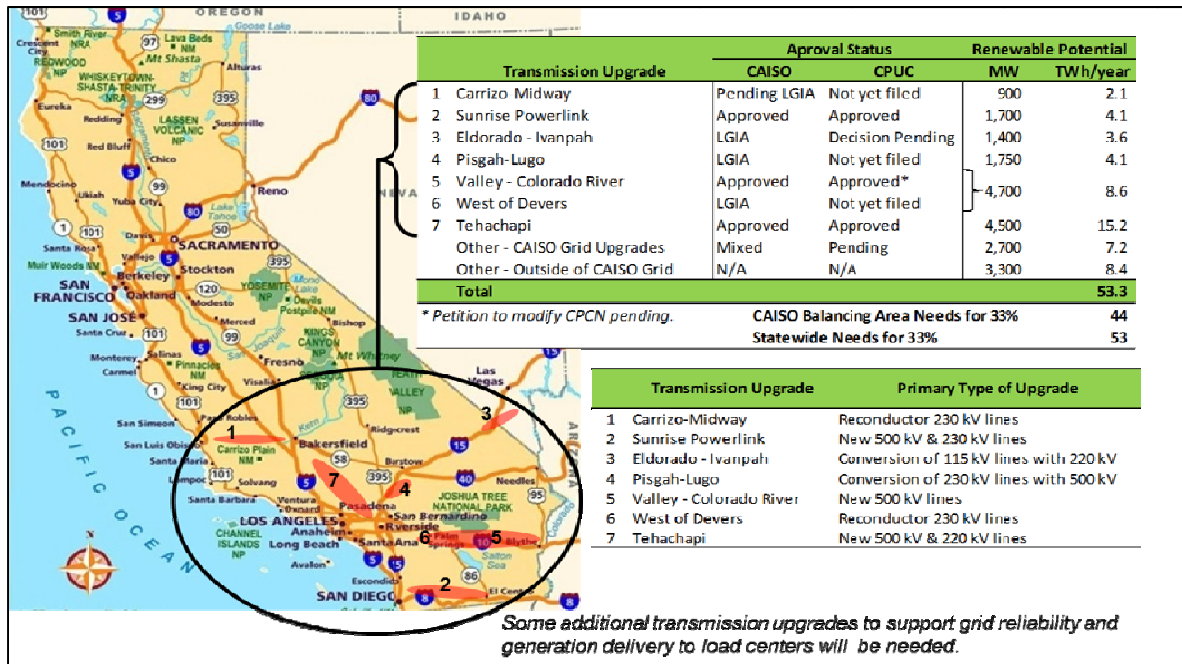
Latest estimates indicate that there is a need for 53 TWh annually to support the 33 percent renewable goal. The projects that are approved or in the approval process represent slightly more than the identified need.

As the amount of renewable generation in California increases, the existing fleet of traditional generators will be called upon more than ever to ramp production up and down quickly to compensate for the variability and intermittency of renewable power production. Our existing fleet will need to provide more regulation, spinning and quick start reserves to maintain grid stability within the parameters set by the North American Electric Reliability Corporation reliability standards. The development of significant demand response and storage resources will be important to mitigate the costs of balancing renewables with conventional generators alone but the development of such resources faces many regulatory and technical challenges.

Over the past few years, much of the new transmission needed to achieve the 20 percent and 33 percent renewable goals has been approved and, in some cases, is already under construction. In fact, the transmission approved by the ISO to date can accommodate enough new in-state renewable energy resources to achieve the 33 percent renewables goal (see Figure 2). However, value from regional diversity and cost considerations will likely lead to a scenario where the 33 percent goal for the ISO balancing authority is achieved through a

combination of new large-scale renewable resources, renewable energy imports and increased levels of renewable energy from distributive generation.

Figure 2: California Planned Transmission Upgrades



Source: California ISO

Renewable energy procurement from outside the ISO balancing authority is critically important to achieving the 33% renewables goal in a cost effective manner and in providing regional diversity. While the capability for importing renewable energy to California is substantial and can accommodate a range of west-wide renewable procurement scenarios, procurement decision may trigger additional transmission needs in neighboring balancing authorities. These decisions, in turn, may or may not trigger modest path upgrades within the ISO. Ultimately, the economics of whether such procurement scenarios make sense requires weighing the potential savings in procurement costs against the incremental cost of any new transmission. Sorting out the cost and benefits of inter-state transmission needs will be challenging and will require tremendous coordination between the ISO, the affected balancing authorities, the CPUC California load-serving entities, and other stakeholders. In the meantime, the more immediate challenge will be to make sure all of the transmission projects shown in Figure 2 receive the necessary regulatory approvals and permits so that they can proceed to construction. Additionally, California load serving entities will need to complete power purchase agreements for new renewable resources in the regions these projects access so that the renewable generation projects can commence construction as well. Making all of this happen will require

unprecedented coordination among various state agencies, resource developers, load-serving entities and the ISO.

In addition to planning and promoting new transmission infrastructure to support access to renewable resources, the ISO will also need to assess the infrastructure requirements for facilitating the retirement and repowering of once-through cooling power plants and assess the implications of limitations on power plant air emissions. Such assessments will need to consider both reliability as well as the renewable integration benefits that conventional gas-fired power plants provide — again in the theme of *Striking the Balance*.

2.4 Environmental Regulation & Policy

On May 4, 2010, the State Water Resources Control Board adopted a policy on use of coastal and estuarine waters for power plant cooling. The policy was approved by the Office of Administrative Law in September and took effect on October 1, 2010. The policy applies to all power plants using coastal and estuarine waters for power plant

While transmission upgrades can facilitate plant retirements, the ISO focus is on the longer-term outlook to ensure regulators, developers and policymakers understand the implications of resource tradeoffs.

cooling, with compliance deadlines ranging from 2012 to 2024. Eighteen power plants are affected, 15 of which are located in the ISO balancing authority area.

Because of the important role these units play in serving load and providing the operating flexibility to integrate California's increasing levels of variable renewable generation, the ISO was actively engaged in the Water Board policy development process in collaboration with the California Energy Commission and the California Public Utilities Commission. The final policy largely reflects the concerns of combined efforts to ensure that implementation of the policy will not risk reliable electric service.

The policy affects both nuclear and gas-fired generators, with the latter facing the earliest compliance deadlines including a requirement to file plans for eliminating once-through cooling or proposing alternative mitigation by April 1, 2011. Compliance could lead to retirement, which could trigger a need for new transmission and/or replacement generation and related permitting requirements. Under the new rule, the ISO and state energy agencies have a key role in reviewing the implementation plans on a continuing basis to ensure that a compliance deadlines do not pose a risk to meeting federal reliability standards.

The lack of air emission offsets in Southern California has stalled applications to license new or repowered power plants in the region. Additionally the California Air Resources Board, under

Assembly Bill 32, is setting statewide greenhouse gas limits to reduce emissions to 1990 levels by 2020, an estimated 25 percent reduction. Our challenge continues to be to understand the uncertainty that may develop and anticipating the operational implications and how best to mitigate reliability issues.

2.5 Emerging Technology

California utilities are deploying smart grid technologies rapidly, especially advanced metering with two-way communications. However, programs and plans to support dynamic pricing based on wholesale market prices, high performance demand response and easily managed electric vehicle smart charging are not fully deployed. Visibility of distributed renewable capacity and production at the take-out point level is of critical importance to the ISO.

Smart grid technologies should lead to smarter pricing as dynamic pricing and demand participation in the markets develop. As retail consumers increasingly participate in the markets, the ISO will have to develop a better understanding of consumer behavior. The ISO will communicate the market and operational benefits available from smart grid to state

The ISO anticipates approximately 20 MW of advanced electric storage capacity operational by 2012. Getting the market right for products and services provided by storage systems will be an important initiative in 2011 and 2012.

policymakers to help facilitate changes that enhance wholesale market price response and two-way visibility of distributed resources and price responsive demand.

Energy storage is increasingly seen as a valuable tool to help integrate renewable resources by providing a storage buffer between generation and load while also addressing critical issues such as ramping and power quality. With the passage of Assembly Bill 2514, the state has mandated that the CPUC and the utilities incorporate storage in their resource planning framework. The ways in which storage supports grid operations, renewables integration and associated products and services will be an important focus of research in the next five years.

Widespread electric vehicle adoption is projected in California in the next decade. Electric vehicle adoption will need to be managed effectively to mitigate potential adverse impacts on electric peak loads and distribution network infrastructure. Conversely, electric vehicles will likely serve to augment demand response resources.

3. The ISO Vision for 2020

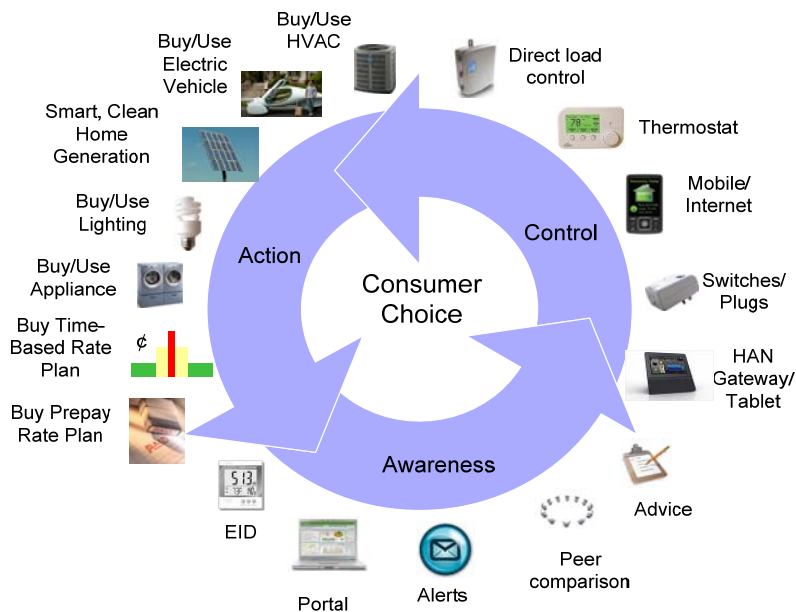
The ISO vision for 2020 drives corporate strategies for the next five years. During this time, the ISO will work with others in the industry to develop an electricity sector that strives to achieve the state's clean energy goals and thrives on being a greener and smarter electric grid. The ISO goal is to be agnostic to which specific technologies succeed by designing flexible market mechanisms and operations that can withstand any number of possible outcomes. Here is the ISO view of how resources, transmission and demand will develop over the next decade, consistent with California's Clean Energy Future.

California's Clean Energy Future identifies measures that reduce peak demand by 5,000-8,000 MW in addition to the 2,300 MW of committed energy efficiency peak demand savings already included in the 2009 demand forecast.

1) Energy Demand

- a) Implementation of state policies and programs to accomplish 100 percent of achievable cost-effective energy efficiency, including zero net energy standards for new construction, will result in significantly decreased energy consumption.
- b) Statewide implementation of smart grid technologies, as well as electric rate design reform will provide additional opportunities for customers to install behind-the-meter resources and enabling technologies to respond to a price signal or other demand response control. As Figure 3 displays, consumers will have a wide variety of technologies and options available to them to facilitate greater consumer control, awareness and action.
- c) Demand response will play a major role in meeting peak power needs and managing intermittency of renewable resources. Price-driven demand response will be eligible to participate in the wholesale market, including ancillary service markets needed to support renewable integration.

Figure 3: Consumer Decision



Source: KEMA

2) Energy Supply

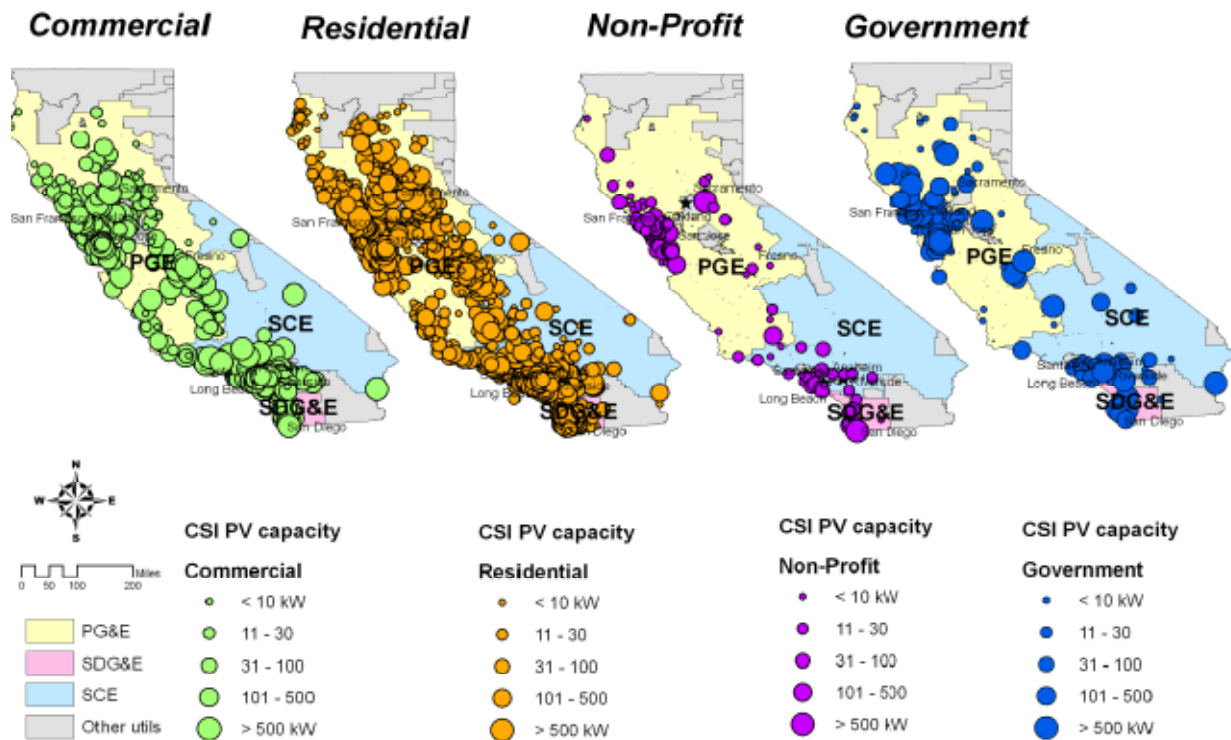
a) Renewable energy is first in California's supply-side loading order.

i) Large renewable power plants will diversify the resource mix and help balance the system while containing costs. These plants will be modified to support balancing / firming services provided via market innovation so as to meet scheduling and ramping requirements.

California's Clean Energy Future targets 5,000 MW of installed renewable distributed generation capacity by 2020 at the right locations to support reliability and provide economic value.

ii) Distributed generation technologies will be deployed at significantly higher levels, both behind the meter and as wholesale power. California's Go Solar initiative is making significant progress toward removing market barriers to distributed generation in the state. Figure 4 displays the number of projects installed under the California Solar Initiative by customer sector and geographic location.

Figure 4: California Solar Initiative: Installed Projects by Sector and Geographic Location



Source: CSI 2009 Impact Evaluation Report, CPUC

- b) California will replace approximately 28,000 gigawatt-hours of coal-fired generation owned by or under long-term contract to the state’s electric utilities through 2030.
- c) Carbon pricing and related policy uncertainties create financial risks for investors making the future resource mix less predictable. As noted in California’s Clean Energy Future, beginning in 2012 an emission allowance market will likely serve to provide additional economic signals to decisions on short-term operations and long-term investments.
- d) Regional coordination expands to help green the grid and increase sharing of resources in the West.
- e) Plant retirements driven by once-through cooling and clean air standards occur as planned

3) Transmission

- a) Planning and permitting are coordinated to ensure that transmission infrastructure is available to achieve renewable goals.
- b) Advanced transmission technologies, improved dispatch algorithms and enhanced system visibility lead to higher grid utilization and productivity.
- c) New generation investment is triggered by permitting of new transmission lines.
- d) Transmission owners remain obligated to maintain safety and reliability, and upgrade network facilities.

4) New Technologies

- a) Electricity storage will be part of the resource mix and will complement renewable resources to enhance reliability
- b) Electric vehicles number as many as 1.0 million to 1.5 million by 2020, reducing emissions and consuming off peak renewable energy but will be concentrated in already congested regions.

According to California's Clean Energy Future, the state is targeting 1,000 MW of additional storage capacity to be brought onto the system by 2020.

4. 2011-2015 Strategy

The ISO Five-Year Strategic Plan focuses on ensuring reliable operations while making sure the market, infrastructure and organization are ready for shifts in resources, transmission and demand. It focuses on four key areas for strategy development:

- Reliable operation
- Market
- Infrastructure
- Organization.

Each area describes the ISO strategies for the next five years.

4.1 Reliable Operation

The ISO will leverage and align markets to ensure the right mix and amount of resource attributes to reliably operate under a high level of renewable energy penetration. Because renewable resources are weather dependent, available supply will swing dramatically depending on location, resource type (e.g., wind or solar) and specific technology, which makes system balancing quite challenging. To strike the balance between cost and reliability the ISO will need to continuously enhance operational capabilities and improve operational tools.

The ISO will assess, test and deploy new technologies to provide:

- Improved situational awareness and visualization tools
- Integrated tools and data bases built upon common data models to increase accuracy and productivity
- Advanced renewables and demand response short-term forecasting tools
- Optimized economic dispatch through improved renewable and demand response forecasting
- A secure, modernized control center and renewables desk within the new ISO LEED-certified headquarters
- Improved quality of operational decisions
- Highest cyber security standards.

Develop improved situational awareness and visualization tools

Grid operators can better plan for and respond to changing system conditions by using technology to efficiently display real-time information that is easily recognized and understood. The ISO receives updated grid and generation condition snapshots every four seconds from the current monitoring and control system. By using wide-area synchrophasor measurements and other technology enhancements attached to transmission lines, operators can now receive updated information every few milliseconds.

Synchrophasor wide-area monitoring will be integrated with ISO data collection and visualization in 2011-2012 to improve transmission system productivity. This will permit the development of

analytic applications such as dynamic line ratings, system separation procedures and adaptive protection settings for stability.

These clearer views of the grid mean operators can more quickly see and resolve problems. Using other advanced technologies, such as those that improve weather forecasting for renewable generators, will give operators another tool to gauge current grid conditions and better anticipate generation levels 15 to 30 minutes into the future and set resources to respond appropriately.

To manage variability of new renewable resources it will be necessary to better optimize planned generation and transmission outages, i.e., to improve current ISO processes and tools for maintenance outages analysis and approval.

The ISO is also focused on utilizing new technologies and operational systems to manage system frequency response under scenarios of high renewable penetration — in terms of managing renewable variability and coping with decreased system inertia and governor response.

Implement integrated tools and databases built upon common data models to increase accuracy and productivity

The ISO will implement integrated tools and databases built upon common data models to increase accuracy and productivity of grid operation, market operations and planning. A centralized enterprise-wide model and data management system will greatly reduce modeling and data errors, increase flexibility of ISO systems to deal with functional changes, reduce complexity in integration of various business processes such as planning and market and grid operations, and reduce the overall maintenance cost of ISO software systems. The ISO will continue to reduce the complexity of its technology platform and improve process efficiencies by consolidating the number of peripheral systems that use a shared data structure. Additionally, the ISO will implement a tool set to integrate requirements tracking with validation testing, root cause analysis and regression testing.

Improved renewables and demand response forecasting tools

Increasing amounts of weather-dependent renewable resources drive the need for major improving ISO forecasting capabilities to “see” what conditions will be on a short-term basis and respond appropriately. The 20 percent and ongoing 33 percent renewables studies have shown the importance of improved renewable forecasting ranging from day ahead to intra-hour.

Economic dispatch optimized for more volatile grid connections

New renewable forecasting tools, innovations in market products and the integration of demand response and storage resources into the dispatch will improve market effectiveness. Building upon the new market platform, real time dispatch will make use of short-term renewables forecasting and will provide required additional market products to manage intermittency.

Operate a secure and modernized control center and renewable desk within new LEED-certified headquarters

The control room in the new ISO headquarters features a high tech video wall pre-programmed to display critical information of operating conditions and emergencies. New workstations will enhance operator communications and deploy an upgraded energy management system. With a state-of-the-art renewable desk, the new ISO control center will help to facilitate continuous improvement in grid operations through enhanced renewables forecasting, monitoring and dispatching tools.

Improve quality of operational decisions

New operational tools and training with enhanced training simulation will improve the control room decision-making process. The ISO will enhance operator training via integration of the market simulator and the system/operations simulator and will develop simulation-training modules for dealing with increased renewables penetration and demand response.

Ensure highest cyber security standards

The ISO will continue to adhere to North American Electric Reliability Corporation and evolving National Institute of Standards and Technology cyber security standards and will collaborate with WECC entities and technology companies to maintain its systems, people and processes at the highest cyber security standards.

4.2 Market

Building on the successful implementation of the new ISO market implemented in 2009, the ISO goal is to evolve market and operations platforms to efficiently and reliably operate the grid to achieve the state's policy objectives in a highly cost-effective manner. To strengthen market functionality and efficiency, the ISO will:

- Implement planned market enhancements

- Increase alignment between wholesale and retail pricing
- Provide for demand response participation in the market
- Improve market transparency
- Implement multi-day commitment in the forward market
- Enhance day-ahead scheduling and real-time dispatchability
- Establish market opportunities for non-generation resource participation
- Develop new market products for renewable integration
- Facilitate dynamic transfers and intra-hour scheduling.

Implement planned market enhancements

A highly liquid spot market providing accurate price signals forms the foundation for an efficient overall wholesale market. Planned market enhancements in the 2011-2013 timeframe include enhanced modeling of multi-stage generation, scarcity pricing convergence bidding and standard performance capacity requirements for non-traditional generation resources.

Increase alignment between wholesale and retail pricing

Ensuring efficient retail rate design is critically important for the overall efficiency of California's energy markets. Just as ISO markets provide for convergence of day-ahead and real-time energy prices, it will be necessary to ensure that retail rates also reflect wholesale market costs, particularly with respect to price variations under different load and supply conditions. The ISO will work with state policy makers to ensure that the impacts of different retail rate designs are understood from a wholesale markets perspective. Over the longer term, as dynamic pricing becomes widespread, the ISO will need to develop a better understanding of how pricing impacts wholesale power demand and incorporate this into load and ancillary services requirement forecasting and the market clearing optimization.

Provide for demand response participation in the markets

Demand response is identified as a key resource for the state going forward. The ISO and state agencies must build on California's Clean Energy Future to develop the array of new state policies necessary to make demand response second in the state's loading order.

The ISO has developed new products and shown, through demonstration projects with both direct access and utility customers, that the systems work. ISO initiatives include:

- Developing a comprehensive vision and long-term plan for demand response participation in the ISO's markets
- Working with the CPUC to address regulatory barriers to increased participation of demand response in the wholesale markets
- Implementing new products aimed at making demand price-responsive and emergency demand response dispatchable through the wholesale markets.

The ISO will continue to work with load-serving entities to conduct demand response pilots and analyze lessons learned. This effort will include a pilot test with a utility-scale demand side resource of over 20 MW.

Demand response is forecast to grow significantly in the plan timeframe.

Improve market transparency

Market transparency promotes market efficiency by providing participants with improved price signals and other information upon which to base decisions regarding infrastructure investments, forward market transactions and behavior in the spot markets. The ISO's market data and analyses also provide important inputs to many activities and decisions of other state agencies. The ISO has initiated a stakeholder process to explore the issue of data release and accessibility in ISO markets and to implement enhancements to its current data provision practices. In 2010, the ISO began providing reports and data on transmission constraints to market participants. The ISO is working with stakeholders to consider providing additional data on factors such as outages, system conditions and more detailed data on market models and outcomes.

The ISO continually seeks to improve the transparency and integrity of its market processes on an equal access basis to all participants, while fully protecting the security and privacy of individual bid and other data. The ISO has already achieved significant reductions in price corrections and the need to issue out-of-market instructions (known as *exceptional dispatches*).

Implement multi-day commitment in the forward market

Currently, the forward-looking time horizon in the market is one day, taking into account the impact of prior commitment of units with very long start-up times. The ISO plans to make

commitment decisions in the forward market that anticipate conditions two to three days ahead to capture increased efficiencies.

Enhance day-ahead scheduling and real-time dispatchability

Given the intermittent nature of renewable resources, having a deep and liquid supply of market bids in both the day-ahead and real-time markets is critical to keeping the system in balance. The ISO will conduct a comprehensive evaluation of market mechanisms to encourage all resources that can respond to dispatch, including renewables and demand response, to submit day-ahead and real-time economic bids.

Establish market opportunities for non-generation resource participation

In 2010, the ISO proposed modifications to the operating and technical requirements for providing ancillary services so that non-generation resources (e.g., storage and demand response) are able to participate in the ISO ancillary services market. These provisions were approved by FERC and slated for implementation. The ISO will continue to explore further reforms to provide even greater opportunities for non-generation resource participation in the ISO markets such as developing standards for demand response technical performance and operational integration and a regulation energy management mechanism to eliminate the current barriers to full participation of limited energy storage resources in ISO's ancillary services market.

Develop new market products for renewable integration

Managing the intermittency and uncertainty of renewable energy production will require higher levels of reserves and fast-ramping response capabilities. Over the next two years, the ISO will focus on adequately defining the operational requirements for renewable integration and developing new market products that provide appropriate compensation for resources providing these services.

Facilitate dynamic transfers and intra-hour scheduling

Dynamic scheduling and intra-hour scheduling can utilize external resources to manage renewable ramping. The ISO will continue to work with Western Electricity Coordinating Council (WECC) balancing authorities to:

- Increase inertia dynamic scheduling capability
- Quantify the impacts of dynamically scheduled variable generation

- Identify grid reinforcements that have the potential to increase intertie dynamic scheduling capability.

4.3 Infrastructure

The ISO is optimizing use of the existing infrastructure, collaborating with participating planning authorities, transmission owners and state regulatory agencies. The ISO strategy for infrastructure development needed to ensure reliability and facilitate the implementation of California's clean energy goals is to:

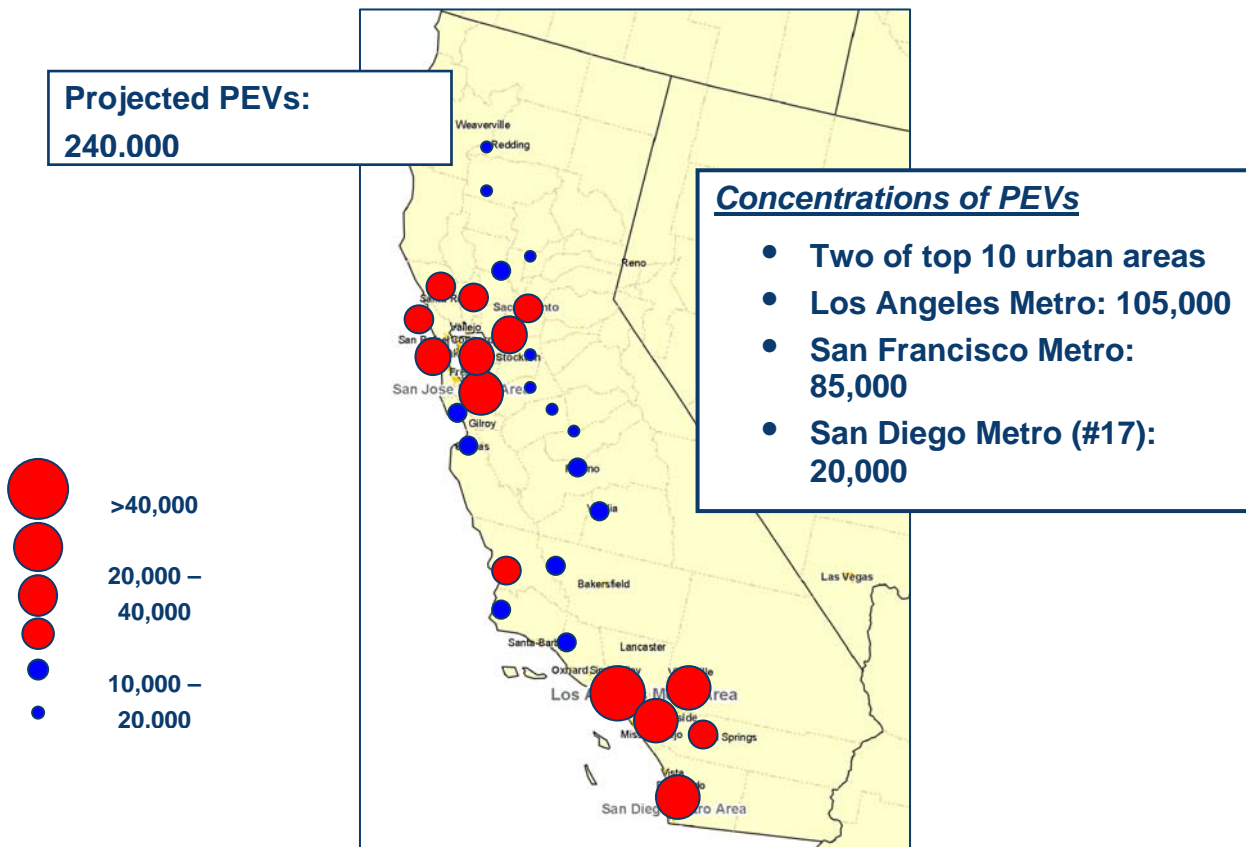
- Evaluate regional growth trends to identify high impact areas
- Develop a comprehensive transmission plan to support renewable deployment
- Develop a new transmission planning paradigm
- Review plans for plant retirements and provide for contingencies
- Continue review of the thermal fleet and operational characteristics needed to support renewable integration
- Streamline generation interconnection procedures

Evaluate regional growth trends to identify high impact areas

Based on the 2009 Integrated Energy Policy Report forecast, electricity load growth will rise 1.2 percent per year through 2018. The ISO evaluates regional growth trends on an ongoing basis to adequately plan for high growth areas. ISO planning efforts will focus on high growth areas such as Southern California to ensure that:

- Sufficient infrastructure will exist to serve future electricity needs
- Economic tradeoffs between generation, demand response, storage and transmission are considered
- Distributed renewables, demand response, electric vehicles and distributed storage all are considered in planning. As Figure 5 displays, the bulk of plug-in electric vehicles that are projected to come on the system are located in the Los Angeles and San Francisco metropolitan areas.

Figure 5: Plug-in Electric Vehicle Projected Concentrations



Source: ISO RTO Council "Impact of Electric Vehicles" 2009 Report

Develop a comprehensive transmission plan to support renewable deployment

Over the past several years, the ISO, other state agencies have made significant progress in identifying and approving the transmission upgrades needed to achieve the 33 percent renewables goals. In fact, the transmission approved by the ISO to date can accommodate enough new renewable energy resources to achieve the 33 percent renewables goal. However, a more likely scenario that would potentially bring additional benefits from regional diversity and lower costs is that the 33 percent renewables goal for the ISO footprint will be achieved through a combination of new large-scale renewable resources, renewable energy imports, and increased levels of renewable energy from distributive generation resources. The ISO plans to perform further technical analyses to determine whether the approved transmission upgrades for renewable access need to be supplemented with additional transmission upgrades to

address reliability, renewable integration needs, or delivery upgrades to major load centers. Finally, the ISO will continue its collaborative work with the California Transmission Planning Group and other western regional transmission planning forums to consider other renewable resource procurement options, particularly out-of-state scenarios and the transmission implications associated with them.

Renewable energy procurement from outside the ISO footprint will be critically important for providing regional diversity and potential cost savings. While the existing inter-tie capability for importing renewable energy to California is substantial and can accommodate a wide range of west-wide renewable procurement scenarios, there may be procurement interests that trigger additional transmission needs in neighboring balancing areas and within the ISO. Ultimately, the economics of whether such procurement scenarios make sense requires weighing the potential savings in procurement costs against the incremental cost of any new transmission. The ISO cannot make such a determination alone and will need to work collaboratively with the CPUC to work with its jurisdictional load-serving entities to assess the economics of this consideration.

Develop a new transmission planning paradigm

In 2010, the ISO developed a new approach to transmission planning that was filed with the FERC in June. The proposed reforms, which are still under consideration by the FERC, would provide a more streamlined and holistic approach to transmission planning and a sensible approach to providing opportunities for independent transmission developers. Importantly, the new approach adds achieving state and federal policy objectives as a new criterion for approving transmission upgrades. Once approved by FERC, the ISO plans to utilize this new planning process to further evaluate and refine a comprehensive transmission plan for achieving the 33 percent renewables goal.

Review plans for plant retirements and provide for contingencies

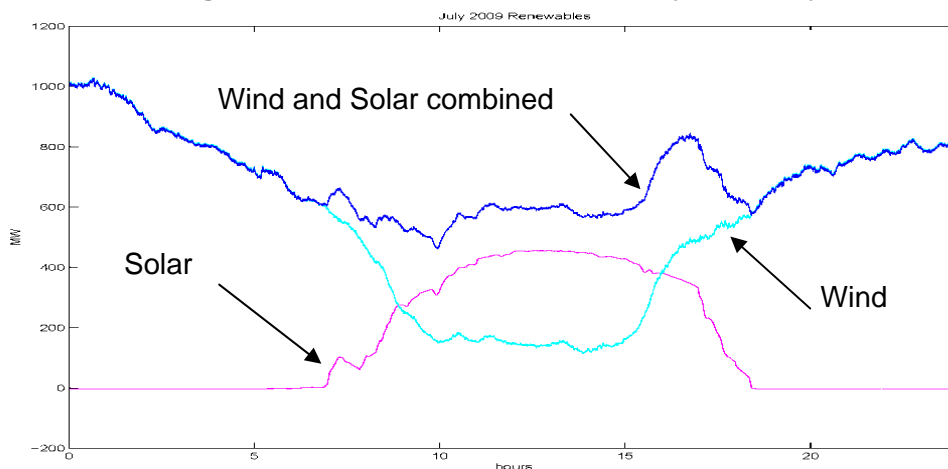
A number of large power plants within the ISO footprint are at the end of their economic and physical life with many facing repowering or retirement. Many of these plants are also subject to once-through cooling regulations and will need to provide a compliance plan for meeting these regulations by April 1, 2012. Working collaboratively with the CEC and CPUC, the ISO will need to assess the reliability impacts of the proposed plans for these facilities and provide appropriate recommendations. Ultimately, this analysis will need to consider local reliability requirements and system needs for balancing the inherent intermittency and ramping requirements of renewable energy resources and in providing system inertia.

Continue review of the thermal fleet and operational characteristics needed to support renewable integration

The ISO will continue to review and update studies to assess the resource requirements of the existing thermal fleet and the additional resources needed to maintain compliant and reliable system operation as renewable generation comes on line.

As displayed in the following Figure 6, renewable production poses diurnal ramping challenges.

Figure 6: Renewable Production July 2009 Day



Source: Research Evaluation of Wind Generation, Solar Generation and Storage Impact on the California Grid, CEC PIER Report, KEMA

Streamline generation interconnection procedures

The ISO implemented new major reforms to its generation interconnection procedures in early 2009 to better streamline the process and provide greater cost and schedule certainty to interconnecting customers. Most notably, the ISO adopted a cluster approach to studying large generation interconnection requests, as opposed to studying each request serially, and introduced significant financial security requirements at different stages of the process to reduce the number of non-viable projects. This change greatly improved the efficiency of the overall process. Since the initial implementation of these reforms, the ISO has carefully monitored the new procedures and solicited customer feedback that triggered additional refinements and modifications.

Most notably, in response to a growing backlog of small generation interconnection requests, the ISO filed with the FERC in October 2010 a proposal to combine its small and large generation interconnection study process into a single cluster study approach. This reform will significantly streamline the overall interconnection study process and provide greater cost and

schedule certainty to small generators in the ISO's current queue, which now includes over 3,000 MW of renewable resources.

Going forward, the ISO will continue to look for new opportunities to further streamline and improve its interconnection study procedures and effectively integrate the interconnection studies with the overall transmission planning process.

4.4 Organization

The ISO is firmly committed to building a world-class organization with an inspired team of globally recognized leaders in the electric industry. The ISO must keep pace with increasingly complex market systems, technological change and demanding operational requirements, all while striking a balance between maintaining reliability and managing costs. In concert with stakeholders, the ISO ensures it effectively manages the interdependencies and individual needs of the grid and industry. The ISO continuously strives to improve its organizational structure through a fully integrated strategy that focuses on people, process and technology.

4.4.1 People

The ISO's people strategy is to attract and retain uniquely skilled professionals who are highly motivated and equipped to execute against the objectives established in the Five-Year Strategic Plan. The global explosion of smart grid investments following a long period of declining excitement and employment in the utility sector makes the ISO technical staff extremely valuable and sought after today, and competition for highly qualified people will only intensify. At the same time, rapidly changing technology requires that ISO keeps the staff up to date and afford them the opportunity to stay at the cutting edge of technology.

Our integrated approach addresses the key objectives to build bench strength, secure knowledge retention, build strong leaders at every level, retain top performers and sustain the organization's ability to compete for scarce and limited resources in the global labor market. We focus on five key areas:

- Enhance knowledge and skills of existing staff
- Continuously develop technical experts
- Strengthen leadership and managerial capabilities
- Retention and recruitment of top talent

- Sustain an engaging workplace environment.

Enhance knowledge and skills of existing staff

Through enhanced training simulation, power system operators will master new tools and advanced technologies designed to ensure system stability and reliability as new intermittent resources are brought onto the system. Operators continuously acquire new skills to model and analyze scenarios and options for grid integration with new resources such as solar and wind energy. Among other challenges, the modernized control center requires advanced skill and decision making capabilities by operators charged with optimizing visualization, high speed synchrophasor and advanced analytics to ensure system reliability.

Operations engineers participate in ongoing simulation training to stay abreast of the intricacies of the ISO market system as design elements evolve and new products and enhanced applications are introduced such as security constraint economic dispatch to network applications, market power mitigation, integrated forward market, user interface and real-time dispatch.

Continuously develop technical experts

The ISO continuously strives to increase the number of subject matter experts on staff. The ISO Academy provides training for economists, transmission engineers, market planners, IT professionals and employees involved with policy development to broaden their knowledge in current and emerging areas such as automated demand response, power storage, renewable integration, forecasting, mechanisms available for green power, smart grid enabling technologies, markets for energy and ancillary services.

Strengthen leadership and managerial capabilities

Our priority emphasis on the development of leaders will build upon the President's Leadership Academy, developed by the ISO to promote the advancement of strong leaders and managers within the organization. We recognize that insightful and well-rounded leaders are required at every level of the organization. Participants in the President's Leadership Academy are initially assessed and immersed in an intense 18-month leadership program that allows them to see and understand the outcomes of their business decisions. They practice their new skills on the job, participate in additional course work and receive coaching and feedback. Top-down mentoring from executive-level sponsors will ensure participants receive hands-on experience as they prepare to assume leadership roles in key functional areas.

Retention and recruitment of top talent

The ISO is committed to retaining its highly specialized workforce which is considered globally as top talent within the power sector. The ISO invests in and partner with its employees, empowering them to take control of their careers while achieving their greatest potential. To retain its valued workforce, the ISO ensures the compensation and benefits programs remain competitive in the local, national and global labor markets. The global explosion of smart grid investments following a long period of declining excitement and employment in the utility sector makes the ISO technical staff extremely valuable and sought after today.

Increasing the number of experts with the requisite knowledge and skills offsets critical resource shortfalls. Recruiting externally for expertise in emerging areas and filling skill and knowledge gaps supplements the ISO's internal mentoring efforts.

Sustain an engaging workplace environment

The ISO maintains an invigorating workplace environment that inspires innovation, promotes team building, seeks greater efficiencies and fosters collaboration across the enterprise and externally with stakeholders to achieve short and long-term objectives. The ISO takes our reputation as an employer of choice seriously and ensures our workplace supports every team member in achieving excellence.

4.4.2 Process

The ISO strategy is to establish a sustainable, integrated and continuous improvement process that:

- Enhances customer service
- Aligns performance with business objectives
- Achieves repeatable and sustainable processes
- Informs decision-making with quality and timely intelligence.

To carry out this strategy, the ISO trains and develops individuals in process leadership. These individuals model, measure and manage ISO processes that result in a cycle of continuous improvement. Process performance will then better inform compliance, risk and performance management-related decisions at the business unit and enterprise levels. The ISO will continue

to accelerate process-centered management activities and enhance enterprise-wide monitoring and reporting mechanisms.

Customer and Participant Support

The ISO continues to mature its customer service model to better meet the needs and expectations of our stakeholders. Our overall objective is to address those needs before they arise. Major initiatives include:

- Enhanced pro-active monitoring programs to identify issues before they affect the customer
- Expanded utilization of existing issue management tools to improve the quality of issue resolution and development of new mechanisms to streamline how customers interact with the ISO
- Drawing on the data available through new issue management tools to target ISO efforts to eliminate the root causes of incoming issues
- Sponsorship of forums and stakeholder proceedings to ensure that all ISO stakeholders have a meaningful opportunity communicate with ISO Management and the Board of Governors
- Development of new communication tools in collaboration with market participants regarding electric system operations and the implications of current and new state policy initiatives.

Accelerate process-centered management activities

We will update the business process framework to achieve a sustainable level of process maturity, as measured by established models. The ISO is already improving its efforts to model, measure and manage core processes in order to drive success.

Enhance enterprise-wide monitoring and reporting mechanisms

Monitoring and reporting against meaningful performance measures informs the ISO decision making process. The ISO is constantly focused on improving core processes, establishing high priority annual goals and aligning long-term strategic

Process-centered management includes process and quality training and a comprehensive assessment of end-to-end and core business processes.

objectives to key performance indicators with identified goals and objectives.

4.4.3 Technology

The ISO's strategy is to prepare for integration of renewable resources and emerging smart grid technologies by increasing flexibility and capacity of corporate IT systems. A complex interaction of various factors influencing electric energy future makes it hard to exactly predict the outcomes and timing of changes.

The ISO technology platform must be agnostic regarding the technology winners. We will be prepared such that we can quickly respond to changes with minimum cost implications.

To achieve the stated goals the IS must stay ahead of change. In preparing for changes ahead, the ISO firsts try to determine all possible scenarios and related impacts on corporate systems and technology platform. Next, the ISO strives to understand the capabilities and dynamics of evolving technologies and the timing of realistic deployment. To achieve this, the ISO engages in pilots and demonstrations, working with market participants as well as organizations such as the Electric Power Research Institute. Last, the ISO will make changes to increase flexibility and capacity of corporate systems to deal with most likely scenarios it may be facing in the future. While doing this, the ISO will continue to strengthen the computing environments to make them more usable, secure and reliable while maintaining strict fiscal discipline to shift resources from maintenance to value-added capabilities.

The ISO strategy is to:

- Update an end-to-end technology architecture that aligns with business process structure and increase flexibility to better respond to ongoing changes
- Improve performance and capacity of technology systems
- Manage operations to be more cost effective
- Increase technological capabilities
- Improve security while increasing data related services to various ISO market participants
- Pilot new technologies.

Update an end-to-end technology architecture that aligns with business process structure and increase flexibility to better respond to ongoing changes

Corporate, market and grid systems are continuously evaluated on their effectiveness. The ISO is looking for further improvements through consolidation of hardware and software platforms, third party software products and functional componentization to better prepare for changes. Emerging smart grid technologies will increase requirement for further end-to-end integration between ISO systems and various others on lower voltage levels like never before. This will pose new challenges for standardization of interfaces to make additional information available, especially related to distributed generation and demand response. The ISO intends to increase collaborative efforts with various stakeholders in establishing a common vision for the system architecture, related integration patterns and standards in support of end-to-end integration of various systems. A main driving factor will be additional needs for monitoring and control of various new flexible generation and demand resources on both wholesale and retail levels.

Improve performance and capacity of technology systems

It is clear that some of the incoming changes can be predicted. Independent of the outcome of meeting state renewable energy targets, it is clear that ISO will have to process much larger volumes of data in both directions — in bound and out bound. Additionally, the dynamics of some of the resources coming to the grid may reduce required response times in system control. These conflicting requirements will be evaluated and built into ISO technology planning.

Manage operations to be more cost effective

Since ISO operations require extensive computing infrastructures with extreme reliability, technology is a large component of the ISO operating budget. The tension between continuing upward cost pressure throughout the energy sector and downward

The ISO explores options to increase reliability while reducing costs by consolidating servers and data centers and automating support.

pressure from consumers that are squeezed economically challenges us to continually improve productivity and is an opportunity to show increased value. We will continue to look for opportunities in consolidating ISO hardware and software systems with the goal to reduce maintenance cost and increase flexibility to respond to imminent changes.

Increase technological capabilities

The ISO is heavily dependent on technology to carry out its mission. We will continue to work with sophisticated technology providers and recruit specialized resources that will help create advanced capabilities needed in

ISO technology is a complex intersection of economics and computing capabilities that are integral to all aspects of our business.

the coming years. Embracing the change means the ISO must recruit new staff and train existing staff in new technologies and business models to enable the innovation in markets and operations essential to ISO continued success. Participation in and support for new technology demonstrations will be an important element of this.

Improve security while increasing data related services to various ISO market participants

Cyber security and protection of commercially sensitive data from non-authorized access are some of the core ISO functions and of paramount importance for ISO market participants. Increased volumes of data required to operate ISO systems in coordination with other systems it did not have to integrate before, will pose new challenges for maintaining and increasing security. Through technology innovation and consolidation and standardization of ISO hardware and software systems, the goal is to maintain and improve security of corporate IT systems while providing additional data services and transparency to ISO market participants and partners in reliability coordination. It is very likely that a significant increase in data flows will be realized over secure internet communications. The ISO goal is to support these additional data flows and provide new data services to market participants including transformation of large volumes of data into information of value for market participants in their decision making processes.

Pilot new technologies

The ISO has begun pilot projects to integrate new storage technologies into the markets and operations. These pilots will be continued and evaluated as part of developing new products, operational processes and resource plans. The ISO will work with the California Energy Commission and other agencies and entities to develop similar pilots of autonomous and automated demand response for dispatch and ancillary services, including new technologies such as electric vehicle smart charging and building to grid applications.

5. Conclusion

The ISO is focused on bringing new renewable resources onto the system at high levels while striking the balance to manage a number of complex and challenging issues to maintain reliability in the most cost effective manner.

The ISO is embracing the changes in our industry in a highly coordinated and strategic manner.

The strategies identified in this plan set the foundation for the ISO's activities for the next five years to meet the challenges associated with multifaceted shifts in demand, widespread renewable generation deployment and rapidly evolving market and infrastructure requirements. The ISO markets and operations are key elements in utilizing new technologies to integrate renewables and fully enable the energy consumer. The ISO will lead the way in market and operations innovation to realize the full potential of its markets and the state resources. The ISO Strategic Plan will be supported by a Strategic Framework that will map out specific initiatives to support the ISO's activities in the next five years. Performance metrics will be implemented throughout ISO operations that tie directly to implementation of the ISO Five-Year Strategic Plan.

The ISO continues to be focused on enhancing its operations to deliver exceptional value to the California market and will leverage its influence across multiple domains. In response, the ISO outlines a plausible and desirable vision of the power industry in 2020 and the strategy to get there. The ISO seeks continuous process improvements to nurture a thriving electricity sector. A high degree of collaboration is essential to effectively managing change and creating this new paradigm.

By working together, the ISO seeks to set the stage for achieving California's clean energy goals. Successfully transforming California's electricity sector raises the bar for the entire industry. It cements California's position as a global leader and sets a new standard for national and international policymakers. This is an exhilarating vision and the ISO invites others to join us for this rewarding journey.