

Mitchell D. Roth  
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## County of Hawai'i

### PLANNING DEPARTMENT

Zendo Kern  
*Director*

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*Deputy Director*

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January 22, 2024

Mary Alice Evans, Director  
Office of Planning and Sustainable Development  
Environmental Review Program  
235 S. Beretania Street, Room 702  
Honolulu, Hawaii 96813

**SUBJECT: Acceptance of the Final Environmental Impact Statement for the Puna Geothermal Venture Repower Project**

Dear Director Evans,

With this letter, the County of Hawai'i Planning Department, **accepts** the Final Environmental Impact Statement (FEIS) for the "Puna Geothermal Venture Repower Project" as having fulfilled the requirements of Chapter 343, Hawaii Revised Statutes (HRS), and Title 11, Chapter 200.1, Hawaii Administrative Rules (HAR). The procedures for assessment, consultation, review, preparation, and submission of the FEIS have been completed satisfactorily. The requirements have been satisfied, and comments submitted during the comment period have received satisfactory responses and have been appropriately incorporated into the FEIS.

The economic, social, and environmental impacts that would likely occur, should this project be implemented, are adequately described in the statement. The analysis, together with the comments made by reviewers, provide useful information to policy makers and the public.

My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws.

Sincerely,

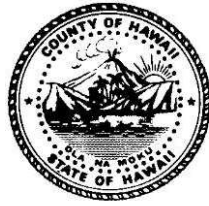
Zendo Kern  
Zendo Kern (Jan 22, 2024 10:31 HST)

ZENDO KERN  
Planning Director, County of Hawai'i

Mitchell D. Roth  
*Mayor*

Deanna S. Sako  
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## County of Hawai'i

### PLANNING DEPARTMENT

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January 31, 2024

Mary Alice Evans, Director  
Office of Planning and Sustainable Development  
Environmental Review Program  
235 S. Beretania Street, Room 702  
Honolulu, Hawaii 96813

**SUBJECT: Supplement to Acceptance of the Final Environmental Impact Statement for the Puna Geothermal Venture Repower Project**

With this letter, the County of Hawai'i Planning Department, requests that the Office of Planning and Sustainable Development Environmental Review Program (OPSD-ERP) publish this supplement to the County's January 22, 2024 letter accepting the Final Environmental Impact Statement (FEIS) for the "Puna Geothermal Venture Repower Project" as having fulfilled the requirements of Chapter 343, Hawaii Revised Statutes (HRS), and Title 11, Chapter 200.1, Hawaii Administrative Rules (HAR).

The County of Hawai'i Planning Department would like to acknowledge that one of the public comment letters provided during the Draft Environmental Impact Statement (DEIS) comment period printed incorrectly in the FEIS package, which was published in *The Environmental Notice* on January 8, 2024. The error occurred as a result of a merging issue when combining the FEIS appendix files in Adobe Acrobat. The program substituted the fonts and printed the characters incorrectly, resulting in illegible text. This occurred to the text in Mr. Falk Amelung's Public Comment Letter 10, which was provided during the DEIS comment period as an attachment to an email. The attachment received was legible; it was only after combining the files into the larger appendix document that it appeared incorrectly.

We note that Mr. Amelung's comment letter was provided twice during the comment period. Public Comment Letter 10 was emailed as an attachment by Mr. Amelung. Public Comment Letter 19 is a scan of the same letter that was hand delivered by Ms. Sara Steiner at the June 1, 2023, public comment meeting. Thus, Mr. Amelung's comment letter appears as two distinct letters in Appendix D to the FEIS: as Public Comment Letter 10 on page D-405 (.PDF page 519), and again as Public Comment Letter 19 on page D-441 (.PDF page 555). The text of Public Comment Letter 19 did not experience an Adobe Acrobat conversion error and appears correctly in the FEIS.

Mary Alice Evans, Director  
Office of Planning and Sustainable Development  
January 31, 2024  
Page 2

The contents of Public Comment Letter 10 and Public Comment Letter 19 are identical. This is also noted in the comment response table. Responses to Public Comment Letter 10 start on page D-1082 (.PDF page 1196), and the response to Letter 19 on page D-1087 (.PDF page 1201) refers to the responses to Letter 10 since the letters are identical. The content of Letter 10 is reproduced in the Appendix D comment response table word for word from the submitted public comment letter. Enclosed please see Letter 10 as it was submitted. HAR § 11-200.1-27(b)(1) requires the Final EIS to include, among other things, “reproduction of all comments and responses to substantive written comments[.]” Since the same letter was submitted twice during the public comment period it appears twice in Appendix D of the FEIS. The Adobe Acrobat version with text conversion issue of Public Comment Letter 10 is reproduced in the comment response table and responses to such are sufficient, the County of Hawai‘i Planning Department's determination that the contents of the FEIS are adequate and acceptable is affirmed.

The County understands that the Applicant's consultant will be sending a notification letter with the above information to Mr. Amelung.

My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws. The County appreciates OPSD-ERP publishing this supplement with the County's January 22, 2024, acceptance letter for the record.

Sincerely,

  
[Zendo Kern \(Jan 31, 2024 15:33 HST\)](#)

ZENDO KERN  
Planning Director

Enclosure: Public Comment Letter 10, Submitted by Falk Amelung



May 30, 2023

To:  
Scott Glenn, Acting Director  
Office of Planning and Sustainable Development  
Environmental Review Program  
235 S. Beretania Street, Room 702  
Honolulu, Hawaii 96813  
[HI\\_Climate@hawaii.gov](mailto:HI_Climate@hawaii.gov)

cc: Zendo Kern, Hawaii County planning department ([planning@hawaiicounty.gov](mailto:planning@hawaiicounty.gov))

**Comments on the Draft Environmental Impact Statement of the Puna Geothermal Venture  
Repower project.**

Dear Mr. Glenn,

I am a professor of Geophysics at the University of Miami and a previous Hawai'i resident. I am writing to bring to your attention four items that are not sufficiently addressed in the Draft Environmental Impact Statement (draft EIS) which are explained in detail below. In essence, the PGV should be mandated to operate dedicated seismic monitoring with open data access to be able to investigate whether and how PGV operations impact the volcano.

I have a long-term interest in studying the Hawaiian volcanoes using geophysical methods (see publication listing below). My expertise regarding the PGV comes from a pending research proposal with the Department of Energy to study (i) how geothermal exploitation affected the propagation of the 2018 dike from Kilauea volcano that erupted in the vicinity of the PGV, and (ii) the subsidence in the PGV area (see item 4). The proposal was submitted to DOE in January 2023.

As a clean energy advocate I am concerned about Hawai'i reaching its climate goals. What will be the future of geothermal energy if another eruption occurs and PGV operations are found to be responsible for focusing the magma?

Please don't hesitate to contact me for additional information. Also please be so kind to confirm that you have received this letter.

Best regards

A handwritten signature in black ink that reads "Falk Amelung".

Falk Amelung

***Item 1: Lack of seismic monitoring.*** The draft EIS lacks a plan to monitor the seismic activity in the PGV area. Although PGV does not inject water at pressures sufficient to fracture the rock (PGV is not an enhanced geothermal system), PGV's operations nevertheless can induce seismicity. This is because the east rift zone is likely under tectonic extension driven by seaward motion of Kilauea volcano's south flank. The injection of water is associated with local increases in pore fluid pressure which in the widely accepted Coulomb Failure model acts to reduce the stress threshold for faults to rupture. Pore fluid pressure increases therefore can lead to the spontaneous generation of seismicity (see section 3.1.1.4 in the draft EIS). Most of these induced earthquakes are small (magnitude -2 to 2) and not detectable by the island-wide seismic network operated by the U.S. Geological Survey's (USGS) Hawaii Volcano Observatory (HVO). However they could be detected by seismographs located inside boreholes in and near the PGV area. Precise local seismic data combined with sub daily production and injection data could demonstrate that PGV operations are safe and answer many questions regarding the induced seismicity such as the seismic swarms during the 2018 eruption (see next item).

**I therefore recommend the operation of a bore-hole seismic network at PGV.**

Geothermal projects in California and Nevada all have excellent seismic monitoring networks (e.g. 48 stations at The Geysers, 16 stations at Coso and 8 stations at the Salton Sea). Community acceptance of these projects is partly based on studies by independent scientists showing that induced seismicity is within expectations.

Although PGV does not use EGS methods, seismic monitoring should be mandated because of PGV's location within an active volcanic rift zone.

The draft EIS does not describe the current state of seismic monitoring in the PGV area. I was informed that PGV operates a borehole seismic network but these data are not shared because they are proprietary. If true, this should give us some pause. Why are these data not openly available and used to demonstrate that the induced seismicity is within expectations?

***Item 2: Hazards from propagating dikes and 2018 co-eruption seismicity.*** The geological hazards section of the draft EIS addresses the hazards from subaerial lava flows but not the hazards from dikes propagating underground. The 2018 dike from Kilauea volcano propagated from the Pu'Ō'Ō area down the lower east rift zone and erupted in the PGV area. When the pressure in the production wells had risen to unusual high values (2000 psig or 13.8 MPa) heavy mud was injected in order to "kill" the well (Spielmann et al., 2020). The draft EIS does not discuss whether this was an appropriate response measure and what are the lessons, if any, for the next eruption.

The injection of heavy mud during an eruption can be debated. It led to high pressure at the bottom of the well and potentially to a hydraulic fracture. In fact, the day when the mud was injected a seismic swarm was detected and the eruption transitioned to erupt hotter, less viscous lava (Neal et al., 2018). This is consistent with the generation of a hydraulic fracture. Whether the pressure was enough to fracture the rock or not, it almost certainly was above the allowable limit for a non-enhanced geothermal system. Precise seismic data (which may exist, see item 1) would allow us to study how the injection of the heavy mud affected the course of the eruption.

The draft EIS should contain a discussion on how a propagating dike can affect the wells. It also should contain an eruption response plan considering whether the injection of heavy mud during an eruption can have unintended consequences. Alternatively the wells could be filled prior to the arrival of the dike.

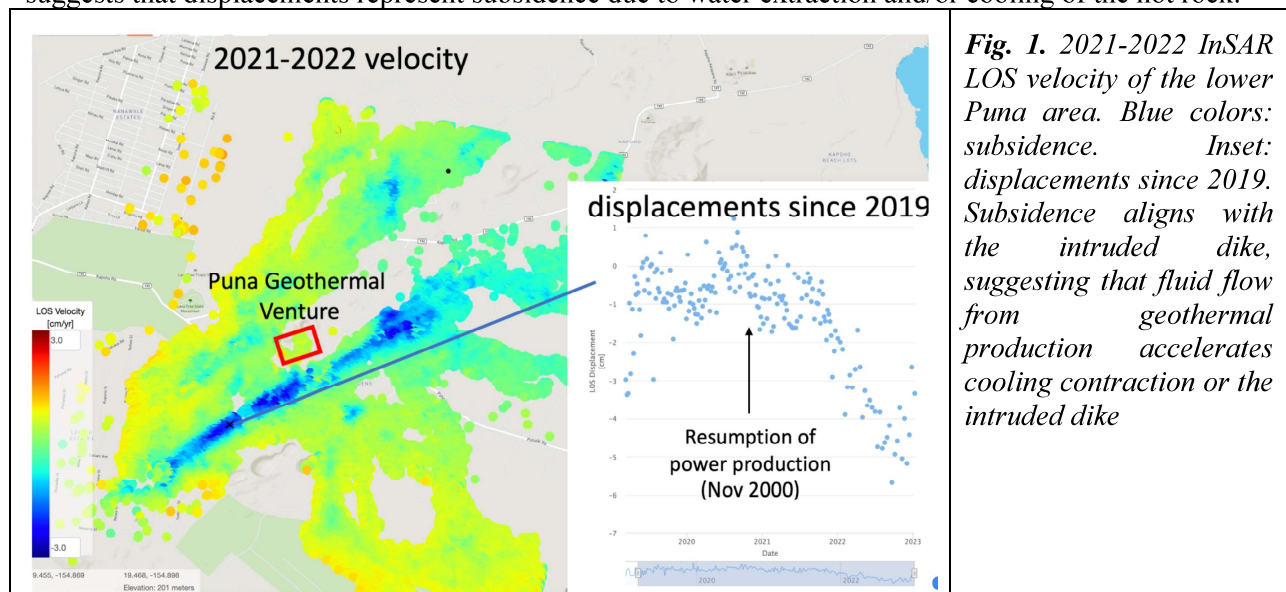
**Item 3: Impact of geothermal exploration on dike propagation.** The draft EIS lacks a discussion on how geothermal exploration affects the trajectory of dikes propagating through Kilauea’s east rift zone. The draft EIS cites a USGS study which concludes that there is no evidence that humans have influenced the volcanic processes in the lower east rift zone (Kauahikaua & Truesdell, 2020). This study, however, only considers *the origin of the dike* (which at 25 km was too far to be affected by the PGV operations), but not *the location of the eruption of the dike*. Was it coincidence that the 2018 dike erupted in the PGV area? Given the length of Kilauea’s lower east rift zone the random probability of a dike to erupt in the PGV area is about 10-20%.

There is a mechanism of how geothermal exploration can affect dike propagation. The extraction of heat leads to the formation of cooling contraction cracks. These cracks make the rock mechanically weak, which can lead to the arrest of dikes. This effect should be estimated in the draft EIS.

An alternative explanation for the eruption of the dike in the PGV area is the presence of the dacitic magma bodies which is the reason why the site was selected for geothermal exploitation in the first place.

**Item 4: Subsidence from geothermal exploration in the lower Puna area.** In the draft EIS it is stated that there have been no significant changes in patterns or trends of deformation due to human activity in the PGV area, based on the Kauahikaua & Truesdell (2020) study mentioned above (section 3.1.1.3). This statement is not correct.

I processed InSAR time series data based on >100 Sentinel-1 SAR images which show for the 2021-2022 period a linear 50-200 meter-wide ground displacements feature in the area of the eruptive fissure at a rate of 2-3 cm/yr (~1 inch/yr) in direction of the satellite (Fig. 1). A displacement time-series starting after the 2018 eruption shows that ground displacements started in fall 2020 when PGV resumed production. This suggests that displacements represent subsidence due to water extraction and/or cooling of the hot rock.



The significance of the observed subsidence will not be known unless the proposed research project is conducted. Nevertheless, it is proof that PGV operations affect a larger area and highlight the need for high-quality seismic monitoring.

These data can be viewed at

[https://insarmaps.miami.edu/start/19.4963/-154.8161/11.5323?flyToDatasetCenter=false&startDataset=S1\\_IW12\\_087\\_0527\\_0531\\_20190106\\_XXXXXXXX\\_N19428\\_N19512\\_W154924\\_W154847\\_noCorrPS&minScale=-3&maxScale=3&refPointLat=19.50517&refPointLon=-154.88401&pointLat=19.46892&pointLon=-154.89778&startDate=20200107&endDate=20230109](https://insarmaps.miami.edu/start/19.4963/-154.8161/11.5323?flyToDatasetCenter=false&startDataset=S1_IW12_087_0527_0531_20190106_XXXXXXXX_N19428_N19512_W154924_W154847_noCorrPS&minScale=-3&maxScale=3&refPointLat=19.50517&refPointLon=-154.88401&pointLat=19.46892&pointLon=-154.89778&startDate=20200107&endDate=20230109)

## **Attachment: Selected publications on the Hawaiian volcanoes by F. Amelung**

Varugu, B., Amelung, F. Southward growth of Mauna Loa's dike-like magma body driven by topographic stress. *Sci Rep* 11, 9816 (2021). <https://doi.org/10.1038/s41598-021-89203-6>

Farquharson, J, F. Amelung; Extreme rainfall triggered the 2018 rift eruption at Kīlauea Volcano, Hawaii (2020), *Nature*, 580(7804), 491-495.

Shuangyu Ge, Guoqing Lin, Falk Amelung, Paul G. Okubo, Don Swanson (2019), The accommodation of the south flank's motion by the Koa'e fault system, Kīlauea, Hawai'i: insights from the June 2012 earthquake sequence, DOI:10.1029/2018JB016961

Baker, S., and F. Amelung (2015), Pressurized magma reservoir within the east rift zone of Kīlauea Volcano, Hawai'i: Evidence for relaxed stress changes from the 1975 Kalapana earthquake, *Geophys. Res. Lett.*, 42, doi:10.1002/2015GL063161.

Lin, G., Shearer, P. M., Matoza, R. S., Okubo, P. G., & Amelung, F. (2014). Three-dimensional seismic velocity structure of Mauna Loa and Kīlauea volcanoes in Hawaii from local seismic tomography. *Journal of Geophysical Research: Solid Earth*, 119(5), 4377-4392.

Lin, G., F. Amelung, P. M. Shearer, and P. G. Okubo (2015), Location and size of the shallow magma reservoir beneath Kīlauea caldera, constraints from near-source  $V_p/V_s$  ratios, *Geophys. Res. Lett.*, 42, doi:[10.1002/2015GL065802](https://doi.org/10.1002/2015GL065802).

Lin, G., Amelung, F., Lavallée, Y., & Okubo, P. G. (2014). Seismic evidence for a crustal magma reservoir beneath the upper east rift zone of Kīlauea volcano, Hawaii. *Geology*, G35001-1.

Amelung, F., S.H. Yun, T. Walter, Paul Segall and S.-W. Kim. Stress control of deep rift intrusion at Mauna Loa volcano, Hawaii. *Science* 316: 1026-1030 [DOI: 10.1126/science.1140035], 2007.

Plattner, C., Amelung, F., Baker, S., Govers, R., & Poland, M. (2013). The role of viscous magma mush spreading in volcanic flank motion at Kīlauea Volcano, Hawai'i. *Journal of Geophysical Research: Solid Earth*, DOI: 10.1002/jgrb.50194

Baker, S. and F. Amelung (2012), Top-down inflation and deflation at the summit of Kīlauea Volcano, Hawaii observed with InSAR, *J. Geophys. Res.*, doi:10.1029/2011JB009123

Walter T. R., F. Amelung, Volcano-earthquake interaction at Mauna Loa volcano, Hawaii, *J. Geophys. Res.*, 111, B05204, doi:10.1029/2005JB003861, 2006.

**From:** [webmaster@hawaii.gov](mailto:webmaster@hawaii.gov)  
**To:** [DBEDT OPSD Environmental Review Program](#)  
**Subject:** New online submission for The Environmental Notice  
**Date:** Monday, January 22, 2024 4:41:24 PM

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**Action Name**

Puna Geothermal Venture Repower Project

**Type of Document/Determination**

Final environmental impact statement (FEIS) acceptance or non-acceptance

**HRS §343-5(a) Trigger(s)**

- (1) Propose the use of state or county lands or the use of state or county funds

**Judicial district**

Puna, Hawai'i

**Tax Map Key(s) (TMK(s))**

(3) 1-4-001: 001, 002, and 019

**Action type**

Applicant

**Other required permits and approvals**

Building Permit (County), Grading Permit (County)

**Discretionary consent required**

DOH noncovered source permit (for Phase 2, upgrades to 60 MW)

**Approving agency**

County of Hawaii Planning Department

**Agency contact name**

April Surprenant

**Agency contact email (for info about the action)**

[planning@hawaiiicounty.gov](mailto:planning@hawaiiicounty.gov)

**Email address or URL for receiving comments**

[planning@hawaiiicounty.gov](mailto:planning@hawaiiicounty.gov)

**Agency contact phone**

(808) 961-8288

**Agency address**

101 Pauahi Street  
Suite 3  
Hilo, HI 96720  
United States  
[Map It](#)



**Accepting authority**

County of Hawaii Planning Department

**Applicant**

Puna Geothermal Venture

**Applicant contact name**

Michael Kaleikini

**Applicant contact email**

[mkaleikini@ormat.com](mailto:mkaleikini@ormat.com)

**Applicant contact phone**

(808) 369-9094

**Applicant address**

P.O. Box 30  
Pahoa, HI 96778  
United States  
[Map It](#)

**Was this submittal prepared by a consultant?**

Yes

**Consultant**

Stantec Consulting Services Inc.

**Consultant contact name**

Michele Lefebvre

**Consultant contact email**

[michele.lefebvre@stantecgs.com](mailto:michele.lefebvre@stantecgs.com)

**Consultant contact phone**

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**Consultant address**

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Hilo, HI 96721  
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[Map It](#)

**Action summary**

Puna Geothermal Venture is currently authorized for and operating a geothermal power plant in the Puna District and proposes to replace the current 12 operating power-generating units with up to four energy converters. The project would increase the production of renewable energy at the existing facility (within the current site fence line) using new, more efficient units on a smaller land footprint compared to the existing units. The project would increase power production from 38 to 46 megawatts in Phase 1 and further increase production to 60 megawatts in Phase 2. The overall property size would remain the same. Most of the existing infrastructure and buildings would remain for the Project including administration buildings, the control room, maintenance areas, well pads, and the gathering system. The

proposed new units would continue to safely supply reliable power from renewable geothermal resources with more efficient and quieter equipment.

**Attached documents (signed agency letter & EA/EIS)**

- [LPGV-FEIS-Acceptance-Signed.pdf](#)

**Action location map**

- [PGV\\_Parcels.zip](#)

**Authorized individual**

Michele Lefebvre

**Authorization**

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.