

Today in Energy

August 24, 2018

Hurricane Lane approaches Hawaii, threatens energy infrastructure

Hurricane Lane and Hawaii energy infrastructure



Source: U.S. Energy Information Administration, Energy Disruptions Map

Hurricane Lane, a Category 3 hurricane, is currently on track to pass just to the south and west of Hawaii, bringing torrential rainfall and high winds to the islands. If Hurricane Lane makes landfall, it would be the first major hurricane to make landfall in Hawaii in 26 years. To help promote understanding of potential energy-related storm effects, EIA maintains an energy disruptions map that displays energy infrastructure and real-time storm information.

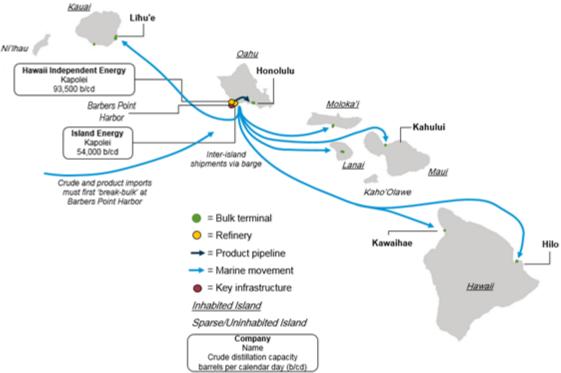
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Effects from Hurricane Lane have already been felt in Hawaii, as more than two feet of rain had fallen on parts of the Big Island as of Friday morning. The hurricane is expected to make its closest approach to the islands of Maui and Oahu Friday night and into Saturday morning. The governor of Hawaii declared a state of emergency on Tuesday, August 21, in advance of the storm.

Hawaii imports nearly all of the energy it consumes, mostly as petroleum. About half of Hawaii's total energy demand is accounted for by the transportation sector, led by jet fuel use. Two operating refineries in Hawaii, both located on the island of Oahu, have the capacity to process 147,500 barrels of crude oil per calendar day (b/cd), based on data in EIA's *Refinery Capacity Report*.

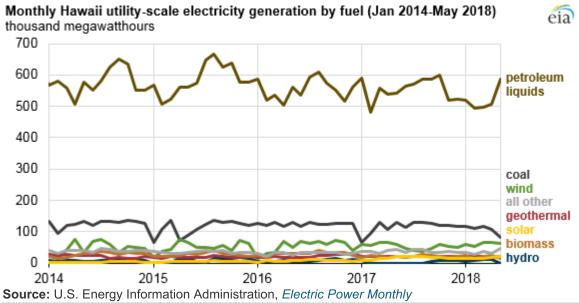
The Par Petroleum Kapolei refinery, also known as Hawaii Independent Energy, has an atmospheric crude distillation capacity of 93,500 b/cd and processes a mix of sweet and moderately heavy crude oils into jet fuel, diesel fuel, and other products. The Island Energy Kapolei refinery, with an atmospheric distillation unit capacity of 54,000 b/cd, refines light, low-sulfur crude oil into motor gasoline, distillate fuel, and jet fuel. These refineries also produce petroleum fuels used in electric power generation.

Petroleum product supply movements and infrastructure in Hawaii



Source: U.S. Energy Information Administration, *West Coast Transportation Fuels Markets*, September 2015 **Note:** Click to enlarge.

More than 68% of Hawaii's utility-scale electricity generation is from petroleum-fired power plants, with coal and wind making up another 14% and 7%, respectively. Hawaii is one of just seven states with utility-scale geothermal generation, but geothermal generation on the Big Island has been shut down since May because of the eruption of the Kilauea volcano.



Hawaii has seven wind energy power plants with a combined electricity generating capacity of 206 megawatts on the islands of Oahu, Maui, and the Big Island. Based on data in EIA's annual survey of electric generators, these seven plants have 114 wind turbines ranging in height from 130 feet to 330 feet. Hawaii has no offshore wind turbines. Small-scale distributed solar photovoltaic systems generated on average about 81,000 megawatthours each month in 2017.

EIA's energy disruptions map displays key layers of energy infrastructure, including power plants and major electric transmission lines, and real-time storm information from the National Weather Service. The web page also has links to the U.S. Department of Energy's Emergency Situation Reports and other websites that provide updates on the effect of severe weather on energy infrastructure.

Principal contributors: Michael Mobilia, Owen Comstock

The Maui News

Updated 4:40 p.m.: Maui firefighters battled three blazes

More than 2,000 acres burned; at least seven homes destroyed or damaged



Firefighters battle a fire in West Maui on Friday. The Maui News / MATTHEW THAYER photo

WAILUKU — As Hurricane Lane approached Maui County from the south, firefighters battled three brush fires in a 10-hour span, from Maalaea to Kaanapali, on Friday. The blazes charred more than 2,000 acres, fire officials reported during a news media briefing.

As of 3 p.m., at least seven homes were either damaged or destroyed by fire, officials said. With Lane moving closer to Maui, interim Fire Chief Lionel Montalvo said crews were trying to get a handle on the fires as soon as possible before stronger winds make them more difficult to fight.

"That's the concern," he said after the briefing at the Kalana O Maui building in Wailuku. "Unpredictable wind patterns."

Battalion Chief Michael Werner told reporters the first fire was reported at 9:44 p.m. Thursday in the Maalaea area, and it burned about 30 acres. That fire is 100 percent contained, he said.

Then, at 1 a.m. Friday, a fire in the vicinity of Kauaula Valley was reported. It blackened 1,500 acres and was 40 percent contained Friday afternoon, Werner said.



It was a long morning for firefighters battling a West Maui fire Friday. The Maui News / MATTHEW THAYER photo

Then, at 7:28 a.m., a fire broke out in Kaanapali. It was estimated at 800 acres and 100 percent contained Friday afternoon.

Fire officials said the 1,500-acre fire destroyed and damaged the homes, which included residences at the back of Lahainaluna High School. Werner stressed that the public high school itself did not burn.

Fire officials did not know the causes of the fires. The only reported injury was to a woman from Kauaula Valley who sustained burns to her arms and legs. She was medivaced to Oahu early Friday morning.

Fire officials said the Air One helicopter could not respond to the fire immediately because of windy conditions.

Montalvo said obtaining a National Guard helicopter from Hawaii island was a possibility, but that possibility fizzled because of adverse weather. On Friday afternoon, weather conditions improved enough for Air One to join the battle against the blaze, Montalvo said.



A brush fire Friday burned close to Sue Cooley Stadium at Lahainaluna High on Friday. The Maui News / MATTHEW THAYER photo

Fire officials estimated that 75 out of around 306 Maui County Fire fighters responded to the three fires.

Maui County crews and personnel from private companies including Hawaii Dredging Construction Co. and Goodfellow Bros. helped fight the fires.

Maui Police Chief Tivoli Faaumu said police have officers and officials with the Federal Emergency Management Agency, the National Parks Service and National Guard going into Kauaula Valley to do damage assessments and check on residents.

The fire affected the Police Department's Central Dispatch because fiber optics were damaged, but because of redundancy built into the system, 911 dispatch was able to function.

If things got worse, the Police Department would be able to divert some calls to Molokai Police, he said.



Firefighters battle a fire in West Maui on Friday morning. The Maui News / MATTHEW THAYER photo

Mayor Alan Arakawa thanked Gov. David Ige and FEMA for providing pallets of food and water.

Arakawa said county officials were worried that the fire would cut off West Maui, so they asked for help.

Herman Andaya Jr., the administrator for the county Emergency Management Agency, said the Hyatt Regency in Kaanapali evacuees in its ballroom, but on Friday afternoon the area was full.

At least one Lahaina church took in evacuees, along with some other churches on the island.

Earlier reports from witnesses indicated that the Kauaula fire raced downhill, grew rapidly from 3 to 300 acres and threatened the mauka side of Lahaina town. Police evacuated more than 100 homes in the Puamana Subdivision as a precaution and advised people to leave their homes along Punakea Loop and Lahainaluna Road.

At least 10 fire companies responded to the scene of the blaze, with Category 2 Hurricane Lane approaching from the south. For hours, Honoapiilani Highway remained closed in both directions, isolating the resort West Maui community from the rest of the island. As of around 9:30 a.m., however, Honoapiilani reopened, but Kahekili Highway remained closed in the Lahaina-bound direction, officials said.

Around 500 people were seeking shelter at the Lahaina Civic Center Friday morning, Maui County spokesman Rod Antone said. There were 300 people inside the center and 200 outside in vehicles, he said.

The fire was located near the Sue D. Cooley Stadium on the Lahainaluna campus. Around 9:15 a.m., trees were still smoldering. The stadium did not appear to have burned.

The fire burned around the campus borders, although it was hard to tell if anything on the campus itself burned.

Around 9:25 p.m., firefighters also battled a brush fire in a gulch next to the Lahainaluna cafeteria.

Homes burned on the Maalaea side of Lahainaluna Road near to a baseyard used by Hawaiian Dredging Construction Co. The baseyard was burned, but it appeared that heavy equipment on the site was not damaged.

A worker at the civic center reported seeking flames and smoke from another, separate, fire in Kaanapali. That report came in at 7:30 a.m.

With the hurricane approaching, Lahaina resident Paul Laub had left his oceanfront home on Front Street and was staying at a friend's guest place in Launiupoko.

At about 1:30 a.m. Friday, "I could see all this red."

"I said, 'This isn't good.' It turned out to be the fire," Laub said. "We packed up and left Launiupoko."

With Honoapiilani Highway closed in the Lahaina direction, he drove to Kahului and spent the night in a shelter at the Maui High School gym.

Laub said he decided to leave Lahaina because of predictions that the hurricane would bring high surf of 10 to 25 feet. "I don't know exactly what that means, but I know the house is about 24 feet tall," Laub said.

He said houses in his neighborhood are about 80 years old. "At least in the last 80 years, it's been able to withstand everything," he said.

"Whatever happens, everyone's alive and I got the kitties," said Laub, who was traveling with four cats.

A Launiupoko resident, who didn't want his name used, said he packed up his car and drove downhill after police went through the neighborhood with loudspeakers at 4:40 a.m. Friday.

"It was a very intense eerily orange glow during the night sky as the hurricane winds swept through neighborhood and added to the emotional contest with ourselves to try and keep calm," he said.

He said the fire was at a lower elevation when he first saw it about 2 a.m. and appeared to climb higher up the mountain just before sunrise.

At about 9 a.m., after being allowed to return home, he said, "It's not imminently dangerous."

He said he was "affected in an emotional sense but not in a physical sense."

Later, shortly after 10 a.m., he said the southern side of the fire appeared to be "dying down quite a bit."

There were some active flames, but "less and less" of them, he said.

"There doesn't appear to be further southward movement," he said.

However, the fire appeared to have destroyed a dragon fruit farm in Launiupoko that had been "engulfed in flames."

West Maui state Rep. Angus McKelvey, who lives in Launiupoko, said neighbors woke him at 2 or 2:30 a.m. Friday.

"The sky was all lit up red and orange," he said.

He could see the fire "marching down the hill toward us and up the mountain."

"It looked like it was backing off.," he said.

"Then all of a sudden," at about 4 a.m., police showed up to evacuate residents.

"It was literally, like, bam, 'OK, get up and go. Evacuate, flee now.' "

He said the wind was whipping through the valley, creating little tornados. "It was grabbing the smoke from the fire," he said. "It was pretty wild."

McKelvey estimated that 100 people, including his 92-year-old mother, were evacuated from the Launiupoko area. He and some others decided to wait in their cars near an emergency staging area until emergency workers said residents could return to their homes, at least temporarily.

"The pre-storm prep came in handy. We had the cars gassed up," said McKelvey, who waited in his car with his dog and cat.

At about 8:30 a.m., he was at home with no power, ready to leave again if conditions changed. "It looks like it's starting to come under control," at least in the Launiupoko area, he said. "It's running out of area to burn and the wind is beating it back."

He said neighbors who tried to drive to Lahaina were stopped by fire burning down toward Honoapiilani Highway. "The fire just kept marching toward Lahaina, then jumped the highway," McKelvey said.

From a distance, he said he could see what looked like a house burning "like a Roman candle."

Barbara Potts, a resident of the Aina Nalu condominium in Lahaina, said she received a phone call around 1:30 a.m. from her sister, Kathy Ramey, who lives near Puamana. She told Potts to get ready to evacuate because of the fire.

Potts went outside to watch the fire, and "finally, it looked like it was getting close."

The Aina Nalu condominium is on Wainee Street, and the closest cross street is Dickenson Street.

Potts said she hoped the fire would be less threatening, but "it kept getting worse and worse." The smoke was "pretty bad," she said.

Finally, she left her condominium around 5 a.m., and as she was driving out of town "there were embers flying all over the place. It looked pretty dangerous."

At the time, there was wind from the hurricane, but no rain.

The wind would "get really strong, then it would die down, and it would change directions a lot," Potts said.

She checked into the Kaanapali Shores condominium where she worried about her sister and her condo unit.

She said she tried to text and call her sister but couldn't get through.

"It's nerve wracking," Potts said. "I haven't slept all night . . . I'm tired but I can't sleep."

A Lahaina resident, who declined to give his name, said he left his home below Princess Nahienaena Elementary school around 3 a.m.

He had already been awakened by Lane's strong winds buffeting his home. He saw a neighbor outside using a flashlight.

"I look out the window and saw big flames everywhere. It always looks like it's closer than it is," he said.

He thought that, with the winds fanning flames, his family should pack up some belongings and leave.

"We could smell it and feel the heat from it," he said.

After he left, he joined many others in going to the north end of the Lahaina bypass to get a closer look at the fire.

He later went to shelter "up north" in West Maui.

McKelvey said the fire demonstrated the need for a second route between West Maui and Central Maui.

"This underscores the broken record that keeps playing over and over again, having one road in and out. You need two highways. This kind of proves it. That's the only thing people will say after it's all said and done."

At least two dozen people were moved from a hurricane shelter at Lahaina Intermediate School to the civic center in the early-morning hours as the fire threatened the location.

At the center, a generator was being used to keep lights on, but it was not strong enough to power air conditioning. With doors left open, smoke from the fire was blowing into the building, the civic center worker said.

Around 1 a.m. today, emergency personnel began responding to reports of a brush fire near Kauaula Valley in Lahaina, officials said. The 3- to 4-acre fire rapidly spread, and – as a precaution – county officials and Red Cross personnel evacuated as many as 26 people from an emergency shelter at Lahaina Intermediate School to the Lahaina Civic Center.

Initially, Honoapiilani Highway was closed in only the westbound direction between Shaw Street in Lahaina and Maalaea. Later, the highway was closed in both directions. It reopened as of 9:30 a.m.

Police reported at 3:29 a.m. that Kahekili Highway, Lahaina-bound, was closed because of the fire. Motorists were advised to avoid the area.

Hawaiian Tel customers were unable to make phone calls in the Lahaina area, police said. And, cellphone service was sporadic.

As of 4 a.m., 10 fire companies, tankers from both the Fire and Public Works departments and one battalion chief were at the fire scene.

At 12:31 a.m., the Hawaii Red Cross reported 381 people were in shelters in Maui County, including 57 at Lahaina Intermediate, 145 at Maui High School in Kahului, 75 at Lokelani Intermediate School in Kihei and 64 at King Kekaulike High School in Pukalani.

The Maui News

Planning panel advances special fund for shoreline issues

Revolving fund would gain revenue from application fees and fines



County Council Planning Committee Chairwoman Kelly King addresses council members during a meeting Thursday. The committee recommended approval of a bill that would create a special management area revolving fund to address shoreline issues like coastal erosion and beach access. • The Maui News / COLLEEN UECHI photo

WAILUKU — A special fund that could bring in more than \$100,000 for shoreline-related issues passed through a County Council committee on

Thursday.

The Planning Committee voted 6-0 to recommend passage of a bill to create a special management area revolving fund. It would draw revenue from application fees and fines for violations along Maui County's shorelines.

"Our coastlines are facing so many challenges, and the community and our agencies are always left scrambling to provide solutions to erosion, beach access, etc., with limited or no resources," said Lahaina resident Kai Nishiki, who worked with Council Member Elle Cochran to propose the revolving fund.

Nishiki said the idea grew out of the Mahinahina Beach condominiums, where owners had to pay \$100,000 in fines to the county and demolish unpermitted structures at the 32-unit complex in Honokowai.

Deputy Planning Director Joseph Alueta said that fines for special management violations generate about \$25,000 to \$75,000 each year. Meanwhile, application fees for special management area assessments, permits and shoreline setback variances bring in about \$60,000 to \$70,000 annually. Those fees currently go into the general fund but would go to the new revolving fund, if approved. Grants and donations could also go toward the fund.



Stacy Crivello

"We should utilize these funds that come off of our shoreline issues into creating solutions for our shoreline issues," Cochran said, adding that the money could help address sea level rise, beach restoration, coastal retreat and purchasing lands for easements and beach access.

Council Member Riki Hokama, who chairs the Budget and Finance Committee, supported the bill but wanted to make sure the fines came back to the county and not the state, since they are collected per state rules. Deputy Corporation Counsel Michael Hopper explained the county has collected those fines in the past.

"I don't know of any case where those fines have gone to the state," he said.

Jeffrey Dack of the Current Planning Division said that use of the funds "would be determined through the normal annual budget process." Every year, the planning staff creates a list of priorities that the director chooses to be included in the mayor's proposed budget.

The bill also calls for the Finance Department director to keep track of all revenues and expenses, and it requires appropriations from the fund to be passed by the council. Any money left over at the end of the year remains in the fund; it does not lapse.

Nishiki said that "the next step is to get our regulatory agencies, our planning agencies and our community members who live along our coastlines to start to think holistically about coastline protection and managed retreat in response to sea level rise."

"It's a big task, but we are up to it," she said. "As an island community, we don't really have a choice."

On Thursday, the committee also discussed a bill that would remove the county's requirement to create a Kahoolawe Community Plan. Committee Chairwoman Kelly King said it's likely to become an issue as the county updates all of its plans. Maui County has limited jurisdiction over Kahoolawe, and the Kaho'olawe Island Reserve Commission essentially "performs many of the functions that the County of Maui would normally perform," Hopper explained.

He said the county created a Kahoolawe community plan in 1982 and another in 1995, a year after the creation of the commission.

"It's still a valid plan," Hopper said. "But it really does not have a legal effect . . . because it's governed by the state, administered by the state."

However, council members were hesitant to do away with Kahoolawe's plan. Council Member Stacy Crivello said Kahoolawe holds an important historical and spiritual place in the county. Her brother, George Helm, and Kimo Mitchell disappeared off Kahoolawe in 1977 during the rise of the aloha aina movement and the efforts to save Kahoolawe from bombing.

"To me (Kahoolawe) is the history and catalyst that we all look at today," Crivello said.

"I feel that Kahoolawe is a beacon of light . . . and it has and continues to raise the political awareness that we have today." Hokama agreed that "whether or not we actually get to utilize the island in the future, I think it's something we should consider, because I think there's an opportunity for residents of our county to have Kahoolawe be a more active part."

The committee deferred action, and King said she planned to meet with the Kaho'olawe Island Reserve Commission to discuss the issue.

"It's good to hear from the committee members about the connection to Kahoolawe, because I think that supersedes the idea of dropping it off the list," King said.

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The Maui News

Shoreline setback rules draw 'line in the sand'

Proposal takes sea-level rise into consideration



Tara Owens, coastal processes and hazards specialist for the University of Hawaii Sea Grant College Program, presents new shoreline rules proposed by Maui County's Planning Department that incorporate sea-level rise data. She appeared at a gathering Wednesday afternoon at the Pacific Whale Foundation in Maalaea. The Maui News / CHRIS SUGIDONO photo

MAALAEA — The Maui County Planning Department is proposing new shoreline setback rules that incorporate sea-level rise data and draw "a literal line in the sand" for coastal development due to erosion.

The new rules, which are the first in the state to address sea-level rise, will be presented to the Maui Planning Commission at 5 p.m. Tuesday in the Kalana Pakui Building in Wailuku. A workshop on the proposed rules will be held Oct. 9 after the commission's regular meeting.

The new rules would effectively wipe out the county's current calculations for shoreline setbacks and establish an erosion hazard line that incorporates future erosion from sea-level rise. The new line would be used for coastal developments uniformly throughout the county, streamlining the application process for applicants and planners.

For areas where the erosion hazard line is mapped, the shoreline setback line would be the erosion hazard line plus 40 feet inland, according to the proposed rules. In areas without a hazard line, the setback would be 200 feet from the nearest points of the approximate shoreline as mapped by the department.

To view the proposed rules, visit www.mauicounty.gov/DocumentCenter/View/114237/ShorelineRules-for-MPC-2018.



This photo from May 2016 shows erosion threatening a structure and part of Royal Kahana's pool deck. TARA OWENS photo

The new rules follow Mayor Alan Arakawa's proclamation in February that directed the department to revise rules and to incorporate sea-level rise in determining shoreline setbacks. A December report by the Hawaii Climate Change Mitigation and Adaptation Commission assessed vulnerabilities to coastal areas with sea-level rise and provided recommendations for improving resilience to coastal hazards.

Planning Director Michele McLean said Wednesday that the new rules are "a lot to take in" and are not up for adoption next week. She said she wants to give the public and planning commissions an opportunity to review and provide feedback before acting on them.

"For some properties, it certainly will be significant," McLean said Wednesday. "This follows the proclamation of Mayor Arakawa and the climate commission report that we have to start factoring in sea-level rise to our shoreline setback rules.

"It would be irresponsible not to."

If the rules are adopted, property owners in the middle of permitting and applications would be grandfathered into the new regulations and allowed to make certain improvements and repairs, McLean said. However, they would not be allowed to expand beyond the erosion hazard line.



This photo from June 2016 shows major erosion from a storm outside Kaanapali Beach Club in Honokowai. TARA OWENS photo

On Wednesday, the Maui Chapter of American Institute of Architects explored the new rules and ramifications for coastal property owners. County and state officials provided a short presentation to about 25 residents and architects at the Pacific Whale Foundation in Maalaea.

Tara Owens, coastal processes and hazards specialist for the University of Hawaii Sea Grant College Program, said Maui's significant erosion is due to sea-level rise; seasonal wave conditions and storms that move sand; and human intervention, such as seawalls, revetments and sand mining. She added that Maui has the highest percentage of beach loss in the state, partly caused by the sinking of the neighboring Big Island.

Eighty-five percent of Maui's shoreline is eroding, she said.

Global sea levels are expected to rise 3.2 feet by 2100, but researchers now believe that the level could be reached by 2060. The rise could submerge or destroy 300 structures, 11 miles of coastal highway, 3,130 acres and cause \$3.2 billion in economic losses to Maui, according to the architects group.

Hawaii ranks second to Florida as the state most at risk and could lose as much as 9 percent of its housing, according to the architects group. The statewide cost is estimated at \$25 billion.



Waves wash over Honoapiilani Highway at Mile Marker 14 in May 2017 in Olowalu. ASA ELLISON photo

Owens listed a number of options coastal experts are pursuing. They include setbacks and relocation; reconfiguring homes; beach nourishment and/or dune restoration; and temporary erosion control, such as sand pushing or erosion blankets.

Owens provided several photos of hotels and condominiums employing some of the options with the majority of those properties in West Maui. Some property owners in the area, though, have been subjected to lawsuits due to permitted work and public outcry against seawalls. Since 2007, more than 25 seawalls have failed with the vast majority from Lahaina to Kapalua, Owens said. Honokowai had six and Keonenui Bay had five.

Jim Buika, coastal resources planner with the planning department, joined Owens at the presentation and said they spend most days traveling to beaches to see "the good, the bad and the ugly." He said Maui's beaches are shrinking due to development, sandbags and other man-made interventions.

"You'd be surprised at how much ugly there is on Maui," Buika said. "It's an incredible struggle to preserve what we have at this point. We need some paradigm shifts in our thinking.

"Our planning process right now is very reactive in nature. It's parcel by parcel. We try to protect one property after a big storm and then it has impacts on the next property and chews up an entire shoreline."

Buika said county planners regularly have to deal with property owners who have built too close to the shoreline using the county's current rules. For individual properties, current setbacks are based on factors, including average erosion rate and the depth of the lot.

Buika showed a photo of two properties on the makai side of South Kihei Road. Both were approved under current setback rules, but the new rules leave them almost completely within the erosion hazard line.

The projected line was displayed using the Hawaii Sea Level Rise Viewer that launched in December. The viewer provides interactive maps of projected exposure and vulnerability to coastal hazards with sea-level rise.

To use the viewer, visit www.pacioos.hawaii.edu/shoreline/slr-hawaii/.

Some architects asked if the line would account for variation in geography and topography. Buika said the line is subject to change but "is a good planning guideline at this point" and accounts for various geographies.

Owens acknowledged that the county could be open to lawsuits from homeowners encroaching the new line if they are told they cannot build a seawall to protect their property. She said property owners at Sunset Beach on Oahu are embroiled in a suit with the state due to unauthorized armoring.

McLean said she would have to consider projects on a case-by-case basis, which could include armoring if there are no impacts to other properties or other extenuating circumstances. She knows there may be a situation, though, where the department would not allow a homeowner to build walls around their home.

"That's a legal matter that I can't get into," she said. "For example, if we were to deny a permit and they filed a suit against the county, what course that would take I really don't know."

McLean said her department has explored the scenario but not in great detail.

"We don't like going into hypotheticals too much, but I do think it's a question we do have to be prepared to answer," she said.

Maui Planning Commissioner Lawrence Carnicelli said during Wednesday's gathering that more education is needed for homeowners on building too close to the shoreline. The former government affairs director for the Realtors Association of Maui said some homeowners may find a way around the new rules, but officials need to draw "a literal line in the sand."

"It's impossible to write law that's going to protect you from every loophole, every attorney or high-paid guy from wherever they are," Carnicelli said. "We're going to do the best we can, but guess what, there's going to be guys that find a workaround.

"It's unfortunate that you can't fix every puka in the law."

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The New York Times Sunday Special Section: Visionaries With the Courage to Change the World

05-29-2018 Karen Albert



On May 27th, *The New York Times* identified visionaries, those who "disrupt, take risks, push boundaries to change the way we see the world or live in it, and even create new enterprises." They chose individuals in the fields of climate, arts, business, medicine, social justice, and technology who are "forward-looking, working on exciting projects, helping others, or taking a new direction."

Visionaries in the climate field include:

- * Nathaniel Stinnett, Founder and Executive Director of the Environmental Voter Project The point of this project is to get people who consider themselves environmentalists to vote, so their priorities would show up in polls of likely voters and politicians would have to pay attention to them to get elected, bringing environmental issues into the national conversation.
- * Elizabeth Yeampierre, Executive Director of Uprose As leader of a Latino community-based organization in Brooklyn, which is one of the United States' most successful community-based climate and environmental justice groups, she has advocated for lead-paint-removal legislation and helping to pass brownfields legislation, and has spoken at a climate-change rally on the National Mall in Washington, DC.
- * Boyan Slat, Founder of The Ocean Cleanup When he was 16, he went scuba diving in Greece and saw more plastic than fish. Within two years, he had started The Ocean Cleanup foundation and invented a device to

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remove plastic from the ocean. He is now preparing to utilize his invention on the North Pacific Garbage Patch, gathering plastic to be taken by barge to land and recycled.

- * Kendra Kuhl, Co-founder of Opus 12 This clean-energy start-up has a goal of turning carbon dioxide emissions into new fuels and materials similar to plastic. They are designing a device that combines carbon dioxide emissions from industrial processes with water and a catalyst in a reactor. When electricity is applied to the reactor, it produces fuel or plastics. Opus 12 founders want to be able to recycle tons of carbon dioxide emissions daily, preventing additional planet warming.
- * Kim Cobb, Professor of Atmospheric and Climate Science at Georgia Institute of Technology She has been researching on Christmas Island in the Central Pacific for more than 20 years and has reconstructed the way El Niño has behaved over the past 7,000 years. Her work demonstrates that El Niño has become more intense as a result of human activity. Cobb has become a public defender of climate scientists, their work, and the planet, challenging scientists to focus on solutions and her students to reduce their carbon footprints.

For additional information on visionaries in other fields, visit The New York Times Web site.

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INDIAN INSTITUTE OF MANAGEMENT KOZHIKODE **COLLABORATES** WITH STANFORD FOR EXECUTIVE POST GRADUATE **PROGRAMME**

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