Forum Handout January 8, 2017 prepared by Jonathan Ormes

The CO2 traps energy is unequivocal

* It is straightforward well understood physics
  + Missile detection must take it into account
* Where the energy is going is less clear
  + >2.2 billion Hiroshima bombs since 1998
* Most of the energy is going into the oceans

The rate of change is frightening

* It’s not volcanoes
  + Volcanoes: 0.13 to 0.44 billion tons per year
  + Human activities: 35 billion tons (2010)
* Rate of change
  + Cenozoic Average (65 M yrs): 0.0001 ppm/yr
  + Ice age change (50,000 years): 0.002 ppm/yr
  + Anthropogenic rate: ~2 ppm/yr (1000 x faster)

Consequences: more energy -> more instability

* Expect climatic instability
  + Droughts and floods
* Expect rising sea levels (time to adapt)
  + Sandy, Katrina
* Expect heat waves
  + France 2003 - 70,000 deaths
    - Dehydrated the grapes
  + Tropical diseases
  + Fires (Australia now typically above 40 oC in summer – 104 oF)

Public policy and climate change

* Don’t expect the government to “lead”
* Action comes when it is demanded by the citizenry
* The government is the “last to know” once it has become obvious to everyone else
* Government insurers are not including climate risk, on the other hand, private insurers have been considering climate change for 4 decades
* DoD takes climate change seriously

<http://energy.lbl.gov/insurance/opportunities.html>

Terminology for Global Perspective (compiled by Milt Hetrick)

* IPCC - Intergovernmental Panel on Climate Change (IPCC)
  + World Meteorological Organization [WMO](http://www.wmo.int/pages/index_en.html) and UN Environment Programme [UNEP](http://www.unep.org/) establish the Intergovernmental Panel on Climate Change [IPCC](http://www.ipcc.ch/) in 1988.
  + UNFCCC – United Nations Framework Convention on Climate Change (UNFCCC) in 1994.
* COP - Conference of the Parties, 1995

* INDC - Intended Nationally Determined Contributions (INDC)
* COP21 (aka Paris Agreement) - 21st meeting.
* The planet now has a goal:
  + “hold the increase in global average temperature to well below 2 deg C above pre-industrial levels **and to pursue efforts to limit the temperature increase to 1.5 deg C “**

UNFCCC (United Nations Framework Convention On Climate Change)

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

IPCC Reports

* IPCC reports are developed through multiple rounds of drafting and review.

IPCC member Governments endorse the report based on a dialogue between those who will use the report – the governments – and those who write it – the scientists.

* + Endorsement is intended to underpin the report’s authority.
  + Endorsement does not guarantee any government action.

Assessment Reports AR

1. 1990, FAR, First
2. 1995 SAR, Second
3. 2001, TAR, Third
4. 2007, AR4, forth
5. 2014, AR5, fifth

Three major IPCC working groups

Assessment reports

major working group reports

(almost 800 authors)

Various supporting materials

I. The Physical Science Basis

II. Impacts, Adaptation and Vulnerability

III. Mitigation of Climate Change

<http://www.ipcc.ch/working_groups/working_groups.shtml>

Progression in findings

* First (FAR 1990): Summary for Policymakers report says they are certain that emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases, resulting on average in an additional warming of the Earth's surface.
* Second (SAR 1995): The balance of evidence suggests a discernible human influence on global climate.
* Third (TAR 2001): Since the mid-20th century, most of the observed warming is "likely" (greater than 66% probability, based on expert judgment) due to human activities.
* Fourth (AR4 2007): Most of the global average warming over the past 50 years is "very likely" (greater than 90% probability, based on expert judgment) due to human activities.
* Fifth (AR5 2014): Human influence on the climate system is clear.It is extremely likely (95-100% probability)that human influence was the dominant cause of global warming between 1951-2010.

National Climate Assessment report (May 2014)

* Melting permafrost in Alaska
* Ocean acidification
* Rising sea level, especially along east coast
* Heat waves in the west
* More severe winter storms and hurricanes

World's Largest Polluters Strike Deal to Curb Global Warming (Nov. 12, 2014)

US and China agree on approaches. Barack Obama and Xi Jinping signed a deal that will cut greenhouse gases and pledged to work together toward a global deal in 2015.

Culminated in the COP21 agreement to limit the temperature rise to 2 deg C with a goal of a 1.5 deg C rise (reference 1850, start of industrial revolution).

EPAs Clean Power Plan

* Supreme Ct. stayed implementation
  + EPA believes they have strong scientific and legal foundation.
* Many states are already moving in this direction
  + State choice on how to implement
  + Targets are reasonable and can be met

<http://www.c2es.org/docUploads/insights-comparative-analysis-clean-power-plan-modeling.pdf>

International agreements in place

* international community objective to limit the increase of mean global T < **2°C** (3.6oF) above pre-industrial levels
  + requires global greenhouse gas emissions to peak by 2020 or sooner
  + limit the atmospheric CO2 < 450 ppm
* This agreement was made in a number of international meetings: G8 2009/2010, G20 2009, UN General Assembly 2009/2010, Copenhagen Conference 2009.

Laudato Si’ (Praised Be) issued by the Pope on May 24, 2015

<http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html>

Paris Accord: COP21

Aka 2015 Paris Climate Conference (Dec 7-8, 2015)

* First international agreement on GHG
* Limit ΔT to <2oC (already have 0.8oC)
  + Try to hold ΔT to <1.5oC
* Statements of intention with tracking
* Arguments about enforcement

Note: Rio Earth Summit in 1992 established the Conference of Parties (hence COP)

[http://www.cop21paris.org](http://www.cop21paris.org/)

2015 Paris Agreement – Highlights

* Global Response – COP21, the 21st Family Reunion about Climate Change
* 195 “parties” involved expressed concern about our planet
* Grave concern about our cousins living on island nations.
* Article 2 of the Agreement
  + 1) …this agreement, … aims to strengthen the global response to the threat of climate change …. By:
    - a) Holding the increase in global average temperature to well below 2 deg C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 deg C … recognizing this would significantly reduce the risks and impacts of climate change.
    - b) Increasing the ability to adapt to adverse impacts of climate change …
    - c) Making finances flow …towards low greenhouse gas emissions and climate-resilient development.
* Article 3
  + … The efforts of all parties will … recognize the need to support developing countries parties for the effective implementation of this Agreement.

Kerry Promises at COP21

* “We will not leave the most vulnerable nations among us to, quite literally, weather the storm alone”, he declared, saying that today, “the United States is committing to double […] public, grant-based adaptation investments by the year 2020”, in reference to the measures that will help face up to the consequences of global warming such as building embankments, reforestation, and weather warning systems. These funds totalled $430 million in 2014, according to American officials.
* More generally, “the United States already contributes more than 2.5 billion to climate finance annually”, according to Secretary Kerry.

**The new administration can easily change this commitment.**

INDC Analyses Show Need for Radical Action (May 2016)

The UNFCCC Secretariat has released an updated synthesis report outlining the aggregate effect of the intended nationally determined contributions (INDCs) submitted by 189 Parties as of 4 April 2016.

The report finds … the INDCs would result in total aggregate global emission levels of 55 Gt carbon dioxide (CO2)-equivalent (eq) in 2025 and 56 Gt CO2-eq in 2030….this emissions trajectory …is far from …the goal of limiting warming to 2°C or 1.5°C above pre-industrial levels.

… [the] 17 INDCs that cover 78% of global energy-related CO2 emissions … finds that the energy supply must be more rapidly de-carbonized and energy productivity … improved at a much greater rate than these 17 Parties committed to in their INDCs.

<http://climate-l.iisd.org/news/indc-analyses-show-improvement-need-for-radical-action/>

US to Fail Paris Emissions Pledge Without 'Fundamental Change' (Sept. 26, 2016)

*Published on Monday, September 26, 2016 by* [*Common Dreams*](http://www.commondreams.org/)

***US to Fail Paris Emissions Pledge Without 'Fundamental Change': Report***

*'This is a call to action to ensure we close the remaining gap‘ By* [*Nadia Prupis, staff writer*](http://www.commondreams.org/author/nadia-prupis-staff-writer)

Scientists at a University of Oxford conference last week similarly warned(1)that greenhouse gas emissions are not being reduced quickly enough to prevent the Earth from reaching the agreed-upon 1.5oC global warming threshold in a decade.

Meanwhile, a report by the environmental group Oil Change International also released last week found(2) that the world has 17 years to get off fossil fuels entirely to prevent reaching the even more lenient 2oC warming threshold.

1) <http://www.commondreams.org/news/2016/09/23/earth-could-reach-critical-climate-threshold-decade-scientists-warn>

2) <http://www.commondreams.org/news/2016/09/22/new-new-climate-math-17-years-get-fossil-fuels-or-else>

<http://www.commondreams.org/news/2016/09/26/us-fail-paris-emissions-pledge-without-fundamental-change-report>

COP21 update Oct. 5, 2016

* As of 5 Oct. 2016, 122/197 had ratified the COP21 agreement.
* So it is in force.
* If the USA wants out, there is a complex 4 year withdrawal process.
* We can pull out of the UNFCCC, the controlling UN body for the COP with a 1 year notice.
* The risk is alienating the international community.

<https://www.scientificamerican.com/article/could-trump-simply-withdraw-u-s-from-paris-climate-agreement/>

Election day Nov. 8, 2016

The Renewable Revolution

Renewables are now competitive with fossil fuels. I believe things have gone too far to be stopped by reactionary forces vested in an outmoded energy system, but they could be slowed as these interests defend their turf.

Change is opportunity (peak oil and cheap renewable energy will force it)

* There are costs to transform our energy system
* There are costs for not transforming
* I don’t think anyone can calculate the net cost

Renewables are here

Bloomberg April 15, 2015

* “The world is now adding more capacity for renewable power each year than coal, natural gas, and oil combined.”

2013:

* 143 gigawatts of renewal capacity
* 141 gigawatts of fossil fuel capacity

<http://finance.yahoo.com/news/fossil-fuels-just-lost-race-202723383.html>

Article in Scientific American by Bobby Magill on December 27, 2016

Progress Report on CPP (Clean Power Plan)

* Sept. 2016 by National Resources Defnece Council (NRDC)
* Goals have become even more readily achievable as the electricity sector is already shifting to clean energy.
* Clean energy to double from 2015 levels by 2021

<https://www.nrdc.org/experts/kevin-steinberger/recent-progress-further-strengthens-clean-power-plan-outlook>

New administration will probably try to stop this action, but EPA was under orders from the Supreme Court to “control pollution by CO2 under the Clean Air Act”. This will be a big fight and expect legal action to delay.

Success stories (an old list)

* Reforestation in South Korea
* Rooftop solar water heating in China
* Crop residues to feed animals
  + Milk production via fodder in India
  + Feeding beef in China
* Geothermal energy in Iceland
* Wind farms in Denmark
* Soil conservation tillage in the USA (but fertilizer)
* Population stabilization in Eastern Europe, Russia
* Ozone hole treaty

China leading global efforts

* To spend $360 B through 2020 on renewable energy
* Driven the price of solar panels down
* Need to solve their pollution problems

Ground based solar arrays

Power Purchase Agreement (PPA) costs are falling: "As recently as 2011, solar PPA prices in excess of $100/MWh were quite common. Barely five years later, most PPAs in the 2015 sample are priced at or below $50/MWh levelized (in real, 2015 dollars), with a few priced as aggressively as ~$30/MWh.

Costs in US are about twice those in rest of the world.

<http://www.vox.com/2016/8/24/12620920/us-solar-power-costs-falling>

It's a security issue (way back on Aug. 9, 2009)

* "We will pay for this one way or another. We will pay to reduce greenhouse gas emissions today, and we’ll have to take an economic hit of some kind. Or we will pay the price later in military terms. And that will involve human lives."

GEN. ANTHONY C. ZINNI, former head of the Central Command, on climate change.

Good news

In 2010, more was invested in renewables than in extracting more ancient hydrocarbons, globally.

* Renewable: $187 billion
* Ancient hydrocarbons: $157 billion

By 2015

* Renewable $266 billion
* Hydrocarbon $130 billion

Renewables still only 10% of global capacity

<http://www.bloomberg.com/news/articles/2011-11-25/fossil-fuels-beaten-by-renewables-for-first-time-as-climate-talks-founder>

<http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf>

The future

Regarding the future, there are no guarantees.

“The past is uncertain but the future is bright.” Russian people in the Soviet Union

“To live without hope is to cease to live.”   Fyodor Dostoyevsky

“Action is the antidote to despair.”   Joan Baez

“Do something wonderful, people may imitate it.”   Albert Schweitzer

“It’s hard to make predictions, especially about the future.”

Lawrence Peter "Yogi" Berra

Closing

* After we are gone, may our lives have made a difference.
* May those who come after us enjoy the quality of life we cherish.