“Muddling Through” is Good Climate Policy…but Not Enough

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To zeroth order...

...the climate problem is the energy problem.

Source: IPCC AR5 WG1
So...how are we going to decarbonize the world's energy system?

International negotiations among ~180 nations are all well and good but what we really need is serious reductions by half a dozen nations or regions.

Source: UCS from EIA 2011 data
Managing carbon from the bottom up

Managing Carbon from the Bottom Up

M. Cozger Morgan

The world needs to get serious about managing the atmospheric growth of greenhouse gases, and there are some promising new ideas for how to do it. One promising approach is to focus on the local level, where small-scale changes can have a big impact. For example, if people in a city started using more public transportation, they could reduce their carbon footprint significantly. This approach would require a shift in mindset, from seeing carbon emissions as a problem that needs to be solved at the global level, to seeing them as a local problem that can be addressed through small-scale changes. The benefits of this approach could be significant, and could help to reduce the overall impact of climate change.

Source: Science, 2000 Sep 29.
In that light…

…because it covers close to half the world’s CO₂ emissions, the recent bilateral agreement with China is a very important step forward.

It may involve incremental “muddling” but for the first time it gets the two nations that produce the most CO₂ emissions discussing concrete steps.

Chinese emissions are to peak by 2030 and not grow thereafter (i.e., exponential growth in CO₂ emissions will end).

EDF reports that at present China has carbon trading programs in five cities and two provinces that cover >2000 sources (16% of total GHG emissions).
Here in the U.S. . .

. . .while the Waxman-Markey Bill was not perfect, clearly it would have offered a better way forward than using Section 111 of the CAC. However, it's better to get started with something than continue to doing nothing.

Source: U.S. GPO.
More than half a century ago political scientist Charles Lindblom argued that such “muddling through” with incremental steps is frequently superior to attempting to design and implement comprehensive policy solutions.

However…

…if climate policy is ultimately to be successful, “muddling” will need to be combined with some longer-term “visioning.”

Modest first steps that reduce emissions of greenhouse gases are wonderful, but to stabilize the climate the world must reduce emissions of greenhouse gases by at least an order of magnitude.

It is not too soon to start thinking about how to avoid getting stuck with policies that do not scale up – how to avoid regulatory lock-in and to move past early incremental steps to achieve deep reductions.
The U.S. is finally getting serious.

Under 111(b)
New sources: 1,000/1,100 lb CO₂/MWh

Under 111(d)
Four blocks:
1) Increase coal boiler heat rate efficiency
2) Re-dispatch to lower CO₂ emitting sources
3) Create low/zero carbon generating sources
4) Improve electricity efficiency

AND ~20 states and ~1000 city mayors have their own plans, with CA clearly the most serious.

The objective: A 30% reduction by 2030
This will be implemented...

...differently in each state. Groups of states can also cooperate to come up with regional solutions.

To assist in this process my colleagues Paul Fischbeck, Haibo Zhai and Jeffrey Anderson have developed a model that characterizes every coal-fired boiler in the U.S.
Public Databases

Working Database

IECM*

Reduced Form Model

State-level Projections

User Scenarios

“On-site” Decision Tool

Costs, Emission Levels, Mitigation Measures

Boiler Categories

Boiler Compliance

Mitigation Measures

External Calculations
**User interface**

**Historical Context**

**2030 Forecast**

**State-level details**

**Boiler-specific details**
However…

…there is a risk that a plethora of different state and other strategies that result in some limited reduction in CO$_2$ emissions will not readily scale-up to larger future reductions.

While I will not talk about it today, there may be similar international risks (e.g., ICAO on CO$_2$ from airlines).
Hopefully…

…litigation will not derail the present U.S. effort under CAC Section 111, and the U.S. will achieve the EPA's goal of reducing power sector emissions to 30% below 2005 levels by 2030.

But 30% is only a less than a third of what will ultimately be needed. Moving beyond the resulting complex patchwork of state-by-state regulatory solutions will likely pose big challenges.
We should applaud…

…incremental progress on emissions reductions in the face of implacable political opposition. But there is no escaping the need for an order of magnitude reduction in global emission of greenhouse gases.

Changing complex regulatory systems once they become firmly established can be extremely difficult.
Hence I believe that for...

...each piece of incremental progress, the policy research community must start now to ask how best to avoid technical or policy lock-in or dead ends, and identify strategies that will readily allow a scale up to larger future reductions.

The resulting challenges in regulatory and policy design will be daunting. However, without those designs, progress could stall.

The success of today should not become the burden of tomorrow.
Promote low/zero CO₂ energy

Source: https://flowcharts.llnl.gov/content/assets/images/energy/us/Energy_US_2013.png
Four examples of strategies

1. DoE should mount a program to coordinate with States and/or utilities and IPPs that want to meet part of their CAA Sec111 obligations with CCS by providing subsidies for commercial scale CCS. Such a program should pay special attention to strategies such as Oxifuel that can reach 100% capture.

Source: Kyle Borgert, Oxyfuel Carbon Capture for Pulverized Coal, EPP PhD, 2015.
Comparison of CCS technologies

Source: Kyle Borgert, Oxyfuel Carbon Capture for Pulverized Coal, EPP PhD, 2015.
Four examples of strategies

2. Congress should adopt a regulatory framework that is similar to the one developed in draft legislation by the CCSReg Project for the underground sequestration of carbon dioxide.
At the moment...

...the regulatory situation is different in different states. (EPA rules don’t address issues like ownership, liability, long-term stewardship.)

The CCSReg project developed an adaptive performance-based approach that would yield a more uniform national regulatory strategy for sequestration and developed a 50-pager draft bill to show how it could be implemented.
Four examples of strategies

3. States, regions and the federal government should develop strategies to sustain the present fleet of nuclear plants in the face of low-cost natural gas and other competitive pressures.

Images from http://insideclimatenews.org/slideshow/14-us-nuclear-plants-closing-or-risk---photographs-and-text
Recently a senior executive at PJM told one of my colleagues that he thinks five more nuclear plants are at risk as a result of low natural gas prices. Several plants have recently closed. It is my understanding that the closure of Kewaunee was entirely economic (i.e., gas prices). Vermont Yankee and San Onofre both needed investment that owners considered unattractive...again largely I think as a result of low gas prices.

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While this is the result of the short-term economic focus imposed by restructuring, it is nuts given that soon the nation is going to have to get serious about decarbonizing our energy system.

Source: www.infomine.com/investment/metal-prices/natural-gas/all/
Four examples of strategies

4. DoE and NRC should reinvigorate the U.S. effort to support the development of advanced and small modular power reactors.

A Workshop we ran in Switzerland on Small Modular Reactors
Promote greater end-use efficiency

Estimated U.S. Energy Use in 2013: ~97.4 Quads

Source: https://flowcharts.llnl.gov/content/assets/images/energy/us/Energy_US_2013.png

Source: LLNL 2014. Data is based on DOE/EIA-0035(2014–03), March, 2014. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant “heat rate.” The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527
Three examples of strategies

1. To improve overall energy conversion efficiency states should promote DG with CHP.

   BUT, in parallel, DoE should work to develop:
   - gas from biological sources (Germany got 10% of its electric power in 2014 from bio sources)
   - distribution systems for H₂ so that wide adoption of DG with CHP doesn't lock us in to continued use of CH₄

   AND we need to find ways around state laws that grant distribution utilities exclusive service territories so as to promote the growth of small micro-grids.
Empirical assessment is essential

Three examples of strategies

Strategies designed to promote consumer adoption of technologies and behaviors that promote improved end-use efficiency should be carefully designed using empirically-based modern behavioral social science.

Focus on GHGs and adopt strategies that scale

Estimated U.S. Energy Use in 2013: ~97.4 Quads

Source: https://flowcharts.llnl.gov/content/assets/images/energy/us/Energy_US_2013.png
Two examples of strategies

1. State legislatures should substitute carbon portfolio standards for renewable portfolio standards. Analysis groups should lay the groundwork for support easy adoption.
If what we care about is reducing emissions of greenhouse gases, then we should focus on that *directly*.

Wind, solar and hydro have strengths, but they also have large environmental impacts (land use, stream flow, etc.).
Examples of impacts from wind

On Appalachian ridges wind arrays result in habitat fragmentation. Bird and bat kills are also a serious issue.

Source: https://thenaturaleyewordpress.com
More generally:

Ausubel argues:

Renewables are not green. To reach the scale at which they would contribute importantly to meeting global energy demand, renewable sources of energy, such as wind, water and biomass, cause serious environmental harm. Measuring renewables in watts per square meter that each source could produce smashes these environmental idols. Nuclear energy is green. However, in order to grow, the nuclear industry must extend out of its niche in baseload electric power generation, form alliances with the methane industry to introduce more hydrogen into energy markets, and start making hydrogen itself. Technologies succeed when economies of scale form part of their conditions of evolution. Like computers, to grow larger, the energy system must now shrink in size and cost. Considered in watts per square metre, nuclear has astronomical advantages over its competitors.

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Keywords: decarbonisation; electricity; environmental impact; nuclear power; renewable energy.


Biographical notes: Jesse Ausubel spent the first decade of his career in Washington DC working with the National Academy of Sciences and National Academy of Engineering. On behalf of the academies, he was one of the main organisers of the first UN World Climate Conference in Geneva in 1979. He was also the main author of the 1983 report Changing Climate, the first comprehensive review of the greenhouse effect. In 1989 he moved to Rockefeller to establish a research programme on the long-term interactions of technology and the environment, patterns of technological diffusion, and means for a large, prosperous society that spares nature.

1 Introduction

Heretics maintain opinions at variance with those generally received. Putting heretics to death, hereticide, is common through history. In 1531 the Swiss Protestant heretic Huldreich Zwingli soldering anonymously in battle against the Catholic cantons was speared in the thigh and then clubbed on the head. Mortally wounded, he was offered the services of a priest. His declination caused him to be recognised, whereupon he was killed and quartered, and his body parts mixed with dung and ceremonially burned. Recall that the first heresy against the Roman Church in Switzerland in 1522 was the eating of sausages during Lent, and the signal heresy was opposition to the baptism of
Two examples of strategies

2. Analysis groups (e.g., RFF, EPP at CMU, ERG at Berkeley, etc.) should help states develop ways to avoid or minimize the use of point-source control strategies that are not easily superseded in the future by simple pricing of emissions or by cap and trade.
On the other hand…

While emissions taxes or cap and trade are sensible for point sources like large power plants…

…performance standards (e.g., CAFE) make more sense for sources like motor vehicles since $1/ton \text{CO}_2 \approx$ a penny a gallon at the pump.

Source: USA Today.com
My bottom line:

Muddling through may be the best we can do in the short-term in order to get started on policy to reduce CO$_2$ emissions.

However, to avoid dead ends, the community of policy analysts should begin to work NOW on identifying and avoiding strategies that might lead to dead ends and find ways to promote strategies that will scale up to the $\geq 90\%$ emission reduction we need.
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