

WRITTEN TESTIMONY AND EXHIBITS

OF

PATRICK LUCKOW

**ON BEHALF OF
THE DIVISION OF CONSUMER ADVOCACY**

SUBJECT: GREENHOUSE GAS EMISSIONS

WRITTEN TESTIMONY OF PATRICK LUCKOW

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Q. PLEASE STATE YOUR NAME, EMPLOYER, AND PRESENT POSITION.

A. My name is Patrick Luckow and I am an Associate with Synapse Energy Economics, Inc., 485 Massachusetts Avenue, Cambridge, MA 02139.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS CASE?

A. I am testifying on behalf of the Department of Commerce and Consumer Affairs of the State of Hawaii, as represented by the Division of Consumer Advocacy (“Consumer Advocate”).

Q. PLEASE DESCRIBE SYNAPSE ENERGY ECONOMICS.

A. Synapse Energy Economics (“Synapse”) is a research and consulting firm specializing in energy and environmental issues, including: electric generation, transmission and distribution system reliability, market power, electricity market prices, stranded costs, efficiency, renewable energy, environmental quality, and nuclear power.

Q. PLEASE SUMMARIZE YOUR WORK EXPERIENCE AND EDUCATIONAL BACKGROUND.

A. At Synapse, I conduct research that focuses on a variety of issues relating to electric utilities, including: integrated resource planning; federal and state clean air policies; emissions from electricity generation; and electrical system

1 dispatch. I also perform modeling analyses of electric power systems, using a
2 variety of spreadsheet analysis tools as well as optimization and electricity
3 dispatch models, such as PROSYM/Market Analytics. I have also reviewed
4 input and output data from additional models, including Strategist.

5 Prior to joining Synapse, I worked as a scientist at the Joint Global
6 Change Research Institute in College Park, Maryland. In this position,
7 I evaluated the long-term implications of potential climate policies, both
8 internationally and in the U.S., across a range of energy and electricity
9 models. This work included researching the land use and energy implications
10 of biomass and biofuels in an integrated assessment modeling context as part
11 of the Institute's integrated assessment model, the Global Change
12 Assessment Model ("GCAM"). I was one of the primary developers of a major
13 expansion of the agriculture and land-use component of the GCAM.

14 I hold a Bachelor of Science degree in Mechanical Engineering from
15 Northwestern University, and a Master of Science degree in Mechanical
16 Engineering from the University of Maryland. I have attached my resume to
17 this testimony as CA-300.

18
19 Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

20 A. My testimony discusses the greenhouse gas emissions associated with the
21 production and use of the biofuels HELCO is proposing to acquire from the
22 AKP project.

1 Q. WHAT SOURCES DID YOU RELY UPON TO PREPARE YOUR TESTIMONY
2 AND EXHIBITS?

3 A. I relied on the Company's application, its responses to various information
4 requests ("IR"), and relevant recent studies on the use of biomass and
5 biofuels.

6
7 Q. HAVE ANALYSES DEMONSTRATED THAT BIOMASS AND BIOFUELS CAN
8 PLAY AN IMPORTANT ROLE IN REDUCING EMISSIONS OF CARBON AND
9 OTHER GREENHOUSE GASES ("GHG")?

10 A. Yes. Generating electricity from biomass and biofuels that are well tracked
11 and produced in a sustainable manner can produce lower emissions of carbon
12 than generating electricity from conventional fossil fuels such as diesel, low
13 sulfur fuel oil, natural gas, and coal. Various studies, based on long term
14 economic models of energy use, have shown that it is more cost effective to
15 reduce carbon emissions substantially through strategies that include biomass
16 and biofuels than through strategies that do not include those resources.
17 Examples of those studies include Edmonds (2013)¹ and Rao (2008)². In the
18 electricity sector, biomass and biofuels help improve the cost effectiveness of

¹ Edmonds, J., P. Luckow, K. Calvin, M. Wise, J. Dooley, P. Kyle, S. Kim, P. Patel, L. Clarke, "Can radiative forcing be limited to 2.6 Wm⁻² without negative emissions from bioenergy AND CO₂ capture and storage?" Climatic Change Jan. 2013 DOI: 10.1007/s10584-012-0678-z

² Rao, S., K. Riahi, E. Stehfest, D. van Vuuren, C. Cho, M. den Elzen, M. Isaac and J. van Vliet (2008), "[IMAGE and MESSAGE Scenarios Limiting GHG Concentration to Low Levels.](#)" IIASA Interim Report IR-08-020, Oct 2008.

1 these strategies because they produce electricity in a consistent, dispatchable
2 manner and because they can be shipped over long distances using existing
3 transportation infrastructure.

4 In order for biomass and biofuels to play this important role, they must
5 be produced in a sustainable manner. In particular, for each proposed source
6 of biomass and biofuels, one must identify the carbon emissions at each stage
7 of production and use, including emissions from the use of the land to produce
8 the feedstocks and emissions resulting from any activities displaced from that
9 land. It is important to consider both the carbon absorption and the carbon
10 emissions associated with biomass production, absorption in order to give
11 accurate credit to biomass and emissions from land use to prevent unjustified
12 clearing of land

13 It is reasonable to assume that future clean energy policies and/or
14 carbon regulation frameworks that includes biomass will account for the
15 emissions associated with biomass in this manner. In other words I expect
16 that when calculating the total emissions associated with combustion of
17 biomass those regulatory regimes will credit the carbon absorption associated
18 with biofuels against the emissions associated with their combustion to arrive
19 at an estimate of net emissions. The life-cycle analysis (“LCA”) prepared for
20 the HBE project provides an illustration of the manner in which this net
21 estimate may be calculated. That LCA estimated that the net carbon

1 emissions associated with HECO's use of HBE biofuel would be at most
2 one-third of the emissions associated with HECO's use of fuel oil.

3 Federal energy policy has begun to account for the lifecycle carbon
4 emissions of biofuels in recent years. For example, the Renewable Fuel
5 Standard (RFS) – a program requiring transportation fuels to contain a set
6 percentage of biofuels – mandates that conventional biofuels demonstrate
7 a 20% life cycle GHG reduction compared to a baseline, and biomass-based
8 diesel to achieve a 50% reduction.³

9
10 Q. ARE THERE ANY PUBLIC AVAILABLE SOURCES OF THE PROJECTED
11 COSTS OF THESE CARBON EMISSIONS?

12 A. Yes. A 2012 report by Synapse collected a series of utility and federal carbon
13 price forecasts to develop a composite forecast. This report is provided in
14 CA-301.

15
16 Q. DOES THE LIFE-CYCLE ANALYSIS PREPARED FOR AKP INDICATE THAT
17 THIS BIOFUEL WILL HELP THE COMPANIES REDUCE THEIR
18 GREENHOUSE GAS EMISSIONS?

19 A. Yes. The LCA prepared for AKP by Eichleay Engineers Inc. estimates
20 GHG emissions associated with feedstock production, conversion to biofuels,

³ US DOE (2013). "Renewable Fuels Standard". Available at:
<http://www.afdc.energy.gov/laws/RFS>

1 and transport of biofuel to the power plant. Based upon its analysis of those
2 three stages, the Eichleay LCA gives the biofuels a substantial emission
3 “credit” for atmospheric CO₂ absorbed by the feedstock plants during their
4 growth. However, that LCA, provided in response to LOL-IR-16, does not
5 include an estimate of the GHG emissions associated with combustion of
6 biofuel at the power plant. Thus, the LCA over-estimates the benefits
7 associated with the use of biofuels.

8 In order to develop a comprehensive estimate, one must compare that
9 credit against the GHG emissions during combustion of the biofuel to arrive at
10 a net amount. In addition, it would be helpful to have the detailed estimates of
11 emissions associated with land use change (“LUC”) and feedstock production
12 underlying the calculation of that credit.

13 I expect that a comprehensive estimate will demonstrate that the AKP
14 biofuel has net carbon emissions greater than those estimated in the Eichleay
15 LCA but still considerably less than the emissions associated with HELCO’s
16 use of diesel.

17
18 Q. DOES THE PROPOSED AKP PROJECT APPEAR SUSTAINABLE BASED
19 ON THE ANALYSES PRESENTED TO DATE?

20 A. Yes. Based on the description of the process revealed in this docket thus far,
21 the AKP project has many of the characteristics of an environmentally
22 sustainable process. The fact that the feedstock will be grown on former

1 sugarcane land is also positive, as intensively managed soils typically have
2 lower terrestrial carbon stocks. Research has shown gains in soil and above
3 ground carbon with certain biofuel feedstocks⁴, although the re-establishment
4 of native and invasive grasses and Christmas berry trees (LOL-SIR-24) may
5 have improved soil conditions in recent years.

6 Once a final feedstock is chosen, it will be important to conduct an
7 updated assessment of the net change in soil carbon as a result of this project.

8

9 Q. ARE THERE POTENTIAL BENEFITS WITH CO-PRODUCTS OF BIODIESEL
10 PRODUCTION?

11 A. Yes. In addition to liquid fuels, the AKP process produces a solid biochar
12 (LOL-SIR-25). In addition to helping soils retain water and nutrients, biochar
13 holds onto its carbon for hundreds of years. Sequestering carbon through the
14 use of biochar as a soil amendment has been explored recently as a cost
15 effective way to offset greenhouse gas emissions⁵.

⁴ Chum, H., A. Faaij, J. Moreira, G. Berndes, P. Dhamija, H. Dong, B. Gabrielle, A. Goss Eng, W. Lucht, M. Mapako, O. Masera Cerutti, T. McIntyre, T. Minowa, K. Pingoud, 2011: Bioenergy. In IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlomer, C. von Stechow (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

⁵ Dominic Woolf, James E. Amonette, F. Alayne Street-Perrott, Johannes Lehmann, Stephen Joseph. "Sustainable biochar to mitigate global climate change," Nature Communications, Aug. 10, 2010. <http://www.nature.com/ncomms/journal/v1/n5/full/ncomms1053.html>

1 Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

2 A. Yes.