

Public Utilities Commission

Docket No. 05-0145

O`ahu Power Plant

Testimony of

Jeffrey Mikulina

re: Environmental Impacts and Externalities

LOL T-5

1 **I am** the Director of the Sierra Club, Hawai`i Chapter (since 1998).

2

3 **Education**

4 Master of Science (pending thesis acceptance), University of Illinois, Champaign/Urbana

5 Department of General Engineering, Design for the Environment

6

7 Bachelor of Science (May 1997), University of Illinois, Champaign/Urbana

8 General Engineering with Specialty in Environmental Quality

9

10 **Awards, Professional Recognitions and Fellowships**

11

12 Passed FE (Fundamentals of Engineering) Exam, October 1996.

13 National Science Foundation fellowship under Professor Deborah Thurston

14 researching Multi-Attribute Decision Systems for Environmental Design,

15 University of Illinois (Jan 1997 – Dec 1998)

16 Lincoln Arc Welding Award (1997) Recipient of Merit Award for Senior Design

17 Project. Proposed a solution for heat reclamation from a kiln for a large wallboard

18 manufacturer.

19 Featured in *Honolulu's Midweek* (November 2003), *Honolulu Magazine's* "Best of

20 2000," *Details Magazine* (October 1999), and appeared on cover of *Hawaii*

21 *Business* (February 2004)

22 Received U.S. Environmental Protection Agency Region 9 "Environmental Hero"

23 Award (2003)

1 Voted as one of the most respected community leaders in the 2003 Honolulu Weekly
2 “Reader Poll” (August 2003)
3 Quoted as a source over 1000 times in local, national, and international news outlets,
4 including *The New York Times*, *Washington Post*, *Boston Globe*, CNN, ABC
5 News, MSNBC, CBS Nightly News, *The Times of India*, ARD1 (Germany),
6 Associated Press, and others.

7

8 **Professional Experience**

9 Director, Sierra Club, Hawai`i Chapter (Dec 1998 – Present) Chief spokesperson and
10 lobbyist for largest grassroots environmental advocacy organization in Hawai`i.

11 Oversees the activities of the four Hawai`i Sierra Club groups that have a
12 combined membership of over 5000. Accomplishments with the Sierra Club
13 includes helping to pass legislation that requires returnable deposits on all
14 beverage containers, increases the funding of natural resources through tourism
15 taxes, increases renewable energy use in the state, and creates dedicated funding
16 for land preservation.

17 Member of the Planning Commission, City & County of Honolulu (2004-2007)

18 Appointed by Honolulu Mayor Jeremy Harris and confirmed unanimously by the
19 City Council.

20 Mayoral Appointee to the 2005 – 2006 Charter Commission, City & County of
21 Honolulu

22 Internship at Unitek Environmental Consultants, Inc., Honolulu, HI (Summer 1995)

23 Authored reports and Phase I Assessments, developed remediation plans,

1 performed field work, and compiled information for Defense Reutilization and
2 Marketing Services contracts.

3

4 **Publications - Scholarly**

5 *IEEE Symposium on Electronics and the Environment Proceedings* (May 1998) Co-
6 author of “Energy Efficiency Uncertainty in Environmentally Conscious Design.”

7 *Industrial Engineering Research Conference Proceedings* (May 1998) Co-author of
8 “Tough Choices: Integration of Environmental Protection in Design

9 Optimization.”

10 *American Society of Engineering Education Proceedings* (Spring 1995) Co-author of

11 “A Customer-Centered Perspective of Engineering Education: Characteristics of
12 Effective Graduate Engineers.”

13

14 **Publications - Popular**

15 *Hana Hou! Magazine* (August 2004) “Lighting the Way”

16 *Hana Hou! Magazine* (December 2003) “Clean getaway”

17 *The Boston Globe* (January 20, 2002) “Hawaii searches for balance”

18 *The Ecotourism Observer* (December 2001) “Bridge to Sustainable Tourism”

19 *Backpacker Magazine* (1998-1999) Author of “Weekend Wilderness”

20 *Hawaii Island Journal* (1999 – Present) Numerous articles on environmental
21 solutions

22 *Honolulu Weekly* (1996 - Present) Various articles, features, and book reviews

23

1

2 According to Hawaiian Electric Company (HECO) documents^{1,2}, HECO proposes to
3 build a central power generating station at Campbell Industrial Park on O`ahu consisting
4 of a single simple-cycle combustion turbine generator producing between 76 megawatts
5 (MW) to 130 MW of electricity capacity. The facility will burn naphtha (a petroleum
6 distillate between) or #2 fuel oil (diesel). In addition, a 2.5 MW to 5 MW “blackstart”
7 generator, likely a diesel-fired reciprocating engine, will be installed. They seek to begin
8 commercial operation of the new facility by 2009. Although the Draft Environmental
9 Impact Statement for the proposed facility considered two simple-cycle combustion
10 turbines as the “preferred alternative,” the application before the PUC contemplates only
11 a single turbine.

12

13 The proposed simple-cycle combustion turbine and black start generator will emit a
14 variety of greenhouse gases into the atmosphere, including carbon dioxide, nitrous oxide,
15 and methane, among others. The exact greenhouse gas generation will vary depending on
16 the type and size of the final unit as well as the fuel source and operating conditions. The
17 simple-cycle turbine proposed for the facility is less efficient than a combined-cycle
18 turbine generator – combined cycle turbines can approach 60% thermal efficiency while
19 simple-cycle units typically have a thermal efficiency less than 40%.³

¹ Hawaiian Electric Company. Application to the Public Utilities Commission for the Campbell Industrial Park Generating Station and Transmission Additions Project, filed as Docket 05-0145.

² Hawaiian Electric Company. *Campbell Industrial Park Generating Station & Transmission Additions Draft Environmental Impact Statement*. Prepared by Planning Solutions, Honolulu, January 16, 2006.

³ Ishii, Jun. *Technology Adoption and Regulatory Regimes: Gas Turbine Electricity Generators from 1980 to 2001*. Center for the Study of Energy Markets, University of California Energy Institute. March 2004

1

2 ***Carbon Dioxide (CO₂)***

3 CO₂ is the most significant greenhouse gas component of the proposed generating
4 facility. Since CO₂ generation rates were not explicitly specified in HECO's PUC
5 application, Draft Environmental Impact Statement, or covered source permit application,
6 they are estimated here based on comparable facility emissions and a variety of other
7 sources. Using an emission factor of 20 metric tons of carbon per terajoule (TJ) of energy
8 content for naphtha (20.2 t C/TJ for diesel oil)^{4,5}, a naphtha-fired combustion turbine would
9 emit approximately 800,627 tons (English) of CO₂ annually.⁶ This equates to an emission
10 rate of approximately 1.66 pounds (lbs) of CO₂ per kilowatt-hour (KWh) of electricity
11 produced (a rate less than HECO's system average of 1.96 lbs/kWh⁷). A 5 MW diesel
12 blackstart generator operating at full capacity for a maximum of 500 hours per year
13 would emit approximately 2100 tons of CO₂.

14 *Total CO₂ = 802,727 tons annually.*

15

16 ***Nitrous Oxide (N₂O)***

17 Again, values were not provided for N₂O emissions, so the following estimate is based on
18 U.S. Department of Energy factors. Using a factor of 0.276 lbs/MWh for an oil-fired

⁴ Intergovernmental Panel on Climate Change. *Revised 1996 Guidelines for National Greenhouse Inventories: Workbook*. (1996).

⁵ Edison Mission Energy. *Greenhouse Gas Emission Factor Review, Technical Memorandum*. February 3, 2003.

⁶ Additional assumptions: 110 MW facility operating at full capacity 8760 hours per year with an energy conversion efficiency of 35%.

⁷ State of Hawaii, Department of Business, Economic Development, and Tourism. *Hawaii Climate Change Action Plan*. November 1998.

1 combustion turbine (0.24 lbs/MWh for gas-fired)⁸, emissions of N₂O are estimated at 133
2 tons annually. N₂O emissions from the black start generator would likely be nominal and
3 were not calculated.

4

5 Emissions of greenhouse gases are typically expressed in a common metric so that their
6 impacts can be directly compared, as some gases are more potent (have a higher global
7 warming potential) than others.

8

9 The international standard practice is to express greenhouse gases in carbon dioxide
10 (CO₂) equivalents. Emissions of gases other than CO₂ are translated into CO₂ equivalents
11 using global warming potentials. The IPCC recommends using 100 year potentials. Based
12 on an IPCC equivalency factor of 296 for N₂O,⁹ the oil-fired combustion turbine would
13 emit 39,361 tons of CO₂ equivalent (CO₂ equiv) N₂O.

14 *Total N₂O CO₂ equiv = 39,361 tons annually.*

15

16 ***Methane (CH₄)***

17 Once again, the following estimate is based on U.S. Department of Energy factors. Using
18 a factor of 0.021 lbs/MWh for an oil-fired combustion turbine (0.16 lbs/MWh for gas-
19 fired)¹⁰, emissions of CH₄ are estimated at 10 tons annually. CH₄ emissions from the
20 black start generator would be nominal and were not calculated. Based on an IPCC

⁸ Department of Energy, Energy Information Administration. *Sector-Specific Issues and Reporting Methodologies Supporting the General Guidelines for the Voluntary Reporting of Greenhouse Gases under Section 1605(b) of the Energy Policy Act of 1992, Appendix C.* (2000).

⁹ Intergovernmental Panel on Climate Change. *Third Assessment Report.* (2001).

¹⁰ Department of Energy, 2000.

1 equivalency factor of 23 for CH₄,¹¹ the oil-fired combustion turbine would emit 233 tons
2 of CO₂ equivalent CH₄.

3 *Total CH₄ CO₂ equiv = 233 tons annually.*

4

5 Other potential greenhouse gas emissions were not calculated. Based on the estimates for
6 the greenhouse gases calculated, the proposed facility would emit approximately 842,321
7 tons CO₂ equivalent annually. If the life of generating station is 36 years, over 30 million
8 tons of CO₂ equivalent greenhouse gas may be emitted by the proposed facility.

9

10 The additional greenhouse gases from the proposed facility would likely accelerate and
11 exacerbate global climate change, a problem that threatens to dramatically alter the
12 Earth's climate, foster extreme weather events, and jeopardize the habitability of Earth
13 for humankind.

14

15 Due to the complex nature of global climate change, it is difficult to quantify the impact
16 of any single source of greenhouse gas emissions. Such difficulty, however, should not
17 prevent a sober analysis of the *collective* impact of all anthropogenic sources of
18 greenhouse gases. When the collective impact of greenhouse gas emissions threaten
19 substantial environmental damage, each individual source is implicated (and new
20 greenhouse gas contributors should receive even closer scrutiny, as they are proposed
21 *after* recognition of the problem has occurred). Simply claiming that each source makes a
22 *de minimis* contribution to the problem does not provide an escape from the realities of
23 global climate change. Yet such rationalization – that a more substantial greenhouse gas

¹¹ IPCC, 2001.

1 source is always available to blame and unilateral action would do little to diminish the
2 threat – has successfully prevented any meaningful response to avoiding global climate
3 change.

4

5 The increased amounts of CO₂ and other greenhouse gases are the primary causes of
6 global climate change (or global warming). They are released by the burning of fossil
7 fuels, land clearing and agriculture, among other activities, and lead to an increase in the
8 greenhouse effect, a phenomenon where energy radiated by the sun becomes “trapped” in
9 the Earth’s atmosphere instead of radiating into space. The prevailing scientific opinion
10 on climate change is that “most of the warming observed over the last 50 years is
11 attributable to human activities”.¹²

12

13 IPCC is not alone in its conclusions. In recent years, all major scientific bodies in the
14 United States whose members’ expertise bears directly on the matter have issued similar
15 statements. For example, the National Academy of Sciences report, *Climate Change
16 Science: An Analysis of Some Key Questions*, begins: “Greenhouse gases are
17 accumulating in Earth’s atmosphere as a result of human activities, causing surface air
18 temperatures and subsurface ocean temperatures to rise.”¹³ The report explicitly asks
19 whether the IPCC assessment is a fair summary of professional scientific thinking, and
20 answers yes: “The IPCC’s conclusion that most of the observed warming of the last 50
21 years is likely to have been due to the increase in greenhouse gas concentrations

¹² Intergovernmental Panel on Climate Change. *Climate Change 2001, Working Group I: The Scientific Basis*. (2001).

¹³ National Academy of Sciences Committee on the Science of Climate Change, *Climate Change Science: An Analysis of Some Key Questions* (National Academy Press, Washington, DC, 2001).

1 accurately reflects the current thinking of the scientific community on this issue.”¹⁴

2

3 Others agree. The American Meteorological Society,¹⁵ the American Geophysical
4 Union,¹⁶ and the American Association for the Advancement of Science (AAAS)¹⁷ all
5 have issued statements in recent years concluding that the evidence for human
6 modification of climate is compelling.

7

8 The measure of the response to increased greenhouse gases and other anthropogenic and
9 natural climate forcings is climate sensitivity. It is found by observational¹⁸ and model
10 studies. This sensitivity is usually expressed in terms of the temperature response
11 expected from a doubling of CO₂ in the atmosphere. The current literature estimates
12 sensitivity in the range 1.5–4.5 °C (2.7–8.1 °F). Models referenced by the IPCC project
13 that global temperatures may increase by between 1.4 and 5.8 °C (2.5 to 10.5 °F) between
14 1990 and 2100.¹⁹ The uncertainty in this range results from both the difficulty of
15 estimating the volume of future greenhouse gas emissions and uncertainty about climate
16 sensitivity.

17

18 Global temperature and greenhouse gas concentrations have moved in lock step for
19 millennia. Recent studies suggest that the relationship has held for upwards of 650,000

¹⁴ *Ibid.*

¹⁵ American Meteorological Society, *Bull. Am. Meteorol. Soc.* 84, 508 (2003).

¹⁶ American Geophysical Union, *Eos* 84 (51), 574 (2003).

¹⁷ See www.ourplanet.com/aaas/pages/atmos02.html.

¹⁸ Gregory, J.M. et al. “An Observationally Based Estimate of the Climate Sensitivity,” *Journal of Climate*, Vol. 15, No. 22, November 2002.

¹⁹ Intergovernmental Panel on Climate Change. *Third Assessment Report, Summary for Policymakers*. (2001).

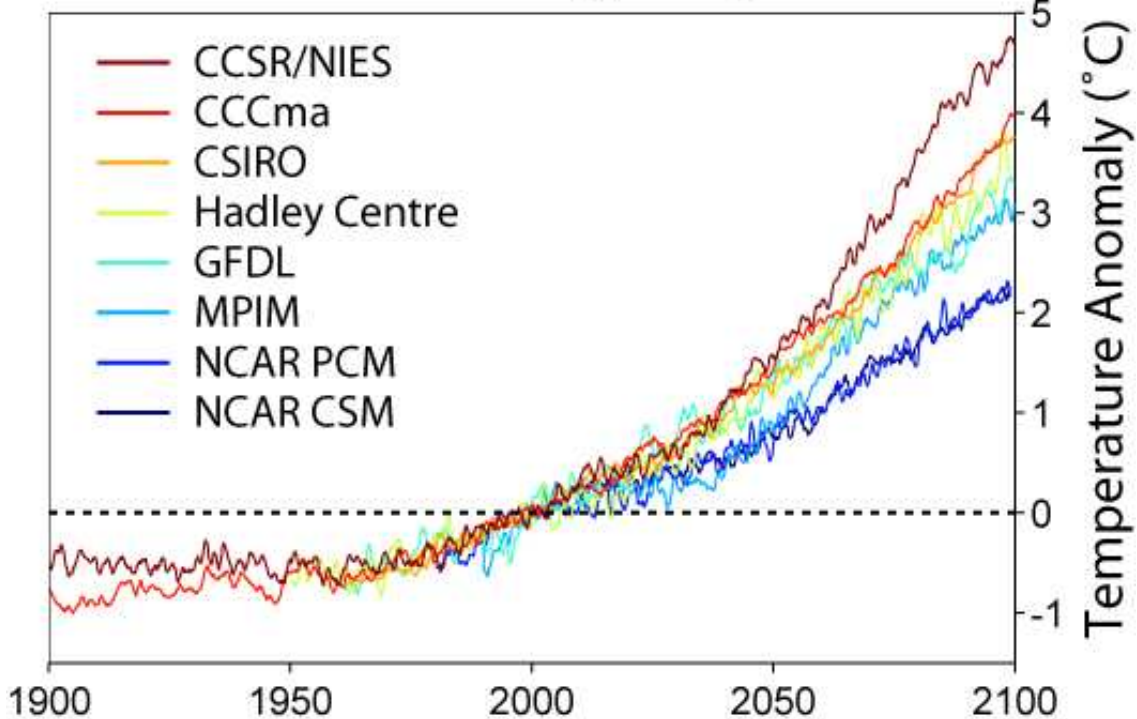
1 years.^{20,21} The same analysis highlights the fact that the current rising atmospheric CO₂
2 concentration, at 380 parts per million by volume, is already 27 percent higher than its
3 highest recorded level during the last 650,000 years.²²

4

5 Based on numerous scenarios for current and future greenhouse gas emissions, the
6 following global warming projects were plotted by the IPCC.²³

7

Global Warming Projections



²⁰ Spahni, R. et al. "Atmospheric Methane and Nitrous Oxide of the Late Pleistocene from Antarctic Ice Cores." *Science*. Vol. 310. no. 5752, pp. 1317 - 1321 (November 2005).

²¹ Siegenthaler, U., et al. "Stable Carbon Cycle–Climate Relationship During the Late Pleistocene." *Science*. Vol. 310. no. 5752, pp. 1313 – 1317 (November 2005).

²² *Ibid.*

²³ Intergovernmental Panel on Climate Change. *Special Report on Emissions Scenarios*. (2001). www.grida.no/climate/ipcc/emission/index.htm

1

2 An increase in global temperatures can in turn cause other changes, including a rising sea
3 level and changes in the amount and pattern of precipitation. These changes may increase
4 the frequency and intensity of extreme weather events, such as floods, droughts, heat
5 waves, hurricanes, and tornados. Other consequences include higher or lower agricultural
6 yields, glacier retreat, reduced summer streamflows, species extinctions and increases in
7 the ranges of disease vectors.²⁴ Warming is expected to affect the number and magnitude
8 of these events; however, it is difficult to connect particular events to global warming.

9 Although most studies focus on the period up to 2100, warming (and sea level rise due to
10 thermal expansion) is expected to continue past then, since CO₂ has a long average
11 atmospheric lifetime.²⁵ According to the U.S. Environmental Protection Agency, climate
12 change could negatively affect Hawai`i with increased flooding, algae blooms, species
13 extinctions, sea level rise, spread of disease, and drought.²⁶

14

15 The ultimate impacts from increased greenhouse gas emissions are difficult to predict,
16 but some highly credible scientists are suggesting that the Earth will be dramatically
17 altered in the relatively near future. Consider what James Hansen, director of NASA's
18 Earth Science Research, claimed on ABC News in March, 2006: “[Hansen] said that
19 disaster could probably be avoided, but that it would require dramatically cutting
20 emission outputs. If the proper actions aren't taken, Hansen said, Hansen said, then the
21 sea level could start rising much more quickly, ultimately reaching 80 feet, and be well

²⁴ Intergovernmental Panel on Climate Change. *Third Assessment Report, Summary for Policymakers*. (2001).

²⁵ See, *inter alia*, www.realclimate.org/index.php?p=134.

²⁶ U.S. Environmental Protection Agency. *Climate Change and Hawaii*. EPA 236-F-98-007e (September 1998).

1 underway toward that by the time today's children are in middle age.”²⁷

2

3 Again, it is difficult to predict the climate forcing effect of any single greenhouse gas
4 source, but given the magnitude and severity of global climate change, a decision to
5 allow the release of upwards of 30 million tons of CO₂ into the atmosphere over the next
6 3 to 4 decades should not be taken lightly.

7

8 According to data from the Draft Environmental Impact Statement for the proposed
9 facility, the facility (combustion turbine and black start generator) could emit air
10 pollutants in annual amounts as follows²⁸:

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²⁷ Blackmore, Bill (for ABC News). “Earth Is Melting at Both Ends.” March 2, 2006.

²⁸ Hawaiian Electric Company, 2006.

1

Pollutant	Tons per year	Significant Level	Significant Increase?
Carbon Monoxide	1764	100	YES
Nitrogen Oxides	1098	40	YES
Sulfur Dioxide	2309	40	YES
Particulates (PM ₁₀)	350	25	YES
Volatile Organic Comps.	168	40	YES
Lead	0.09	0.6	NO
Beryllium	0.00098	0.0004	YES
Mercury	0.0078	0.1	NO
Fluorides	0.0656	3	NO
Sulfuric Acid Mist	228	7	YES
Benzene	0.36	Any	YES
Arsenic	0.0714	Any	YES

2

3

1 In addition to the pollutants described in the table above, fugitive air emissions from
2 transporting (valves, flanges, and handling) and storage of the various fuels is expected.
3 Water vapor from the water injection intended to control emissions will also contain an
4 unknown quantity of pollutants.

5
6 While HECO will be required to use “Best Available Control Technology” to reduce the
7 regulated air pollutants and their air quality impact assessment suggests that Federal
8 pollution limits and ambient air quality standards will not be violated, air emissions may
9 still pose risks to the environment and human health.

10

11 *Carbon Monoxide*

12 Carbon monoxide (CO) is a colorless, odorless and poisonous gas produced by
13 incomplete burning of carbon in fuels. When CO enters the bloodstream, it reduces the
14 delivery of oxygen to the body’s organs and tissues. Health threats are most serious for
15 those who suffer from cardiovascular disease, particularly those with angina or peripheral
16 vascular disease. Exposure to elevated CO levels can cause impairment of visual
17 perception, manual dexterity, learning ability and performance of complex tasks.²⁹ Some
18 experts believe that even small concentrations of CO produce undesirable effects.³⁰

19

20 *Nitrogen Oxides*

21 The health effects of nitrogen oxides include irritation to throat and lungs, respiratory
22 tract infection, exacerbation of asthma, lung function, and possible increased

²⁹ U.S. Environmental Protection Agency, “Criteria Pollutants.” *Green Book*, 2006.

³⁰ Wark, K. et al. *Air Pollution: Its Origin and Control* 3rd Edition. Addison Wesley Longman Publishing Co., Inc., Menlo Park, CA, 1998.

1 susceptibility to allergens. Nitrogen oxides also contribute to the formation of acid rain,
2 which causes acidification of water bodies and can damage trees, crops, historic buildings
3 and statues.³¹

4

5 *Sulfur Dioxide*

6 Sulfur dioxide (SO₂) can affect breathing and may aggravate existing respiratory and
7 cardiovascular disease. Sensitive populations include asthmatics, individuals with
8 bronchitis or emphysema, children and the elderly. SO₂ is also a primary contributor to
9 acid rain. In addition, sulfur compounds in the air contribute to visibility impairment.³²

10

11 *Particulate Matter*

12 Epidemiological studies show that exposure to particulate matter has been linked to:

13 Hospital and emergency room visits;

14 Acute respiratory symptoms;

15 Decline in pulmonary function;

16 Exacerbation of chronic respiratory and cardiovascular diseases;

17 Work and school absences; and

18 Premature mortality.³³

19

20 *Volatile Organic Compounds*

21 Many volatile organic compounds (VOCs), such as benzene, polycyclic aromatic

³¹ *Ibid.*

³² U.S. Environmental Protection Agency, "Criteria Pollutants." *Green Book*, 2006.

6 ³³ Wark, 1998.

1 hydrocarbons, and 1,3 butadiene, are known to be carcinogenic.³⁴ VOCs can also
2 combine with nitrogen oxides to form ozone (O₃), a substance which can cause health
3 problems because it damages lung tissue, reduces lung function and sensitizes the lungs
4 to other irritants. Scientific evidence indicates that ambient levels of O₃ not only affect
5 people with impaired respiratory systems, such as asthmatics, but healthy adults and
6 children as well. Exposure to O₃ for several hours at relatively low concentrations has
7 been found to significantly reduce lung function and induce respiratory inflammation in
8 normal, healthy people during exercise. This decrease in lung function generally is
9 accompanied by symptoms including chest pain, coughing, sneezing and pulmonary
10 congestion.³⁵

11

12 *Sulfuric Acid Mist*

13 Sulfuric acid mist is can irritate and impair the respiratory system and may be a human
14 carcinogen.³⁶

15

16 Approximately 81,000 gallons of wastewater would be generated daily from the facility if
17 an onsite saline well were used or 9,000 gallons daily if RO water from the Honouliuli
18 wastewater treatment plant were used. In addition, over 40,000 gallons per day of water
19 vapor will be created from the water injection emissions control.³⁷

20

³⁴ *Ibid.*

³⁵ U.S. Environmental Protection Agency, "Criteria Pollutants." *Green Book*, 2006.

³⁶ IARC. *Occupational Exposures to Mists and Vapours from Strong Inorganic Acids; and other Industrial Chemicals*. World Health Organization, (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Vol. 54). 1992.

³⁷ Hawaiian Electric Company, 2006.

1 According to the Draft Environmental Impact Statement for the project, if RO water from
2 the Honouliuli wastewater treatment plant is used, about 9,000 gallons per day will be
3 injected into an onsite well. If the supply source is an onsite saline well, about 81,000
4 gallons per day will be injected into an onsite well. The approximately 60,000 gallons of
5 domestic wastewater generated annually will be treated in an onsite septic tank and then
6 emptied into an onsite injection well.³⁸

7

8 The proposed injection well will likely be a 400-foot-deep, 8-inch diameter well, with
9 solid casing on the upper 200 feet and perforated casing on the lower 200 feet.³⁹

10 Although the wastewater would be injected into a lower aquifer that is currently
11 hydrologically isolated from the upper, saline aquifer, there is a risk that the lower aquifer
12 could discharge into the upper aquifer, as the pressure, or “head” in the lower aquifer has
13 risen over the past two decades. The facility’s wastewater will contain some pollutants
14 and will have an increased temperature compared with the supply water.

15

16 In economics, an externality is a cost or benefit imposed outside of the parties directly
17 involved in a transaction. Externalities can be either positive, when an external benefit is
18 generated, or negative, when an external cost is generated from a market transaction. A
19 negative externality occurs when a cost of a transaction is borne by an individual, society,
20 or the environment that is not a party to that transaction. For example, an ecotour
21 operator is creating a negative externality when their operation takes busloads of tourists
22 on the same public trail day after day, causing erosion and muddying an adjacent stream.

³⁸ *Ibid.*

³⁹ *Ibid.*

1 Neither the ecotour operators nor the hiking tourists pay the external cost the
2 environment and society experience in such a case.

3

4 HECO's rate structure does not reflect (or internalize) the majority of negative
5 environmental externalities created by their generation of electricity. The most obvious
6 environmental externality not incorporated in HECO's rate structure is global climate
7 change. The damage from the estimated 30 million tons of greenhouse gases emitted over
8 the life of the proposed facility will likely have the greatest impact on individuals who
9 are not yet born.

10

11 The facility is at an elevation of about 12 feet above sea level and approximately 0.5
12 miles from the ocean.⁴⁰ A tsunami affecting the South shore of O`ahu (similar to the one
13 that occurred in the East Indian Ocean on December 26th, 2004) could have a devastating
14 impact on the facility and surrounding fuel storage tanks. Not only would this create
15 significant environmental problems for the near-shore waters and surrounding land uses,
16 but it would probably knock out a majority of the power generating capacity and fuel
17 supply for the entire island. This would create a myriad of secondary environmental
18 problems, including the likely loss of the ability to run pumps for drinking water and
19 sewage treatment. Building additional central station power generating facilities in this
20 area exacerbates this very real threat.

21

22

⁴⁰ Hawaiian Electric Company, 2006.