

Thoughts on Carbon Credits, Oregon, and Promoting Innovation in Industry

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Résumé:

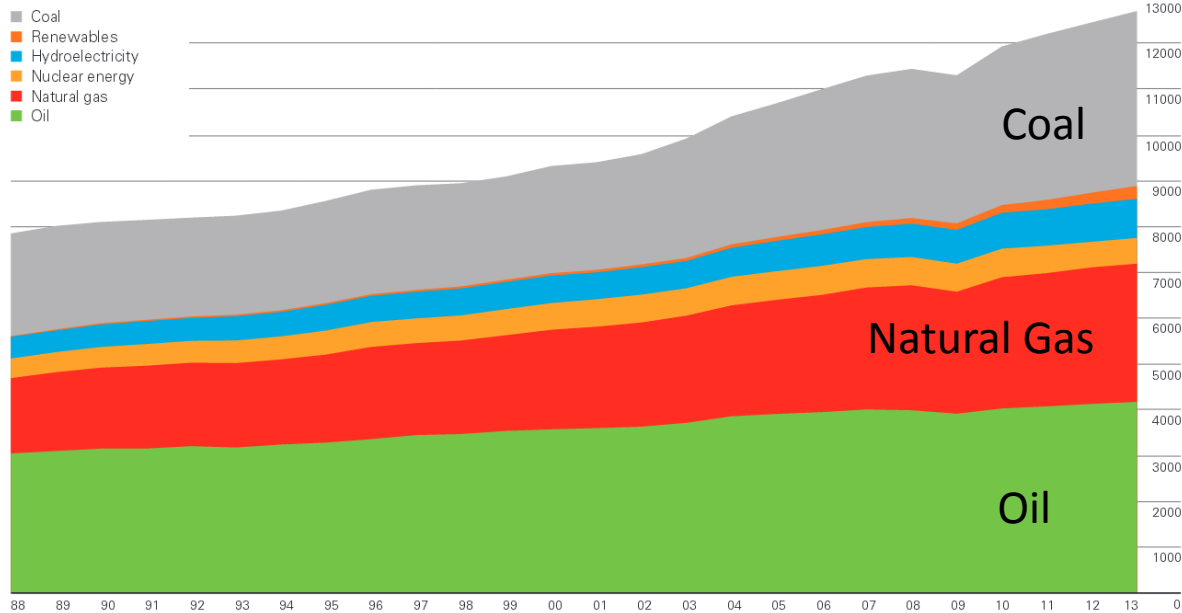
- B.S. Oregon State, M.S. Ga. Tech, Ph.D. University of Washington
- Registered P.E. in OR and WA, 14 patents
- Process engineering experience in oil and paper
- Manufacturing experience with HP
- Product development experience with HP (energy & life science)
- Currently serve as industrial liaison with local industry and perform consulting work with a variety of companies

Energy Consumption since 1988

Reported by BP Statistical Review of World Energy

World consumption

Million tonnes oil equivalent



<http://www.bp.com/content/dam/bp/pdf/Energy-economics/statistical-review-2014/BP-statistical-review-of-world-energy-2014-full-report.pdf>

Observations:

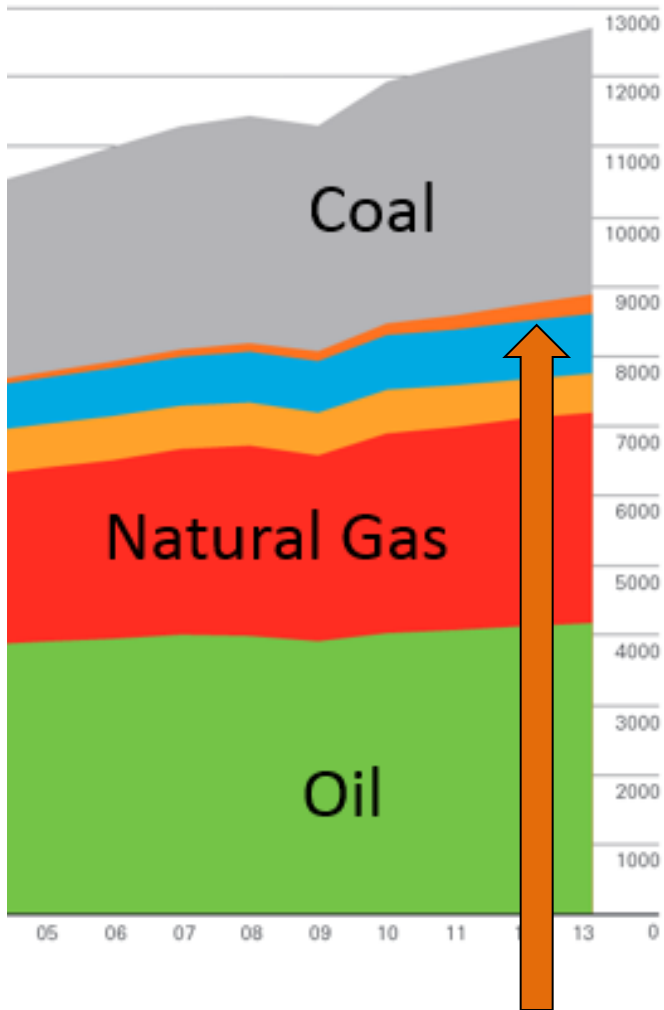
- Renewables are but a sliver of total energy usage.
- Nuclear and Hydro haven't and can't, respectively, grow at a pace for significant displacement of fossil fuel.

Conclusions:

- Our thirst for energy grows at a rate that far exceeds the growth of options.
- Society must self-impose controls in a way that instigates innovation and promotes conservation.

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Harding 5.6 kW System and Nissan Leaf

1. Renewables will not make a significant contribution.

Carbon Caps: *Exciting Opportunity for Innovation*

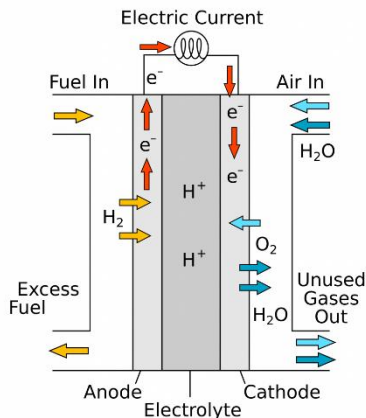
- Oregon (and the U.S. in general) hungrily looks for business and product niches that correspond to customer needs and market opportunities.
- Oregon has extremely favorable factors of (1) high density of highly skilled engineers/scientists and (2) consumer base willing to consider planet health.

Carbon Caps: *Exciting Opportunity for Innovation*

2. Oregon is poised to lead business and innovation.

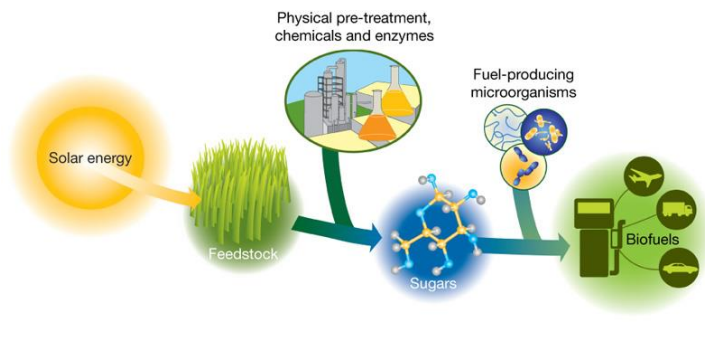
Carbon Caps: *Innovation Case Studies*

- Fuel cells (HP)
 - Response to customer need for battery life (kW-h)
 - Investigation into hydrogen, methanol, and solid-oxide fuel cells striving to improve customer experience
 - Battery performance and fuel costs (competition) was *predictable* and we made the right decision to cancel program.



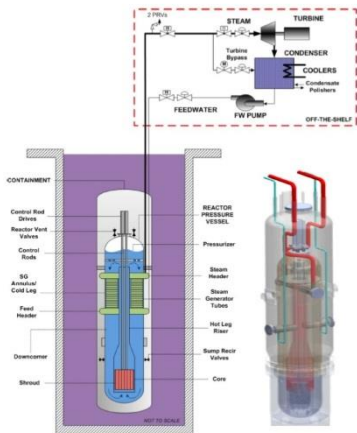
Carbon Caps: *Innovation Case Studies*

- Cellulosic ethanol (Trillium)
 - Response to high fuel costs (\$/gal, \$/mile)
 - Development of processes to produce ethanol from local agricultural lands, e.g. grasses
 - Price of competitor (petroleum) was *unpredictable*, dropped twice, company closed its doors after spending \$M.



Carbon Caps: *Innovation Case Studies*

- Distributed, Safe Nuclear (NuScale)
 - Response to safety and high fossil fuel costs (\$/kW-h)
 - Development of processes to improve safety and make nuclear power more distributable
 - Competitor (petroleum) is *unpredictable*, and NuScale has endured cyclical layoffs and loss in efficiency)



Carbon Caps: *Innovation Case Studies*

3. Innovators and investors require long-term stability.

.... On the multi-decade scale, not two years.