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Project Title:	Incremental Efficiency Improvements to the Natural Gas Fleet for Electric System Reliability and Resiliency
TN #:	235827
Document Title:	December 2, 2020 Lead Commissioner Workshop PowerPoint - Morning Session
Description:	Lead Commissioner Workshop --Incremental Efficiency Improvements to Natural Gas Power-Plants for Electric System Reliability and Resiliency December 2, 2020
Filer:	Cody Goldthrite
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Docketed Date:	12/2/2020

California Energy Commission

Lead Commissioner Workshop -- Incremental Efficiency Improvements to Natural Gas Power-Plants for Electric System Reliability and Resiliency

December 2, 2020

Remote Compliance

This workshop is being held remotely, consistent with **Executive Orders N-25-20 and N-29-20** and the recommendations from **California Department of Public Health** to encourage physical distancing to slow spread of COVID-19.

Telephone access

- Dial (669) 219-2599 or (877) 853-5257
- Morning Session ID: 927 7901 5365

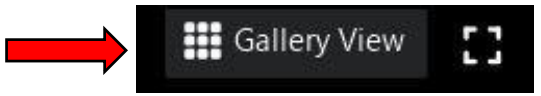
Remote participation instructions can be found in the Workshop Notice at: **energy.ca.gov under "events" or**

https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-SIT-01

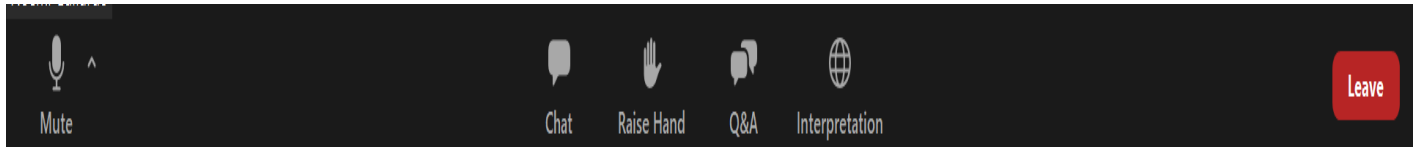
Keep California Healthy

Zoom Instructions

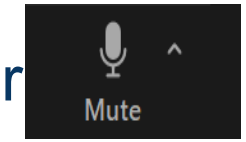
- Click on “Gallery View” in upper right corner of screen to see all speakers simultaneously or “Speaker View” to see one speaker at a time



- For participation options, look for black bar at bottom of screen



  - To un/mute, click on microphone/phone/headphones icon in lower left corner



  - Use “Raise Hand” to comment

Public Comment Instructions

Rules
- 3 minutes per person
- 1 person per organization

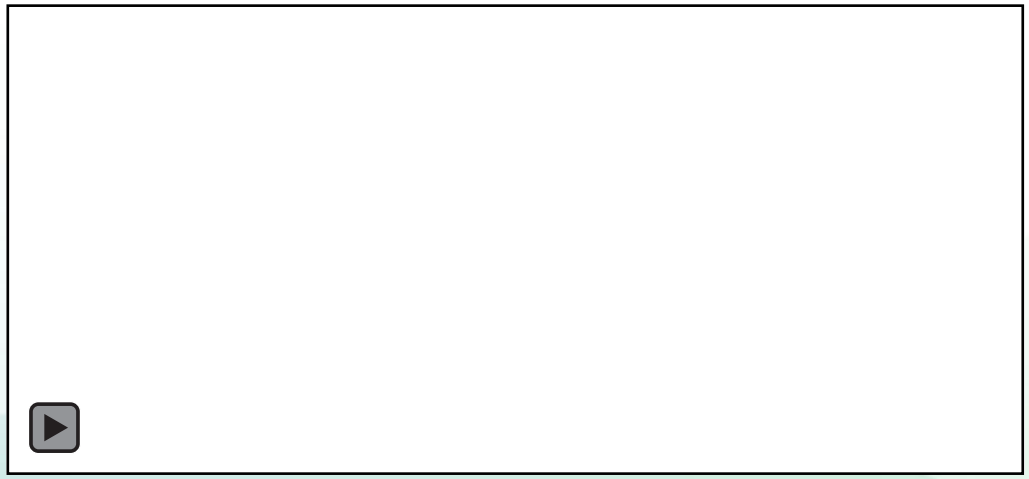
Zoom
- Click “raise hand”

Telephone
- Press *9 to raise hand
- Press *6 to (un)mute

When called upon
- Zoom hosts will open your line
- Unmute, spell name and state affiliation, if any, for the record, then begin your comments

Written Comments:
- Due December 16, 2020 by 5:00 pm (PST)
- Visit: https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=20-SIT-01
- Click: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-SIT-01

3-MINUTE TIMER



Today's Agenda

Morning Session

- Opening Remarks
- Workshop Overview
- Staff Presentation of Possible Technology Upgrades
- Panel 1: Incremental Technology Improvements and Benefits
- Panel 2: Opportunities, Challenges and Process Modifications
- Public Comments

Afternoon Session

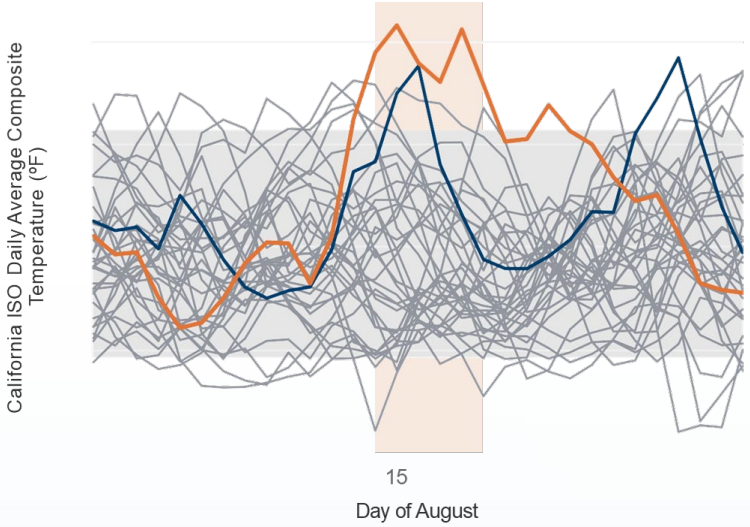
- Panel 3: Discussion of Finance and Governance Opportunities
- Public Comments
- Closing Remarks

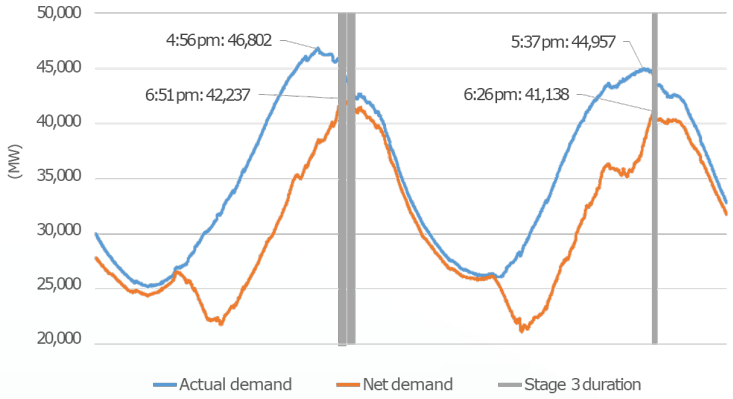
2020 Extreme Heat Events

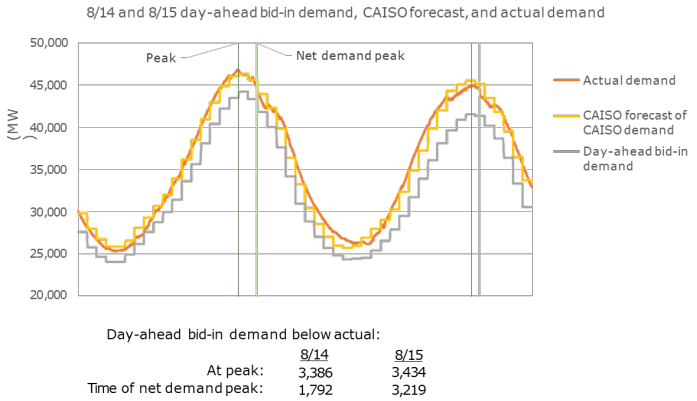
- California and the Western U.S. experienced unprecedented heat storms in both August and September
- Multiple active wildfires raged across California and the Western U.S.
- Energy demand exceeded supply AND planning targets
- Heat and wildfires significantly impacted energy generation and transmission
- High temperatures and dispatch stressed multiple sub-systems of natural gas power plants
  - ✓Resulted in power loss in combustion turbines, steam tube leaks, condenser pump failures
  - ✓Plant were derated due to inlet air and cooling system stresses

Preliminary Root Cause Analysis (PRCA)

http://www.caiso.com/Documents/Preliminary-Root-Cause-Analysis-Rotating-Outages-August-2020.pdf







- Unprecedented extreme heat storm
- Deficiency and Planning
- Day-ahead Market challenges

PRCA – Recommendations

- Recommendations
  - ✓Examine emergency procurement
  - ✓Perform state-wide resource assessments
  - ✓Improve communications protocols
  - ✓Enhance market practices

Today's Workshop

- The existing natural gas fleet can help meet near-term system reliability and resiliency as we move towards SB100 goals
- Plant improvements implemented by the summer of 2021 and beyond can help mitigate future stresses on California's electric system like those caused by extreme heat events in 2020.
- Near-term physical improvements can increase plant output, efficiency, turndown, and flexibility – all of which can provide insurance against extreme weather, fire, or climate-related events and help smooth the transition to SB100 goals.

Kenneth Salyphone
California Energy Commission

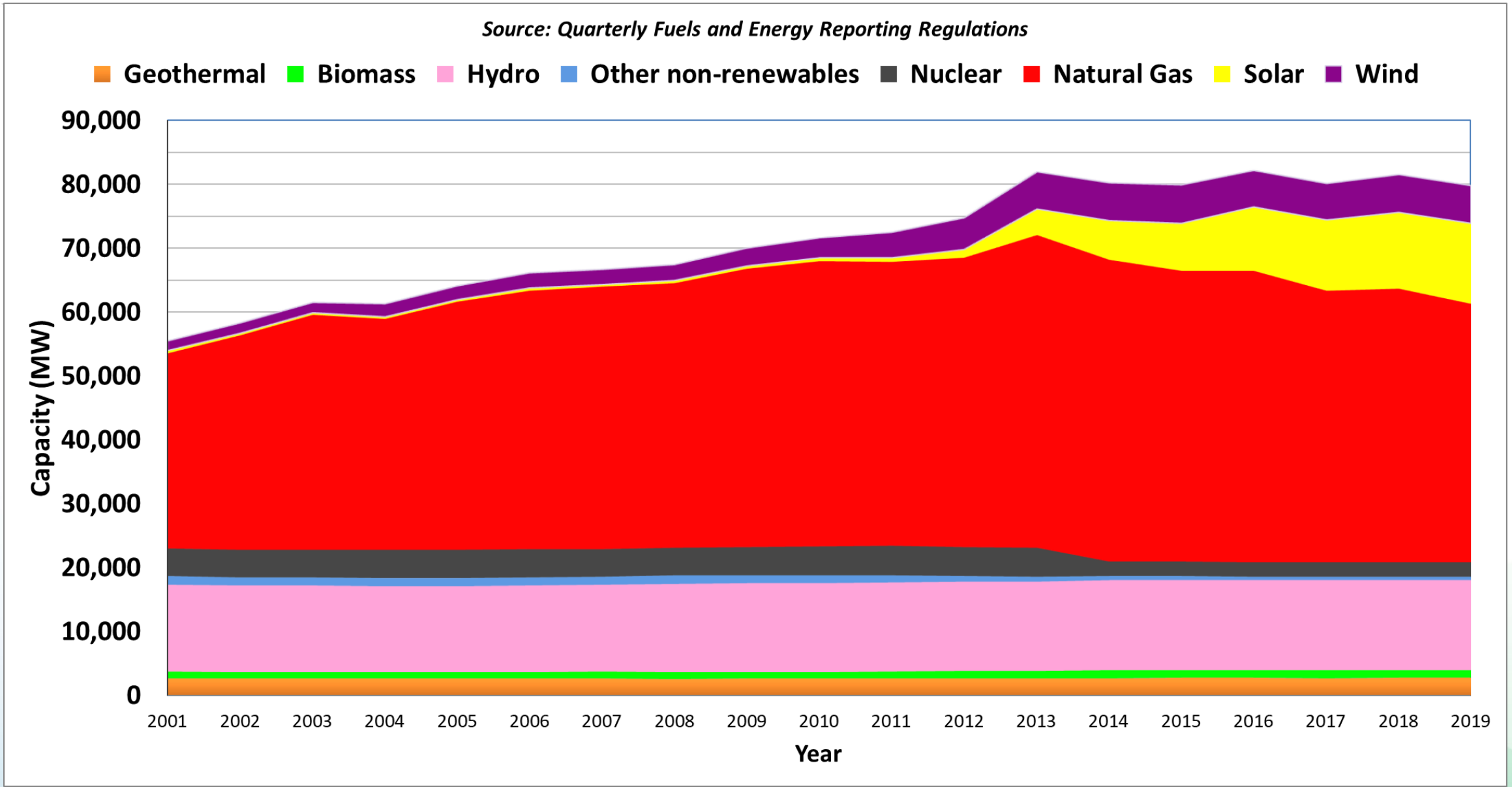
California Energy Commission

Natural Gas Fleet Resiliency Workshop

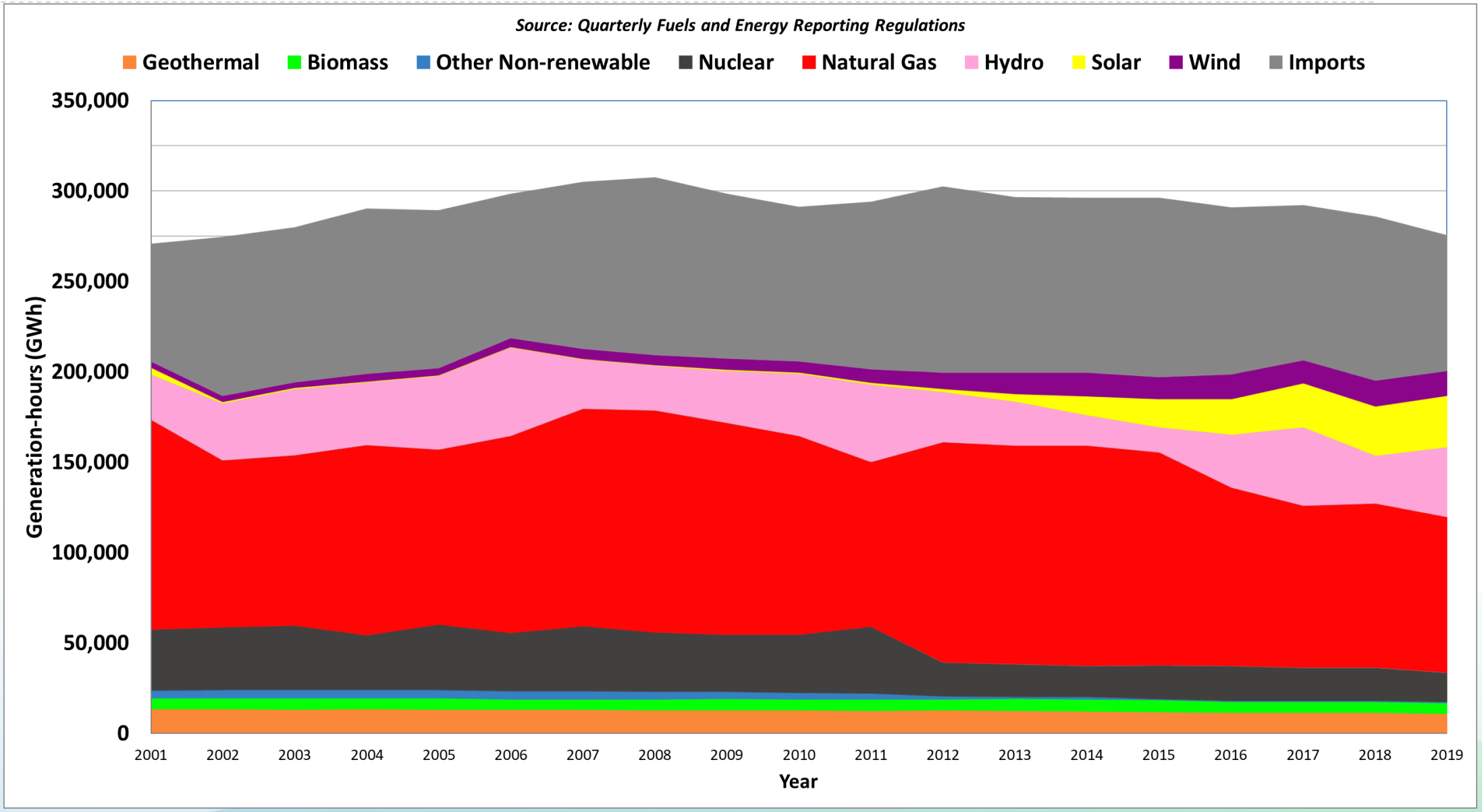
STEP Division Staff

December 2, 2020

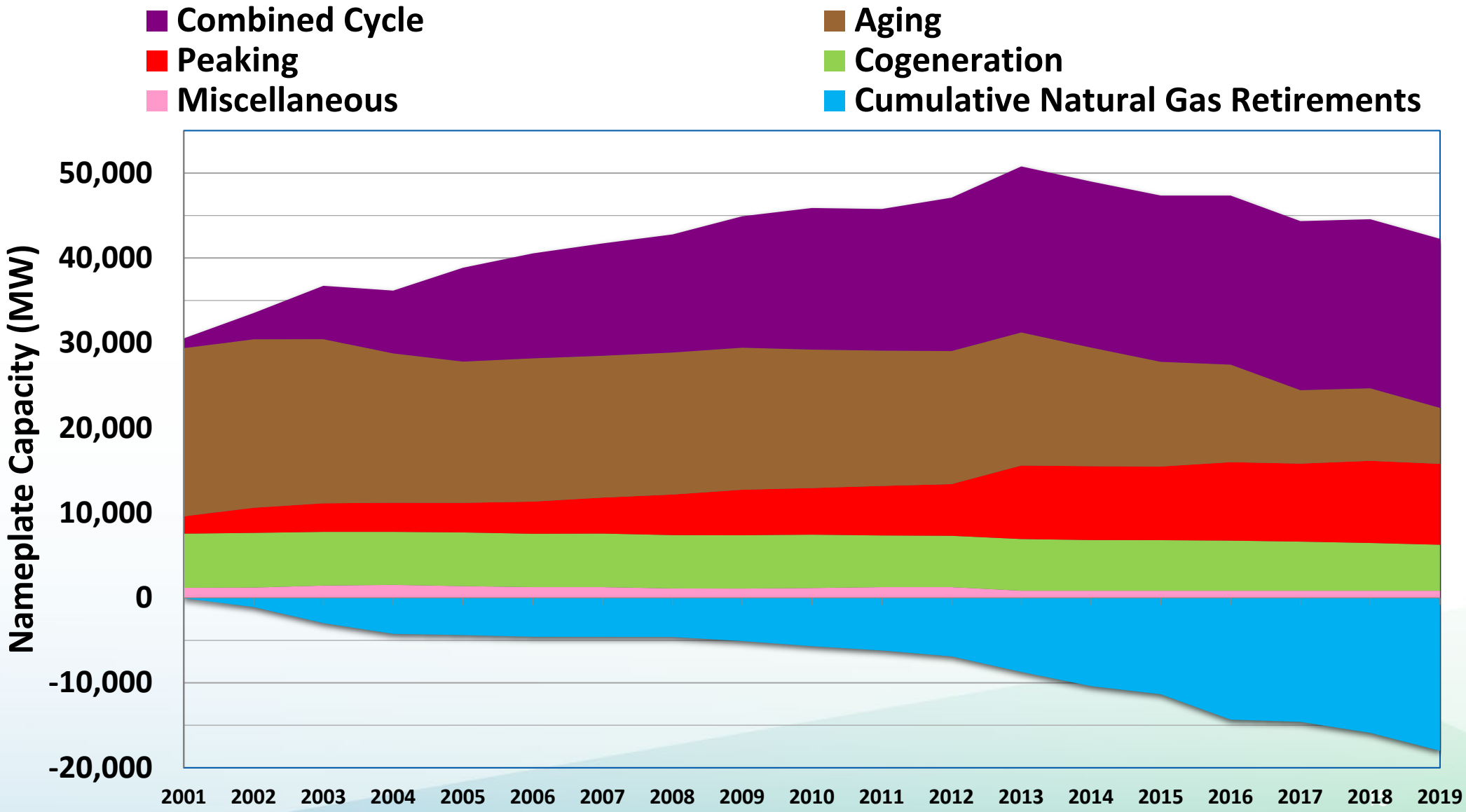
Historical Trend of In-State Generation (MW)



Historical Trend of In-State Generation (GWh)



In-State Natural Gas Capacity



2020 Extreme Heat Events

- Due to the record-breaking heat storms this year
  - ✓ Peak demand stressed multiple sub-systems of natural gas powerplants
  - ✓ Smoke from wildfires decreased solar output
  - ✓ Wind generation impacted
- Energy generation fell short of demand
- Load shedding prevented rolling blackouts in September

Summer 2021 and Beyond

- Natural gas is currently integral to California's generation capacity
- Natural gas powerplants are highly dispatchable
- Potential incremental improvements can be made to the existing natural gas fleet in the following areas:
  - ✓ Flexibility (Start-times/Ramp up/Turndown)
  - ✓ Efficiency
  - ✓ Increase peak capacity

NG Fleet Improvements by Technology

- Combined cycle and simple cycle gas turbines
  - ✓ Advanced Gas Path (AGP)
  - ✓ Inlet air cooling (evaporative/refrigeration)
  - ✓ Other cooling system improvements
- Cogeneration plants
  - ✓ Not considered here for improvements: dependent on the thermal hosts, not as dispatchable

Improvement Opportunities – AGP

- Advanced Gas Path
  - ✓ Replacing mechanical components within the turbine (blades, buckets, nozzles, shrouds)
  - ✓ Advancements in metallurgy have allowed upgraded components to withstand higher pressure and temperature
  - ✓ Improves output, efficiency, and operational flexibility (i.e., ramp up, and turndown)

Improvement Opportunities – Inlet Air Cooling

- Cooling the air before entering the gas turbine to increase air density.
- Evaporative Coolers
  - ✓ Relatively inexpensive
  - ✓ Low parasitic load
  - ✓ Consume water
- Mechanical Chillers
  - ✓ Improve energy efficiency and power output
  - ✓ Add to parasitic load
  - ✓ Some refrigerants are hazardous

Improvement Opportunities – Other Cooling Systems

- ACC/Cooling Tower on Combined Cycle
  - ✓ Pre-cooling inlet air to air cooled condensers
  - ✓ Improve cooling tower performance and efficiency
- Simple Cycle Heat Rejection
  - ✓ Spray intercooling
  - ✓ Improve turbine performance and efficiency

Other Improvement Opportunities

- Onsite Battery Storage
  - ✓ Acts as spinning reserve
  - ✓ Serves station loads during peak demand
- Software Upgrades
  - ✓ To operate above design or warranty limits to meet short term peak demand

Panel 1

Incremental Technology Improvements and Benefits

- Peter Blaes and Joshua Minnix, General Electric
- Mike Salvatore, Siemens
- Alex Morris, California Energy Storage Alliance
- Matt Garner, Roseville Electric
- Ross Gould, Sacramento Municipal Utility District
- Frank Messineo, Burbank Power & Water
- Matthew Zents, Southern California Edison

Peter Blaes & Joshua Minnix
General Electric

GE Heavy Duty (HD) Gas Turbine Fleet
Providing California with over 10GW of Power

GE California HD Fleet

F Class

40+ Units
10+ CC GWs

E Class

28 Units
2-3 GWs

B Class

50+ Units
1.5-2 GWs

GE Gas Power offers advanced technology enhancements to provide highly efficient, flexible, and responsive power.

Improving Existing Gas Turbine Capabilities for system reliability and resiliency

Solutions for increased Output and Operating Range

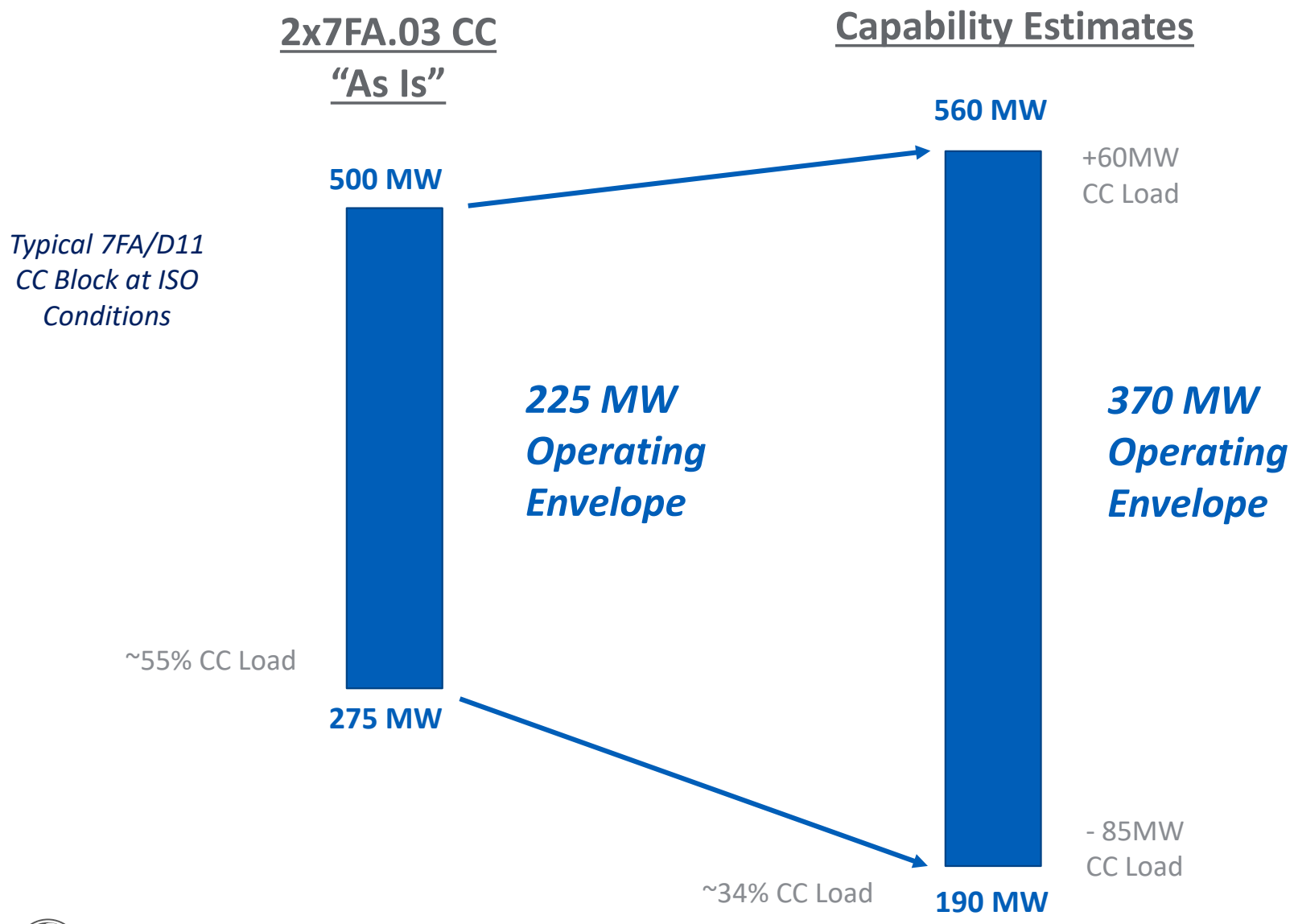
1. **Output Solutions… ranging from 1% - 13%+ MW increase**
   - Hardware Upgrades
   - Peak Fire Controls/Tuning Enhancements

2. **Turndown or Minimum Emissions Compliance Enhancements**
   - Combustor Upgrades (DLN)
   - Piping System Enhancements
   - Controls/Tuning Enhancements

3. **Flexibility Enhancements**
   - Faster Starts, Faster Ramp rates, Fuel Flexibility

All values shown are estimates and for illustration purposes only

7F Example… Opening up the operating envelope



The Possibilities….

+145 MW of Range!
Ramp Rates 2-3x faster
Full CC Load in under an hour
Optimized Maintenance Intervals

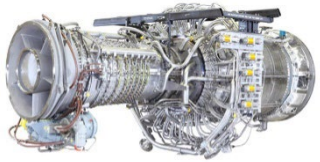
Driving a CC Plant to look/react like a peaking plant

All values shown are estimates and for illustration purposes only

GE Aeroderivative Gas Turbine Fleet
Providing California with over 9GW of Power

GE California Aeroderivative Fleet

GE LM2500

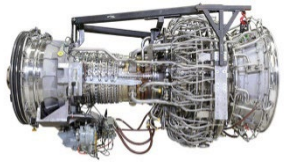


36 Units
~900 MWs

GE LM6000

95 Units
~4.5 GWs

GE LMS100



33 Units
~3.3 GWs

GE Aeroderivative Gas Turbines leverage advanced aviation technology to provide highly efficient, flexible, on-demand power.

Improving Existing Gas Turbine Capabilities for System Reliability and Resiliency

Solutions for Summer of 2021

Maximize Technology Performance Entitlement

LM6000 Summer Peak Output Upgrade: +232MWs
Estimated potential for mature fleet
Restores degraded performance for critical summer energy production
Highest impact for peaking assets with greater than a decade of operation

LMS100 PA+ Modernization Upgrade: +43MWs
Estimated potential fleet output

Reinforce Availability through Aeroderivative Asset Exchanges

GE Spare engine & lease engine program: +187MWs
Availability adjusted fleet output
GE Aeroderivative fleet has a ~98% Availability
Programs to backstop outages available
48-hour outage to exchange engines and resume operation possible

Enable renewable-integrating Gas Turbine Operational Flexibility

LM6000 Fast Start – +376MWhs
Modify from 10-minute to 5-minute startup time

Solutions for Summer of 2022

Implement Incremental Technology Upgrades

LM6000PC Upgraded Turbine Replacement: +760MWs
Estimated potential fleet output
Up to 8% higher output

LM6000PAU Obsolescence Upgrade: +20MWs
Estimated potential fleet output

Large Peaker Summer Performance Solution – +>200 MWs
Under Development

Hybridization of Aeroderivative Assets

GE LM6000 Hybrid EGT™ : +50MWs of Spinning Reserve
10MW/4MWh Battery Energy Storage System + hybrid controls system
Minimum load of 0 MWs, 25MW of regulation

All values shown are estimates and for illustration purposes only

Mike Salvatore
Siemens

Operating Gas Plant - Flexibility Services

To remain competitive, the current energy market requires new operating profiles with increased flexibility. Siemens Energy is leveraging its OEM expertise and decades of O&M experience to provide innovations for the energy of tomorrow.

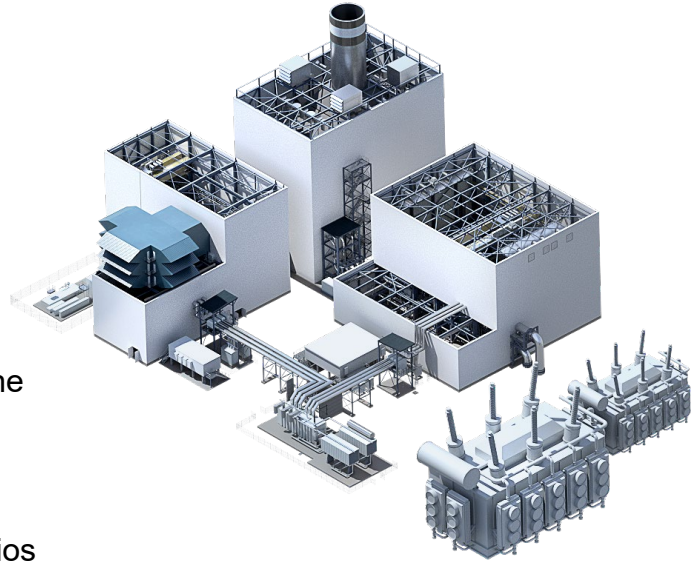
Power on Demand

Reduced Emissions

Expanded Operating Range

Faster Ramp Rates

December 2, 2020



Solutions

Tailored solutions through the evaluation of:

- Requirements and tasks
- Operational limitations
- Future operational scenarios
- Historic operation regimes

Benefits

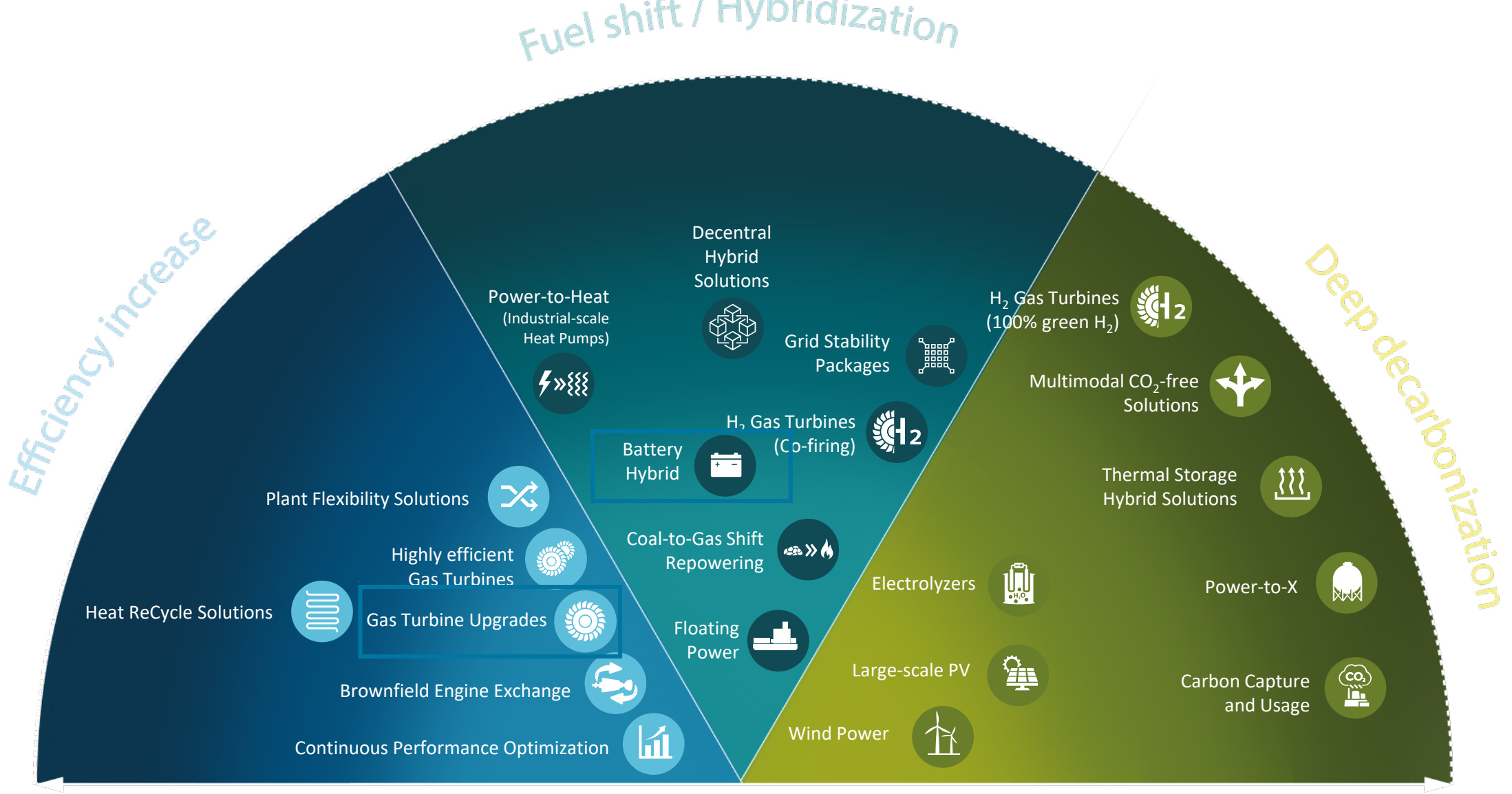
- Increased dispatch
- Improved profitability
- Enhanced grid stability
- Extended service intervals
- Improved renewable integration

Scope

A comprehensive portfolio of products for increasing:

- Operational flexibility
- Thermal performance
- Availability and reliability
- Capability of plant upgrades

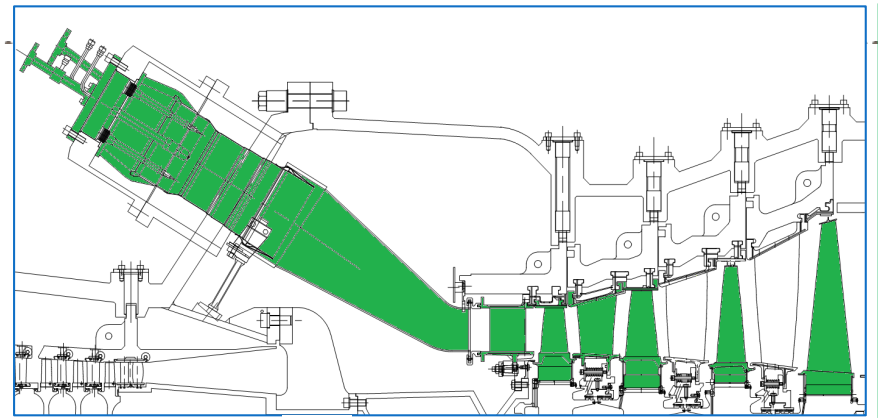
Making Energy Greener

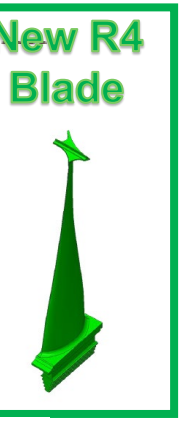


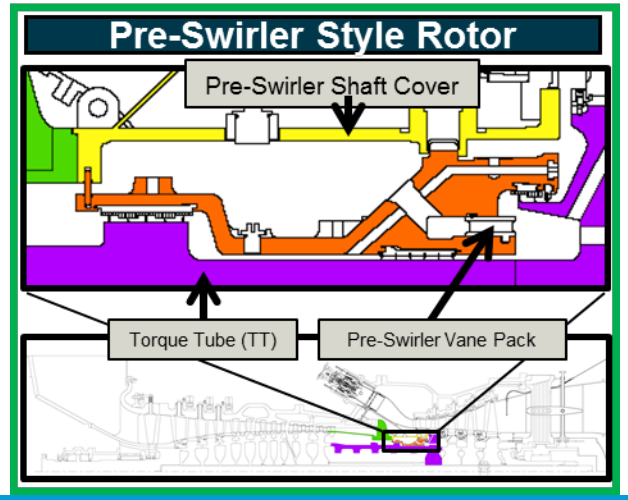
FD2 → FD2(6) – 3X1 CC Plant in Eastern U.S.
FTA May 2019 - Thermal Performance Upgrade w/New High Performance Row 4 Blades, Hybrid Rotor with Advanced DLN Combustor

	Pre-Upgrade	Post Upgrade
Combustor	Standard DLN	Advanced DLN 2.3
Turbine	FD2	▪ TPU + FD(6) stages 1 & 2 ▪ Coated R3TB ▪ High performance R4TB ▪ DAIS
Rotor	FD2	Hybrid rotor (material upgrade + pre-swirler)
Exhaust	Standard TPEX	Advanced TPEX (ATP)
GT Power	-	+ 24 MW / GT*
GT Heat Rate	-	- 577 BTU / GT*

* Performance numbers @ ISO conditions; based upon models and including outage degradation recovery

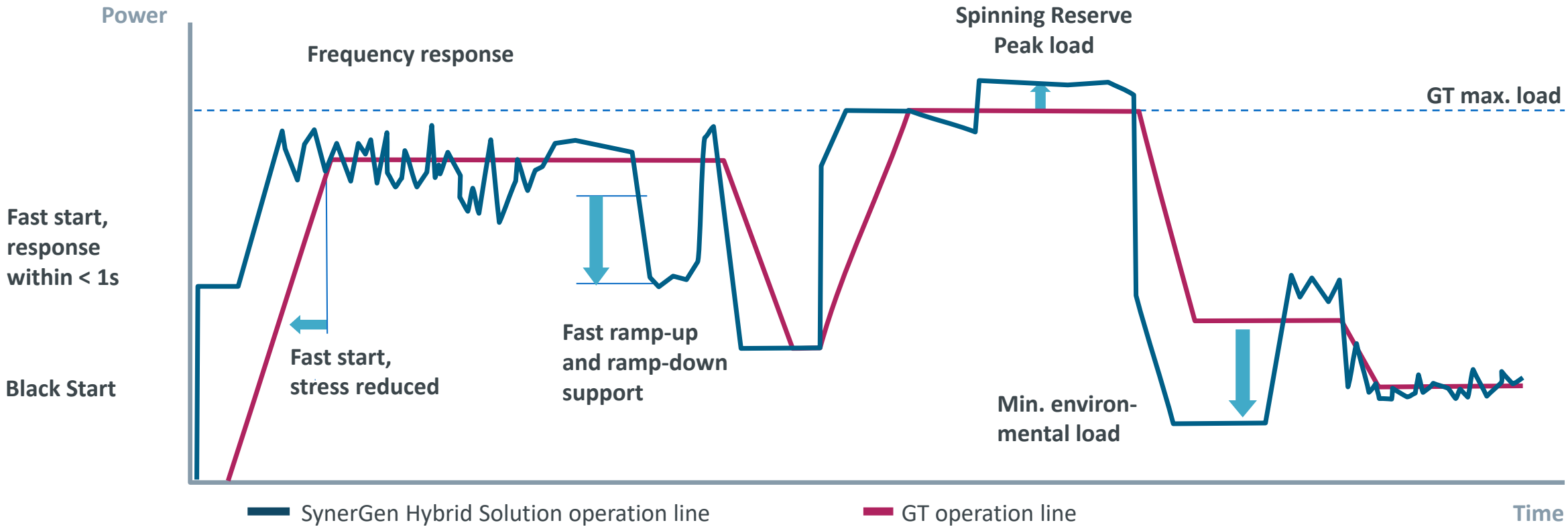






Significant improvement in efficiency, capacity, flexibility and reliability - 2/3 installations completed

SynerGen – Integrated Battery Energy Storage Systems
Market participation through grid support and ancillary services



Black start and support of grid restorage	Fast start-up	Primary frequency response	Secondary frequency response	Acceleration & stabilization of load ramps	Operating reserve for peak power	Minimum load

Alex Morris
CA Energy Storage Alliance

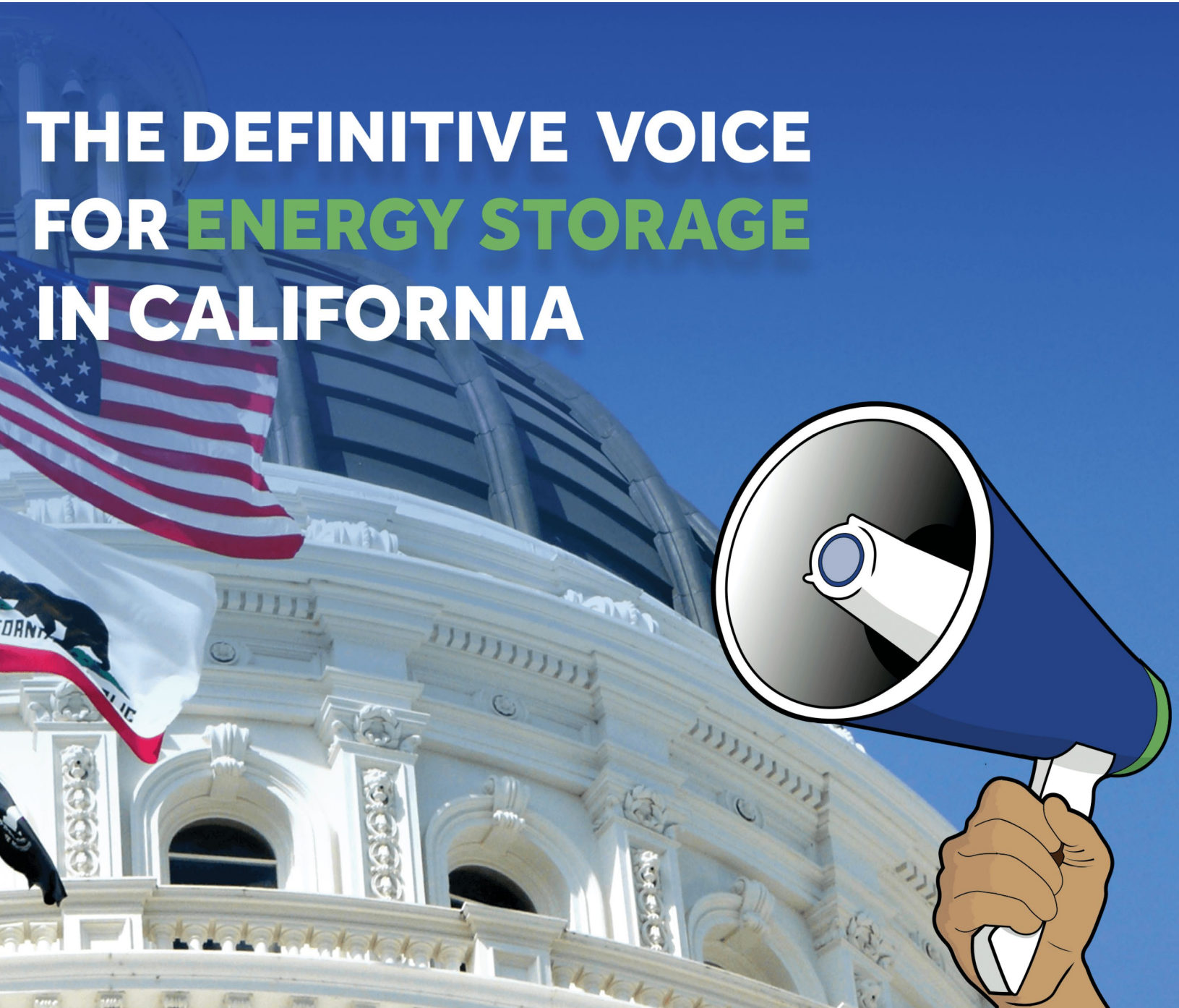
Energy Storage additions to gas units: clever, affordable, beneficial, immediate

California Energy Storage Alliance

Alex Morris, Executive Director

December 2, 2020

THE DEFINITIVE VOICE FOR ENERGY STORAGE IN CALIFORNIA



CESA creates and builds energy storage markets and networks to support the grid in CA. CESA members help drive our advocacy, build relationships with our 100+ members, gain insight, and connect with energy storage policy-makers and buyers such as IOUs, CCAs, Munis, and more.

CESA

100+ MEMBERS

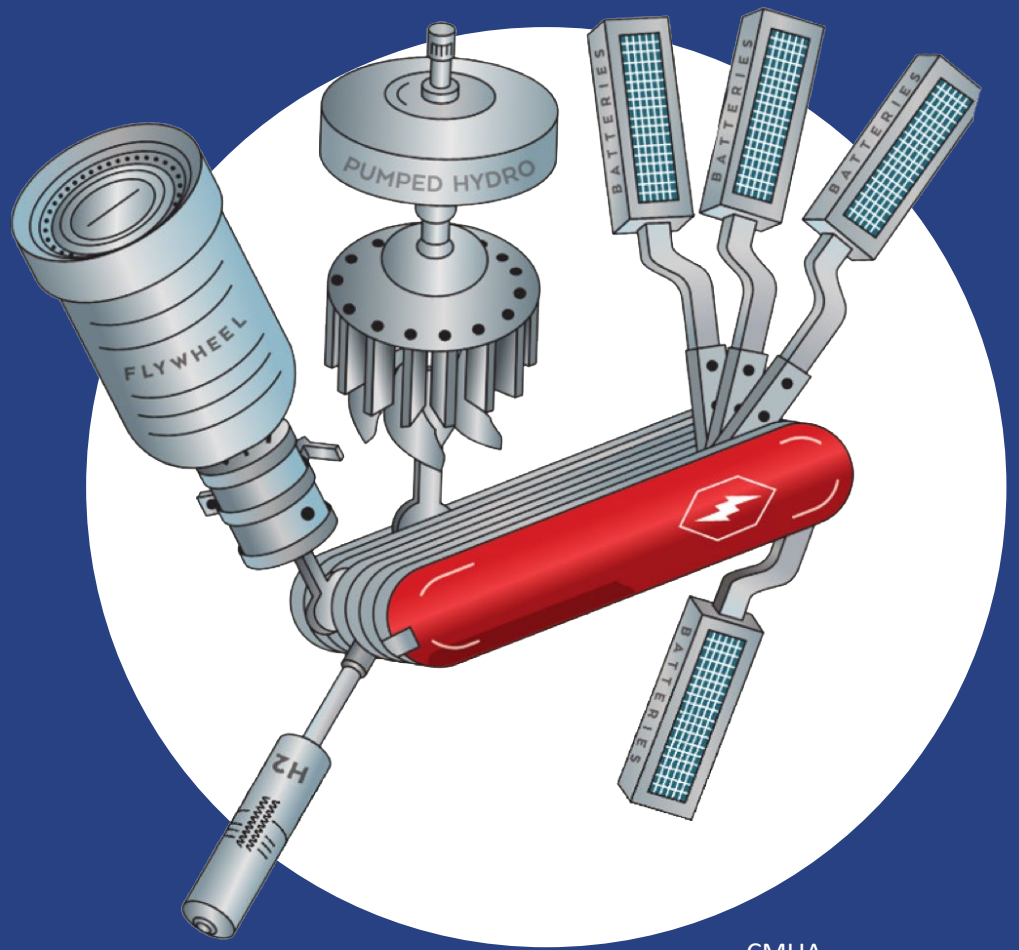
CALIFORNIA ENERGY STORAGE ALLIANCE

Diverse Energy Storage Technologies

CESA
CALIFORNIA ENERGY STORAGE ALLIANCE

CESA advocates for all types of storage technologies.

- COMPRESSED AIR
- ELECTRO-CHEMICAL BATTERY
- FLYWHEEL
- GRAVITY
- HYDROGEN
- THERMAL



CMUA

Hybridization – a key component for SB 100 Achievement

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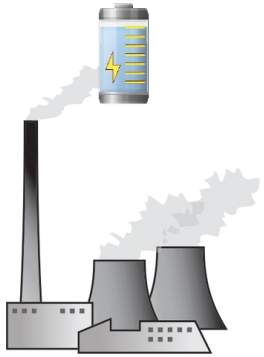
Add Renewables ✓



Add Storage ✓

What is the pathway for CA's natural gas fleet? ?

CA GAS Fleet

180

Operating gas power plants in CAISO[1]

~50%

Gas plants are based in disadvantaged communities[2]

- Today, CAISO depends on natural gas resources for certain critical grid reliability services.
- A credible roadmap for hybridizing the gas fleet shows how we can initially reduce and ultimately phase out the gas fleet.

0

Zero electricity from natural gas

2018 **2045**

+ GHG −

[1]: Based on plants included in the CAISO NQC List as of August 2018.
[2]: Approximate based on count of plants located in areas with a CalEnviroScreen within the top 30th percentile.

Transitioning the Existing Gas Fleet: A Simple Analogy

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CURRENT	NEAR-TERM	FUTURE
Internal Combustion Engine	Plug-in Hybrid Electric	Fully Electric
		
(e.g. Volkswagon Jetta) Gasoline or diesel engine	(e.g. Chevy Volt) Electric motor with an integrated fuel engine	(e.g. Tesla Model 3) Electric motor with batteries charged by zero emissions resources

+ GHG -

Benefits of Hybridizing Gas Units

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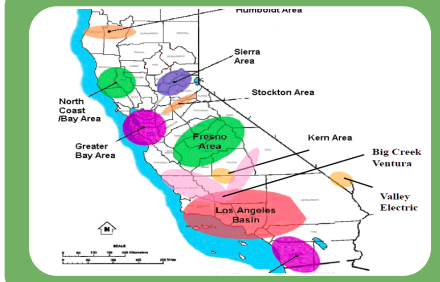

1. A Cost-Effective RA Solution

2. A Cleaner Option for Local Communities

3. Near-term and Long-term GHG Benefits

Pio Pico Energy Center

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The Pio Pico peaking power plant is a prime candidate for hybridization given its dispatch profile, its fast start GE LMS100 technology, and its long-term tolling PPA with SDG&E

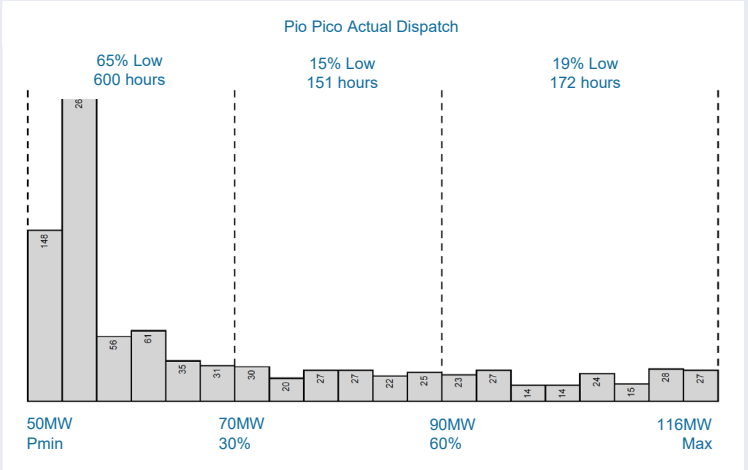
The Plant

336MW gas fired peaking under Toll with SDG&E through 2042, COD 2017, south of San Diego

Three GE LMS100 turbines
9050 full load heat rate
10min start time to full load

Dispatch in 2017/18

Over a year Pio Pico was dispatched at Pmin for >50% of the time Pio Pico runs. Indicates that Pio Pico is likely used for reserves and load following.



~400 hours at Pmin
~250 Pmin starts
250,000 MMBtu of fuel
13,000 metric tons of CO2

>$1million per year per turbine avoidable costs

All three turbines run in this manner.

Dispatch in 2030

California's reserve requirements are only expected to increase over time. By 2030, Pio Pico is forecasted to run 3x-4x more than it ran in 2018(1).

8,000 to 20,000 cumulative hours run at Pmin
5 to 12 million MMBtu of fuel
300,000 to 600,000 MT of CO2

$20 to $50 million of avoidable costs per turbine (2)

Hybridizing Pio Pico could save SDG&E ratepayers $60-150 M by 2030 and reduce plant CO2 emissions by 1-2 million MT. Reduced unit starts and fuel burn would also benefit the local community by reducing criteria pollution.(3)

1. Forecasts created by Wellhead using RESOLVE model with CPUC's integrated resource planning (IRP) inputs; Gridwell Consulting, Hybrid Storage Technology, https://docs.wixstatic.com/ugd/fe68bf_ff74a8c24c6d4907b8bea661be9f99df.pdf
2. Gas & CO2 price forecasts provided by PA Consulting Q1 2019
3. A hybrid plant operated by SCE demonstrated a 78% reduction in particulate matter emissions after hybrid technology was installed

Key Takeaways

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- Hybridization of existing gas resources provides GHG reduction benefits without significantly increasing system costs (will reduce costs in some cases)
- As renewables increase, hybridization can help manage challenges related to increased unit starts and criteria pollutants. Immediate relief also provided to disadvantaged communities (DACs)
- Hybrid resources are relatively cost-effective for providing essential reliability services, including operating reserves (spin, freq. response), as well as local RA, with minimal emissions
- Early hybridization enables reliable grid operations even with significant gas retirements
- Hybridization should play an important role in transitioning gas fleet towards SB 100 goals

Matt Garner
Roseville Electric

Ross Gould
Sacramento Municipal Utility District

Cosumnes Power Plant
Advance Gas Path Upgrades

Powering forward. Together.

SMUD

The June 2017 heat wave changed SMUD's Load Serving Capacity (LSC) assumptions:

- Going into that summer, calculated LSC was 3,350MW
  - Previous all-time high load was 3,299MW, recorded in 2006
  - 1 in 10 forecasts were at or below 3,000MW
- Several Outages combined to reduce the LSC by 250MW
  - SMUD hydro facility off line due to mechanical issues
  - Non-SMUD thermal facility on Northeast edge derated due to mechanical issues
  - California-Oregon Intertie (COI) Transmission line derated due to maintenance work
- On June 19, 2017, SMUD system peak load reached 3,149MW
  - First of four consecutive days at or above 3,100MW
  - Required use of mitigation tools
- Examination of assumptions/recalculation of LSC requirements
  - Increased LSC requirement by 120MW
  - Kicked off several immediate projects to increase

Cosumnes Power Plant

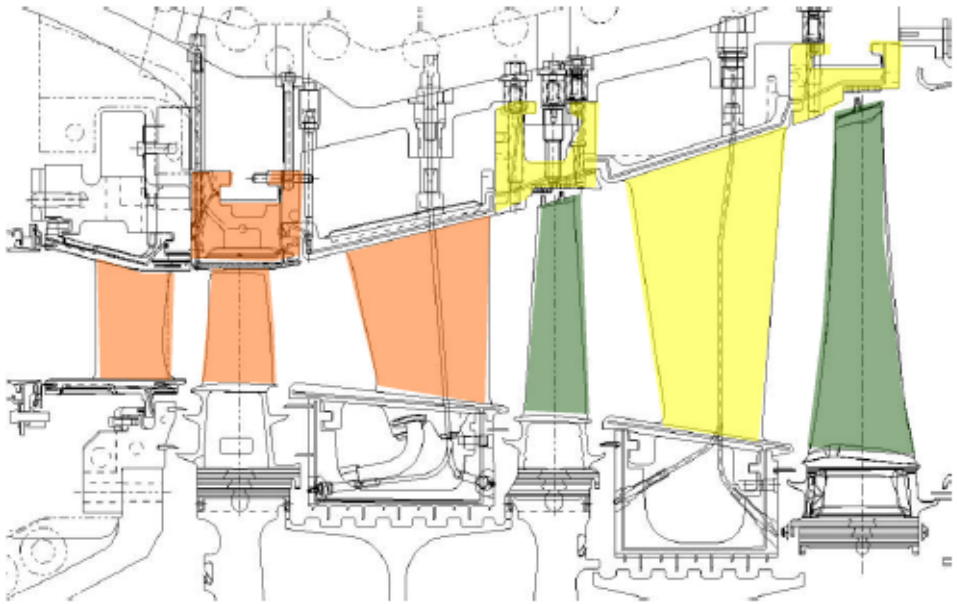
- 500MW Combined Cycle Gas Turbine facility
  - 2 GE 7FA (7241) gas turbines
  - 1 Mitsubishi Steam Turbine
- Commercial Operation Date 2006
  - Both gas turbines due for major overhaul in 2018/2019
  - Staff was already studying modification and upgrades
- Advanced Gas Path Upgrade Opportunity
  - Increased combined cycle output of 56MW
  - Improved heat rate by 2%
  - Incremental cost was attractive
  - Calculated Return on Investment (ROI) was less than 2 years

AGP ‘performance’ hardware

Improved TBC, improved cooling and sealing

Improved sealing technology

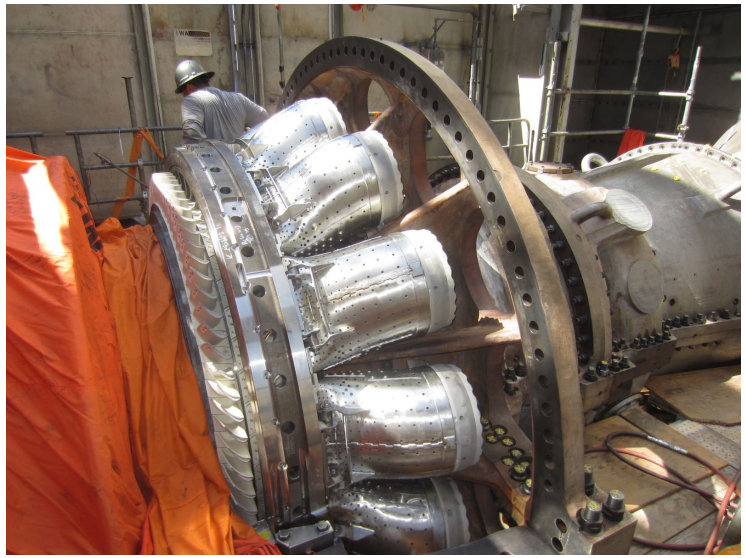
Upgraded material for higher creep strength



- ✓ Next evolution of AGP constructs
- ✓ Unlocks full load capability of

  DLN 2.6+ combustor
  - Increased output
  - Improved efficiency

AGP installation and results



GT3-Serial Number: 298335, Tested in Combined Cycle on Natural Gas Fuel
Test Conducted On: 18-Dec-2018
The post AGP official test was conducted after 4580.7 hours accumulated since the end of AGP outage.

Parameter	Units	Pre	Post	Change	Target Delta	Tolerance	Achieve?
Generator Net Output	kW	173,875	196,772	13.17%	12.8%	±0.31%	Yes
Generator Net Heat Rate (LHV)	BTU/kWh	9,200.0	8,998.1	-2.2%	-2.7%	±0.65%	Yes

Issues/Lessons learned

- Permitting issues
  - Title V
    - Increases in Potential to Emit
    - BACT review
  - CEC Commission Decision
- Balance of Plant Impacts
  - Increased water usage
  - HRSG Pressure Limits
  - Steam Turbine flow restrictions
  - NERC/WECC Compliance

Frank Messineo
Burbank Power & Water

CITY OF BURBANK

WATER AND POWER

MAGNOLIA POWER PROJECT

ENHANCEMENTS

Presented by Frank Messineo, Power Production Manager

Background

- Southern California Public Power Authority project
- Six participant cities - Anaheim, Burbank, Cerritos, Colton, Glendale, Pasadena
- Combined cycle plant
  - ✓ GE Frame 7 combustion turbine (CT)
  - ✓ GE A14 steam turbine
- Commissioned in 2005 – baseload plant

Challenge

- Increase of renewables
  - ✓ Decreased need for baseload
  - ✓ Increased need for flexibility
- Operating range - 165 MW to 300 MW
- Ramp rate - 5 MW/min. up, 2.5 MW/min. down
- 5 starts per month

Solution

- GE CT Enhancements –
  - ✓ Overboard Bleed, March 2020
  - ✓ Axial Fuel Staging, 2021
    - New product
- Expected operating range - 91 MW to 300 MW, 74 MW of additional turndown
- Ramp rate – at least double
- Align with major maintenance to make enhancements cost effective

Matthew Zents
Southern California Edison

Southern California Edison's Hybrid Enhanced Gas Turbine Projects at Center Peaker and Grapeland Peaker

LOCATIONS

Grapeland Peaker Plant,
Rancho Cucamonga, CA

Center Peaker Plant, Norwalk, CA

In Service Date:

- Energy storage systems: December 30, 2016
- Control systems and upgrades: March 30, 2017

Matthew K. Zents, P.E.
Major Construction Project Manager
Generation Major Projects and Engineering
1515 Walnut Grove Avenue, Rosemead, CA 91770
T. 626-302-0334 | M. 714-474-1527 | matthew.zents@sce.com

Objectives and Results

Objective	Met / Not Met
Increased Market Services	Met
Increased Asset Utilization	Met
Increased Fuel Savings	Met
Decreased Maintenance	Not Met
Decreased Emissions	Met
Decreased Water Consumption	Met

Broader array of market services

Conventional peaker plants only provide energy dispatch and non-spin (NS) ancillary services in addition to serving resource adequacy needs for load serving entities. NS service can be provided by an offline resource for a capacity amount that it is fully deployable within 10 minutes. Because conventional peakers take less than 10 minutes to start up and reach full load, they are able to provide NS reserves throughout the year. However, there is a large fleet of resources which can provide such NS reserves, hence the value of NS services is very low in most independent system operator markets.

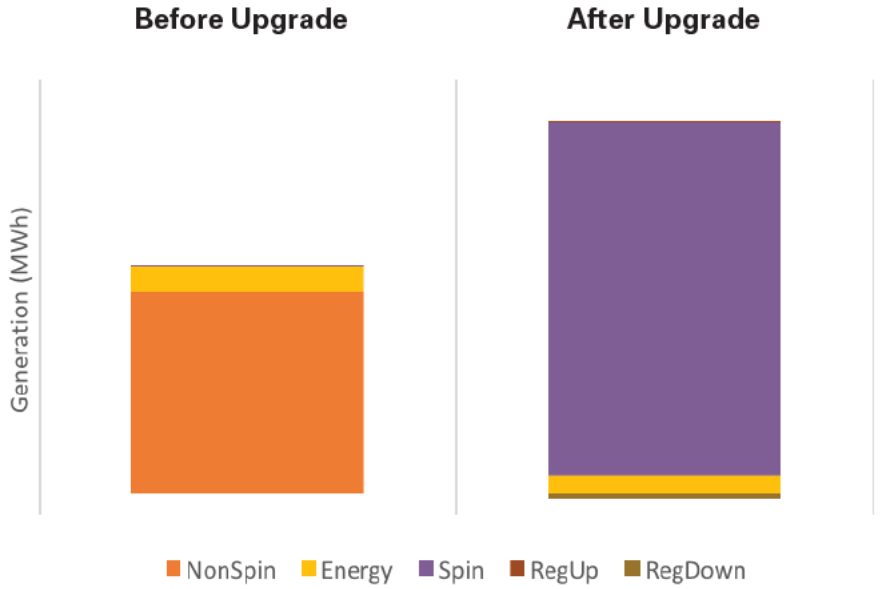
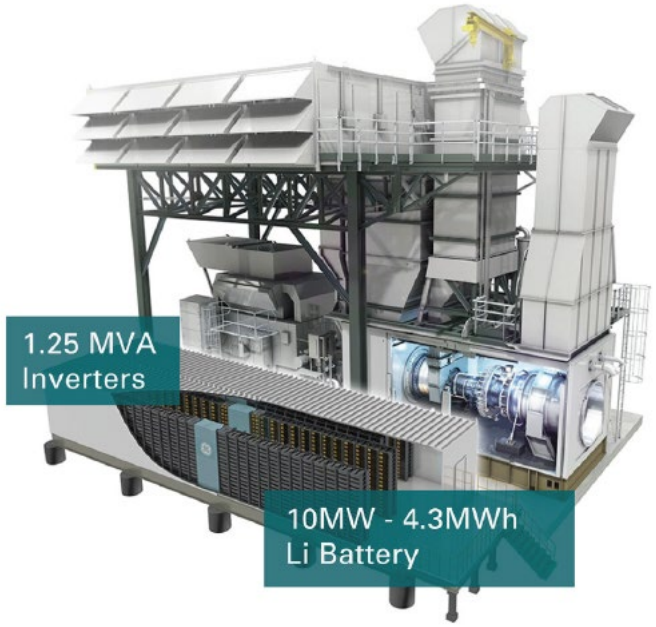


Figure 7: Historical Peaker Usage and Usage Forecast of Hybrid EGT (Annual Average)

Some Things We Didn’t Expect

- Frequency response to system disturbances draining the batteries
- Unusual dispatches
- Mismatch between SCE data and CAISO data resulting in Spin award “claw-back”



Panel 2

Opportunities, Challenges, and Process Modifications

- Barbara McBride, Calpine Corporation
- Jan Smutny-Jones, Independent Energy Producers Association
- Dennis Jang, Bay Area Air Quality Management District
- John Annicchiarico San Diego Air Pollution Control District
- Tom Jordan, San Joaquin Valley Air Pollution Control District
- Amir Dejbakhsh, South Coast Air Quality Management District
- Eric Knight, California Energy Commission
- Dawn Weisz, Marin Clean Energy
- Deb Le Vine, California Independent System Operator

Barbara McBride
Calpine Corporation

CEC Workshop

Efficiency Improvements to the Natural Gas Fleet for Electric System Reliability and Resiliency

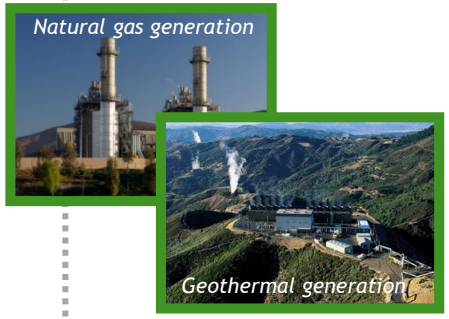
December 2, 2020

Calpine at a Glance

National generation portfolio of approximately 26,000 MW with diverse, complementary services platform

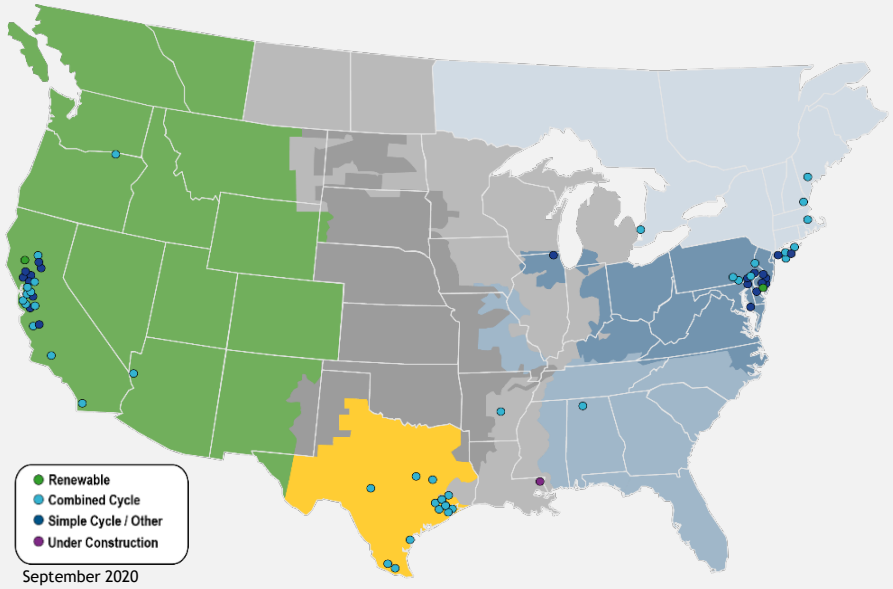
POWER GENERATION

Natural gas, geothermal & alternative technologies; best-in-class maintenance program



INFRASTRUCTURE DEVELOPMENT

Energy storage pipeline; since 2000, constructed more MW in CA than any other entity



September 2020

Serve customers in **24 states**, Canada and Mexico

Largest **geothermal** power producer in the world

More than **2,300** employees

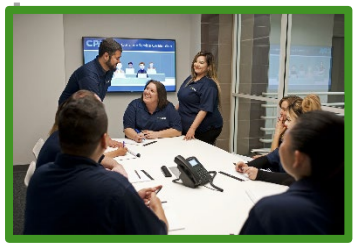
CHAMPION ENERGY SERVICES® CALPINE ENERGY SOLUTIONS North American Power®

RISK MANAGEMENT & ENERGY SERVICES

24 hour trade desk and expertise in load management

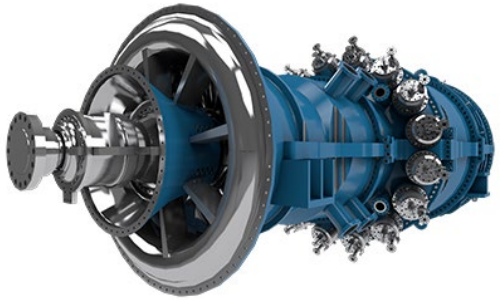
CCA DATA MANAGEMENT & CUSTOMER SERVICE

Data management and call center services



Potential Summer 2021 Incremental Capacity Evaluated

Combustion Turbine Upgrades
10-15 MW per Frame Turbine

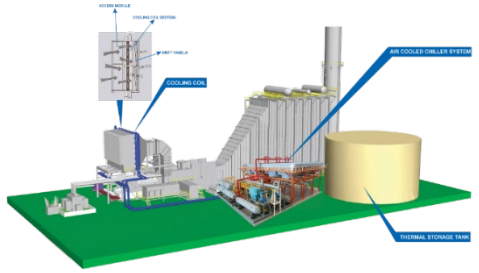


- Requires turbine parts retrofit to improve operations at increased temperatures and improve efficiency
- Requires Air District Authority to Construct
- Parts Procurement by December 2020 to meet Summer 2021 operation

Peak Firing
2 -5 MW per Turbine

- Requires software upgrade
- Increase firing temperature on Frame and Aeroderivative turbines
- Intermittent peaking capacity for grid reliability
- Dramatically Increases maintenance costs

Chillers
10 - 15 MW per Frame Turbine at high temps



- Mechanical Turbine inlet air cooling
- Increased Parasitic load
- Additional water required
- Engineering/procurement at minimum 18 months
- Not very cost effective as most facilities already have fogging

Air Cooled Condenser Spray
2 -2.5 MW per Steam Turbine

- Only applicable to 2 ACC Units in California
- Requires additional treated water use

Incremental summer capacity of ~95 MW by June 2021 at existing facilities

Delta

- 880 MW, 3 x 1 configuration
- Combustion Turbine Upgrades and
- Peak firing upgrades
- Incremental Capacity 40.5MW

Pastoria

- 750 MW, 3 x 2 configuration
- Peak firing upgrades
- Incremental Capacity 10.5MW

Metcalf

- 600 MW, 2 x 1 configuration
- Combustion Turbine Upgrades or
- Peak firing upgrades
- Incremental Capacity up to 30MW

Peakers

- 487 MW, LM6000 Peakers
- Throttle Push upgrades
- Incremental Capacity 13.6MW

Where are we for Summer 2021 upgrades?

- ✓ Identify opportunities to upgrade existing facilities for an additional ~95 MW
- ✓ Approval for upgrades under existing licenses from CEC
- ✓ No interconnection or transmission upgrades needed at identified sites
- ✓ Confirmed vendor and equipment availability to execute upgrades in Spring 2021
- ● Submitted permit applications to Air Districts
- ● Coordination and approval from CAISO to schedule and extend planned outages
- ? *Contract to support upgrade capital investment*

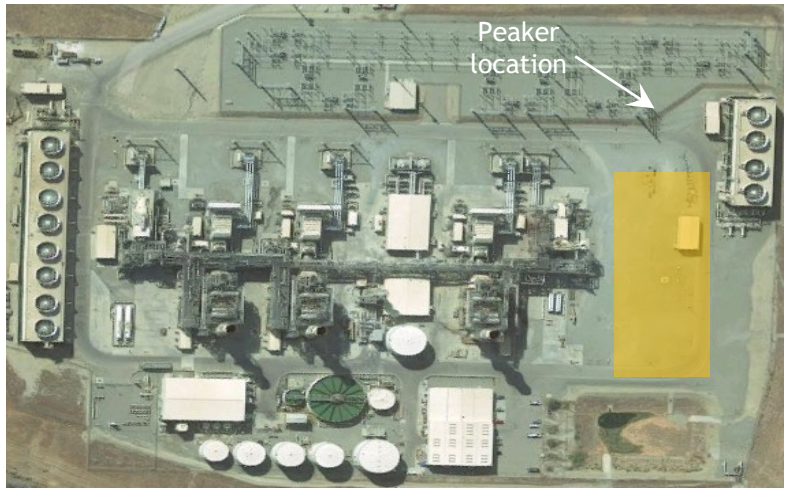



Note: Upgrades work is subject to labor availability due to COVID labor constraints, and CAISO allowance for outages.

Pastoria Energy Facility: New Unit ~200 MW Additional Capacity by Summer 2024 - *Subject to Procurement*

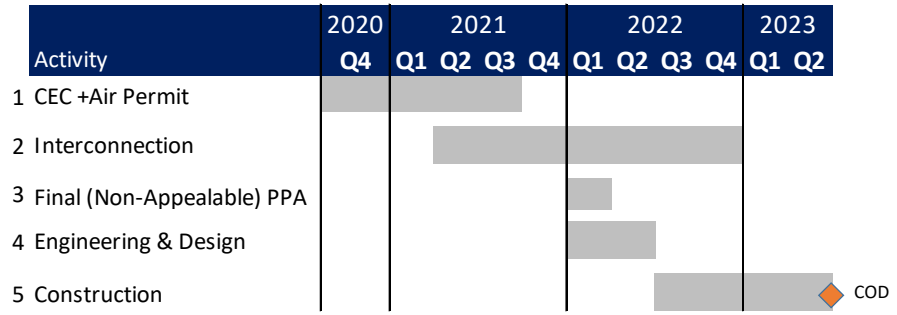
Facility Overview

- SP15 Local Resource
- Previously entitled (docket #: 05-AFC-01); Expired 2011 so new application required
- NOT a disadvantaged community under SB535 in Cal Enviroscreen 3.0
- Additional Emission Reduction Credits not required
- Land available within existing footprint of Pastoria facility
- Existing switchyard capacity
- Adequate gas supply established (provided by either Kern or SoCal Gas)
- Need term contract to construct facility



Permitting

- Full Application required for CEC review
- NSR Permit required with SJVUAPCD
- Permit fees:$550,000



Jan Smutny-Jones
Independent Energy Producers Association

Dennis Jang
Bay Area Air Quality Management District

John Annicchiarico
San Diego
Air Pollution Control District

Incremental Efficiency Improvement Permitting

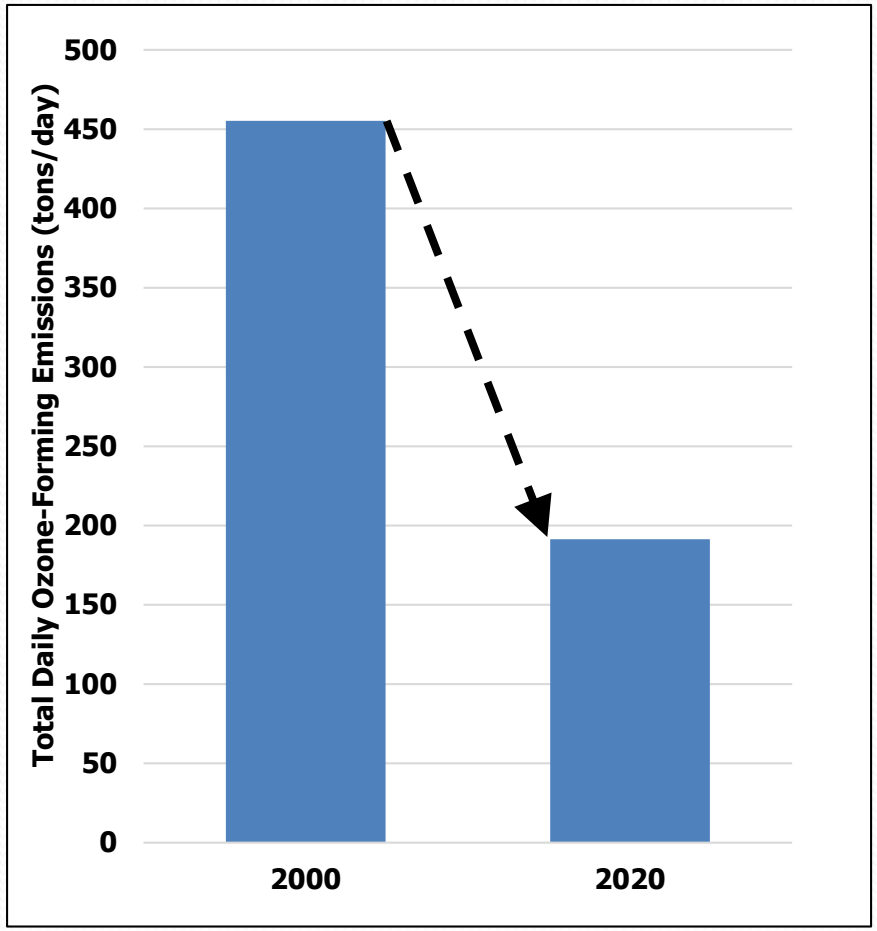
Presented by
John Annicchiarico, Senior Engineer
December 2, 2020

What We Do

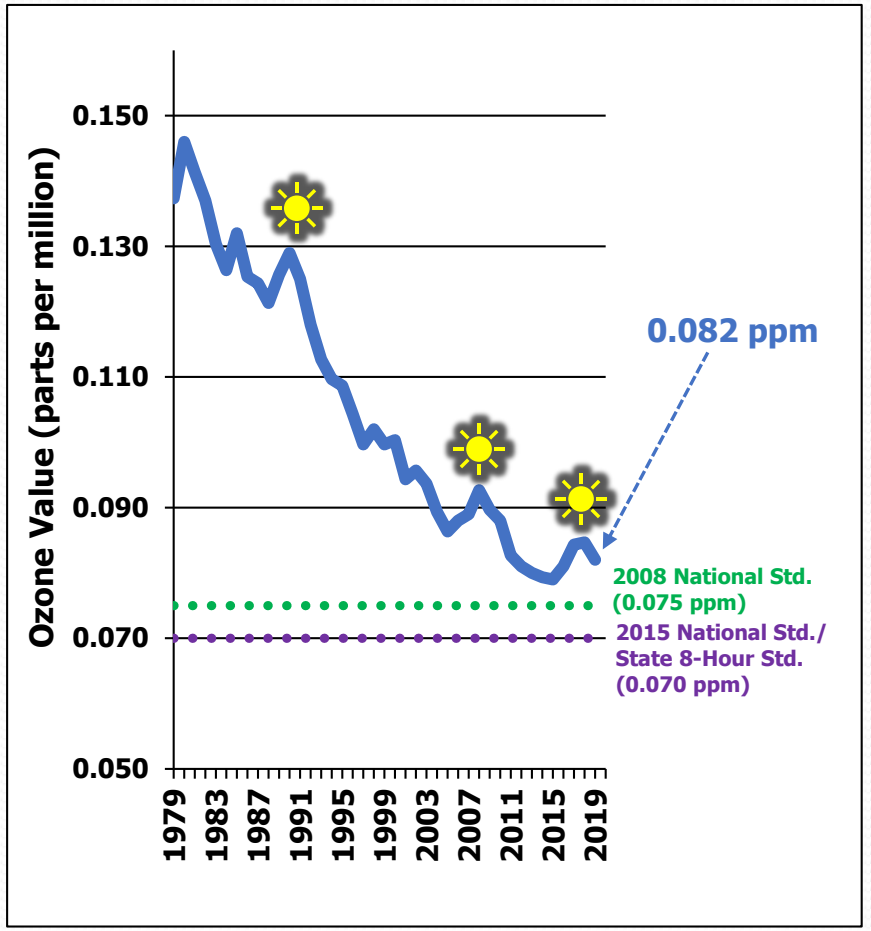
- Protect the public from harmful effects of air pollution
- Achieve & maintain air quality standards
- Foster community involvement
- Cost effective programs to meet air quality mandates

APCD
AIR POLLUTION CONTROL DISTRICT
COUNTY OF SAN DIEGO

Ozone Forming Emissions Decreasing



Ambient Ozone Levels Decreasing



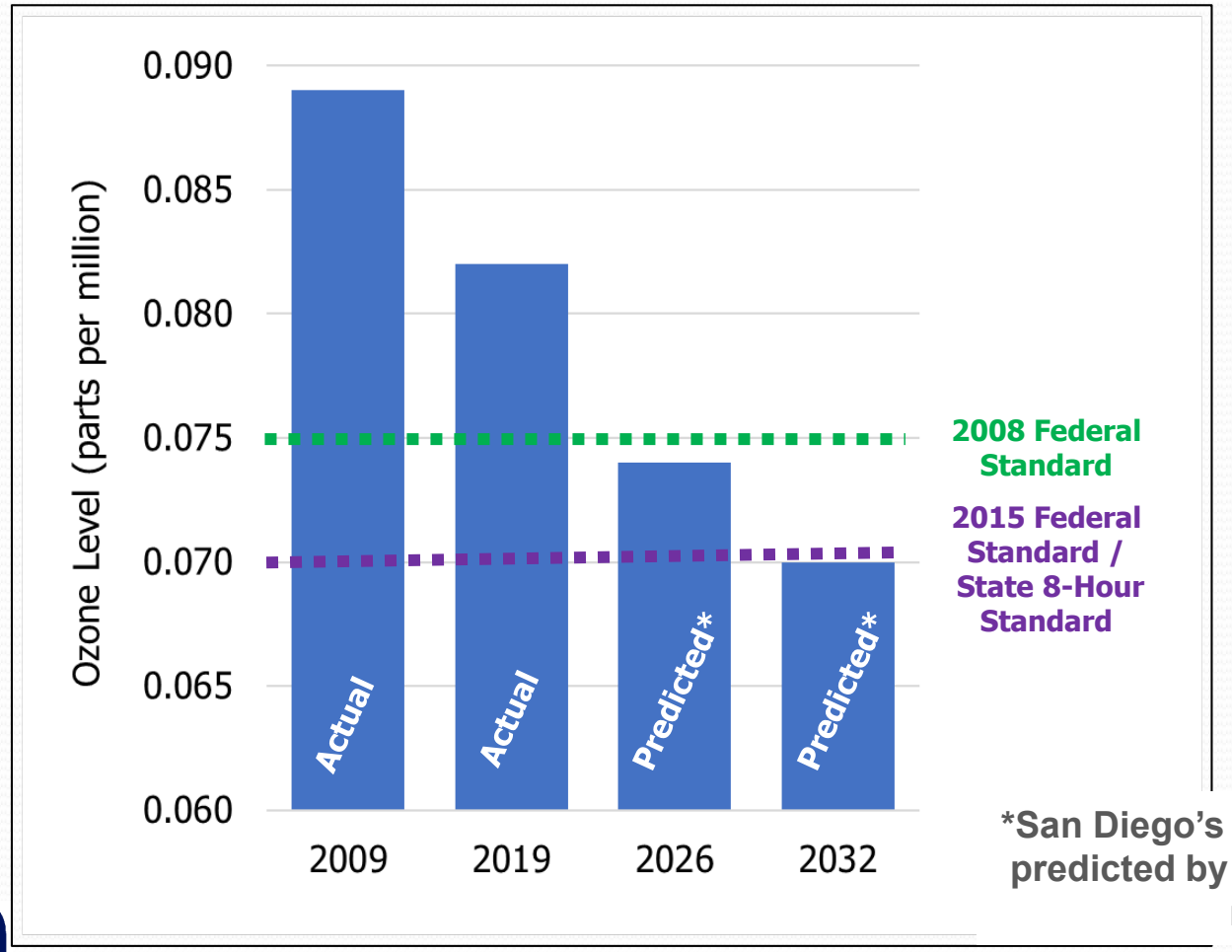
APCD
AIR POLLUTION CONTROL DISTRICT
COUNTY OF SAN DIEGO

Region's Attainment Status

Applicable Pollutant	Federal Designation	State Designation
Ozone (8-hour)	Non-Attainment	Non-Attainment
Carbon Monoxide	Attainment	Attainment
PM10	Unclassifiable *	Non-Attainment
PM2.5	Attainment	Non-Attainment
Nitrogen Dioxide	Attainment	Attainment
Sulfur Dioxide	Attainment	Attainment
Lead	Attainment	Attainment
Sulfites	No Standard	Attainment
Hydrogen Sulfide	No Standard	Unclassified
Visibility	No Standard	Unclassified

APCD
AIR POLLUTION CONTROL DISTRICT
COUNTY OF SAN DIEGO

When Will the Region Attain Ozone Standards?



*San Diego's future ozone levels predicted by CARB's air quality model

APCD
AIR POLLUTION CONTROL DISTRICT
COUNTY OF SAN DIEGO

District Permitting

- Forty five (45) Permitted Turbine Plants
- Range from 1 to over 600 MW
- 2475 MW under Permits

APCD
AIR POLLUTION CONTROL DISTRICT
COUNTY OF SAN DIEGO

Advanced Gas Path Permitting Examples

Example #1

- Increase Turbine Firing Temperature
- No Increase In Firing Rate
  - No Increase Above Permitted Energy Output
  - No Increase In Emissions
- Four Month Approval Process

Example #2

- Increase Firing Rate and Electrical Output
  - No Increase in NOx, CO, VOC, Above Permitted Levels
  - Increase in SOx
- Significant Modification to Title V Permit
  - Voluntary Limits to Avoid Permitting Thresholds
- 15 Month Approval Process

APCD
AIR POLLUTION CONTROL DISTRICT
COUNTY OF SAN DIEGO

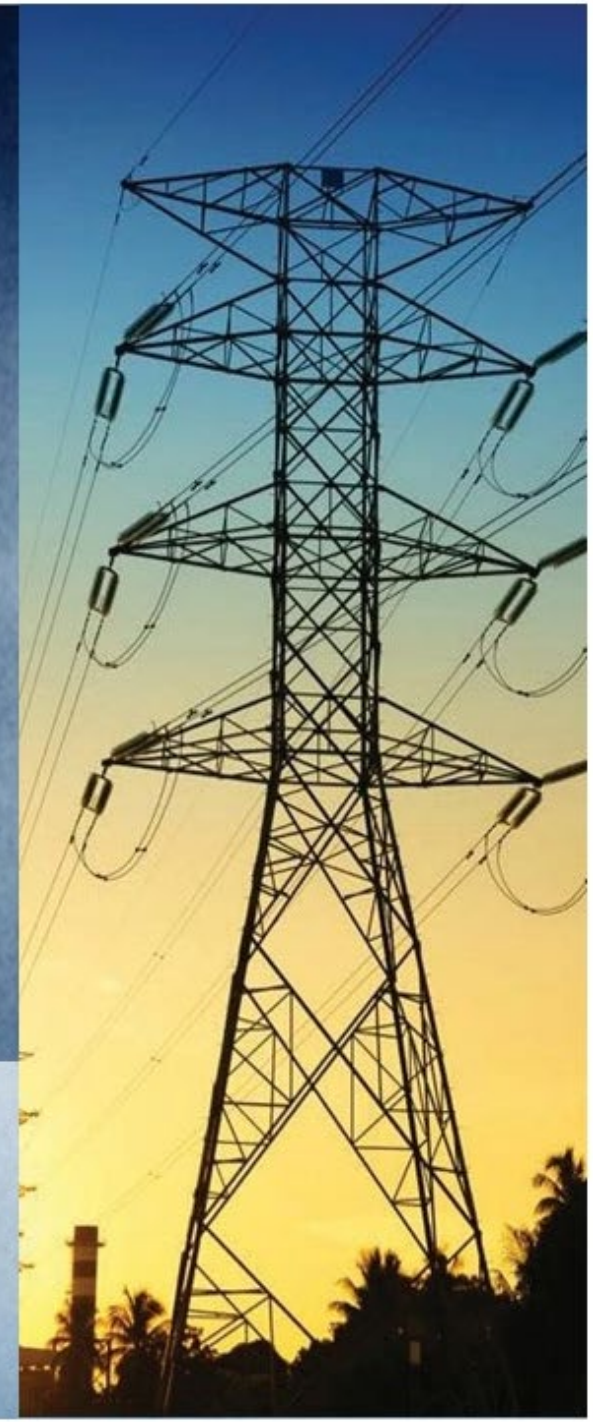
Tom Jordan
San Joaquin Valley Air Pollution Control District

Amir Dejbakhsh
South Coast Air Quality Management District

Incremental Efficiency Improvements to the Natural Gas Power Plant Fleet for Electric System Reliability and Resiliency

California Energy Commission
Lead Commissioner Workshop

December 2, 2020



Amir Dejbakhsh
Deputy Executive Officer
Office of Engineering & Permitting
South Coast Air Quality Management District

What is South Coast AQMD?

- One of 35 Air Districts in California
- Jurisdiction: non-desert portion of Los Angeles, Riverside & San Bernardino Counties and all of Orange County
- Population of 16..4 million (about half of California State's population)
- Area of 10,7.43 mi^2
- Regulate 27,000 facilities, including 360 Major Sources
- Worst air quality in the U.S. (Ozone & PM 2.5)
- Total Number of Power Plants: 33
- Total Power Plant Output Capacity: > than 12,000 MW

South Coast AQMD

General Power Plant Permitting Process at South Coast AQMD

- Co-Air Permitting Authority with California Energy Commission (CEC) for Power Plants 50 MWs or larger
- Air Permitting Authority for all Power Plants within South Coast AQMD
  - Title V Permit Program - facilities that are Major Stationary Sources of Toxic and Criteria Pollutants and/or subject to Acid Rain, New Source Performance Standards (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations
  - REgional Clean Air Incentives Market (RECLAIM) Program - facilities with Oxides of Nitrogen (NOx) and Oxides of Sulfur (SOx) emissions greater than .4tons/year
  - Majority of Power Plants are subject to both Title V and RECLAIM program requirements

South Coast AQMD

South Coast AQMD Determination of Compliance (DOC) & Permitting Process for Power Plants

In order for South Coast AQMD to propose a preliminary or final DOC or a grant a Permit (new construction or modification), project must meet specific requirements:

- CEQA Determination
- New Source Review for Criteria Emissions - BACT/LAER, Modeling, Emission Offsets
- New Source Review for Toxics - Cancer and Non-Cancer risk analysis
- Prevention of Significant Deterioration for Criteria Emissions
- Federal Regulations (NSPS/NESHAP)
- Public Notice / Public Comments / US EPA Review
- Other requirements (i.e., continuous monitoring, emission testing, record keeping and reporting)

South Coast AQMD

Permitting Challenges

- Complexity of Regulations
- Review by Other Agencies
- Public Participation

For further information please contact:

Amir Dejbakhsh
Deputy Executive Officer
Office of Engineering & Permitting
South Coast AQMD
Phone: (909)-396-2618
Email: Adejbakhsh@aqmd.gov

Thomas Liebel
Senior Engineering Manager
Office of Engineering & Permitting
South Coast AQMD
Phone: (909) 396-255.4
Email: Tliebel@aqmd.gov

Eric Knight
California Energy Commission

California Energy Commission

Title: Processing Efficiency Improvements to CEC Certified Natural Gas Power Plants

Presenter: Eric Knight, STEP Environmental Office Manager

Date: December 2, 2020

Change in Design, Operation, or Performance Requirements?

Yes. Submittal of post-certification petition required:

- Complete description of the change
- Environmental effects and any needed mitigation
- Compliance with laws, ordinances, regulations & standards (LORS)

No. Petition not required. Staff issues authorization letter:

- Limited to proposed scope of activities
- Conditions of certification must be followed
- Delegate Chief Building Official review may be required

Petition – Two Paths to Approval

Staff Approval

- No possibility the change will cause a significant environmental effect, or change is exempt from CEQA
- Project will continue to comply with applicable LORS
- Project change will not require changes to conditions of certification
  - ONE EXCEPTION: Staff can approve changes to air quality conditions of certification that DO NOT increase daily, quarterly, annual or other emission limits.

Commission Approval

- Criteria for staff approval not met:
  - Changes to conditions of certification required to ensure no significant environmental effects or LORS noncompliance
- Objection to staff's approval
  - Must be filed within 14 days and must be supported by facts

Timeframes

- "Non-petitions" – authorized within 1-2 weeks after receipt of questionnaire

- Petitions – 30 to 90 days
  - Staff Approved – 14-day public comment period
  - Commission Approved – 10-day to 30-day public notice
    - Scheduling factors (Business Meetings typically held only once per month; internal meeting deadlines)

Technical Assistance

CEC has expertise in environmental review/permitting, facility design and engineering, and land use/local government planning and coordination. CEC could assist local and state agencies with permitting of generation and transmission resources. This could include:

- Making environmental information available and providing technical assistance to local agencies.
- Helping local agencies perform complex environmental analysis and devise mitigation strategies in areas where they do not have expertise.
- Providing personnel to expedite CEQA analyses and complete required environmental documents.

Dawn Weisz
Marin Clean Energy

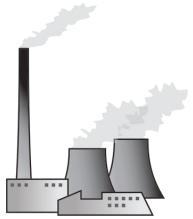
MCE

A local, not-for-profit electricity provider

SB 100: The Vision for California's Clean Energy Future

Add Renewables ✓

Add Storage ✓



What is the pathway for CA's natural gas fleet? ?

CA GAS Fleet

180
Operating gas power plants in CAISO[1]

~50%
Gas plants are based in disadvantaged communities [2]

- Today, California depends on natural gas resources for certain critical grid reliability services.
- How can California transition to clean reliability sources?

0
Zero electricity (kWh) and zero power (kW) from natural gas

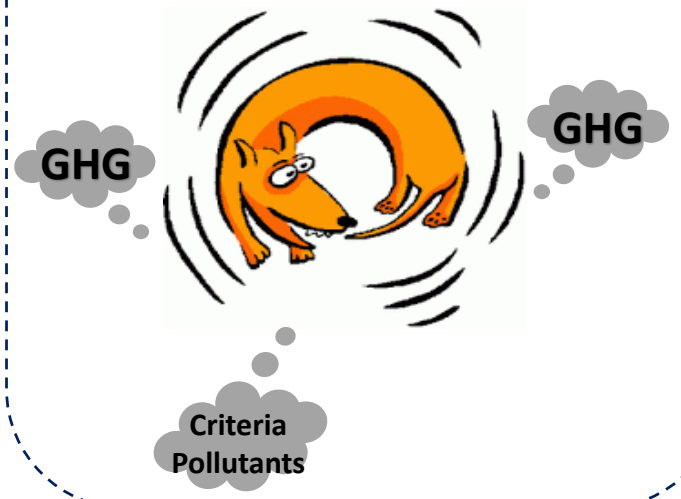
2018 — **2045**

GHG (+ to −)

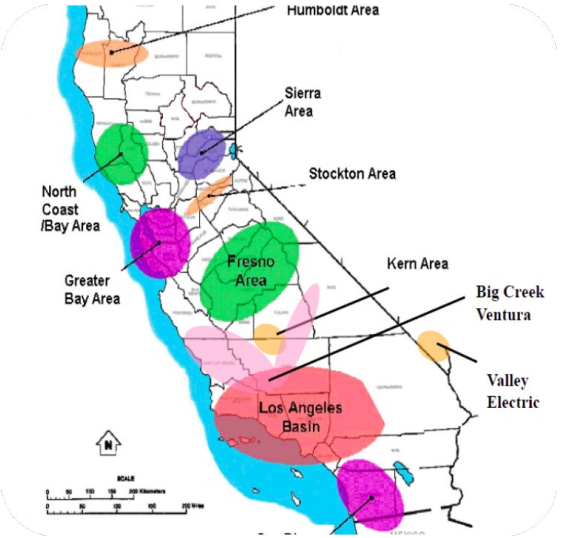
[1]: Based on plants included in the CAISO NQC List as of August 2018.
[2]: Approximate based on count of plants located in areas with a CalEnviroScreen within the top 30th percentile.

Opportunities and Challenges for the Gas Fleet

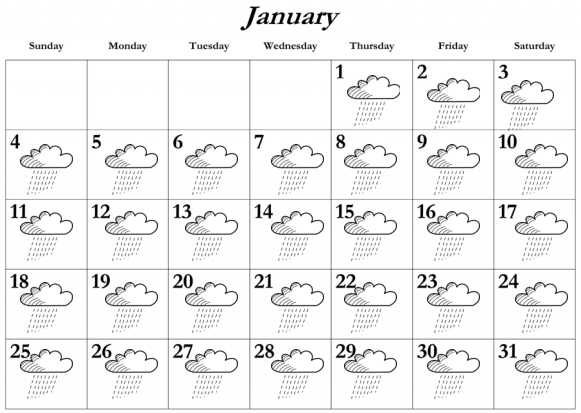
Adding renewables can require more reserves and ramping from existing gas plants, increasing local pollutants & causing diminishing returns on GHG reduction



Local grid constraints require large amounts of generation in urban areas where it's hard to site new resources



Extended cloudy, windless days can put reliability at risk at high renewable energy penetration levels



Process Improvement: Add storage to existing gas plants

1 Hybrid
10 MW/5 MWh battery added to 50 MW existing gas peaker

=

- Eliminates 15,000 - 30,000 tons GHG annually
- Allows more flexibility for renewables to generate reserves

---

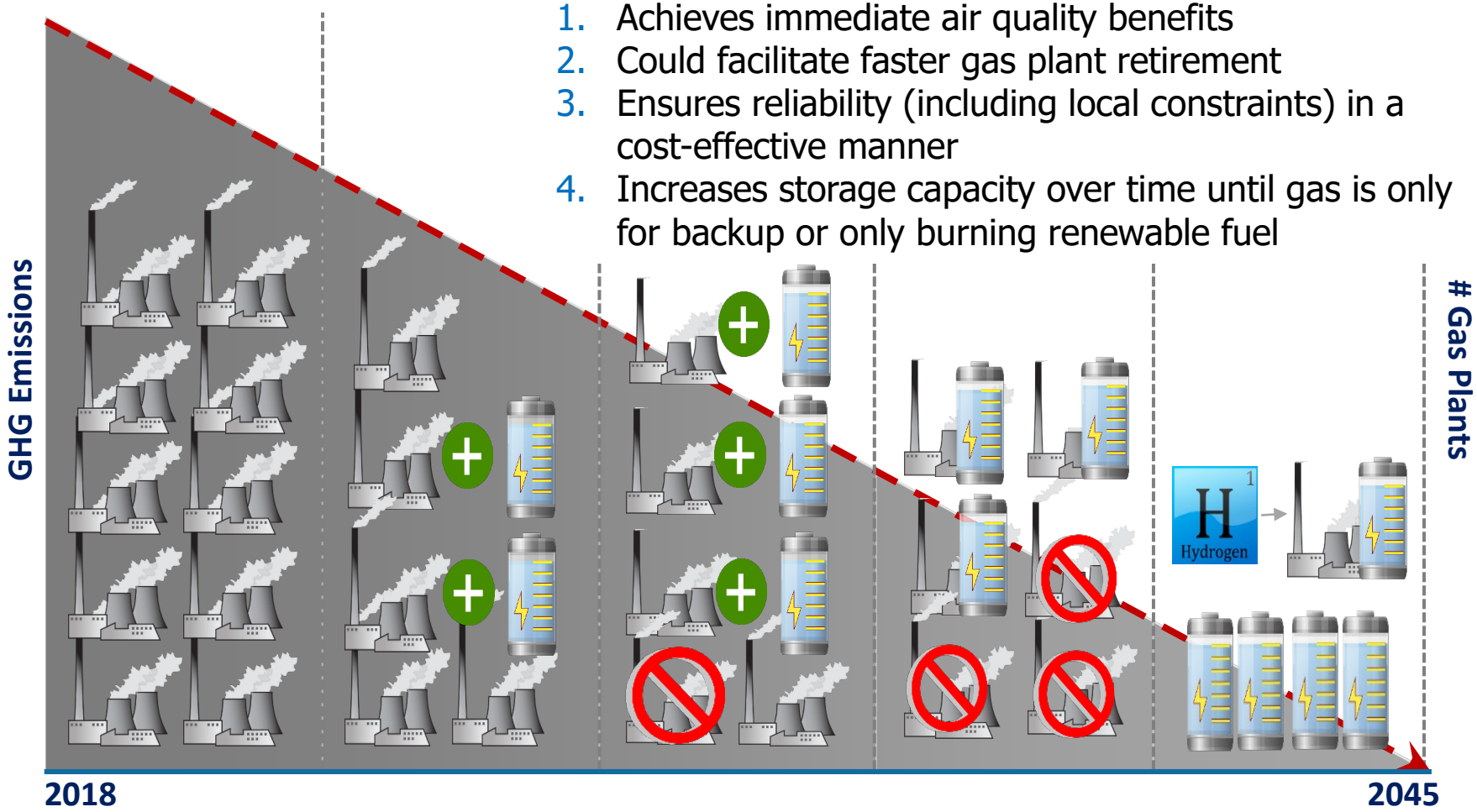
22 Hybrids
460 MW of batteries installed on 4,500 MW existing plants

=

- Eliminates 50% unit starts fleetwide
- Immediate air quality benefits
- Allows retirement of 5,500 MW gas plants (increased flexibility enables retirement)

A Potential Roadmap to Zero Carbon by 2045 … While Ensuring Reliability

1. Achieves immediate air quality benefits
2. Could facilitate faster gas plant retirement
3. Ensures reliability (including local constraints) in a cost-effective manner
4. Increases storage capacity over time until gas is only for backup or only burning renewable fuel



Deb Le Vine
CA Independent System Operator

CEC Workshop: Improvements to the Existing Natural Gas Fleet for Electric System Reliability and Resiliency

Deb Le Vine
Director, Infrastructure Contacts & Management

December 2, 2020

August 2020 Heat Storm

- August 14 and 15 power outages
- Temperatures 10 – 20 degrees above normal
  - 4 out of the 5 hottest August days since 1985
- Extreme heat impacts both demand and supply
  - Demand was high throughout the 24 hour period versus the general cooling at night
  - Thermal generation operates less efficiently
  - Imports decreased due to west-wide heat event
  - Numerous fires threatened loss of major transmission

Events of the Days

- August 14
  - 6:38 pm reserves fell below minimum 6% requirement
  - CAISO initiated rotating outages – 492,000 customers impacted for 15 – 150 minutes
  - 6:51 pm net demand peak
- August 15
  - 6:28 pm reserves fell below minimum 6% requirement
  - CAISO initiated rotating outages – 321,000 customers impacted for 8 – 90 minutes
  - 6:28 pm net demand peak

Opportunities to Assist in the Coming Summers

- CAISO emergency measures during heat storm to allow operation above PMax
  - Process
  - Challenges
  - Lessons learned
- Impact of proposed improvements
- Improve contingency planning with the CEC, CPUC and Governor's office
- Continue to pursue market enhancements and new resources to augment the loss of solar and wind at net peak demand

Public Comment Instructions

Rules
- 3 minutes per person
- 1 person per organization

Zoom
- Click “raise hand”

Telephone
- Press *9 to raise hand
- Press *6 to (un)mute

When called upon
- Zoom hosts will open your line
- Unmute, spell name and state affiliation, if any, for the record, then begin your comments

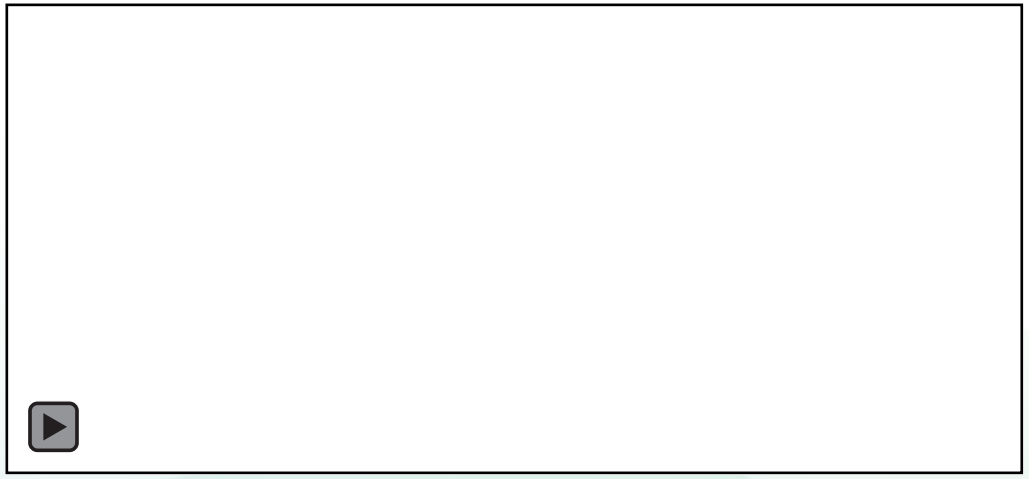
Written Comments:

Due December 16, 2020 by 5:00 pm (PST)

Visit: https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=20-SIT-01

- Click: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-SIT-01

3-MINUTE TIMER



December 2, 2020

Lead Commissioner Workshop on Incremental Efficiency Improvements to The Natural Gas Powerplant Fleet for Electric System Reliability and Resiliency

Morning Session has ended

Afternoon Session begins at 1:30 pm (PST)

https://energy.zoom.us/j/93781267870?pwd=YkI1MFZ0TC9uanVaSUxsWm9rcFpvQT09.

Phone: +1 (669) 219-2599 or (877) 853-5257 (Toll Free)

Meeting ID: 937 8126 7870. **Meeting password:** 296858.