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Outreach Efforts of the Hawai‘i Groundwater and Geothermal Resources Center

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ABSTRACT

The Hawai‘i Groundwater and Geothermal Resources Center (HGGRC) within the University of Hawai‘i at Mānoa,was formed in 2014 to provide a central hub from which to disseminate data and information related to Hawai‘i’s groundwater and geothermal resources. In Hawai‘i, geothermal development faces mistrust among some sectors of the community. Contributing to the mistrust are concerns about environmental impact and people’s safety, protests by activists regarding indigenous beliefs about the volcano, resistance to corporate development, a blowout at a geothermal power plant in 1991, and a persistent misinformation campaign by a vocal activist community. Recently HGGRC has launched an outreach campaign to disseminate accurate information about geothermal resources and energy production. The outreach program features a website (www.higp.hawaii.edu/hggrc), social media, and presentations, and we are in the process of developing educational materials such as an informational flier and a documentary. The website disseminates the following information about Hawai‘i’s geothermal resources: facts, news, datasets, and historical articles and photographs. While HGGRC recognizes the sensitivities around geothermal in Hawai‘i, it identifies geothermal as a clean, baseload renewable energy that can enable Hawai‘i to achieve its green energy goals. HGGRC envisions a sustainable Hawai‘i that practices responsible, active stewardship over its natural resources, and promotes evidence-based energy and management policies that protect the people, the land, and the future of the islands.

1. INTRODUCTION

The Hawai‘i Groundwater and Geothermal Resources Center (HGGRC), founded in 2014, serves as a hub for geothermal and groundwater research, education and community outreach. This research entity at University of Hawai‘i at Mānoa:

- Compiles, organizes, and makes publicly available data on Hawai‘i’s groundwater and geothermal resources from private and public agencies and organizations
- Provides close to ‘real-time’ data stemming from active projects within the Center
- Facilitates regional investigations on Hawai‘i’s groundwater and renewable energy resources
- Provides policymakers with the necessary information to optimally utilize Hawai‘i’s natural resources and plan for the future.

Contributors to HGGRC include faculty, research staff, federal and state agencis, and undergraduate and graduate students.

As part of HGGRC’s mission to inform stakeholders, especially the public, HGGRC aims to perform outreach to disseminate accurate information about geothermal. The campaign features a website, digital collections, social media, and presentations, and HGGRC is currently developing educational materials such as a one-page flier, an informational booklet, and aims to compile a documentary. To date, HGGRC has not ever received funding specifically for this outreach effort. Figure 1 shows the HGGRC logos.

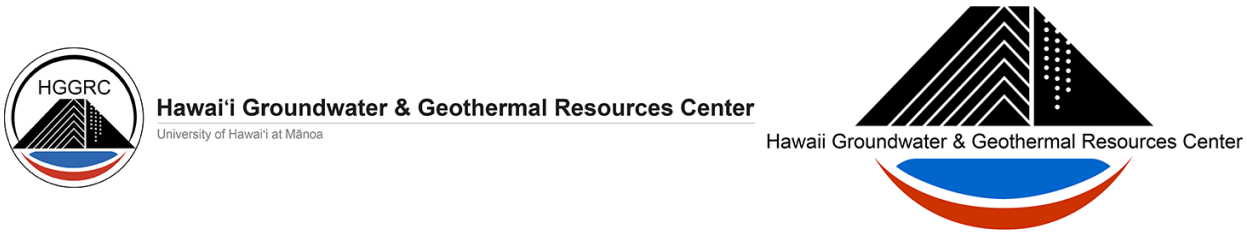


Figure 1: HGGRC’s logos.

2. WEBSITE AND DIGITAL COLLECTIONS

The HGGRC website (www.higp.hawaii.edu/hggrc) was launched in 2014 as a central hub from which to disseminate data and information related to Hawai‘i’s groundwater and geothermal resources. Prior to the formation of the HGGRC website, we were using ‘blogspot.com’ to give project updates and submitting newly digitized material (largely thanks to the National Geothermal Digitization Project) and providing data to the public only through national repositories. The HGGRC website is hosted by the Hawai‘i Institute of Geophysics and Planetology at UHM. It has proven a highly effective tool to dessiminate our science to collegues and both international and local communities.

Since the 2015 launch, the HGGRC website has received over 58,000 visitors and 163,000 hits from around the world. Hosted on the website are a number of datasets, further described below.

2.1 The Geothermal Collection

The Hawai‘i Geothermal Digital Collection[1] hosts data and information relating to geothermal exploration and development in Hawai‘i that was digitized largely thanks to the National Geothermal Data System project. The website features a historic timeline for geothermal in Hawai‘i and historical photos, newspaper clips and videos. The website links to the Geothermal Collection (on eVols[2] and ScholarSpace[3], which are hosted by UH Mānoa Library). The collection includes documents, photographs, maps, and videos, and over 1,000 digital documents that are freely available online. More than 296,000 documents have been downloaded in the past five years.

2.2 Hawai‘i Play Fairway Project

The U.S. Department of Energy-funded Hawai‘i Play Fairway project[4] has produced the first updated geothermal resource assessment for the State of Hawai‘i since 1985. On the website, the project’s publications, conference presentations, and datasets (via an external site) are available for download. On the blog-style *Lāna‘i Island Project Updates*, we provide drilling updates.

2.3 Humu‘ula Groundwater Research Project

The U.S. Army-funded Humu‘ula Groundwater Research Project[5] (HGRP) drilled two test holes in Hawai‘i Island’s ‘Saddle’ region between Mauna Loa and Mauna Kea volcanoes to investigate groundwater resources. Results included the discovery of: i) groundwater at a much shallower depth than expected, ii) a dike-impounded aquifer, and iii) a potential geothermal reservoir. For this project, the website features publications, conference presentations, a blog, and data--rock core run depth logs, working core box logs, and photos of the core boxes. On the blog-style “HGRP Progress Updates,”[6] we provide drilling and project updates between February 2013 to June 2016.

2.4 The Groundwater Collection

This digital collection[7] includes three important series of work regarding groundwater resources in Hawai‘i. The Hawai‘i Division of Hydrography Bulletins contain the first comprehensive and detailed studies of the geology and water resources of Hawai‘i. Written by prominent geologists Harold T. Stearns and Gordon Macdonald, the Bulletins have long been out-of-print, but are still important references in the field of Hawaiian hydrology. By prominent private hydrologist Tom Nance and previously not available to the public, the Blackhawk Geophysics Reports included geophysical surveys for determining groundwater resources for five major Hawaiian islands. From the City & County of Honolulu, the historical soil survey investigation reports date from 1965 to 1988. Property owners submitted these reports to the City’s Department of Planning and Permitting to obtain approval for construction. The reports’ data include geotechnical borings done for building foundations on O‘ahu, which included detailed geologic information. Engineers, consultants, property owners, and graduate students have used these reports for research.

2.5 Hawai‘i State Water Wells

The Hawai‘i State Water Wells[8] project lists water wells and additional information in tabular/database format. This project digitized all 3,500+ of the water well files at the Department Land and Natural Resources, Commission of Water Resource Management. This legacy collection contains records of early siting, drilling, testing, and initial operation of water wells in the main Hawaiian islands.

2.6 ‘Ike Wai -- Hawai‘i EPSCoR

‘Ike Wai aims to collect new hydrological and geophysical data at two study sites, on O‘ahu and Hawai‘i Island and elucidate groundwater flow; develop a new data and modeling platform for Hawai‘i volcanic hydro-geology, economic modeling, and decision support. HGGRC participates in the hydrogeochemistry research of the ‘Ike Wai project . The website features publications and conference presentations by the project’s hydrogeochemistry team.[9]

[1] https://www.higp.hawaii.edu/hggrc/projects/geothermal-digital-collection/geothermal-collections/
[2] https://evols.library.manoa.hawaii.edu/handle/10524/12279
[3] https://scholarspace.manoa.hawaii.edu/handle/10125/21320
[4] https://www.higp.hawaii.edu/hggrc/projects/hi-play-fairway/
[5] https://www.higp.hawaii.edu/hggrc/projects/humuula-groundwater-research-project/
[6] https://www.higp.hawaii.edu/hggrc/category/progressupdates/
[7] https://www.higp.hawaii.edu/hggrc/projects/geothermal-digital-collection/groundwater-collections/
[8] https://www.higp.hawaii.edu/hggrc/projects/hawaii-state-waterwells/
[9] https://www.higp.hawaii.edu/hggrc/projects/ike-wai-groundwater/ike-wai-papers-conference-proceedings/

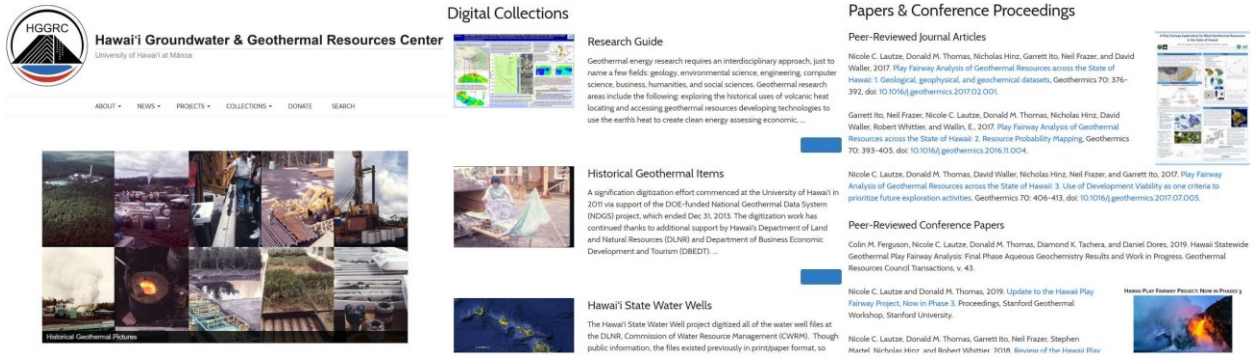


Figure 2: Screenshots of three of the pages on the HGGRC website. The first page from the left is the front page of the website. The middle page lists and describes HGGRC's digital collections. The first page from the right lists citations for a project's papers and conference proceedings and link to those materials for download.

3. SOCIAL MEDIA

HGGRC's social media efforts aim to broadcast local to global news related to groundwater and geothermal as well as to publicize going-ons within HGGRC. Through posts and images, the Facebook[10] and Twitter[11] accounts, with 330 "likes" and 212 followers respectively, have disseminated information including:

- Introductory educational information about groundwater and geothermal resources (e.g. defining jargons and explaining the water cycle and the Earth's creation of geothermal energy)
- News about HGGRC
- Historical articles and photographs relating to Hawai'i's geothermal development
- Links to news articles related to Hawai'i's groundwater and geothermal resources

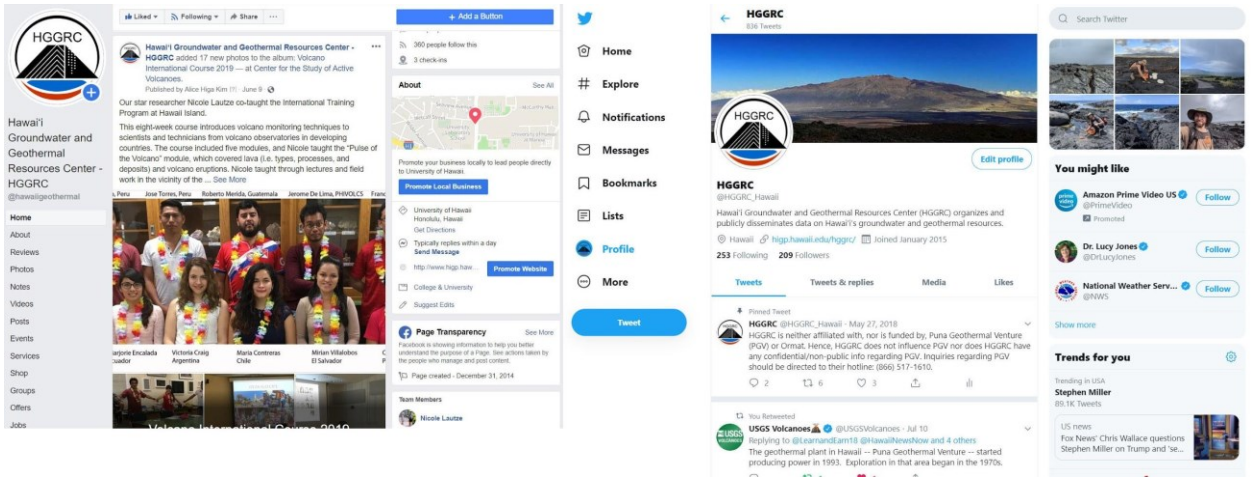


Figure 3: HGGRC's Facebook and Twitter.

[10] https://www.facebook.com/hawaiigeothermal/

[11] https://twitter.com/HGGRC_Hawaii

4. OUTREACH MATERIAL

A goal of HGGRC is to generate geothermal outreach material, such as fact-based fliers, a powerpoint presentation, and even a balanced documentary. A few examples of what we have accomplished to date are shown in figures 4, 5, and 6 below.

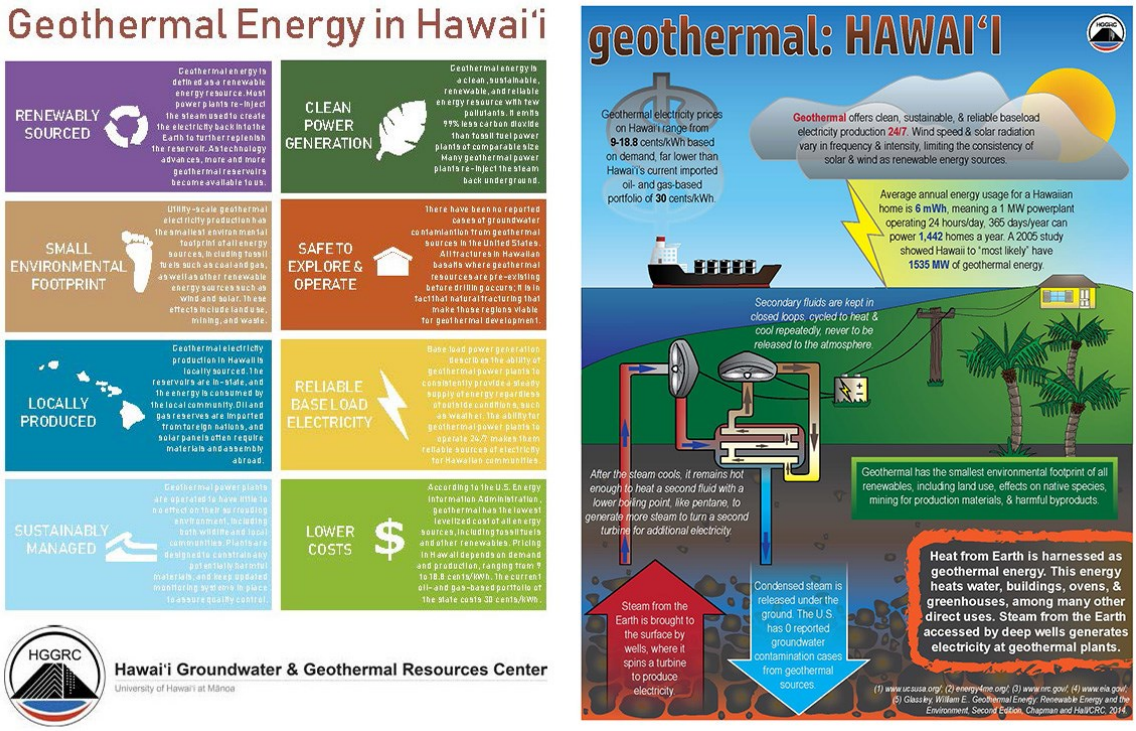


Figure 4: Pages from the informational flier. The left page lists the advantages and benefits of geothermal in Hawai'i. With illustrations, the right page explains how a binary cycle geothermal plant converts heat from the Earth into electricity.

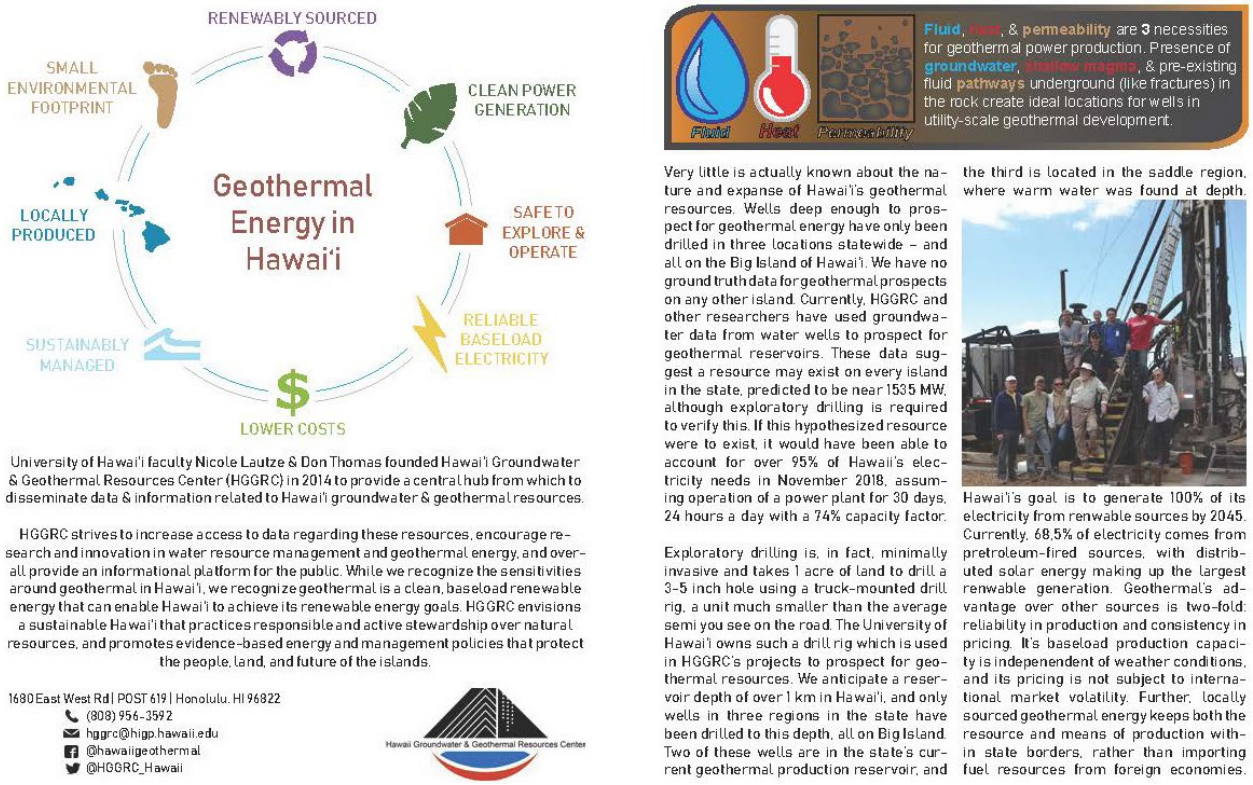


Figure 5: Pages from the informational flier. The left page introduces HGGRC, and the right page explains about geothermal research in Hawai'i.

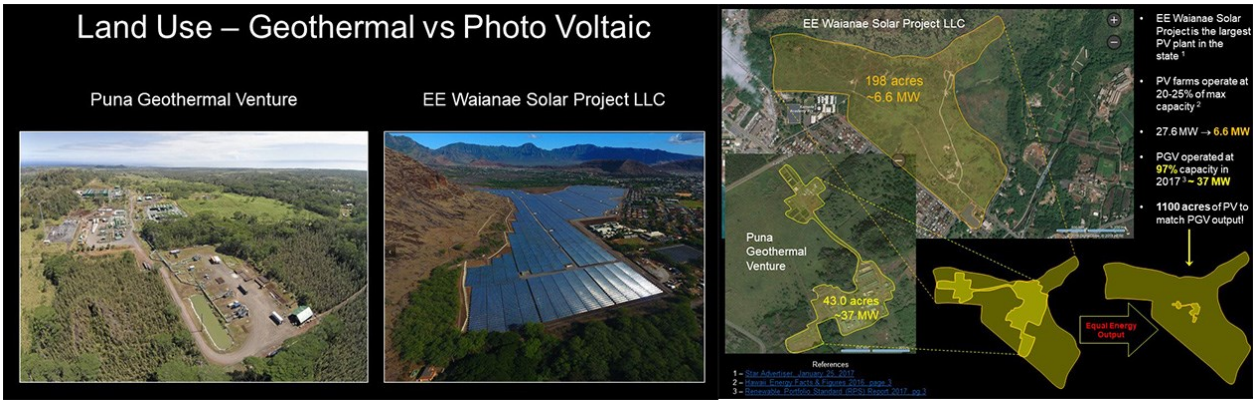


Figure 6: Geothermal is generally has the lowest land use per unit energy output than wind and solar. In Hawaii, Puna Geothermal Venture (PGV) occupies roughly 25% of the land area of the EE Waianae Solar Project, yet produces over 5 times as much energy. PGV produces about 1 MW of electricity per acre while solar typically requires 5 to 10 and wind typically 30 to 100 acres to produce 1 MW. (from Brennis, 2019).

5. HGGRC DURING THE 2018 KILAUEA ERUPTIONS

Interest in HGGRC spiked during Kilauea's eruptions from May 3 through August 2018 as the lava flow encroached on Puna Geothermal Venture's power plant, Hawai'i's only geothermal power plant. People searched for information about geothermal resources in Hawai'i on HGGRC's website, geothermal digital collection, and social media.

5.1 Social Media

All of the major newspapers--statewide[12] and island-wide[13]--and TV news stations[14] in Hawai'i were reporting on Puna Geothermal Venture's status regarding the Kilauea lava flow in May and Summer 2019. Hence, we aggregated the news articles onto our social media. During the peak of the coverage, several news articles and TV news segments about PGV were being produced each day.

It seemed that as a result of this, some of the public, and even news reporters from *CBS News* and *Honolulu Civil Beat* mistook HGGRC for PGV's parent company Ormat Technologies. When this occurred, HGGRC provided Ormat's contact information.

After receiving a large number of messages aimed towards PGV, HGGRC posted the following disclaimer onto its Facebook:

"HGGRC has received multiple inquiries regarding ongoing activities at the Puna Geothermal Venture (PGV) facility in Lower Puna. Although HGGRC has been tracking press reports and Civil Defense and USGS messages regarding the current eruption, HGGRC is neither affiliated with, nor is funded by, PGV or Ormat. Hence, HGGRC does not have any influence over past, current, or future actions taken by PGV nor do our staff or affiliates have any confidential or non-public domain information regarding PGV's wells or policies. All inquiries regarding PGV should be directed to their hotline at (866) 517-1610. Thank you."

Figure 7: Disclaimer notice on HGGRC's Facebook and Twitter.

[12] *Honolulu Star-Advertiser*, *Honolulu Civil Beat*, and *Pacific Business News*

[13] *Hawaii Tribune-Herald*, *West Hawaii Today*, *Big Island Video News*, and *Big Island Now*

[14] *Hawaii News Now*, *KITV*, and *KHON*

Afterwards, people still posted angry messages about PGV, and their general themes, with examples, are as follows:

- Profiting from geothermal risked people's health.
  - "Your leaking poisons and gasses has been very hurtful to many families in the neighborhood. Many had to abandon their homes next to your plant. Only a greedy, dishonest, Destructive for profit Corporation would disrupt Tutu Pele's life flow in a Residential Area."
- Hawai'i's natural resources should be left alone.
  - "Everything has potential. Geothermal is not wanted anywhere on our aina [land], leave our Natural resource ALONE!"
- Hawaiian fire goddess Pele disapproved geothermal energy in Hawai'i.
  - "When I asked Pele last Saturday why she's so upset she said "geothermal energy." I googled and found your site and a link about how the company would profit and then how the hazardous chemicals were moved bc of risk. She was going straight for them intentionally. She doesn't want to be used to make millions of dollars of profit for others and she doesn't want hazardous chemicals on the island at all. That is why she did all these eruptions this time. She doesn't want anything that can harm the island and she won't stop until they're gone. Please listen to the aina and respect her and reconsider how you can use the gifts of the Island to make low cost public utilities (not for profit) without adding all the negatives. Thanks for listening, from Pele."
- PGV needed close permanently.
  - "NO MORE PGV!"
- PGV deserved punishment for the perceived damages it caused.
  - "Good.. they caused the increase in volcanic activity.. hope it burns to the ground"
- PGV caused the Kilauea eruptions through fracking.
  - "... since Geothermal "fracking" is known to cause seismic disturbances, and the recent eruption in Puna was right in PGV's location, why do we assume the wells had nothing to do with this devastating eruption?"

Along with online messages, the HGGRC office would receive a phone call from people wanting more information about once a week.

In September 2018, PGV allowed HGGRC to post PGV's newspaper ad on HGGRC's social media. Now that the eruption had stopped, in the ad, PGV gave updates and expressed commitment to reopen the plant. The full-page ad ran in the *Honolulu Star-Advertiser*, Hawai'i's largest circulating daily newspaper, for a few weeks.

5.2 Website

During the eruption, HGGRC's website experienced sharp increases in visitors and visits, as illustrated on **Figure 8**.

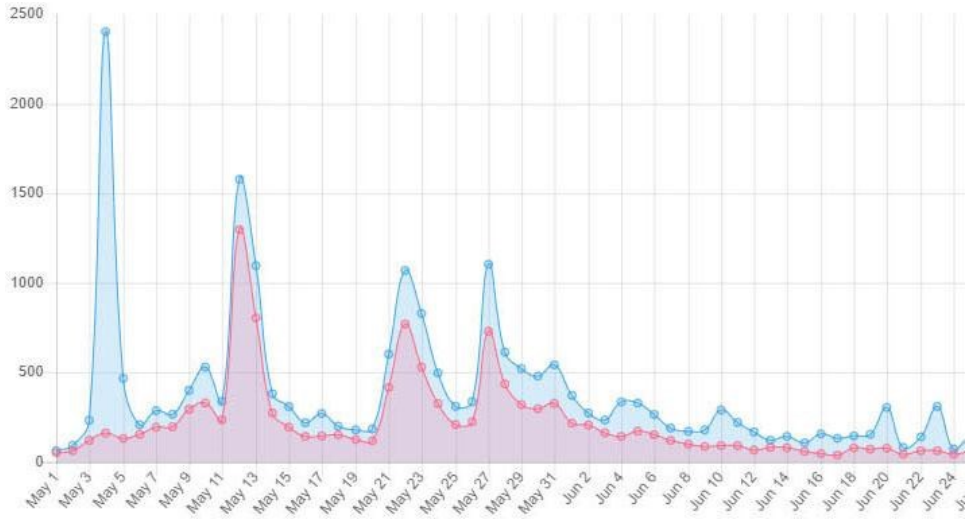


Figure 8: Hit statistics of the HGGRC Website from May 1 to June 24, 2018, with the numbers of visitors (red line) and visits (blue line).

Sharpest increases occurred during May 2018, when the lava flow was approaching and encroaching PGV's facilities. The spikes seemed to happen every time a volcanic event threatens PGV. The following table lists the dates of the increases, numbers of visitors and visits, and PGV's ongoing events. From May 1 to September 10, 2018, during the eruptions, HGGRC's website received 16,150 visitors and 31,207 visits

Table 1: Numbers of Visitors and Visits to the HGGRC Website and PGV's Ongoing Events from May 1 to June 1, 2018.

Date	Number of Visitors	Number of Visits	Event at Lower Puna
May 1	32	52	Before the eruption
May 5	161	2,403	May 3: The first fissure open and started spewing out lava.
May 11	329	530	May 10: PGV moved all 60,000 gallons of its to Shipman Industrial Park in Kea'au, Hawai'i.
May 13	1,298	1,579	May 12: New fissure formed east of PGV.
May 23	770	1,069	May 21: Lava started flowing onto PGV property. Final PGV well plugged
May 28	729	1,104	May 27 and 28: Lava flow covered wells KS-5 and KS-6. May 27: On his website, conspiracy theorist Michael Salla accused PGV of fracking and causing the Kilauea eruption.
June 1	327	542	May 30: Lava destroyed PGV's substation and a warehouse with a drilling rig and covered PGV's main access road.

5.3 Geothermal History Timeline

On HGGRC's website, the page "Geothermal History" got the most hits during the Kilauea eruptions.[15] This page featured a historical timeline of geothermal development and exploration in Hawai'i. As **Figure 9** shows, visits per day to this page spiked from a range from 0 to 12 from May 1 to May 20 to 161 on May 23, 240 on May 27, 133 on May 30, and 93 on June 2.

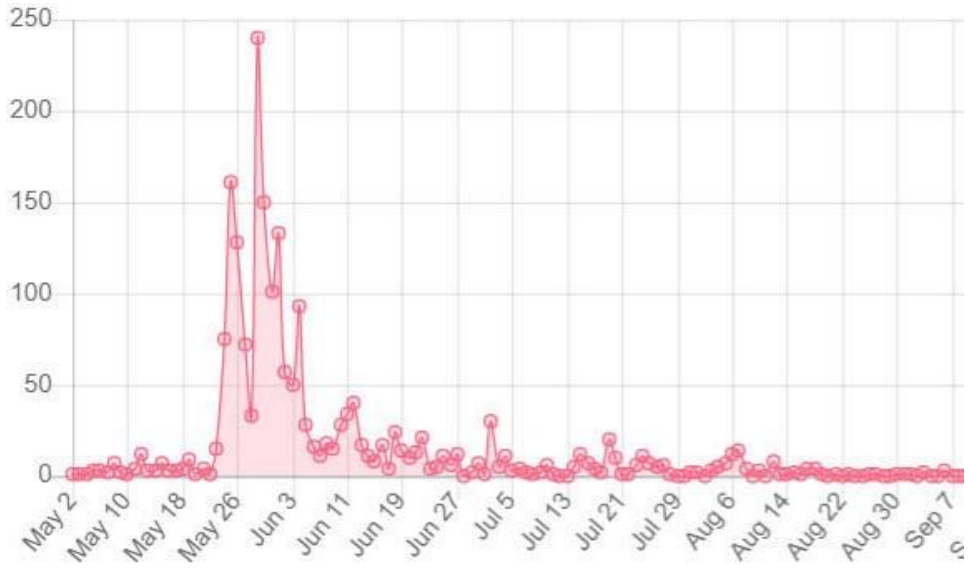
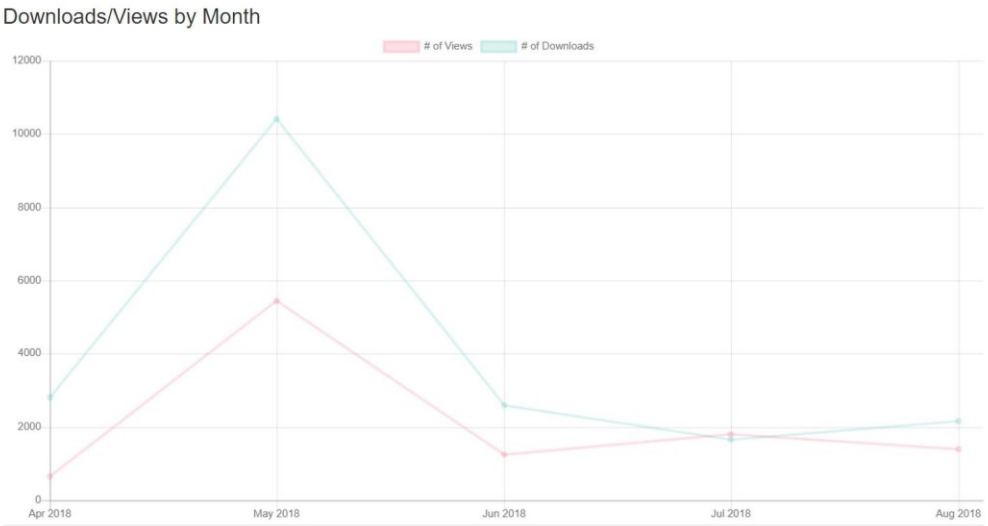


Figure 9: Hit Statistics of the HGGRC website's "Geothermal History" page from May 2 to September 7, 2018.

[15] https://www.higp.hawaii.edu/hggrc/history/geothermal-development-2/

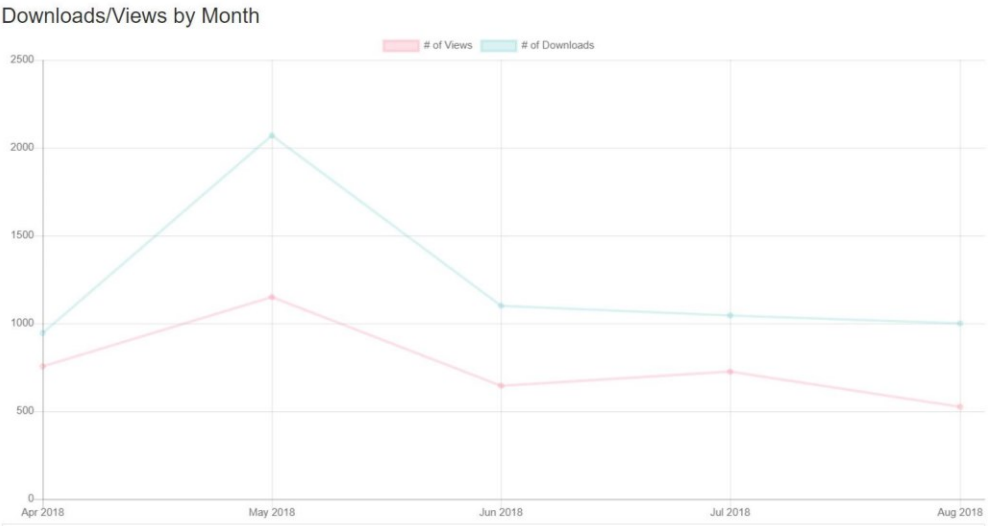
5.4 DIGITAL COLLECTIONS

HGGRC developed "The Geothermal Collection," two mirror digital collections, each with over 1,400 documents with in-depth information about geothermal development in Hawai'i. Documents included reports, journal articles, book chapters, newspaper articles, and maps. Hosted by the University of Hawai'i at Mānoa Library, The Geothermal Collection are on two institutional repositories: eVols[16] and ScholarSpace[17]. During the Kilauea eruptions, both of the repositories saw dramatic increases in numbers of page hits and downloads, as shown on **Figure 10** and **Figure 11**.



	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Total
Downloads	2803	10425	2583	1648	2159	19618
Page Views	658	5460	1246	1790	1381	10535

Figure 10: Statistics of views (red line) and downloads (blue line) of The Geothermal Collection on eVols (hosted by UH Mānoa Library) and the numbers below.



	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Total
Downloads	946	2068	1101	1044	999	6158
Page Views	754	1151	644	723	523	3795

Figure 11: Statistics of views (red line) and downloads (blue line) of The Geothermal Collection on ScholarSpace (hosted by UH Mānoa Library) and the numbers below.

[16] https://evols.library.manoa.hawaii.edu/handle/10524/12279

[17] https://scholarspace.manoa.hawaii.edu/handle/10125/21320

As the Kilauea eruption threatened the lower Puna residents' livelihood and the PGV power plant, The Geothermal Collection's ten most downloaded files from April to August 2018 are listed in the table below.

Table 2: Ten of the most downloaded files on The Geothermal Collection on eVols and ScholarSpace (hosted by UH Mānoa Library) from April to August 2018.

Title	Number of Downloads
Puna Geothermal Venture (map of PGV's facility)	3959
The Puna Geothermal Venture Project power for the Island of Hawaii	997
Hawaii geothermal blowout prevention manual : Circular C-125	584
Puna Geothermal Venture Facility Emergency Response Plan (ERP), Version 6.1	537
Puna property maps : including Kahaualea, Kapaahu to Kikala, and Puna Forest Reserve	532
Environmental impacts - native flora and fauna	472
Abbreviation listing (relating to the petroleum industry)	412
State of Hawaii geothermal action plan element III part II, micrometeorological aerometric and health effects analysis	400
Barriers to protect Hilo from lava flows	374
Geothermal : big protests sparked by issue	345

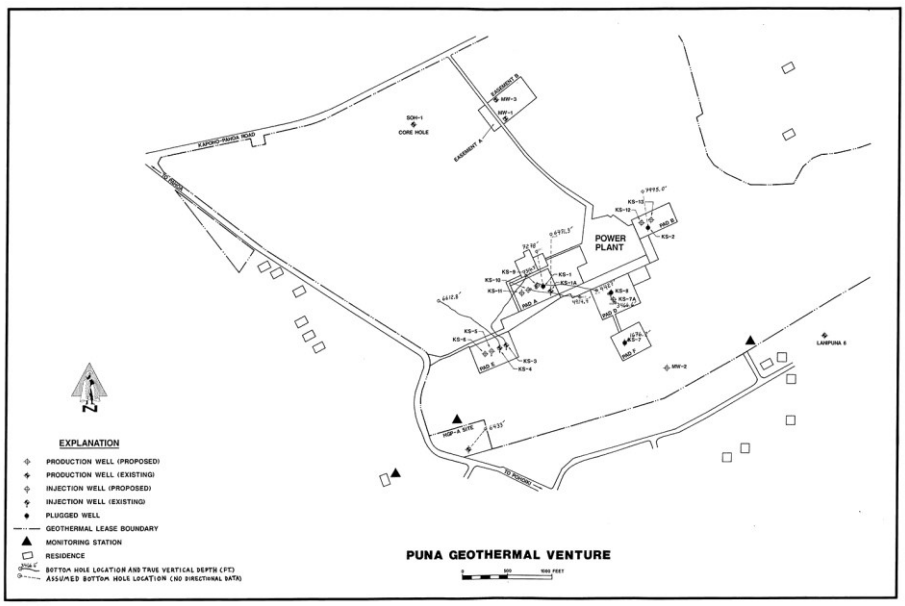
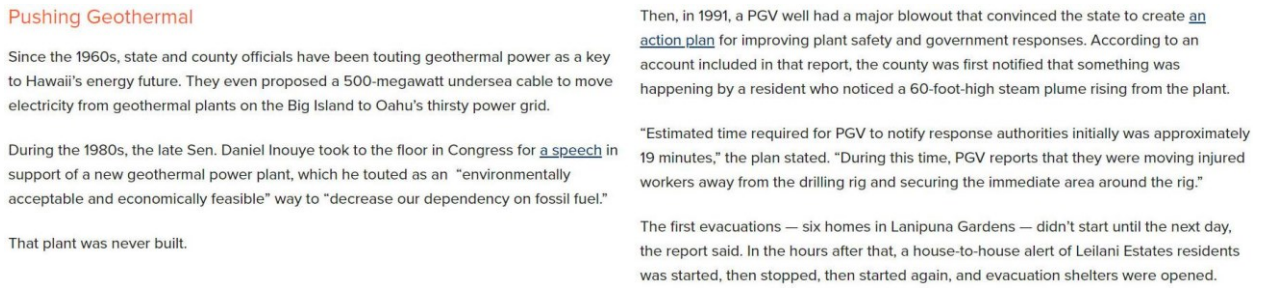


Figure 12: A map of the Puna Geothermal Venture power plant[18] -- the most downloaded file on The Geothermal Collection from April to August 2018.

[18] https://evols.library.manoa.hawaii.edu/handle/10524/46378

Local news reporters linked materials in The Geothermal Collection in their articles about PGV. For example, a *Honolulu Civil Beat* article, "Big Island: Geothermal Plant and Its Neighbors Have Clashed for Decades," referred to the following materials (McNarie, 2018):

- Daniel K. Inouye's statement to the U.S. President defending Hawaii's geothermal energy development[19]
- Geothermal action plan, element ii : review of emergency plan and response to the 12 June 1991 uncontrolled venting of the Puna Geothermal Venture (PGV) KS8 geothermal well[20]



Pushing Geothermal

Since the 1960s, state and county officials have been touting geothermal power as a key to Hawaii's energy future. They even proposed a 500-megawatt undersea cable to move electricity from geothermal plants on the Big Island to Oahu's thirsty power grid.

During the 1980s, the late Sen. Daniel Inouye took to the floor in Congress for a speech in support of a new geothermal power plant, which he touted as an "environmentally acceptable and economically feasible" way to "decrease our dependency on fossil fuel."

That plant was never built.

Then, in 1991, a PGV well had a major blowout that convinced the state to create an action plan for improving plant safety and government responses. According to an account included in that report, the county was first notified that something was happening by a resident who noticed a 60-foot-high steam plume rising from the plant.

"Estimated time required for PGV to notify response authorities initially was approximately 19 minutes," the plan stated. "During this time, PGV reports that they were moving injured workers away from the drilling rig and securing the immediate area around the rig."

The first evacuations — six homes in Lanipuna Gardens — didn't start until the next day, the report said. In the hours after that, a house-to-house alert of Leilani Estates residents was started, then stopped, then started again, and evacuation shelters were opened.

Figure 13: Excerpts from the Civil Beat article that linked materials in The Geothermal Collection.

The "major blowout" mentioned in the article was technically not a blowout (when the steam bypasses the well casing completely), but rather an uncontrolled release. This release emitted a loud sound, and two employees received minor injuries as a result, but did not seek medical treatment (Pang and Witty, 1994). However, this release did not pose any health threat to the surrounding neighborhood. While neighbors claimed the uncontrolled release caused their illnesses, the deputy director of the Hawaii State Department of Health at the time, Bruce Anderson said that most of those illnesses were likely "psychosomatic," or were caused by psychological and emotional stress (Pang and Witty, 1994).

6. CONCLUSION

HGGRC found that its outreach campaign was successful in disseminating evidence-based information about geothermal resources and energy production through HGGRC's website, social media, presentations, and other outreach material. Its website provides information about Hawai'i's geothermal resources including facts, news, datasets, and historical articles and photographs that help to keep the public informed on geothermal energy in Hawaii, while aiming to dispell any misinformation that may be circulating throughout the local community. Through acknowledging the mistrust initially surrounding geothermal in Hawai'i and maintaining a factual, science-based approach to promote geothermal as a clean, baseload renewable energy that can help Hawai'i to achieve its green energy goals, we have seen a positive response to our outreach efforts. Facebook and Twitter provide us with the ability to distribute up-to-date information, breaking news, articles and other easily approachable sources of information, as well as providing platforms on which our audience can interact with HGGRC. The mission and vision of HGGRC helps centralize our outreach efforts in both public perception and in our own generation of educational material, keeping our focus on promoting a sustainable Hawai'i that cares for its natural resources and advances evidence-based energy and management policies for the people, land, and future of the islands.

ACKNOWLEDGEMENTS

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Pang, G.Y.K., and Witty, J.: PGV Agrees to Pay Neighbors, *Hawaii Tribune-Herald* (1994).

[19] https://evols.library.manoa.hawaii.edu/handle/10524/22866

[20] https://evols.library.manoa.hawaii.edu/handle/10524/48054