Silver lining of climate change: Does it exist?

Peter Nightingale

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http://www.phys.uri.edu/nigh/transportation-forum-2016.html

29th Transportation Forum, URI 10/28/2016
Governor Gina Raimondo supports expansion of the natural gas infrastructure:

- **Press release:**

  *I am committed to moving ahead with cost-effective, regional energy infrastructure projects — including expansion of natural gas capacity — that will improve our business climate and create new opportunities for Ocean State workers. [emphasis added]*

- **Power plant proposed in Burrillville (quoted in ecoR):**

  *The only silver lining of climate change, if there is one, is that if we take action and get ahead of it, we can create jobs. [emphasis added]*
• RI Office of Energy Resources’ zero-emission vehicles
• If we build the proposed new Burrillville power plant will they run on fracked gas?
• Likely: 30 MW wind vs. 900 MW fossil fuels
Introduction
Climate science
Energy politics
The Alternatives

Zero-emission vehicles
U.S. Energy Consumption
R.I. Greenhouse gas emissions

U.S. Energy Consumption 2015

Estimated U.S. Energy Consumption in 2015: 97.5 Quads

- Natural Gas: 26.3
- Coal: 15.7
- Petroleum: 35.8
- Biomass: 4.72
- Hydro: 2.39
- Wind: 1.02
- Geothermal: 0.27
- Solar: 0.53
- Nuclear: 8.34
- Electricity Generation: 38.0
- Net Electricity: 0.02
- Imports: 0.28
- Residential: 11.3
- Commercial: 8.71
- Industrial: 24.6
- Transportation: 27.7
- Rejected Energy: 59.1

Source: Lawrence Livermore National Laboratory

100 Quad/year ≈ 100 EJ/year = 10^{20} J/year ≈ 3000 GW

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Figure 2. 2010 Rhode Island Greenhouse Gas Emissions

Source: SIT Default Run, 2013.
Climate change

1. **West Antarctic Ice Sheet** is collapsing

2. There are indications that the **AMOC (Atlantic Meridional Overturning Circulation)** is collapsing. If that happens, the weather patterns in the North Atlantic will change dramatically

3. **Arctic Report Card**: Extensive regions of the Arctic, the "weather kitchen of the globe," have warmed up by more than 3°C (5.4°F)

4. **The Antarctic is disintegrating** on a time scale of 15 years
Weather extremes

- Extreme weather: 45 years ago 0.3% of the time; now 15%
- Hansen & Sato, Regional climate change and national responsibilities
Clean Power Plan: **The market will bail us out!**

*fully consistent with the recent changes and current trends in electricity generation, and as a result, would by no means entail fundamental redirection of the energy sector.* [emphasis added]

Federal Register/ Vol. 80, No. 205/Friday, October 23, 2015/Rules and Regulations, page 64785
Clean Power Plan is based on bad science: Robert Howarth (Cornell University)

*both shale gas and conventional natural gas have a larger GHG [greenhouse gas footprint] than do coal or oil, for any possible use*

Fracked-gas links are here.
The problem with natural gas

- $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- Half-life of $\text{CH}_4$ in atmosphere: 7 years
- per unit mass, compared to $\text{CO}_2$, $\text{CH}_4$ is more than 100 times as potent a greenhouse gas

<table>
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<tr>
<th>horizon</th>
<th>$\text{CO}_2$ equivalent</th>
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IPCC: *Anthropogenic and Natural Radiative Forcing* (PDF page 56)
US Congress: *Table A–1 Subpart A of Part 98—Global Warming Potentials*
**CO₂: 1750-today**

2.2% increase per year since 1750
**CH$_4$—3% escapes**

The chart illustrates the comparison between coal/oil and gas over a period of 100 years into the future, assuming 3% methane loss. The graph shows the concentration of ppm CO$_2$ equivalent over time, with the methane emissions for coal/oil and gas represented by red and blue lines, respectively.
\[
\text{CH}_4—5\% \text{ escapes}
\]

![Graph showing ppm CO\(_2\) equivalent over time for coal/oil and gas with 5% methane loss.](image)
CH$_4$—10% escapes

![Graph showing ppm CO$_2$ equivalent over years into future with 10% methane loss for coal/oil and gas.]
Does nature ignore full life-cycle greenhouse gas emissions?
RI OER EFSB-2015-06 Advisory Opinion page 21
Question 6
(c) State Bikeway Development Program
$10,000,000
100% wind, water and solar in RI

**The Solutions Project:** electricity, transportation, heating / cooling, industry

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Percentage</th>
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<td>residential photo-voltaic rooftop</td>
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- 20% increase in price per unit energy compared to fossil fuels
- electricity only: 40% decrease in energy consumption
- 6,000/7,500 new 40-year jobs created in operation / construction

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Recent report from Political Economy Research Institute of UMass in Amherst:

*New investments in energy efficiency and renewable energy will generate more jobs for a given amount of spending than maintaining or expanding each country’s existing fossil fuel sectors.*
WHO on pollution

WHO: Ambient Air Pollution

- Air pollution represents the biggest environmental risk to health. In 2012, one out of every nine deaths was the result of air pollution-related conditions.
- Of those deaths, around 3 million are attributable solely to ambient (outdoor) air pollution.
- Citizens in Africa, Asia or the Middle East breathe much higher levels of air pollutants that those in living other parts of the world.