Portland Planning and Sustainability Commission,

Attached you will find my comments opposing the proposed propane terminal. The purpose of my comments is to provide the Commission with perspective on the magnitude of the GHG emissions associated with the proposed propane terminal. I have three observations to share:

- The atmospheric heating effect of propane combustion is over 500 times as great as the energy content of the fuel.

- The permanent jobs created by the proposed propane terminal are 25 times as carbon-intensive as the average for the Portland economy.

- When emissions from inbound rail and outbound shipping are included, GHG emissions from the proposed propane terminal are equivalent to three years of reductions that Portland has worked so hard to achieve since 1990.

After considering these observations, I urge the Commission to reject the Amendment.

Thank you for the opportunity to comment.

Mike Burnett

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# Comments in Opposition to the Proposed Propane Terminal

**Mike Burnett**

March 12, 2015

The Portland Planning and Sustainability Commission (Commission) is considering a Terminal 6 Environmental Overlay Zone Code Amendment and Environmental Overlay Zone Map Amendment ("Amendment") to enable the construction and operation of the Pembina Portland Propane Terminal ("proposed propane terminal"). My expertise is in accounting for and mitigating greenhouse gas (GHG) emissions. I was the founding Executive Director of The Climate Trust. A one-page resume is attached. The purpose of my comments is to provide the Commission with perspective on the magnitude of the GHG emissions associated with the proposed propane terminal. I have three observations to share:

- The atmospheric heating effect of propane combustion is over <u>500 times as great as the energy content of the fuel</u>.

- The permanent jobs created by the proposed propane terminal are <u>25 times as carbon-intensive</u> as the average for the Portland economy.

- When emissions from inbound rail and outbound shipping are included, GHG emissions from the proposed propane terminal are <u>equivalent to three years of reductions</u> that Portland has worked so hard to achieve since 1990.

After considering these observations, I urge the Commission to reject the Amendment. One of the fundamental purposes of the Commission is to "ensure sustainability principles and practices are integrated into policy, planning and development decisions." Approving the Amendment is diametrically opposed to this fundamental Commission purpose.

The 2015 Climate Action Plan Public Comment Draft ("CAP") starts off by saying: "Climate change is the greatest environmental challenge of the 21st century." It maintains a mid-century goal of 80% GHG reductions from 1990. As demonstrated above, **<u>approving the Amendment is a big step in the wrong direction</u>**. Carbon dioxide (CO2) is such a potent atmospheric heating agent that its heating effect is 500 times as great as the energy content of the fuel combustion of which it is a by-product. It is little wonder that our planet is warming so rapidly, and that such dramatic GHG reductions are needed. The relatively few long-term jobs created by the proposed propane terminal are high-carbon jobs, when we need more low carbon jobs instead. And the GHG emissions associated with the proposed propane terminal are equivalent to a several year setback in our progress in reducing Portland's emissions.

The CAP states that "we must do it together," and that government's role is policy making and leading by example. The Commission is in a position to provide such sustainable policy leadership by rejecting the Amendment.

Detailed comments appear below.

## The atmospheric heating effect of propane combustion is over 500 times as great as the energy content of the fuel

- Over the lifetime of CO2 in the atmosphere, how does the magnitude of the atmospheric heating effect of the CO2 by-product compare to the energy released by burning the propane?

  Burning fossil fuels is the most important cause of climate change. Burning fossil fuels releases energy, but at the same time releases carbon dioxide (CO2) as a by-product. CO2 is a potent greenhouse gas, and acts like a blanket that traps heat and warms our planet. CO2 is also a long-lived gas in the atmosphere. When considering the proposed propane terminal, it is important that policy makers understand the relative magnitudes of this atmospheric heat trapping effect and the energy content of propane. This analysis investigates the question: Over the lifetime of CO2 in the atmosphere, how does the magnitude of the atmospheric heating effect of the CO2 by-product compare to the energy released by burning the propane?

- In the year of combustion, the CO2 heats the atmosphere nearly twice as much as the energy content of propane.

  First, consider the atmospheric heating effect of the $CO_2$ during the year in which the propane is combusted. The ratio of annual atmospheric heating energy to energy content for propane is 1.79. In the year of combustion, the CO2 heats the atmosphere nearly twice as much as the energy content of propane.

- Over the lifetime of CO2 in the atmosphere, the CO2 heats the atmosphere over 500 times as much as the energy content of propane.

  Next, consider the warming effect over the lifetime of $CO_2$ in the atmosphere. For the purposes of this analysis, the average lifetime of $CO_2$ in the atmosphere is assumed to be 300 years. This assumed $CO_2$ lifetime can be considered as conservative, and understates $CO_2$ lifetime by two orders of magnitude. Using this assumed lifetime, the ratio of lifetime atmospheric heating energy to energy content for propane is 537. Over the lifetime of CO2 in the atmosphere, the CO2 heats the atmosphere over 500 times as much as the energy content of propane.

  The fire created by combusting propane, then, burns five hundred more times in our atmosphere due to the heat trapping effect of $CO_2$. On an energy basis, over its lifetime in the atmosphere, the by-product is more than five hundred times as potent as the propane product. Burning propane, then, is a fire that burns five hundred times!

- A seven step series of calculations is used to compute the lifetime atmospheric heating effect per metric ton of $CO_2$. A spreadsheet showing these calculations for propane is attached.

1. Calculating the increase in atmospheric heating (in $W/m^2$) per part per million increase in $CO_2$ concentration. This is done using available data from recent observations.
2. Converting this increase in atmospheric heating per part per million increase in $CO_2$ concentration from a per square meter basis to a global basis.
3. Calculating the mass of $CO_2$ in the atmosphere (in metric tons) on a global basis per part per million of $CO_2$ concentration.
4. Calculating the amount of atmospheric heating per metric ton of $CO_2$ on an instantaneous power flow basis. This is done by dividing the results of Step 2 by the results of Step 3.
5. Converting the atmospheric heating per metric ton of $CO_2$ from an instantaneous power flow basis to an annual energy basis.
6. Determining the average lifetime of $CO_2$ in the atmosphere.
7. Converting the atmospheric heating per metric ton of $CO_2$ from an annual energy basis to a lifetime basis by multiplying by the average lifetime of $CO_2$ in the atmosphere.

## The permanent jobs created by the proposed propane terminal are 25 times as carbon-intensive as the average for the Portland economy

- One of Portland's key competitive advantages – its leadership in sustainability – would be severely compromised by the proposed propane terminal.

  Portland is an acknowledged international leader in sustainability, and has received numerous awards and accolades for its accomplishments in GHG reducing emissions. The Portland Plan builds on this in Policy P-6, Enhance Portland as a national model for sustainability and as a center for business development by commercializing sustainability practices, products and services. The proposed propane terminal generates few long term jobs, and these jobs are highly carbon-intensive. Taking action to enable the proposed propane terminal and its high-carbon jobs would call into question Portland's commitment to sustainability.

- On the average, 20 MTCO2e are emitted for each job in Portland economy.

  The 2015 Climate Action Plan Public Comment Draft shows sector-based GHG emissions totaling 7,695,000 metric tons of CO2-equivalent (MTCO2e) for Multnomah County. Census data shows Multnomah County nonfarm employment as 383,401. On the average, 20 MTCO2e are emitted for each job in the Portland economy.

- For each permanent job at the proposed propane terminal, 500 MTCO2e would be emitted.

  The City's ESEE analysis determined that the facility will be one of Portland's largest energy users, requiring an estimated 8,000 MWh of electricity per month resulting in 20,000 metric tons of CO2 emissions/year. The proposed propane terminal up to 40 permanent jobs. Each permanent job at the proposed propane terminal would emit 500 MTCO2e. This is the narrowest definition of the carbon footprint of the proposed propane terminal. It does not include the emissions from combusting the propane, or upstream or downstream emissions.

- Jobs from the proposed propane terminal would be 25 times as carbon-intensive as the average for the Portland economy.

  The proposed propane terminal would emit 500 MTCO2e per job, while 20 MTCO2e are emitted for the average job in the Portland economy. The jobs from the proposed propane terminal would be 25 times as carbon-intensive.

- The emissions that would be dedicated to the proposed propane terminal could otherwise support 1,000 typical Portland jobs.

  The proposed propane terminal would emit 20,000 MTCO2e. Average emissions per job in the Portland economy are 20 MTCO2e. Thus, 1,000 average Portland jobs could be supported by the emissions from the proposed propane terminal, in contrast to the 40 jobs the terminal would actually create.

**When emissions from inbound rail and outbound shipping are included, GHG emissions from the proposed propane terminal are equivalent to three years of reductions that Portland has worked so hard to achieve since 1990.**

- Portland has averaged 56,300 MTCO2e reductions per year since 1990.

  Portland has placed a high priority on expended and a great deal of effort on reducing GHG emissions over the past two decades. In 1990, emissions were 8,990,000 MTCO2e. By 2013, emissions had been reduced to 7,695,000 MTCO2e. This represents a reduction of 1,295,000 MTCO2e over a 23 year period, for an average reduction of 56,300 MT CO2e per year.

- For the proposed propane terminal, electricity-related GHG emissions would total 20,000 MTCO2e per year.

  The City's ESEE analysis determined that the facility will be one of Portland's largest energy users, requiring an estimated 8,000 MWh of electricity per month resulting in 20,000 metric tons of CO2 emissions/year.

- For the proposed propane terminal, inbound rail-related GHG emissions would total 108,000 MTCO2e per year.
  Propane would be unloaded from rail cars arriving approximately one unit train every two days (a unit train carries a single commodity, in this case propane, and is approximately 100 cars in length). Life cycle GHG analysis shows rail fuel-related GHG emissions of 5 kg CO2e per barrel for shipment from Calgary to Vancouver BC, a distance of 972 kilometers. Since the distance from Edmonton to Portland is 1,540 kilometers, it follows that GHG emissions

would be around 7.9 kg CO2e per barrel, assuming that fuel consumption and emissions are linear with distance. The proposed propane terminal would produce 37,500 barrels per day, or 13,687,500 barrels per year. The resulting rail fuel-related GHG emissions would be 108,000 MTCO2e per year.

- For the proposed propane terminal, outbound shipping-related GHG emissions would total 34,000 MTCO2e per year.

  The proposed propane terminal expects to use ships called Very Large Gas Carriers (VLGC). These are ships specifically designed to carry products such as refrigerated liquid propane. The ships may be up to 750 feet in length and carry up to 23 million U.S. gallons of propane. VLGC consume 22 tonnes of heavy fuel oil per day of operation. Heavy fuel oil emits 3,114 kg MTCO2e/tonne fuel consumed, so a VLGC emits 68.5 MTCO2e/day. A VLGC travels around 418 miles per day (80% of design speed x 18.9 knots x 1.151 mph/knot = 17.4 mph x 24 hours = 418 mi/day). A trip from Portland to Shanghai (for example) is 5,783 miles, so the journey would take around 14 days. Total GHG emissions per vessel shipment would be 14 days x 68.5 MTCO2e/day, or 959 MTCO2e/vessel shipment. The proposed propane terminal estimates there to be two-to-three vessel shipments per month. The higher figure means there would be 36 vessel shipments per year, each emitting 959 MTCO2e. The total GHG emitted from outbound shipping would be 34,000 MTCO2e per year.

- For the proposed propane terminal, total electricity- and shipping-related GHG emissions would total 162,000 MTCO2e.

| | |
|---|---|
| Electricity | 20,000 MTCO2e |
| Inbound Rail | 108,000 MTCO2e |
| Outbound Shipping | 34,000 MTCO2e |
| TOTAL | 162,000 MTCO2e |

- When emissions from inbound rail and outbound shipping are included, GHG emissions from the proposed propane terminal are equivalent to three years of reductions that Portland has worked so hard to achieve since 1990.

  For the proposed propane terminal, total electricity- and shipping-related GHG emissions would total 162,000 MTCO2e. Portland has averaged 56,300 MTCO2e reductions per year since 1990. The electricity- and shipping-related emissions from the proposed propane terminal are equivalent to nearly three years of GHG reductions that Portland has worked so hard to achieve since 1990. This does not include the emissions from combusting the propane. The emissions from the proposed propane facility are enormous in comparison to the progress that Portland has made in reducing its emissions.

# PART 1: CALCULATING THE ATMOSPHERIC HEATING ENERGY OF CARBON DIOXIDE

## STEP 1: Radiative Forcing Per Part Per Million of CO2

| | | | | | | |
|---|---|---|---|---|---|---|
| | 391 | ppm | | | <1> | 2011 CO2 concentration |
| - | 278 | ppm | | | <3> | 1750 CO2 concentration |
| = | 113 | ppm | | | | Difference between 2011 and 1750 CO2 concentrations |
| | 1.68 | watts | per | m2 | <1> | 2011 CO2 radiative forcing |
| - | 0.00 | watts | per | m2 | <1> | 1750 CO2 radiative forcing |
| = | 1.68 | watts | per | m2 | | Difference in radiative forcing between 2011 and 1750 |
| | 1.68 | watts | per | m2 | | Difference in radiative forcing between 2011 and 1750 |
| / | 113 | ppm | | | | Difference between 2011 and 1750 CO2 concentrations |
| = | **0.0149** | **watts/m2** | **per** | **ppm** | | **Radiative forcing per ppm of CO2** |

## STEP 2: Global Radiative Forcing Per Part Per Million of CO2

| | | | | | | |
|---|---|---|---|---|---|---|
| | 0.0149 | watts/m2 | per | ppm | | Radiative forcing per ppm of CO2 |
| * | 5.10E+14 | m2 | | | | Earth's surface area in square meters |
| = | **7.58E+12** | **watts** | **per** | **ppm** | | **Global radiative forcing per ppm of CO2** |

## STEP 3: Tons of CO2 Per Part Per Million

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2.163E+12 | metric tons of CO2 | | | <2> | Pre-industrial CO2 mass |
| / | 278 | ppm | | | <3> | Pre-industrial CO2 concentration |
| = | **7.78E+09** | **metric tons of CO2** | **per** | **ppm** | | **Metric tons of CO2 per part per million** |

## STEP 4: Radiative Forcing Instantaneous Power Per Metric Ton of CO2

| | | | | | | |
|---|---|---|---|---|---|---|
| | 7.58E+12 | watts | per | ppm | | Global radiative forcing per ppm of CO2 |
| / | 7.78E+09 | metric tons of CO2 | per | ppm | | Metric tons of CO2 per part per million |
| = | **975** | **watts** | **per** | **metric ton of CO2** | | **Radiative forcing instantaneous power per metric ton of CO2** |

## STEP 5: Radiative Forcing Annual Energy Per Metric Ton of CO2

| | | | | | | |
|---|---|---|---|---|---|---|
| | 975 | watts | per | metric ton of CO2 | | Radiative forcing instantaneous power per metric ton of CO2 |
| * | 8,760 | hours | per | year | | Conversion factor |
| = | 8.54E+06 | watt-hours | per | metric ton of CO2 | | Radiative forcing annual energy per metric ton of CO2 |
| / | 1,000 | watt-hours | per | kWh | | Conversion factor |
| = | 8.54E+03 | kWh | per | metric ton of CO2 | | Radiative forcing annual energy per metric ton of CO2 |
| * | 3.6 | MJ | per | kWh | | Conversion factor |
| = | **3.07E+04** | **MJ** | **per** | **metric ton of CO2** | | **Radiative forcing annual energy per metric ton of CO2** |

## STEP 6: Average Lifetime of CO2 in the Atmosphere

| | | | | | | |
|---|---|---|---|---|---|---|
| | **300** | **years** | | | <4> | **Average lifetime of CO2 in atmosphere** |

## STEP 7: Radiative Forcing Lifetime Energy Per Metric Ton of CO2

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3.07E+04 | MJ | per | metric ton of CO2 | | Radiative forcing annual energy per metric ton of CO2 |
| * | 300 | years | | | | Average lifetime of CO2 in atmosphere |
| | **9.22E+06** | **MJ** | **per** | **metric ton of CO2** | | **Radiative forcing lifetime energy per metric ton of CO2** |

# PART 2: CALCULATING THE RATIO OF ATMOSPHERIC HEATING ENERGY TO FUEL ENERGY CONTENT

## PART 2A: RATIO OF ANNUAL RADIATIVE FORCING TO ENERGY FOR PROPANE

**Global Radiative Forcing Annual Energy Per Kilogram of CO2**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3.07E+04 | MJ | per | metric ton of CO2 | | Radiative forcing annual energy per metric ton of CO2 |
| / | 1,000 | Kg | per | metric ton | | Conversion factor |
| = | **30.7** | **MJ** | **per** | **Kg of CO2** | | **Radiative forcing annual energy per kilogram of CO2** |

**Radiative Forcing Annual Energy Per Gallon of Propane**

| | | | | | | |
|---|---|---|---|---|---|---|
| | 30.7 | MJ | per | Kg of CO2 | | Radiative forcing annual energy per kilogram of CO2 |
| * | 5.6 | Kg of CO2 | per | gallon of propane | <5> | Constant Climate Registry |
| = | **1.72E+02** | **MJ** | **per** | **gallon of propane** | | **Radiative forcing annual energy per gallon of propane** |

**Energy Content Per Gallon of Propane**

| | | | | | | |
|---|---|---|---|---|---|---|
| | 0.091 | million BTU | per | gallon of propane | | Energy content per gallon of propane |
| * | 1055 | MJ | per | million BTU | | Conversion factor |
| | **9.60E+01** | **MJ** | **per** | **gallon of propane** | | **Energy content per gallon of propane** |

**Ratio of Annual Radiative Forcing Energy to Energy Content for Propane**

| | | | | | | |
|---|---|---|---|---|---|---|
| | 1.72E+02 | MJ | per | gallon of propane | | Radiative forcing annual energy per gallon of propane |
| / | 9.60E+01 | MJ | per | gallon of propane | <5> | Energy content per gallon of propane |
| = | **1.79** | | | | | **Ratio of annual radiative forcing energy to energy content of propane** |

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## PART 2B: RATIO OF LIFETIME RADIATIVE FORCING TO ENERGY FOR PROPANE

**Global Radiative Forcing Lifetime Energy Per Kilogram of CO2**

| | | | | | | |
|---|---|---|---|---|---|---|
| | 30.7 | MJ | per | Kg of CO2 | | Radiative forcing annual energy per kilogram of CO2 |
| * | 300 | years | | | <4> | Average lifetime of CO2 in atmosphere |
| = | **9.22E+03** | **MJ** | **per** | **Kg of CO2** | | **Radiative forcing lifetime energy per kilogram of CO2** |

**Radiative Forcing Lifetime Energy Per Gallon of Propane**

| | | | | | | |
|---|---|---|---|---|---|---|
| | 9.22E+03 | MJ | per | Kg of CO2 | | Radiative forcing lifetime energy per kilogram of CO2 |
| * | 5.6 | Kg of CO2 | per | gallon of propane | <5> | Constant |
| = | **5.15E+04** | **MJ** | **per** | **gallon of propane** | | **Radiative forcing lifetime energy per gallon of propane** |

**Energy Content Per Gallon of Propane**

| | | | | | | |
|---|---|---|---|---|---|---|
| | 0.091 | million BTU | per | gallon of propane | | Energy content per gallon of propane |
| * | 1055 | MJ | per | million BTU | | Conversion factor |
| | **9.60E+01** | **MJ** | **per** | **gallon of propane** | | **Energy content per gallon of propane** |

**Ratio of Lifetime Radiative Forcing Energy to Energy Content for Propane**

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5.15E+04 | MJ | per | gallon of propane | | Radiative forcing lifetime energy per gallon of propane |
| / | 9.60E+01 | MJ | per | gallon of propane | <5> | Energy content per gallon of propane |
| = | **537** | | | | | **Ratio of lifetime radiative forcing energy to energy content of bituminous coal** |

## Michael S. Burnett

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***SUMMARY**: Thirty year career as a "serial pioneer" in emerging sustainability arenas, with fifteen years as a successful start-up chief executive officer and a history of highly creative technical, policy, program design, and project development work in the formative stages of the energy efficiency, renewable energy, carbon offset, and GHG inventory and GHG management fields.*


### EMPLOYMENT

**Hot Sky Consulting** — ***Principal*** — 2010-current

- Authored online training course on assessing/selecting facility greenhouse gas management options
- Workshops on community GHG inventories/GHG management plans for Filipino local governments

**The Climate Trust** — ***Executive Director*** — 1999-2009

- Start-up CEO for the nation's first carbon offset enterprise
- Strategically leveraged small non-profit into 2nd-most-recognized carbon offset provider in world
- Acquired largest portfolio of carbon offsets then recognized by a US GHG regulatory scheme
- Developed top-rated voluntary carbon offset programs for business and consumers
- Pioneered industry-replicated processes for offset qualification, quantification, and contracting
- Established organization as a key participant in national and international debate on offsets
- Financial excellence: outstanding audits, consistent revenue growth, built six-month reserve
- Built national organization on state-based foundation: recruited excellent Board and successor

**Trexler and Associates** — ***Vice President*** — 1998-1999

- Facilitated corporate climate strategies for utility, petroleum, and manufacturing clients
- Prepared feasibility study on major international forest conservation/management offset project
- Created early action crediting proposal to Congress for a national sustainable industry CEO group

**Conservation and Renewable Energy System** — ***Managing Director*** — 1993-1998

- As CEO, managed start-up of a Joint Operating Agency of 8 Washington consumer-owned utilities
- Negotiated $65 million in conservation and wind contracts on a fast track
- Conducted largest municipal bond sale to fund energy conservation to date ($38 million)
- Tripled historical energy saved per dollar invested, earning $4 million bonus for organization
- Obtained all environmental and construction permits for one of the first wind farms in Washington
- Turned $300,000 in start-up investment into $21 million in net financial benefits

| | | |
|---|---|---|
| **Public Power Council** | ***Senior Engineer*** | 1987-1992 |
| **Pacific NW Utilities Conference Committee** | ***Senior Conservation Planner*** | 1983-1986 |
| **Bonneville Power Administration** | ***Load Research Manager*** | 1982-1983 |
| **Western Solar Utilization Network** | ***Energy Systems Analyst*** | 1980-1982 |
| **National Park Service** | ***Assistant Servicewide Energy Coordinator*** | 1978-1980 |

### EDUCATION

**University of Florida** — *M.S., Environmental Engineering* — 1978

- National Science Foundation Graduate Fellow studying with Dr. Howard Odum
- Concentration: Systems ecology and energy analysis

**Hiram College** — *B.A., Biology* — 1975