FILED
03-02-12
04:59 PM

2013 Flexible Capacity Procurement Requirement

Supplemental Information to Proposal

March 2, 2012

Prepared by: Market and Infrastructure Policy
California Independent System Operator

Contents

1.0 Executive Summary 3

2.0 What is flexible capacity? 6

2.1 What is resource flexibility? 6

2.2 What are the characteristics of each of the three categories of flexible capacity: maximum continuous ramping, load following and regulation? 7

2.2.1 What is maximum continuous ramping? 7

2.2.2 What is load following? 8

2.2.3 What is regulation? 9

2.3 Does flexibility include upward and downward ramping capability? 10

2.4 Is needed flexibility provided by resources participating in the market? 11

3.0 Why is a flexible capacity requirement needed in 2013? 11

3.1 The once-through-cooling water policy reduces fleet flexibility. 12

3.2 New intermittent resources risk displacement of flexible capacity resources. 13

3.3 Retirements threaten fleet flexibility 14

4.0 What are the risks of waiting to set a flexible capacity requirement until 2014? 15

4.1 Lost opportunity 15

4.2 Lost flexibility 15

4.3 Delayed learning curve 15

5.0 What are the flexible capacity requirements for 2013? 15

5.1 What are the proposed system flexible capacity requirements for 2013? 17

5.2 How much flexible capacity must be shown by LSE's annually and monthly? 18

5.3 Why is the ISO proposing a monthly flexible capacity requirement? 19

5.4 Is market power a concern in 2013 for the amount of flexible capacity required? 19

5.5 How would the ISO determine compliance with a flexible capacity requirement? 20

6.0 What resources are eligible to provide flexible capacity? 20

6.1 Will the ISO be able to quantify the amount of flexible capacity by resource? 21

6.2 Could the ISO procure a once-through-cooled resource for flexible capacity under its backstop procurement authority? 21

6.3 How do use-limited resources count toward flexible capacity? 21

6.4 Can demand response and storage devices count toward flexible capacity? 22

6.5 Are long-start resources eligible to provide flexible capacity? 22

7.0 Flexible capacity proposal for 2013 22

7.1 ISO flexible capacity procurement requirement proposal for 2013 22

7.1.1 Eligible resources 22

7.1.2 Partial flexible capacity procurement ... 23
7.1.3 Must offer obligations ... 23
7.1.4 Self-scheduling rules ... 23
7.1.5 Annual and monthly showing rules ... 23
7.1.6 Deficiency assessment, when done and how done ... 24
7.1.7 Opportunity to cure deficiencies ... 24
7.1.8 Criteria for selecting flexible capacity for ISO backstop procurement ... 24
7.1.9 Backstop terms and conditions ... 25
8.0 CPUC flexible capacity requirement considerations ... 25
8.1 Establish load-serving entity authority to procure flexible capacity ... 25
8.2 Allocation of the requirement to load-serving entities ... 25
8.3 Showing requirements and timing of showings ... 25
8.4 Deficiency and cure rules ... 26
9.0 Conclusion ... 26

Figures

Figure 1: Calculating the Continuous Ramp Value ... 7
Figure 2: Each Capacity Category Must Equal the Overall RA Capacity Requirement ... 16
Figure 3: Resource Eligible to Provide All Categories of Flexible Capacity ... 17
Figure 4: Resource Not Eligible to Provide All Categories of Flexible Capacity ... 17
Figure 5: Number and Magnitude of Continuous Ramp Periods from August 2011 ... 18

Tables

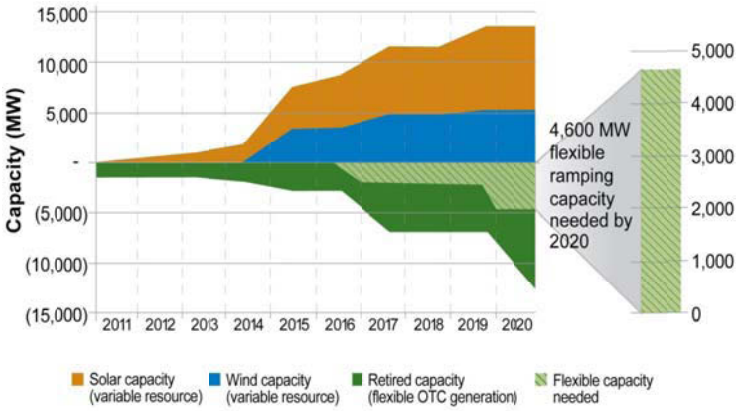
Table 1: ISO Proposed Flexible Capacity Requirement Categories ... 10
Table 2: 20% RPS Flexible Capacity Impacts Relative to the 2012 Reference Case ... 14
Table 3: ISO Proposed 2013 Flexible Capacity Requirement ... 18
Table 4: Maximum Continuous Ramping Capability (excluding hydro) ... 19
Table 5: Percent Maximum Continuous Ramping Requirement to Fleet Capability ... 19
Table 6: Load Following Capability (excluding hydro) ... 20

Appendices

Appendix A: Multi-year Comparison of Flexible Capacity Needs ... 27

1.0 Executive Summary

California's electric system is undergoing one of its most significant transformations ever. In an effort to drive California toward a cleaner, greener and more diverse energy supply portfolio, policy makers have enacted some of the strictest and time-aggressive environmental regulations in the country. California is simultaneously implementing a renewables portfolio standard, which requires that 33 percent of retail energy sales be met by eligible renewable energy by 2020, while simultaneously eliminating the use of once-through cooling technology at coastal power plants, causing the potential retirement of 12,079 megawatts of generation, or 21 percent of California's installed generation capacity, over the next eight years.[1] The ISO anticipates that retirement of once-through cooled resources will create a capacity gap of more than 3,500 megawatts needed to serve load in the ISO's balancing authority area as early as the end of 2017, and the ISO projects this capacity gap to grow to 4,600 megawatts by 2020. The ISO's analyses identifying this capacity gap take into account new capacity additions, most of which will be variable energy resources. The 4,600 megawatt deficiency by 2020 also assumes that the 535 megawatt Sutter Energy Center, which is currently at risk of retirement, is part of the supply fleet.



California is also pursuing the development of 12,000 megawatts of distributed generation resources, which are relatively small-scale and largely inflexible resources connected to utility distribution systems and located close to load. Distributed generation is another component of California's strategy for diversifying and increasing the share of renewable resource electricity production in the state. Even though increased levels of distributed generation may decrease system peaks, it may also increase load variability on the grid, potentially adding to the overall energy variability of the grid.

As the system operator for a majority of the state, the ISO is responsible for maintaining grid reliability and doing so in a cost-effective manner, particularly in light of the significant transformation that the electricity grid is undergoing. Nothing, however, could undermine the state's environmental policy goals more quickly than reliability issues or significant consumer cost impacts. Planning for the availability of flexible resources, which are those resources that can respond to ISO dispatch instructions, can help avoid reliability and cost impacts in the near future.

[1] Installed net dependable capacity in the ISO balancing authority area in January 2012 was 58,458 MW.

Given the impending challenges of this transformation, the ISO has identified several concerns that underlay the need for securing sufficient flexible capacity to respond to the changing grid conditions and to propose a flexible capacity requirement beginning in 2013. These concerns are:

1. The once-through-cooling policy will reduce the number of flexible resources.

   California's State Water Resources Control Board has promulgated a rule that eliminates most once-through-cooled resources by the end of 2020. As a result, 12,079 megawatts of flexible generation resources are impacted and could retire as early as the end of 2017.

2. Intermittent resource additions will quickly displace flexible capacity in meeting resource adequacy obligations.

   Without timely modification to the Commission's resource adequacy program, inflexible and variable resources will displace resource adequacy capacity sourced from traditional flexible resources that have historically satisfied the CPUC's resource adequacy capacity requirements. Unlike most conventional resources, many renewable resources operate on intermittent fuel supplies, such as sunshine and wind, and are incapable of responding to ISO dispatch instructions and needs.

3. Flexible resources will retire prematurely due to revenue insufficiency unless enhancements are made to the resource adequacy program.

   ISO studies show that intermittent resources increase supply variability and decrease supply predictability, which require greater readiness and response from flexible generation. These studies also demonstrate that increases in the penetration of renewable resources will result in decreasing energy market revenues for traditional, flexible generation as more energy is provided by renewable generation. Moreover, the traditional, flexible generation resources will be cycled more frequently, causing greater wear and tear and increasing operating costs.

Any parameters for flexibility must support ISO operational needs and align with the existing market structure and resource adequacy construct. Consistent with these objectives, the ISO has determined that appropriate, durable parameters for assessing flexibility are these three operational attributes:

- Maximum continuous ramping --

  Maximum continuous ramping is the megawatt amount by which the net load (load minus wind and solar) is expected to change in either an upward or a downward direction continuously in a given month.

- Load following --

  Load following is the ramping capability of a resource to match the maximum megawatts by which the net load is expected to change in either an upward or a downward direction in a given hour for the relevant resource adequacy compliance month.

- Regulation --

  Regulation is the capability of a generating unit to automatically respond during the intra-dispatch interval to the ISO's four-second automatic generation control signal to adjust its output to maintain system frequency and tie line load with neighboring balancing area authorities.

These three categories represent the operational flexibility attributes needed by the ISO and can be applied on a resource-by-resource basis to assess the amount of flexible capacity each resource can provide. To determine the total amount of capacity needed of each of these three categories for 2013, the ISO based the requirements on an historical analysis of the 2011 changes in net load for durations relevant to the three categories of flexible capacity. A comparative analysis of the net load changes for the years 2006 and 2010, and a comparison of the three flexible capacity categories across the years 2006, 2010 and 2011 can be found in Appendix A.

The table below lists the proposed 2013 resource adequacy requirements for each of the three flexible capacity categories by month for the ISO balancing authority area. The maximum continuous ramping capacity is based on the duration of the continuous upward ramp for each month. For the regulation requirement, the values are shown only for informational purposes. Although the table shows the approximate regulation requirement based on analysis of the 1-minute change in net load within any 5-minute interval, the ISO recommends that a regulation requirement not be set in 2013, but be evaluated for use in 2014 and beyond based on additional information provided by the implementation of regulation pay-for-performance metrics.

2011							
Monthly System Requirements	Maximum Continuous Ramp			60-Minute Load Following Requirement		Regulation Requirement	
	Capacity (MW)	Ramp Rate (MW/min.)	Duration (Hr.)	60-min Capacity (MW)	Ramp Rate (MW/min.)	5-minute Capacity (MW)	Ramp Rate (MW/min.)
January	8,133	32.7	4.2	3,935	66	664	132.8
February	6,982	32.8	3.6	3,630	60	656	131.3
March	5,453	26	3.4	3,271	55	1,020	204.0
April	8,859	20	7.4	2,897	48	544	108.7
May	8,000	22	6.0	2,951	49	678	135.7
June	11,382	32	5.9	2,637	44	637	127.5
July	13,544	23	9.8	3,137	52	840	167.9
August	18,181	27	11.1	2,933	49	686	137.1
September	17,824	34	8.7	3,004	50	634	126.8
October	9,510	20	7.8	3,514	59	635	126.9
November	7,855	22	5.9	3,746	62	1,351	270.2
December	7,577	29	4.3	4,506	75	668	133.7

The ISO proposes that flexible capacity requirements be established for each month of the year. Establishing the requirements monthly will recognize that the amounts of flexible capacity needed differ month to month. The inventory of traditional flexible capacity resources that can provide maximum continuous ramping and load following capacity, as demonstrated in this report, should provide sufficient procurement headroom in 2013 to avoid any market power concerns with meeting these requirements.

The implementation of a flexible capacity procurement requirement for compliance year 2013 requires CPUC action in this proceeding to modify the resource adequacy program and FERC approval of the tariff amendments that result from the ISO stakeholder process on flexible capacity procurement. It is critical that we take action this year to put these requirements in place to ensure the resource adequacy fleet can continue to meet the reliability needs of the system for 2013 and beyond. Doing so will also mitigate the need for the ISO to engage in backstop procurement of flexible generation capacity should load-serving entities fail to procure sufficient flexible capacity on their own.

The ISO has put forth a reasonable, needs-based proposal for 2013 to begin refining the CPUC's resource adequacy program to incorporate flexible capacity. The ISO looks forward to working collaboratively with the CPUC, other local regulatory authorities and stakeholders to preserve sufficient flexible resources that can satisfy the maximum continuous ramping and load following capabilities for 2013 while preparing the way for the 33 percent renewables portfolio standard and the possible retirement of 12,079 megawatts of flexible capacity once-through-cooled resources.

2.0 What is flexible capacity?

2.1 What is resource flexibility?

The first step in determining a resource's flexible capacity is to assess its operational flexibility, which is the resource's ability to respond to ISO dispatch instructions. The degree of flexibility each resource has is determined by:

- How fast the resource can ramp up or down;
- How long the resource can sustain an upward or downward ramp;
- How quickly the resource can change its ramp direction;
- How far the resource can reduce output and not encounter emission limitations;
- How quickly the resource can start; and
- How frequently the resource can be cycled on and off.

A resource's degree of flexibility is largely qualitative; a resource's flexibility at any particular time can vary depending on the status of that resource (e.g., on-line or off-line) or other operating parameters (e.g., current MW output or operating range).

Given the essential, yet qualitative nature of flexibility, the ISO must set parameters to reasonably assess a resource's flexibility. Any parameters for flexibility must support ISO

operational needs and align with the existing market structure and resource adequacy construct. Consistent with these objectives, the ISO determined that the appropriate parameters for assessing flexibility are these three operational attributes:

- Maximum continuous ramping;
- Load following; and
- Regulation.

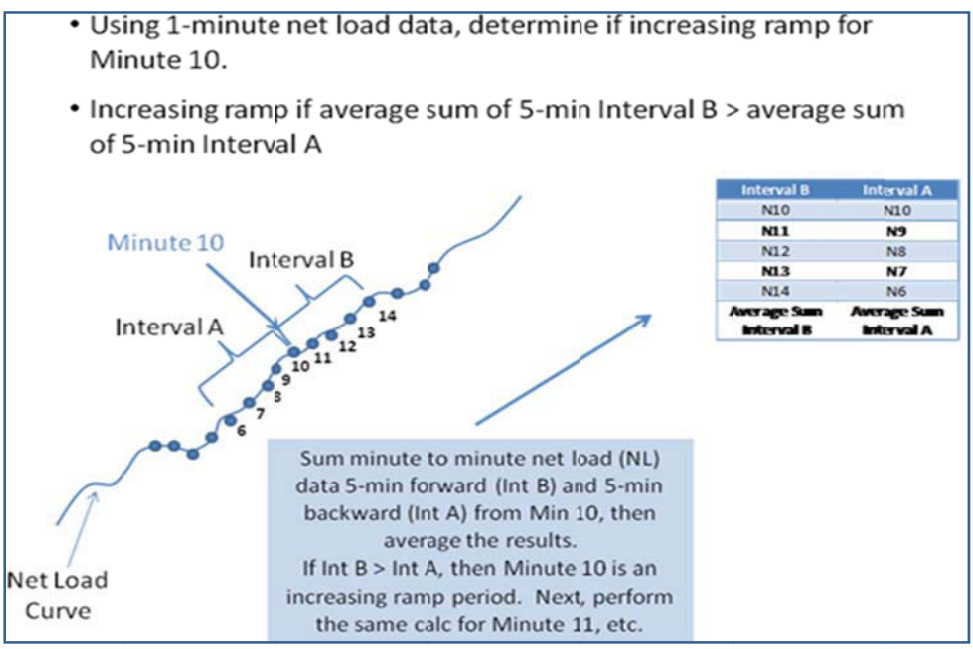
These three categories represent the operational flexibility needed by the ISO and can be applied on a resource-by-resource basis to assess the amount of flexible capacity each resource can provide.

2.2 What are the characteristics of each of the three categories of flexible capacity: maximum continuous ramping, load following and regulation?

2.2.1 *What is maximum continuous ramping?*

Maximum continuous ramping is the megawatt amount the net load (load minus wind and solar) is expected to change in either an upward or a downward direction continuously in a given month. As illustrated below in Figure 1, the maximum continuous upward ramp is determined by a moving five-minute window and taking the sum of the net load for each minute within a five-minute interval. As long as the sum of a subsequent five-minute interval is greater than the sum of the previous five-minute interval, the ramp is increasing. The maximum continuous ramping capacity requirement will ensure that there is sufficient ramping capacity to meet the ISO's largest continuous net load ramp for a particular month. Maximum continuous ramping capacity is expressed in megawatts.

Figure 1: Calculating the Continuous Ramp Value



For 2011, the maximum continuous upward-load ramp occurred in August and reached 18,181 megawatts over approximately 11 hours. Based on this experience, resources that can start and reach their net qualifying capacity (NQC) within 11 hours would meet the maximum ramping requirement for August 2013. The maximum ramping capacity in August for a long start unit that requires a start time greater than 11 hours would be its NQC minus Pmin (the minimum normal capability of a generating unit), assuming that this value is less than the unit's ramp rate multiplied by 11 hours. A resource's maximum continuous ramp capacity can be calculated as follows:

- Maximum Continuous Ramping
  - For resources that have a startup time ≥ longest ramp duration:
    - min((NQC-Pmin),ramp duration*RRavg)
  - For resources that have a startup time < longest ramp duration:
    - min(Pmin+(longest ramp duration--SUT)*RRavg, NQC)

    Where:

    SUT is the start-up time; and

    RRavg is the weighted average ramp-rate. The weighted is based on the MW size of a resources ramp-rate segment.

For resources that can start in less time than the monthly continuous ramp duration, Pmin can also count toward meeting the maximum continuous ramping requirement.[2] While the ISO encourages all dispatchable capacity to bid into the ISO's real-time market, a portion of the maximum continuous ramp may be met by flexible resources that are ramping from one self-schedule to another. For 2013, the ISO would not prohibit resources contributing to the maximum continuous ramp from self-scheduling. For 2014 and beyond, the ISO will reevaluate self-scheduling rules.

2.2.2 *What is load following?*

Load following is the ramping capability of a resource to match the maximum megawatts by which the net load is expected to change in either an upward or a downward direction in a given hour for the relevant resource adequacy compliance month. The ISO is proposing a 1-hour timeframe for this category to ensure that enough unloaded capacity with a defined ramping capability is available to be dispatched on a five-minute basis through the ISO real-time dispatch market application.

To determine the load-following capacity of a resource, the resource must have a ramping capability greater than the ramping capability of resources meeting the continuous ramp criteria.

[2] See Table 3 for a list of the monthly duration periods.

Load following capacity is calculated as follows:

For resources with a start-up time ≥60 minutes:

- min((NQC-Pmin),60min*RRavg)

For resources with a start-up time < 60 minutes:

- min(Pmin+(60-SUT)*RRavg, NQC)

Where:

SUT is the start-up time; and

RRavg is the weighted average ramp-rate. The weighted is based on the MW size of a resources ramp-rate segment.

2.2.3 *What is regulation?*

Regulation is the capability of a generating unit to automatically respond during an intra-dispatch interval to the ISO's four-second automatic generation control signal to adjust its output to maintain system frequency and tie line load with neighboring balancing area authorities.

Only resources that are certified to provide regulation by the ISO will be eligible to satisfy the regulation flexible capacity requirement. To determine the regulation capacity requirement of a resource, the ISO will look at the weighted average ramp rate of the unit over the range for which it can provide regulation. The regulation flexible capacity requirement is satisfied if the sum of the five-minute capacity with a defined ramp rate from all resource adequacy regulation resources exceeds the maximum five-minute change of the net load for each month. The regulation requirement is expressed as a megawatt per minute value.

For 2013, the ISO proposes not to set a minimum regulation requirement. The risk of insufficient regulation capacity in 2013 is low and all regulation-certified resource adequacy resources are obligated to make their regulation service available to the ISO.

The following table summarizes the characteristics of the three types of flexible capacity.

Table 1: ISO Proposed Flexible Capacity Requirement Categories

Maximum Continuous Ramp	Load Following	Regulation
Maximum Capacity (MW): Maximum Continuous Upward Net Load Ramp for the Month **Ramp Rate (MW/min):** Maximum Capacity/Ramp Duration	**Capacity (MW):** Maximum 1-hour upward Change in Net Load **Ramp Rate (MW/min):** Maximum Capacity Change in 1-hour/60	**Capacity (MW):** Maximum 5-minute Change in Net Load **Ramp Rate (MW/min):** Maximum 5-minute Change in Net Load/5
Requirement is determined by largest continuous ramping period in the relevant month.	Requirement is the 1-hour capacity need and the 60-minute ramping capability need in the relevant month.	Requirement is the need for 5-minute capacity expressed as a MW/min ramp rate in the relevant month.
Unit must respond to ISO dispatch instructions. Renewable generation and base load units are not eligible to provide this capacity.	Unit must respond to ISO dispatch instructions.	Units must be regulation certified.
Each resource's contribution is ramping capacity over the time period: • NQC – Pmin if the unit cannot start within the maximum continuous ramping period. • NQC if the unit starts and reaches NQC during the maximum continuous ramping period.	Each resource's contribution is the minimum of: • NQC - Pmin • Ramp Rate(/minute) * 60 minutes • Ramp Rate based on the MW weighted average ramp-rate of the resource for a resource with different ramp-rates for different operating ranges (i.e., use the megawatt size of the operating zone to weight the ramp rate for that zone).	Each resource's contribution is: • Ramp rate based on the MW weighted average ramp rate of the resource for the operating ranges where it can provide regulation. • No regulation requirement set for 2013.

2.3 Does flexibility include upward and downward ramping capability?

Yes, flexibility is characterized by – (i) a resource's ability to move both up and down, to produce or curtail energy, (ii) a demand resource's ability to consume or curtail energy, and (iii) a storage device's ability to charge or discharge – based on an ISO dispatch instruction or automatic generation control signal.

For 2013, the ISO will not separately require downward ramp capability, but will assume that any resource that counts for flexible capacity can ramp up and down. In subsequent years, both upward and downward ramping needs will be considered. For example,

regulation up and down are separate ancillary services, so sufficient regulation would need to be available in both directions as flexible capacity. This will be further discussed and developed by the ISO for 2014 and beyond.

2.4 Is needed flexibility provided by resources participating in the market?

No. The ISO is concerned that, without a flexible capacity requirement, the resources participating in the market may provide some level of flexibility, but it may not be sufficient to meet the ISO's reliability needs. As an extreme example, if all resource adequacy capacity were either base load, intermittent, or fully self-scheduled, the current resource adequacy requirement would be met, but there would be no flexible capacity available to operate the grid under normal conditions. While the ISO expects flexibility from the fleet of resource adequacy resources, hoping that sufficient flexibility is provided based on market participation alone is not a sound strategy. The risk of a shortage moving into the future is unacceptably high without an express requirement.

3.0 Why is a flexible capacity requirement needed in 2013?

Adopting a flexible capacity requirement for the 2013 resource adequacy program will ensure that the ISO has sufficient flexible capacity available in 2013 and beyond to manage current and incremental operation needs as more intermittent resources come on-line over 2012-2013 period. Establishing these requirements now for 2013 will allow us to gain experience and make refinements to the requirements in subsequent years so that the program is robust and well established in the 2015-2017 timeframe when we will have even higher penetrations of renewable resources and once-through-cooled generation retirements underway. Finally, having these requirements in place beginning in 2013 will mitigate the need for the ISO having to resort to ISO backstop procurement to address flexibility deficiencies in the resource adequacy fleet.

The CPUC's resource adequacy program imposes local and system resource adequacy procurement obligations on its jurisdictional load-serving entities for each month in the resource adequacy compliance year. To date, the Commission has not imposed an obligation on those load-serving entities to procure resources with specific operational characteristics. Load-serving entities are not required to demonstrate that they have procured capacity with specific operational characteristics in their year-ahead or month-ahead resource adequacy showings. Accordingly, the characteristics of the resource adequacy fleet available to reliably operate the grid during the compliance period may or may not meet the operational flexibility required by system conditions, especially in light of the grid transformation occurring over the next few years.

Going forward, the prudent course is for the ISO and CPUC to begin the challenging transition to the new supply paradigm, which means operating with a more variable and less predictable supply fleet. We must start this transition now by establishing and refining rules that will ensure reliability for the very near future. Any decision to avoid or delay a timely

transition is untenable and only shortens the limited time we have to "get it right." In the end, the risks of doing nothing versus doing something are asymmetric. Securing too little flexible capacity in 2013 may not be correctable until several years later given the time to re-commercialize retired resources or build new ones. Since over the next few years the need for flexible capacity will continue to grow with the addition of new renewable resources and, as existing once-through-cooled plants retire, the situation will worsen before it will improve. Specifically, the ISO is concerned about the following three issues:

1. The once-through-cooling policy will reduce the number of flexible resources;
2. Intermittent resource additions will quickly displace flexible capacity in meeting resource adequacy obligations; and
3. Flexible resources will retire prematurely due to revenue insufficiency unless there are enhancements to the resource adequacy program.

3.1 The once-through-cooling water policy reduces fleet flexibility.

In 2010, the State Water Resources Control Board adopted a rule to reduce the effects associated with cooling water intake structures on marine and estuarine life.[3] According to the California Energy Commission, the once-through-cooling rule and the emission offsets for new fossil power plants "are two of the most important challenges facing the electricity generating industry."[4]

Implementation of the once-through-cooling rule makes grid planning more challenging. The rule affects sixteen power plants within the ISO grid, which to comply, must retrofit, repower or retire. About 17,500 megawatts of generation are subject to the once-through-cooling policy, which has phased-in levels of compliance through 2024. Over the next six to eight years, the ISO anticipates that 12,079 megawatts of the 17,500 megawatts of once-through-cooled flexible generating units will retire absent long-term power purchase agreements that make it financially feasible to repower or retrofit the resources. The ISO's core concern around the rule is well expressed by the California Energy Commission in its recently published 2011 Integrated Energy Policy Report:

> To reduce impacts [of the OTC rule], many of the owners of California's aging power plants are choosing to retire rather than make capital investments in the facility, causing a need for new capacity to satisfy peak demand and appropriate reserves. However, licensing new power plants is difficult, given the scarcity and corresponding cost of offsets required to avoid harmful impacts on air quality. Even repowering at the site of an aging power plant has its challenges. So, while policies to reduce the use of OTC are increasing the demand for new power plants, air quality constraints are restricting the development of fossil fuel power plants. This complexity is especially apparent in those areas of the state where existing air quality fails to satisfy ambient standards. The South Coast Air Basin, for example, is experiencing the full effects of these opposing forces. To satisfy local capacity

[3] http://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/index.shtml

[4] California Energy Commission Integrated Energy Policy Report, January 2012, at pg. 112.

> requirements (LCR) and help integrate variable renewable generation, the region will have to replace some of its older capacity with dispatchable, flexible fossil power plants when existing OTC power plants retire.[5]
>
> …
>
> Most owners of California's plants that use once-through cooling would prefer to repower them, according to implementation plans submitted in April 2011, but no owners indicated willingness to make the necessary investment without a long term power purchase agreement. Similarly, plant owners say they would need long-term power purchase agreements to finance refitting their existing plants with alternative cooling technologies. Retirement of these plants will increase the need for new generating capacity to satisfy peak electricity demands and maintain appropriate reserves. [6]

Without any assurance that a portion of these resources will be replaced, the ISO, together with the CPUC and other local regulatory authorities, must ensure that a robust and effective procurement framework is in place to ensure sufficient flexible capacity is available.

3.2 New intermittent resources risk displacement of flexible capacity resources.

The 33 percent renewables portfolio standard is a floor, not a ceiling on mandated energy deliveries from renewable resources. Over the next six to eight years, the ISO anticipates the addition of 13,600 megawatts of new wind and solar resources and the retirement of 12,079 megawatts of once-through-cooled flexible generation resources.

Along with these additions and retirements, substantial amounts of renewable distributed generation resources are being developed as relatively small-scale and largely inflexible resources connected to utility distribution systems and located close to load. Distributed generation is a key component of California's strategy for increasing the share of renewable resource electricity production in the state. The state has adopted a goal of 12,000 MW of distributed generation by 2020.

Load-serving entities want their distributed generation procurement to count toward resource adequacy requirements. Since a majority of the distributed resources built will be inflexible photovoltaics, if counted as resource adequacy capacity, these will displace flexible resources under the CPUC current resource adequacy program.

The ISO's fundamental concern is that new intermittent and distributed resources will displace existing flexible dispatchable capacity that currently satisfies a portion of the 115

---

[5] California Energy Commission Integrated Energy Policy Report, January 2012, at p. 112.

[6] Id. at p. 3.

percent local and system resource adequacy capacity requirement. Without sufficient flexible resources in the fleet, the ISO will be unable to reliably operate the grid. The ISO proposal is to set a flexible capacity requirement for 2013 that ensures a reasonable amount of ramping capability exists and prevents the degradation of flexible capacity. For these reasons, the ISO strongly believes that refinements to preserve flexible capacity resources must be determined in this phase of the CPUC's resource adequacy proceeding.

3.3 Retirements threaten fleet flexibility

Renewable resources will offset energy sales from conventional flexible resources. Table 2 below demonstrates this fact *even* at the 20 percent renewables portfolio standard achievement level. As dependence on conventional, flexible generation increases to balance swings in load net of variable generation, capacity and energy revenues will decrease. Diminished energy sales from conventional flexible resources increase the probability of their retirement.

Table 2: 20% RPS Flexible Capacity Impacts Relative to the 2012 Reference Case[7]

	Combined Cycle	Simple Cycle	Gas Fired Steam Turbine
Number of starts	35 %	-21 %	-22 %
On-peak Energy (MWh)	-11 %	-39 %	-29 %
Off-peak Energy (MWh)	-16 %	-33 %	-18 %
Revenue ($,000)	-16 %	-39 %	-29 %

Thus, the Commission's resource adequacy program, and the programs of other local regulatory authorities, must ensure that these flexible resources remain viable and available to the ISO to maintain system reliability and to minimize the need for procurement through ISO backstop mechanisms.

[7] ISO Integration of Renewable Resources 20% RPS Report, August 31, 2010, at p.87. The 2012 reference case uses the same load and other assumptions as the 20 percent RPS case, except that the renewable portfolio includes only the renewable resources online in 2006.

4.0 What are the risks of waiting to set a flexible capacity requirement until 2014?

4.1 Lost opportunity

Time is short and the issues are pressing. Any refinements not adopted in this proceeding will be delayed for further consideration until 2014. The more delay, the more compressed are the opportunities to plan and refine the CPUC's resource adequacy program in time to have the flexible capacity requirement in place as increasing renewable resources come on-line and once-through-cooled resources retire. Also, the less time, the less "incremental" the necessary modifications will be to the program to address the changing resource mix. If the CPUC, in this proceeding, delays a decision on the ISO's proposed transitional flexible capacity requirement for 2013, there will be a lost opportunity and more pronounced modifications to the resource adequacy program will be needed in 2014.

4.2 Lost flexibility

At the workshop, SCE suggested the CPUC consider a flexible capacity pilot for 2013. The ISO's concern with a pilot is that a pilot does not preserve existing flexibility for 2014 and beyond, and it allows for the potential degradation of the fleet by an additional year. It is necessary that the CPUC take steps now to preserve fleet flexibility as a bridge to 2014 and beyond.

4.3 Delayed learning curve

The ISO believes that the three flexible capacity categories — maximum ramping, load following and regulation — have durability, even though the ISO may refine the megawatt requirement values by category in future years. It is prudent for the Commission to take an incremental step in 2013 to establish a flexible capacity requirement. In this way, market participants have the opportunity to plan and procure for flexible capacity resources and gain experience that will help the process for future years, prior to the need for flexible capacity becoming overwhelmingly urgent.

5.0 What are the flexible capacity requirements for 2013?

In response to CPUC workshop participants' comments, the ISO submits this supplemental information to its flexible capacity proposal filed on January 13, 2012. This supplement moves away from an inventory-based flexible capacity requirement to an analytically determined, needs-based requirement.[8] For 2013, the flexible capacity requirement is assessed based on a historical analysis of the 2011 changes in net load for durations relevant to the three categories of flexible capacity. A comparative analysis of the net load changes for the years 2006, 2010, and 2011 can be found in Appendix A. The year 2006 is included for

[8] California Independent System Operator Corporation Proposal On Phase 1 Issues, R.11-10-023, January 13, 2012. The proposal is posted on the ISO's website at http://www.caiso.com/Documents/2012-01-13_Phase1Proposal_FlexCap.pdf

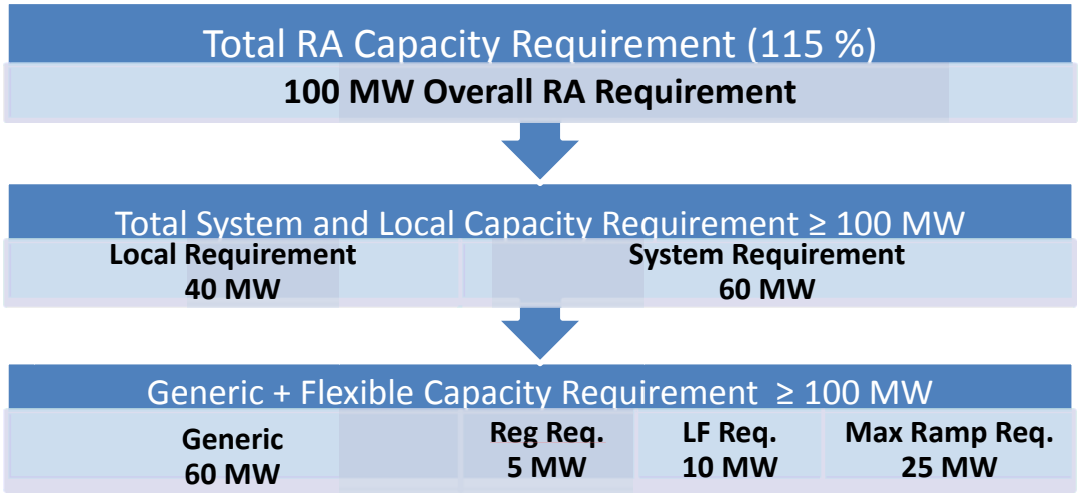
comparative purposes as it represents the year with the highest peak loads recorded by the ISO.

For 2014 and beyond, the ISO intends to produce a forward looking needs-based analysis of load and net load ramps, which best aligns with the ISO's methodology used in the renewable integration studies.

For 2013, the ISO proposes not to set a minimum regulation requirement. Although regulation is an important operational characteristic and should be included as a specific requirement in a future resource adequacy program, the risk of insufficient regulation capacity in 2013 is low and all regulation-certified resource adequacy resources are obligated to make their regulation service available to the ISO. Additionally, with the implementation of regulation pay-for-performance measures, the ISO expects to have additional information in the future that better defines regulation requirements in terms of capacity and performance. Specific regulation requirements will be re-evaluated for 2014 and beyond.

Further, similar to how local capacity counts as system capacity, the ISO proposes that the three flexible capacity categories contribute to the overall generic capacity requirement resulting in four capacity categories. The four capacity categories are: generic capacity, maximum continuous ramping, load following, and regulation. Generic capacity is then further defined by its locational attribute: system or local capacity. Figure 2 below illustrates how each capacity category must ultimately add up to the overall 115 to 117 percent resource adequacy capacity requirement.

Figure 2: Each Capacity Category Must Equal the Overall RA Capacity Requirement



Many flexible resources will be able to provide megawatts in three of the flexible capacity categories; however, certain other resources may only be able to provide generic resource adequacy capacity (i.e., they have no flexibility) or just one or two categories of flexible capacity. To allow for these varying levels of flexibility, the categories are not mutually exclusive by resource. A flexible resource located in a local capacity area may fulfill

all capacity requirements depending on its operational capabilities– system, local, regulation, load following and maximum continuous ramping. Examples of how a resource can be eligible to provide multiple categories of flexible capacity are shown below in Figure 3 and Figure 4.

Figure 3: Resource Eligible to Provide All Categories of Flexible Capacity

Example 1:

NQC = 500 MW, Pmin = 300 MW
Ramp rate =10MW/min, regulation certified
3-hour start-up time (SUT)
Not self-scheduled

- Provides the following RA capacity:

Generic:	500 MW	(NQC)
Maximum Ramping	500 MW	(NQC, SUT< Max Ramp Period)
Load Following	200 MW	(NQC – Pmin, since SUT> 1 hr.)
Regulation	10 MW/min	

Figure 4: Resource Not Eligible to Provide All Categories of Flexible Capacity

- Example 2:

NQC = 500 MW, Pmin = 200 MW
Ramp rate = 3 MW/min, not regulation certified
18 hour start-up time (SUT)
Not self-scheduled

- Provides the following RA capacity:

Generic:	500 MW	(NQC)
Maximum Ramping	300 MW	(NQC - Pmin, SUT> Max Ramp Time)
Load Following	180 MW	(3 MW/min * 60 min)
Regulation	0 MW/min	(not regulation certified)

5.1 What are the proposed system flexible capacity requirements for 2013?

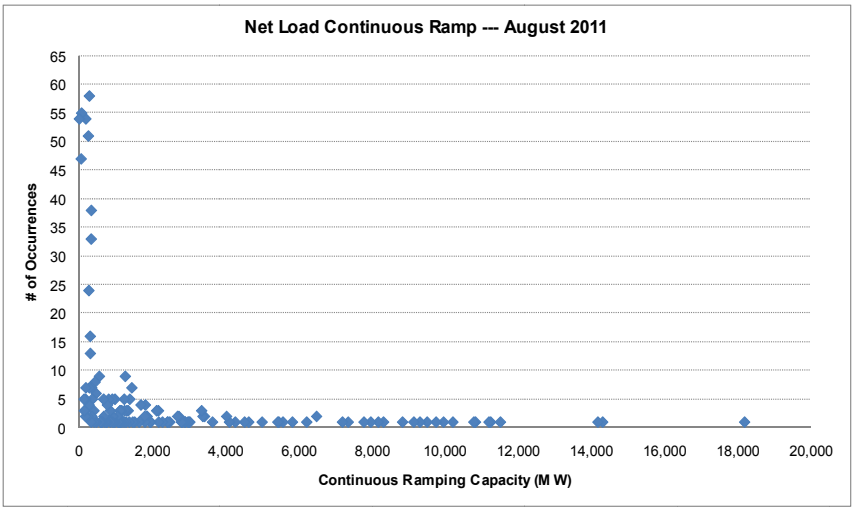
Table 3 below lists the proposed 2013 resource adequacy requirements for each of the three flexible capacity categories by month for the ISO balancing authority area. The maximum continuous ramping capacity is based on the duration of the continuous upward ramp for each month. For the regulation requirement, while Table 3 shows the approximate regulation requirement based on analysis of the net load 1-minute change within any 5-minute interval, the ISO recommends that a regulation requirement not be set in 2013, but be evaluated for use in 2014 and beyond, based on additional information provided by the implementation of regulation pay-for-performance metrics.

Table 3: ISO Proposed 2013 Flexible Capacity Requirement

2011							
Monthly System Requirements	Maximum Continuous Ramp			60-Minute Load Following Requirement		Regulation Requirement	
	Capacity (MW)	Ramp Rate (MW/min.)	Duration (Hr.)	60-min Capacity (MW)	Ramp Rate (MW/min.)	5-minute Capacity (MW)	Ramp Rate (MW/min.)
January	8,133	32.7	4.2	3,935	66	664	132.8
February	6,982	32.8	3.6	3,630	60	656	131.3
March	5,453	26	3.4	3,271	55	1,020	204.0
April	8,859	20	7.4	2,897	48	544	108.7
May	8,000	22	6.0	2,951	49	678	135.7
June	11,382	32	5.9	2,637	44	637	127.5
July	13,544	23	9.8	3,137	52	840	167.9
August	18,181	27	11.1	2,933	49	686	137.1
September	17,824	34	8.7	3,004	50	634	126.8
October	9,510	20	7.8	3,514	59	635	126.9
November	7,855	22	5.9	3,746	62	1,351	270.2
December	7,577	29	4.3	4,506	75	668	133.7

Figure 5 highlights the number and magnitude of maximum continuous ramp periods for August 2011.

Figure 5: Number and Magnitude of Continuous Ramp Periods from August 2011



5.2 How much flexible capacity must be shown by LSE's annually and monthly?

The ISO proposal is that each load-serving entity shows procurement of 90 percent of its flexible capacity requirement on the annual resource adequacy showing and 100 percent procurement of the requirement on the monthly resource adequacy showing. The ISO is also

proposing that the annual showing be changed to require a showing for all months, rather than just the five summer months. This change is necessary so that the ISO can assess the flexibility of the fleet for that resource adequacy compliance year.

5.3 Why is the ISO proposing a monthly flexible capacity requirement?

The ISO is proposing that flexible capacity requirements be established for each month of the year. Establishing the requirements monthly will recognize that the amounts of flexible capacity needed differ month to month. The flexible capacity requirement will be assessed based on analysis of the 2011 changes in net load for durations relevant to the three categories of flexible capacity.

5.4 Is market power a concern in 2013 for the amount of flexible capacity required?

No. The inventory of traditional flexible capacity resources that can provide maximum continuous ramping and load following capacity, as shown in Table 4 and Table 6 below, should provide sufficient procurement headroom in 2013 to avoid any market power concerns.

Table 5 shows the depth of the 2011 fleet that can provide maximum continuous ramping capacity relative to the proposed 2013 maximum continuous ramping capacity requirement. The worst case is September where the amount of maximum continuous ramping capacity is 66 percent of the fleet capability.

Table 4: Maximum Continuous Ramping Capability (excluding hydro)

Fleet Capability	Month											
Technology	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
Combined Cycle	7,493	8,301	8,160	10,770	9,596	9,554	10,557	11,858	10,701	10,655	9,575	8,301
Gas Turbine	3,905	3,902	3,880	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905	3,905
Pump-Storage	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330
Steam	11,266	11,266	11,266	11,266	11,266	11,266	11,266	11,194	11,266	11,266	11,266	11,266
Grand Total	23,994	24,799	24,636	27,271	26,098	26,055	27,058	28,287	27,202	27,156	26,076	24,803

Table 5: Percent Maximum Continuous Ramping Requirement to Fleet Capability

Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
34%	28%	22%	32%	31%	44%	50%	64%	66%	35%	30%	31%

Table 6: Load Following Capability (excluding hydro)

Load Following Capability	
Technology	**Total (MW)**
Combined Cycle	8,176
Gas Turbine	3,504
Pump Storage	1,330
Steam	10,235
Grand Total	23,244

The highest 60-minute load following need in 2011 occurred in December, which was 4,506 megawatts. The ISO fleet in 2011 had 23,244 megawatts of load following capability in 2011.

5.5 How would the ISO determine compliance with a flexible capacity requirement?

Based on the annual and monthly showings each load-serving entity submits, the ISO will evaluate the quantity of flexible capacity provided in each of the three flexible capacity categories for the respective annual or monthly time period for the total system and by local-regulatory authority. If all load-serving entities in aggregate demonstrate sufficient system-level flexible capacity, then the ISO has no need to take any further action. However, if in aggregate, the system flexible capacity requirement has not been met, then the ISO will evaluate the showings by load-serving entity. The ISO will notify in writing the deficient load serving entity's scheduling coordinator and the relevant local regulatory authority. The ISO proposes that the local regulatory authority coordinate with its load-serving entities to cure any deficiencies and provide a revised showing to the ISO. If the local regulatory authority's load-serving entities do not cure the deficiency, the ISO may exercise its backstop authority to cure the deficiency and satisfy the system-level flexible capacity requirement. The specific form of this backstop procurement and the allocation of the backstop procurement costs are being considered in the ISO's flexible capacity procurement stakeholder process.

6.0 What resources are eligible to provide flexible capacity?

As a general principle, the ISO proposes that all resource adequacy resources be eligible to provide flexible capacity, except those resources that are unable to respond to ISO dispatch instructions. Under this criterion, most renewable generation resources, which generate only when the sun is shining or the wind is blowing, base load generation, such as the nuclear units that do not respond to dispatch instructions unless there is a system emergency, and other physically or contractually limited resources should not count as flexible capacity if they cannot respond to ISO dispatch signals. Eligibility rules require further stakeholder input and will be developed fully through the ISO's flexible capacity procurement initiative. Eligibility will be discussed in greater detail in the ISO's straw proposal to be published in March as part of that initiative.

6.1 Will the ISO be able to quantify the amount of flexible capacity by resource?

Yes, the ISO intends to produce a table identifying the flexible capacity attributes of each resource adequacy eligible to provide flexible capacity and provide this information to the respective resource owners, or, if not subject to confidentiality concerns, make it available through the ISO's website.

The maximum contributions a dispatchable resource can contribute to load following and maximum continuous ramping are as follows:

- Load Following:
  - For resources that have a startup time ≥60min:
    - min((NQC-Pmin),60min*RRavg)
  - For resources that have a startup time <60min:
    - min(Pmin+(60-SUT)*RRavg, NQC)
- Maximum Continuous Ramping
  - For resources that have a startup time ≥ the longest ramp duration:
    - min((Pmax-Pmin),ramp duration*RRavg)
  - For resources that have a startup time < the longest ramp duration:
    - min(Pmin+(longest ramp duration--SUT)*RRavg, NQC)

      Where:

      SUT is the start-up time; and

      RRavg is the weighted average ramp-rate. The weighting is based on the megawatt size of a resource's ramp-rate segments.

6.2 Could the ISO procure a once-through-cooled resource for flexible capacity under its backstop procurement authority?

In compliance year 2013, if the resource adequacy showings indicate a deficiency in a flexible capacity category, and if it is not cured by a load-serving entity, the ISO could use backstop authority to procure a once-through-cooled resource that could provide the flexible capacity required.

6.3 How do use-limited resources count toward flexible capacity?

For 2013, the ISO proposes allowing a maximum of 15 percent of the maximum continuous ramping requirement to come from use limited resources, and the balance coming from non-use limited resources. This will enable use-limited resources to contribute during ramps that are greater than one standard deviation over the mean ramp.

6.4 Can demand response and storage devices count toward flexible capacity?

If a demand response resource or storage device is dispatchable in the ISO market, and is capable of providing one or more of the flexible capacity requirements, then, subject to the rules of the CPUC and other local regulatory authorities, as applicable, these resources would be eligible to provide flexible capacity.

6.5 Are long-start resources eligible to provide flexible capacity?

Yes. Long-start units are eligible to provide flexible capacity. If a long-start resource can start in less than the maximum continuous ramping monthly duration period, then the resource's full net qualifying capacity may count as flexible capacity. The maximum ramping capacity for a long start unit that requires a start time greater than the monthly duration period would be its net qualifying capacity minus Pmin, assuming that this value is less than the unit's ramp rate multiplied by the monthly duration hours.[9]

7.0 Flexible capacity proposal for 2013

The implementation of a flexible capacity procurement requirement for compliance year 2013 requires CPUC action in this proceeding to modify the resource adequacy program and FERC approval of the tariff amendments that result from the ISO stakeholder process on flexible capacity procurement. In this section, the ISO describes its general concept of the flexible capacity procurement requirement for 2013 under the composite regulatory provisions. Certain elements of the requirement, such as self-scheduling rules and ISO backstop authority, will be developed more thoroughly in the ISO's flexible capacity procurement stakeholder initiative. The straw proposal in that initiative will be issued in March and will contain additional information about those elements of requirement envisioned for 2013. Upon issuance, the ISO will provide the straw proposal to the CPUC and the parties in this proceeding.

7.1 ISO flexible capacity procurement requirement proposal for 2013

7.1.1 *Eligible resources*

The ISO will compute the flexible capacity amount that each resource adequacy resource can provide in the three separate flexible capacity categories. For 2013, the ISO proposes that all resource adequacy resources be eligible to provide flexible capacity, including dynamically scheduled resources and pseudo-ties within their resource adequacy import limitations; except that the following resources will not be eligible to provide flexible ramping capacity:

1. Base load resources – This includes, for example, nuclear-fueled generators and other resources that produce energy at a relatively constant rate to meet continuous energy demand, which have limited or no flexibility.

[9] See Table 3 for a list of the monthly duration periods.

2. Intermittent resources – This includes solar photovoltaic and wind resources that can only produce energy when the fuel source is available, i.e., sunshine or wind. These resources have no inherent upward ramp capability.
3. Hydro-electric generation– Hydro resources can be very flexible, but are often constrained by water and environmental regulations. The ISO and stakeholders will require more time to properly assess the flexibility of hydro-electric resources. Their eligibility to provide flexible capacity should be deferred for further consideration.
4. Hourly intertie resources – The limited flexibility of hourly intertie schedules prevents their ability to provide flexible capacity.

7.1.2 *Partial flexible capacity procurement*

Like other resource adequacy capacity, a portion of a resource's availability capacity can be procured as flexible capacity. For example, capacity below a very long start resource's Pmin can count toward the system or local capacity requirement, but would not count as maximum continuous ramping if it cannot fully ramp during the maximum continuous ramping period.

7.1.3 *Must offer obligations*

For 2013, the ISO is not proposing any change to the resource adequacy must offer obligations under the ISO tariff. All resource adequacy resources will be required to submit bids for energy and certified ancillary services, along with a bid of zero in the residual unit commitment.

7.1.4 *Self-scheduling rules*

For 2013, the ISO does not propose to prohibit flexible capacity resources from submitting self-schedules in the day-ahead and real-time markets, as the resource adequacy resources can today. This will be re-evaluated for 2014 and beyond.

7.1.5 *Annual and monthly showing rules*

In the annual resource adequacy showings to the CPUC, each jurisdictional load-serving entity will have to demonstrate 90% procurement of resource adequacy requirements, 100% procurement of local capacity requirements, and 90% procurement of the flexible capacity requirements. In the 2013 monthly showings, each LSE must show 100 percent procurement of all requirements.

The ISO is also proposing that the annual showing for system capacity and flexible capacity be changed from the current form of only the five summer months to all months in the year. This will enable the ISO to make a preliminary assessment of flexible capacity based on the annual showings.

7.1.6 *Deficiency assessment, when done and how done*

The ISO will conduct deficiency assessments for both the annual showing and the monthly showings. For 2013, the deficiency assessment will be conducted by the ISO in two stages, which the ISO will develop in the stakeholder process. In the first stage, the ISO will assess the flexible capacity provided by all load-serving entities within its footprint using a portfolio assessment. If the combined portfolio does not provide adequate flexible capacity, then the ISO will assess the sufficiency of each individual load-serving entity's portfolio. Flexibility requirements will be set for each local regulatory authority using a load ratio share. Using these allocations and working with the local regulatory authority, the ISO will determine which load-serving entities are deficient. The ISO will notify the respective local regulatory authorities if any of their jurisdictional load-serving entities are do not meet the flexible capacity requirement.

7.1.7 *Opportunity to cure deficiencies*

If after the ISO assesses the overall system flexible capacity needs against the aggregate showings and a deficiency remains, any load-serving entities that do not meet the flexible capacity requirement will have an opportunity to cure their deficiencies. For annual deficiencies, load-serving entities will have 30 days to cure. For monthly showings, load-serving entities will be required to cure the deficiency before the final monthly showing. If deficiencies are not cured within these time frames, the ISO will consider the procurement to be deficient and will exercise its backstop procurement authority to resolve the deficiency.

7.1.8 *Criteria for selecting flexible capacity for ISO backstop procurement*

For 2013, in circumstances where multiple resources are able to provide flexible capacity, the ISO will through its stakeholder process develop the criteria to be used to select which resource will be chosen to provide flexible capacity when the ISO must exercise its backstop procurement authority. Examples of the criteria the ISO will consider are:

1. Effectiveness – The electrical effectiveness of the resource at resolving the required flexible capacity need and, where possible, local capacity need.
2. Least cost– The capacity costs associated with the resource's eligible flexible capacity.
3. Uncontracted for capacity- The amount of capacity a resource has that was not contracted as resource adequacy capacity in the current resource adequacy compliance year.
4. Ramp rate – The ramp rate of a resource.
5. Sustainability – The potential upward ramp capability of the resource (NQC-Pmin).
6. Availability – The resource's amount of flexible capacity.
7. Restrictions – The constraints and use limitations on the resource.
8. Flexible attributes – The ability of the resource to provide flexible capacity in each of the flexible capacity categories.

7.1.9 *Backstop terms and conditions*

The backstop procurement mechanism the ISO will use to procure flexible resources in the event deficiencies are not cured in a timely manner is currently under development in an ISO stakeholder process and subject to FERC approval. The stakeholder process will also consider the cost allocation of the backstop procurement.

8.0 CPUC flexible capacity requirement considerations

The ISO proposes that the CPUC take action to ensure the future reliability of the system by establishing a flexible capacity procurement requirement as part of the 2013 resource adequacy program. The requirement should be based on ISO studies which have consistently demonstrated the dual impacts of increased variable renewable generation and the retirement of once-through-cooled generation resources. Structuring the requirement around the three categories of flexible capacity procurement will give load-serving entities time to adjust and shape their procurement practices and portfolios while they are still in the process of acquiring renewable generation; waiting until their portfolios are fully procured to meet the 33 percent renewables portfolio standard will be too late and could have costly impacts that could be avoided by taking action now.

8.1 Establish load-serving entity authority to procure flexible capacity

Similar to the process used for local capacity requirements, the ISO will publish the total flexible capacity needed by category for 2013 by July 2012. The CPUC and other local regulatory authorities will then require their jurisdictional load-serving entities to procure the required amount of flexible capacity.

8.2 Allocation of the requirement to load-serving entities

The ISO recommends the CPUC allocate the flexible capacity requirement to its load-serving entities by implementing a process similar to the allocation of local capacity for the 2013 resource adequacy compliance year.

8.3 Showing requirements and timing of showings

The CPUC should require its jurisdictional load-serving entities to make an annual resource adequacy showing that meets 90 percent of system procurement requirements for all months, 100 percent of local capacity requirements, and 90 percent of the flexible capacity requirements for all months. Annual showings would be submitted in October as they are today, but should require showings for all months. For each month in 2013, each load-serving entity should be required to show that they are able to meet 100 percent of all requirements. The annual and monthly showings need not show the same resources.

8.4 Deficiency and cure rules

Load-serving entities should have an opportunity to cure deficiencies in the procurement of flexible capacity as determined by the local regulatory authority and in advance of the final monthly showing.

9.0 Conclusion

The implementation of a flexible capacity procurement requirement for compliance year 2013 requires CPUC action in this proceeding to modify the resource adequacy program and FERC approval of the tariff amendments that result from the ISO stakeholder process on flexible capacity procurement. It is critical that we take action this year to put these requirements in place to ensure the resource adequacy fleet can continue to meet the reliability needs of the system for 2013 and beyond. Doing so will also mitigate the need for the ISO to engage in backstop procurement of flexible generation capacity should the utilities fail to procure sufficient flexible capacity on their own.

The ISO has put forth a reasonable, needs-based proposal for 2013 to begin refining the CPUC's resource adequacy program to incorporate flexible capacity. The goal is to preserve sufficient flexible resources that can satisfy the maximum continuous ramping and load following capabilities for 2013 while preparing the way for the 33 percent renewables portfolio standard and the possible retirement of 12,079 megawatts of flexible capacity once-through-cooled resources.

Appendix A:

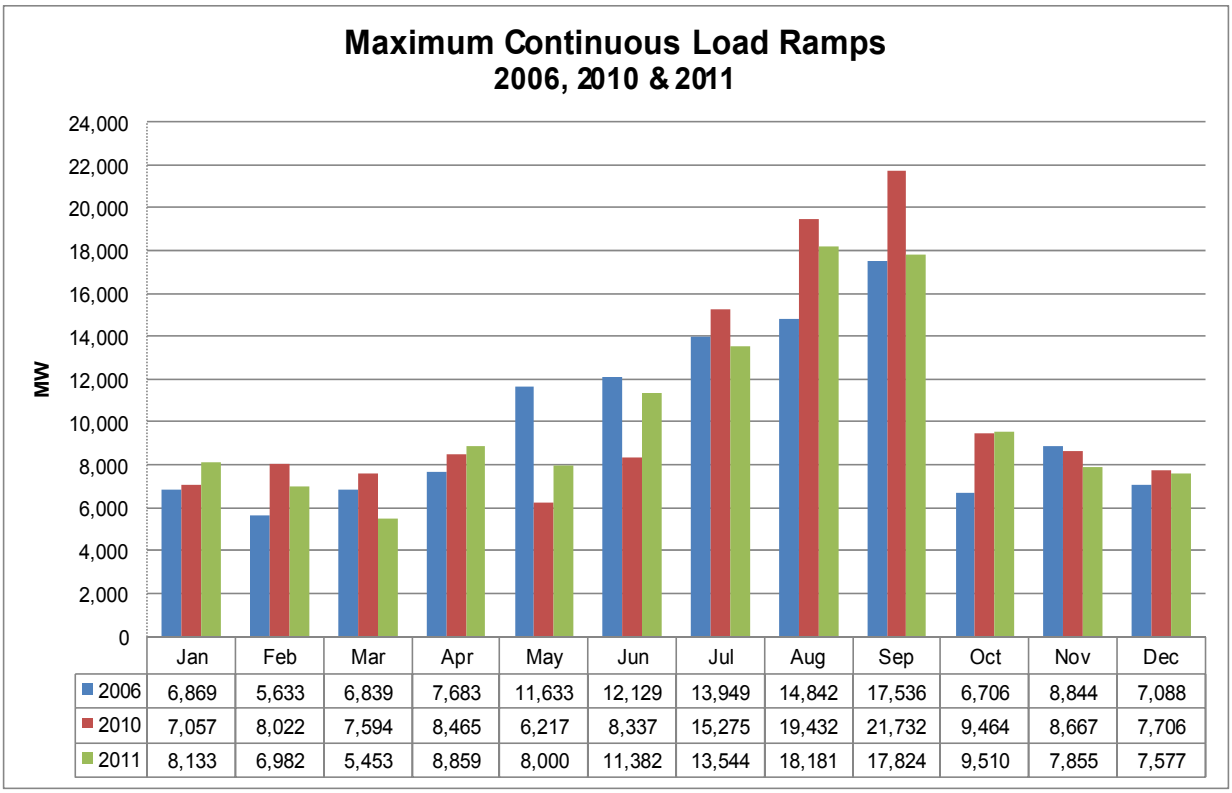
Multi-Year Comparison of Flexible Capacity Needs: 2006, 2010, and 2011

The ISO's proposed flexible capacity requirement is based on the 1-minute net load data from 2011. For comparison purposes, the ISO is including here a multi-year analysis of flexible capacity needs based on 2006, 2010 and 2011 1-minute net load data. The year 2006 is included since that year had the highest recorded ISO coincident peak load, even though it had a lower penetration of variable energy resources than 2010 or 2011.

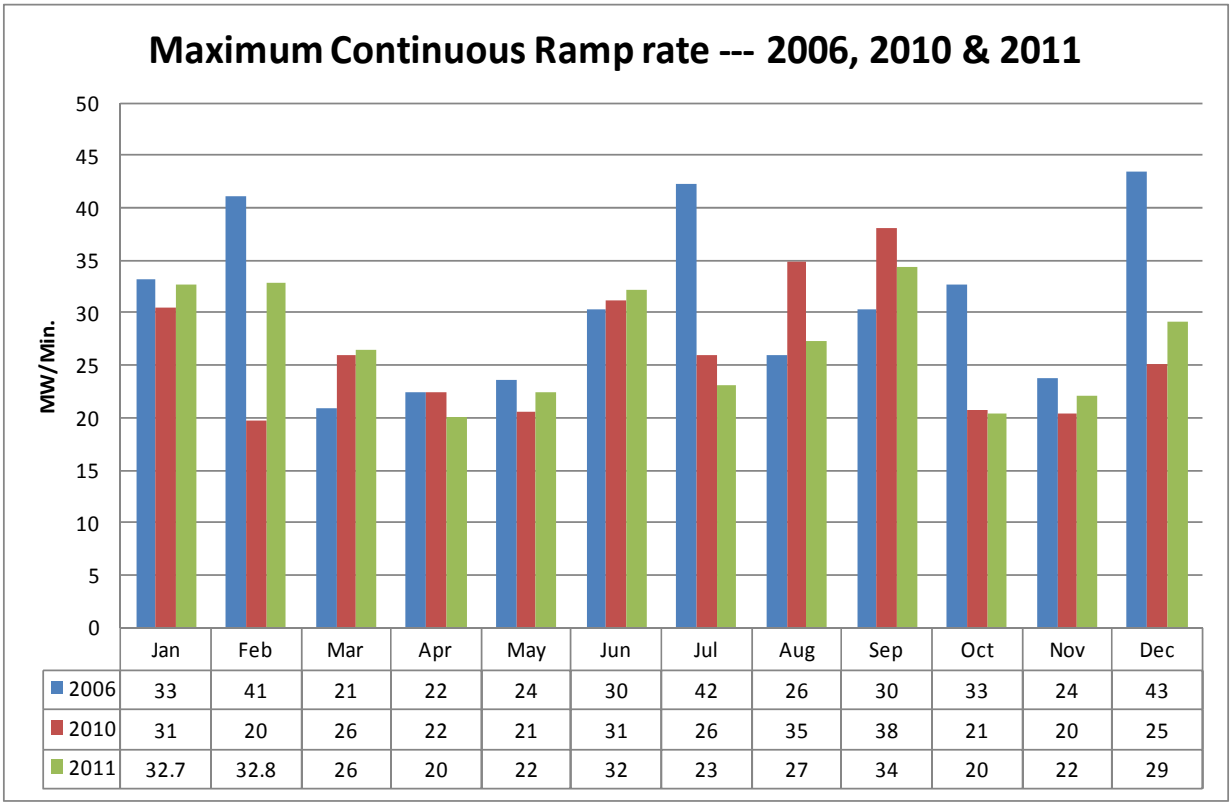
2010							
Monthly System Requirements	Maximum Continuous Ramp			60-Minute Load Following Requirement		Regulation Requirement	
	Capacity (MW)	Ramp Rate (MW/min.)	Duration (Hr.)	60-Min Capacity (MW)	Ramp Rate (MW/min.)	5-Minute Capacity (MW)	Ramp Rate (MW/min.)
January	7,057	31	4	4,120	69	609	122
February	8,022	20	7	3,440	57	645	129
March	7,594	26	5	3,329	55	797	159
April	8,465	22	6	2,629	44	654	131
May	6,217	21	5	2,527	42	544	109
June	8,337	31	4	2,675	45	552	110
July	15,275	26	10	3,061	51	636	127
August	19,432	35	9	3,010	50	674	135
September	21,732	38	10	2,963	49	655	131
October	9,464	21	8	3,531	59	1,430	286
November	8,667	20	7	4,321	72	626	125
December	7,706	25	5	4,198	70	1,667	333

2011							
Monthly System Requirements	Maximum Continuous Ramp			60-Minute Load Following Requirement		Regulation Requirement	
	Capacity (MW)	Ramp Rate (MW/min.)	Duration (Hr.)	60-Min Capacity (MW)	Ramp Rate (MW/min.)	5-Minute Capacity (MW)	Ramp Rate (MW/min.)
January	8,133	32.7	4.2	3,935	66	664	132.8
February	6,982	32.8	3.6	3,630	60	656	131.3
March	5,453	26	3.4	3,271	55	1,020	204.0
April	8,859	20	7.4	2,897	48	544	108.7
May	8,000	22	6.0	2,951	49	678	135.7
June	11,382	32	5.9	2,637	44	637	127.5
July	13,544	23	9.8	3,137	52	840	167.9
August	18,181	27	11.1	2,933	49	686	137.1
September	17,824	34	8.7	3,004	50	634	126.8
October	9,510	20	7.8	3,514	59	635	126.9
November	7,855	22	5.9	3,746	62	1,351	270.2
December	7,577	29	4.3	4,506	75	668	133.7

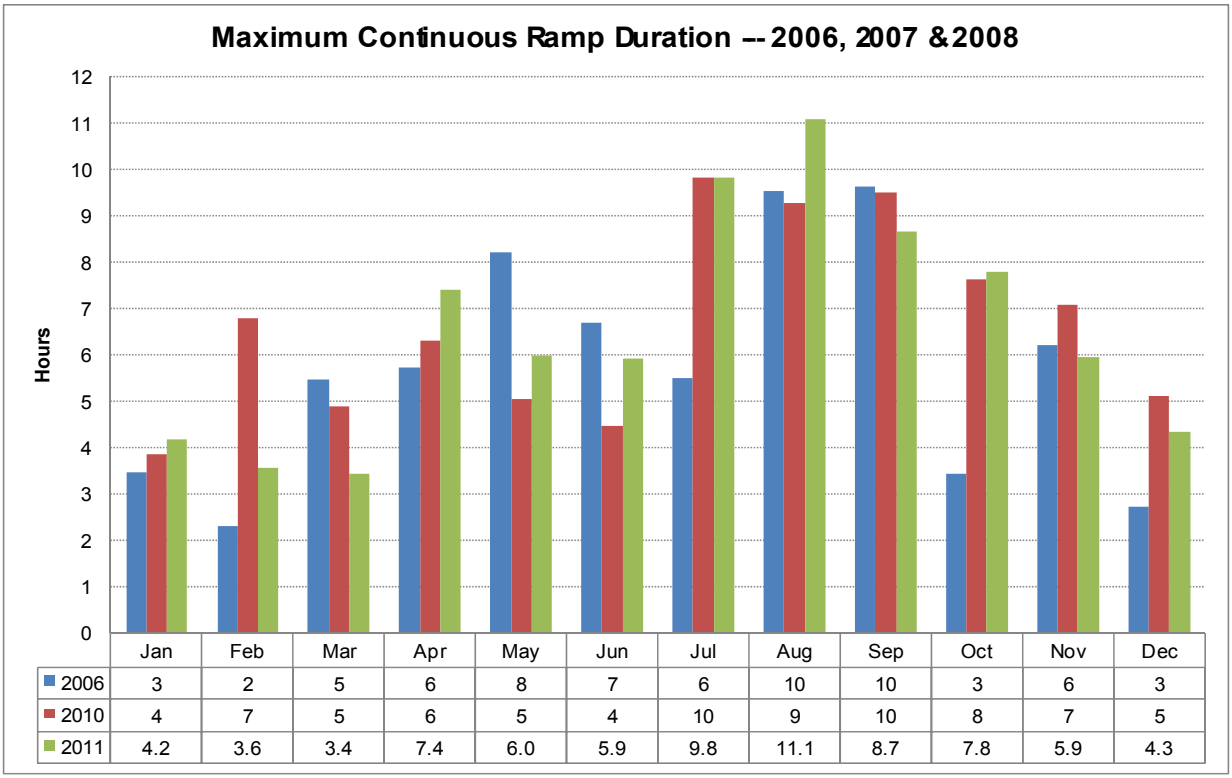
2006							
Monthly System Requirements	Maximum Continuous Ramp			60-Minute Load Following Requirement		Regulation Requirement	
	Capacity (MW)	Ramp Rate (MW/min.)	Duration (Hr.)	60-Min Capacity (MW)	Ramp Rate (MW/min.)	5-Minute Capacity (MW)	Ramp Rate (MW/min.)
January	6,869	33	3	4,217	70	695	139
February	5,633	41	2	3,833	64	1,356	271
March	6,839	21	5	3,414	57	891	178
April	7,683	22	6	3,195	53	1,250	250
May	11,633	24	8	2,839	47	1,520	304
June	12,129	30	7	3,374	56	1,851	370
July	13,949	42	6	3,904	65	1,533	307
August	14,842	26	10	2,887	48	607	121
September	17,536	30	10	2,928	49	620	124
October	6,706	33	3	3,477	58	622	124
November	8,844	24	6	3,969	66	1,429	286
December	7,088	43	3	5,194	87	819	164



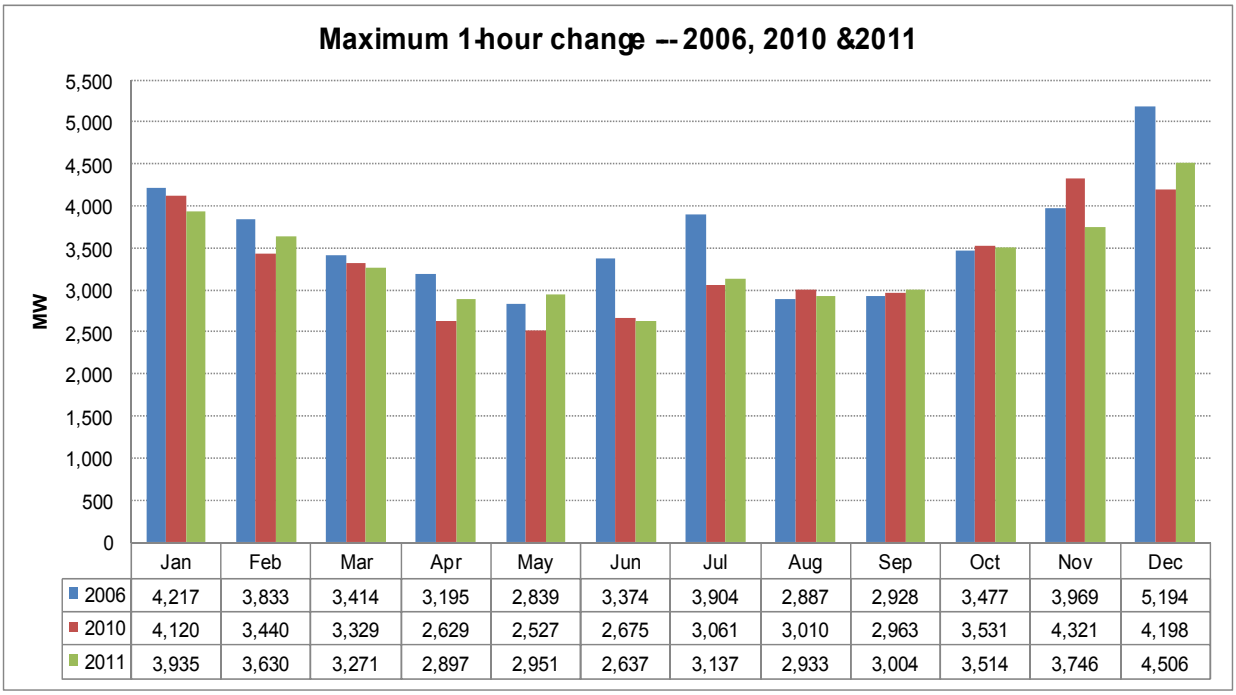
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	6,869	5,633	6,839	7,683	11,633	12,129	13,949	14,842	17,536	6,706	8,844	7,088
2010	7,057	8,022	7,594	8,465	6,217	8,337	15,275	19,432	21,732	9,464	8,667	7,706
2011	8,133	6,982	5,453	8,859	8,000	11,382	13,544	18,181	17,824	9,510	7,855	7,577



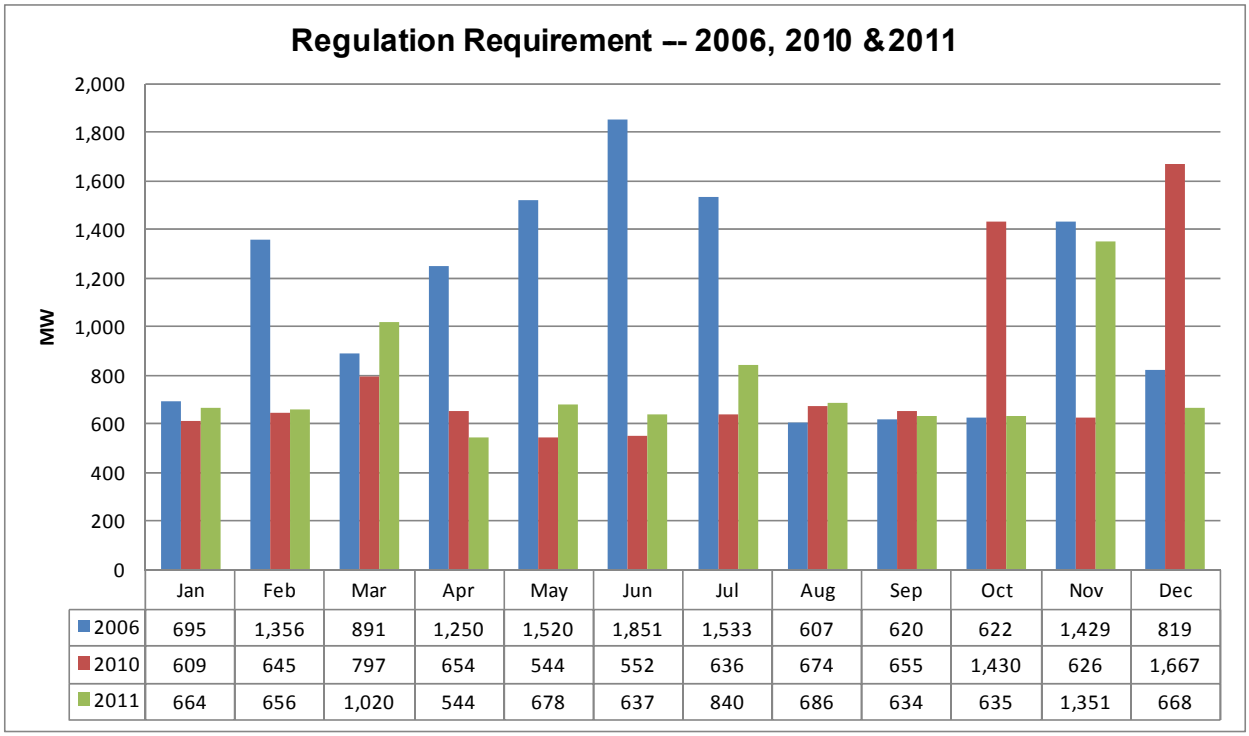
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	33	41	21	22	24	30	42	26	30	33	24	43
2010	31	20	26	22	21	31	26	35	38	21	20	25
2011	32.7	32.8	26	20	22	32	23	27	34	20	22	29



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	3	2	5	6	8	7	6	10	10	3	6	3
2010	4	7	5	6	5	4	10	9	10	8	7	5
2011	4.2	3.6	3.4	7.4	6.0	5.9	9.8	11.1	8.7	7.8	5.9	4.3



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	4,217	3,833	3,414	3,195	2,839	3,374	3,904	2,887	2,928	3,477	3,969	5,194
2010	4,120	3,440	3,329	2,629	2,527	2,675	3,061	3,010	2,963	3,531	4,321	4,198
2011	3,935	3,630	3,271	2,897	2,951	2,637	3,137	2,933	3,004	3,514	3,746	4,506



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	695	1,356	891	1,250	1,520	1,851	1,533	607	620	622	1,429	819
2010	609	645	797	654	544	552	636	674	655	1,430	626	1,667
2011	664	656	1,020	544	678	637	840	686	634	635	1,351	668