High temperature sets another record in Honolulu
Globally 2015 was the HOTTEST year in recorded history.
Climate change: UN report confirms 2015 hottest year since records began

28/01 16:11 CET | updated at 28/01 - 22:01
Global temperature changes since 1850 by month

Temperature change since pre-industrial times [°C]

@ed_hawkins

HadCRUT4 data
Mercury rising: India records its highest temperature ever

By Huizhong Wu, CNN

Updated 4:01 PM ET, Fri May 20, 2016
407.57
Atmospheric carbon dioxide for April 2016
(the most important number on Earth)
Tropical Cyclone Pam smashes Vanuatu

'Unbelievable destruction'

33 million in U.S. under severe weather threat

By Rachel Aissen, CNN Meteorologist

Updated 3:19 PM ET, Sun May 10, 2015
Scientists Discover Sudden Melting in the Antarctic

Warmer waters are eating away at protective ice shelves, letting glaciers flow into the sea

A Large Chunk of Antarctica May Disappear Into the Ocean By 2020

Justin Worland @justinworland May 15, 2015

The loss of the ice shelf will likely increase the rate of global sea level growth

A 618-square mile section of Antarctica’s Larsen B Ice Shelf has been melting away and may disappear into the ocean entirely by 2020, according to a new study. The area is the last remaining section of a 10,000-year-old ice shelf that partially collapsed in 2002.
CAUTION
BEACH EROSION
Over 1 billion Catholics globally
2015 Paris Climate Agreement
<1.5°C
100% CLEAN ENERGY BY 2045
Hawai‘i should not only demonstrate the future of clean energy, it should help invent it.
World's first royal residence lit by electricity
November 16, 1886
Policy solutions

- Solar tax credit (and other incentives)
- Net energy metering
- Renewable Portfolio Standards
- Greenhouse gas reduction law
- Solar water heating mandate (all new homes)
- Oil barrel tax for clean energy programs
- Energy efficiency portfolio standards
- Feed-in tariff
Solar mandate: SUCCESS
Feed-in tariff: FAILURE
Energy Agreement Among the State of Hawaii, Division of Consumer Advocacy of the Department of Commerce & Consumer Affairs, and Hawaiian Electric Companies

October 2008
Anticipated NEM PV by end of 2015: **23 MW**

Actual NEM at end of 2015: **345.2 MW**

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<thead>
<tr>
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<tbody>
<tr>
<td><strong>ENERGY EFFICIENCY/CUSTOMER SITED GENERATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PV (through feed-in tariff or PPA)</td>
<td>6.5</td>
<td>23.0</td>
<td>65.0</td>
<td>108.0</td>
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<tr>
<td>Solar Opportunity</td>
<td></td>
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<tr>
<td>PV Host Program</td>
<td>2.0</td>
<td>12.0</td>
<td>22.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Net Energy Metering</td>
<td>5.0</td>
<td>23.0</td>
<td>57.0</td>
<td>97.0</td>
</tr>
</tbody>
</table>
>15x
Solar Photovoltaics Cost

Average Solar PV Module Cost per Watt vs. Cumulative PV Module Shipments

Nearly **eighty thousand** residential properties in Hawai‘i now have solar systems installed.

That’s more than **one in three** single-family dwellings.
100% renewable 2045
Dear Legislators,

We are tomorrow's scientists, farmers, teachers, dreamers, and leaders, asking you to make our future brighter by passing House Bill 623: 100% clean, renewable energy by 2040.

100% renewable energy by 2040
Hawaii’s renewable energy goal should be 100%

By Gov. George Ariyoshi, Christine Camp and Peter Crouch

Under the state’s existing renewable energy laws, in 2031 — around the time today’s preschoolers will graduate high school — the majority of our energy could still come from fossil fuels. We owe it to the kids growing up today, and the ones following them, to do better than that.

Climate reality is everywhere: eroding coastlines, dying coral reefs, droughts, Hawaii and the Hawaiian Electric companies acknowledged and agreed: "The future of Hawaii requires that we move more decisively and irreversibly away from imported fossil fuel for electricity and transportation and towards indigenously produced renewable energy and an ethic of energy efficiency. The very future of our land, our economy and our quality of life is at risk if we do not make this move and we do so for the future of Hawaii and of the genera-

George Ariyoshi was governor of Hawaii 1974-1986; Christine Camp is managing director of Avalon Development Co., LLC; and Peter Crouch is dean of the College of Engineering at the University of Hawaii-Manoa. They are on the board of directors of Blue Planet Foundation.

achieve this target by 2040, if not sooner.

Elsewhere, 100 percent renewable goals are becoming a norm. The island nations able targets and related policies, there is “no doubt that Hawaii is further along the path to increased utilization of renewable and indigenous progress in clean energy technology and policies, as well as a rising tide of citizens intent on reversing climate change. With continued action in these areas — building on progress like advanced rooftop solar inverters to accommodate high solar penetration, an 80 percent drop in solar power module prices since 2008, a strong barrel tax and greenhouse gas laws, solar hot water on every new home, low-cost green financing, and a movement to divest our univer-


LEADERSHIP MATTERS

- New Governor
- New CEO of Hawaiian Electric utility
- New Chair of Public Utilities Commission
Hawaii legislature approves 100% renewables target

JOHN CONROY | 7 MAY, 12:19 PM
CLIMATE | ENERGY MARKETS | POLICY & POLITICS | RENEWABLE ENERGY | SOLAR ENERGY | WIND POWER

Hawaii’s legislature has passed a bill calling for a 100% renewable power target by 2045, with interim targets of 70% by 2030 (up from a previously agreed 40%) and 30% by 2020, Energy Matters reports.
Hawaii Votes to Go 100% Renewable

Follow the Leader: Hawaii Aims for 100 Percent Renewable Energy

Hawaii legislature sets 100% renewable portfolio standard by 2045

Hawaii Will Soon Get All Of Its Electricity From Renewable Sources
Hawaii just set a goal of generating 100 percent of its electricity from renewable resources: ofa.bo/r7hi #SwitchToClean

Gov. Ige signs bill setting 100 percent renewable energy goal for...
By Hawaii News Now @HawaiiNewsNow

Gov. David Ige on Monday signed into law four energy bills, including one that strengthens Hawaii's commitment to clean energy by directing the state's utilities to generate 100 percent of their el...
FOR HAWAII’S FUTURE
Committed to Achieving Hawaii’s 100 Percent Renewable Energy Goal

“NextEra has the financial clout and experience that can help Hawaiian Electric build a grid network that will benefit our community for generations to come. This merger makes sense for Hawaii.”

- Dean Okimoto, Nalo Farms

It’s their future we are creating today.
Hawai'i’s Renewable Energy Future

- Hawaiian Electric Plan
- Achieved ~21%
- House Bill 623
Renewable Energy Trends
2015 Renewable capacity vs energy produced

- Oahu:
  - Capacity: 53%
  - Energy: 17%

- Big Island:
  - Capacity: 78%
  - Energy: 49%

- Maui:
  - Capacity: 71%
  - Energy: 35%

- Kauai:
  - Capacity: 90%
  - Energy: 38%
Resource Combinations to Achieve 100% Renewable Power (Oahu)

Matthias Fripp

University of Hawaii, Manoa

- Asst. Prof. of Electrical Engineering
- U.H. Energy Research Organization (UHERO)
- Renewable Energy & Island Sustainability (REIS)
Framework for Achieving 100%

- **Meet overall energy requirements**
  - Build wind projects where appropriate (~300 MW Oahu)
  - Build a lot of solar power (2,000–3,000 MW)
  - Use biofuels as needed/appropriate (0-16% of energy)
- **Meet hourly energy requirements**
  - Harness demand response via real-time pricing (300 MW?)
    - Same loads can also provide “spinning” reserves
  - Build pumped hydro storage if cost-effective (150 MW+)
  - Build as much battery capacity as needed (100–400 MW)
  - Fill in with biofuel or hydrogen as needed (400-600 MW)
- **Meet seasonal energy requirements**
  - Use biofuel or hydrogen on low-sun days
    - Produce hydrogen on high-sun / high-wind days
Year-Round Energy Balance with 5% Biofuels (~22.0¢/kWh)

Hourly Power Production (MW)
- Curtail Wind
- Curtail Solar
- Generate from Hydro
- Solar
- Wind
- Diesel
- LSFO-Diesel-Blend
- LNG
- Hydrogen
- Biodiesel
- Pellet-Biomass
- Coal
- H-POWER
- Marginal Cost (p.u.)

Hourly Power Consumption (MW)
- Charge EVs
- Responsive Demand
- Store Hydro
- Charge Batteries
- Liquify Hydrogen
- Produce Hydrogen
- Nominal demand
“We call it the Airbnb of energy. We give that virtual platform and let customers participate with each other.”

Sonnen’s CEO
Boris von Bormann
Data Storage

September 1956

IBM 305 RAMAC

4.4 megabytes of data

$50,000 ($11,000 per MB)
June 2016
128,000 megabytes
$29.97
$0.00023 per MB
1/47,000,000th the cost

* and slightly smaller
Battery Costs
Electric and Hybrid Vehicle Batteries

Source: Generation Investment Management

Battery Costs ($/kWh)

- 2000: $1,600
- 2005: $1,200
- 2009: $1,000
- 2012: $600
- 2016E: $300
- 2020E: $200
Tesla Gigafactory

Jefferies Analyst: Tesla To Drive Down Battery Costs By 50% Via Economies Of Scale, Supply Chain Optimization
Tesla Model 3
373,000 reservations in first month
Registered Electric Vehicles

Registered EVs

2010 2011 2012 2013 2014 Today
POWERED BY HYDROGEN

MIRAI
FUEL CELL VEHICLE

SSP 458
ALOHA STATE
What does an electric utility look like in a world where customers can produce and store their own energy, where businesses want energy that doesn’t change the climate, and where electric cars can store enough energy to power a home for days?
“The ultimate hope for this transformation is a “plug-and-play” grid, where the grid is a distribution platform that's been designed to allow for distributed resources to plug in.

Maintain that plug and play grid and provide a market where third party providers provide grid services and they must be compensated fairly.”

Pedro Pizarro, President, Southern California Edison
“These resources are so valuable to the grid when they are properly valued and integrated that whatever amount of money you can make selling hardware is not significant.”

eMotorWerks CEO Val Miftakhov
Community-based renewable energy
The Energy Cloud: Today and Tomorrow

TODAY: ONE-WAY POWER SYSTEM

- Large, centrally located generation facilities
- Designed for one-way energy flow
- Utility controlled
- Technologically inflexible
- Simple market structures and transactions
- Highly regulated (rate base) and pass through

EMERGING: THE ENERGY CLOUD

- Distributed energy resources
- Multiple inputs and users, supporting two-way energy flows
- Digitalization of the electric-mechanical infrastructure: smart grid and behind the meter energy management systems
- Flexible, dynamic, and resilient
- Complex market structures and transactions
- Regulation changing rapidly around renewables, distributed generation (solar, micro-grid, storage), net metering etc.

(Source: Navigant Consulting)
Hawaiian Electric opposes increasing cap of solar program

May 26, 2016, 1:49pm HST

INDUSTRIES & TAGS  Energy, Solar Energy

Duane Shimogawa
Reporter
Pacific Business News
HECO proposes plan to use LNG to generate electricity

Published: Wednesday, May 18th 2016, 8:45 pm HST

WAIANAE, OAHU (HawaiiNewsNow) - Hawaiian Electric company proposed a plan to ship Liquefied Natural Gas (LNG) and overhaul the aging Kahe power plant to burn it.

The LNG would be delivered to Kahe and other power plants on the Big Island after arriving by ship from Canada.

Hawaiian Electric says the natural gas is cheaper and cleaner than the oil now burned at the plant and would save typical electric customers hundreds of dollars a year.
LNG is a fossil fuel. LNG is imported. And any time and money spent on LNG is time and money not spent on renewable energy...I have reached the conclusion that Hawai‘i does not need LNG in our future. It is time to focus all of our efforts on renewable energy...
NEW GENERATION ADDED FIRST QUARTER 2016

RENEWABLES SMASHED NATURAL GAS IN THE FIRST QUARTER OF 2016

megawatts added

| Source: FERC |

- Natural gas: 18 megawatts
- Wind: 707 megawatts
- Solar: 522 megawatts
- Biomass/Hydro: 62 megawatts

THINKPROGRESS
By the late 1970s, Kodak enjoyed 85% of camera sales and 90% of film sales in the United States.
“But it was filmless photography, so management’s reaction was, ‘that’s cute—but don’t tell anyone about it.’”
Decline of Film

Film rolls sold

[Graph showing the decline of film rolls sold from 1995 to 2010.]

Camera sales

[Graph showing the increase in camera sales, with separate lines for digital and analog cameras from 1995 to 2010.]
Kodak stock prices since 1997 (Weekly closes)

$92.87 Feb. 10, 1997

36¢ Thursday
To clear the path for clean energy

• We inspire leaders to change the rules and accelerate cost-effective, secure, renewable energy.
• We inspire communities to adopt smart, replicable energy solutions.
• We inspire everyone to believe in the power and possibility of a future beyond fossil fuels.
Damien Memorial School - Phase II
Project: Gymnasium Lighting Upgrade

Damien Memorial School serves students in grades 6 through 12 with the mission to guide young men and women to become responsible, respectful and community-minded citizens. This second phase of Damien’s energy efficiency campaign will enable Damien to save over $9,700 annually by upgrading their existing gym lighting. This upgrade will benefit Damien athletics, by providing a tournament ready facility for future generations of young student athletes.

Boys and Girls Club of Hawaii
Project: Clubhouse lighting upgrade

Boys and Girls Club of Hawaii (BGCH) is a nonprofit organization that inspires Hawaii’s youth to become successful and responsible members of their communities. By enabling high efficiency lighting upgrades for BGCH’s Clubhouses on Oahu, WEfficiency will facilitate approximately $18,000 in savings annually. Each $1 loaned through WEfficiency yields $3 in energy savings for BGCH. The savings achieved via lighting upgrades will allow Boys and Girls Club of Hawaii to allocate more funds toward their developmental programs and further empower Hawaii’s youth.
WE ARE USING 1,060 MEGAWATTS RIGHT NOW

CURRENT ENERGY MIX

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<tr>
<th>Resource</th>
<th>Percentage</th>
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<tr>
<td>Wind</td>
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<tr>
<td>Solar</td>
<td>5%</td>
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<tr>
<td>Waste</td>
<td>6%</td>
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<tr>
<td>Coal</td>
<td>17%</td>
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<tr>
<td>Oil</td>
<td>68%</td>
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WEEKLY PROGRESS

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<tr>
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<tr>
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<td>687</td>
<td>1,116</td>
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<tr>
<td>Sat</td>
<td>709</td>
<td>1,043</td>
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<tr>
<td>Sun</td>
<td>674</td>
<td>1,092</td>
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<tr>
<td>Mon</td>
<td>694</td>
<td>1,110</td>
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<tr>
<td>Tue</td>
<td>683</td>
<td>1,104</td>
</tr>
<tr>
<td>Wed</td>
<td>683</td>
<td>1,109</td>
</tr>
<tr>
<td>Today</td>
<td>670</td>
<td>1,108</td>
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POWERED BY

blue planet FOUNDATION

Hawaiian Electric

islandpulse.org
We have everything we need to change our energy culture.
blue planet FOUNDATION

100% Renewable Islands

IUCN World Conservation Congress
Hawai‘i 2016
What do residents want?

Market Trends Pacific
Poll of 615 households statewide April 2015
Price is the most important; use the cheapest energy available

Market Trends Pacific Poll of 615 households statewide, April 2015