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## Climate change law has reshaped California in 10 years

By David R. Baker | September 24, 2016 | Updated: September 24, 2016 8:55pm

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Photo: Carlos Avila Gonzalez, The Chronicle

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### IMAGE 1 OF 3

**A cow grazes near wind turbines of the Shiloh Wind Power Plant in the delta area outside Rio Vista, Calif., on Wednesday, September 21, 2016. The region has hundreds of wind turbines that generate power for the ... more**

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Just past noon on a broiling Central Valley day, the strain on California's electrical grid is rising with the temperature.

Inside the control room that runs the grid, on the outskirts of Folsom, a yellow line on a glowing wall of data squiggles steadily higher, then hits a stable plateau. It marks the amount of renewable electricity surging onto the system as the fierce sun fires up solar power plants scattered across the state.

More than 27 percent of California's demand for electricity at this moment is being met by renewable sources — primarily the sun, the wind and the Earth's own heat.

Just a few short years ago, that would have been considered astonishing. Now it happens on a regular basis. Next summer, the percentage will be even higher. State law requires that California get 33 percent of its electricity from renewables by 2020 and 50 percent 10 years later.

“It's remarkable what we can do,” says Eric Schmitt, vice president of operations for the California Independent System Operator, as engineers immersed in the control room's data screens monitor grid conditions. “Think about it — we're sitting here right now, and there's 7,000-plus megawatts of solar on our system. That's eight nuclear reactors' worth of electricity on our system — just from solar.”

Tuesday will mark 10 years since then-Gov. Arnold Schwarzenegger committed California to stopping climate change.



Photo: Carlos Avila Gonzalez, The Chronicle

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**Eric Schmitt, vice president of operations for the California Independent System Operator, says that at times there are “eight nuclear reactors’ worth” of solar electricity on our system.**

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With the San Francisco skyline behind him, **the Republican governor signed AB32**, a law requiring California to cut its greenhouse gas emissions back to 1990 levels by 2020. Although the state had already starting trying to curb emissions, AB32 became the centerpiece of California’s climate fight.

A decade later, much has changed — probably more than most Californians realize.

Progress has been neither quick nor steady. Some emission-cutting technologies touted with great promise 10 years ago — biofuels from yeast or algae, cars powered by hydrogen fuel cells — have never quite borne fruit or are just now entering the marketplace.

And yet, **1.7 percent of new cars registered in California last year** ran solely on electricity, not gas. In the territory of Pacific Gas and Electric Co., the state’s largest utility, another

family installs a rooftop solar array every seven minutes. Solar power plants capable of generating enough electricity for entire towns have spread across the state, from the Central Valley through the Mojave Desert.

And the state's emissions have fallen almost every year since 2007.

They've dropped 9.5 percent since their absolute peak, in 2004. This month, Gov. Jerry Brown signed a law, **SB32**, that set California's next goal, slashing emissions 40 percent below 1990 levels by 2030.

The decarbonization of the economy has barely started in much of the country. In California, it's well underway.

"People don't realize how much it's changed," said state Sen. Fran Pavley, who wrote both AB32 and its 2016 sequel just signed by Brown. "I think they'd be shocked."

Although broadly popular with the public, the effort still has critics.

Oil companies spent more than \$8 million trying to **suspend AB32 with a 2010 ballot measure**, only to be shot down by voters. Some of the state's biggest business lobbies insist the war on emissions is slowly piling costs onto California companies that their competitors elsewhere don't face.

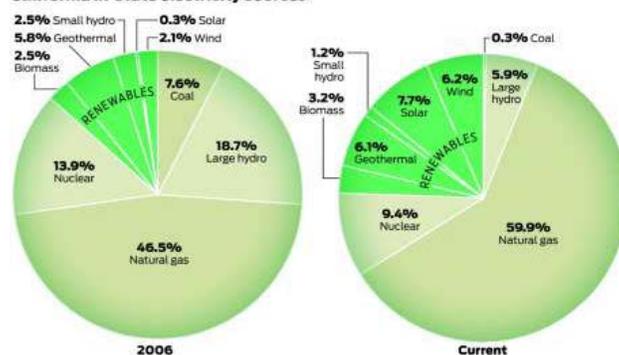
"If we want to do something about climate change, it's important to get other states on board," said Dorothy Rothrock, president of the California Manufacturers & Technology Association. "If California can't keep its manufacturing jobs while fighting climate change, other states aren't going to join.."

At the same time, however, California's climate policies during the last decade have

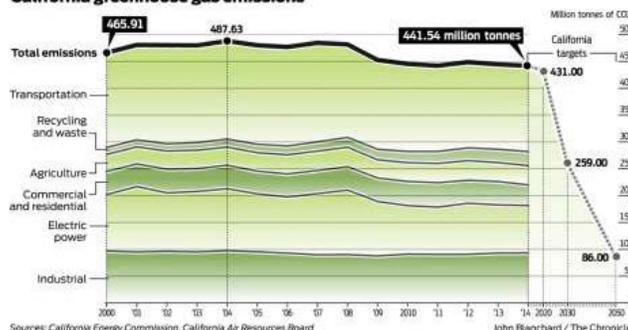
### Progress in California's climate fight

Ten years after Gov. Schwarzenegger signed California's landmark climate law, renewable power generation is up and greenhouse gas emissions are down. But the state has called for much steeper greenhouse gas cuts to come, shown in a compressed time scale at the right.

#### California in-state electricity sources



#### California greenhouse gas emissions



Sources: California Energy Commission, California Air Resources Board  
John Blanchard / The Chronicle

attracted and nurtured companies focused on renewable power and sustainability.

Many — most notably Fremont’s **Solyndra, maker of tube-shaped solar panels** — flamed out, leaving burned investors in their wake. But some survived and thrived.



Photo: Michael Noble Jr., The Chronicle

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**SunRun installers Brandon Anderson and Will LaRocque prepare to install one of 28 Q-Cell panels on a home in Sunnyvale. In the territory of Pacific Gas and Electric Co., the state’s largest utility, another family installs a rooftop solar array every seven minutes.**

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Less than 2 miles from Solyndra’s factory, Tesla Motors builds luxury electric cars for export around the world. Other electric-vehicle startups have set up shop in Silicon Valley, drawn by the nation’s largest market for plug-in vehicles and a pool of talented engineers. And the American solar industry has turned the Bay Area into its home base.

“Those policies have made us what we are today,” said Tom Werner, CEO of SunPower in San Jose, one of the country’s largest solar manufacturers and power plant developers.

“Without them, I think we’d exist. But we wouldn’t be based here.”

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Formally known as the Global Warming Solutions Act of 2006, AB32 passed at a time when the politics of climate change had not grown as polarized as they are today.

The Republican Schwarzenegger in 2005 had **declared the debate about climate science over** and vowed action, issuing an executive order that called on California to cut its emissions back to 1990 levels by 2020.

Pavley, a Democrat from the Los Angeles suburbs, had already authored **a 2002 law** forcing automakers to improve the fuel efficiency of their cars, curbing emissions in the process. Schwarzenegger’s order, she thought, wasn’t enough, since future governors could easily discard it.

“Executive orders are fine,” Pavley said, “but as a legislator, I want policies to stay in place.”

Signing the climate law gave Schwarzenegger, running for re-election in 2006, a way to appeal across party lines in deep-blue California. And while only one Republican legislator voted for AB32 — Shirley Horton, from Chula Vista (San Diego County) — the law had **virtually the same level of support** among the state’s Republican and Democratic voters, with roughly two-thirds backing it.

California wasn’t starting from scratch.

In 2002, another law had ordered the state’s utility companies to start buying more renewable power. It set off a boom in wind farms and large-scale solar power plants, some using mirrors to concentrate sunlight, others employing the same photovoltaic solar cells that homeowners slap on their roofs.

Not everything worked quite as planned.



Photo: Ethan Miller, Getty Images

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**The Ivanpah Solar Electric Generating System mirrors look like a lake in an aerial view over the Mojave Desert in February 2014.**

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From a distance, the Ivanpah Solar Electric Generating System looks like a shimmering lake in the middle of the desert, punctuated by three tall towers whose tops are blindingly bright. Drivers on nearby Interstate 15 sometimes call it the Eye of Sauron, in a nod to the menacing figure from the Lord of the Rings.

Designed by Oakland's BrightSource Energy and financed with help from Google and the U.S. government, the \$2.2 billion plant was for a time considered the future.

Ivanpah and similar solar thermal plants can churn out large amounts of electricity by focusing sunlight to produce heat for steam turbines. An **earlier generation of plants** had been quietly generating power in the Mojave Desert near Edwards Air Force Base since the 1980s.



Photo: Ethan Miller, Getty Images

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**The Ivanpah Solar Electric Generating System in the Mojave Desert, opened in 2014, generates more electricity each year.**

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But Ivanpah, which opened in 2014, didn't produce as much electricity as expected.

And solar thermal plants found themselves facing another threat — the plunging price of photovoltaic panels, which convert sunlight directly into electricity.

As late as 2010, many **experts were convinced solar panels would remain too expensive** to use for large-scale power plants. But panel prices tumbled 82 percent during the last 5 years, changing the equation. Photovoltaic solar plants started popping up throughout the state.

Now many analysts consider Ivanpah and other solar thermal plants white elephants in the desert.

“They looked like the best bet at the time,” said Matthew Freedman, staff attorney with The Utility Reform Network consumer group, who worked on the 2002 renewable power law. “The conventional wisdom changes every few years about what the future’s going to look like.”

Ivanpah’s co-owner and operator, NRG Energy, says it always expected that ramping the plant up to full production would take four years. The plant’s energy output last year rose 50 percent, according to NRG, and the company expects another 20 percent improvement in 2016.



Photo: Michael Macor, The Chronicle

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**Members of an engineering team gather at the headquarters of Proterra in Burlingame. The electric bus company moved from Colorado to Burlingame in 2015 to draw on the Bay Area’s electric vehicle talent.**

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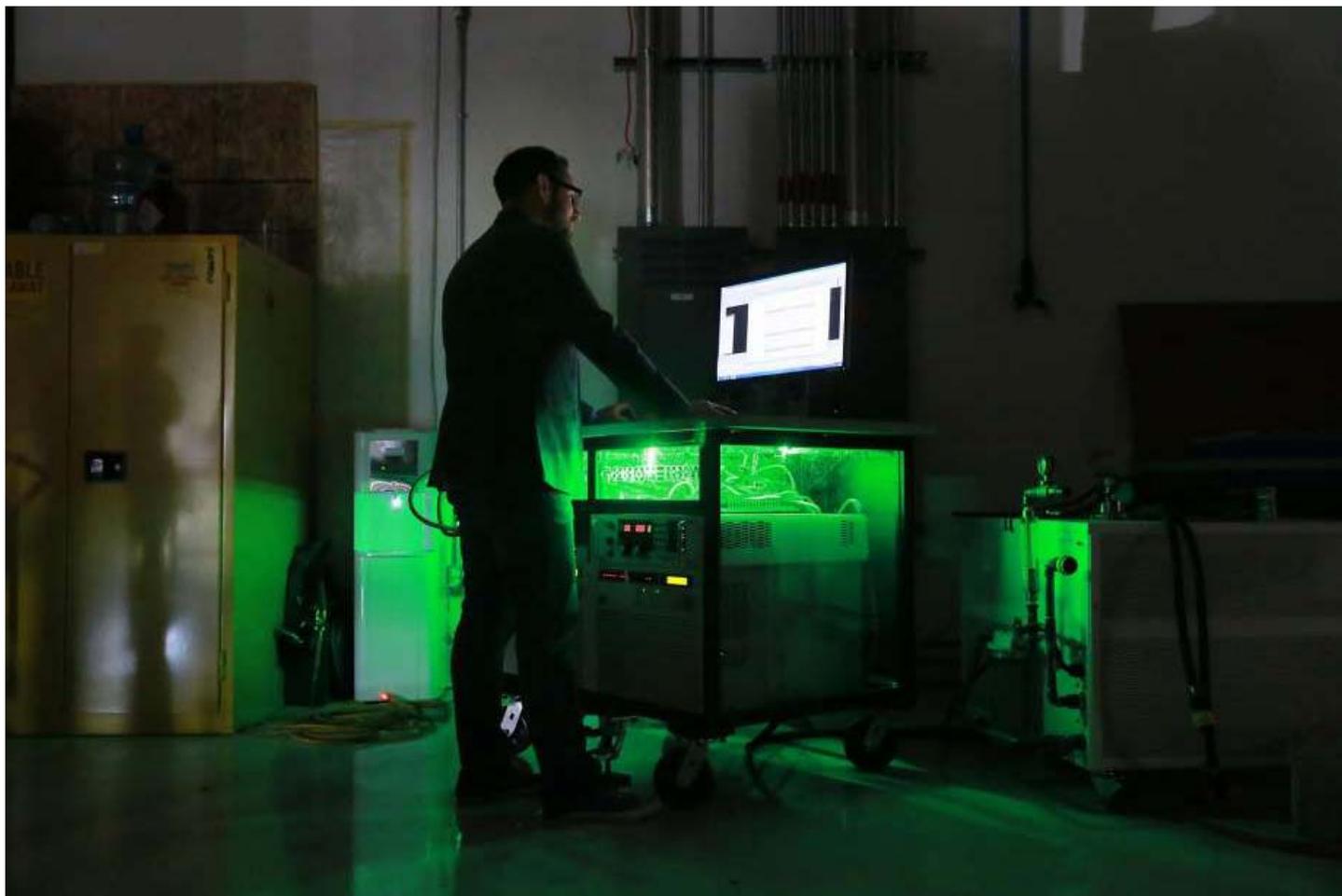
“The hope that I have for NRG, and the hope that I have for Ivanpah, is that the project turns out to be a good investment, and that we and a whole bunch of other people learn

from operating the plant,” said Craig Cornelius, head of NRG Renewables.

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To see California’s largest source of greenhouse gases in action — and glimpse a possible solution — look no farther than the Nimitz Freeway on a weekday morning.

Rows of idling cars pump exhaust into the sky. For decades, local governments in this car-loving state promoted development that separated housing from shops and offices — a recipe for sprawl. Today, transportation accounts for 36 percent of California’s emissions.



**Photo: Michael Macor, The Chronicle**

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**Thomas Blazak , engineering manager of validation is seen at a battery power cycling station, at the headquarters of Proterra, an electric bus company in Burlingame, Calif., on Thurs. September 22, 2016.**

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But look to the far left lane of the Nimitz. The carpool lane has turned into a parade of electric vehicles, from Nissan, BMW, Fiat and yes, Tesla, whose factory lies just east of the freeway. Their drivers have obtained a coveted perk — a small sticker from the state that

gives them the right to drive solo in carpool lanes.

Even as the state pushed to make gasoline-burning cars more efficient, it also badgered automakers into offering cars that don't use gas at all. Regulators at the California Air Resources Board took a pollution-cutting program that dated back to 1990 and used it to force automakers to sell zero-emission vehicles in the state or buy credits from companies that do.

“It says, ‘Thou shalt build this kind of car — a zero emission vehicle,’” said Diarmuid O’Connell, Tesla’s vice president of business development. “If you want to sell your gas guzzlers here, you’ve got to make some EVs. That’s helpful.”

Sales have not been brisk.

Since the current crop of electric vehicles hit the market at the end of 2010, Californians have bought or leased 123,773 pure-electric vehicles and 107,709 plug-in hybrids, according to the **Plug-In Electric Vehicle Collaborative**. That’s 47 percent of all battery electrics and plug-in hybrids nationwide, but it’s still less than 1 percent of all cars registered in the state.

And yet, California’s nascent EV market has triggered its own wave of businesses.

“The Bay Area is absolutely the epicenter of electric vehicle technology — that’s what drew us here,” said Ryan Popple, CEO of Proterra.



Photo: Carlos Avila Gonzalez, The Chronicle

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**Wind turbines run at the Shiloh Wind Plant outside Rio Vista. State law requires that California get 33 percent of its electricity from renewables by 2020 and 50 percent 10 years later.**

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His company, which makes electric buses, started in Colorado and opened its first factory in South Carolina. But California held the potential to be Proterra's biggest U.S. market, as cities throughout the state drafted their own plans to cut emissions. And thanks in large part to Tesla, the company could find in the Bay Area engineers with EV experience, Popple said.

Proterra moved its headquarters to Burlingame in 2015 and will open a new factory in the Los Angeles area next year.

"Our policies have had two really important outcomes: our air is getting cleaner, and we're winning the jobs," Popple said.

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Gauging the full economic impact of

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California's climate fight, however, remains difficult.

Supporters of the effort, including the governor, note that California's economy has grown even as its emissions have shrunk. And several studies, such as **one released this year by the Advanced Energy Economy** business group, have found roughly half a million Californians working in green or "advanced energy" jobs.

But critics have often pointed out flaws in which jobs those studies do and don't count.

They also don't factor in jobs that may have been lost due to the state's climate policies, said UC Berkeley energy economist Severin Borenstein.

Some individual climate policies have specific costs to consumers that can be counted.

For example, **California's cap-and-trade system**, which forces companies to buy permits for each ton of greenhouse gases they emit, adds about 11 cents to the price of every gallon of gas sold in the state. Another policy that forces oil companies to cut the "carbon intensity" of their fuels, by using more biofuels or offering hydrogen for fuel-cell cars, adds an estimated 3 cents per gallon.

But how much has the expanded use of renewable power cost? PG&E offers a general estimate, saying the drive to add renewables has pushed up electricity bills about 1 to 2 percent per year.

"It is frustrating," Borenstein said. "When you try to extrapolate to the effect on the overall economy, that's when you end up in la-la land."

California's efforts to stop climate change, while extensive, are just getting started.

Most analysts expect the state to reach AB32's target of returning to 1990's emission level, 431 million metric tons, in 2020. But cutting emissions 40 percent by 2030 will be harder. And California's long-term goal, not yet set into law, calls for an 80 percent reduction by



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2050, down to 86 million tons.

“We can be pleased with our success and be proud of it, while still recognizing it’s a drop in the bucket in terms of what we need to do,” said Mary Nichols, chairwoman of the California Air Resources Board, which runs most of the climate policies that sprang from AB32. “The fact is that, globally, emissions are continuing to go up, not down.”

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