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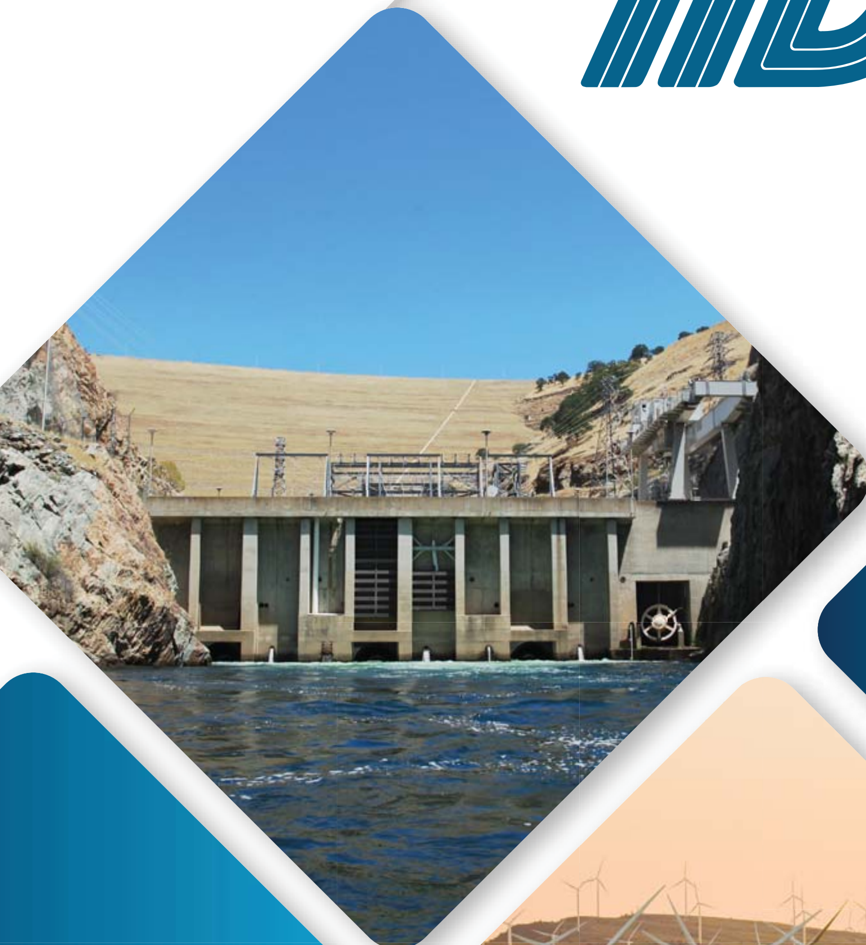
INTEGRATED RESOURCE PLAN 2018 - 2030



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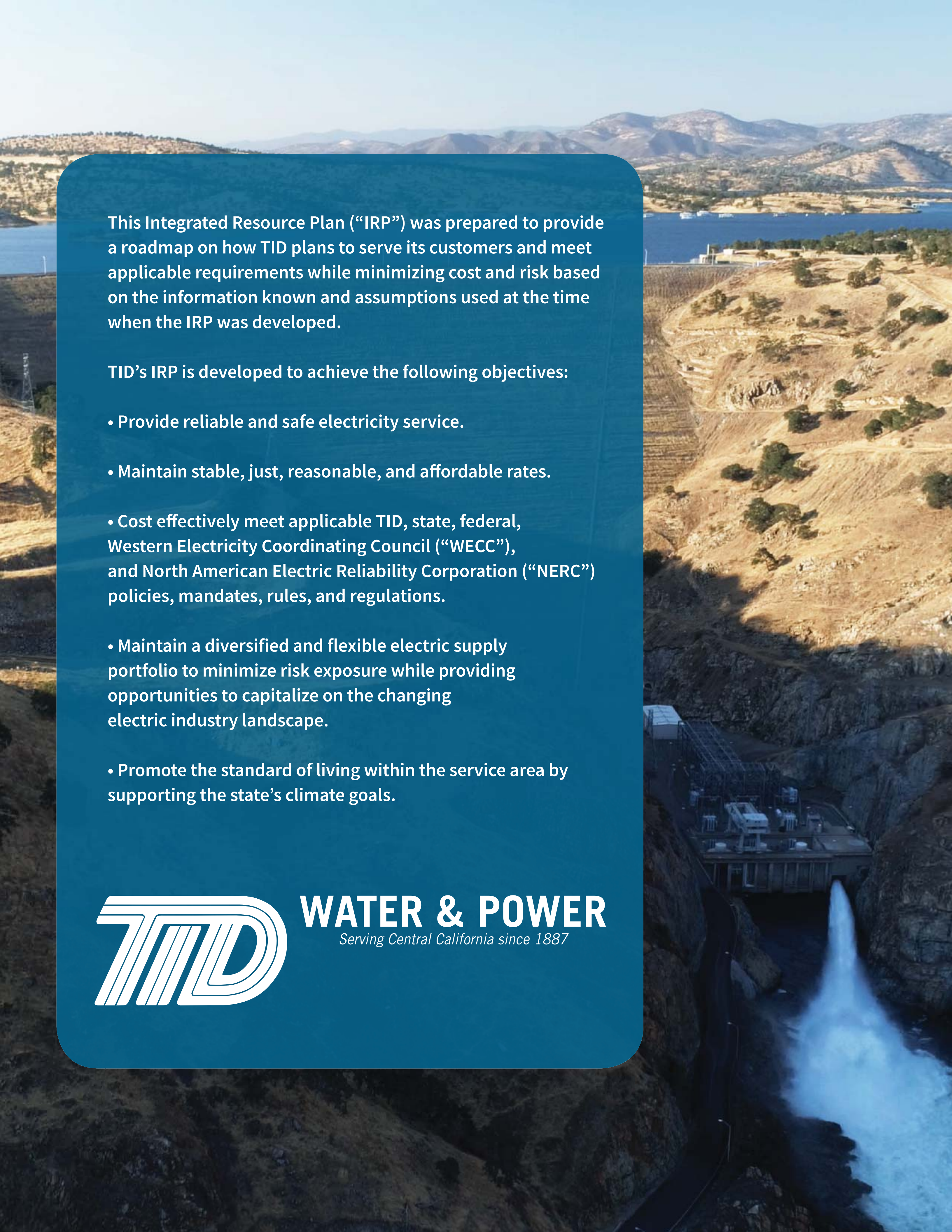

This Integrated Resource Plan ("IRP") was prepared to provide a roadmap on how TID plans to serve its customers and meet applicable requirements while minimizing cost and risk based on the information known and assumptions used at the time when the IRP was developed.

TID's IRP is developed to achieve the following objectives:

- Provide reliable and safe electricity service.

- Maintain stable, just, reasonable, and affordable rates.

- Cost effectively meet applicable TID, state, federal, Western Electricity Coordinating Council ("WECC"), and North American Electric Reliability Corporation ("NERC") policies, mandates, rules, and regulations.

- Maintain a diversified and flexible electric supply portfolio to minimize risk exposure while providing opportunities to capitalize on the changing electric industry landscape.

- Promote the standard of living within the service area by supporting the state's climate goals.

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1. EXECUTIVE SUMMARY

Established in 1887, the Turlock Irrigation District (TID) was the first publicly owned irrigation district in the state and is one of only four in California today that also provides electric retail energy directly to homes, farms and businesses. Organized under the Wright Act, TID operates under the provisions of the California Water Code as a special district and is governed by a five-member, locally elected Board of Directors ("TID Board").

TID delivers irrigation water through 250 miles of a gravity-fed canal system that irrigates approximately 150,000 acres of farmland. In addition, TID owns and operates an integrated and diverse electric generation, transmission and distribution system that serves more than 100,000 customer accounts within a 662 square-mile area that includes portions of Stanislaus, Merced, and Tuolumne counties. TID is one of seven California Balancing Authorities and operates independently within the Western United States power grid. As a Balancing Authority[1] ("BA"), TID is fully responsible for generating, securing, scheduling, and delivering electricity to its customers.

TID's Integrated Resource Plans (IRPs) are prepared to provide a roadmap on how TID plans to serve its customers and meet applicable requirements while minimizing cost and risk based on the information known and assumptions used at the time when the IRPs were developed. TID's IRPs are developed to achieve the following objectives:

1) Provide reliable and safe electricity service.
2) Maintain stable, just, reasonable, and affordable rates.
3) Cost effectively meet applicable TID, state, federal, Western Electricity Coordinating Council ("WECC"), and North American Electric Reliability Corporation ("NERC") policies, mandates, rules, and regulations.
4) Maintain a diversified and flexible electric supply portfolio to minimize risk exposure while providing opportunities to capitalize on the changing electric industry landscape (see Section 2.2).
5) Promote the standard of living within the service area by supporting the state's climate goals.

Senate Bill 350 ("SB350") approved by the California Governor on October 7, 2015 requires that the governing body of certain publicly owned electric utilities (including TID) adopt an IRP and a process for updating the IRP at least once every five years, on or before January 1, 2019.
The adopted IRP must ensure that the utility achieves the following:

1) Meets the greenhouse gas ("GHG") emissions reduction targets established by the California Air Resource Board ("CARB") for the utility that reflects achieving GHG emissions reductions of 40% from 1990 levels by 2030.

2) Ensures the procurement of at least 50% eligible renewable energy by 2030 consistent with Article 16 (commencing with Section 399.11) of Chapter 2.3 of the California Public Utilities Code ("CA PUC").

1 Balancing Authority is defined by NERC as the responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a Balancing Authority Area, and supports Interconnection frequency in real time.

3) Meets the following goals:

a. Enable the utility to fulfill its obligation to serve its customers at just and reasonable rates.
b. Minimize impacts on ratepayers' bills.
c. Ensure system and local reliability.
d. Strengthen the diversity, sustainability, and resilience of the bulk transmission and distribution systems, and local communities.
e. Enhance the distribution systems and demand-side energy management.
f. Minimize localized air pollutants and other GHG emissions with early priority on disadvantaged communities.

4) Must address procurement for the following:

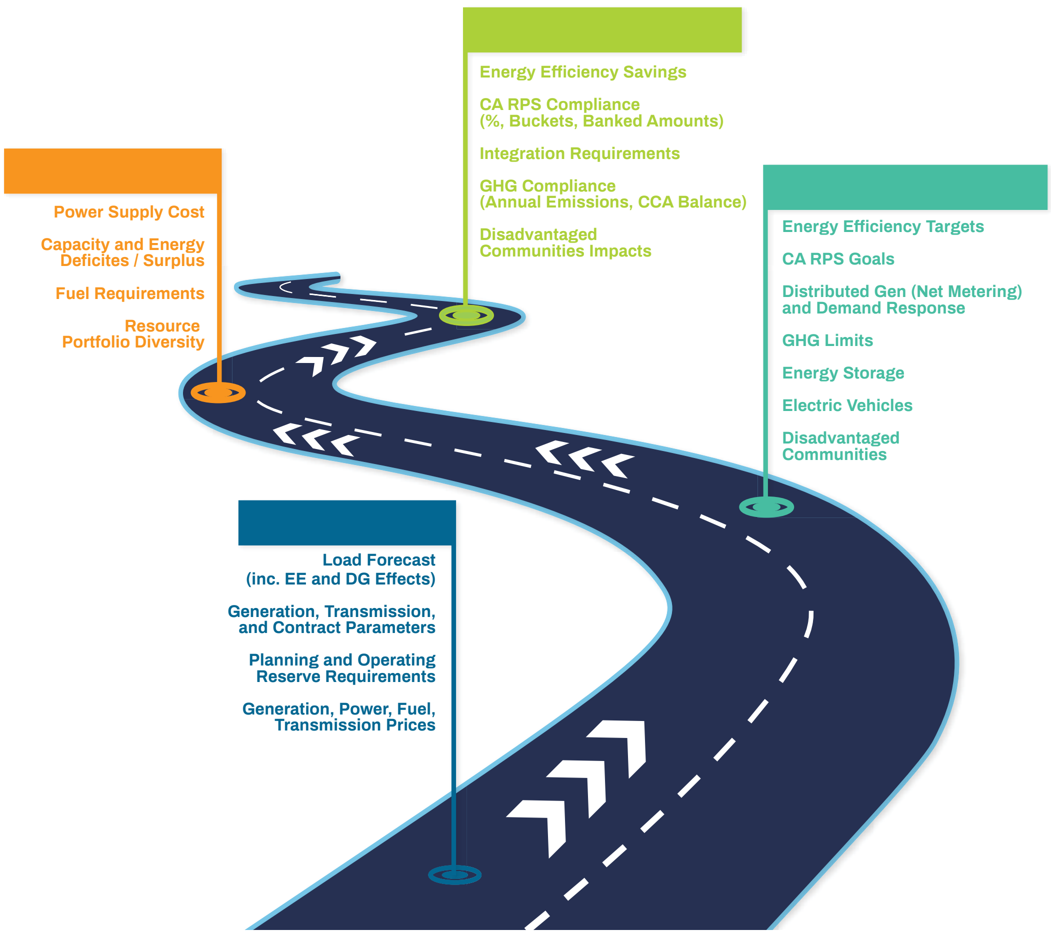
a. Energy efficiency and demand response resources pursuant to Section 9615 of the CA PUC.
b. Energy storage requirements pursuant to Chapter 7.7 (commencing with Section 2835) of Part 2 Division 1 of the CA PUC.
c. Transportation electrification.
d. A diversified procurement portfolio consisting of both short-term and long-term electricity, electricity-related, and demand response products.
e. The resource adequacy requirements established pursuant to Section 9620 of the CA PUC.

Since the above SB350 IRP requirements are consistent with TID's normal IRP objectives, meeting TID's normal IRP objectives will also satisfy the SB350 IRP requirements. This IRP takes into account several key factors affecting the California electric utility industry such as the following:

1) California's ambitious goal to reduce GHG emissions in 2030 by 40% of 1990 levels.
2) Growth of distributed energy resources such as customer owned rooftop solar.
3) Ongoing efforts at the federal and state level to promote and increase energy efficiency.
4) California's renewable resource mandate.
5) Electrification of transportation and buildings.
6) Technological improvements relating to renewable and energy storage resources.
7) Growing consumer adoption of sustainability/environmental goals.
8) Increasing natural gas transportation cost.
9) Western power market initiatives such as the California Independent System Operator's Energy Imbalance Market and efforts to create a regional independent system operator that covers the western states.

These factors present challenges and opportunities for an electric utility such as TID. See Section 2.2 for a detailed discussion of the above factors.

INTEGRATED RESOURCE PLAN



This IRP attempts to develop a plan that will allow TID to meet TID's objectives, the SB350 IRP requirements, mitigate any negative impacts and capitalize on opportunities presented by the factors affecting the California electric utility industry described above.

Customer owned solar photovoltaic generation ("Customer PV") in TID's service area has grown over the last few years. *Figure 5* shows that the amount of Customer PV in TID's service area grew from over 5 MW in 2012 to about 35 MW in 2017. In this IRP, Customer PV installations are projected to grow on average 7.5% per year reaching 87 MW by 2030 (see *Figure 20*). The growing Customer PV not only reduces the amount of load to be served by TID but also changes the pattern of the load to be served by TID (see *Figure 23*, *Figure 24*, *Figure 25*, *Figure 26*, *Figure 27*, and *Figure 28*).

This IRP also plans for achieving TID's most recent Board adopted energy efficiency goals (see *Table 1*). Achieving the adopted energy efficiency goals are forecasted to reduce energy consumption by 5.1% in 2030 (see *Figure 29*). To achieve such goals, TID has a menu of energy efficiency programs which are described in Section 3.2.1. At the same time, due to the continued consumer adoption of zero-emission vehicles ("ZEV")[2] and California policies that promote ZEVs the load forecast used in this IRP includes 6,614 ZEVs in 2030 increasing load by 1.3% (see *Figure 31*). TID's Board recently adopted a program aimed at ZEVs (see Section 3.3). After incorporating the effects of Customer PV, energy efficiency goals, and ZEV, TID's energy requirements are forecasted to grow on average 0.4% per year and peak demand to grow on average 0.1% per year reaching approximately 2,300,000 MWh and 542 MW by 2030 (see *Figure 32*).

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2 California considers the following as Zero Emissions Vehicles: hydrogen fuel cell electric vehicles, plug-in hybrid electric vehicles, and battery electric vehicles.

TID employs a diversified portfolio of electric resources to meet its customer's energy requirements (see *Table 2*). The portfolio is comprised of different types, location, and fuel source most of which are renewable and/or GHG free. For a detailed description of TID's electric resources see Section 4. Due to TID's access to neighboring utilities and power markets, TID also supplements its electric resources with short-term power purchases and engages in short-term power sales to reduce power supply costs.

Figure 33 shows the TID Balancing Authority Area's ("TID BAA") projected monthly energy balance for the 2018-2030 period. As shown in Figure 33, TID is expected to meet its energy requirements using existing electric resources supplemented by short-term power purchases. Furthermore, as fuel transportation and greenhouse gas costs increase, reliance on natural gas generation declines and is replaced by increased power purchases. The Boardman power purchase agreement expires on December 31, 2018 thereby reducing TID's carbon footprint significantly beginning in 2019.

Using TID's diversified portfolio of electric resources, TID expects to meet its customers energy requirements, maintaining sufficient reserves to ensure a reliable system, and support California's environmental goals and mandates while maintaining just, reasonable, and affordable rates.

TID has a Board approved Resource Adequacy Policy ("RA Policy") that requires the procurement of sufficient electric resources to meet 115% of forecasted peak demand for a month at least 60 days before the beginning of such month. This policy ensures that TID will have sufficient resources to serve customer demand and provide operating reserves to meet applicable WECC requirements. Moreover, as a BA, TID must maintain a prescribed amount of Contingency Reserve (as such term is defined in WECC Standard BAL-002-WECC-2a — Contingency Reserve). TID expects to meet its RA Policy and Contingency Reserve requirements during the 2018-2030 period using existing electric resources supplemented by short-term power purchases (see ***Figure 35***, ***Figure 36***, and ***Figure 37***).

TID has been generating renewable and GHG free power since the early 1920's. For example, TID's Don Pedro power plant was built in 1923. La Grange power plant was completed in 1924. The Hickman, Turlock Lake, and Dawson power plants came online around the early 1980s. The NCPA geothermal power plant was also constructed in the early 1980s. Since then TID has continued its environmental stewardship by adoption of a Renewable Portfolio Standard policy in 2004 which has been updated several times to remain consistent with California requirements. To meet its Renewable Portfolio Standard and California requirements, TID continued adding renewable resources with the addition of the 136.6 MW Tuolumne Wind Project ("TWP") in 2009, the 54 MW Golden Fields Solar I Power Purchase Agreement in 2017, and the 0.8 MW Loyalton Biomass Power Purchase Agreement in 2018, generating more renewable resources than currently required.

California Senate Bill 100 ("SB100") became law on September 10, 2018 establishing a mandate of procuring a minimum of 60% of electric retail load from eligible renewable energy resources. TID expects to be compliant with SB100 until 2024 (see ***Figure 38***). In order to continue to be compliant with SB100, TID would need to add about 300,000 MWh per year of new renewable resources in 2024 and another approximately 300,000 MWh per year in 2029 (see ***Figure 39***). The proposed renewable additions will not only help TID comply with SB100, it will also allow TID to meet the GHG target for TID established by CARB (see ***Figure 41***).

Currently the most common renewable resource acquired by other utilities have been from solar or wind generation which are intermittent variable energy resources ("VERs"). Their generation output is weather dependent and can be hard to predict (see ***Figure 10***, and ***Figure 11***) and therefore presents challenges such as drastic changes to the load shape often referred to as the "Duck Curve" (see ***Figure 13***), and generation exceeding loads resulting in negative power prices (see Section 2.2.3). Despite the challenges they present, VERs have in recent years become more competitive with other generation resources (see Section 2.2.6, ***Figure 17***, and ***Figure 18***). Also, the generation cost of traditional generation resources such as thermal generation are anticipated to increase due to rising natural gas, natural gas transportation, and greenhouse gas emissions cost (see Sections 2.2.4, 2.2.8, 4.6, and ***Figure 40***).

Although this IRP suggests a need for additional renewable resources in 2024 and 2029, this IRP does not attempt to recommend the type and location of the renewable resource to be acquired. As was done in the past, prior to procuring the additional renewable resource TID will issue a request for proposals ("RFP") and evaluate the proposals received to select the best option available at that time. However, based on recent acquisitions by other utilities, solar power currently seems to be the most cost effective renewable resource and represents the majority of recent acquisitions. Hence, this IRP modeled adding a twenty year 100 MW solar power purchase agreement in 2024 and another similar agreement in 2029. For comparison purposes, the solar additions were modeled in the California Independent System Operator ("CAISO") grid and in TID's service area. If the solar resource is connected to the CAISO's grid, the resource will be subject to potential curtailments and negative power prices increasing the resource's cost to TID. Staff did some preliminary analysis on how an energy storage system can help mitigate the effects of negative power prices on such resource. The preliminary analysis showed that the energy storage system would be able to optimize around negative power prices and produce other revenue streams to offset the cost of the energy storage system. If the solar resource is instead located in TID's service area, due to the amount of renewable resource needed (about 200 MW) balancing TID' system will be a challenge and may require additional flexible resources be acquired (see Section 4.7, ***Figure 46***, ***Figure 47***, ***Figure 48***, ***Figure 49***, and ***Figure 50***). Staff did some preliminary analysis on how an energy storage system can help integrate the renewable resource into TID' system. The preliminary analysis showed that the energy storage system would be able to optimize the renewable resource and TID's other generation resources to produce revenues and cost savings that offset the cost of the energy storage system.

The IRP estimates TID's purchased power and fuel expense reaching $121 Million in 2030 (see ***Figure 56***) due to rising power, natural gas, natural gas transport, and greenhouse gas emissions cost.

TID owns 379 miles of transmission lines, approximately 2,200 miles of distribution lines, and 29 substations and has interconnections with neighboring utilities and power markets. TID has been diligent in maintaining the reliability of its electric system with projects such as the installation of specialized software that provides continuous real-time contingency analysis capabilities in 2016 and the construction of the 115/12 kV Washington Substation. TID is committed to maintaining the reliability of its electric system going forward (see Section 5).

As a publicly owned utility, TID has always had their customer's best interest in mind including low income/disadvantaged communities. TID has several programs (some of which have been in place since the 1990s) that target the low income and disadvantaged communities like the TID CARES program (see Section 7). TID is also a steward for local air quality with investments as early as the 1920s on renewable and greenhouse gas free resources and the rigorous environmental review that TID's generation resources have undergone (see Section 6).

2. BACKGROUND

Established in 1887, TID was the first publicly owned irrigation district in the state and is one of only four in California today that also provides electric retail energy directly to homes, farms and businesses. Organized under the Wright Act, TID operates under the provisions of the California Water Code as a special district and is governed by a five-member, locally elected Board of Directors.

TID delivers irrigation water through 250 miles of a gravity-fed canal system that irrigates approximately 150,000 acres of farmland. In addition, TID owns and operates an integrated and diverse electric generation, transmission and distribution system that serves more than 100,000 customer accounts within a 662 square-mile area that includes portions of Stanislaus, Merced, and Tuolumne counties. TID is one of seven California Balancing Authorities and operates independently within the Western United States power grid. As a BA, TID is fully responsible for generating, securing, scheduling, and delivering electricity to its customers.

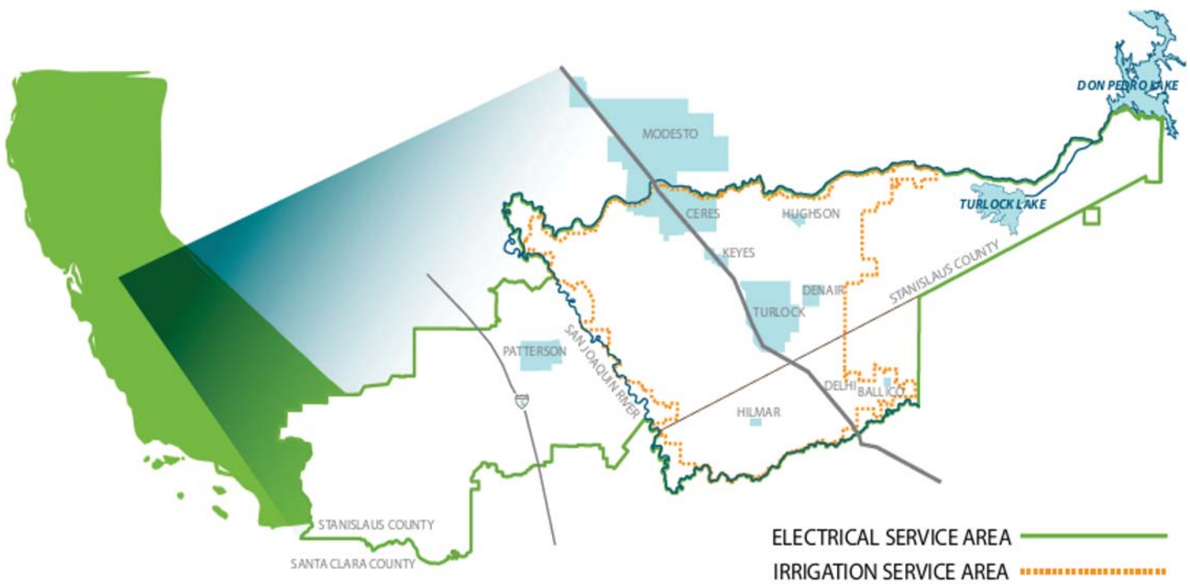


FIGURE 1 - TID Service Area

2.1. Integrated Resource Plan

An IRP provides a guide on how a utility plans to serve its customers and meet applicable requirements while minimizing cost and risk based on the information known and assumptions used at the time when the IRP was developed. An IRP provides information on future resource deficits and surplus and the type of resource needed or surplus projected. For example, an IRP would show whether a baseload or peaking resource is needed to support projected load growth or an expiring Power Purchase Agreement ("PPA"). Once the type of resource is determined (e.g. baseload or peaking) available options are evaluated to determine the optimal resource (e.g. geothermal vs. natural gas plant, gas turbine vs. internal combustion engine, build or PPA). A utility's load is not constant and varies each hour. TID load is generally higher during the late afternoons and early evenings relative to other hours (see ***Figure 2***). Summer loads are generally higher than the non-summer months (see ***Figure 3***). At the same time, a power plant's capacity is generally the same throughout the day and year. Due to this load variation, there are times when surplus resources will be available for sale to others. Furthermore, during periods when load is projected to grow, resource shortfalls will escalate over time. Often, a new resource addition will be sized to meet the average of the projected shortfalls creating a surplus early on and a deficit later. An IRP would identify when and how much surplus are available and evaluate potential actions to monetize the surplus.

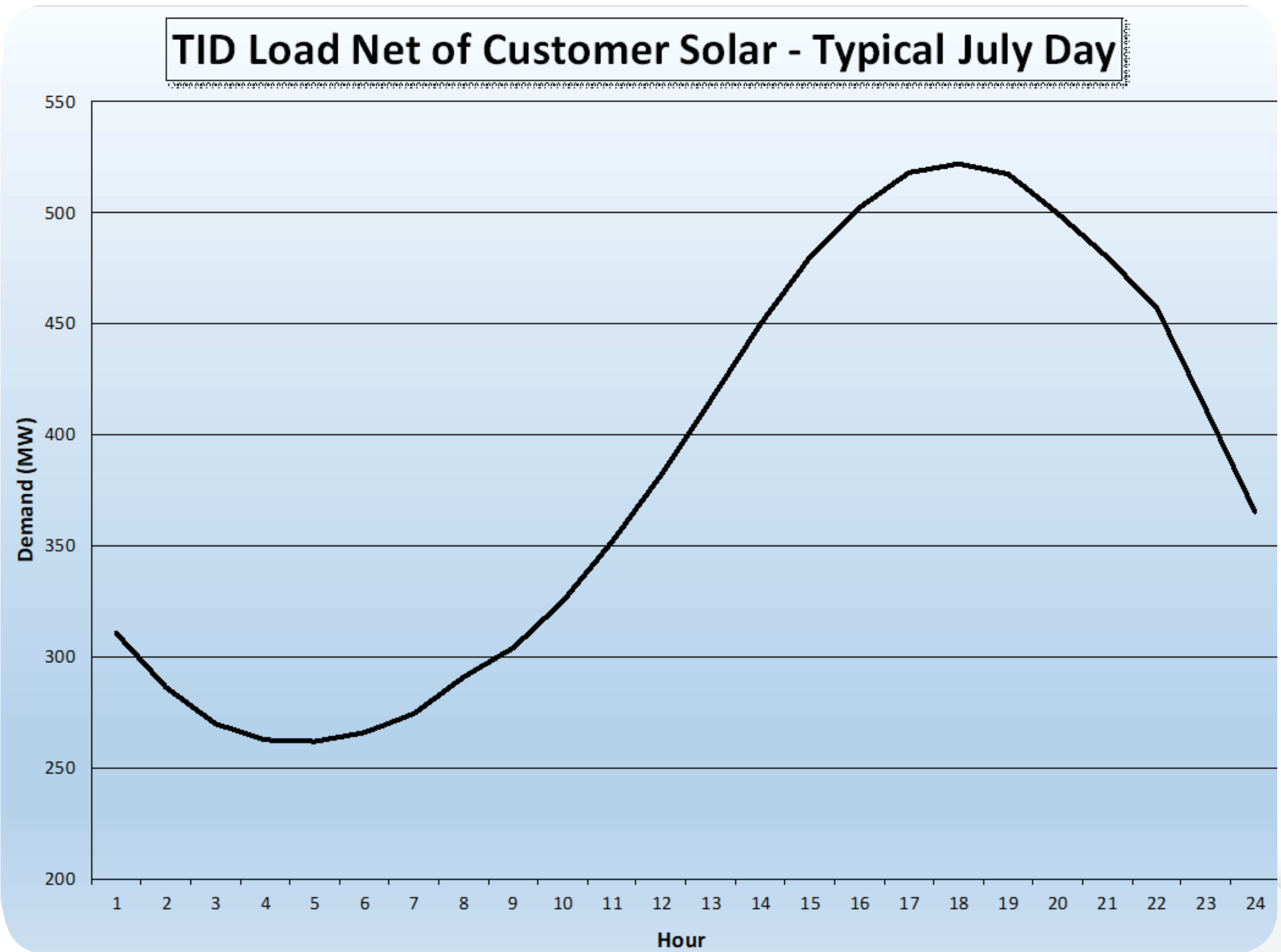


FIGURE 2 - TID Net Load - Typical July Day

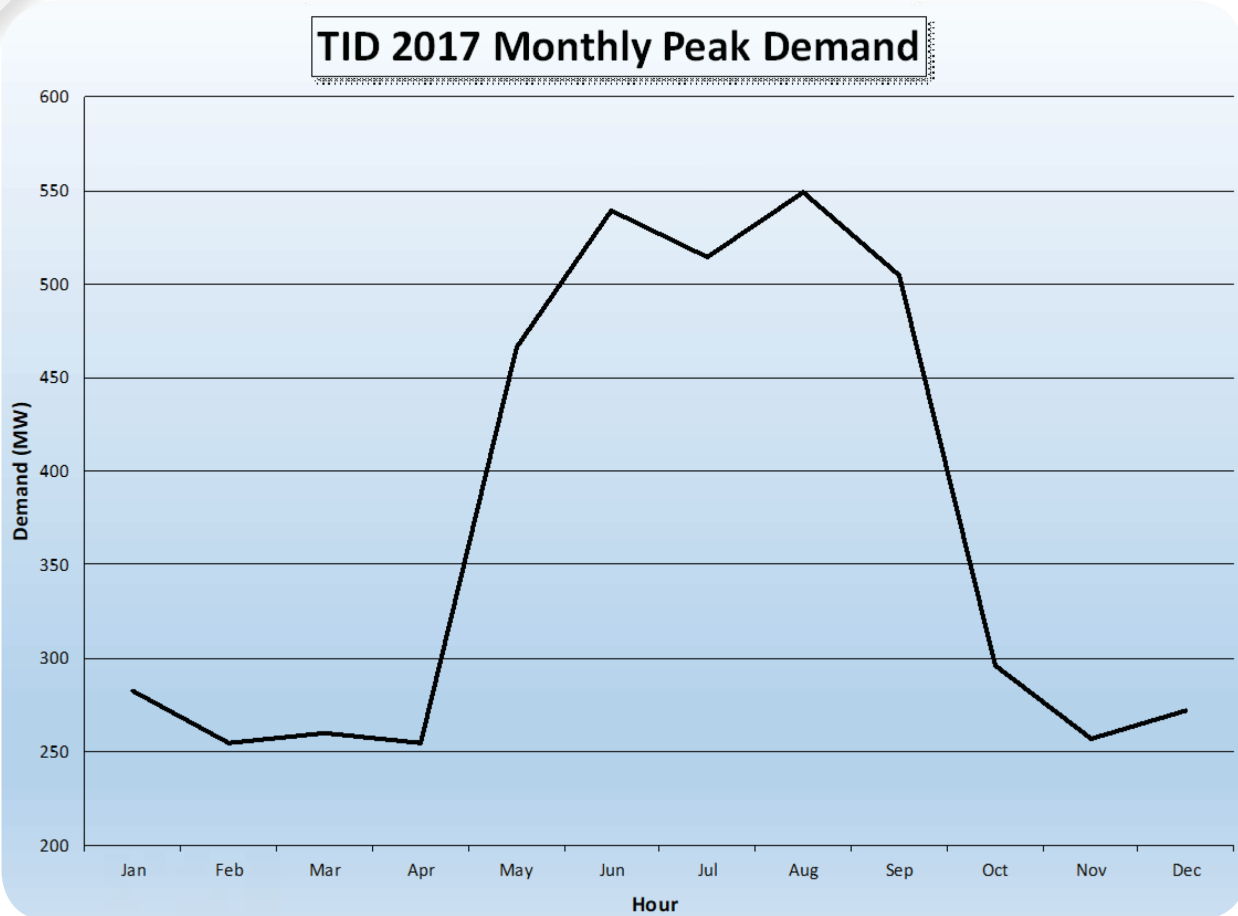


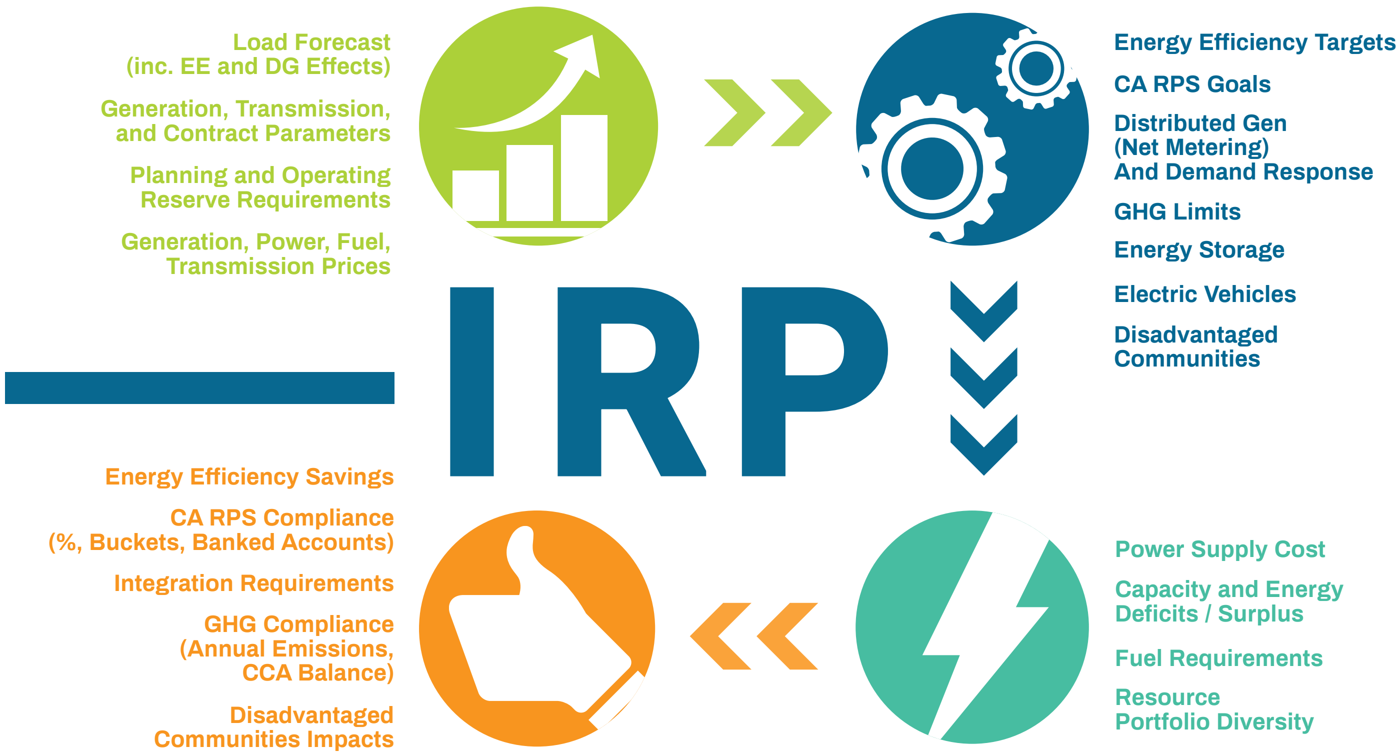
FIGURE 3 - TID 2017 Monthly Peak Demand

An IRP would also show compliance with applicable requirements such as reserve requirements and environmental regulations. IRPs normally cover a time horizon of 10+ years due to the long lead time associated with acquiring new resources or selling surplus resources (e.g. building a power plant, negotiating and entering into a PPA to buy or sell power on a long-term basis).

Prior IRP related efforts at TID resulted in several key endeavors such as the following:

- To replace expiring power contracts and to support a growing load including the acquisition of the Westside area, TID entered into a PPA with Calpine in 2000.
- To replace the expiring Calpine PPA and support projected load growth, TID constructed the Walnut Energy Center.
- To provide for the projected increase in natural gas use due to the addition of Walnut Energy Center, TID acquired rights to natural gas pipeline capacity and natural gas storage capacity, and natural gas reserves interests.
- To optimize TID's power supply portfolio and capitalize on surplus capacity, TID completed several power and/or capacity sales to neighboring utilities and power marketers.
- Determined the need for additional renewable resources resulting in the construction of the Tuolumne Wind Project and entering into a PPA with Golden Fields Solar I, LLC.

INTEGRATED RESOURCE PLAN



TID's IRP has the following objectives:

- *Provide reliable and safe electricity service.*
- *Maintain stable, just, reasonable, and affordable rates.*
- *Cost effectively meet applicable TID, state, federal, Western Electricity Coordinating Council ("WECC"), and North American Electric Reliability Corporation ("NERC") policies, mandates, rules, and regulations.*
- *Maintain a diversified and flexible electric supply portfolio to minimize risk exposure while providing opportunities to capitalize on the changing electric industry landscape (see Section 2.2).*
- *Promote the standard of living within the service area by supporting the state's climate goals.*

This IRP covers the calendar years 2018 to 2030 ("Planning Period").

SB350, approved by the California Governor on October 7, 2015, added Section 9621 to the California Public Utilities Code ("9621"). 9621 applies to local publicly owned electric utilities with an annual electrical demand exceeding 700,000 MWh as determined on a three-year average commencing January 1, 2013. TID's average retail sales for the 2013-2015 period was over 2,000,000 MWh and therefore has to abide by 9621. 9621 requires that the governing body of certain utilities, including TID, adopt an IRP and a process for updating the IRP at least once every five years, on or before January 1, 2019.

The adopted IRP must ensure that the utility achieves the following:

1) **Meets the GHG emissions reduction targets established by the CARB for the utility that reflects achieving GHG emissions reductions of 40% from 1990 levels by 2030.**

2) **Ensures the procurement of at least 50% eligible renewable energy by 2030 consistent with Article 16 (commencing with Section 399.11) of Chapter 2.3 of the CA PUC.**

3) **Meets the following goals:**
   a. **Enable the utility to fulfill its obligation to serve its customers at just and reasonable rates.**
   b. **Minimize impacts on ratepayers' bills.**
   c. **Ensure system and local reliability.**
   d. **Strengthen the diversity, sustainability, and resilience of the bulk transmission and distribution systems, and local communities.**
   e. **Enhance the distributions systems and demand-side energy management.**
   f. **Minimize localized air pollutants and other GHG emissions with early priority on disadvantaged communities.**

4) **Must address procurement for the following:**
   a. **Energy efficiency and demand response resources pursuant to Section 9615 of the CA PUC.**
   b. **Energy storage requirements pursuant to Chapter 7.7 (commencing with Section 2835) of Part 2 Division 1 of the CA PUC.**
   c. **Transportation electrification.**
   d. **A diversified procurement portfolio consisting of both short-term and long-term electricity, electricity-related, and demand response products.**
   e. **The resource adequacy requirements established pursuant to Section 9620 of the CA PUC.**

Comparing TID's IRP objectives and the requirements of 9621 shows that meeting TID's IRP objectives will result in compliance with 9621. Below is a mapping of the IRP objectives against the 9621 requirements:

- **Provide reliable and safe electricity service**
  - Ensure system and local reliability.
  - Strengthen the diversity, sustainability, and resilience of the bulk transmission and distribution systems, and local communities.
  - Enhance the distributions systems and demand-side energy management.
  - Energy efficiency and demand response resources pursuant to Section 9615 of the CA PUC.
  - Energy storage requirements pursuant to Chapter 7.7 (commencing with Section 2835) of Part 2 Division 1 of the CA PUC.
  - A diversified procurement portfolio consisting of both short-term and long-term electricity, electricity-related, and demand response products.
  - The resource adequacy requirements established pursuant to Section 9620 of the CA PUC.

- **Maintain stable, just, reasonable, and affordable rates.**
  - Meet GHG reduction targets established by CARB.
  - Ensure procurement of at least 50% eligible renewable energy by 2030.
  - Enable the utility to fulfill its obligation to serve its customers at just and reasonable rates.
  - Minimize impacts on ratepayers' bills.

- **Cost effectively meet applicable TID, state, federal, WECC, and NERC policies, mandates, rules, and regulations.**
  - Meet GHG reduction targets established by CARB.
  - Ensure procurement of at least 50% eligible renewable energy by 2030.
  - Energy efficiency and demand response resources pursuant to Section 9615 of the CA PUC.
  - Energy storage requirements pursuant to Chapter 7.7 (commencing with Section 2835) of Part 2 Division 1 of the CA PUC.
  - A diversified procurement portfolio consisting of both short-term and long-term electricity, electricity-related, and demand response products.

- **Maintain a diversified and flexible electric supply portfolio to minimize risk exposure while providing opportunities to capitalize on the changing electric industry landscape (see Section 2.2).**
  - Energy efficiency and demand response resources pursuant to Section 9615 of the CA PUC.
  - Energy storage requirements pursuant to Chapter 7.7 (commencing with Section 2835) of Part 2 Division 1 of the CA PUC.
  - Transportation electrification.
  - A diversified procurement portfolio consisting of both short-term and long-term electricity, electricity-related, and demand response products.
- **Promote the standard of living within the service area by supporting the state's climate goals.**
  - Minimize localized air pollutants and other GHG emissions with early priority on disadvantaged communities.
  - Transportation electrification.

In addition to this IRP, TID has performed IRP related studies/analyses related to 9621 requirements such as the adoption of energy efficiency goals pursuant to Section 9615 of the CA PUC and consideration of energy storage targets pursuant to the requirements of Chapter 7.7 (commencing with Section 2835) of Part 2 Division 1 of the CA PUC.

2.2. Future of the California Electric Utility Industry

California has established a goal to reduce GHG emissions in 2030 by 40% of 1990 levels ("2030 GHG Goal"). The 2030 GHG Goal was by codified into law by passage of Senate Bill 32 in 2016.

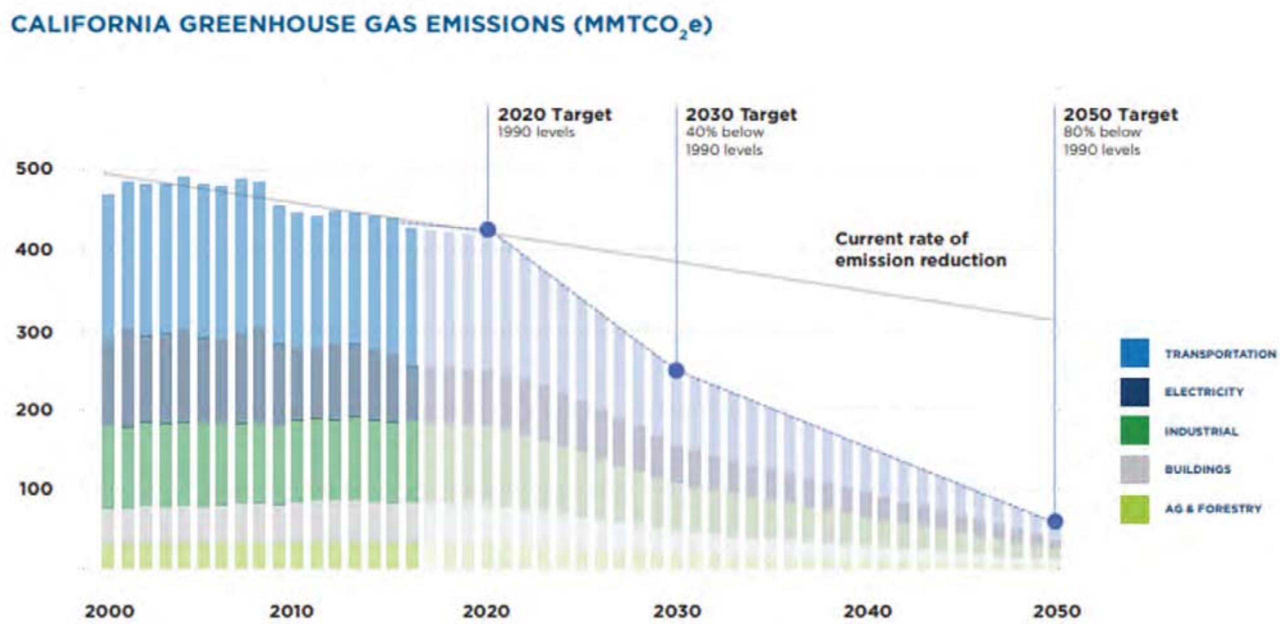


FIGURE 4 - California Greenhouse Gas Emissions Targets (Source: California Air Resources Board)

The 2030 GHG Goal is planned to be achieved through mandates in areas such as GHG, energy efficiency, renewable generation, energy storage, and electrification of the transportation fleet and buildings. As a result, the type of resources used to supply electric load in California has evolved and will continue to evolve in the future. These mandates present risk and opportunities for an electric utility like TID and are factored into this IRP. A few examples of the risks and opportunities are as follows:

How will the growth in distributed energy resources ("DER") affect how much load TID will serve in the future?

Will TID be faced with a significant amount of surplus power resources or stranded resources?

Can TID accommodate the expected growth in DER and ZEV in its service area with existing resources?

Will TID be able to continue to provide low cost reliable electric service while meeting regulatory requirements with existing resources?

How can we lower power supply cost using resources such as energy efficiency, renewable generation, and energy storage?

How can we benefit from and reduce our risk from negative power prices?

Sections 2.2.1 through 2.2.9 discuss in more detail the changes brought about by California's environmental goals.

2.2.1. Distributed Energy Resources

Due to several factors such as California's clean air goals, tax incentives, rebates, net metering tariffs, and the decline in the cost of solar modules, the number of DERs in California has grown over the last several years. According to the California Energy Commission ("CEC") as of December 31, 2017 more than 11,700 MW of DER was installed in California with about 9,640 MW in solar photovoltaic generation. The growth in Customer PV has also been experienced in TID's service area. As can be seen from ***Figure 5***, the amount of Customer PV in TID's service area grew from over 5 MW in 2012 to about 35 MW in 2017.

A few years ago, in response to our customer's growing interest in installing Customer PVs, TID developed interconnection standards that allow customers to install Customer PV facilities less than 1 MW in size on their premises. The interconnection standards provide the customer all the information needed to make an informed decision and prepare a complete application to interconnect. Standard drawings with interconnection requirements and application forms are available on TID's web page (www.tid.org). Rate information is also accessible on TID's web page so that customers can assess how their electric bills will change if they add photovoltaic generation. TID also has knowledgeable staff to provide requested customer assistance.

TID expects the growth in Customer PVs to continue resulting in lower load growth and increased load variability possibly requiring more flexible resources.

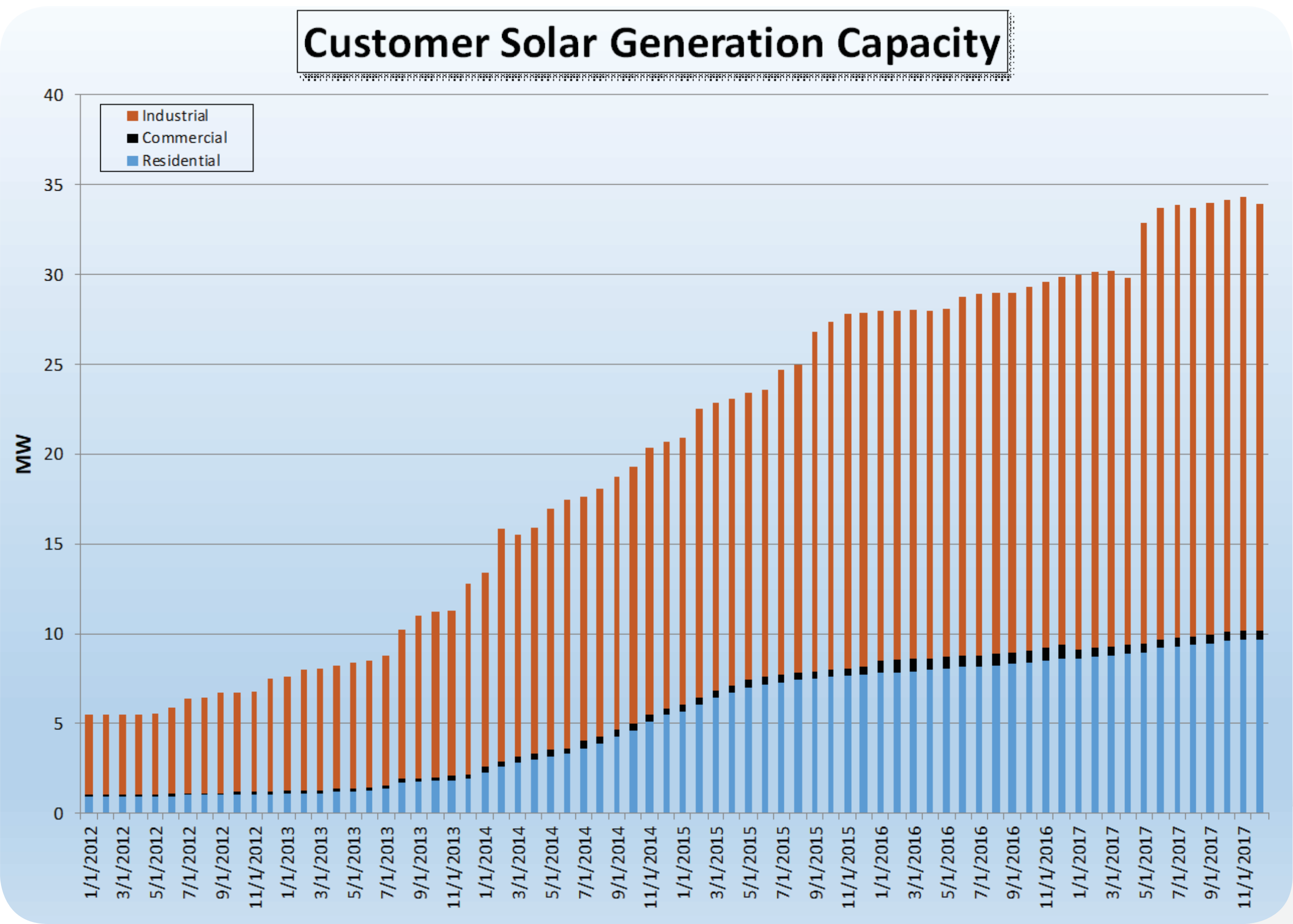


FIGURE 5 - Customer Owned Solar Generation Capacity

2.2.2. Energy Efficiency

Federal and California energy efficiency standards aim to reduce electric consumption. California's Energy Efficiency Strategic Plan calls for the development of Zero Net Energy buildings defined as an energy-efficient building where, on a source energy basis, the actual annual consumed energy is less than or equal to the on-site renewable generated energy. Furthermore, SB350 directed the CEC to establish statewide annual energy efficiency savings and demand reduction targets that would achieve twice the amount of energy and demand reduction than the previous target (see *Figure 6*). These standards, policies, and goals will lead to reduced energy use and potentially alter the TID's system load shape.

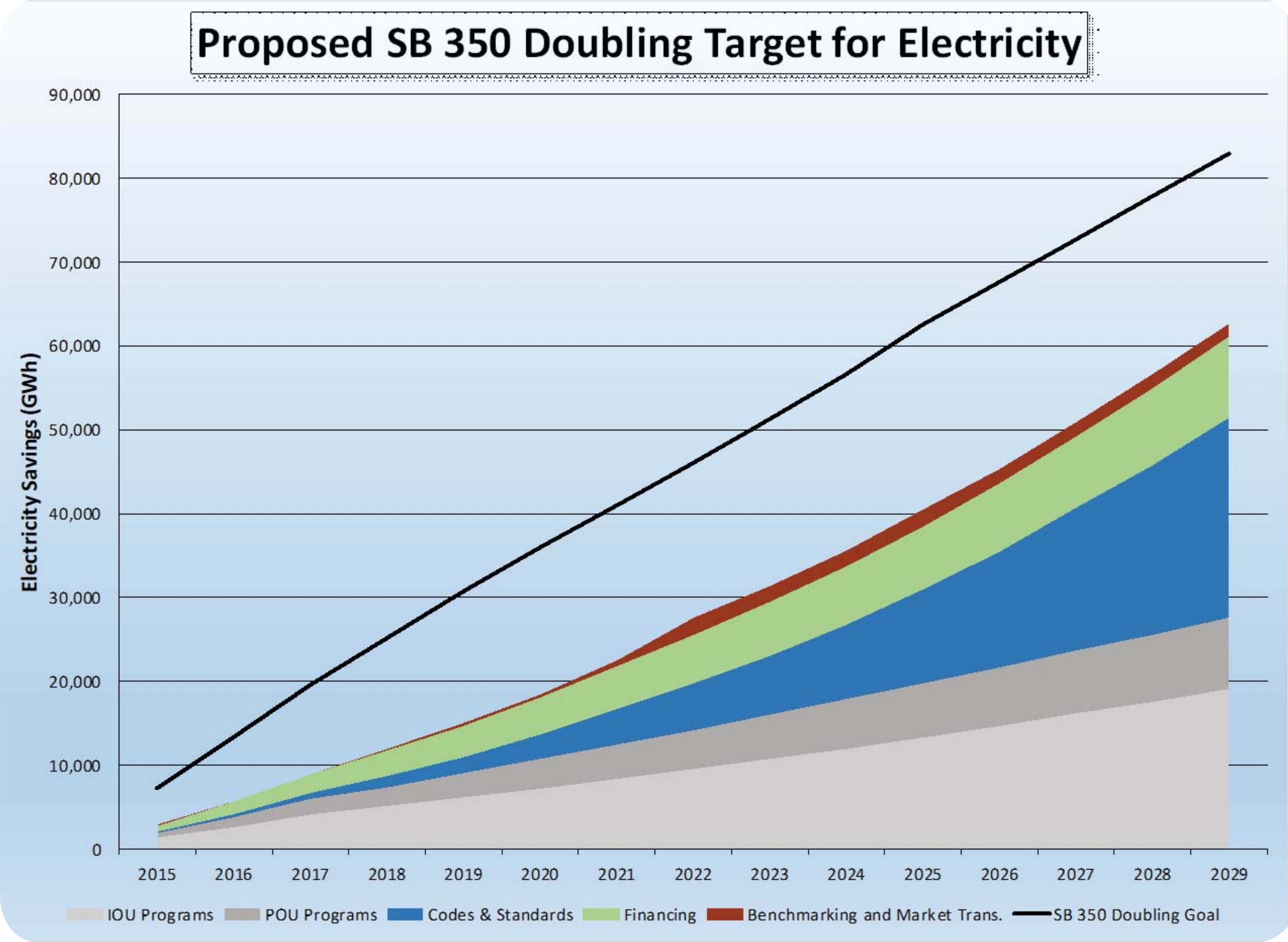


FIGURE 6 - SB350 Doubling Electricity Energy Efficiency Target (Source: California Energy Commission)

2.2.3. California Renewable Portfolio Standard

California's Renewable Portfolio Standard ("CA RPS") began in 2002 requiring that by 2017 20% of electric load be served from eligible renewable resources ("Renewable Resources"). The CA RPS has been revised several times since then and currently requires that 60% of the electric load be served from Renewable Resources in 2030 and beyond.

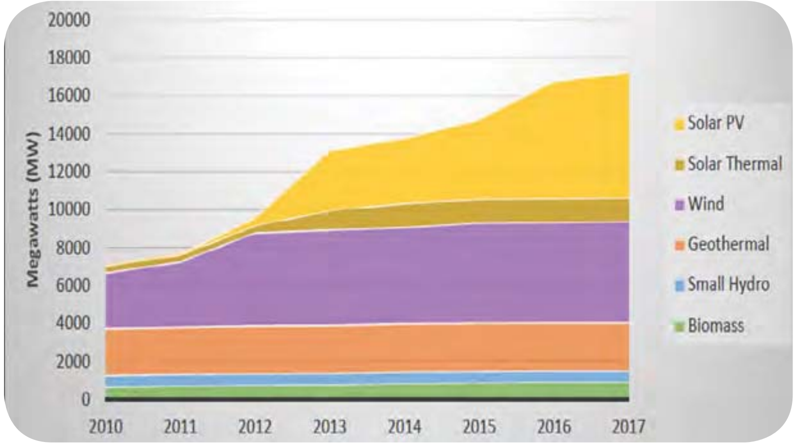


FIGURE 7 - Cumulative Installed Large-Scale Renewable Capacity by Technology Type (Source: CEC)

According to the CEC, there were over 17,300 MW of renewable capacity (mostly solar and wind) installed in California since 2010 (see ***Figure 7***) and that 81,000 GWh of CA RPS eligible generation was generated in 2017 representing 32% of electric load (see ***Figure 8***). Also, according to the CAISO there were periods in 2017 where close to 60% of their load was met by solar and wind generation (see ***Figure 9***).

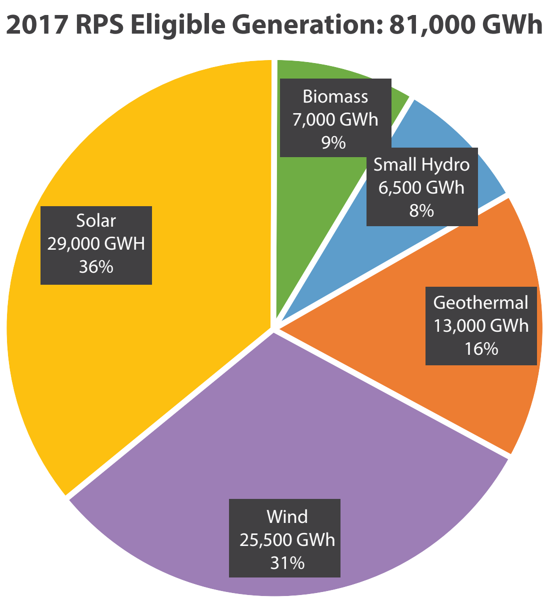


FIGURE 8 - Estimated In State and Out-of-State 2017 RPS Eligible Generation (Source: CEC)

Solar and wind generation are weather dependent and therefore are often referred to as VERs. Since their output is heavily dependent on weather, the generation output of VERs are hard to predict. For example, as can be seen from ***Figure 10***, the actual generation from TID's Tuolumne Wind Project deviated from scheduled amount by as much as 48 MW at 2 am on June 30, 2018, about 70% more than scheduled. Furthermore, the actual generation for the day ranged from a low of about 14 MW to a high of about 132 MW (118 MW swing in one day).

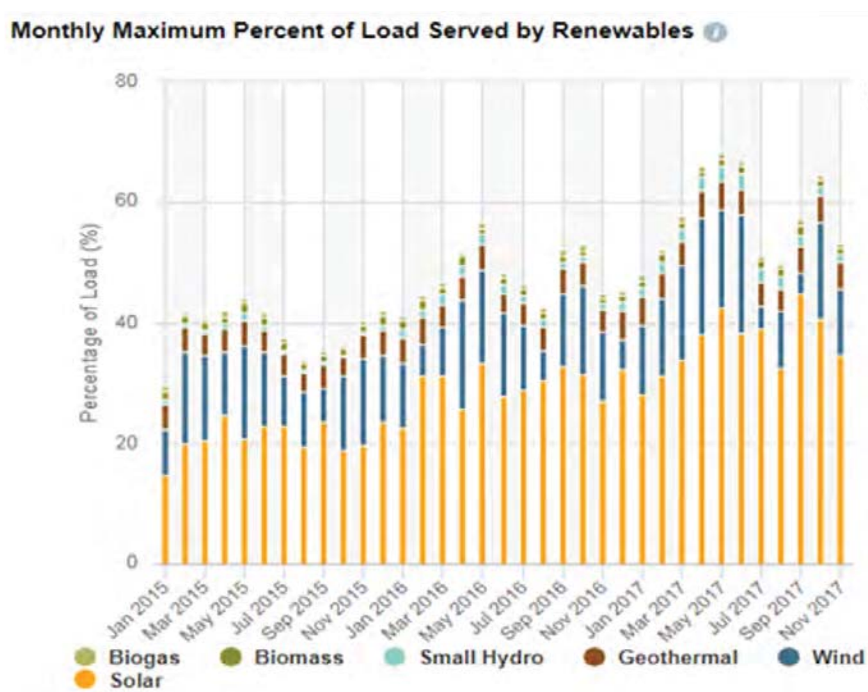


FIGURE 9

Maximum Percent of Load Served by Renewables (Source: CAISO)

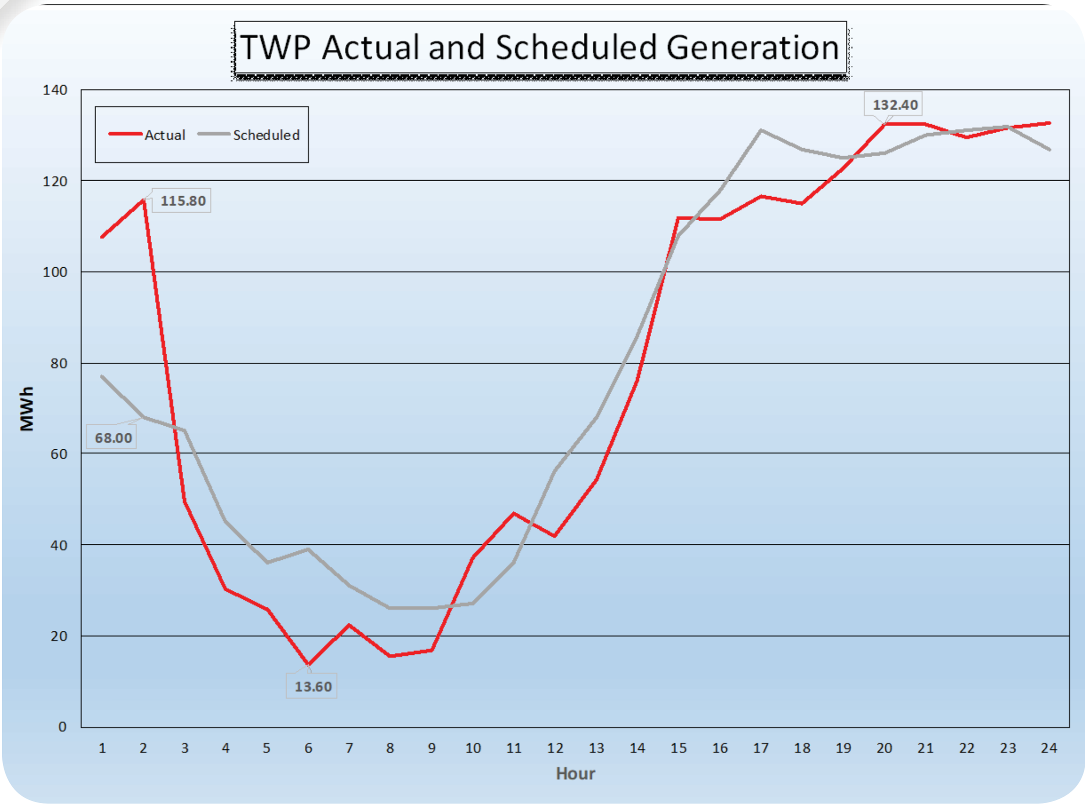


FIGURE 10 - TWP Actual and Scheduled Generation for June 30, 2018

Predicting solar generation is also a challenging endeavor. ***Figure 11*** shows that the actual generation of the Rosamond West Solar 2 plant was 30 MW (73%) less than forecasted for 10 am and 20 MW (76%) more than forecasted for 3 pm.

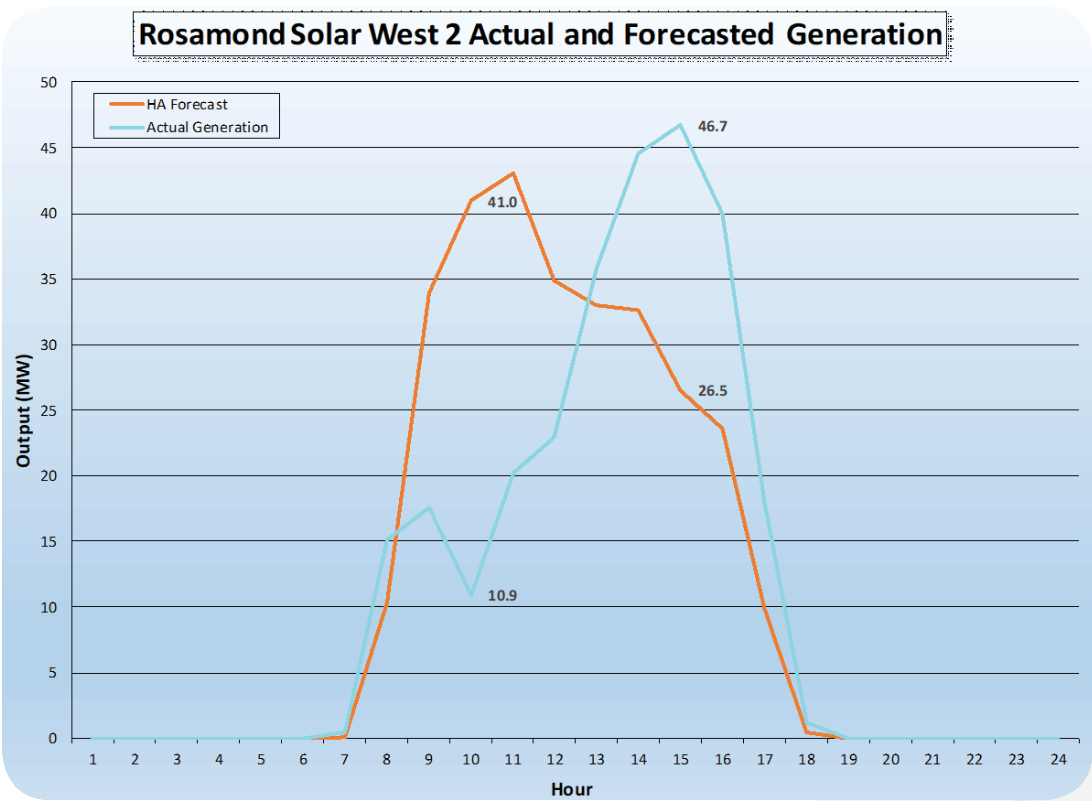


FIGURE 11 - Rosamond West Solar 2 Actual and Forecasted Generation (February 10, 2018)

To compensate for the difference between the actual and forecasted generation of VERs, the output of other generation resources have to move appropriately to keep the system balanced.

According to the CEC in 2017 there were 17,550 MW of solar plants serving California load (see *Figure 12*). Because of the significant amount of solar generation in California, there are times where the available generation exceeds load ("Over Generation"). Over Generation generally occurs during the mid-morning through the early afternoon periods resulting in generation curtailments. As more VERs come online, Over Generation is expected to occur more frequently. The CAISO reported that about 1% of total potential renewable generation in Q1 2017 was curtailed (147% more than the same period of the previous year).

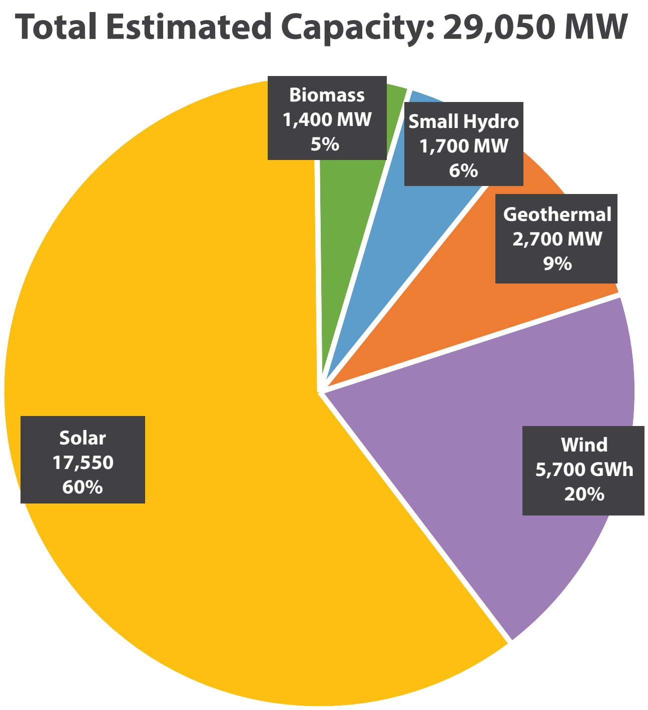


FIGURE 12 - Estimated In State and Out-of-State 2017 RPS Eligible Capacity (Source: CEC)

Over Generation also results in negative power prices (meaning generators pay to generate and not get curtailed rather than being paid for their output). For the period March 2015 to July 2018 the CAISO's SP15 5-min market price was negative 6% of the time reaching as low as -$602/MWh. As more VERs are added to the grid, the occurrence and the magnitude of negative power prices ("Negative Power Prices") is expected to increase.

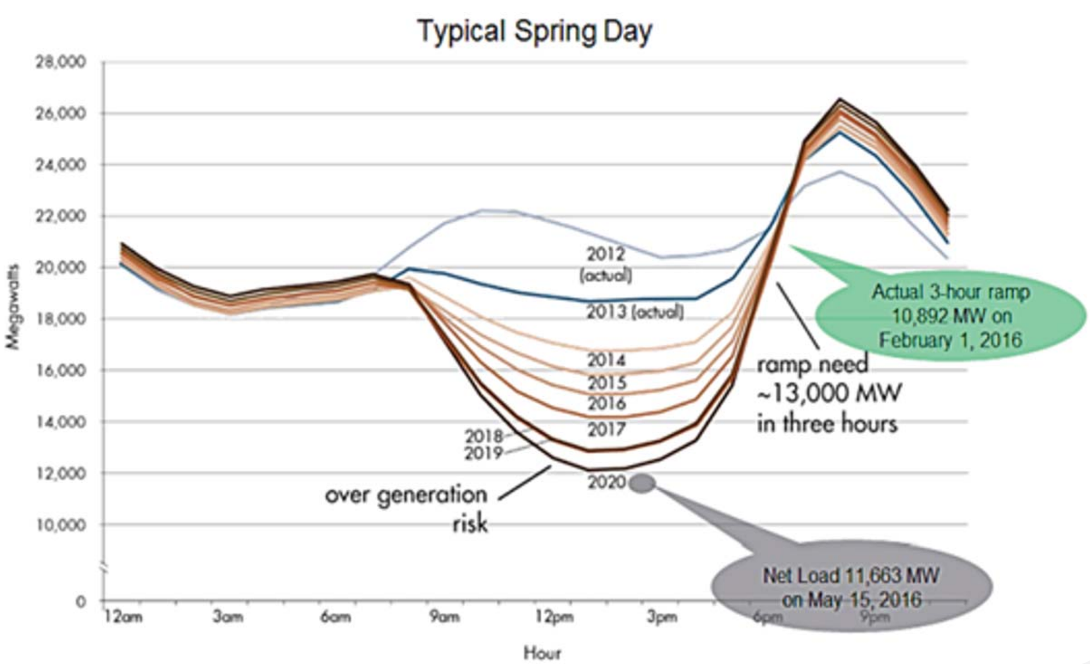


FIGURE 13 - Duck Curve (Source: CAISO)

Figure 13 shows the electric load shape after deducting solar generation ("Net Load"). As seen from *Figure 13* there is a steep drop in Net Load when solar generation begins in the early mornings and a steep increase in Net load once solar generation stops in the early evenings (often referred to as the "Duck Curve"). This means that in order to balance the system, non-solar generation or load has to be able to adjust its output/consumption up or down to offset the change in solar output.

To ensure a reliable electric grid, dependable dispatchable resources (such as hydropower, combustion turbines, energy storage, and demand response) are needed to accommodate the variability and the shape of solar and wind generation ("Flexible Resources"). As the amount of VERs in California grow, there is concern that not enough Flexible Resources will be available to balance the electric grid. To address the issues discussed above, California has implemented several measures including flexible capacity resource requirements, policies/mandates to promote energy storage, and the promotion of a multi-state real time energy imbalance market ("EIM") and regional grid. In 2015, the California Public Utilities Commission ("CPUC") implemented flexible capacity resource requirements.

Furthermore, the three large investor owned utilities in California (Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric) have targets to procure 1,325 MW of energy storage by 2020. In 2014, the CAISO launched an EIM. The CAISO reported that the EIM reduced renewable curtailment in Q2 of 2018 by 129,128 MWh.

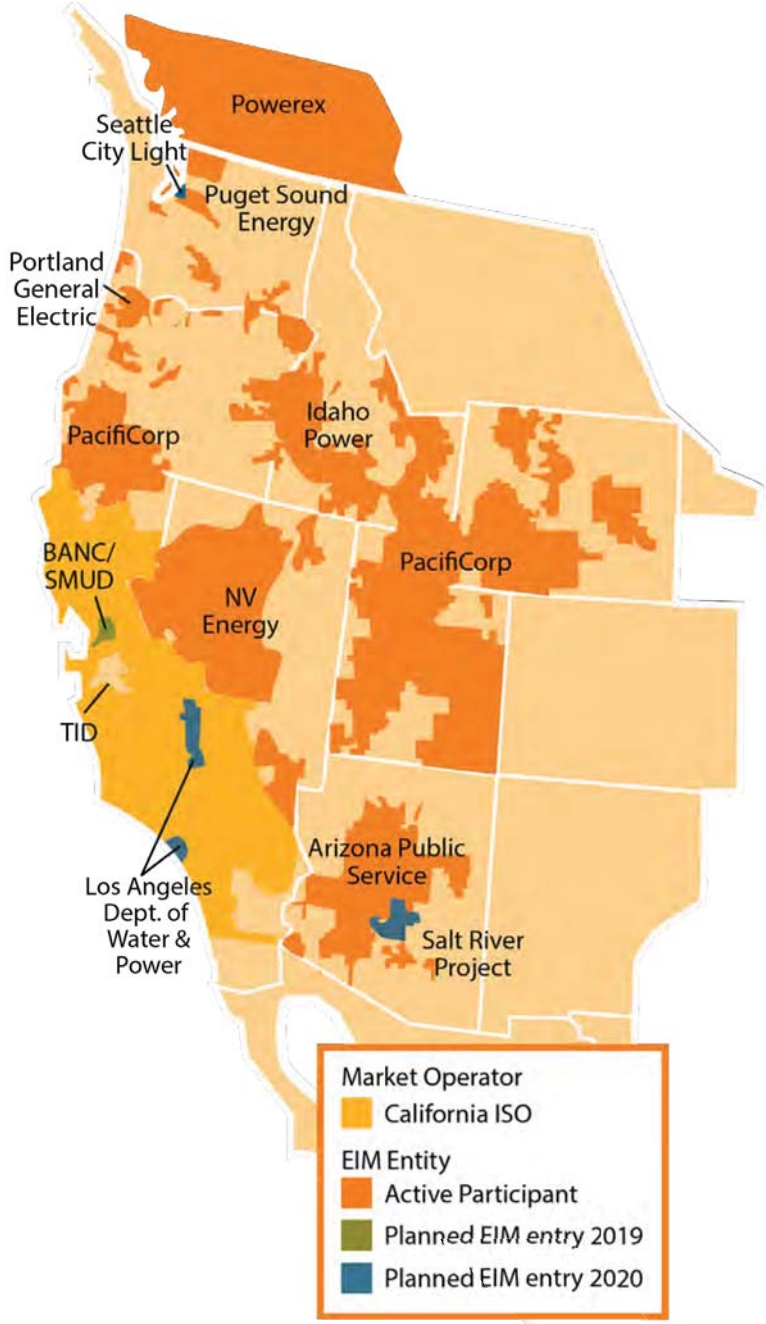


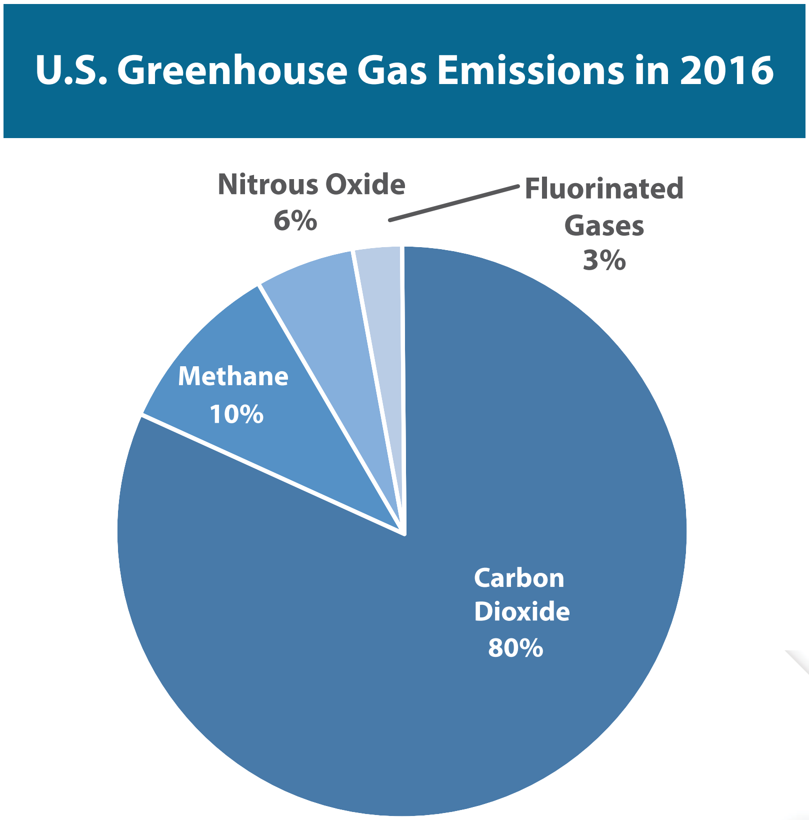
FIGURE 14 - Western EIM Active and Pending Participants (Source: CAISO)

2.2.4. Greenhouse Gas

Like other California electric utilities, in 2013 TID started incurring a cost for emitting GHG pursuant to Title 17 Division 3 Subchapter 10 Article 5 of the California Code of Regulations ("Cap and Trade"). Whenever TID generates power from its natural gas fired power plants or imports power from out of state non-GHG free resources, TID incurs an obligation to surrender California Carbon Allowances ("CCA"). TID incorporates this cost in determining how to meet its load.

Some of this cost is mitigated by the allocation of CCAs that TID receives from the CARB. Currently a CCA costs over $15/mTon. Over the past few years, TID had to procure several million dollars' worth of CCAs. This cost is expected to increase in the future and will affect what energy resources TID uses to meet future electric load.

In addition, the California Code of Regulations prohibits long-term investments in baseload generating plants that do not meet the established emissions performance standard of 1,100 lbs CO2/MWh. This regulation limits the energy resource options TID can consider to meet future needs. For example, coal plants are no longer a viable resource option in California because of this regulation.



U.S. Environmental Protection Agency (2018). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2016

FIGURE 15 - U.S. Greenhouse Gas Emissions in 2016

2.2.5. Transportation Electrification

The transportation sector is a major source of GHG emissions. In 2016, CARB reported that the transportation sector was responsible for 41% of statewide GHG emissions in 2016 (see *Figure 16*). In an effort to reduce GHG emissions from the transportation sector, there are several California policies/regulations that encourage a shift from gasoline to ZEVs such as battery electric vehicles. For example, in January 2018 Governor Brown issued Executive Order B-48-18 that directed state agencies to reach 5 million ZEVs in California by 2030. Furthermore, in addition to federal tax incentives of up to $7,500, California offers a rebate of up to $7,000 for the purchase or lease of a ZEV. The San Joaquin Valley Air Pollution Control District also currently offers a rebate of up to $3,000. Various financial incentives for ZEVs and charging stations are also being offered by several California electric utilities. According to the CEC as of May 2017, nearly 300,000 ZEVs have been sold in California with over 300 ZEVs currently in the TID service area. ZEVs will increase electric usage and can help integrate VERs.

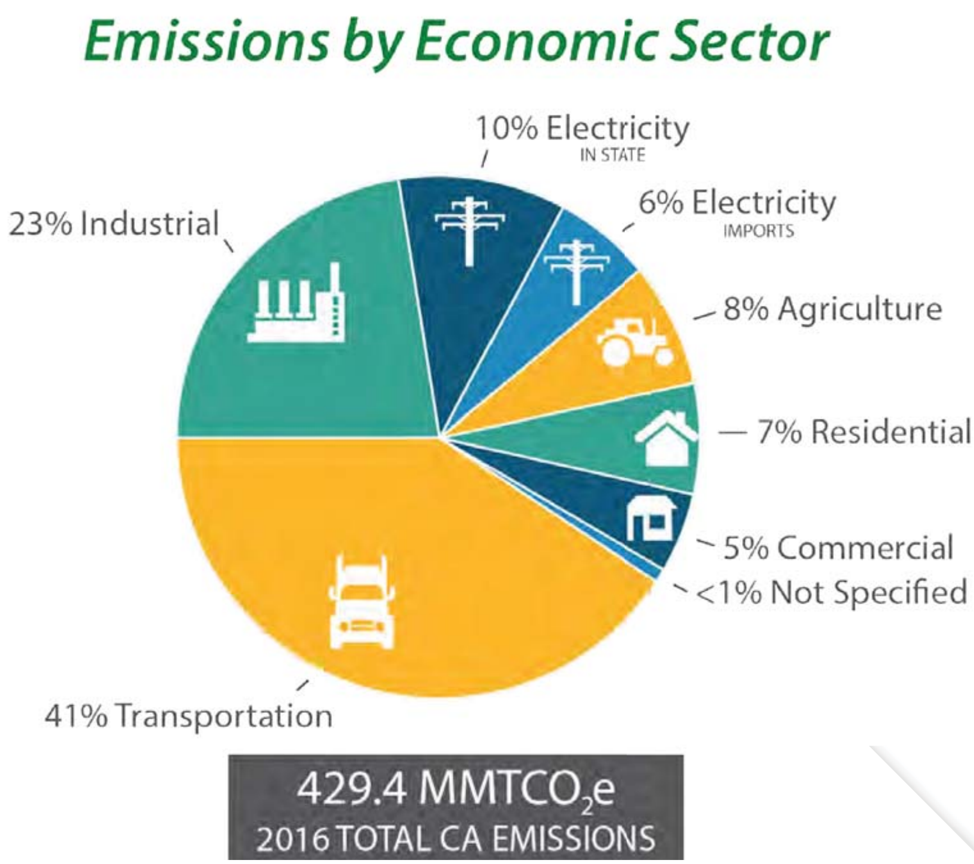
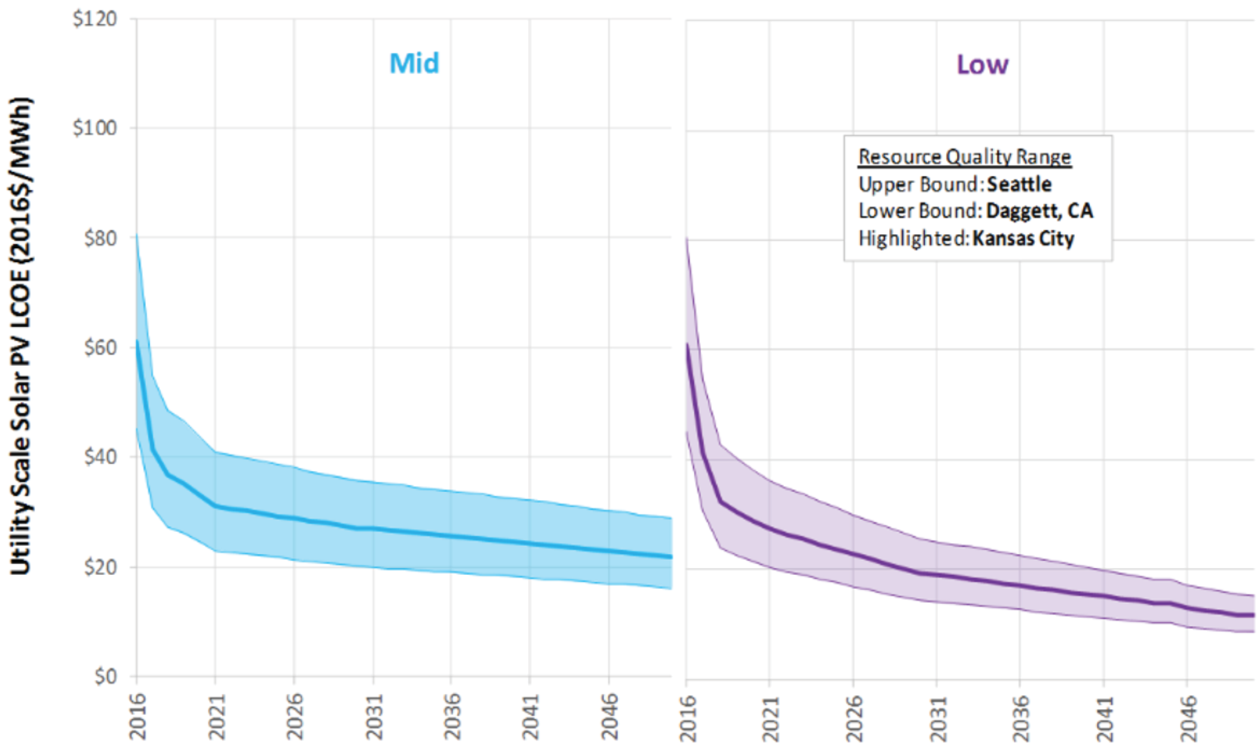


FIGURE 16 - California Carbon Emissions by Sector
(Source: California Air Resources Board)

2.2.6. Technological Improvements

Historically, solar and wind generation were not a cost effective substitute for carbon fuel based generation. In recent years solar and wind generation costs have declined considerably. Coupled with increasing emissions costs associated with carbon fuel based generation, solar and wind have become competitive with carbon fuel based generation (see *Figure 17* and *Figure 18*).



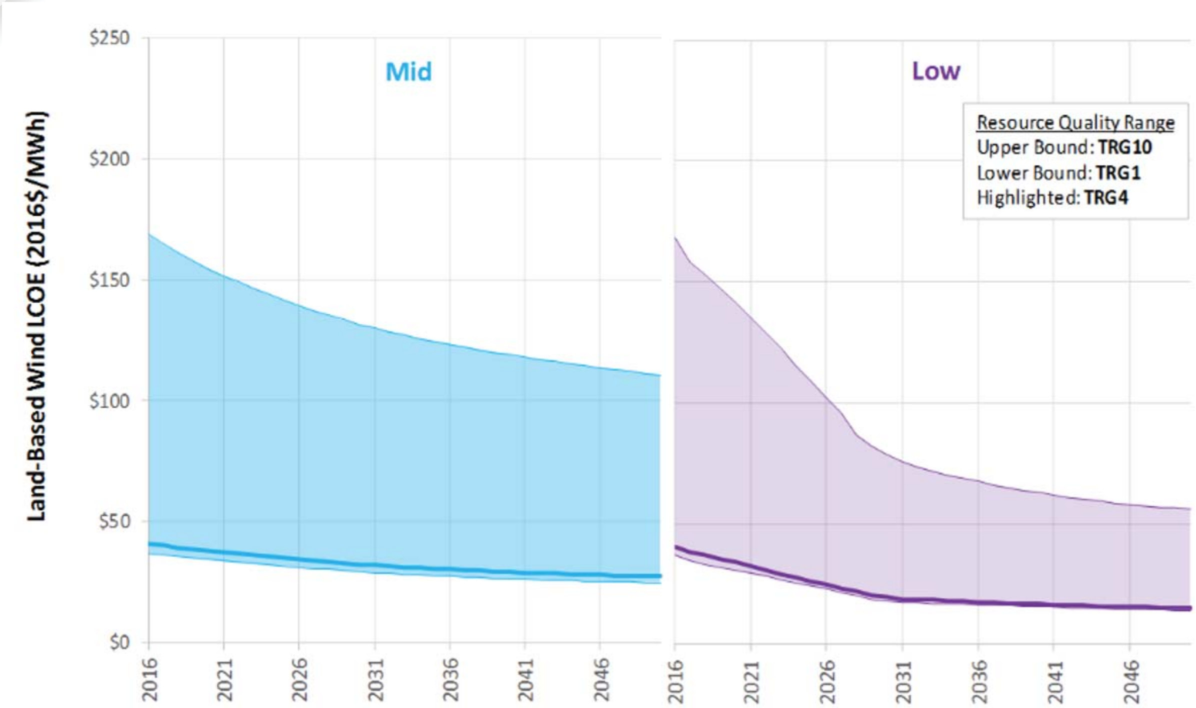
Utility PV (AC) plant LCOE projections with R&D financials

Source: National Renewable Energy Laboratory Annual Technology Baseline (2018), http://atb.nrel.gov

The ATB representative plant characteristics that best align with those of recently installed or anticipated near-term utility-scale PV plants are associated with Utility PV - Kansas City.

R&D Only Financial Assumptions (constant background rates, no tax or tariff changes)

FIGURE 17 - US Utility Scale Solar PV Levelized Cost of Energy (Source: National Renewable Energy Laboratory Annual Technology Baseline (2018))



Land-based wind plant LCOE projections with R&D financials

Source: National Renewable Energy Laboratory Annual Technology Baseline (2018), http://atb.nrel.gov

The ATB representative plant characteristics that best align with those of recently installed or anticipated near term land-based wind plants are associated with TRG 4

R&D Only Financial Assumptions (constant background rates, no tax or tariff changes

FIGURE 18 - US Wind Plant Levelized Cost of Energy (Source: National Renewable Energy Laboratory Annual Technology Baseline (2018))

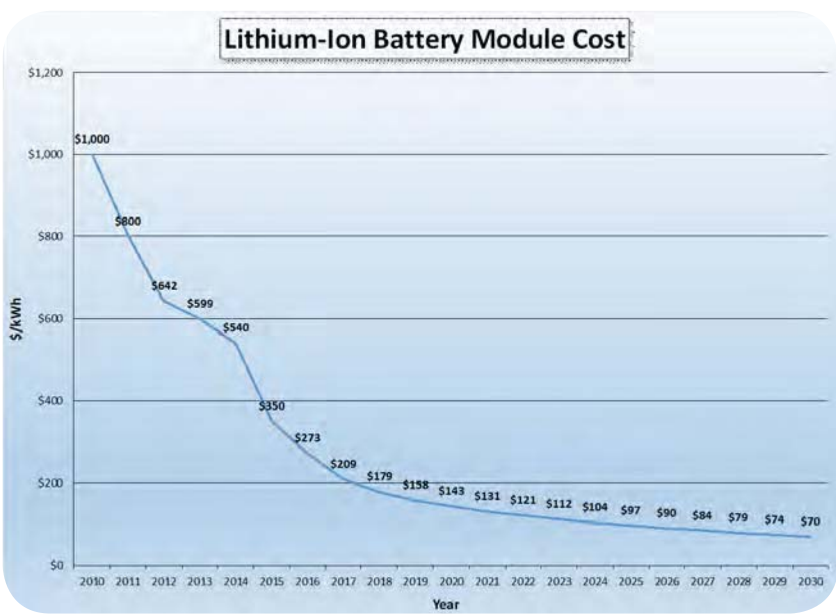


FIGURE 19 - Lithium-Ion Battery Module Cost per kWh (Source: Bloomberg New Energy Finance)

Similar to solar and wind, the capital cost of several energy storage technologies have decreased in recent years and are expected to continue to decrease over the next several years. According to a Bloomberg New Energy Finance article[3], Lithium-Ion battery module costs are expected to decline 93% from $1,000/kilowatt-hour (“kWh”) in 2010 to $70/kWh by 2030 (see ***Figure 19***).

These cost declines coupled with performance improvements have made these resources a viable option for a utilities’ power supply portfolio.

3 “The Battery Will Kill Fossil Fuels—It’s Only a Matter of Time” dated March 8, 2018.

2.2.7. Consumer Environmental Stewardship

As mentioned earlier, more consumers are installing solar generation, trying to reduce energy consumption, and procuring ZEVs. Furthermore, several companies have adopted sustainability/environmental goals to cater to their customers' growing concern for the environment. For example, Facebook recently announced a partnership with PacifiCorp that will result in the development of 437 MW of new solar projects in Oregon and Utah to cover the load of Facebook's data center in Prineville, Ore. The partnership involves Facebook paying PacifiCorp's standard electric rates while also financing development of the solar projects by purchasing the renewable attributes of those projects. In 2017, Microsoft got approval from the Washington Utilities and Transportation Commission to directly procure clean energy to serve 80% of the electric load of its Puget Sound region campus with the remaining 20% to be provided by the local utility Puget Sound. Early this year Apple announced that its global facilities are 100% supplied by clean energy and currently has 25 operational renewable energy projects worldwide totaling 626 MW.

2.2.8. In-State Gas Transportation Cost

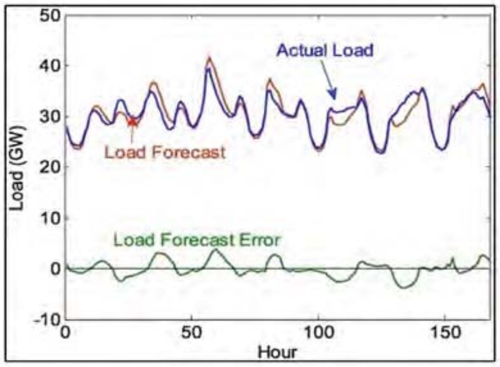
TID pays Pacific Gas and Electric ("PG&E") under a CPUC approved rate ("Gas Transport Rate") to deliver natural gas to TID's natural gas fired power plants. Prior to 2016, the Gas Transport Rate was less than $0.50/MMBtu. Beginning mid-2016 the Transport Rate increased to more than $1.00/MMBtu (more than double the pre-2016 rates). In PG&E's latest rate filing with the CPUC, they have requested for CPUC approval of a Gas Transport Rate for 2019 of around $1.50/MMBtu, which is about half the current cost of the natural gas. TID expects the Gas Transport Rate to continue to rise and put upward pressure on TID's generation cost.

2.2.9. Western Power Markets Initiatives

As mentioned earlier, the CAISO launched the EIM in 2014 which allows the balancing of electric load and resources over a larger geographic area on a sub-hourly basis (currently in 8 western states, see ***Figure 14***) resulting in lower power supply cost, and improved integration of VERs resulting in less curtailments. Current participants in the EIM are PacifiCorp, NV Energy, Puget Sound Energy, Arizona Public Service, Portland General Electric, Idaho Power, and Powerex. Several other entities such as the Balancing Authority of Northern California/SMUD, Los Angeles Department of Water and Power, Salt River Project, and Seattle City Light are expected to become participants within a few years. TID is currently evaluating the merits of joining the EIM. This IRP modeled hourly power markets only and did not model sub-hourly markets associated with EIM participation. However, we do not expect that participation in the EIM will materially affect the findings and recommendations of this IRP.

California is also exploring the expansion of its electric grid operations into other western states, forming a regional independent system operator ("Regional ISO"). Similar to the EIM, a Regional ISO will allow for balancing of electric load and resources over a larger geographic area. In addition, a Regional ISO would also improve transmission planning and grid reliability. The success of California forming a Regional ISO and the details of such an organization is still uncertain. As a result, this IRP did not assume a California Regional ISO operating during the Planning Period.

3. ENERGY AND DEMAND REQUIREMENTS



TID's load forecast is developed using an econometric model that produces a forecast of number of customers, energy consumption, and peak demand for each rate class. For each rate class and each projected variable, the model develops several multi-variable linear and logarithmic regression equations and generally utilizes the equation that has the best fit. The model uses historical and projected customer, economic and demographic data from numerous sources. The inputs used by the model are as follows:

- **A. Historical number of customers and energy consumption by rate class for the last twenty years.**
- **B. Historical load and coincidence factors by rate class for the last five years.**
- **C. Historical system load data for the last 20 years.**
- **D. Historical distribution losses for the last 7 years.**
- **E. Historical temperature data (1950 to present).**
- **F. Historical and projected employment, income, and population for Stanislaus County from Woods & Poole Economics.**
- **G. Historical Consumer Price Index (CPI) for All Urban Consumers, U.S. city average from the United States Department of Labor's Bureau of Labor Statistics.**
- **H. Historical delivered natural gas prices to commercial consumers and electric power consumers from the United States Energy Information Administration (EIA).**
- **I. Projected California natural gas prices from IHS Markit and several broker data reports.**
- **J. Historical number of customer solar installations, capacity, and generation by customer class.**
- **K. Customer solar growth forecasts from the EIA, CEC IEPR 2018-2030 Mid Demand Case, and IHS Markit.**
- **L. Historical hourly customer solar generation profile by customer group.**
- **M. Projected cumulative energy efficiency savings and demand reduction from Navigant's Electricity Resource Assessment Model (ELRAM), created for CMUA members and used in setting the latest TID Board adopted energy efficiency targets.**
- **N. Projected # of electric vehicles and associated energy consumption for the TID service area based on the latest CEC "Light Duty Plug-In EV Energy and Emission Calculator".**
- **O. ZEV hourly charging profile from IHS Markit.**

Three scenarios (base, high growth, and low growth) are modeled to reflect varying economic and demographic growth expectations. Peak demand under a 1-in-5, 1-in-10, and 1-in-100 (extreme case) temperature scenarios are also developed. The forecast reflects the effects of future distributed generation additions, projected electric vehicle growth, and anticipated load reductions from TID's energy efficiency programs and California building standards (including the requirement to include solar generation in new homes). The forecast also takes into account large customers expected to be online within a few years.

3.1. Distributed Generation Forecast

Due to several reasons explained above, TID expects that the number of Customer PVs to continue growing. TID is projecting to have about 87 MW of total installed capacity by 2030, more than double the 35 MW currently installed. In 2030, Customer PVs are expected to generate close to 145,000 MWh (representing about 6.6% of forecasted energy load in 2030). This growth was estimated based on historical growth patterns, the recently adopted California building standards, and several industry Customer PV growth projections. This growth in Customer PV will result in lower load growth, increased load variability, and change the shape of the load served by TID resources.

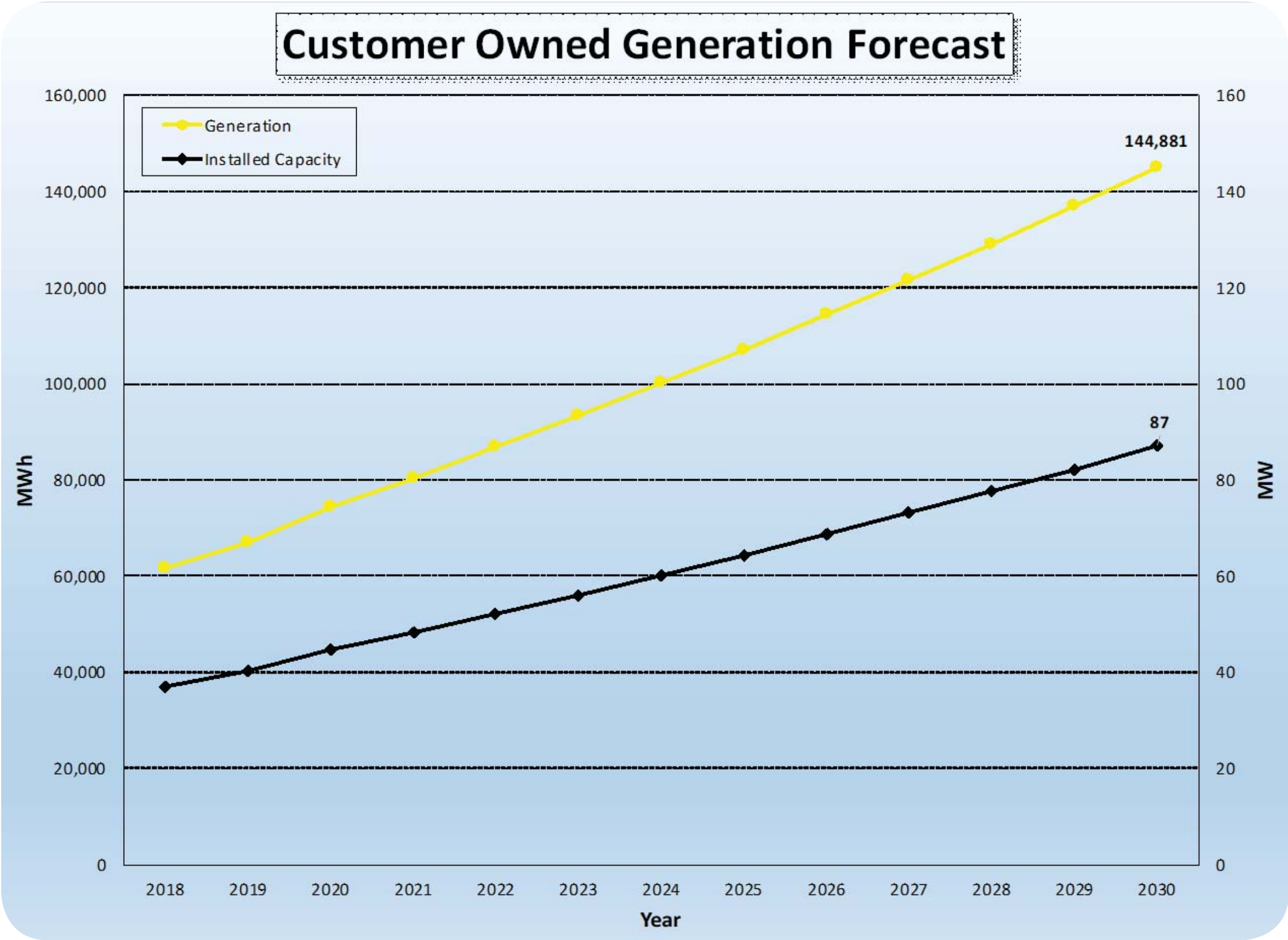


FIGURE 20 - Customer Owned Distributed Generation Forecast

Historical data on current Customer PV generation show that generally Customer PV generates between the hours 8 am to 9 pm (see *Figure 21*) with peak generation occurring in the early afternoons. Notice the steep slope of the generation profile before and after the peak generation hours. On a monthly basis Customer PV generation is greater during the summer months when TID loads are higher (see *Figure 22*). As Customer PV grows in our service area, the shape of TID's Net Load will be affected.

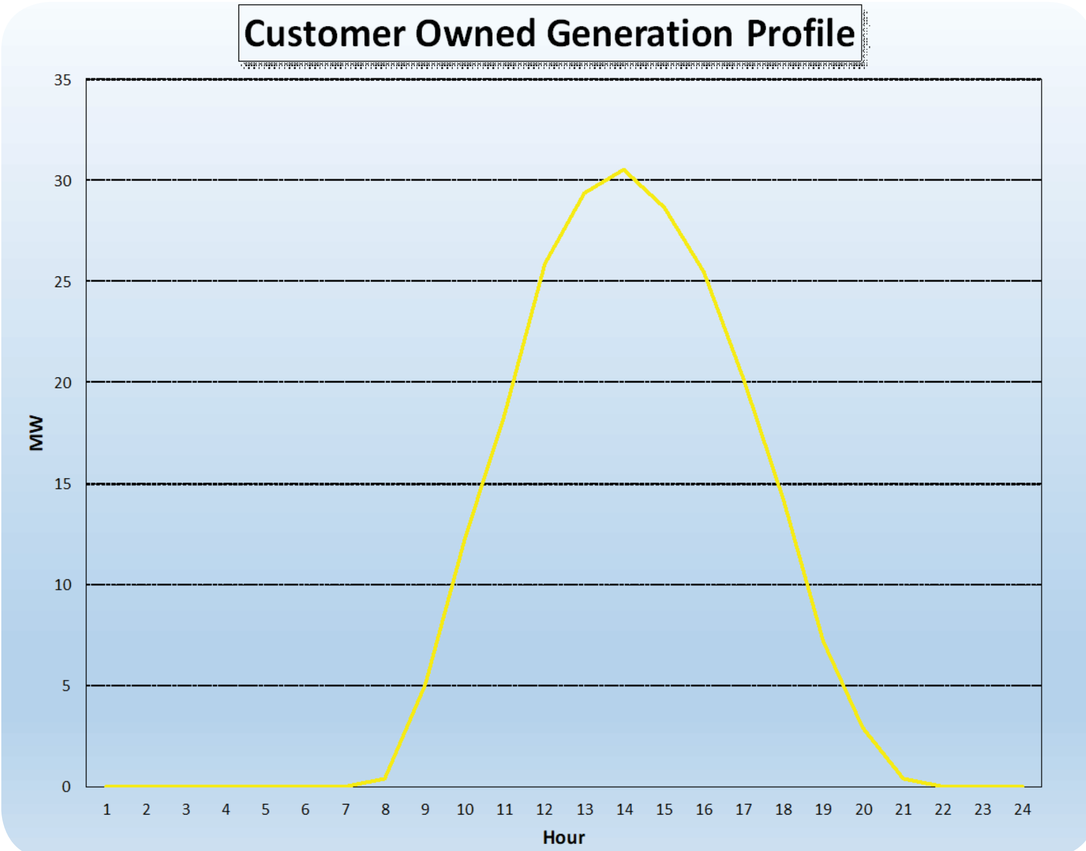


FIGURE 21 - Typical April Day Customer Owned Generation Profile

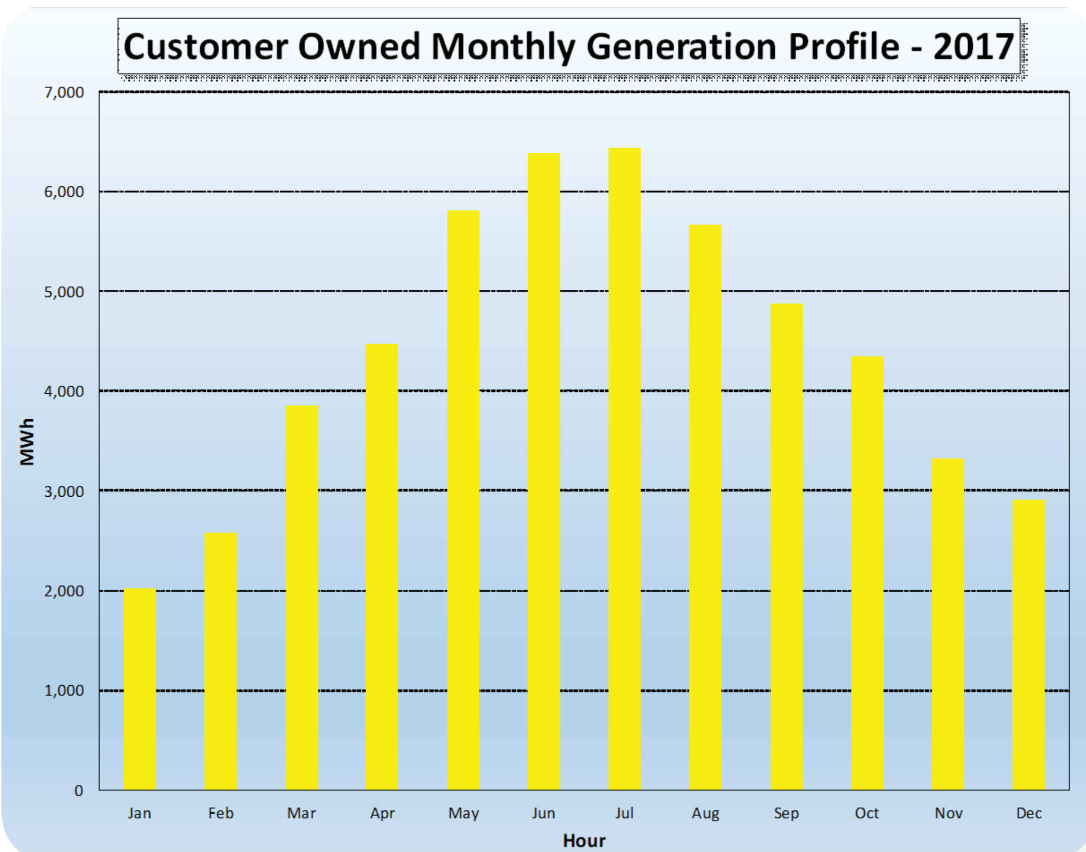


FIGURE 22 - 2017 Customer PV Generation by Month

Figure 23 shows the anticipated change in load shape for a sample April day due to the projected growth in Customer PV[4]. In 2030, TID projects that a typical April day would show a steeper decline in load beginning mid-morning and sharper increase by the early evenings relative to today. In certain months of the year the peak load is expected to occur later in the day. For example, the peak load in a typical July day is projected to move from 6 pm currently to 7 pm by 2030 (see *Figure 24*). Due to the changing load shape, TID anticipates the difference in load between periods ("Load Ramp") will be greater going forward. For example, the average load decrease in hour ending ("HE") 12 will be 9 MW greater for February 2030[5] compared to February 2017 (see *Figure 25*). The average load increase in HE 18 will be 18 MW greater for January 2030 compared to January 2017 (see *Figure 26*). The longer the period of measurement (e.g. a 3 consecutive hours period) the larger the change in Load Ramp (see *Figure 27* and *Figure 28*).

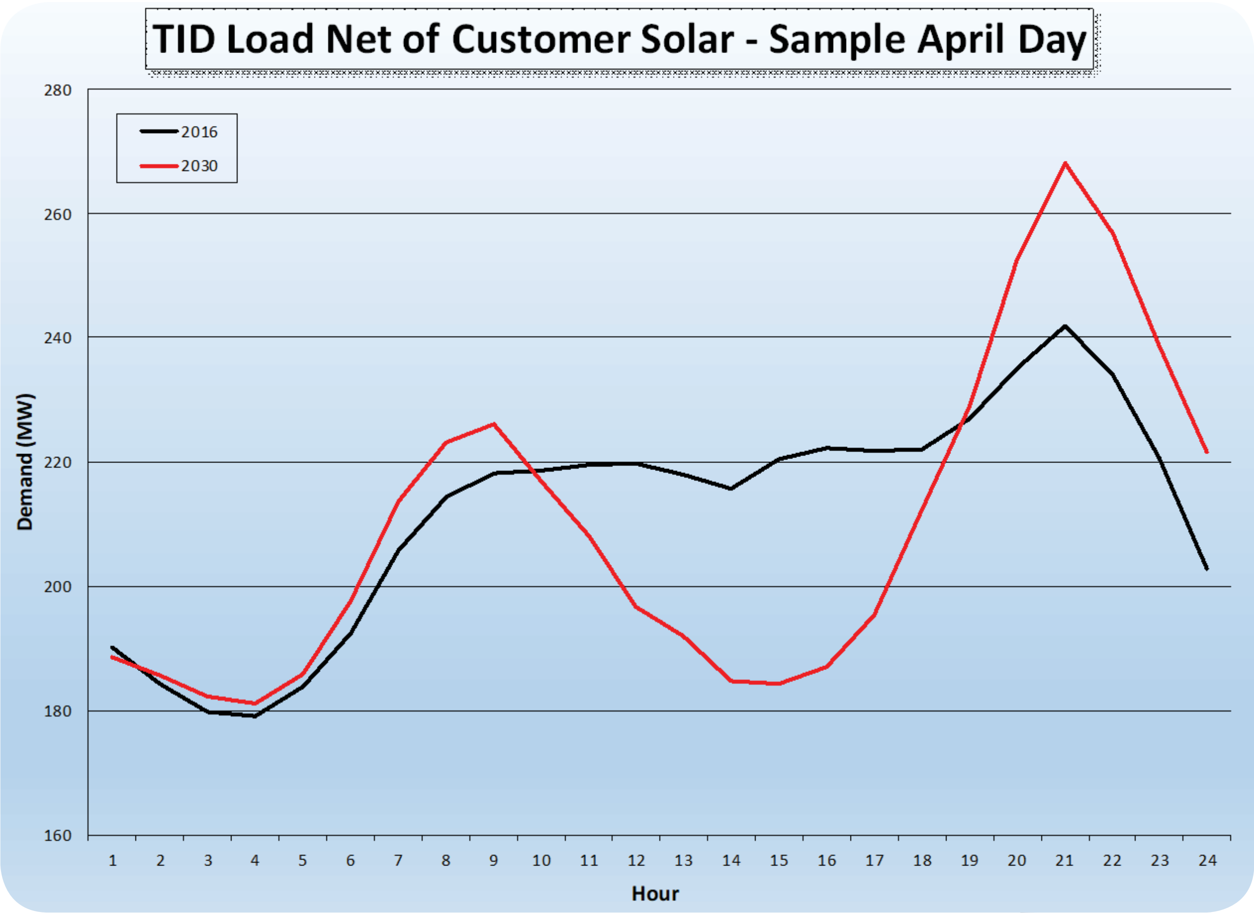


FIGURE 23 - TID Net Load - Sample April Day

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4 The actual effect of PV's on TID's load shape will be dependent on how many PV installations will be paired with some form of energy storage and how such energy storage is operated.

5 2017 values are shown as the solid portion of the stacked bars and the increase in Load Ramp values are shown as the diagonal pattern portion of the stacked bars.

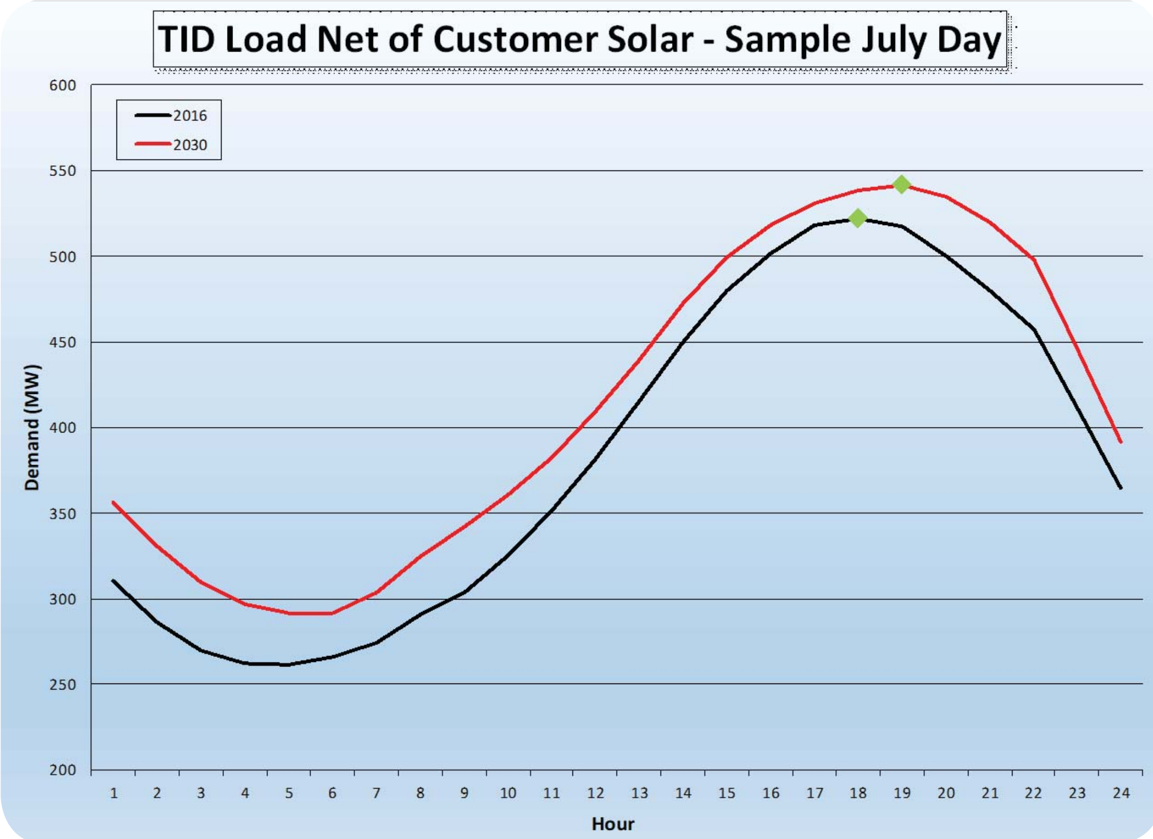


FIGURE 24 - TID Net Load - Sample July Day

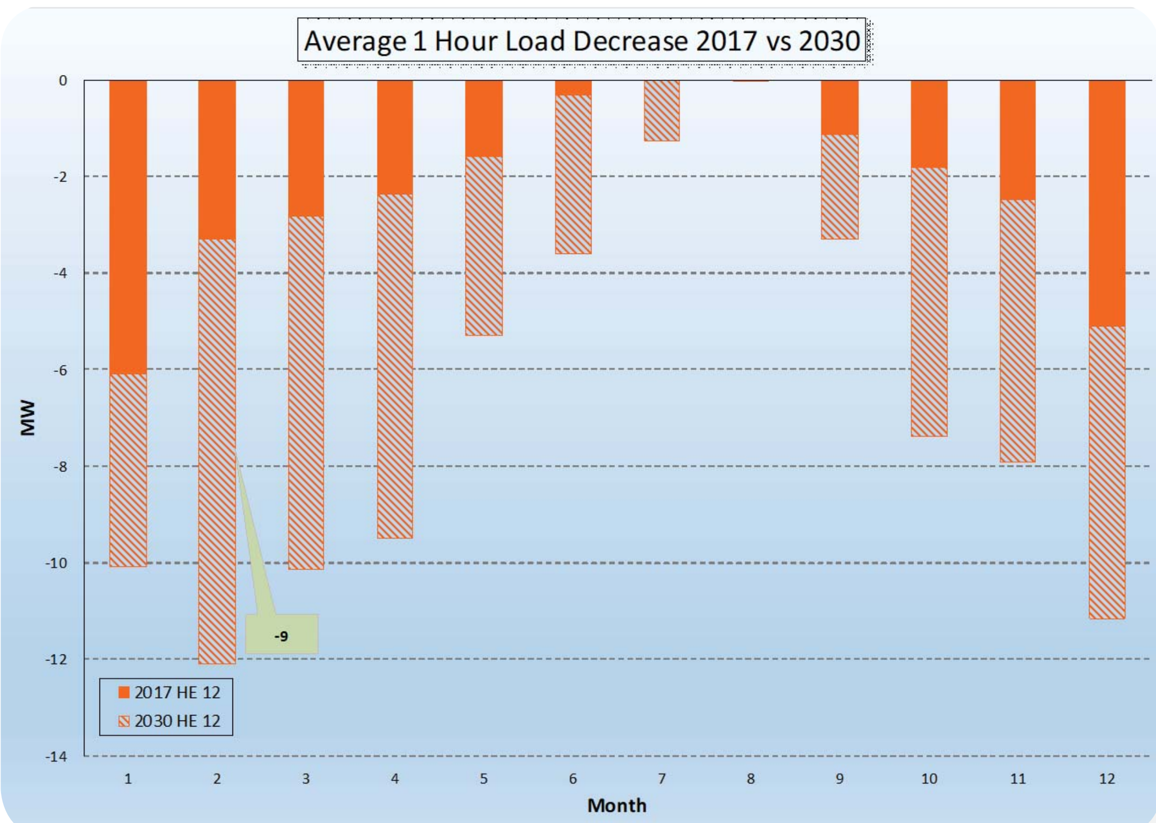


FIGURE 25 - Average 1 Hour Load Decrease 2017 vs 2030

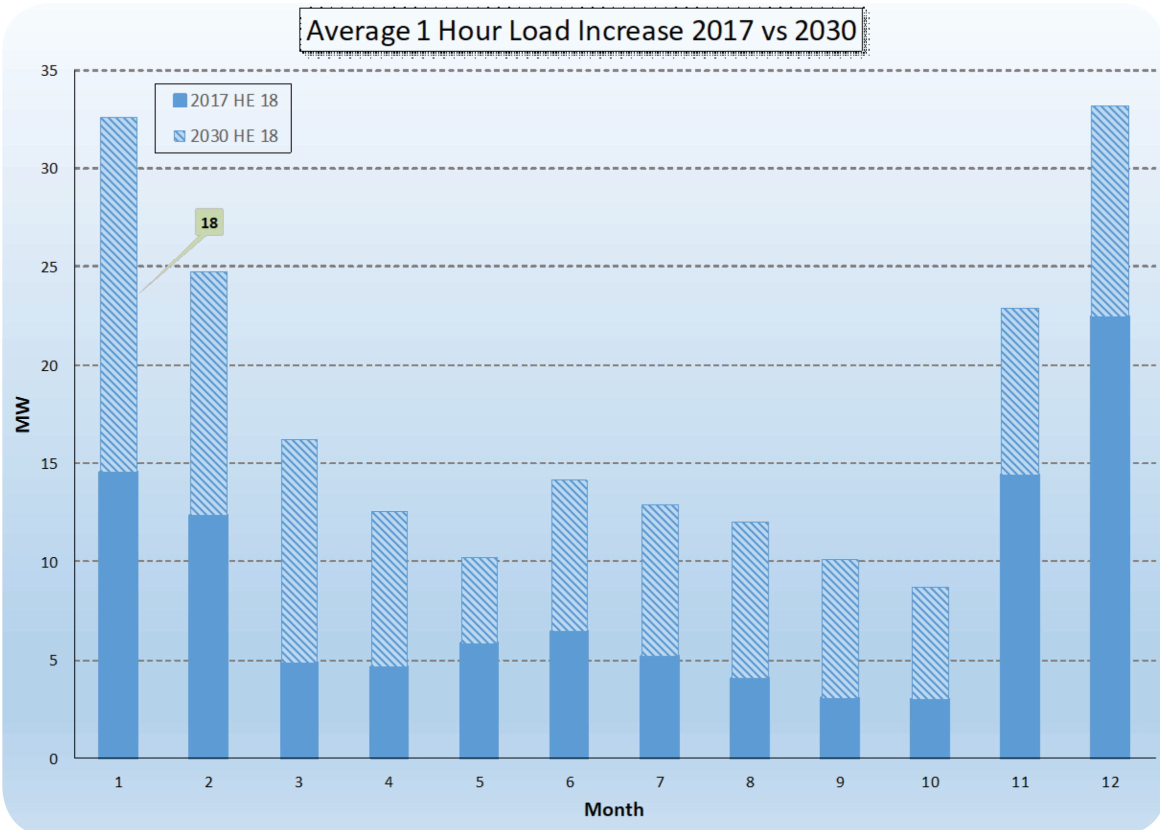


FIGURE 26 - Average 1 Hour Load Increase 2017 vs 2030

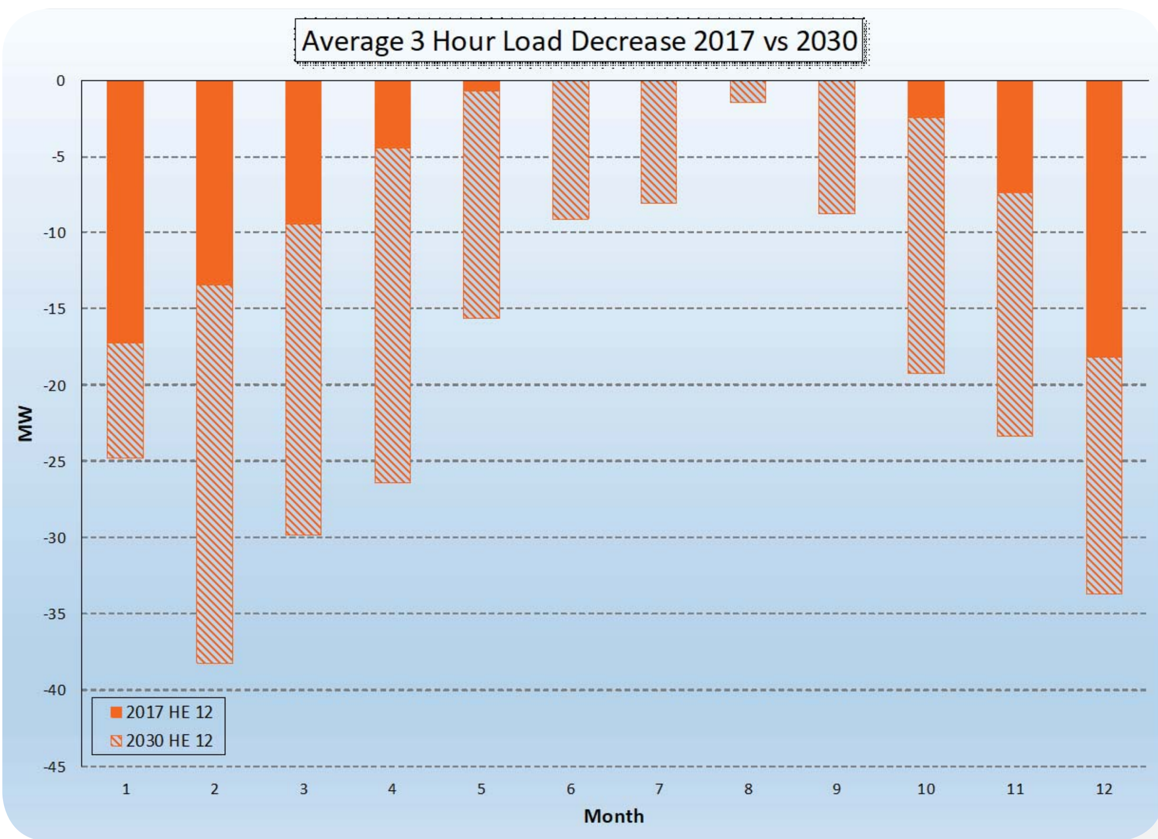


FIGURE 27 - Average 3 Hour Load Decrease 2017 vs 2030

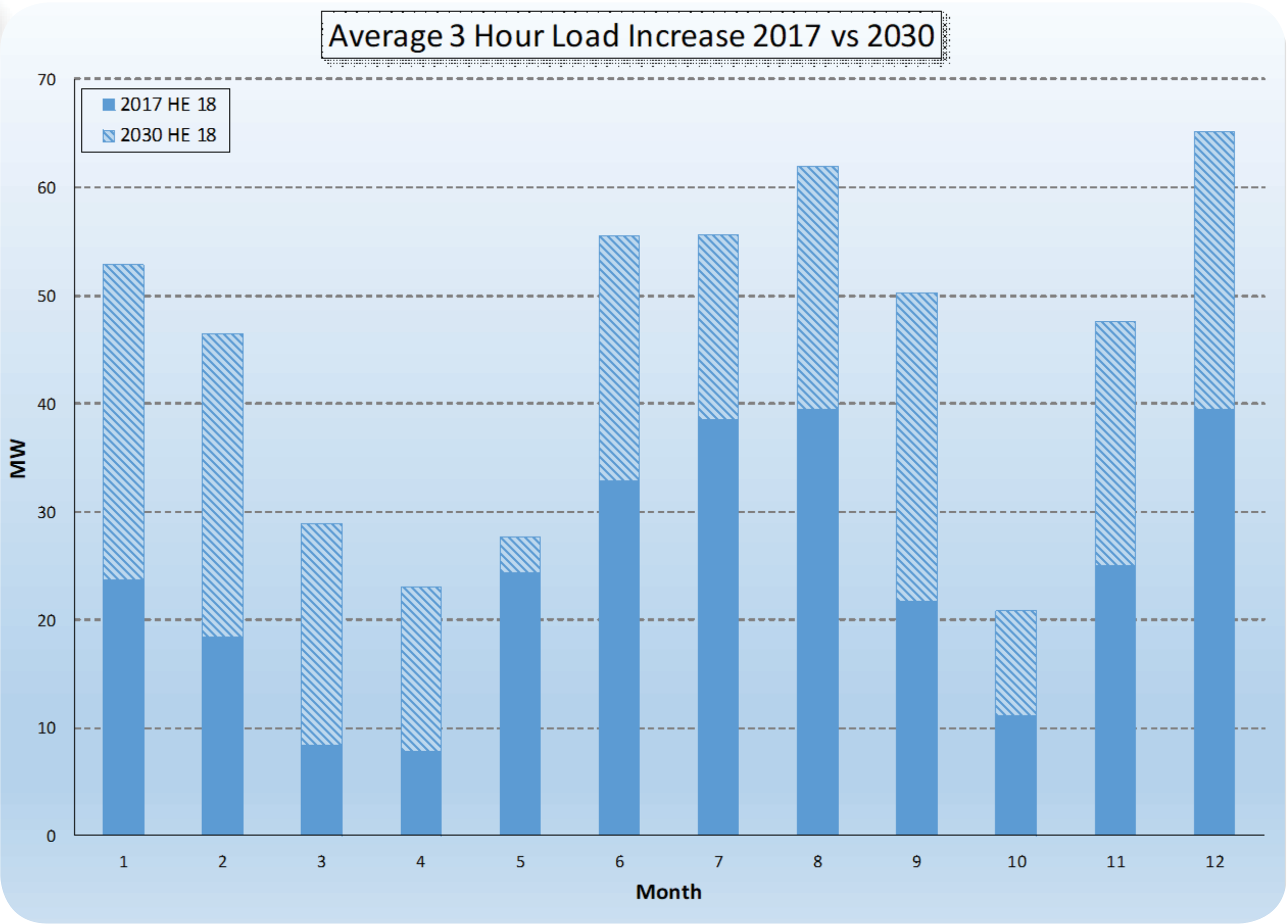


FIGURE 28 - Average 3 Hour Load Increase 2017 vs 2030

Given that TID has several flexible generating units in its portfolio and access to power markets, during the Planning Period TID was able to reliably meet load despite the projected increase in Load Ramps. For example, the Almond II power plant can increase generation from 0 to about 150 MW in ten minutes. To analyze the effect of the growing Customer PV generation on intra-hour load deviation, we analyzed load variation between minutes and inferred from such data the load variation due to Customer PV. We then took that historical load variation attributed to Customer PV and escalated it by the projected growth of Customer PV. The results show that the minute to minute load variation due to Customer PV increases on average by 5 MW in 2030. Further analysis is needed to determine whether this increased intra-hour load variation can be handled with existing resources.

3.2. Energy Efficiency and Demand Response

3.2.1. Energy Efficiency

TID strives to meet its customers' electric needs using the least cost resources feasible and is committed to providing our customers with cost-effective energy efficiency solutions and programs ("EE Programs"). Energy efficiency programs not only reduce energy consumption but also result in lower emissions, reduced need for distribution infrastructure, and promote the local economy (i.e. customer energy cost savings means better profits for the customer, and more jobs for the local economy since local contractors are often involved in installing the energy efficiency measures).

TID has several EE Programs, most of which have been in place for several years. Since 2001, TID has spent approximately $18.62 million on its EE Programs resulting in reduced energy consumption and emissions. Below are several of TID's EE Programs:

- **Our non-Residential Lighting program offers an incentive to replace fluorescent, metal halide, high induction density lighting with light-emitted diode ("LED"). This program allows customers to tailor their lighting efficiency upgrades to better meet their needs and attain greater energy savings. TID has sustained a high participation rate with this program.**
- **The Commercial Direct Install ("CDI") program is available to qualifying businesses whose average monthly electrical demand is 100 kilowatts or less. In this program TID replaces the customer's inefficient lighting with LED's with little to no installation cost for the customer.**
- **Our Home Energy Analysis program provides the customer with information regarding their monthly usage compared to similar homes in our community or compared to their prior year(s) usage. In addition, the customer has access to a web portal where they can customize their home energy use using the energy audit tool, and access helpful energy saving tips.**

TID continues its commitment to developing robust, cost-effective EE Programs with measurable and verifiable goals. As part of this commitment, the TID Board periodically adopts ten-year energy efficiency goals ("EE Goals"). Currently, the EE Goals are updated every four years. TID's current EE Goals (shown in *Table 1*) are based on a study performed in conjunction with most of the California publicly owned utilities that identified all potentially achievable cost-effective electricity efficiency savings for each participating utility using well established industry accepted data and methodology ("EE Goals Study") (for details on the study please see "Energy Efficiency in California's Public Power Sector" submitted to the CEC in 2017).

YEAR	ANNUAL ENERGY EFFICIENCY GOALS	
	MWh	MW
2017	16,394	3.6
2018	14,939	3.6
2019	15,001	3.6
2020	14,938	3.5
2021	14,172	3.3
2022	13,698	3.2
2023	12,530	2.9
2024	11,638	2.7
2025	11,023	2.5
2026	10,476	2.4

Table 1 - TID Board Adopted Annual Energy Efficiency Goals 2017-2026

Based on the results of the EE Goals Study, TID expects to achieve 114,010 MWh of energy savings in 2030[6] from its energy efficiency programs and its support for development of appliance and building codes and standards (representing about 5.1% of forecasted energy load in 2030).

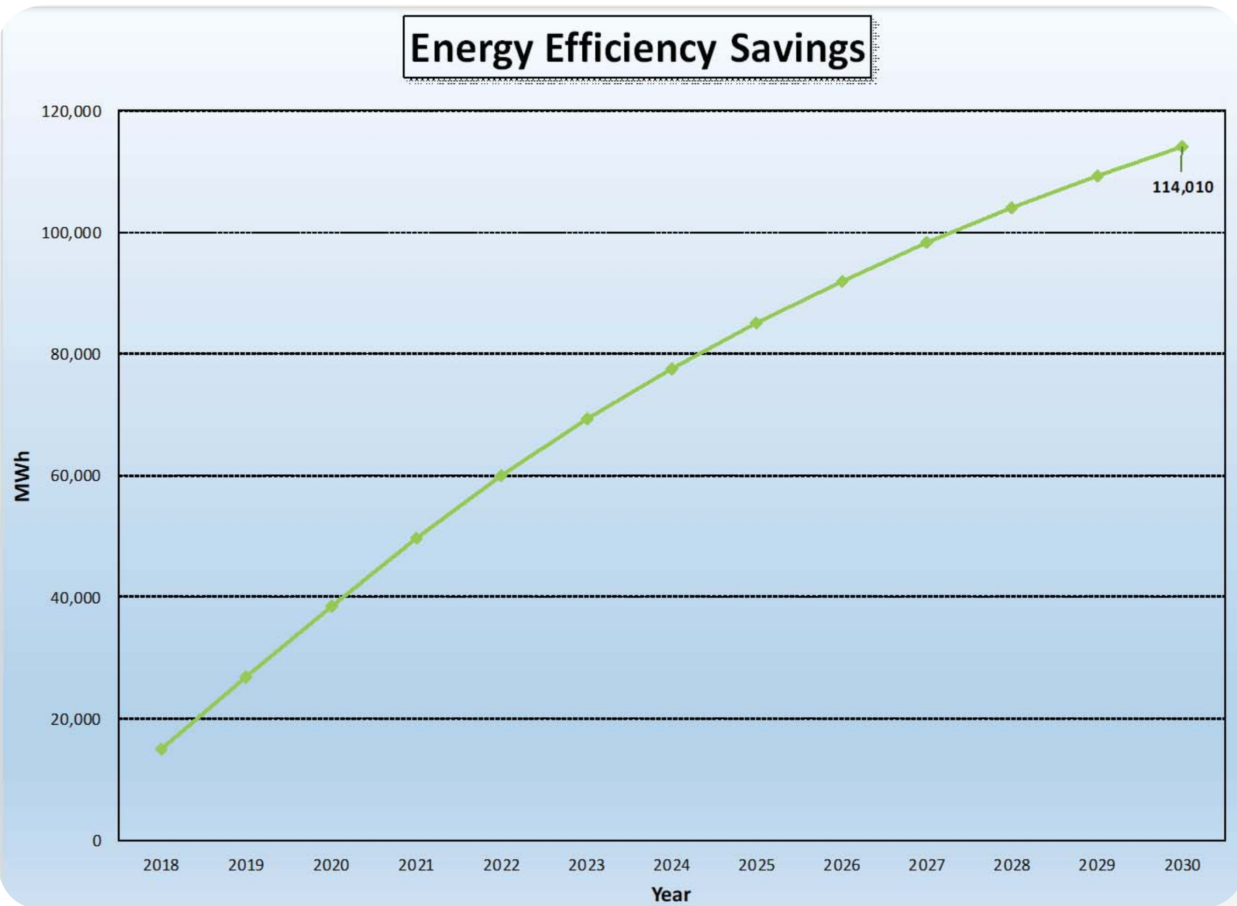


FIGURE 29 - Annual Energy Efficiency Savings from TID Programs

6 Although the EE Goals were only adopted through 2026 the EE Goals Study estimated savings through 2040.

3.2.2. Demand Response

While TID does not currently offer event based demand response programs to our customers, TID has been encouraging customer load shifting behavior through our time of use rates ("TOU Rates"). Since 2001, TID has offered TOU Rates to all non-residential customers. In 2017, 32% of our retail load was billed on TOU Rates. TID began deploying "smart meters" in 2008, and as of January 2018 had 87,000 deployed representing over 90% of customer meters with an expectation of reaching 100% by the end of 2018. The meters have reduced connection and disconnection costs, and have allowed residential customer electric usage to be tracked in hourly intervals and non-residential customer electric usage tracked in 15 minute intervals. In addition, as part of TID's Strategic Plan, TID recently started installing a new Customer Information System and Meter Data Management software ("CIS System"). The smart meters and the CIS System will create the foundation for future programs to meet changing technology and customer needs including demand response. Based on this new technological foundation, TID will continue to research and analyze prospective customer programs that could benefit our customers.

3.3. ZEV Load Forecast

As mentioned earlier, the transportation sector is a major source of GHG emissions and is important in meeting California's goal of reducing GHG emissions. Hence, TID expects that California policies and regulations will continue to promote the growth of ZEVs in California. The CEC's most recent transportation and energy demand forecast projected ZEV range to increase significantly by 2020 and ZEV prices to decline. Furthermore, several automakers have announced plans of increasing the number of ZEV models that they will offer in the future. All such factors point towards higher ZEV adoption in the future.

Company	Target Year	Announcement
BMW	2025	will offer 25 electrified vehicles – 12 will be fully-electric
Mercedes Benz	2022	10 plug-in electric vehicles, rest will have hybrid option
Fiat Chrysler	2022	More than half of Maserati models will use some form of electric powertrain
Ford	2022	13 new electric (and plug-in hybrid) models
Volvo	2019	every ***new*** model will be electric, plug-in hybrid, or hybrid
GM	2023	20 new fully electric models
Hyundai Kia	NA	electric cars at the center of future product stategy
Jaguar Land Rover	2020	every ***new*** model will be electric, plug-in hybrid, or hybrid
Renault - Nissan	2022	12 pure electric models to be launched
Volkswagen Group	2030	will electrify (electric, plug-in hybrid, and hybrid)entire model portfolio by 2030

FIGURE 30 - Major Announcements by Automakers on Vehicle Electrification
(Source: CEC Revised Transportation and Energy Demand Forecast, 2018-2030)

In support of California's goal to decarbonize the transportation sector, TID has designed a program aimed at electric vehicles ("EV Program"). TID's EV Program was approved by the TID Board of Directors on October 2, 2018, and will formally start on January 1, 2019. It is comprised of the following five major components:

1. *Customer incentives*
2. *Community/government partnerships*
3. *TID fleet*
4. *TID employee charging*
5. *EV rate (pending rate hearing early 2019)*

The customer incentive piece of our EV Program offers rebates for the purchase of both new and used electric vehicles ("EV"), residential level II EV chargers, and multi-family/non-residential level II EV chargers. The program also offers higher rebates for low income customers to encourage higher participation from disadvantaged communities within our service area.

Another facet of TID's EV Program is creating partnerships with local government, school districts, delivery companies, as well as any other customer who is interested in fleet electrification or charging station installations. We want to guarantee that if/when government and business customers within TID are looking to electrify their fleet or add vehicle charging, that we are there to partner and assist in the process.

Currently, TID has several hybrid pool vehicles. As part of the EV Program, TID will extend the practice of considering hybrid or electric vehicles when replacing or expanding our fleet. For example in addition to pool vehicles replacements, hybrid and electric vehicles will now be considered when replacing line trucks and forklifts. Grants are also being pursued to further the adoption of hybrid and electric vehicles. Furthermore, in an effort to minimize emissions from our fleet, we have been monitoring and have reduced gas vehicle idle time.

Another aspect of TID's EV Program is TID employee charging. In order to promote the purchase of ZEV's by TID employees, TID has committed to provide level 1 charging capabilities at various locations throughout TID. We currently have approximately 20 employees that own ZEV's and would anticipate this number to grow with the availability of workplace charging.

TID implemented a pilot EV rate from 2015-2017 with the intention of learning our EV customer's charging patterns. The pilot had limited participation and therefore did not provide adequate information. For now, TID has developed a ZEV charging profile based on third party studies which was used in developing the hourly ZEV load forecast for this IRP.

The EV Program also includes proposed EV rates ("EV Rates") that is planned for TID Board consideration in the first quarter of 2019. The EV Rates will be time of use rates designed to incentivize more energy use in the off-peak periods. The energy usage data will be gathered and analyzed to inform future program enhancements or expansion, load forecasts, and IRPs.

TID's EV Program will have a featured webpage on our website designed to promote ZEV adoption. The website will provide our customers with information about our rebates, links to state and federal rebates, as well as a myriad of other information and links about electric vehicles and greenhouse gas emission reductions. We also plan to add functionality to this web page and have our customers be able to fill out TID's rebates electronically. We are also launching an internal education program to reach our 450 employees via TID's internal intranet site as well as focused training for customer service representatives. This effort will help ensure our employees will be aware of the benefits of ZEV's and prepared to assist customers' inquiries about the EV Program or ZEVs in general.

The EV Program has an annual budget of approximately $150,000 for the various aspects of our EV Program. TID plans to join the Low Carbon Fuel Standard program managed by CARB to assist in the funding of our EV Program.

Given the above factors, TID developed an EV load forecast that is in line with California's ambitious goal of 5 Million ZEVs by 2030. Using the CEC's Light Duty Plug-In EV Energy and Emission Calculator ("CEC ZEV Calculator"), TID projects the number of ZEVs in its service area to grow from approximately 300 currently to more than 6,600 by 2030 (see ***Figure 31***) adding close to 28,000 MWh of additional load (representing about 1.3% of forecasted energy load in 2030). The CEC ZEV Calculator estimates that this additional electric load equates to over 12,000 mTons of added GHG emissions for TID in 2030. However, after taking into account the reduction in gasoline powered vehicles, the net effect of increasing ZEVs in TID service area will be a net reduction of over 8,000 mTons of GHG emissions in 2030.

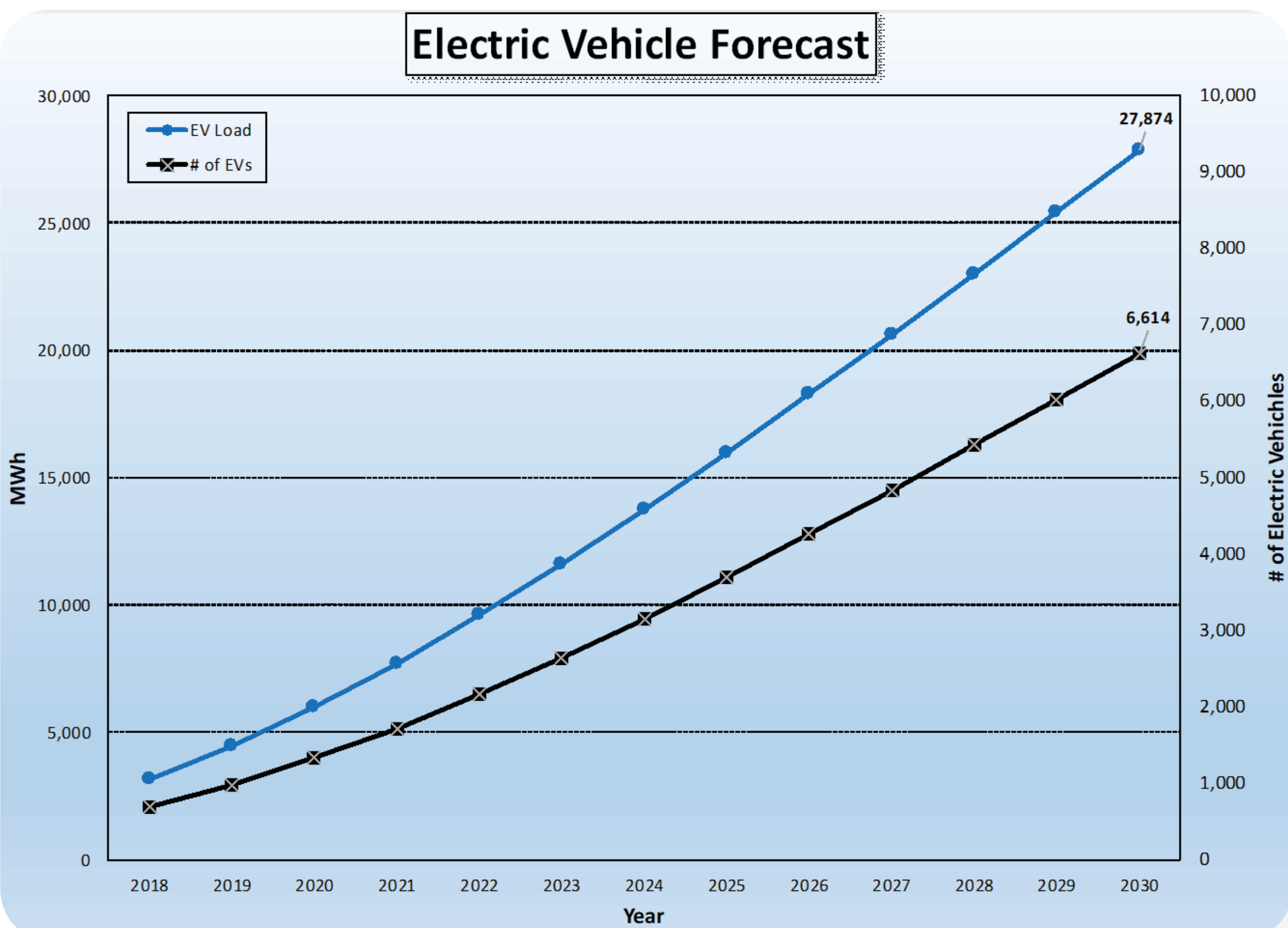
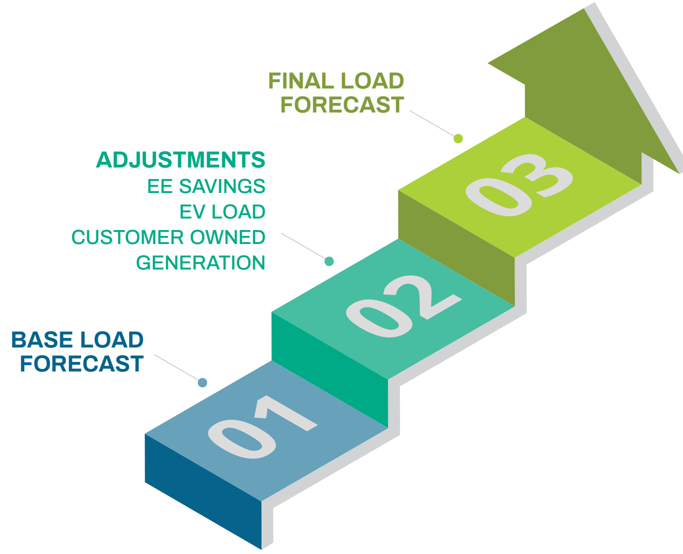


FIGURE 31 - Electric Vehicle Forecast

3.4. Load Forecast

To estimate the electric demand to be supplied by TID, TID begins with a load forecast using the econometric model and inputs described above prior to taking into account future estimates of energy efficiency savings, electric vehicle load, and customer owned generation ("Base Load Forecast"). The Base Load Forecast is then adjusted to take into account forecasted energy efficiency savings, electric vehicle load, and customer owned generation.



For the period 2018 to 2030 TID is anticipating energy load to grow on average 0.4% per year and peak demand to grow on average 0.1% per year reaching approximately 2,300,000 MWh and 542 MW by 2030. The forecasted load growth is lower than historical growth rates. Load growth from 2018 to 2019 is higher than other years in the Planning Period due to the addition of several industrial customers in 2018 and 2019[7].

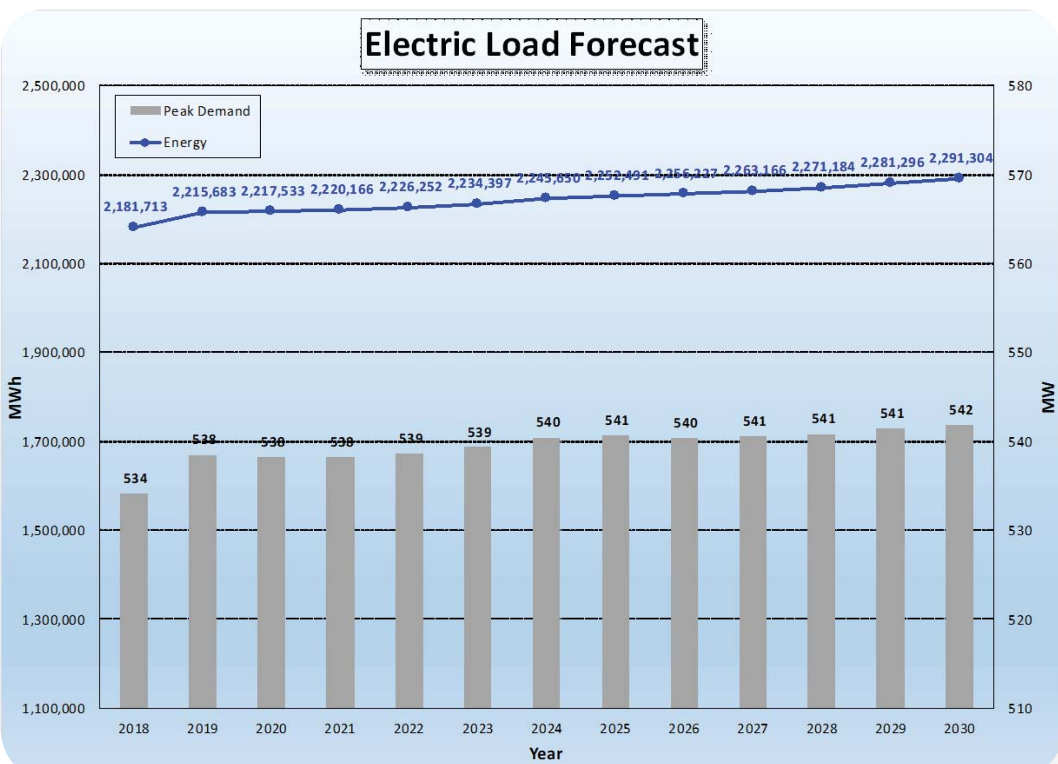


FIGURE 32 - TID's Electric Load Forecast

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7 The load forecast for 2018 reflects only a partial year load for some of the new large customers. In 2019, a full year load is reflected for those customers, which affects the load growth between 2018 and 2019.

4. ELECTRIC RESOURCES

4.1. Existing Power Supply Resources

TID has a diverse electric resource portfolio ("Resource Portfolio"). The Resource Portfolio is comprised of TID owned resources and power purchase agreements with terms ranging from 5 to 25 years (see *Table 2*)[8]. The portfolio relies on several fuel sources, which reduces TID's exposure to commodity price volatility. The portfolio includes a mix of baseload, intermediate, and peaking resources allowing TID to manage supply against demand and integrate Customer PV.

Several resources are located in TID's service area, which helps increase the reliability of TID's electric system. Furthermore, several of TID's resources are either renewable or GHG free.

Resource Name	Capacity (MW)	Ownership Type	Term	Fuel	Type	Inside TID BAA	Renew-able	GHG Free
Don Pedro	139.0	TID Owned	Life of Project	Hydro	Energy Limited Dispatchable	✓		✓
La Grange	5.3	TID Owned	Life of Project	Hydro	Energy Limited Run of River	✓	✓	✓
Hickman	1.1	TID Owned	Life of Project	Hydro	Energy Limited Run of River	✓	✓	✓
Turlock Lake	3.3	TID Owned	Life of Project	Hydro	Energy Limited Run of River	✓	✓	✓
Dawson	5.5	TID Owned	Life of Project	Hydro	Energy Limited Run of River	✓	✓	✓
Walnut	49.6	TID Owned	Life of Project	Natural Gas	Peaker	✓		
Almond	48.3	TID Owned	Life of Project	Natural Gas	Intermediate	✓		
Almond 2	174.0	TID Owned	Life of Project	Natural Gas	Peaker	✓		
Walnut Energy Center	250.0	TID Owned	Life of Project	Natural Gas	Baseload	✓		
Tuolumne Wind Project	136.6	TID Owned	Life of Project	Wind	Variable Energy Resource		✓	✓
NCPA Geothermal	7.0	TID Owned	Life of Project	Geothermal	Baseload		✓	✓
WAPA	4.0	PPA	20 Years (Expires in 2024)	Hydro	Energy Limited Dispatchable			✓
Boardman	59.0	PPA	25 Years (Expires in 2018)	Coal	Baseload			
Rosamond West Solar 2	54.0	PPA	20 Years (Expires in 2037)	Solar	Variable Energy Resource		✓	✓
Loyalton Biomass	0.8	PPA	5 Years (Expires in 2023)	Biomass	Baseload		✓	

Table 2 - TID's Current Electric Resource Portfolio

To minimize power supply costs, TID supplements the above resources with purchases from several power markets and other wholesale electric providers such as neighboring utilities. For example, rather than generating power from one of TID's natural gas-fired power plants, TID would procure power if it cost less than generating. Following are more detailed descriptions of TID's current electric resources.

8 The capacity figures shown in the table are approximate values and do not reflect temperature and annual degradation (if applicable).

4.1.1. Large Hydroelectric and GHG Free

Built in 1923, TID has a 68.46% ownership share of the 203 MW Don Pedro Project ("Don Pedro"), which equates to approximately 139 MW. The Don Pedro Project consists of a dam, a reservoir, and a powerhouse on the Tuolumne River 3.5 miles upstream of La Grange Dam. These units provide TID with inexpensive GHG free energy, operating reserves, and flexible capacity.

Don Pedro Power Plant on the Tuolumne River

4.1.2. Natural Gas

4.1.2.1. Walnut

The Walnut power plant ("Walnut") consists of two combustion turbine generating units, each having a capacity of 24.8 MW (49.6 MW total) which was placed in service in 1986. The units mainly provide non-spinning reserve but at times generate power during peak periods to reduce power purchases when prices are high.

4.1.2.2. Almond

The Almond power plant ("Almond"), a steam-injected combustion turbine, was brought online in 1996 and was repowered in 2003 with a new LM 6000 turbine generator, which resulted in a slight increase in capacity to 48.3 MW and an improvement in fuel efficiency. These units at times generate power during peak periods to reduce power purchases when prices are high and at the same time can provide operating reserves when generating.

4.1.2.3. Almond II

The Almond II power plant ("A2PP") consists of three LM 6000PG units with a total capacity of 174 MW. A2PP achieved commercial operation in July 2012. The A2PP was constructed to provide for increased system reliability, operating reserves, flexible capacity, a hedge against high power prices, and to defer planned transmission additions.

4.1.2.4. Walnut Energy Center

The Walnut Energy Center ("WEC") consists of two 85 MW combustion turbine generators and one steam turbine-generator rated at 100 MW with a net capacity of 250 MW. WEC became operational in 2006. WEC is a highly efficient plant designed to use reclaimed water from the wastewater treatment plant operated by the City of Turlock. WEC provides the bulk of TID's energy needs, operating reserves, and flexible capacity.

Turlock Irrigation District's Walnut Energy Center

4.1.3. Renewable and GHG Free

4.1.3.1. Small Hydroelectric

TID owns and operates four small hydroelectric plants with a combined total capacity of 15.2 MW. These units provide TID with inexpensive renewable GHG free energy. These plants became operational between 1924-1983.

4.1.3.2. Tuolumne Wind Project

The TWP is a 136.6 MW wind generating facility located near Goldendale, Klickitat County, Washington, along the Columbia River. TWP consists of 42 Siemens and 20 Senvion wind turbines. The project achieved commercial operation in May 2009. TWP is currently TID's largest source of renewable power generally providing close to 400,000 MWh of renewable GHG free power each year.

4.1.3.3. NCPA Geothermal

TID has a 6.33% share of Northern California Power Agency's Geothermal Plants No. 1 and No. 2. ("NCPA Geo"). Over the last few years TID's share of the generation has averaged about 52,000 MWh per year. This resource has been a steady source of renewable GHG free power for TID.

4.1.3.4. Golden Fields Solar I Power Purchase Agreement

In an effort to continue meeting its obligations under the CA RPS and achieving the 50% by 2030 requirement[9], TID issued an RFP for renewable energy in September 2014. TID received a total of 129 proposals (10 from existing projects and 119 from proposed projects) representing several renewable technologies from 29 entities. As provided for in the RFP, some proposals included some form of energy storage. As a result of the RFP, in November, 2015, TID executed a 20 year power purchase agreement ("PPA") with Golden Fields Solar I, LLC to procure renewable power from the 54 MW Rosamond West Solar 2 project ("Rosamond West Solar 2") located in Kern County, California. TID began receiving commercial power from the plant in February of 2017. TID projects receiving approximately 155,000 MWh per year under the PPA.

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9 At this time SB100 has not been approved.

4.1.3.5. Loyalton Biomass Power Purchase Agreement

Senate Bill 859 ("SB859") was approved by the California Governor on September 14, 2016 which, among other things, requires local publicly owned electric utilities ("POUs") serving more than 100,000 customers to procure its proportionate share, based on the ratio of the utility's peak demand to the total statewide peak demand, of 125 megawatts of cumulative rated capacity from existing bioenergy projects that commenced operations prior to June 1, 2013. TID's proportionate share under the SB859 requirements is 1.3 MW.

The procurement must have a term of at least five years and on an annual basis have a feedstock of at least 80 percent from byproducts of sustainable forestry management, which includes removal of dead and dying trees from Tier 1 and Tier 2 high hazard zones and is not from lands that have been clear cut, with at least 60 percent of this feedstock coming from Tier 1 and Tier 2 high hazard zones.

To meet its requirement under SB859, TID participated in a joint procurement with the other POU's covered by SB859 ("Joint POU") by entering into an 18 MW 5 year PPA with ARP-Loyalton Cogen LLC in December 2017. TID's share under the PPA is 0.8 MW. Power under the PPA is supplied from the 19.9 MW biomass power generating facility located in Loyalton, California. TID began receiving power under the PPA in April 2018. The Joint POU is in the process of contracting for their remaining obligation under SB859.

4.1.4. Other Resources

4.1.4.1. PRC Power Purchase Agreement

On January 1, 1994, TID entered into a 25-year PPA with the Pacific Northwest Generating Cooperative (now Power Resources Cooperative ("PRC")) to purchase a 10% (59 MW) share of the output from the Boardman generating project. Under the agreement, PRC delivered the power to the California-Oregon border ("COB"). TID delivered the power from COB to TID's service area using its ownership share of the California-Oregon Transmission Project ("COTP"). This PPA terminates on December 31, 2018.

4.1.4.2. WAPA Power Purchase Agreement - GHG Free

TID, pursuant to a 20 year PPA with the Western Area Power Administration, has a 0.34088% share of capacity and energy from the Central Valley Project power plants, which is comprised of 11 hydroelectric power plants with a combined total capacity of 2,113 MW. The PPA provides TID on average about 4 MW and 10,000 MWh per year. The PPA terminates on December 31, 2024. Prior to termination, TID will have an opportunity to extend this PPA[10].

4.1.4.3. Short-Term Market Purchases

As mentioned in detail later in this report, TID's electric system is directly interconnected with Hetch Hetchy Water and Power at Oakdale, Pacific Gas and Electric at Westley, Modesto Irrigation District at Parker, Western Area Power Administration at Tracy, and Merced Irrigation District at Pioneer. This gives TID the ability to procure power from several entities and markets such as the CAISO.

Furthermore, TID has ownership interest in the COTP that gives it 237 MW of transmission rights to COB giving it access to the Northwest power markets.

Grand Coulle Dam hydropower plant in Washington

10 For the purpose of this IRP, it was assumed that the Western Area Power Administration PPA was renewed past 2030.

4.2. Energy Requirements

Due to its diverse power supply and transmission resources, TID is able to adapt its power supply mix to react to load and market conditions to benefit its customers.

In addition to serving its retail customers, TID is obligated to provide power to Merced Irrigation District ("MeID") pursuant to a power sales agreement between TID and MeID dated December 19, 2016 ("MeID PSA"). Although the term of the MeID PSA ends in April 2028, this IRP assumes that TID will continue providing power to MeID throughout the Planning Period. *Figure 33* below shows how TID plans to serve its retail and wholesale power obligations during the Planning Period.
As can be seen from *Figure 33* and *Figure 34*:

- **TID expects to take advantage of the wholesale power markets to minimize its power supply cost particularly when wholesale power prices are negative due to the proliferation of VERs.**
- **As the cost of emitting GHGs and natural gas transportation rates increase, the use of TID's natural gas-fired resources (gray and orange areas in *Figure 33*) decline over time.**
- **Due to its diverse power supply and transmission resources, TID is able to adapt its power supply mix to react to load and market conditions to benefit its customers. In other words, the power supply mix is optimized each time period (minute, hour, day, months, and year) to minimize cost and ensure a reliable system (see *Figure 34*).**

As seen from *Figure 34*, Don Pedro generation (shown as the light green area) is adapted to accommodate Customer PV generation (shown as the difference between the orange and black lines). Also, the renewable purchases output (currently modeled as coming from solar resources) start to decline in the early evening hence the Almond II peaking natural gas-fired units (shown as the orange area) are called upon to replace the declining solar generation.

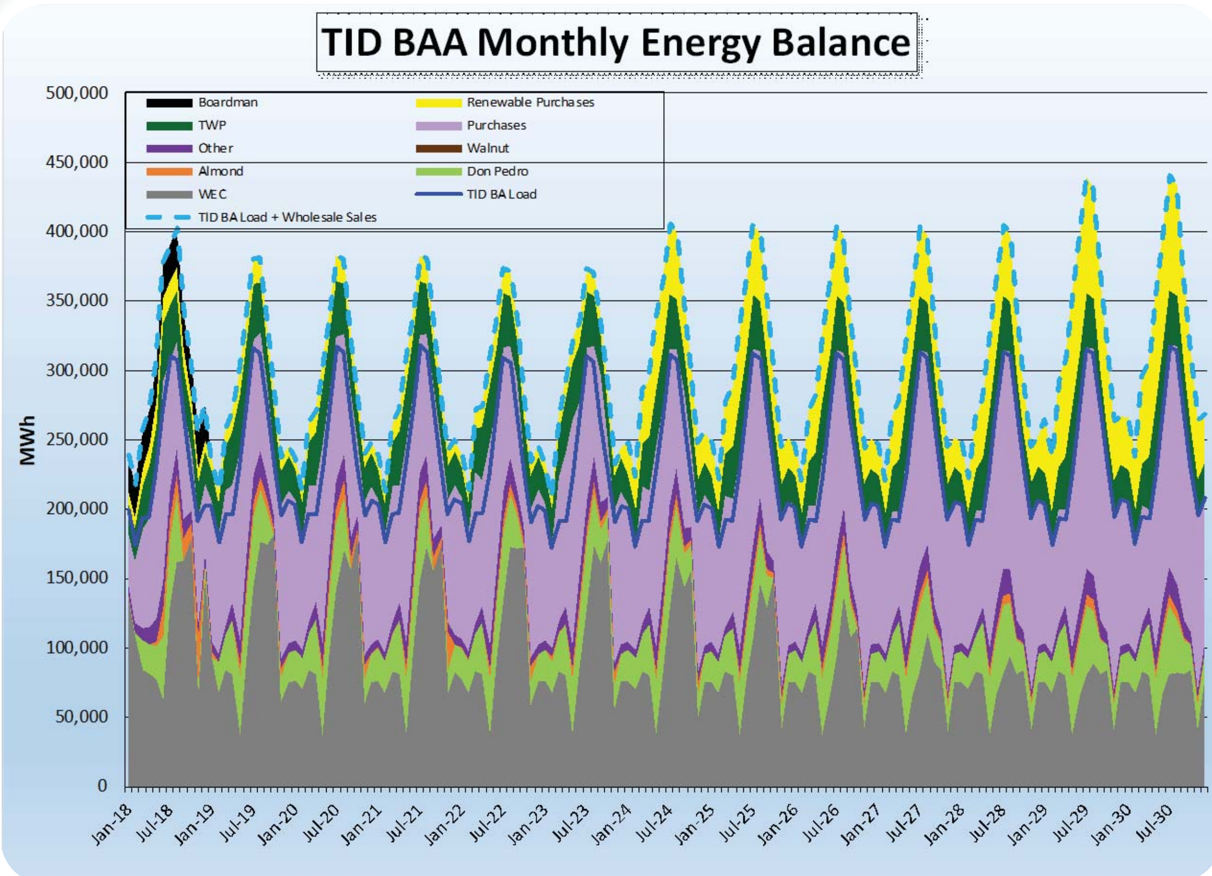

FIGURE 33 - TID Balancing Authority Area Monthly Energy Balance

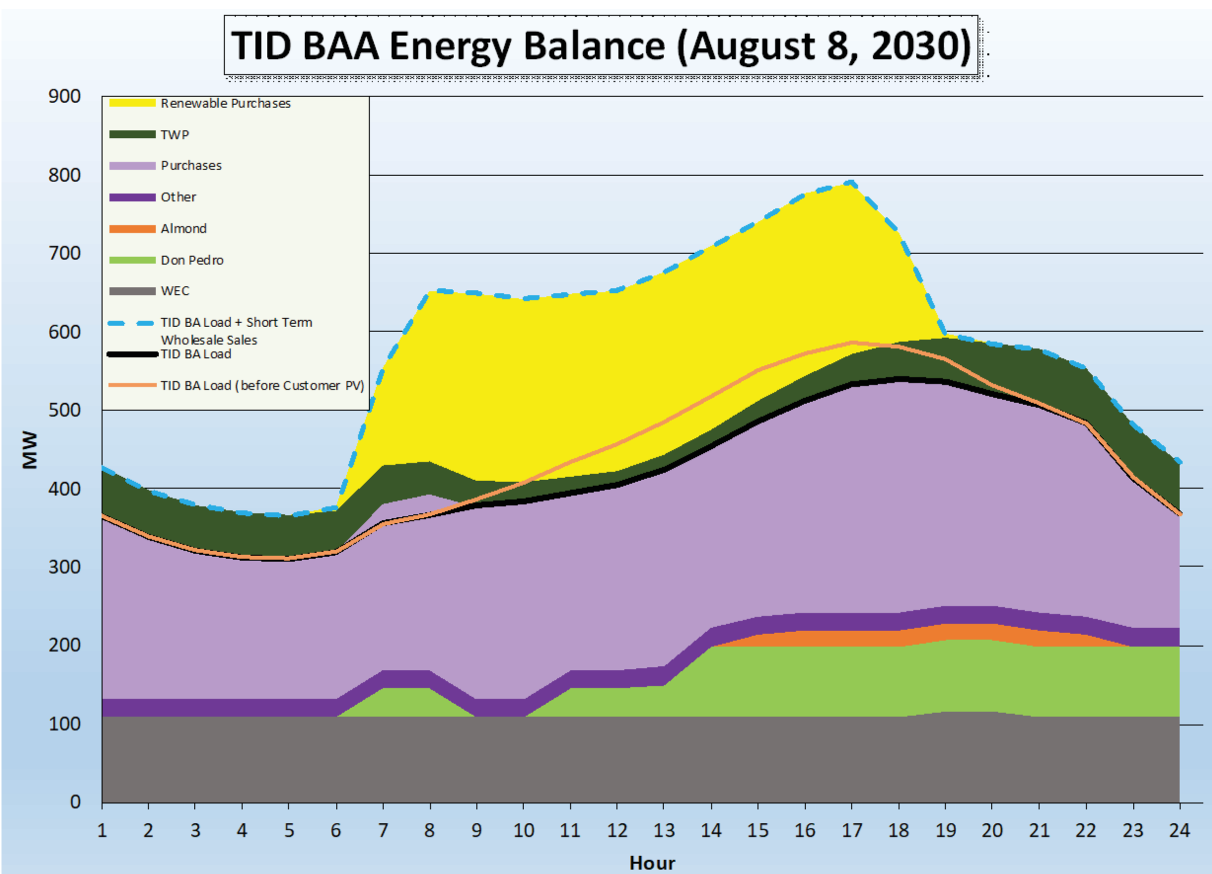

FIGURE 34 - TID Balancing Authority Area Energy Balance (August 8, 2030)

4.3. Resource Adequacy/Planning Reserves Requirements

TID will meet or exceed the required planning reserve margin of 15% (as prescribed by the RA Policy) through its existing resources, planned additional renewable resources (see Section 4.5), and market purchases.

TID has a Board approved RA Policy that requires the procurement of sufficient electric resources to meet 105% of forecasted peak demand for the months May through September of the following year by June 1st of the current year, and 115% of forecasted peak demand for a month at least 60 days before the beginning of such month. This policy ensures that TID will have sufficient resources to serve customer demand and provide operating reserves to meet applicable WECC requirements. *Figure 35* shows TID's BAA capacity balance during the Planning Period.

Figure 35 shows that throughout the Planning Period:

- **TID will meet or exceed the required planning reserve margin of 15% (as prescribed by the RA Policy) through its existing resources, planned additional renewable resources (see Section 4.5), and market purchases.**
- **Market purchases are only needed when WEC or Don Pedro is unavailable due to maintenance. Note that maintenance on TID's internal generation are closely coordinated to minimize effects on reliability and cost.**

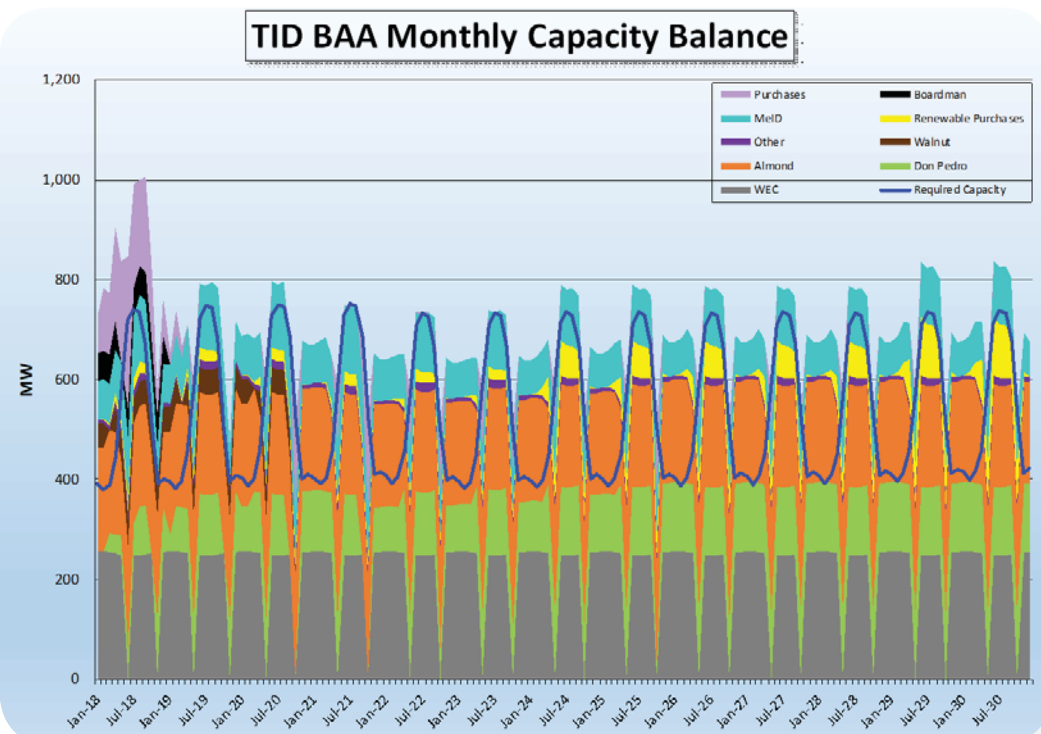

FIGURE 35 - TID Balancing Authority Monthly Capacity Balance

4.4. Contingency Reserves Requirements

Using existing resources, TID will be able to maintain the required amount of Contingency Reserve during the Planning Period ensuring a reliable electric system.

As a BA, TID must meet a number of reliability standards promulgated by the NERC and WECC. TID has consistently met all applicable standards as recognized in the periodic audits conducted by WECC. These standards are established to ensure electric system reliability.

One such standard is the WECC Standard BAL-002-WECC-2a — Contingency Reserve standard ("WECC BAL 002"). WECC BAL 002 specifies the quantity and types of Contingency Reserve (as such term is defined in WECC BAL 002) that must be maintained in order to ensure electric system reliability under normal and abnormal conditions. In summary, WECC BAL 002 requires that a BA or a Reserve Sharing Group maintain a certain amount of generation capacity in excess of load that is capable of generating within ten minutes.

TID meets WECC BAL 002 through participation in the Northwest Power Pool Reserve Sharing Group ("NWPP RSG"). Participation in the NWPP RSG has reduced TID's cost of complying with WECC BAL 002 and gives TID access to resources of other NWPP RSG members to respond to a resource contingency. The modelling done for this IRP shows that during the Planning Period TID will be able to provide the required amount of Contingency Reserve using existing electric resources (see ***Figure 36*** and ***Figure 37***).

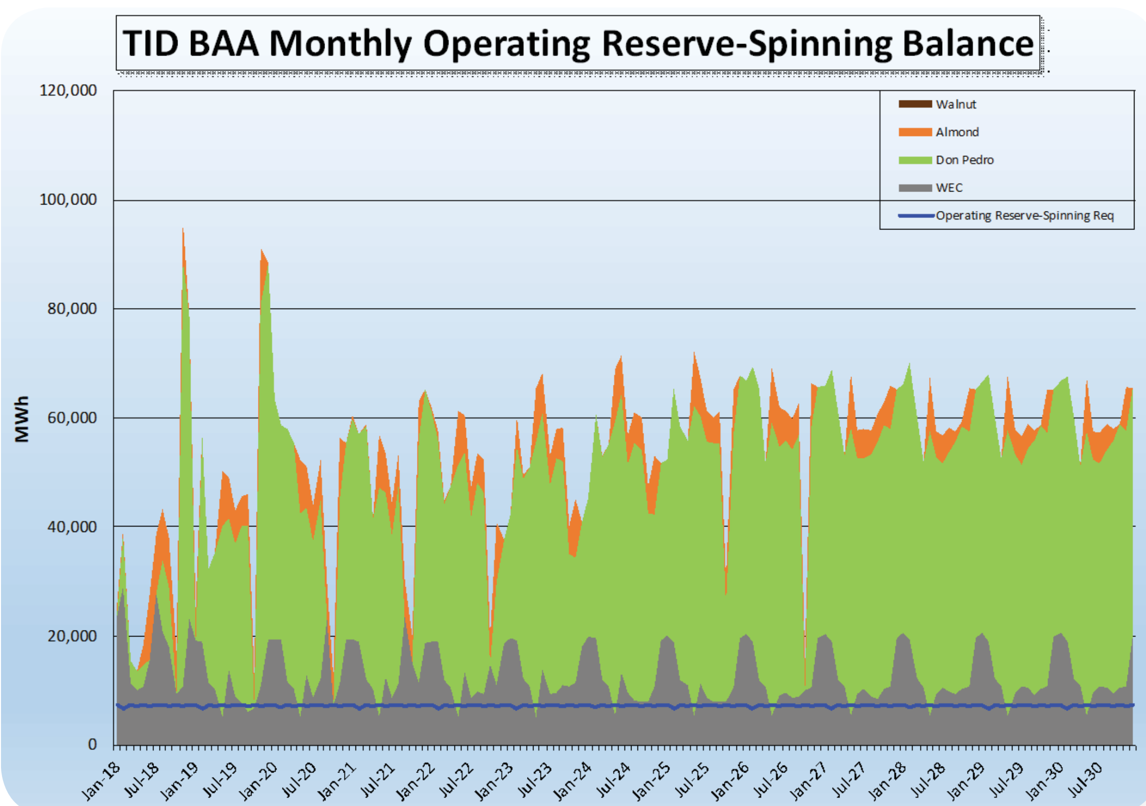

FIGURE 36 - TID Balancing Authority Area Monthly Operating Reserve-Spinning Balance

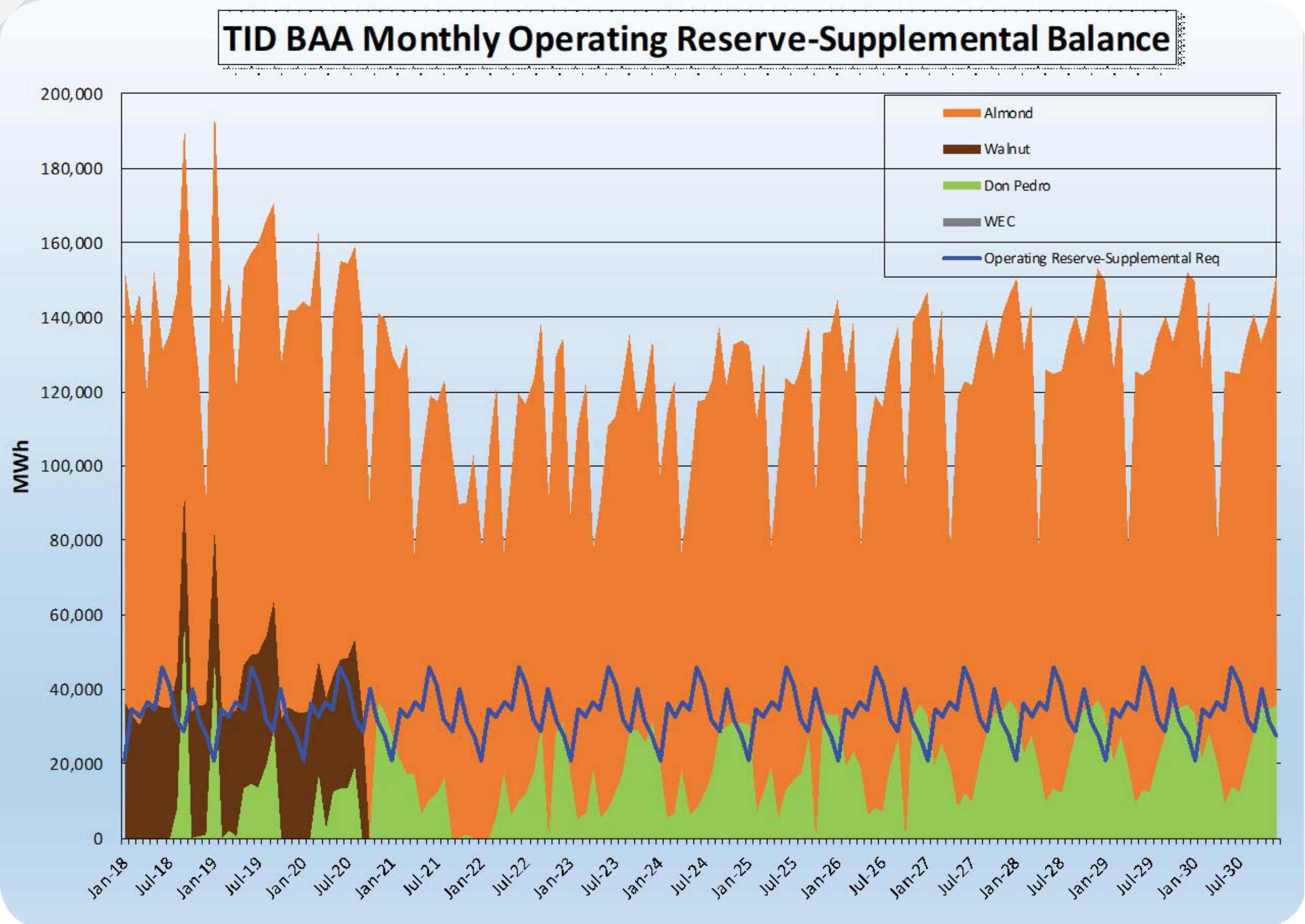

FIGURE 37 - TID Balancing Authority Area Monthly Operating Reserve-Supplemental Balance

4.5. Renewable Generation Requirements

As early as the 1920s, TID has utilized renewable and/or GHG free generation in its resource portfolio. For example, TID's Don Pedro power plant was built in 1923. La Grange power plant was completed in 1924. The Hickman, Turlock Lake, and Dawson power plants came online around the early 1980s. The NCPA Geo was also constructed in the early 1980s.

In 2004, the TID Board adopted a Renewable Portfolio Standard ("TID RPS") to increase the amount of retail sales supplied by renewable resources by at least 1% each year and to reach 20% by 2017. Since then the TID RPS has been revised several times to remain consistent with California requirements. To meet TID's RPS and the CA RPS, in 2009 TID's TWP came online providing close to 400,000 MWh of renewable GHG free power each year, more than what was required under the CA RPS at that time. In February 2017, TID began receiving power from Rosamond West Solar 2, and on April 2018 TID began receiving power from the Loyalton biomass plant. *Figure 38* shows TID's current sources of renewable power. Note that TID has a diverse renewable resource mix of wind, small hydro, geothermal, solar, and biomass.

TID forecasts to be able to meet the CA RPS with existing resources until 2024.

Currently the CA RPS requires that TID supply at a minimum 33% of its retail sales from Renewable Resources by December 31, 2020, 44% by December 31, 2024, 52% by December 31, 2027, and 60% by December 31, 2030 and thereafter. The CA RPS also requires that beginning in 2021 at least 65% of renewable resources used for compliance be from owned resources or resources under contracts of ten years or more. ***Figure 38*** shows TID's progress in meeting the CA RPS. As can be seen from ***Figure 38***, current projections show TID producing more renewable credits ("REC") than required in 2018 and 2019. Beginning in 2020, TID begins to use banked surplus RECs from prior years to meet the requirements. TID anticipates depleting banked surplus by 2025 and would need to procure more renewable generation by then to meet the CA RPS.

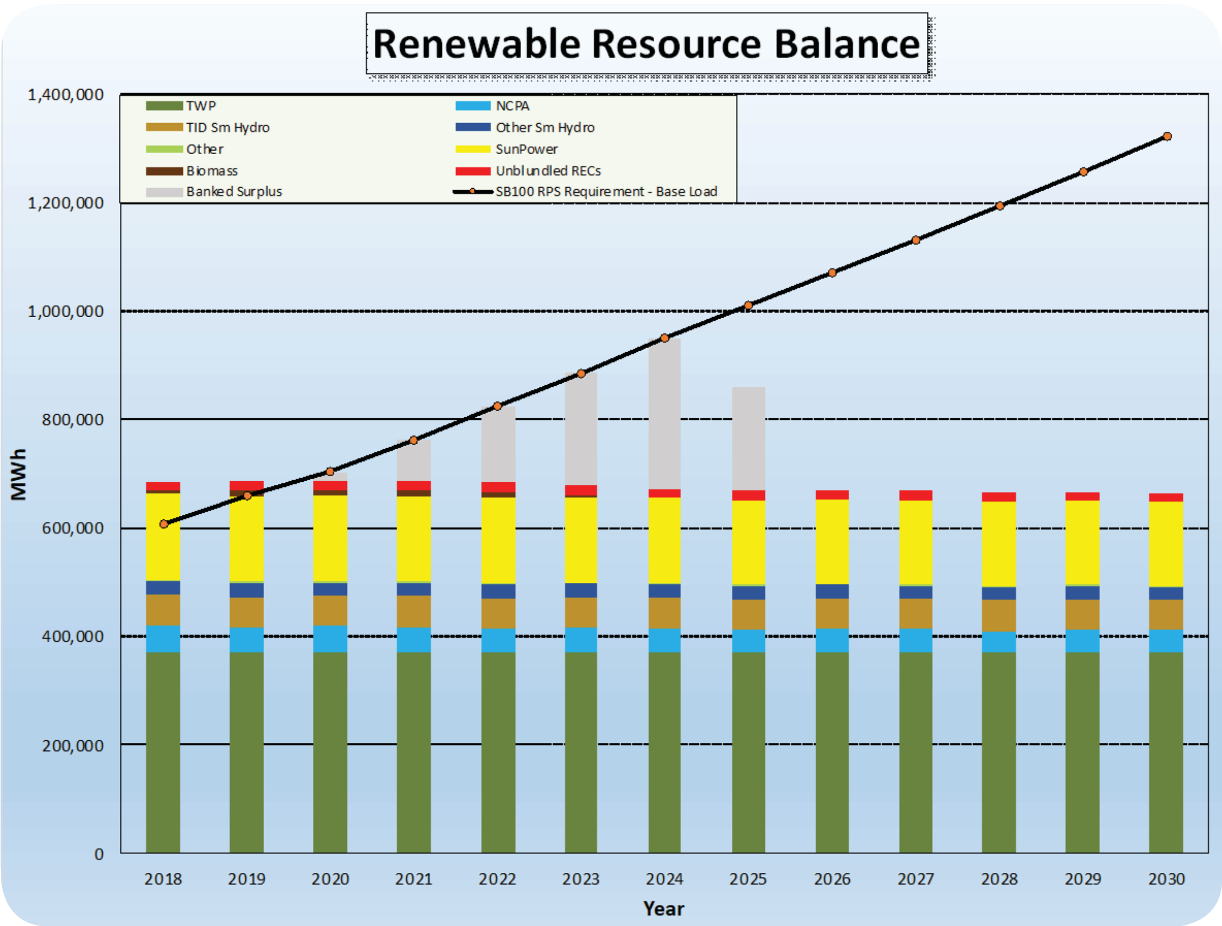

FIGURE 38 - TID Annual Renewable Resource Balance

To continue complying with the CA RPS during the Planning Period, TID would need to add about 300,000 MWh per year of new renewable resources in 2024 and another approximately 300,000 MWh per year in 2029. Although additional procurement is not needed until 2025, planning to acquire additional renewable resources in 2024 allows for forecast errors, potential delays in the procurement process, and flexibility in timing of procurement based on market dynamics.

Based on recently executed PPAs, solar power currently seems to be the most cost effective renewable resource and represents the majority of the recently executed PPAs. Hence, this IRP modeled adding a twenty year 100 MW solar power purchase agreement in 2024 and another similar agreement in 2029.

However, the cost effectiveness of a renewable resource is affected by the resource location and actual financial terms. Hence, as was done in the past, prior to procuring the additional renewable resource TID will issue an RFP and evaluate the proposals received to select the best option available at that time. ***Figure 39*** shows TID's projected renewable resource balance with the assumed renewable resource additions in 2024 and 2029. Furthermore, under the proposed CA RPS compliance plan shown in ***Figure 39*** more than 65% of the renewable procurement used towards CA RPS compliance for each year of the Planning Period will come from either owned resources or resources under contracts of ten years or more. The actual timing, amount, and type of additional renewable procurement may vary from what is shown herein due to future market conditions, changing regulatory requirements, and other factors. For example, under certain pricing terms and conditions, it may be beneficial for TID to add renewable resources prior to 2024. Also the projected reduction in tax credits for renewable resources may make it desirable for TID to procure earlier than suggested here. For example the tax credits for wind are scheduled to be reduced by 60% for projects that begin construction in 2019 and the tax credits for solar are scheduled to go down from 30% to 10% for projects placed in service after 2023.

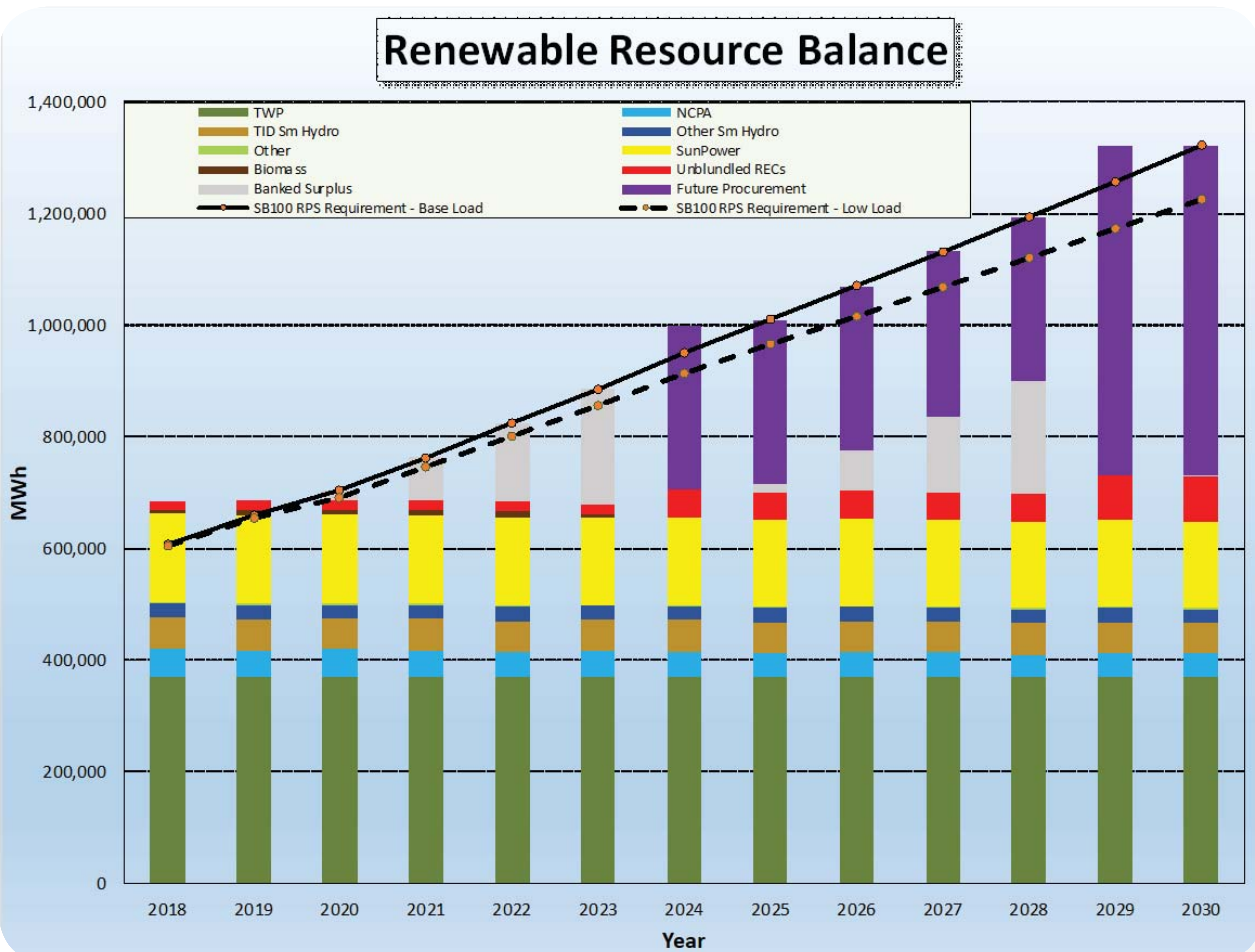

FIGURE 39 - TID Annual Renewable Resource Balance with Future Procurement

4.6. GHG

By 2030, TID's projected annual GHG emmissions are 316,256 mTons, which is within the TID GHG Target Range established by CARB.

As mentioned earlier, the Cap and Trade regulations require TID to surrender one CCA for every metric ton of GHG emitted. Under the Cap and Trade regulations, TID emits GHG whenever it generates power from its natural gas fired power plants or imports power from out of state non-GHG free resources. For example, each MWh of generation from WEC results in approximately 0.42 mTons of GHG, which at the current CCA price of over $15/mTon equates to about $6.30/MWh. At current natural gas prices WEC's delivered fuel cost averages about $35.00/MWh. Adding GHG cost to WEC in essence increases its variable cost of generation by about 18% at current prices ($6.30/$35.00)[11]. Accordingly, this IRP takes into consideration GHG emissions and the cost of acquiring CCAs when selecting resources to meet load. CCAs can be acquired at quarterly CARB auctions or from third parties in the secondary markets. The CARB auctions sell CCAs at the auction clearing price ("Auction Settlement Price"). The Auction Settlement Price cannot be lower than the minimum price established by CARB for such auction ("Auction Reserve Price").

The Auction Reserve Price is established for each year by CARB. The Auction Reserve Price escalates annually at a rate equal to 5% + Consumer Price Index for All Urban Consumers. Since inception of Cap and Trade in 2013, there have been 23 CARB auctions. Historical Auction Settlement Prices and Auction Reserve Prices for the current vintage CCAs are shown in ***Figure 40***. As can be seen from ***Figure 40***, the Auction Settlement Prices were higher during the first few auctions and have since been closer to the floor price.

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11 The actual GHG and delivered fuel cost will vary from the example since it would be dependent upon the actual dispatch levels at WEC, CCA and natural gas prices realized.

As shown in *Figure 4*, California has an aggressive mandate of reducing statewide GHG emissions by 40% of 1990 levels in 2030. Because of the steep emissions reductions targeted and an increasing Auction Reserve Price, future CCA prices are expected to be much higher than historical prices. However, CARB's proposed amendments to the current Cap and Trade regulations would limit the maximum price of CCAs at under $100/mTon for the calendar years 2021 to 2030. This IRP took into account the cost of emitting GHG in its resource mix selection to minimize its impact on our customers.

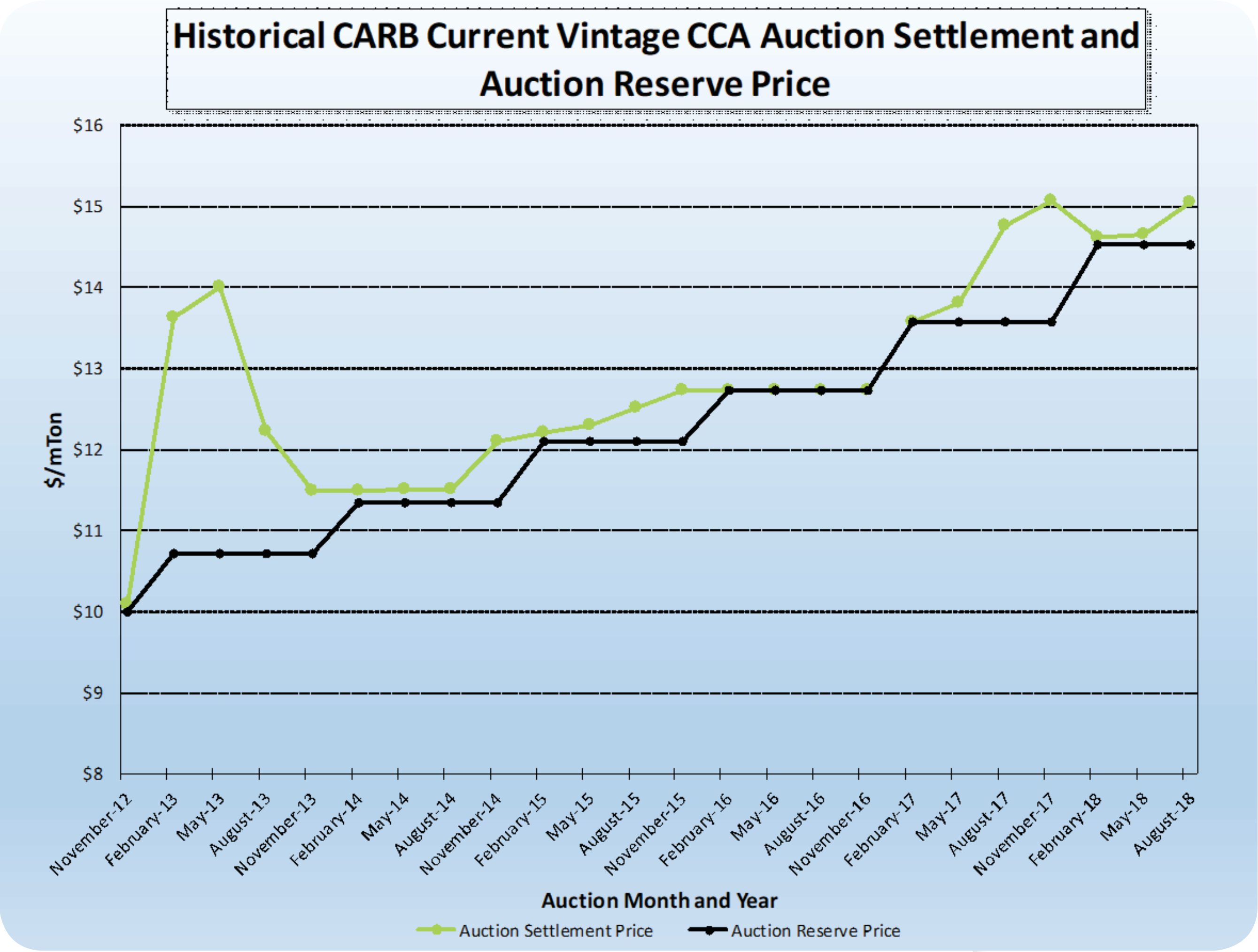

FIGURE 40 - Historical CARB Current Vintage CCA Auction Clearing Price

SB350 requires that TID's adopted IRP achieves the GHG emissions targets established by CARB for TID. On July 26, 2018 in coordination with the CEC, CPUC, and after several public workshops, CARB adopted GHG emissions targets for use in integrated resource plans of load serving entities and public utilities. TID's GHG emissions target range established by CARB for this IRP is 189,000 to 333,000 mTons in 2030 ("TID GHG Target Range"). SB350 also requires that this IRP be submitted to the CEC for review. To facilitate their review of integrated resource plans, the CEC adopted submittal and review guidelines and standardized reporting tables. One of the standardized reporting tables tabulates the resulting GHG emissions of an integrated resource plan ("GEAT") which the CEC will compare to the TID GHG Target Range.

Figure 41 shows the projected annual GHG emissions of TID's power supply portfolio using the CEC's methodology of calculating GHG emissions as laid out in the GEAT. Notice that the emissions drop significantly in 2019 due to the expiration of the Boardman contract. GHG emissions see further significant declines in 2024 and 2029 coinciding with the addition of renewable resources as proposed in Section 4.5. By 2030, TID's projected annual GHG emissions are 316,256 mTons, which is within the TID GHG Target Range established by CARB.

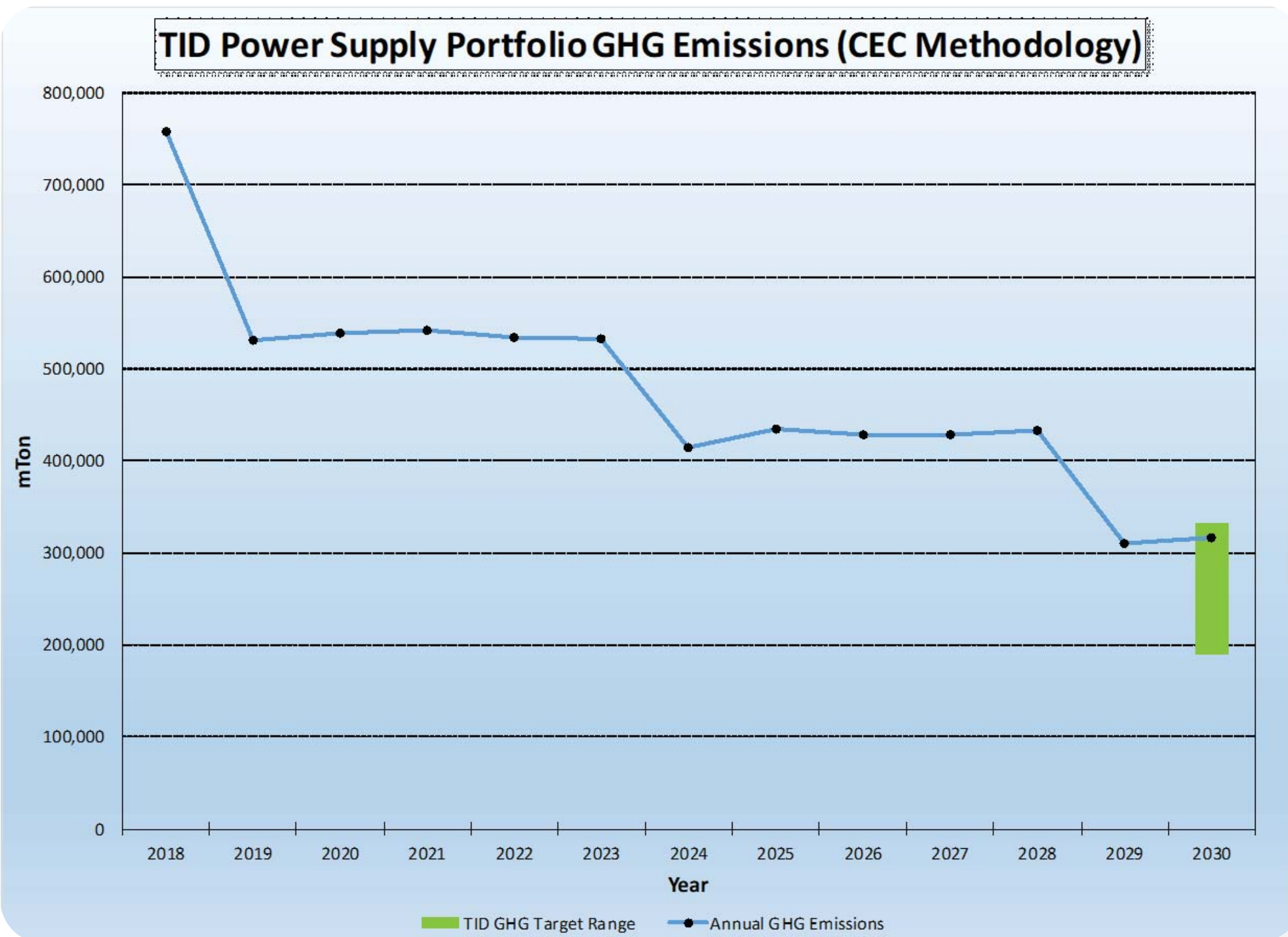

FIGURE 41 - TID Power Supply Portfolio GHG Emissions

TID'S projected power supply mix will be 77% GHG free by 2030.

Note that the CEC's methodology of accounting for GHG emissions in the GEAT is different than the methodology used by CARB pursuant to the Cap and Trade regulations and therefore does not reflect TID's compliance obligations under the Cap and Trade regulations. *Figure 42* shows TID's projected power supply mix as a percentage of retail load which shows that TID's projected power supply mix will be 77% GHG free by 2030.

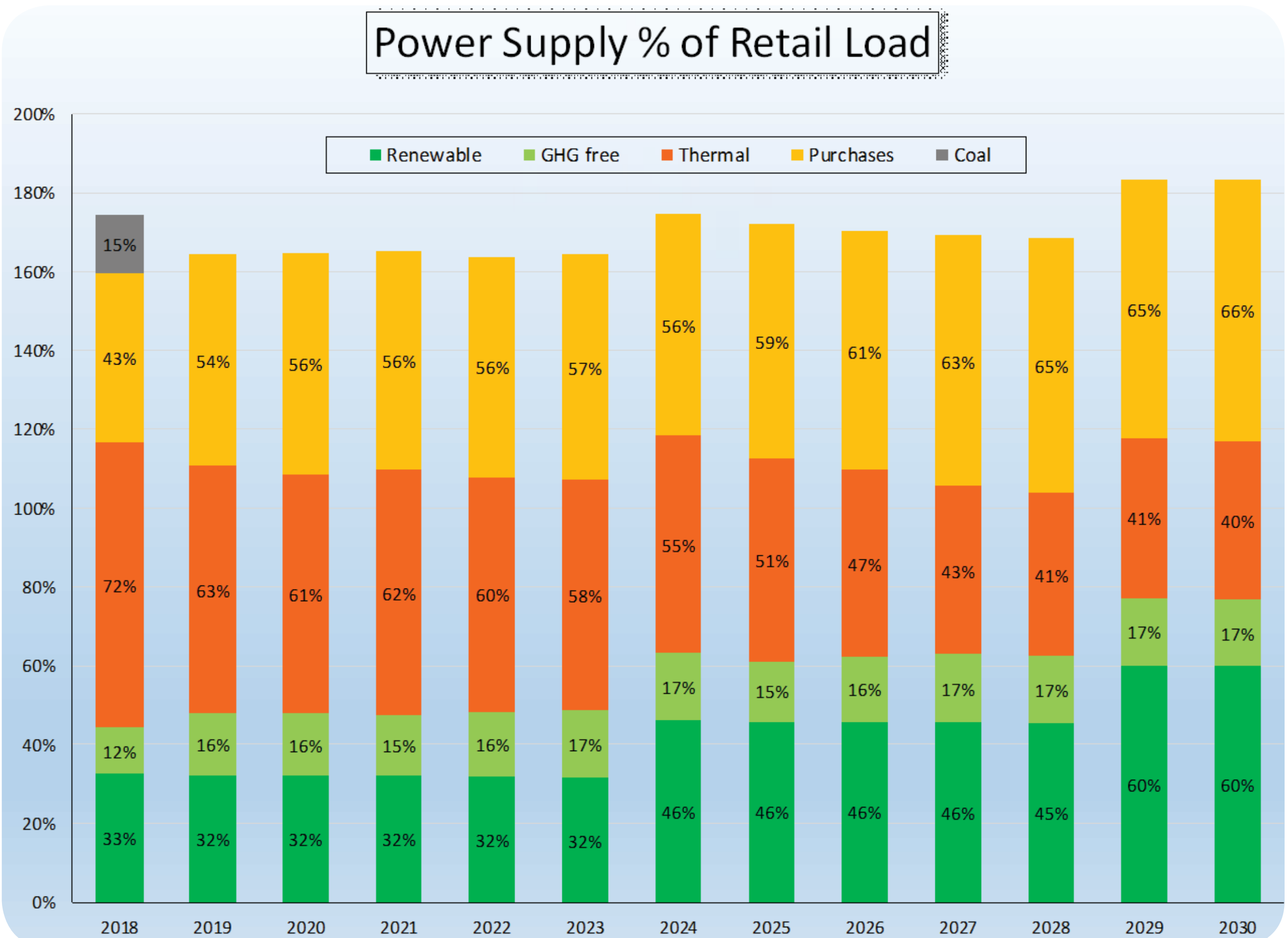

FIGURE 42 - Projected Power Supply Mix as a percentage of TID retail load

4.7. Energy Storage

As discussed in Sections 4.2, 4.3, and 4.4, TID expects to be able to reliably meet customer demand (including the peak hours) with existing power supply resources in combination with market purchases. Due to the efforts to decarbonize California resulting in an increase in VERs, Over Generation and Negative Power Prices are expected to remain a challenge for some time. Over Generation and Negative Power Prices already have an impact on TID. Negative Power Prices adversely affect the value of TID's generation sold into the CAISO markets. TID currently sells the power received from Golden Fields Solar I into the CAISO markets at the nearest local pricing hub ("Local Hub") to offset the cost of the resource. Such Local Hub's daily markets experienced 131 hours of Negative Power Prices in 2017 (with more Negative Power Prices occurring in the real time markets for such Local Hub) resulting in higher net cost to TID. Furthermore, during times when TID has surplus resources, Negative Power Prices and Over Generation adversely impact TID's ability to market such surplus. On the other hand, due to TID's access to several power markets (see discussion in Section 4.1.4.3) coupled with the flexibility of TID's generation portfolio, TID has the ability to benefit from Negative Power Prices by lowering internal generation to accommodate power purchases. TID periodically monitors its electric resource mix to mitigate the negative effects of and capitalize on Over Generation and Negative Power Prices. Furthermore, as discussed in Section 2.2.6, the cost of energy storage has been declining and is anticipated to continue declining (see ***Figure 19***) which will make energy storage a viable resource option in the future. At some point, adding energy storage into TID's portfolio could be beneficial and may be necessary.

TID has been actively evaluating various energy storage technologies and has published a report in 2014 and the results of an update to such report in 2017. In compliance with Chapter 7.7 of Part 2 of Division 1 of the California Public Utilities Code, TID has made determinations on the appropriate energy storage procurement targets in 2014 and 2017. TID has been continually monitoring developments in this field including regular discussions with energy storage vendors. In this IRP, we performed additional analysis on energy storage using updated cost information. According to the Department of Energy database, the most prevalent electric energy storage technology deployed in recent years was lithium ion (see ***Figure 43***). Hence, in this IRP our analysis focused on lithium ion battery storage systems ("Energy Storage").

Tesla's Powerpack battery project in South Australia

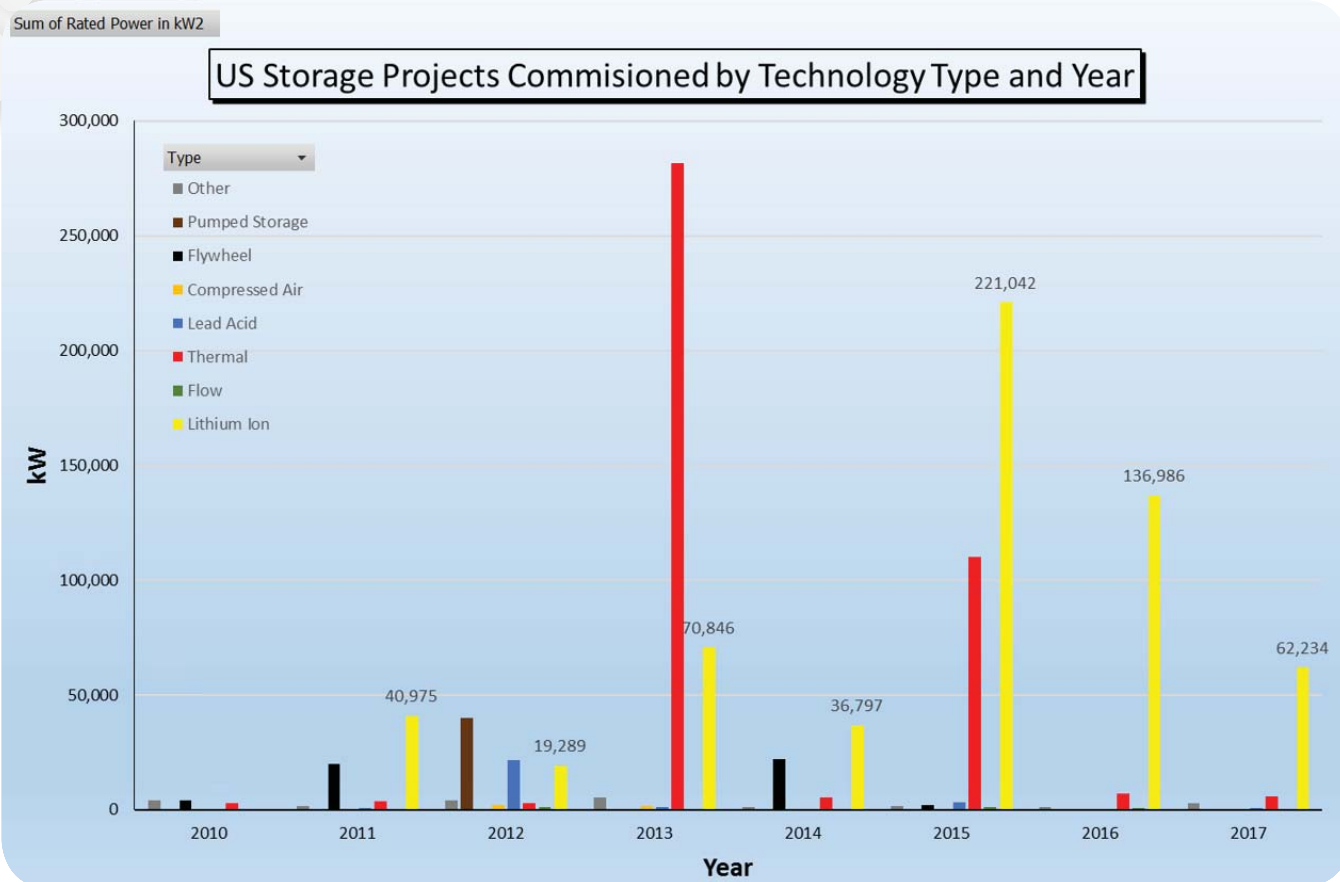

FIGURE 43 - US Energy Storage Projects Commissioned by Technology Type and Year (Source: Department of Energy)

There are several ways we can fill the renewable resource deficit identified in Section 4.5. One option is to fill the deficit by adding renewable resources within the CAISO grid. Another option would be to add the renewable resource within TID's service area. A renewable resource added within the CAISO grid will be subjected to Negative Power Prices. To analyze how an energy storage system can minimize the adverse effects of Negative Power Prices, we evaluated adding a 50 MW 4 hour duration lithium-ion battery ("Energy Storage") in conjunction with a 100 MW solar plant located on the CAISO's system. The Energy Storage absorbed the solar generation during lower price hours (shown as the difference between the red and light blue dashed lines in ***Figure 44***) and produced it when power prices were higher (shown as the light brown area in ***Figure 44***) thereby maximizing the revenues received from the solar plant's generation. The Energy Storage also generated revenues through sales of ancillary services ("AS"). The analysis shows that the Energy Storage would likely generate sufficient benefits to recover the majority of the Energy Storage cost. Absorbing the solar generation during lower price hours and moving it to higher price hours ("Energy Price Arbitrage") represented about half the benefits with the remaining half coming from AS sales. Additional value may also be extracted by selling capacity from the Energy Storage and deferral of transmission and distribution upgrades.

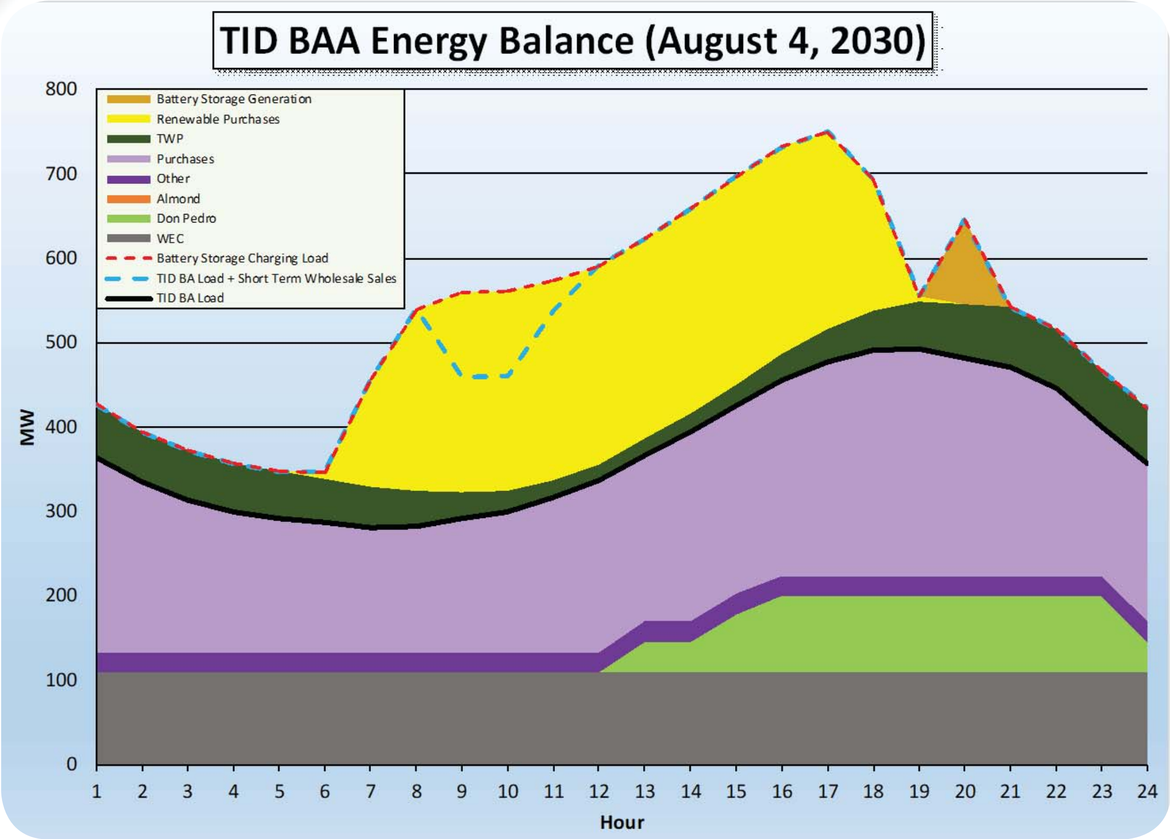

FIGURE 44 - TID Balancing Authority Area Energy Balance (August 4, 2030)

If instead we opted to add the renewable resource within TID's service area, due to the intermittent nature of VERs it could present challenges to balancing TID's system. Since the most likely renewable resource that would be located within our area is solar, we analyzed adding a 112 MW solar plant in 2024 and a second 112[12] MW solar plant in 2029 ("TID Solar Plant"). ***Figure 45*** shows the projected energy balance for the TID Balancing Authority Area for a spring day in 2030 with the addition of the TID Solar Plant. As expected, the TID Solar Plant is generating between 7 am and 7 pm with most of the generation coinciding with the hours where the load (represented by the black line) is the lowest. Under this scenario, about half the time the TID Solar Plant's generation would be equal to 60% or greater of load for that hour. In some cases (4% of the time) the generation would be greater than load (see ***Figure 46***). Furthermore, the Load Ramp after taking into account the generation from the TID Solar Plant would increase dramatically compared to what they are currently (shown in ***Figure 47***, ***Figure 48***, ***Figure 49***, and ***Figure 50*** as the difference between the transparent dashed bars and the solid colored bars). For example, with the addition of the TID Solar Plant the load decrease during HE9 in March 2030 on average will be over 90 MW and the load increase during HE18 in January 2030 on average will be about 140 MW. Such Load Ramps are significant compared to TID's overall load and will be challenging to follow with existing resources. Subject to further studies, we believe that due to the intermittent nature of solar generation and the expected increase in Load Ramps, TID will need to add flexible resources to integrate the TID Solar Plant.

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12 Because of the anticipated lower capacity factor for a solar plant located within TID's service area relative to a solar plant located in Southern California, a larger plant is needed to provide a similar amount of MWh as provided by a 100 MW solar plant in Southern California.

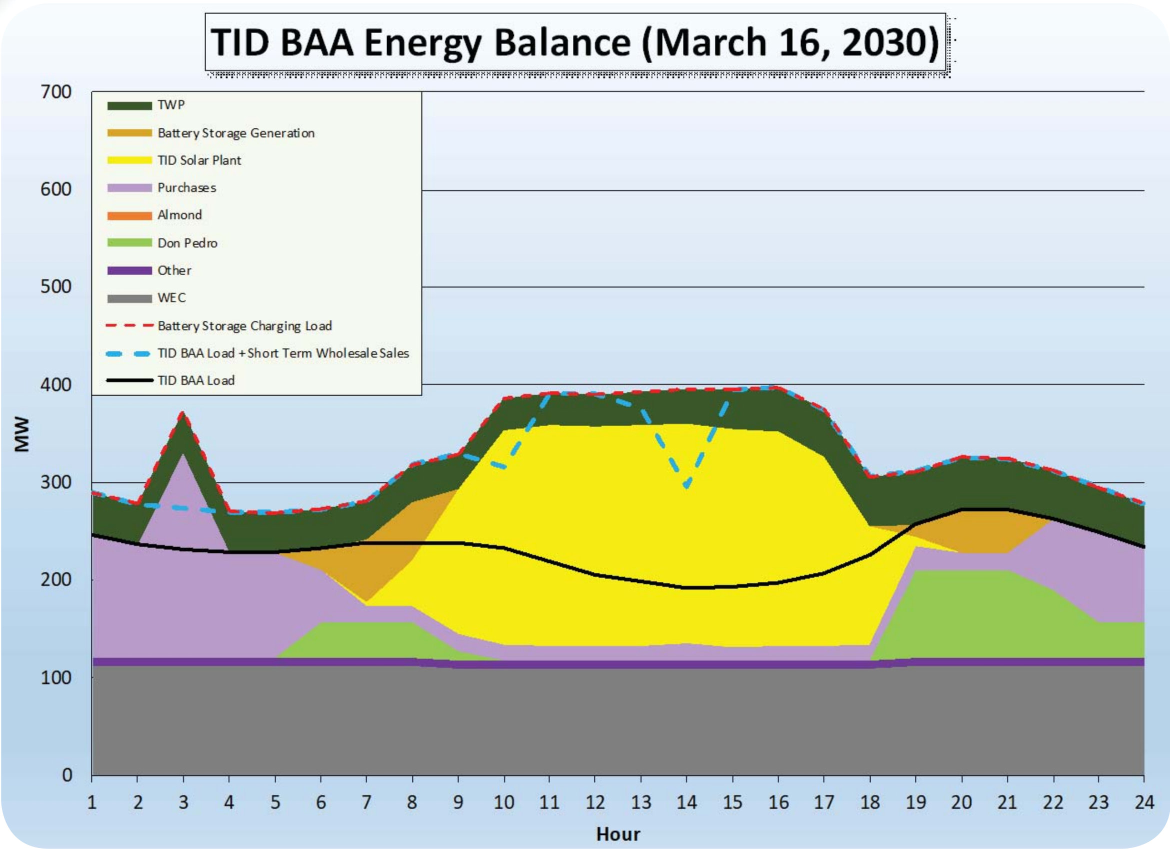

FIGURE 45 - TID Balancing Authority Area Energy Balance (March 16, 2030)

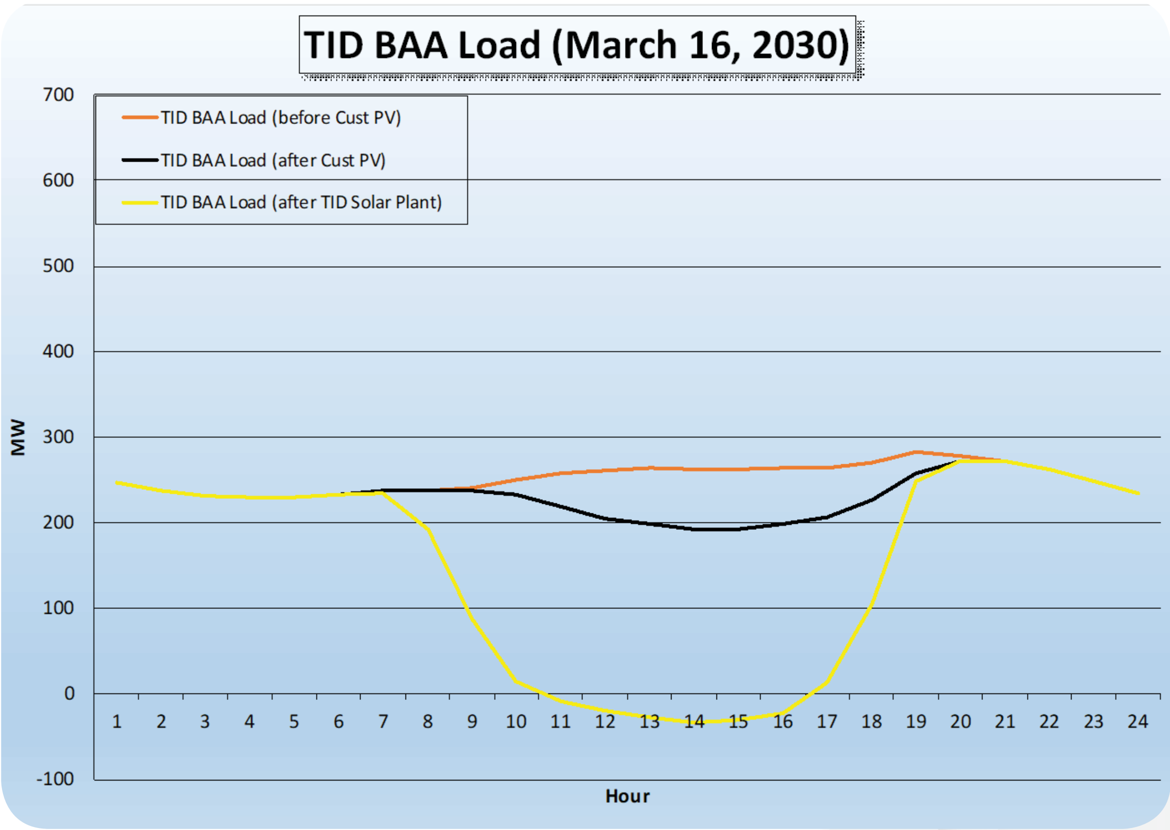

FIGURE 46 - TID Balancing Authority Area Load (March 16, 2030)

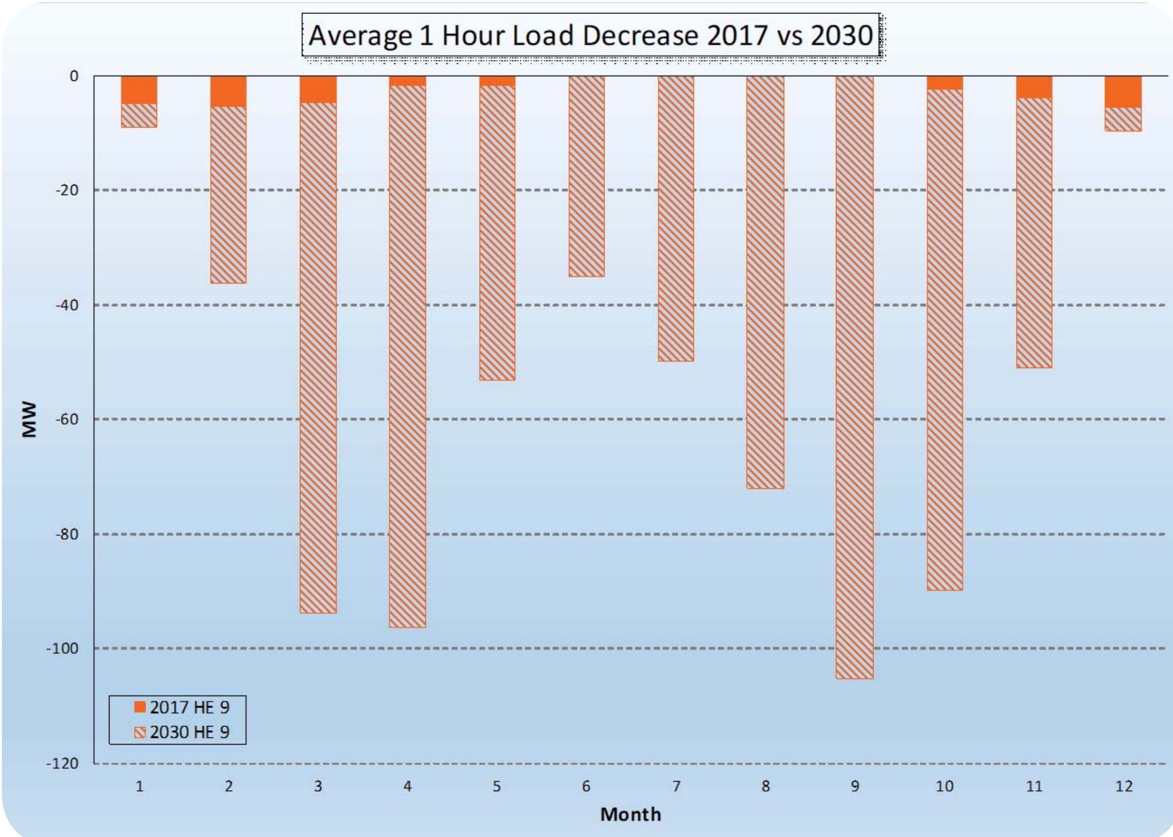

FIGURE 47 - Average 1 Hour Load Decrease 2017 vs 2030 (with TID Solar Plant)

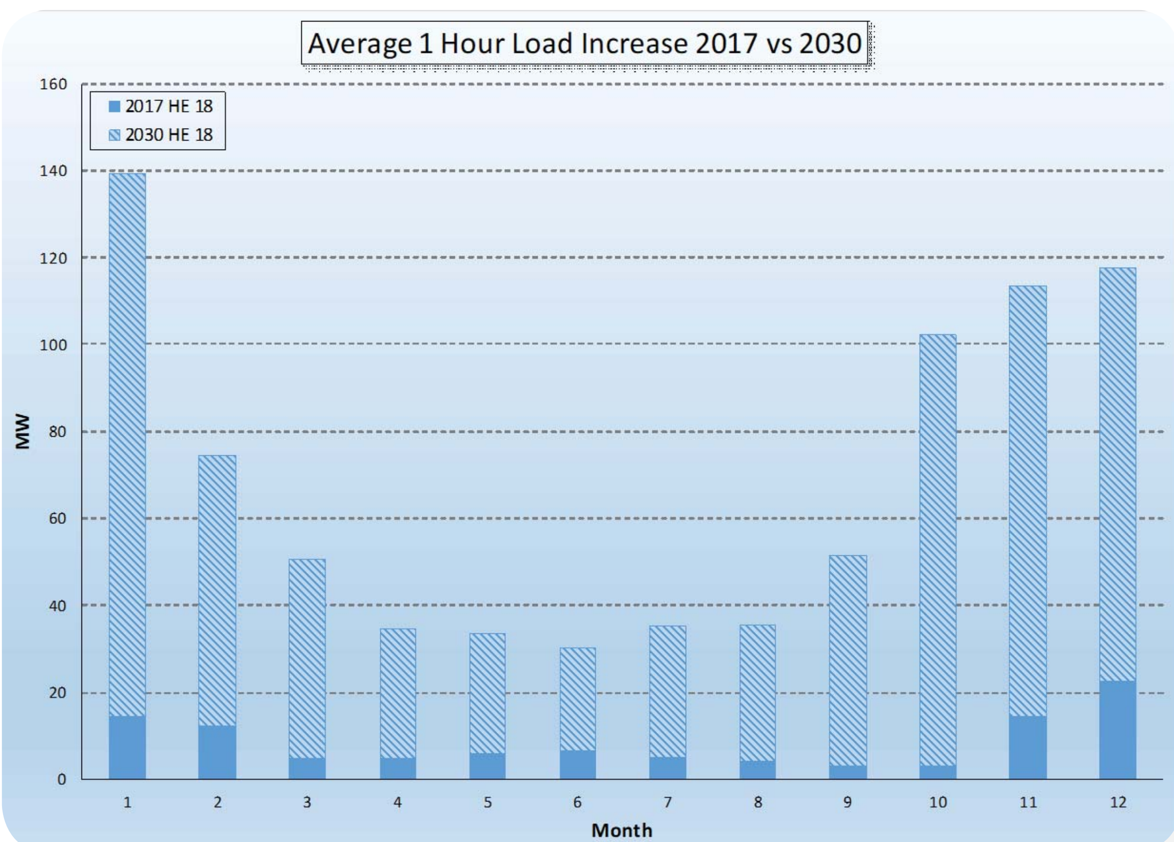

FIGURE 48 - Average 1 Hour Load Increase 2017 vs 2030 (with TID Solar Plant)

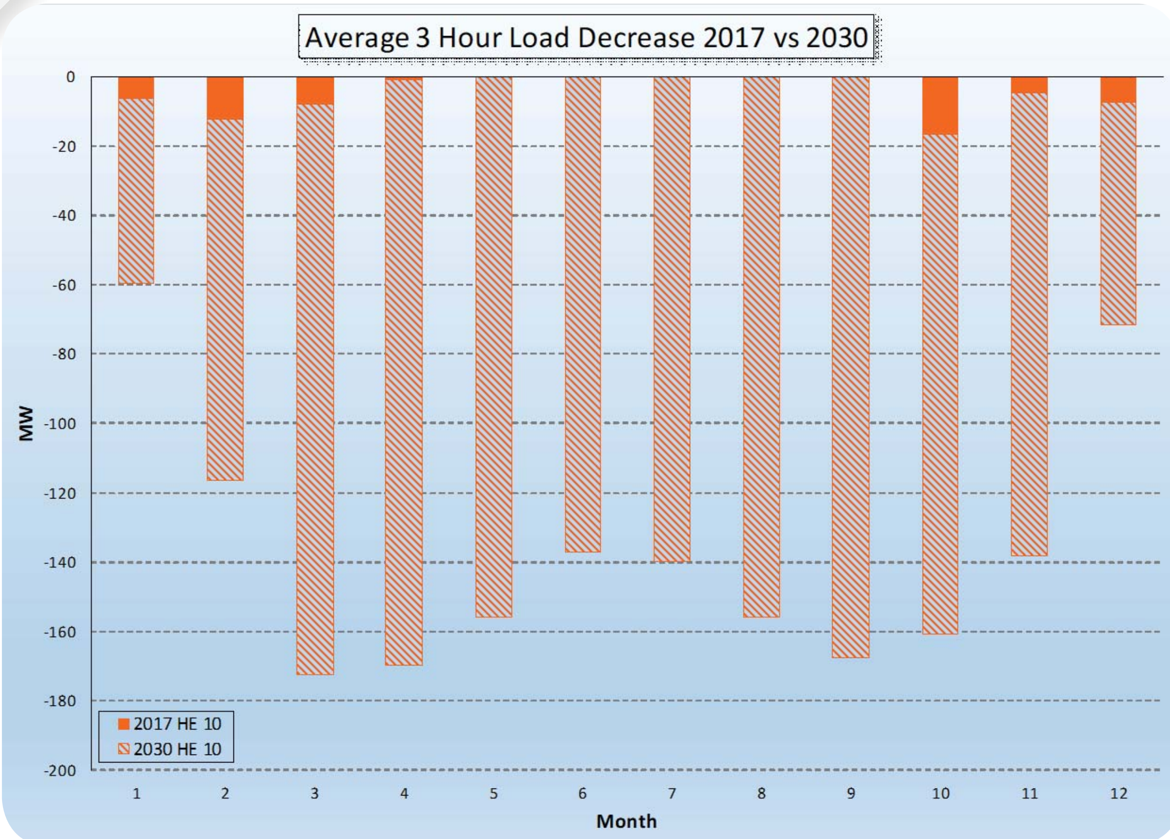

FIGURE 49 - Average 3 Hour Load Decrease 2017 vs 2030 (with TID Solar Plant)

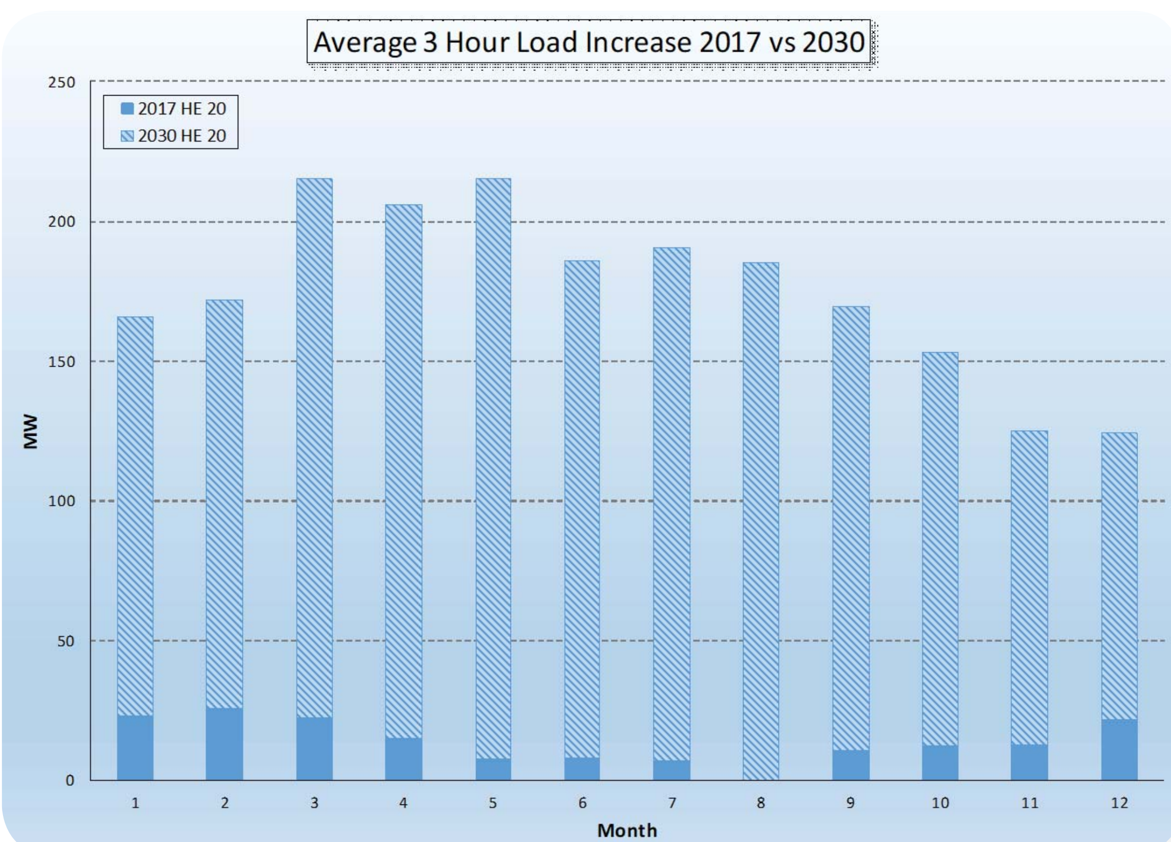

FIGURE 50 - Average 3 Hour Load Increase 2017 vs 2030 (with TID Solar Plant)

Therefore, we modeled a scenario where we paired an Energy Storage system in conjunction with each solar plant added to help integrate the solar plant into TID's grid. ***Figure 45*** shows that the Energy Storage absorbed the TID Solar Plant's output during the hours where the load was declining to assist in balancing the system (depicted as the difference between the red and the light blue dashed lines) and generated during the hours where the solar plant was not generating to help balance the system as the load increases in the early evening (shown as the light brown areas). Similar to the earlier analysis on the Energy Storage system paired with a solar plant in the CAISO system, the Energy Storage system was able to effectively defer the solar generation to a later period when the value was greater and load was higher. Load Ramps were on average lower than without the Energy Storage (see ***Figure 51***, ***Figure 52***, ***Figure 53***, ***Figure 54***). For example, the average 1 hour load decrease for HE9 in March 2030 was reduced by about 22 MW (reflected as the patterned portion of the bar in ***Figure 51***). The average 1 hour load increase for HE 19 in February 2030 was reduced by about 67 MW (reflected as the patterned portion of the bar in ***Figure 52***). The analysis also showed that the benefits derived from the Energy Storage would likely generate sufficient benefits to recover the cost of the Energy Storage. Energy Price Arbitrage and AS sales in this application represented about 68% of the benefits with the remaining benefits coming from optimization of TID's other resources (such as reduced fuel use and GHG emissions). Additional value may also be extracted by selling capacity from the Energy Storage and deferral of transmission and distribution upgrades. Furthermore, the addition of the Energy Storage in TID's grid allowed a better optimization of our existing resources resulting in reduced GHG emissions.

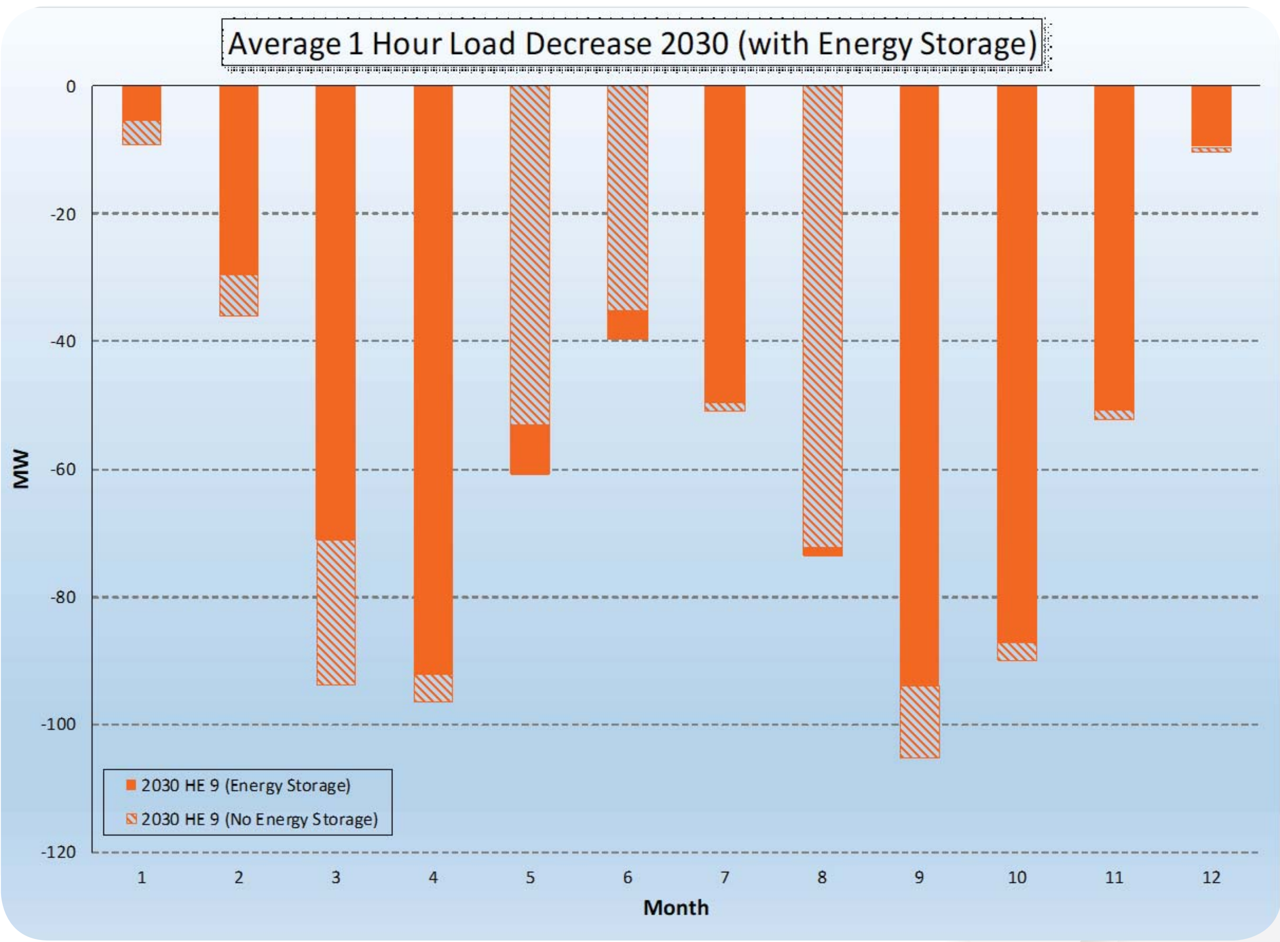

FIGURE 51 - Average 1 Hour Load Decrease 2030 (with TID Solar Plant and Energy Storage)

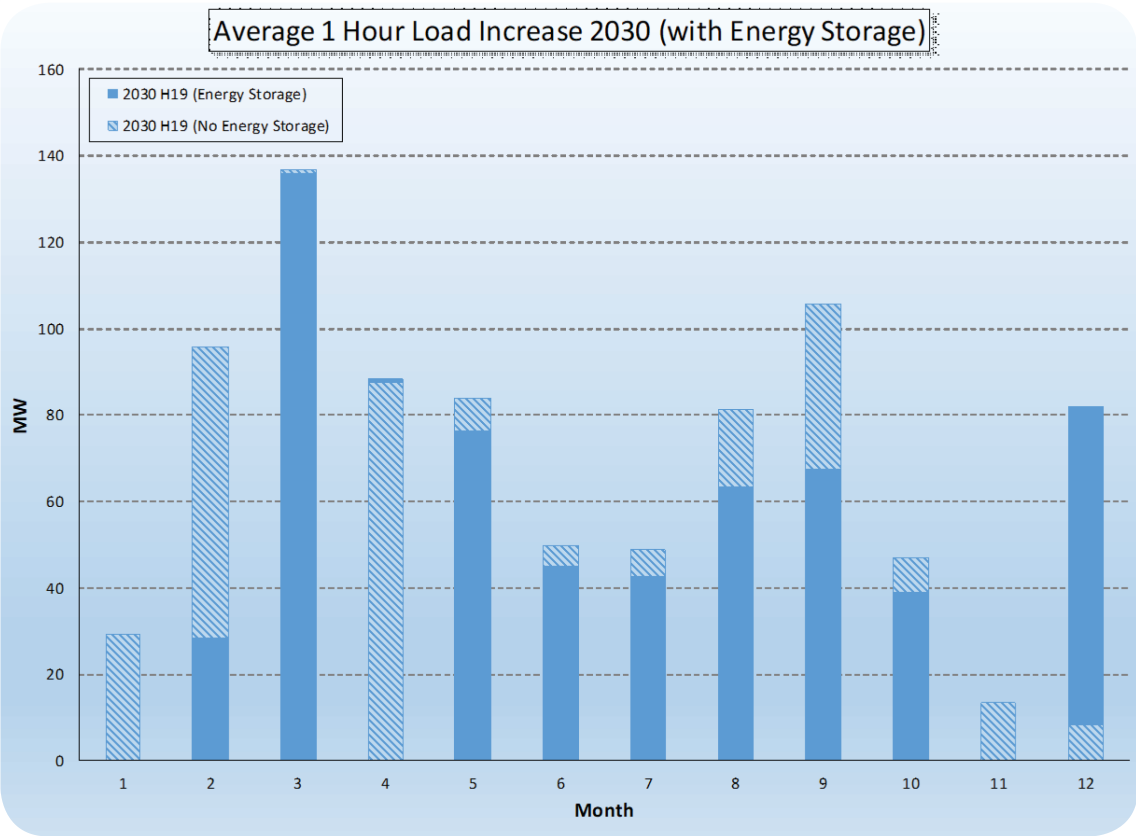

FIGURE 52 - Average 1 Hour Load Increase 2030 (with TID Solar Plant and Energy Storage)

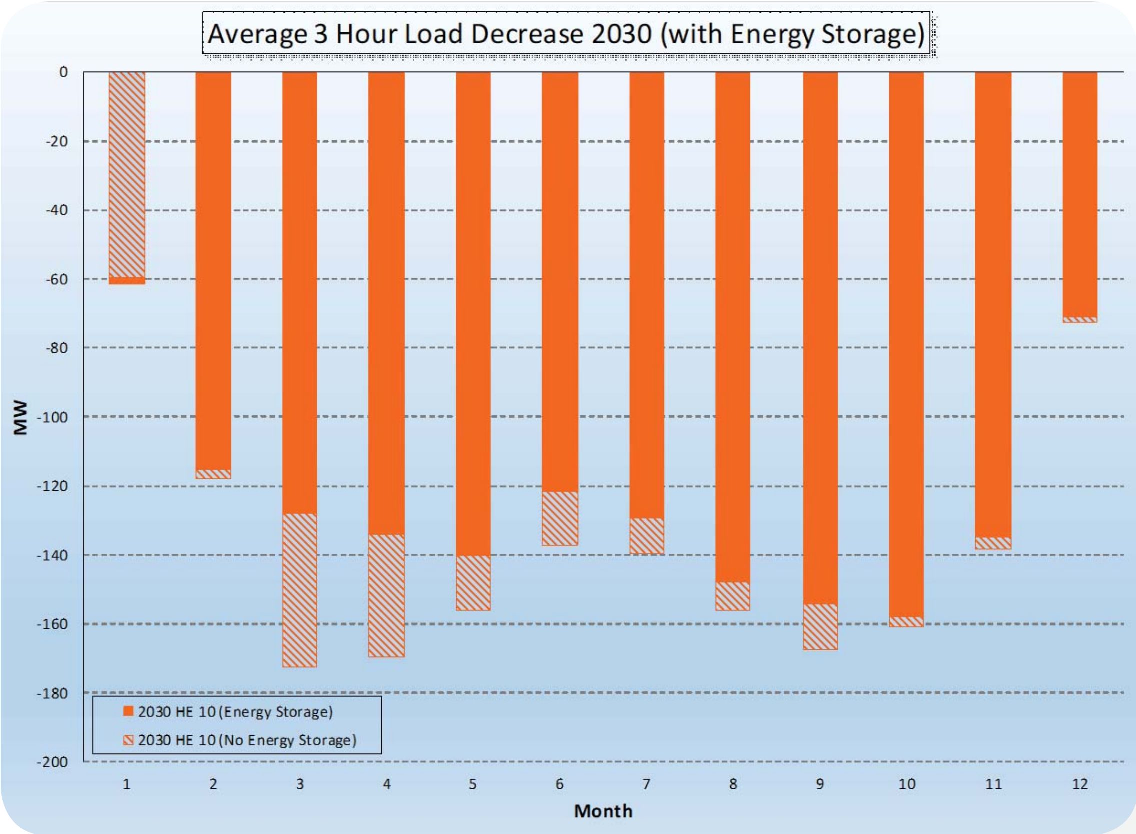

FIGURE 53 - Average 3 Hour Load Decrease 2030 (with TID Solar Plant and Energy Storage)

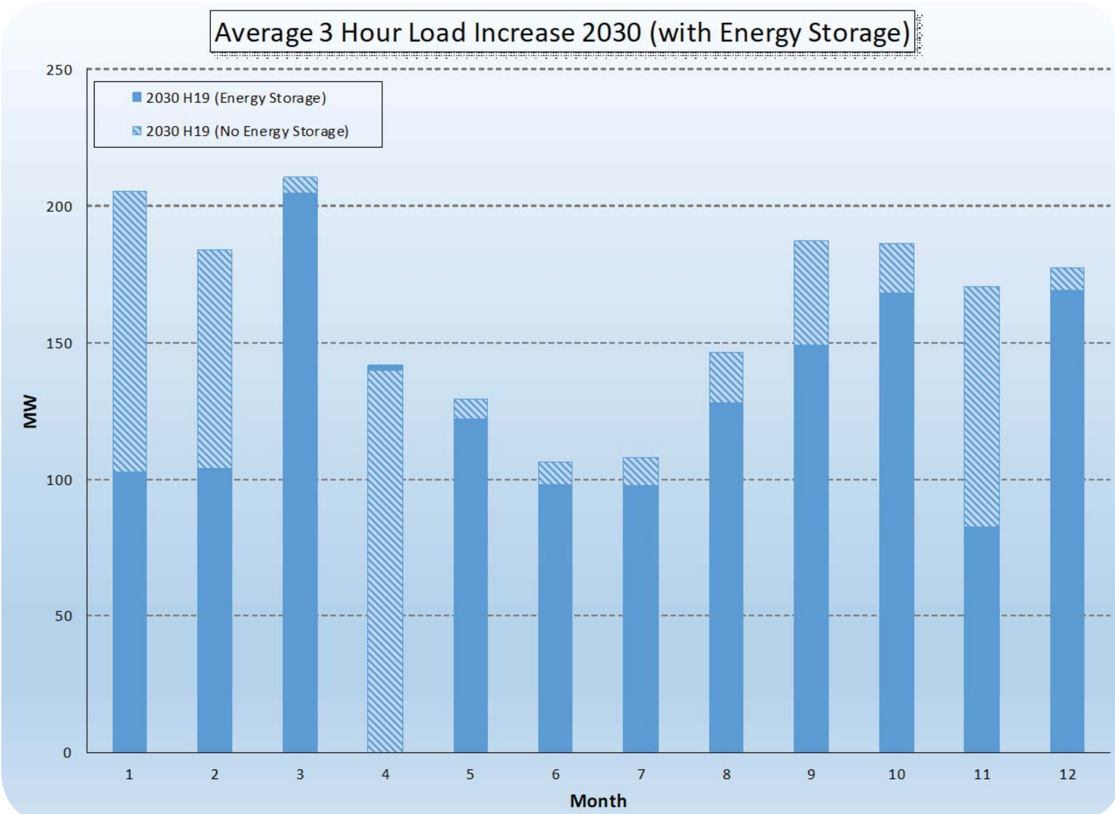

FIGURE 54 - Average 3 Hour Load Increase 2030 (with TID Solar Plant and Energy Storage)

From a transmission system electric reliability planning perspective, procurement of energy storage (or any other supply source) has not been a typical consideration in the past. With appropriate modelling of the energy storage facilities, the TID transmission system can be planned for load flow reliability. The addition of an energy storage system may allow greater resource dispatch flexibility when performing system load-flow study work. However, this could be limited to the nearer-term seasonal planning horizon (or less) since the unknown charge/discharge nature of the energy storage medium could require conservative planning assumptions for the longer-term that might artificially de-rate the associated generator(s) which could lead to load-flow planning challenges.

From a distribution system electric reliability planning perspective, the outlook is much the same; that is, when utility-scale energy storage is to be considered as a plausible distribution system-level resource, then the distribution system will be planned accordingly with one of the more notable challenges being the development of a suitable distribution-system-scale energy storage facility model.

In general, the electric planning paradigm does not typically consider the provision of load or supply – only how load affects system load flow and how supply must be dispatched to accommodate load flow. With those considerations met, TID electric planning can offer suggestions on how to bridge the difference between system capability and system need with regard to reliability.

As discussed in more detail in Section 5, VERs and ZEVs have not yet made a material impact on TID's electric system and therefore addition of flexible resources has not yet been necessary. However, additional flexible resources may become necessary as Customer PV grows and if significant amounts of utility scale VERs are added in the TID service area. Given efforts to reduce emissions and anticipated energy storage cost decline, Energy Storage may be the optimal flexible resource.

5. TRANSMISSION AND DISTRIBUTION

TID owns 379 miles of transmission lines, approximately 2,200 miles of distribution lines, and 29 substations. TID's electric system is directly interconnected with Hetch Hetchy Water and Power at Oakdale, Pacific Gas and Electric at Westley, Modesto Irrigation District at Parker, Western Area Power Administration at Tracy, and Merced Irrigation District at Pioneer. TID also has ownership interest in the California Oregon Transmission Project that gives it 237 MW of transmission rights to COB, giving it access to the Northwest power markets.

To maintain the reliability of TID's electric system, in 2016 TID completed installation and setup of specialized software that provides continuous real-time contingency analysis capabilities. This software models the TID's system and predicts the system's response to various internal and external contingencies should those contingencies occur in real-time. The result is increased situational awareness and reliability of the TID's transmission system and the ability to preempt the effects of various contingencies before they might occur. In 2017 TID invested approximately $11.4 million in new distribution facilities and line upgrades such as the 115/12 kV Washington Substation. This will support new industrial load west of Turlock and will reduce load on the nearby Commons Substation.

Furthermore, TID has expanded several programs to control the number and duration of distribution system outages and is using industry standard measures of reliability to monitor quality of service. Programs include contracting out tree-trimming, replacement of underground cable based on failure trends, prioritizing preventative equipment inspections according to reliability impact, and refinement of data categorization. In 2017, the average customer was without power for approximately 74 minutes. Frequency of outages in 2017 averaged less than one outage per customer. TID continues to use these statistics to help identify distribution system challenges.

In its normal operating configuration, TID has no load-constrained areas within its electric system that can only be reliably served if there is sufficient local dispatchable generation capable of providing operating reserves and the associated energy under high-load conditions. However, as load begins to increase throughout the day, TID does employ the use of must-run generation dispatch to manage the TID system load flow patterns. TID regularly evaluates its electric system in order to assess system capabilities, which can lead to identifying the need for potential system upgrades. As such, TID currently anticipates a need for future transmission and distribution projects to support projected load growth and potentially to support distributed generation and EV growth. TID expects the system to serve anticipated load growth until 2030 without a need to increase internal local generating capacity that is intended to address transmission constraints, distribution constraints, expected load growth, distributed generation growth, or EV load growth.

As mentioned earlier, there is currently about 35 MW of Customer PV connected to the TID system with expectations of reaching 87 MW by 2030. Currently over 90% of the Customer PV installations are residential systems with an average size of 0.006 MW. Less than 2% of the Customer PV installations have installed capacities greater than 0.25 MW. Given that most Customer PV installations are small and not concentrated in any specific local area they have not caused major issues on TID's transmission and distribution system. Although TID has received several inquiries in the past regarding interconnecting larger solar photovoltaic plants to date none have materialized.

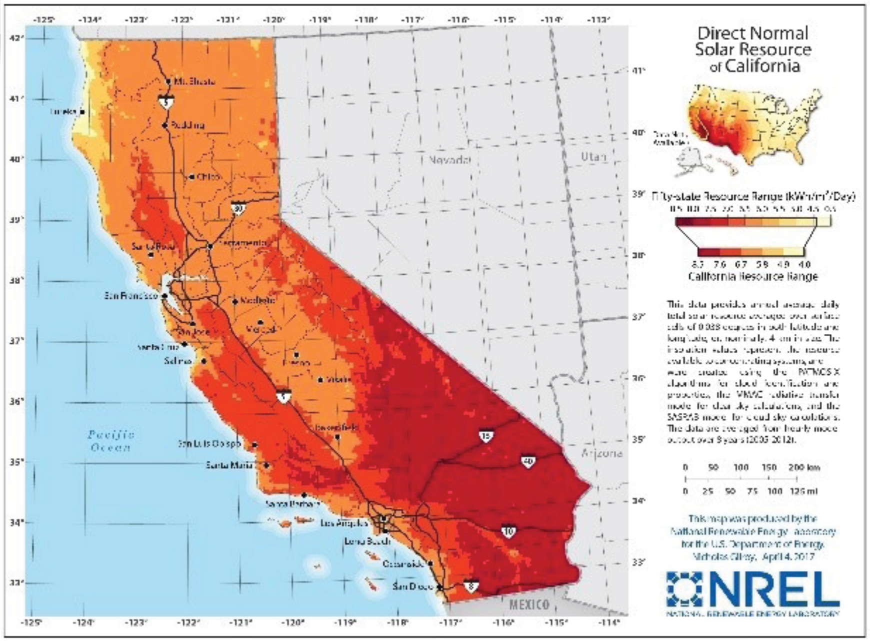

FIGURE 55 - Direct Normal Irradiance (Source: NREL)

Since the TID service area does not have the same solar generation potential as the southeast part of California (see FIGURE 55), no large solar photovoltaic plants are anticipated in the near future. TID will be monitoring the growth of Customer PV and larger photovoltaic plants in its service area and any associated impacts to its electric system.

According to the CEC, as of May 2017 there were over 300 ZEVs in the TID service area. Similar to Customer PV, ZEVs have been geographically dispersed within the TID service area. Due to the small amount and geographic diversity of ZEVs currently in the TID service area, TID has not yet seen an impact to its electric system due to ZEVs. However, as mentioned earlier, TID expects to have more than 6,600 EVs in its service area by 2030. TID will be monitoring the growth of ZEVs in its service area and any associated impacts to its electric system. Furthermore, TID will be launching a program focused on EVs (see Section 3.3).

TID regards the reliability of its distribution system carefully and regularly plans, constructs, operates, and maintains a variety of projects and activities dedicated to preserving a high standard of reliability for the TID ratepayer base. Distribution system upgrades over the planning horizon can include work dedicated to replacing equipment that has reached its useful end-of-life, system voltage control improvements, system capacity improvements, system load balancing improvements, and more. Given that Customer PVs and ZEVs are expected to be dispersed in the TID service area, beyond the regular upgrades and enhancements, there are currently no upgrades or enhancements planned on TID's distribution or transmission system specifically designed to integrate Customer PV or ZEVs into the TID system.


TID Line Crews work to ensure the reliability of TID energy.

6. LOCAL AIR QUALITY

In order to understand TID's impact on local air quality, it is important to have some historical perspective on TID's electric operations. TID was the first irrigation district established in the State of California in 1887, and started serving local retail power in 1923 upon completion of the Don Pedro Dam and powerhouse. Over the years, as the TID territory was developed and the demand for power increased, TID expanded its portfolio of electric generating resources in order to serve its mission of providing low cost, reliable power to its customers. In 1970, Don Pedro Dam was expanded, ensuring an adequate supply of water and power for generations to come. Don Pedro reservoir, dam and powerhouse also provide numerous recreational and environmental benefits to the region, and is a GHG free generating resource. In 1979, TID began construction on the first of eight small scale hydroelectric power plants at strategic points on our canal system as well as several places on surrounding irrigation districts' canal system where water flows were sufficient to spin a turbine. In 1986, TID began construction on Walnut, and in 1995, TID built Almond.

The California State Legislature passed Assembly Bill 1890 in 1996, which paved the way for deregulation of California's wholesale power market. For various reasons, this led to the 2001 California energy crisis, during which many in the state were forced to do without power for extended periods of time, and a majority of Californians paid exorbitant power prices. TID, due to its interconnection with the newly created CAISO, was subject to rolling brownouts. Shortly after the energy crisis, TID decided to take action and ensure TID customers would have reliable power by becoming its own BA. As such, TID built WEC in 2005, a state of the art combined cycle natural gas fired plant. WEC provides the necessary power, voltage support, and reserves for TID to become a BA, and ensure that the lights stay on in the TID service area.

In 2009, 2 years ahead of the legislative mandate to do so, TID built TWP which, at the time, brought TID to a 28% renewable portfolio, 8 years ahead of the TID Board of Directors adopted goal of 20% by 2017.

In 2011, the California Legislature passed SB2 (1x), which established for the first time a renewable mandate of 33% by 2020 on POUs such as TID. Due to market conditions, and potential expiration of tax credits on certain renewable resources, TID issued an RFP for renewable projects in September 2014. TID looked across all technologies, ownership arrangements, terms of both 10 years and 20 years, and locations. After a lengthy process and rigorous evaluation, TID ultimately signed the Golden Fields Solar I PPA for the Rosamond West Solar 2. The Rosamond West Solar 2 generates enough energy to power approximately 20,000 homes every year, and will help TID meet the 60% renewable goal by 2030 as mandated by SB100. TID is monitoring the renewable market, and is poised to add another layer to its portfolio if it provides benefits to its customers.

With California aggressively promoting renewable resources through a variety of legislative mandates, the growth of renewables both inside and outside TID's service territory began to accelerate rapidly starting in 2009. As a result of the California mandate to offer Net Energy Metering, and the precipitous decline in solar pricing, solar expansion in the TID territory was growing rapidly, and coupled with TID's BA responsibilities, it became clear that TID needed additional, fast ramping generation in our service territory in order to integrate the growing Customer PV. As a result, in 2012 TID built the A2PP to provide TID the needed flexibility to serve demand reliably.

As mentioned earlier, TID operates several natural gas-fired generating plants ("TID Gas Plant") within its service area and are subject to the jurisdiction of the San Joaquin Valley Air Pollution Control District ("SJVAPCD"). One of the objectives when building and operating a generation plant is to minimize environmental and air quality impacts. To achieve this, TID conducts extensive air quality impact analyses to show that any impact on ambient air quality is going to be mitigated to the satisfaction of the United States Environmental Protection Agency ("EPA"), CEC, CARB, and SJVAPCD. The air quality impact analyses are prepared in accordance with SJVAPCD approved modeling protocol and use dispersion models and techniques that have been accepted by the CEC for other similar sites. Ambient air impact assessments are conducted using EPA-approved air quality dispersion models.

WEC and A2PP went through the CEC permitting process. The CEC permitting process entails a thorough and extensive 12-month, one-stop process that is certified under the California Environmental Quality Act ("CEQA"). The CEC permitting process also provides many opportunities for public participation to assure compliance with federal, state, and local laws and regulations. For any project under CEQA's jurisdiction, the agency sponsoring the project must identify mitigation measures and alternatives by preparing an Environmental Impact Report ("EIR"). The agencies must also approve projects with feasible mitigation measures and the environmentally superior alternative. Both the WEC and A2PP, as part of the CEC permitting process, identified and mitigated environmental impacts in the eighteen areas identified in the CEQA guidelines. These areas are Aesthetics, Biological Resources, GHG Emissions, Land Use, Housing, Traffic and Transportation, Agriculture and Forestry Resources, Cultural Resources, Hazardous Materials, Mineral Resources, Public Services, Utility Systems, Air Quality, Geology and Soils, Water Quality, Noise, Recreation, and Mandatory Finding of Significance.

The SJVAPCD is the local agency that issues the Authority to Construct permits and Permits to Operate for all of the TID Gas Plants. The SJVAPCD is the lead agency within the CEQA process for the CEC permitted TID Gas Plants, WEC and A2PP, and non-CEC permitted TID Gas Plants, Almond and Walnut. The SJVACPD ensures that all power plant projects are constructed and operated according to federal and state regulations as well as SJVAPCD rules. Every TID Gas Plant has gone through the rigorous SJVAPCD permitting process that includes undergoing the New Source Review process that requires the project implement Best Available Control Technology to control emissions and adequate amounts of emissions offsets to ensure the project will not deteriorate the ambient air quality. There is also a Risk Management Analysis that determines the concentration of identified pollutants near local residents and worksites. The projected concentration of each pollutant is compared to national and state standards and analyzed for the potential health risks.

After the project undergoes the rigorous permitting process described above, TID is still obligated to construct and operate the project according to all the federal and state regulations and SJVAPCD rules according to the permit issued by the SJVAPCD. For CEC permitted projects, another layer of compliance is added for all the areas described in the CEQA process. In addition to ensuring that the plant is maintained and operating well, the project must also maintain a compliance program. For Almond, A2PP, and WEC, the emissions are monitored by a Continuously Emissions Monitoring System ("CEMS") to satisfy federal regulations. The CEMS requires its own maintenance program to ensure quality data is measured to assure compliance with all emission limits. The CEMS is subjected to daily calibrations and quarterly quality assurance tests using EPA certified calibration gas cylinders to ensure quality data. In addition, an Annual Source Emissions Testing and a Relative Accuracy Test Audit are performed to test the CEMS equipment against a third party CEMS to ensure that the gas turbine units are within their permitted emission limits.

The WEC, A2PP, and Almond are also subject to federal and state GHG reporting on an annual basis. WEC, A2PP, Almond, and Walnut are all subject to the Air Toxics "Hot Spots" Information and Assessment Act (AB2588). TID actively monitors Carbon Monoxide and Nitrogen Oxides at WEC, A2PP, and Almond, and reports those values to the SJVAPCD and EPA. TID also reports permitted values for Total Organic Gases, Reactive Organic Gases, Volatile Organic Compounds, Oxides of Sulfur, and Particulate Matter (PM2.5 and PM10). The WEC, A2PP, and Almond are in close proximity to a major freeway and agriculture land, which are both major sources of Particulate Matter, which leaves TID limited abatement opportunities.

Turlock Irrigation District's Walnut Energy Center

7. DISADVANTAGED COMMUNITIES

TID, due to prudent planning, has some of the lowest energy rates in the State, making our service territory attractive for commercial and industrial expansion, as well as keeping costs down for our residential sector.

TID currently has several programs that target the low-income/disadvantaged communities (some of which have been in place since the 1990s). Below are TID's current programs:

- **TID provides payment assistance for low income customers through the TID CARES Program. Eligible customers receive an $11 discount on the residential customer charge, and a 15% discount on the first 800 kWh of monthly energy use.**
- **TID provides rate assistance to customers who depend on medical equipment, or if their medical condition requires special heating or air conditioning. Eligible customers receive a 50% discount on the first 500 kWh of monthly energy use.**
- **TID provides a "Budget Billing" option to all residential customers in order to eliminate the bill shock associated with months of high energy use. TID simply divides a customer annual electric bill into equal monthly payments, so the customer has the same bill every month.**
- **TID's Weatherization Program is a free direct install program to all low income customers. TID contracts a 3rd party vendor to install a wide variety of energy efficiency measures in the home.**

In May of 2018, TID commissioned a comprehensive research project amongst customer owners in order to gain a deeper understanding of the demographic make-up of its customer base, the levels of interest in products and services offered, and opportunities to improve service. The primary goal of the research study was to assess the effectiveness of TID's ability to serve its customers in areas of our service territory classified by the California Legislature as either "disadvantaged communities (as determined by Senate Bill 535) or a "low-income community" (as determined by Assembly Bill 1550). The survey of over 1,000 TID Customers provided TID with a wealth of information about our customer base, and will be strongly considered in future policy discussions and program design.

In December of 2016 the CEC adopted the report entitled "SB 350 Low-Income Barriers Study, Part A – Commission Final Report" which had 12 recommendations to promote a coherent vision for low-income clean energy programs, explore innovative solutions to expanding access, and ensure that economic benefits of public investments are realized by low-income customers and disadvantaged communities. TID is familiar with the recommendations. A majority of the TID service territory is classified as either low income (per AB 1550) or disadvantaged (per SB 535). To that end, a tenet of TID's mission is to keep energy rates low for all customers, and to continue serving our customers with low cost, reliable power. TID, due to prudent planning, has some of the lowest energy rates in the State, making our service territory attractive for commercial and industrial expansion, as well as keeping costs down for our residential sector. Some of the 12 recommendations in the Barriers Report TID is already doing, such as the Weatherization Program, which is a low income direct install program, and the demographic survey focused on understanding the low income and disadvantaged communities that we serve. TID is also in the process of implementing a direct install energy efficiency program for mobile home customers that are located in disadvantaged communities and low-income areas. This program installs energy efficiency measures such as LED lighting, weather-stripping, and caulking at no cost to the customer. TID has taken a look at community solar in the past, and will continue to evaluate the merits of a community solar program if deemed in the best interest of our ratepayers.

In addition, TID implemented a rebate for the purchase of EV and installation of chargers with extra incentives for low-income customers (see Section 3.3).

TID Lineworkers give a presentation to elementary school children.

8. RATES

Since TID's formation in 1887, TID has focused on bringing value to the communities that we serve. To further that cause, and due to a likely transcendent change in the electric utility industry, TID Management developed a Strategic Plan in 2017. In it, TID's Mission statement is defined as follows: "TID will provide reliable and competitively priced water and electric service, while being good stewards of our resources and providing a high level of customer satisfaction." With that mission statement as a foundational element, TID's focus on keeping retail electric rates low resonates throughout all TID Departments as well as the community we serve. As a publicly owned utility, TID's retail rates are set by a 5 member, locally elected Board of Directors, in a local, transparent process.

TID evaluates revenue requirements annually to ensure strong financial standing. Along those lines, aligning customer rates with the costs to serve is critical to keeping rates competitive and stable. The TID Board ensures that electric rates be sufficient to pay for the operations and maintenance of the TID electric system, maintenance of financial reserves to assure debt service, capital costs of new facilities and the improvements of existing facilities, and the costs incurred as a result of various laws and mandates.

TID has nearly completed the Advanced Metering Infrastructure rollout, and will be implementing a new Customer Information System in early 2020. Having the data, and the ability to use that data, is a critical piece to enabling TID to tailor programs and evaluate rate incentives to align with grid and supply conditions for the benefit of our customers as well as the TID distribution system. TID will also be considering a pilot EV charging rate in early 2019 to go along with our Board adopted EV Program.

9. SUMMARY FINDINGS

Customer PV is projected to continue growing, reaching 87 MW by 2030 and will alter TID's future load shape. TID's energy efficiency programs are anticipated to result in a cumulative load reduction in 2030 of 114,010 MWh (representing about 5.1% of forecasted energy load in 2030). The ZEV population in TID's service area is expected to grow to over 6,000 vehicles providing an additional load of 28,000 MWh in 2030 (representing about 1.3% of forecasted energy load in 2030) and net GHG emissions reductions of 8,000 mTons. During the Planning Period energy load and peak demand are forecasted to grow on average 0.4% and 0.1% per year respectively, reaching approximately 2,300,000 MWh and 542 MW by 2030.

TID currently has a diverse Resource Portfolio in terms of fuel source, term, resource type, ownership, and location. Such diverse Resource Portfolio supplemented by short-term power purchases will be sufficient to serve the forecasted load and reserve requirements during the Planning Period. However, to continue complying with the CA RPS during the Planning Period, TID at a minimum, would need to add about 300,000 MWh per year of new renewable resources in 2024 and another approximately 300,000 MWh per year in 2029. With the addition of the renewable resources in 2024 and 2029, TID will also be able to meet the TID GHG Target.

Increasing GHG emissions and natural gas transportation costs during the Planning Period result in lower use of TID's natural gas-fired power plants. Below is the projected Purchased Power and Fuel Expense Forecast during the Planning Period. This forecast reflects the forecasted natural gas commodity and transport prices, power prices, and CCA prices.

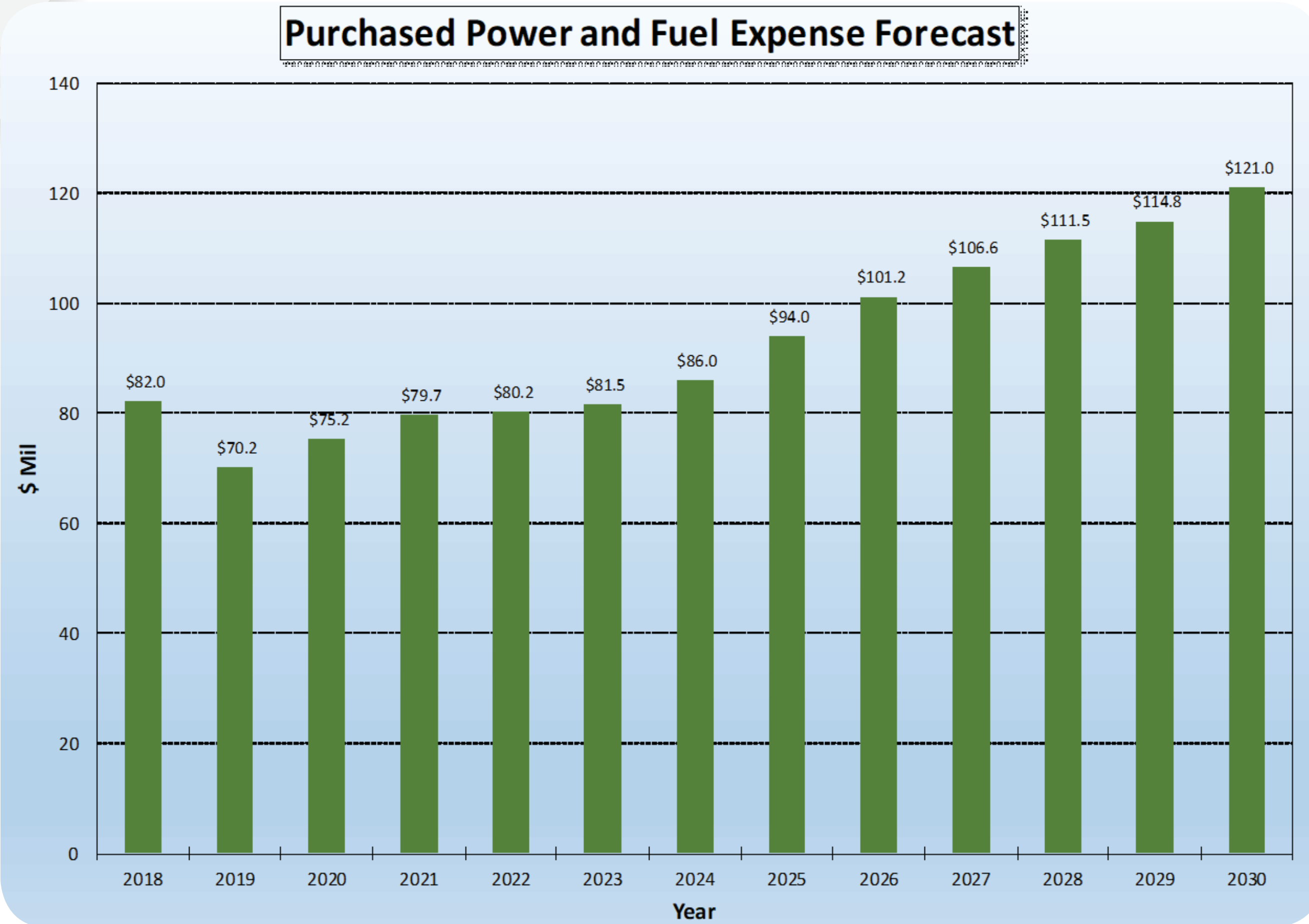

FIGURE 56 - Purchased Power and Fuel Expense Forecast

Continued efforts to decarbonize California are expected to result in an increase in VERs, Over Generation (outside the TID system) and Negative Power Prices during the Planning Period. Over Generation and Negative Power Prices already affect TID. Energy storage systems can be used to optimize around Over Generation and Negative Power prices, and to assist in integrating utility scale VERs within TID's service area. Energy storage costs have been declining and are forecasted to continue declining, which will make energy storage a viable resource option in the future. The growth in Customer PV and the potential addition of utility scale VERs in our service area most likely will require us to add more flexible resources in our system. Given California's preference for non-GHG emitting resources and anticipated energy storage cost decline, Energy Storage may be the optimal flexible resource to add in the future. At some point, adding energy storage into TID's portfolio could be beneficial and may be necessary, particularly if utility scale VERs are added in TID's service area. TID should consider beginning with a small-scale energy storage system in the near term to gain a better understanding of how to maximize the benefits of an energy storage system prior to a potential larger energy storage procurement later on.

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