

PURSuing A STRATEGIC VISION FOR A SUSTAINABLE ENERGY FUTURE 2015



California ISO

THIS VISION
OUTLINES THREE
OVERARCHING
STRATEGIES.

STRATEGY
1

LEAD THE TRANSITION TO
A LOW CARBON GRID

STRATEGY
2

RELIABLY MANAGE THE GRID
DURING ENERGY INDUSTRY
TRANSFORMATION

STRATEGY
3

EXPAND COLLABORATION
TO UNLOCK REGIONAL
BENEFITS

A MESSAGE FROM THE CEO & BOARD

OUR VISION: WHAT WE CAN DO TO ENSURE GRID RELIABILITY AND EFFICIENCY WHILE LEADING THE TRANSITION TO A LOW CARBON GRID.

This strategic vision builds on the goals outlined in the ISO's 2014-2016 strategic plan. While the ISO has made significant progress on the initiatives in the strategic plan, the energy industry has continued to evolve. Far-reaching environmental policies, regulatory changes, shifts in economics and consumer demands, and innovative technologies that were once on the horizon now provide new opportunities for the energy landscape.

As increasing amounts of renewable resources come on line, challenges emerge for using those resources efficiently. There are already certain times of day when more renewable energy is being generated than there is demand to use it. Relying more on renewable resources to meet our energy needs will require thoughtful changes in policy and innovations in technology.

To meet carbon reduction goals, we will continue work to integrate renewable generation and distributed energy resources, increase energy efficiency standards, and encourage investment in the infrastructure necessary to support millions of zero-emission vehicles on our roads. The interconnected nature of the western grid focuses us on developing ways to improve reliability and reduce costs and emissions, not just for California but for the entire western grid. The Energy Imbalance Market, for example, demonstrates that the ISO is uniquely positioned to inform and help facilitate the changes necessary to lead the way to a reliable, efficient, low-carbon grid.

We look forward to working with regional leadership; state, federal and regulatory agencies; and our stakeholders on policy, process and technology solutions. We are committed to learning, and prepared to be nimble, as we help lead the transition to a sustainable future.

MANAGING THE EVOLVING GRID

Climate change policy is driving important innovation across the economy and ushering in new ways to grow and evolve the electric system. California's goal to provide 33% of electricity from renewable resources by 2020 has encouraged significant investments in large-scale, sustainable power generation, such as wind farms, solar projects and geothermal resources. In January, California Governor Jerry Brown announced a 50% renewable energy goal by 2030, which means California will continue to foster development of increasing levels of renewable resources. Absent new technologies and increased regional collaboration, it could also create risk.

When energy supply exceeds demand

The risk arises when there is more electricity than there is demand to use it — a condition known as overgeneration. Current studies show that this risk will grow quickly after 2020 with higher levels of renewable generation in the mix — even after fossil fuel power plants have reduced output as much as possible. When that occurs, some renewable generation may need to be curtailed, which would be a missed opportunity to use clean power at a minimal marginal cost.



The risk of curtailment can be minimized by finding uses for the excess power. This includes increasing electricity exports to nearby states, developing energy storage systems, and electrifying transportation — all of which help further reduce carbon emissions. Some of these options are costly, some save money, and some take years to develop, but they are feasible. To take advantage of these opportunities, we must understand the options and advance the quickest, lowest cost policy and technology solutions.

INCREASED RISK OF
OVERGENERATION



SUCCESS WILL ESTABLISH CALIFORNIA'S LEADERSHIP ON CLIMATE CHANGE POLICY AND DRIVE INNOVATION ACROSS THE REGION. ALL EYES ARE ON US AS STATE POLICIES AND PROGRAMS LEAD TO REDUCTIONS IN GREENHOUSE GAS EMISSIONS.

AMBITIOUS GREENHOUSE
GAS REDUCTION
GOALS



GROWING LEVELS OF
DISTRIBUTED ENERGY
RESOURCES NOT VISIBLE
TO ISO OPERATIONS



INCREASINGLY
COMPLEX GRID
OPERATIONS



ENVIRONMENTAL CHANGES

1.4°F

amount Earth's average
temperature has risen
over the past century¹

5%

growth of carbon dioxide
emissions nationwide from
1990-2012¹

32%

of greenhouse gas emissions
in the U.S. in 2012 were from
electricity production¹

93 days

in 2014 when air pollution
levels in the South Coast Air
Basin exceeded the federal
8-hour ozone standard²

¹ www.epa.gov/climatechange

² www.aqmd.gov/docs/default-source/publications/aqmd-advisor/2015janadvisorpdf.pdf

MANAGING THE EVOLVING GRID — *CONTINUED*

Supporting national clean air and climate goals

New federal clean energy goals require a significant reduction of carbon emissions from the existing generation fleet by 2030. The ISO can help states across the western grid achieve their goals by deploying new technology for optimizing generating resources, enabling more electricity exports, and allowing resources held in reserve to be shared across the region.



Changing role for consumers

As the sources of electricity are changing, so too is the role of the consumer. Modern tools and technologies are enabling consumers to more effectively manage their energy use and even produce their own electricity. Distributed energy resources — such as rooftop solar, energy storage, plug-in electric vehicles, and demand response programs — are growing and will be a valuable part of the future resource mix. However, unlike traditional power plants, the control of these resources is in the hands of consumers. Technology innovators are poised to integrate these systems in ways that further lower carbon emissions, and the ISO is committed to supporting these changes, consistent with reliable system operations.

RENEWABLE ENERGY GOALS

California Renewables
Portfolio Standard:

33% renewable
energy by
2020

Striving for:

50% renewable
energy by
2030

CARBON REDUCTION GOALS

California's goal:

80% reduction in
carbon dioxide
levels by 2050
(from 1990 levels)

U.S. Environmental Protection
Agency's Clean Power Plan:

30% reduction in carbon dioxide
levels from existing power
plants by 2030
(from 2005 levels)

STRATEGY 1: LEAD THE TRANSITION TO A LOW CARBON GRID

Advancements in technologies and products are changing the way energy is generated, transmitted and stored, and how consumers make decisions about their energy use. Some of these technologies and products are available today, while others are in development. Some transform how consumers manage their use, others change how the distribution and transmission systems interact, and some may drive changes we cannot anticipate today. While these developments could present challenges for operating the grid, the ISO sees them as opportunities and is committed to advancing changes that will make our electric system more secure and sustainable.

By its nature, electricity is used the instant it is generated. Because power from wind and solar resources varies with weather, and does not consistently align with the instantaneous demand for electricity, the ISO must be constantly ready to adjust other resources to serve demand. Storage resources, such as batteries and pumped storage,

will be essential to allow for storage of excess renewable energy generated when demand is low, so it can be used when demand increases. Policy and regulatory changes are necessary to support the development of these resources.

In recent years, consumers have become more savvy about managing their energy use and even producing their own power. Home automation solutions like smart thermostats, outlets and other fixtures are already on the market, and can be controlled through smart phone applications. These tools will become even more powerful when consumers have information about when it is of greatest value to change their energy use. This requires clear energy price signals in the form of time-of-use rates.



IT'S IMPORTANT TO ACKNOWLEDGE WHAT WE DO NOT KNOW. NOT LONG AGO, TELEPHONE CALLS WERE THE ONLY FUNCTION FOR MOBILE PHONES. TODAY, THEY CARRY MORE COMPUTING POWER THAN NASA USED TO SEND APOLLO 11 TO THE MOON. INNOVATIVE NEW TECHNOLOGIES AND INFRASTRUCTURE DEVELOPMENTS MAY SIMILARLY TRANSFORM HOW AND WHEN ELECTRICITY IS USED AND FACILITATE OUR TRANSITION TO A LOW-CARBON GRID.



STRATEGY 1: LEAD THE TRANSITION TO A LOW CARBON GRID—CONTINUED

With energy rates that reflect system conditions, consumers will be able to choose to use electricity when excess supply creates low prices and reduce electricity use when demand and prices are high. This is a win-win scenario for the consumer and for the grid.

The right price signals would allow electric and hybrid vehicles to not just cut down on fossil fuel use but also help smooth the flow of renewables into the grid. If informed consumers charge their vehicles when renewable generation is abundant, but demand and prices are low, they help stabilize the grid while using clean-sourced electricity. Fleets of electric vehicles can similarly balance the grid, with operators sending signals to increase or decrease electricity flow to or from the vehicle. With the right technology, electric vehicles could coordinate with the grid for the roughly 90 percent of the time they are parked and still be fully charged when the consumer needs them.

Critical to the success of this strategy is an increase in the number of electric vehicles on the road and advancements in charging infrastructure to send signals to electric vehicles to adjust their charging rates according to grid conditions.



reduce use
of fossil fuels

LEVERAGE THE ELECTRIFICATION
OF THE TRANSPORTATION
SYSTEM TO HELP CONSUME
SURPLUS ENERGY WHEN
RENEWABLE GENERATION
OUTPUT IS ABUNDANT



educate &
empower consumers

store
surplus
energy

STRATEGY
1

WHAT NEEDS TO HAPPEN

encourage
low carbon
energy
solutions



DEVELOP ENERGY STORAGE TECHNOLOGIES TO REDUCE RELIANCE ON THE THERMAL FLEET WHEN RENEWABLE RESOURCES ARE NOT ON LINE



IMPLEMENT ELECTRIC RATES THAT ENCOURAGE CONSUMERS TO MAKE SMARTER CHOICES ABOUT THEIR ENERGY USE...



...AND ENCOURAGE DEVELOPMENT OF TECHNOLOGIES THAT WILL ENABLE THEM TO DO SO EFFORTLESSLY

encourage
innovation



POLICY AND REGULATORY CHANGES MUST SUPPORT CLEAN ENERGY RESOURCES

STRATEGY 2: RELIABLY MANAGE THE GRID DURING ENERGY INDUSTRY TRANSFORMATION

Wind and solar generation vary with the weather and time of day. Geothermal and biomass resources cannot always increase or reduce production as demand changes in real time. Innovative policy and technology solutions are needed to enable these resources to operate more flexibly. Carbon benefits will increase if we are successful in using renewable resources to meet flexibility requirements to ensure grid reliability.

Today, conventional power plants play an important role in producing power to ensure reliability in times when renewable energy is not available. Some of those plants must run at a minimum level to respond to quick changes in demand. When renewable energy is abundant, this minimum level of generation adds to the potential for overgeneration. Going forward, existing less-flexible plants that have high minimum generation levels should be retired or retrofitted to provide more flexibility.

In recent years, large consumers of electricity have invested in smart grid devices and control systems to meet their individual business objectives to increase efficiency and reduce energy costs.



**WITH SOLAR PRODUCTION PROJECTED TO OUTPACE
THE MID-DAY DEMAND FOR ELECTRICITY, IT IS CRITICAL
NOT JUST TO MATCH SUPPLY TO DEMAND, BUT TO
COORDINATE USAGE TO MATCH PRODUCTION.**



Leveraging these capabilities to reduce, stop, or even increase electricity consumption depending on grid conditions can provide significant reliability and economic benefits to the entire electric system and all who depend on it.

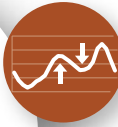
It is also imperative to develop market mechanisms and procurement policies to ensure we have adequate flexible generation available to maintain reliability. Some new policies are already in place to help identify what flexible generation is needed to operate the grid reliably, such as procurement of flexibility as part of the state's year-by-year resource adequacy program. Additional work is needed to embed this in a forward-looking, multi-year policy to ensure we are ready for opportunities that are coming.



ENCOURAGE AND
ACCOMMODATE
EMERGING
TECHNOLOGIES

support
processes
to streamline
integration

IMPLEMENT MARKET CHANGES
THAT ENCOURAGE GENERATORS
TO PROVIDE FLEXIBILITY



encourage
flexibility

FACILITATE DEVELOPMENT
OF MORE FLEXIBLE
GENERATION RESOURCES



modernize
the grid



RETROFIT
OR RETIRE
AGING, INFLEXIBLE
POWER PLANTS

reshape the
demand curve

STRATEGY
2

WHAT NEEDS TO HAPPEN

coordinate
energy use



PROVIDE INCENTIVES FOR
ENERGY CONSUMERS TO
RESPOND TO CHANGES IN
ENERGY SUPPLY AND DEMAND



STRATEGY 3: EXPAND COLLABORATION TO UNLOCK REGIONAL BENEFITS

Electricity on the interconnected grid ignores state boundaries. Regional collaboration can improve reliability, reduce costs and emissions, and facilitate integrating renewables.

The western North America region is rich in renewable resources, from vast hydro resources in British Columbia and the northwest to geothermal generation in California, Nevada, Utah and Colorado, wind in Montana and Wyoming, and solar potential in the deserts of the southwest and Mexico. Drawing resources from a larger geographic region smooths the peaks and valleys of energy supply and demand, adding flexibility and reliability to the grid.

Expanded regional collaboration also strengthens grid reliability by providing grid operators with visibility to broader grid conditions. Market-based solutions, such as the Energy Imbalance Market, lower costs and expand the pool of resources available to meet supply and demand needs in real time.

Closer collaboration on large-scale transmission projects can facilitate renewable energy development and the movement of renewable power between states. This can help individual states meet their own policy goals. It will also help mitigate overgeneration by allowing excess power to be shared across a much larger geographic area at a reduced cost to consumers.

Every state in the nation is faced with the challenge of ensuring reliable electricity while moving to cleaner, more sustainable resources. Today, grid operators in California and across the western grid are working together to manage the variability of renewable energy generation in their long-range planning processes. Further integration and expansion of markets such as the Energy Imbalance Market will help ensure a successful transition to a renewable energy future – not just for California but for the entire region.



**FEDERAL, STATE AND LOCAL POLICIES ENCOURAGE
THE INTEGRATION OF RENEWABLE RESOURCES,
ENERGY EFFICIENCY AND CARBON REDUCTION
INTO REGIONAL PLANS.**

**INCREASE REGIONAL
COORDINATION TO
EXPAND THE DIVERSITY
OF RESOURCES**



provide cleaner
energy options



COLLABORATING TO MEET GRID RELIABILITY AND CARBON REDUCTION GOALS

The ISO is more dedicated than ever to building and maintaining the cleanest and most reliable electricity grid in the world. This strategic vision describes actions that we believe will ensure a reliable electric system that depends more on clean energy resources. While the ISO has work to do, it will take close collaboration with regional leaders; federal, state and local regulators; stakeholders; and innovators to make this vision real.

WHAT NEEDS TO HAPPEN	WHAT THE ISO NEEDS TO DO
Encourage low carbon energy solutions such as energy storage, demand response and expanded energy efficiency standards.	Support pilot projects that help inform state and local authorities on the characteristics needed to ensure grid reliability as new solutions are designed. Develop technical requirements and related tariff provisions to enable participation of low carbon energy resources in our markets.
Facilitate renewable generation contribution to grid reliability.	Define the characteristics needed for renewable generation to provide grid services such as ramping and voltage control to enable less reliance on conventional generation. Develop market mechanisms to incent renewable generation and facilitate participation through effective interconnection processes.
Provide incentives for consumers to adjust energy use in response to changes in supply and demand.	Inform state and local regulatory authorities responsible for rate design about seasonal and time-of-day system needs.
Leverage the electrification of the transportation system to reduce greenhouse gas emissions and help consume energy when renewable generation is abundant.	Inform state and local regulatory authorities regarding the most effective time and place to encourage low-carbon vehicle charging. Study and incorporate the infrastructure needed to support increased electric vehicle charging into transmission plans.
Encourage development of more flexible generation resources that can adjust to constantly changing system conditions.	To inform policy decisions, model and study the flexibility characteristics needed to ensure grid reliability.
Increase regional collaboration to expand the diversity of resources and to leverage opportunities for infrastructure and operations efficiencies.	Demonstrate the benefits of the Energy Imbalance Market to interested parties across the region. Lead the effort to develop a governance framework that enables expanded regional collaboration.

THROUGH COLLABORATION, WE
BELIEVE GRID RELIABILITY AND
CARBON REDUCTION WILL CO-EXIST



COMPREHENSIVE SOLUTIONS

Funding is needed for research and development to identify the next generation of low carbon energy solutions that can help reduce overall electricity load.

Energy policy must allow these solutions to qualify as part of the clean energy resource mix to meet carbon reduction goals.

Regulatory authorities must consider the necessary characteristics as they authorize procurement of resources.

Electricity rates must encourage customers to adjust their energy use. Rate making authorities need to adopt and modify rates to encourage new technologies that enable consumers to take advantage of favorable market pricing at times of low demand.

Vehicle charging systems need to be installed to support a growing number of low carbon vehicles on the road. This charging infrastructure must support overall system needs and should have the capability to respond to price signals.

Existing inflexible plants should be retired or retrofitted to provide the flexibility needed to meet system needs. Regulatory authorities must authorize procurement that allows for retrofitting existing plants to provide flexibility where feasible.

The Energy Imbalance Market Transitional Committee must complete its work to create an Energy Imbalance Market governance structure while longer term regional governance options are considered.



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