RESILIENTPOWER

A project of CleanEnergyGroup

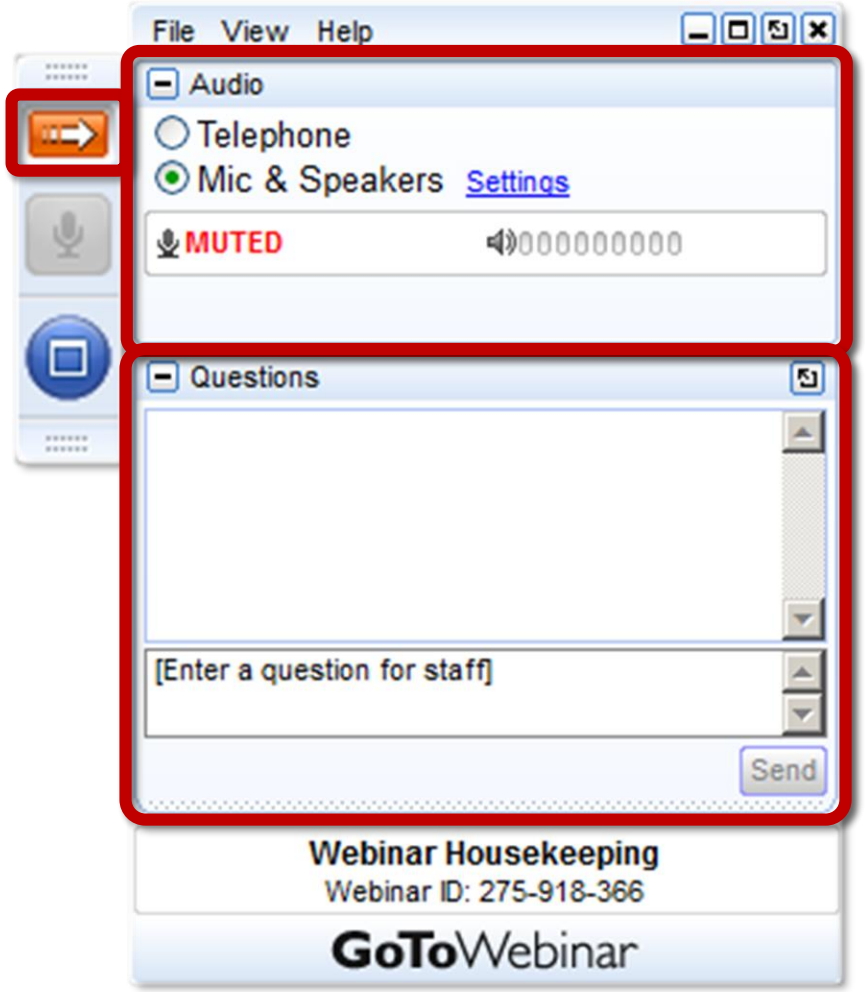
Replacing Peaker Plants with Battery Storage

CleanEnergyGroup

Innovation in Finance, Technology & Policy

July 19, 2018

HOUSEKEEPING



Use the orange arrow to open and close your control panel

Join audio:

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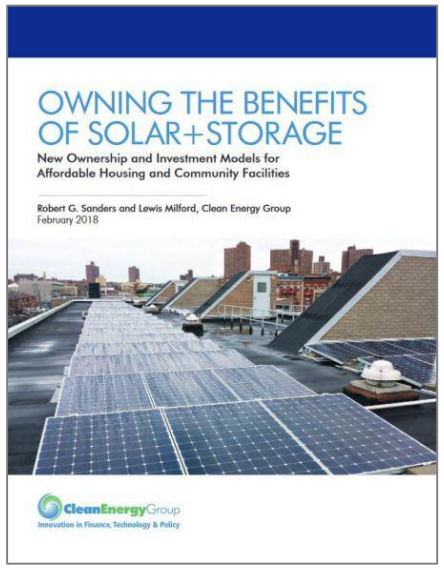
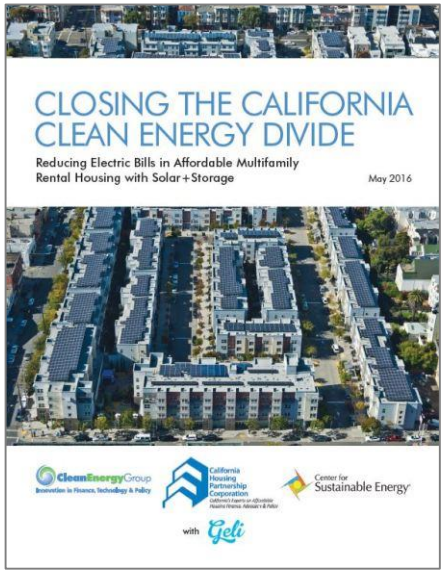
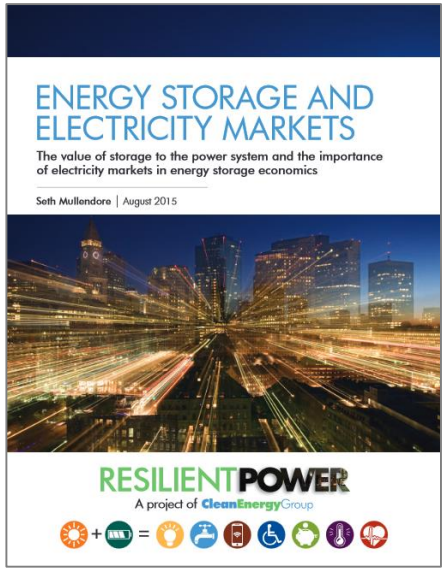
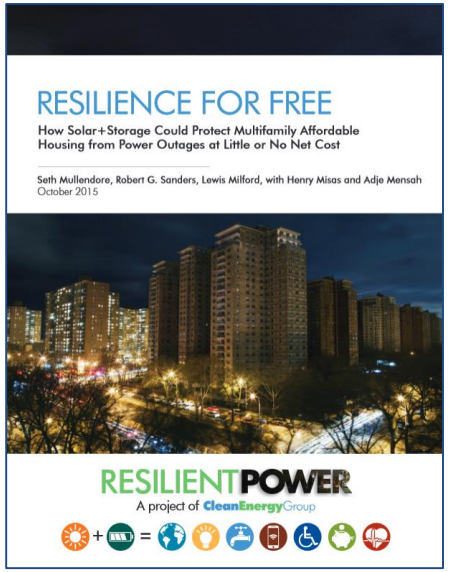
THE RESILIENT POWER PROJECT

- Increase public/private investment in clean, resilient power systems (solar+storage)
- Protect low-income and vulnerable communities, with a focus on affordable housing and critical public facilities
- Engage city, state and federal policy makers to develop supportive policies and programs









SUPPORTING 100+ PROJECTS ACROSS THE COUNTRY

Portland: Assessment of 10 LMI properties including affordable housing, foodbanks, medical centers, and shelters

Boston Medical Center: One of the first hospitals in the country to install storage for resiliency

DC: Largest solar+storage installation at affordable housing in the country

Puerto Rico: Supporting the installation of solar+storage at more than 60 medical clinics

California: Multiple housing properties representing hundreds of units of affordable housing

Resilient Power in Practice: Lessons Learned from the Field

Webinar Speakers

- **Elena Krieger,** Director, Clean Energy Program, PSE Healthy Energy
- **Lucas Zucker,** Policy and Communications Director, Central Coast Alliance United for a Sustainable Economy (CAUSE)
- **Seth Mullendore,** Vice President & Project Director, Clean Energy Group

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Peaker Plants
vs.
Battery Storage

Seth Mullendore, Vice President/Project Director
Clean Energy Group

July 19, 2018

WHAT IS A PEAKER PLANT?

Run during periods of **high electricity demand**

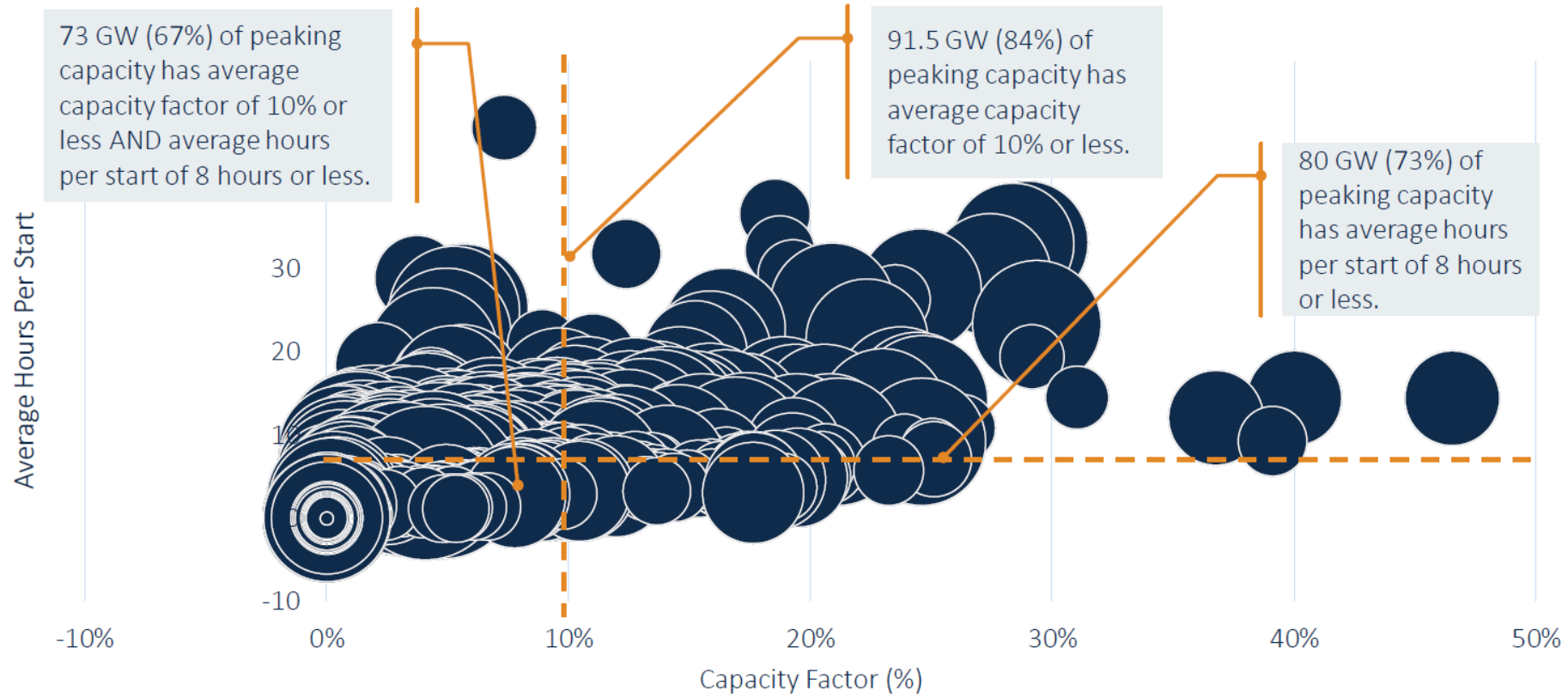
Less efficient (worse emissions)

Located **closer to population centers**

Low capacity factor (< 10%)

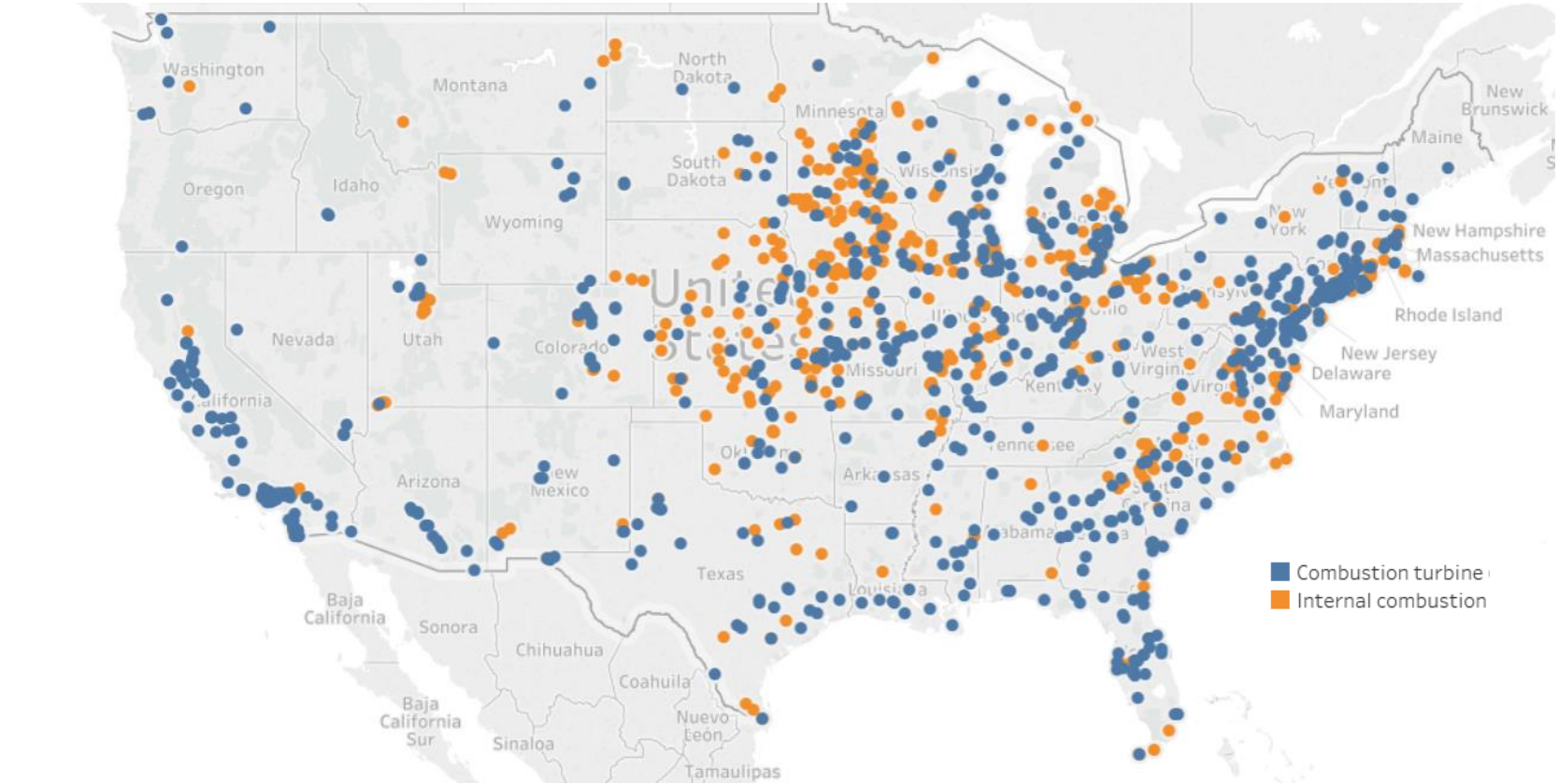
Only **operate for a few hours** at a time

120 GW OF PEAKERS IN THE U.S.



Source: Wood Mackenzie based on EIA

PEAKERS IN THE U.S.



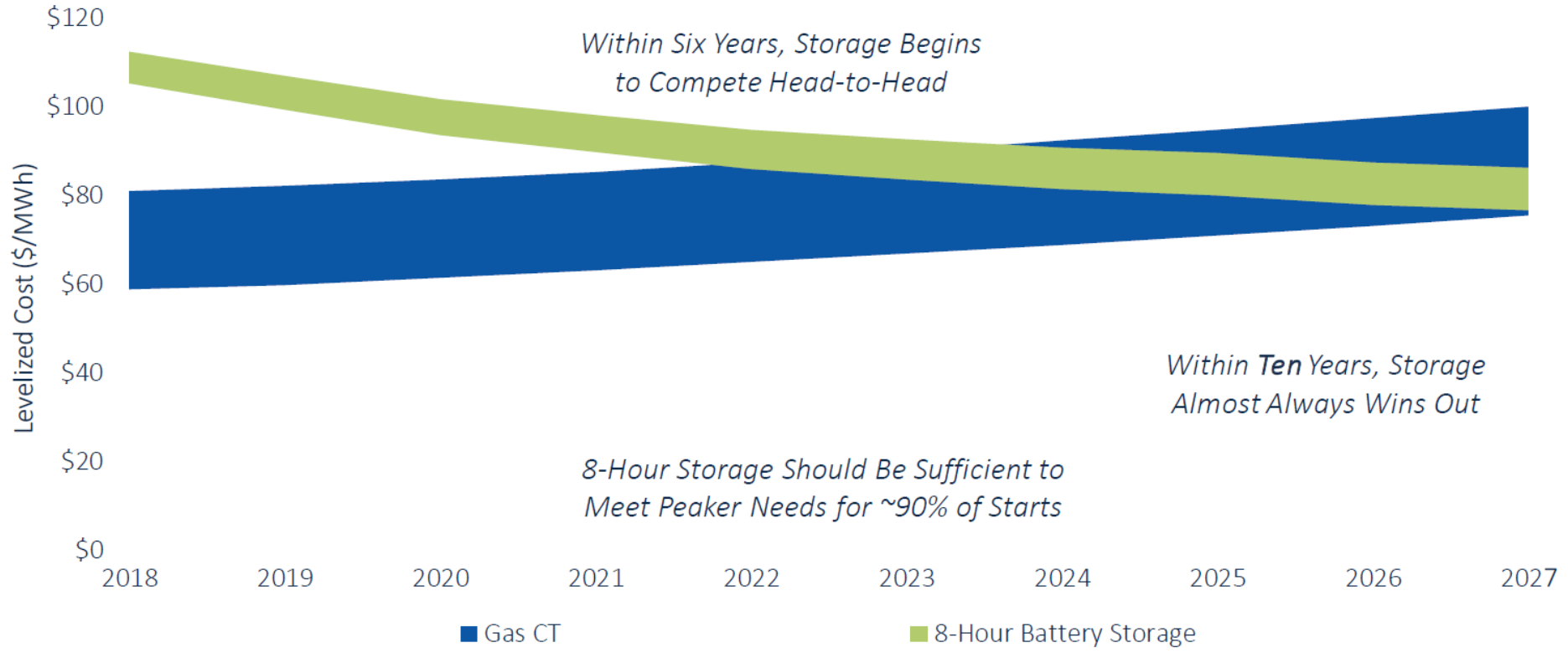
Source: U.S. Energy Information Administration Form 923 Schedule 3B (2016)

TECHNOLOGY: PEAKERS VS STORAGE

“We could replace every gas peaker in the U.S. with batteries right now if we wanted to, but it probably wouldn’t make economic sense everywhere.”

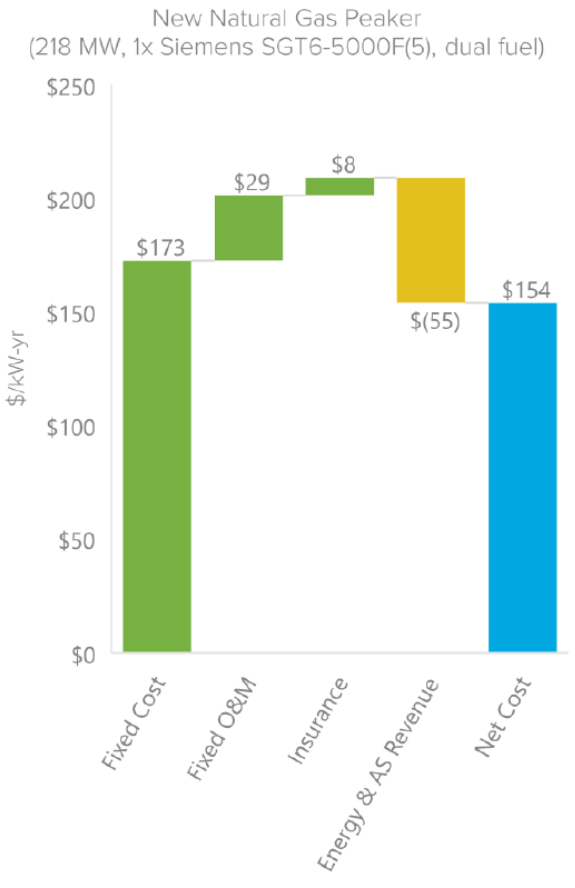
Abe Silverman, vice president for the regulatory affairs group and deputy general counsel at NRG Energy (GTM Forum: Energy Storage vs. Gas, May 2018)

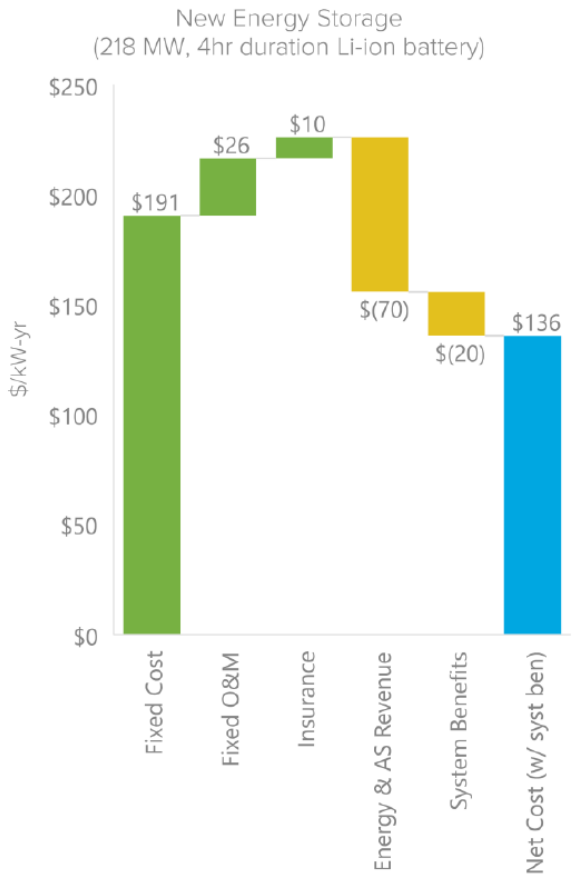
ECONOMICS: PEAKERS VS STORAGE



Source: GTM Research, Wood Mackenzie

ECONOMICS: NEW YORK CITY





Nearly **3 GW** of aging peakers approaching retirement

Highly **constrained area**

Air pollution represents a major public health problem

Source: Strategen Consulting ,*New York City's Aging Power Plants: Risks, Replacement Options, and the Role of Energy Storage*

BATTERY PEAKER PROJECTS:

ARIZONA PUBLIC SERVICE

First Solar Made Good on Its Promise to Beat Out Gas Peakers With Solar and Batteries

A 50-megawatt battery will give Arizona peak power from the sun.

- 50-MW / 135-MWh battery, 65-MW solar
- 15-year PPA with First Solar
- Request for proposal open to any technology
- Proposals had to deliver power between 3 pm and 8 pm in the summer

BATTERY PEAKER PROJECTS:

SALT RIVER PROJECT

Arizona Is Getting Its First Standalone Battery Peaker

The Salt River Project's new battery system will charge up on existing energy sources to serve the Phoenix metropolitan area.

- 10-MW / 40-MWh battery
- 20-year PPA with AES
- Peaking capacity for the Phoenix metropolitan area
- Sited near population center

BATTERY PEAKER PROJECTS:

PACIFIC GAS & ELECTRIC

PG&E to replace 3 gas plants with world's biggest battery projects

- 4 proposed battery storage projects, more than 2 GWh
- Built to eliminate need for 3 gas peaker plants with reliability must-run contracts in constrained area

BATTERY PEAKER PROJECTS:

NEVADA ENERGY

Breaking Down the Numbers for Nevada's Super-Cheap Solar-Plus-Storage

- ***Battle Mountain***:
  - 25-MW / 100-MWh battery, 101-MW solar
  - LCOE = $30.94/MWh, Capacity = $93/kW-year
- ***Dodge Flat***:
  - 50-MW / 200-MWh battery, 200-MW solar
  - LCOE = $34.87/MWh, Capacity = $73/kW-year

FOR MORE INFORMATION

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www.resilient-power.org

PSE
Bringing science to energy policy

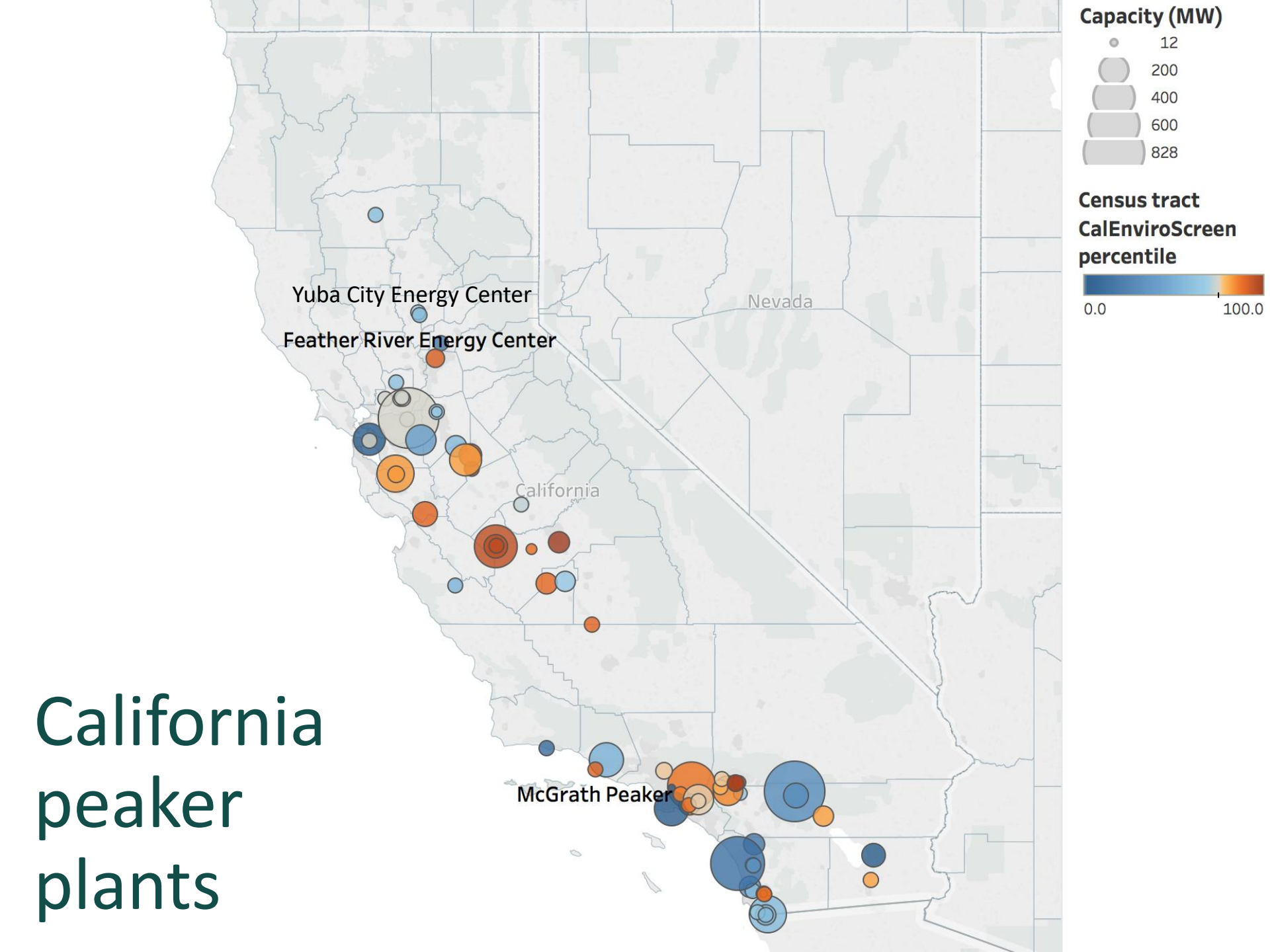
Using health, environment and equity metrics to target peaker replacement

Elena Krieger, PhD
Director, Clean Energy Program
PSE Healthy Energy

Clean Energy Group Webinar
July 19, 2018

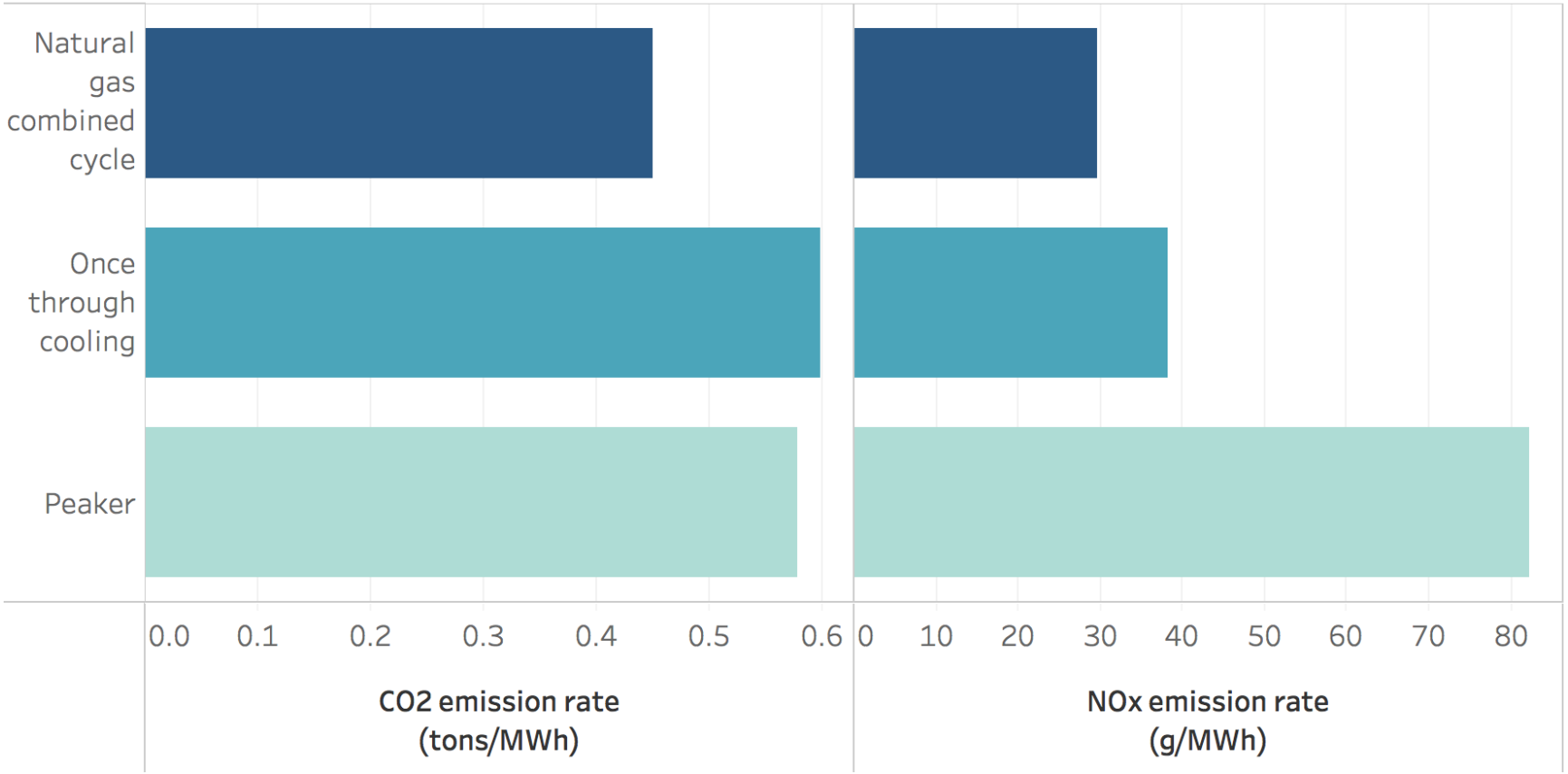
Health, environment and equity considerations for targeting peakers for storage replacement

- **Emissions:** which plants have highest carbon dioxide and nitrogen oxide emissions per MWh?
- **Background air quality:** is the plant operating on days with high air pollution?
- **Demographics:** how many people live nearby and is the plant located in a vulnerable or environmentally overburdened community?
- **Grid constraints:** does local clean energy deployment affect local grid need for the peaker?



California peaker plants

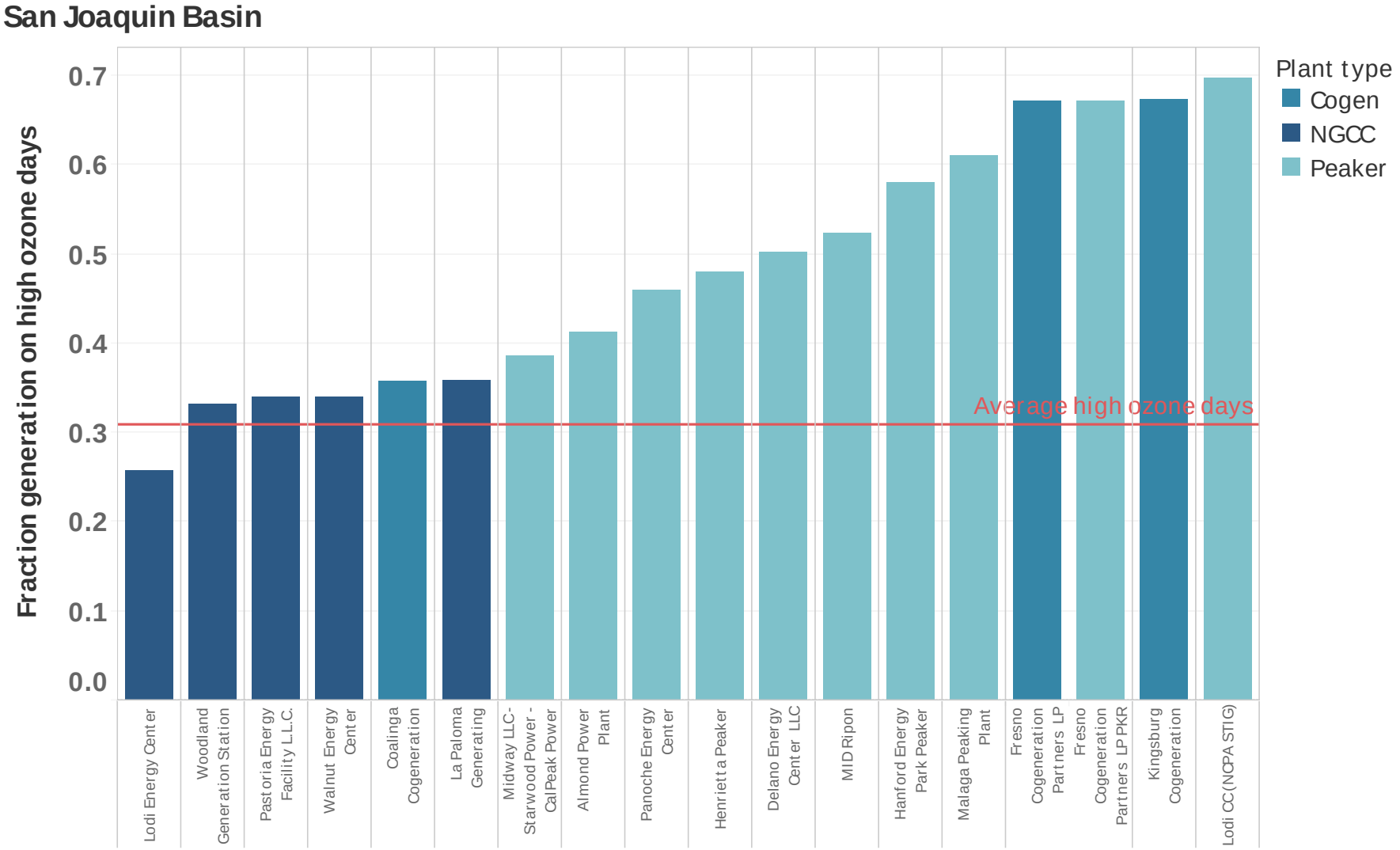
Gas peaker emission rates higher than combined cycle plants



- Nitrogen oxide (NOx) emissions contribute to the formation of air pollutants like ozone and particulate matter.
- High peaker emissions due to lower efficiency, larger proportion of start-up time.

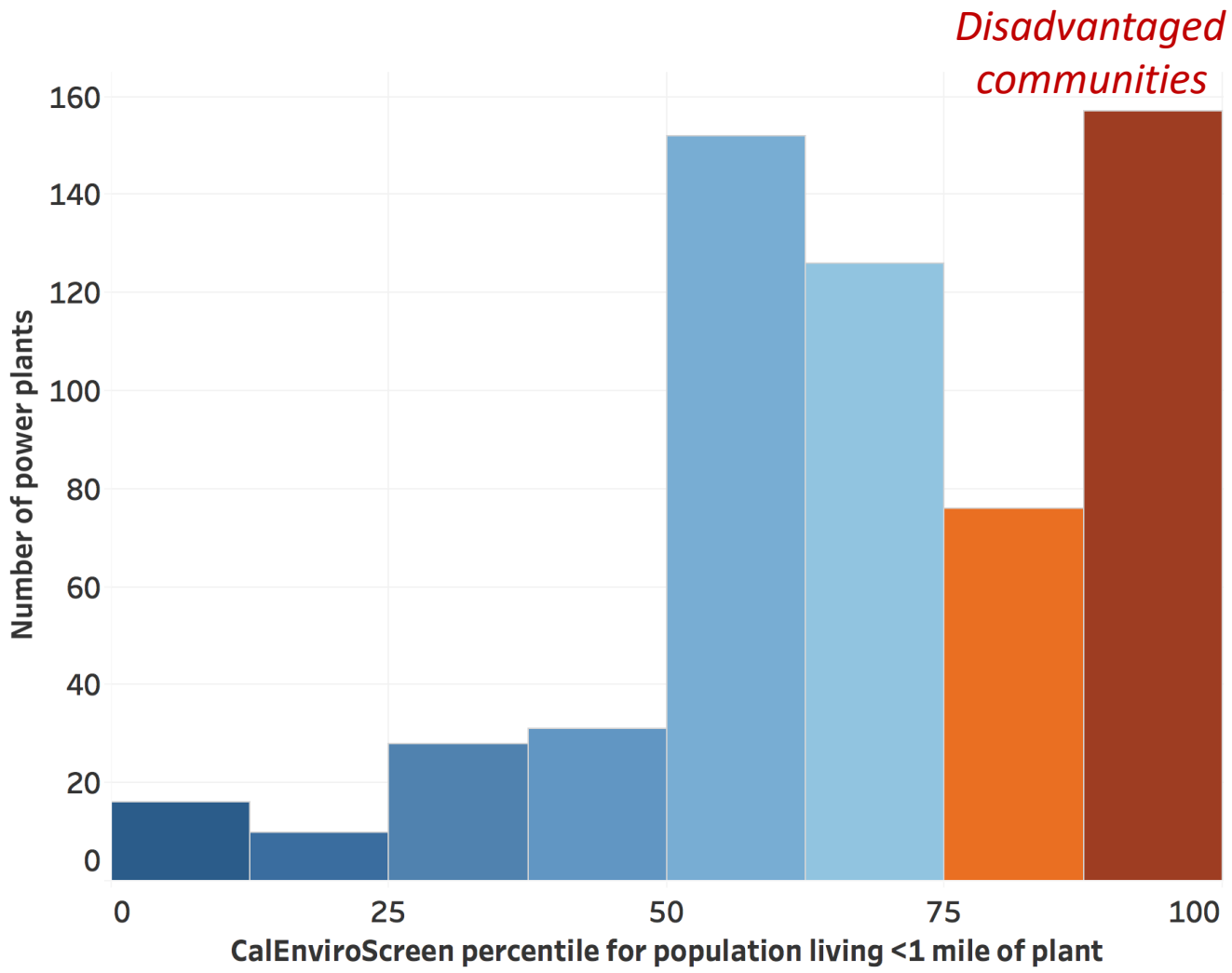
Data source: EPA Air Markets Program Data (ampd.epa.gov)

Peakers disproportionately operate on polluted days



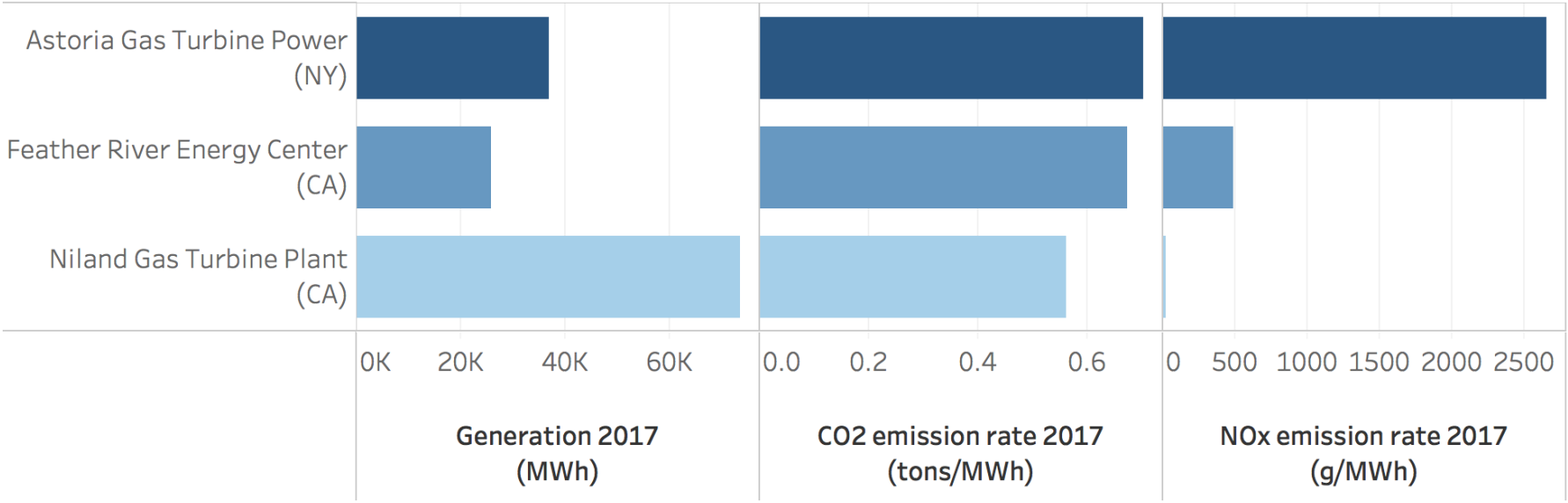
Data sources: EPA Air Markets Program Data (ampd.epa.gov), EPA AirNow (www.airnow.gov)

CA peakers disproportionately located in disadvantaged communities



Storage benefits even greater if displacing oil peakers

- New York and other regions have even higher-polluting oil-fired peakers
- For emission benefits, must ensure that storage is charged with lower-emissions sources (e.g. hydro, not coal)



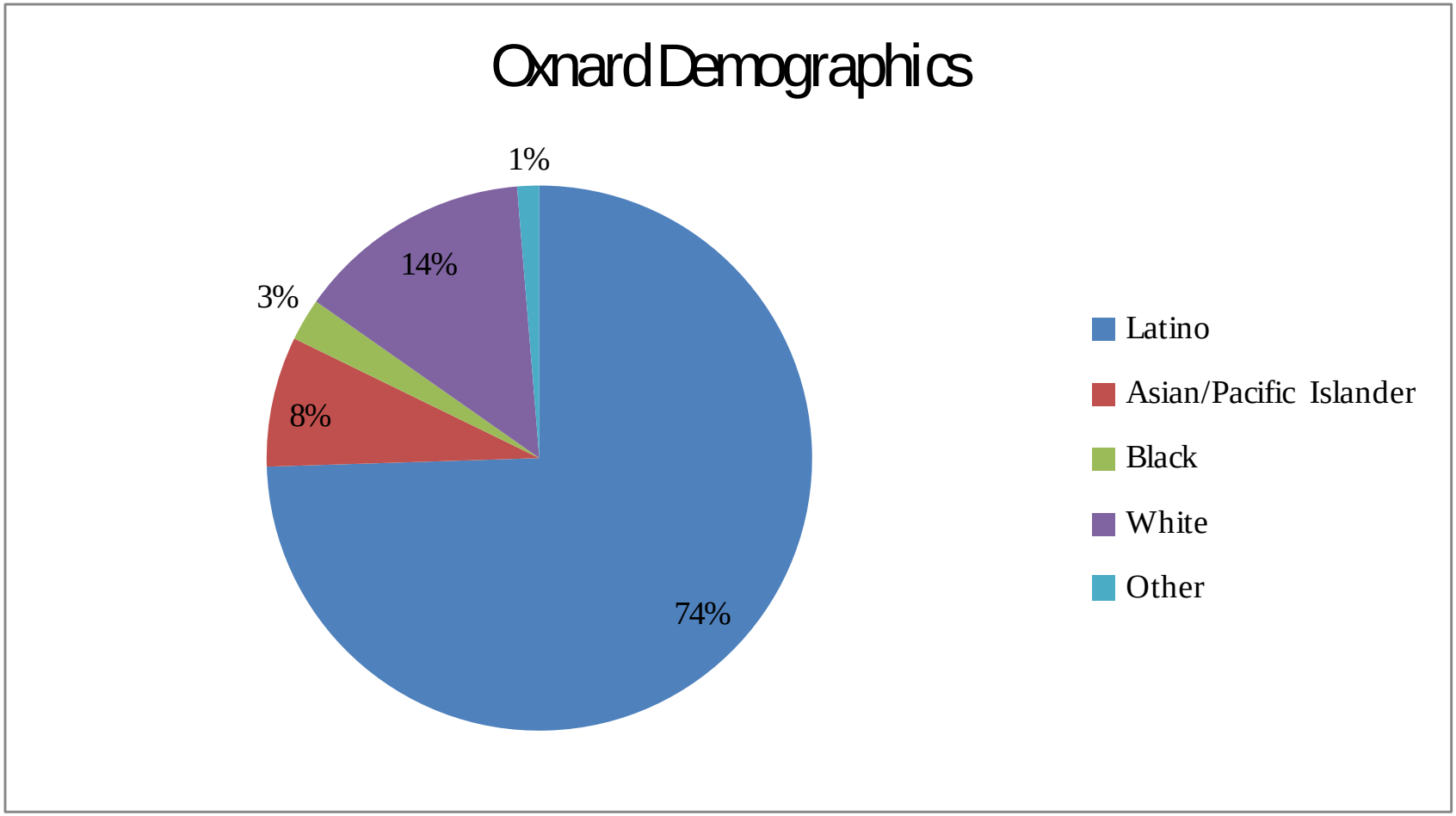
Data: EPA Air Markets Program
Additional reading: Strategen report on NY peakers: www.strategen.com/reports-1/09-20-2017/new-york-best

Strategies to incorporate co-benefits into storage peaker replacement

- **Incentives** needed to value:
  - Emissions
  - Equity
  - Resilience
- **Operational strategies** include:
  - Use storage to minimize peaker starts, stops and ramping
  - Charge storage at times of lowest marginal emissions, discharge at times of high marginal emissions
  - Dispatch storage preferentially on poor air quality days
- **Siting strategies** initially include using storage instead of:
  - Repowering old plants
  - Siting new plants
- **Targeted policies** include:
  - Cap-and-trade funds directed to disadvantaged communities
  - Pilot projects
  - Combining air quality, clean energy, equity, and grid services funding to enable projects

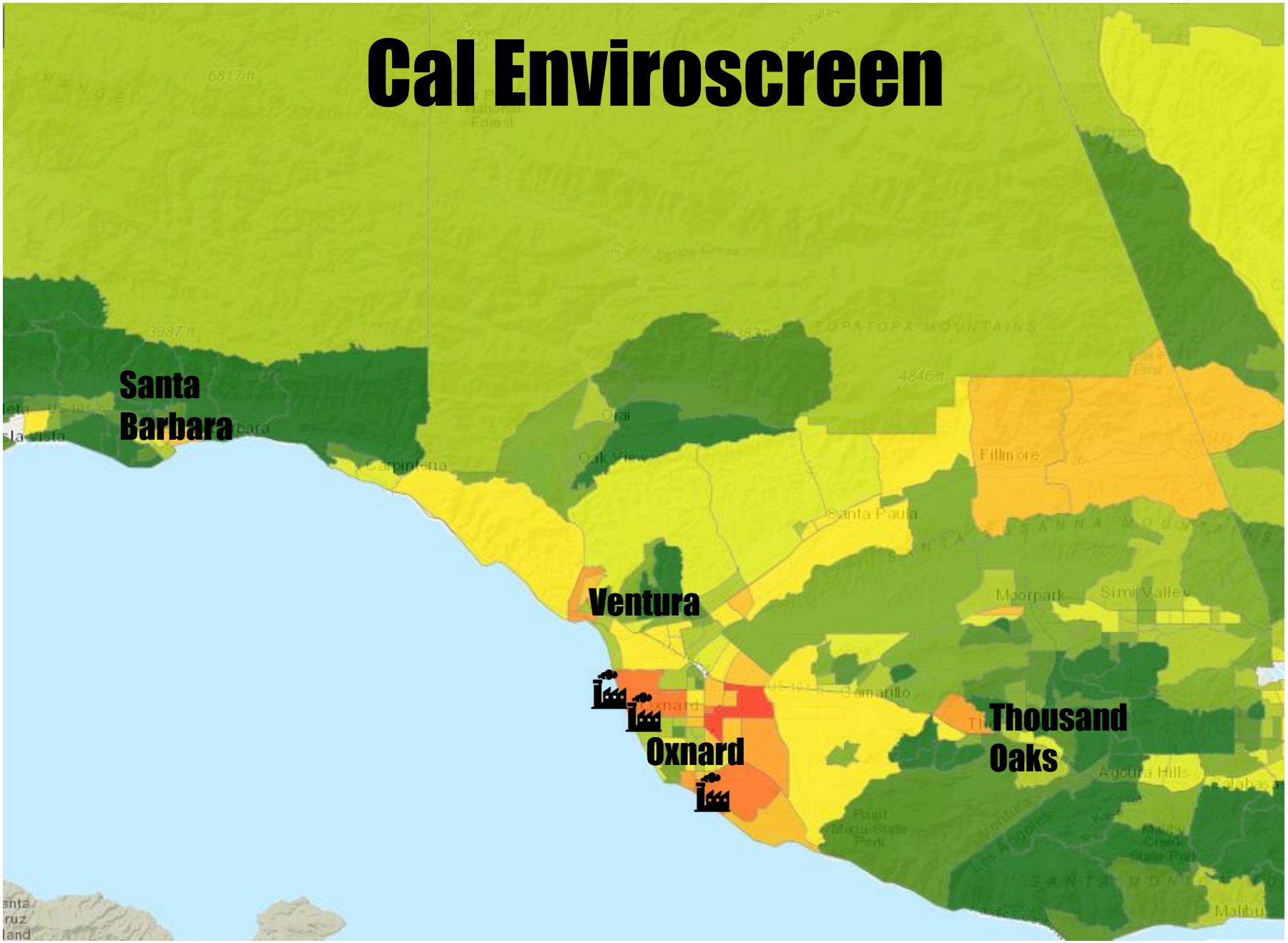
PSE is developing a California power plant mapping tool
which incorporates all of these data and more. Stay tuned!

www.psehealthyenergy.org
krieger@psehealthyenergy.org



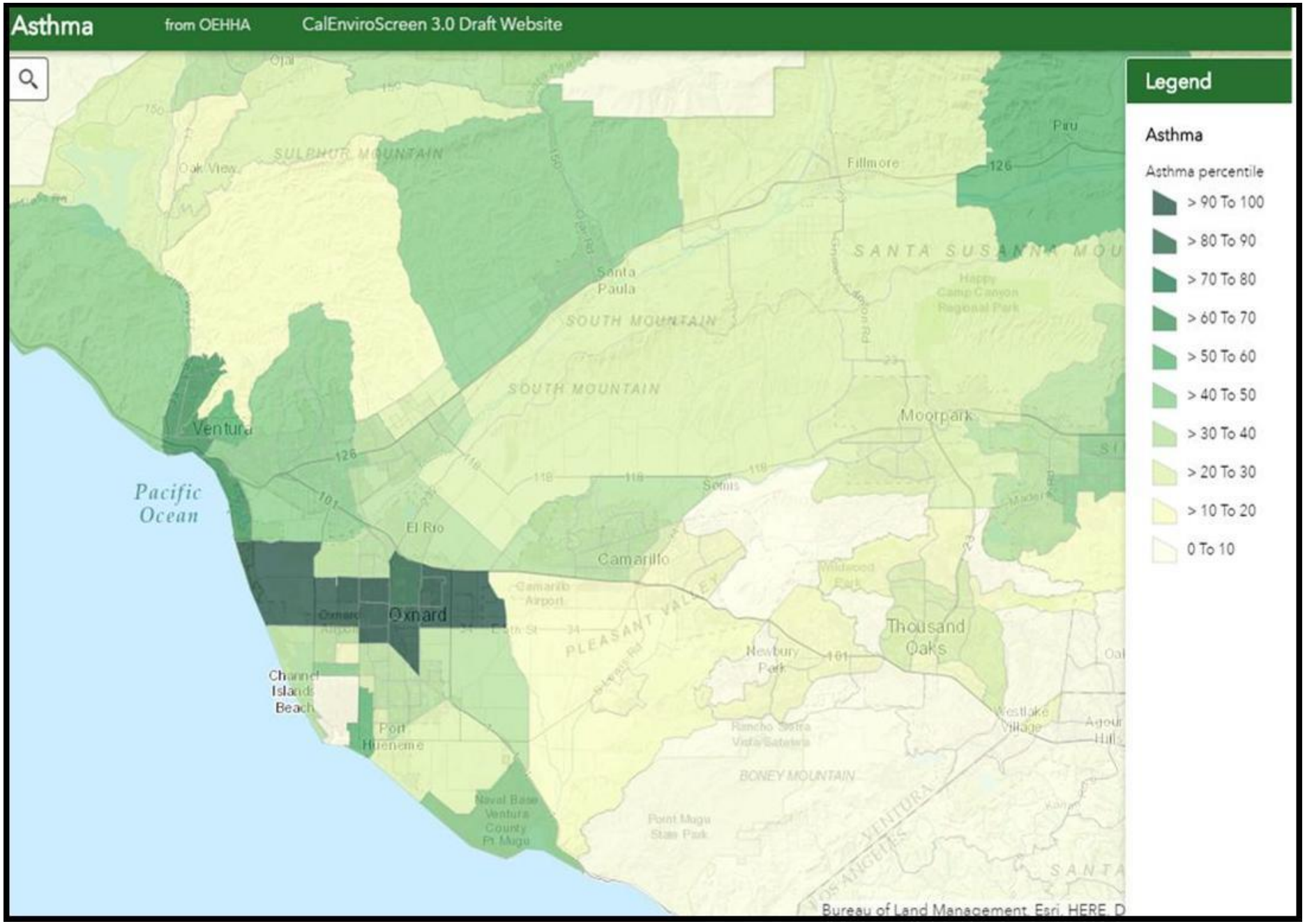
Total Population: 207,252

	California	Oxnard
People of color	61%	86%
Latino	39%	74%
Immigrant	27%	38%
Undocumented	7%	17%
Less than high school	18%	34%
Less than bachelors	69%	84%
Non-English at home	44%	68%
Under 18 years old	25%	30%


Cal Enviroscreen
Santa Barbara
Ventura
Oxnard
Thousand Oaks

History of Environmental Justice Struggles in Oxnard

- 1999 lawsuit from Rio Mesa school, Oxnard now #1 in state for students attending school near highest levels of toxic agricultural pesticides
- 2004 Halaco toxic waste dumping site abandoned, 2007 designated EPA Superfund Site
- 2007 Oxnard community defeats proposed BHP Billiton liquefied natural gas terminal
- All of Ventura County's power plants in Oxnard, community fights McGrath Peaker unsuccessfully in 2012


Asthma
from OEHHA
CalEnviroScreen 3.0 Draft Website
Legend
Asthma
Asthma percentile
> 90 To 100
> 80 To 90
> 70 To 80
> 60 To 70
> 50 To 60
> 40 To 50
> 30 To 40
> 20 To 30
> 10 To 20
0 To 10
Pacific Ocean
Ventura
Oxnard
Camarillo
Moorpark
Thousand Oaks
Fillmore
Santa Paula
El Rio
Somis
Channel Islands Beach
Port Hueneme
Naval Base Ventura County Pt Mugu
SULPHUR MOUNTAIN
SOUTH MOUNTAIN
PLEASANT VALLEY
BONEY MOUNTAIN
Bureau of Land Management, Esri, HERE, D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STOP CLIMATE CHAOS
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CLEAN AIR
THE GREAT SEAL OF THE STATE OF CALIFORNIA
EUREKA


YOU GAVE
WE GAVE YOU
YEARS
WE DESERVE

Protesters short-circuit Oxnard power plant meeting

Lawmakers urge against Oxnard power plant

Environmentalist Tom Steyer lends voice in opposition to Oxnard power plant

Regulators want more info before deciding on power plant

Energy needs can be met without new Oxnard power plant, study shows

State energy committee to recommend denial of Oxnard power plant

NRG calls for suspension of Oxnard power plant plans as it mulls full withdrawal

Edison's latest plan sees no need for gas-fired power plants in Ventura County

EDITORIALS

Editorial: Oxnard power plant approval seems inevitable

Posted: July 02, 2016

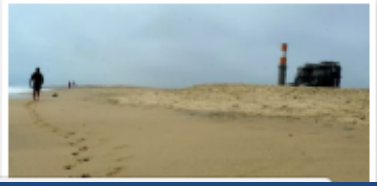
0 Comments

There seems to be a growing air of inevitability about the new power plant project at Mandalay Beach.

MORE OPI

Editorial: Is Puente a turning point in our energy future?

Ventura Published 4:27 p.m. PT Oct. 10, 2017 | Updated 4:29 p.m. PT Oct. 10, 2017



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All the residents, community leaders, environmentalists and city officials fighting plans for a


NIKE
AIR


EXIT
WE DESERVE
CLEAN
AIR
NO POWER PLANT!
NO POWER PLANT!
US 3 MIN
2 YE

Thank you for attending our webinar

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Upcoming Webinars

Simplifying Resilient Power Design with REopt Lite: A Look at New Features Added to NREL's Solar+Storage Tool

Wednesday, July 25, 1-2pm ET

Building Markets: Energy Storage in Massachusetts and Offshore Wind in Rhode Island

Thursday, August 9, 1-2:30pm ET

Read more and register at www.cleanegroup.org/webinars