Multiple immediate benefits of emissions mitigation

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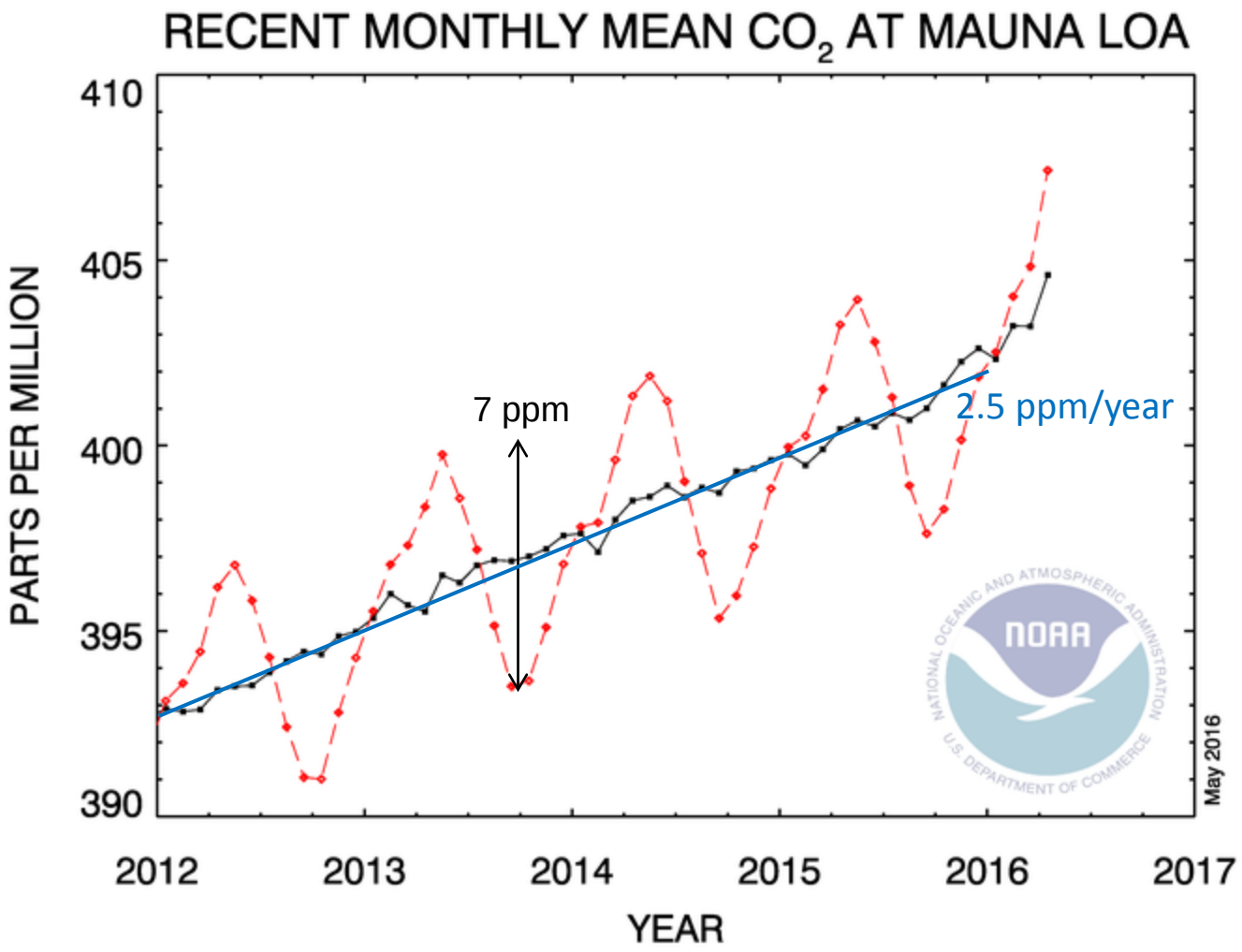

RECENT MONTHLY MEAN CO_2 AT MAUNA LOA
PARTS PER MILLION
410
405
400
395
390
2012
2013
2014
2015
2016
2017
YEAR
7 ppm
2.5 ppm/year
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
May 2016

Excerpts from the COP21 (Paris, December 2015) preamble:

Recognizing that climate change represents an urgent and potentially irreversible threat to human societies …

Also recognizing that deep reductions in global emissions will be required …
… and emphasizing the need for urgency in addressing climate change …

The main immediate mitigation options:

energy efficiency improvements

wind and solar

MITIGATION = JOBS

U.S. building sector
employment 6.2 M
output 1,200 B $

→ 500,000 jobs per 100 B $ investment
or $200,000 of product/year per job

Nature, 2008

1950's building in Frankfurt before (left) and after (right) retrofit. Energy use dropped 90%

Brooklyn, NY

Where does the money come from?

Government could take on more debt
Tax offshore wealth
Return to progressive income tax
Price on GHG emissions

MITIGATION = JOBS

Some jobs will be lost:

employment in coal sector	70,000
oil/gas	190,000
other minerals	100,000
Total	360,000

Total production 650 B $ per year

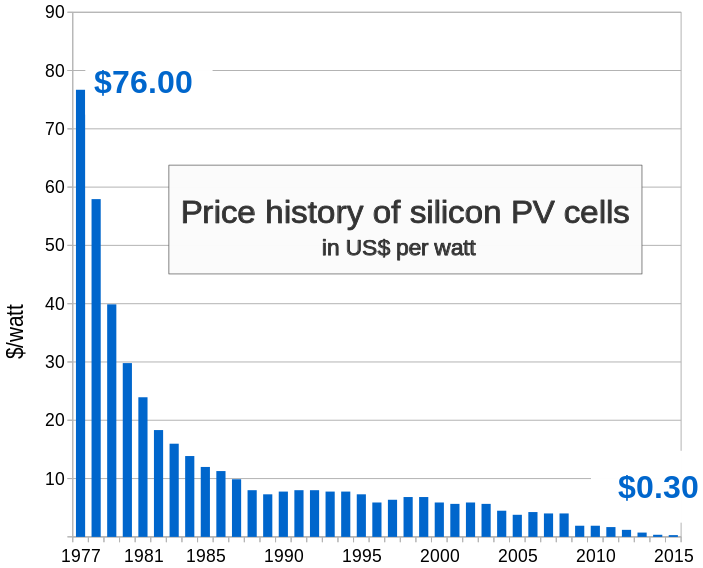
→ 1,800,000 $ of product/year per job

MITIGATION = JOBS

Currently 80,000 jobs

Projection DOE Wind Vision report 2014:
2020 20% of grid power
2050 50% of grid power and 600,000 jobs

Currently 200,000 jobs in solar PV, same as in oil/gas sector



Electrical grid power can be made 80% renewable without changing the cost of electricity:

MacDonald et al., Nature ClimChange 2016

$1.50 per Watt full system installed
Capacity factor ~20%, 25 year lifetime
3.5 cent/kWh on the grid

Energy Return on Energy Invested (ERoEI)

Net energy = energy content of produced resource (ER)
minus energy spent to produce it (EI)

$$\text{ERoEI} \equiv \frac{\text{ER}}{\text{EI}}$$

Ghawar field	100
Conventional oil	10-20
Tight oil	4-5
Shale oil	3-5
Deep offshore	4-7
Heavy oil (Venezuela)	3-5
Tar sands (surface)	6
Tar sands (underground)	3

Having to use more energy to extract and process the fuel acts as a demand (and emissions) multiplier,

$$\frac{\text{ERoEI}}{\text{ERoEI}-1}$$

The quality of a finite resource tends to go down gradually as the best pieces are exploited first. Technology improvements have to overcome decreasing quality.

Typically, environmental damages increase with lower quality.

The cost of using renewable resources continues to get lower as technology develops.

Headline: Oil exploration drops to 60 year low in 2015

This will very likely lead to higher prices in 5 -10 years.

Energy security: Successful mitigation policies will liberate us from the boom-bust cycles that have (almost) always accompanied traditional mining activities. Those cycles are costly because of unemployment peaks and mis-allocated resources (stranded assets).

Energy insecurity:

Costs of the Iraq and Afghan wars:

more than 500,000 casualties
health problems for veterans
about 4.4 trillion US $
US torture policies
failed states in Middle East

Gross Domestic Product

GDP = Consumption + Investments + Government spending + Exports – Imports

Major drawbacks: no distinction between investments and consumption

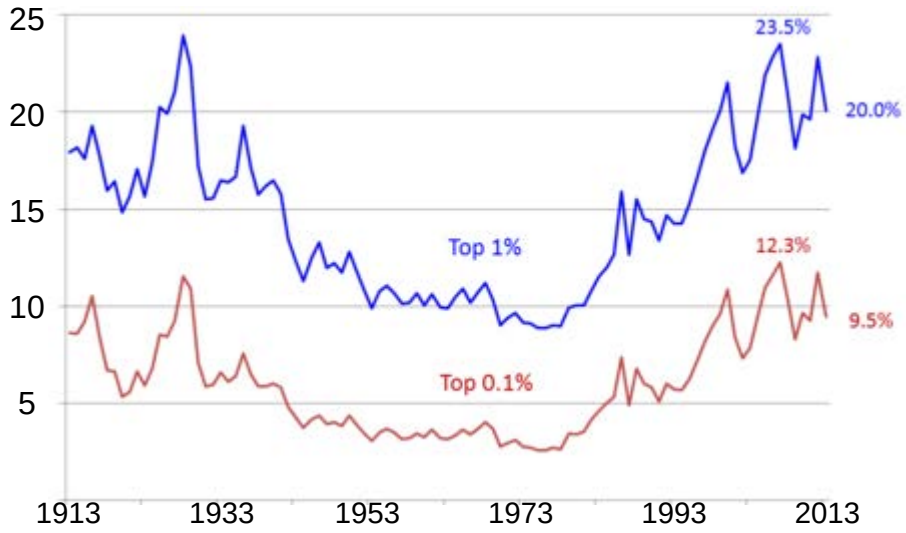
ignores assets, natural or man-made

ignores savings and debts

ignores the distribution of income

ignores non-market services, social costs

Percent share of all income by the top 0.1% and 1% income households



THE NEVER-ENDING GROWTH PROBLEM

Introduce new measures of economic success, alongside GDP:

Aggregate human-made wealth
Aggregate natural wealth, both renewable and non-renewable

Helm proposes the "Strong Aggregate Natural Capital Rule":

The aggregate level of renewable natural capital should be held at least constant. Economic rents from the depletion of non-renewable capital should be invested in renewable natural capital.

We need balance sheets that include both assets and liabilities.

How can we put monetary value on natural capital?

The species perspective: Take fish, with stocks above a certain threshold maintenance costs are close to zero and yields are assured. But we need to stay above the threshold → catch quotas can be auctioned off.

However, there is also the ecosystem perspective, with many complicated issues:

There is currently no market for most natural capital, but there often are regulations.
Severity of pollution impact depends strongly on local situation.
Unknowns in connections between species within ecosystems.
International relations and responsibilities.

Dieter Helm, Natural Capital, Yale U. Press, 2015

Currently, we already demand compensation for (some) damages
(e.g. Deepwater Horizon, Exxon Valdez)

We could do much more:

Compensation to future generations for the loss of non-renewable resources.
This can pay for maintenance and restoration of renewable resources
[the Aggregate Natural Capital Rule].

Shift taxation from the cost of labor to polluting emissions through
taxes or permits.
Use that money to subsidize more sustainable economic behavior.