



International Risk
Governance Council



engineering and public policy

Preparing Technical Leaders to Address Policy Issues
that Involve Science and Technology.

Some Considerations in The Design of Adaptive Policies

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While there is...

...a strong case to be made that policies should be adaptive, and should change as we learn more about physical processes and the behavior of regulated entities, designing such policies can pose a variety of challenges. In this brief overview talk, I will identify and discuss:

- 1) The use of policy experiments to identify promising policy options and "red teams" to identify ways in which proposed regulatory strategies might be gamed;
- 2) Periodic mandatory regulatory review (including the need to differentiate general rules from specific applications);
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Adaptive policy and learning

Often policy makers do not get things right the first time, or the circumstances change so that what ones that previously made sense no longer work as well.

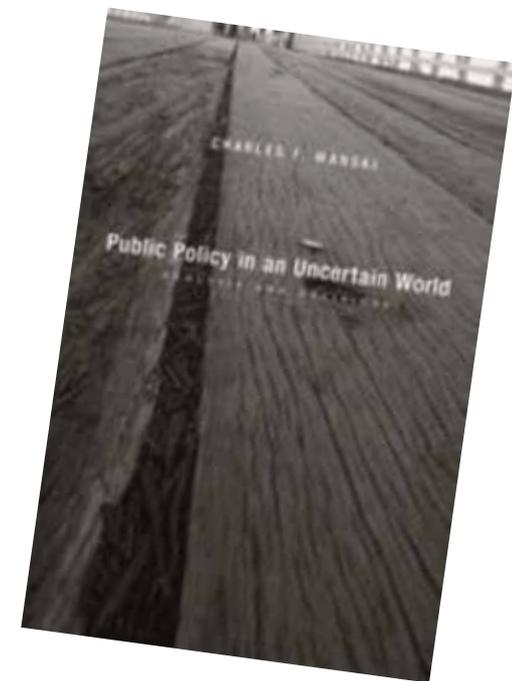
However, once a policy is implemented it can often be difficult to revisit and correct it.

One strategy to deal with this is to try to treat policies as experiments, learn as outcomes evolve, and design the initial policy to allow for adaptation in the face of learning and changed circumstances.

Policy experiments

Manski (2013) makes a case for adopting a *diversity* of policies (e.g., different plausibly good treatments for different populations).

Such diversification strategies, especially if they are well-documented and the consequences are well-monitored, are especially feasible in a federal system such as the U.S. in which 50 different states can serve as laboratories for policy assessment or across the EU in which the possibility exists for 28 different member states to work to achieve the same general objective through the adoption of different strategies.



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At least in my country, that can sometimes be a problem!

Red teams

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The basic idea is to "game" the proposed policy and try to "break" it before it is implemented so that problems can be found and corrected while that is still easy to do.

One place...

...where using red teams could make a big difference is in the design of new tariff structures for electric power markets.

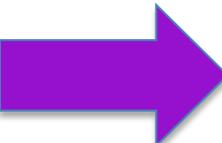
Regulators often find themselves trying to patch up tariffs that are being manipulated by market players.

Many of these problems could be found in advance if MBA students were turned loose on the proposed tariff with an award for finding ways to game it.



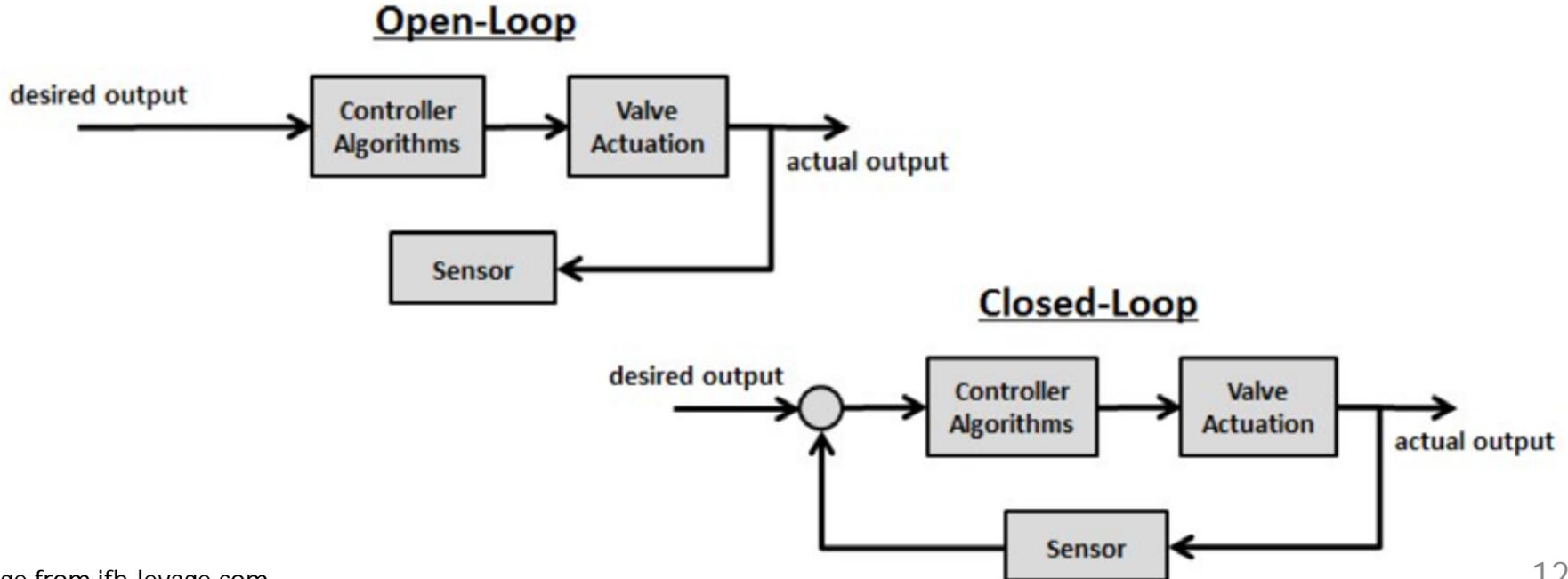
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More policy should run "closed loop"

In engineering, we differentiate between systems that run "open loop," that is, without corrective feedback, and those that run "closed loop," that is, with feedback to the system to provide corrective adjustment.



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However, because the process of formulating a rule and getting it implemented requires enormous effort, agencies tend to want to get something fixed in place and not have to revisit it.

An effective strategy to counteract this tendency is to implement mandatory reviews and/or sunset rules.

Mandatory review

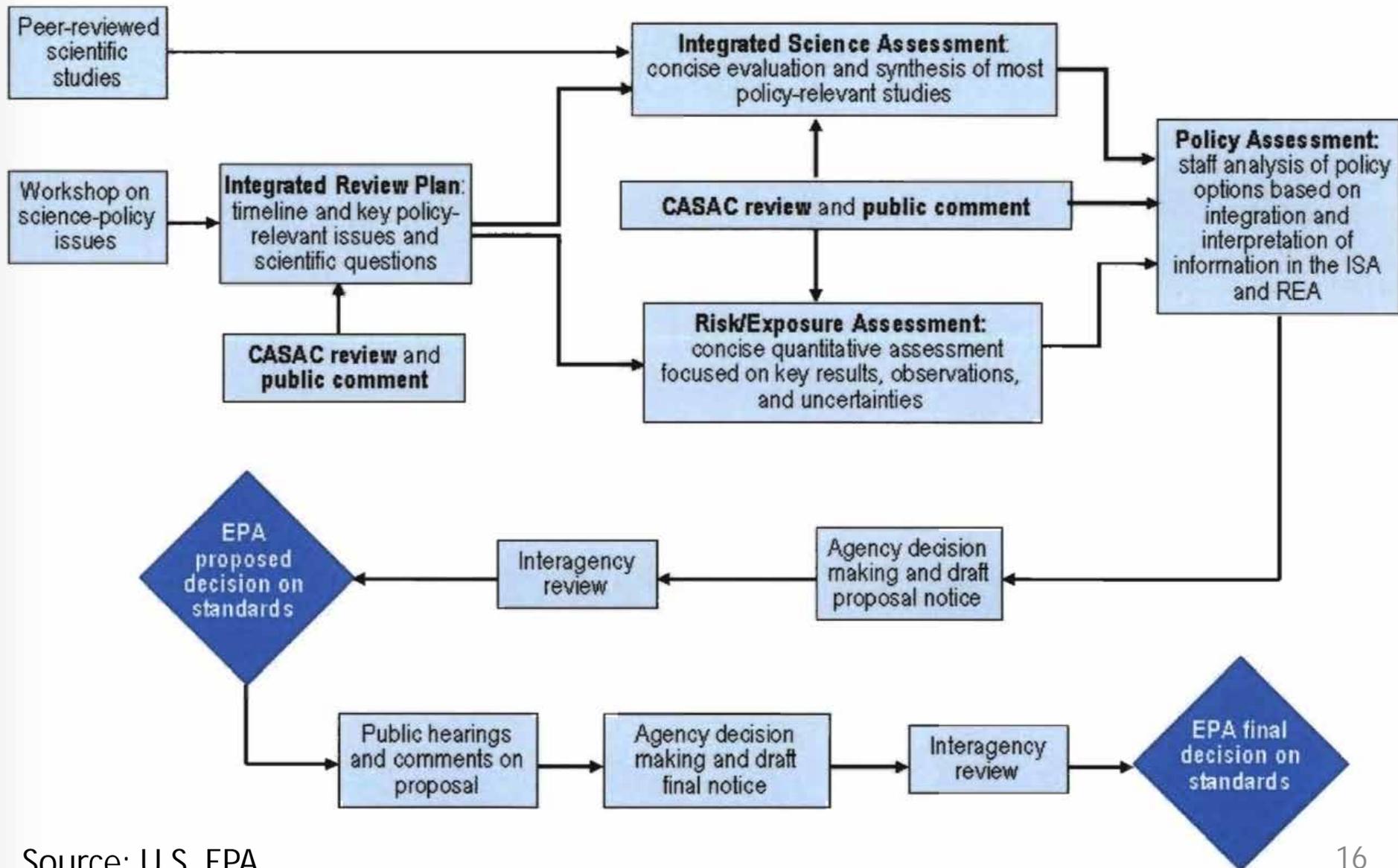
Perhaps the best example of a mandatory review is the requirement under the U.S. Clean Air Act that all of the six "criteria air pollutants" must be periodically revisited and considered for revision.*

Over the years the implementation of this process has undergone various revisions, but it has always involved a detailed review by staff of all relevant refereed literature, and a subsequent peer review by an independent "Clean Air Science Advisory Committee" (CASAC).

* The six "criteria air pollutants" are CO, NO₂, O₃, Pb, PM₁₀ and PM 2.5, and SO₂.

New NAAQS review process

April 2009



EPA Clean Air Scientific Advisory Committee (CASAC)

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The **Clean Air Scientific Advisory Committee (CASAC)** provides independent advice to the EPA Administrator on the technical bases for EPA's national ambient air quality standards. Established in 1977 under the Clean Air Act (CAA) Amendments of 1977 (see 42 U.S.C. § 7409(d) (2)), CASAC also addresses research related to air quality, sources of air pollution, and the strategies to attain and maintain air quality standards and to prevent significant deterioration of air quality. The Chair of the CASAC also serves as a member of the chartered [Science Advisory Board](#).

This website provides information on:

- [the seven members of CASAC](#) , including the [annual process for nominating and providing comment on candidate experts](#) to serve CASAC,
- CASAC [advisory activities](#) and [reports](#) (both [activities](#) and [reports](#) can be viewed by CASAC topic),
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NAAQS Reviews: Status Update

(as of December 2015)

	Ozone	Lead	Primary NO ₂	Primary SO ₂	Secondary NO ₂ and SO ₂	PM	CO
Last Review Completed (final rule signed)	Mar 2008	Oct 2008	Jan 2010	Jun 2010	Mar 2012	Dec 2012	Aug 2011
Recent or Upcoming Major Milestone(s)¹	<u>August 2014</u> Final REAs Final PA <u>Nov 25, 2014</u> Proposed rule <u>Oct 1, 2015</u> ² Final rule	<u>May 2014</u> Final PA <u>Dec 2014</u> Proposed decision <u>2016</u> Final decision	<u>Jan 2015</u> 2 nd Draft ISA <u>May 2015</u> REA Planning Document <u>Summer 2016</u> 1 st Draft PA	<u>October 2014</u> Final IRP <u>Fall 2015</u> 1 st Draft ISA <u>2016</u> REA Planning Document	<u>Fall 2015</u> Draft IRP	<u>Winter 2015/16</u> Draft IRP	TBD ³

Additional information regarding current and previous NAAQS reviews is available at: <http://www.epa.gov/ttn/naaqs/>

¹ IRP – Integrated Review Plan; ISA – Integrated Science Assessment; REA – Risk and Exposure Assessment; PA – Policy Assessment

² **Bold and underlined** dates indicate court-ordered or settlement agreement deadlines

³ TBD = to be determined

Thanks to Karen Wesson of EPA for this slide.

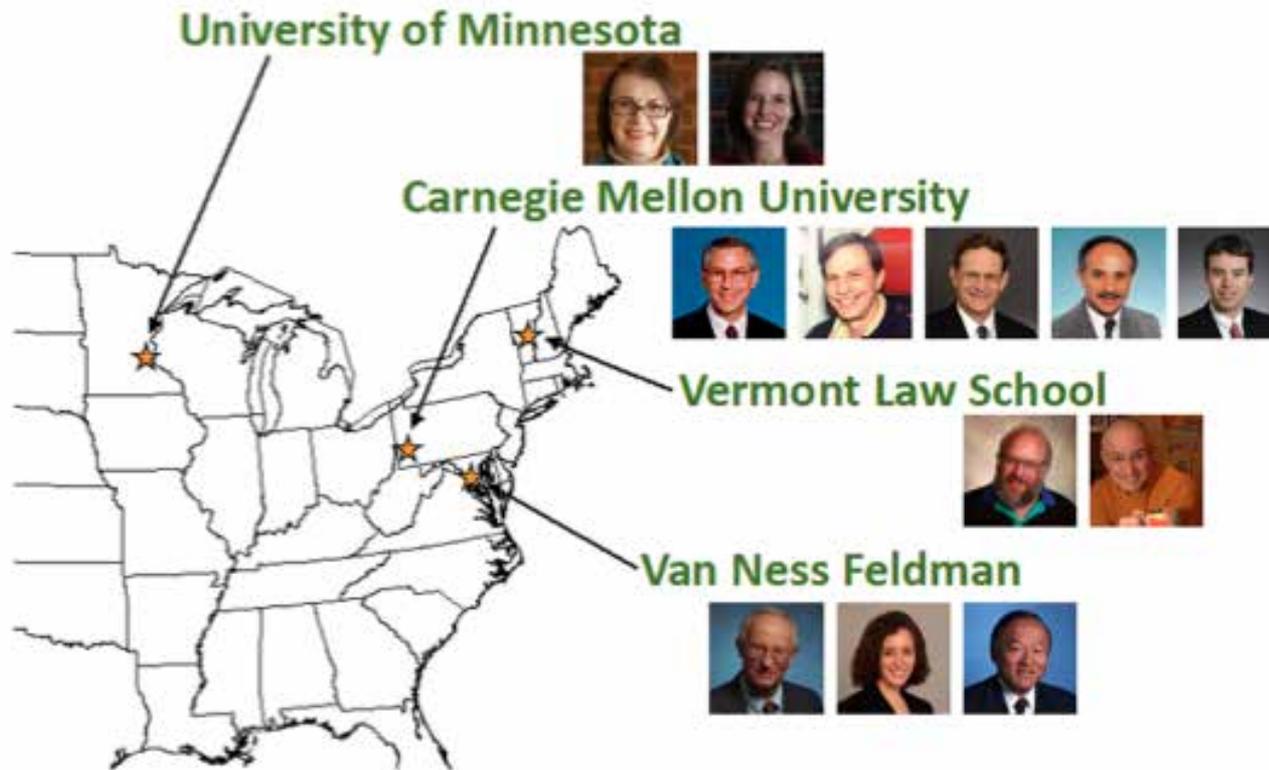
Two examples of proposals we've made for periodic review

1. In connection with a strategy to regulate the deep geological sequestration of carbon dioxide.
2. In connection with the development of FAA strategies to certify aircraft parts made with metallic additive manufacturing (MAM).





1. The CCSReg Project



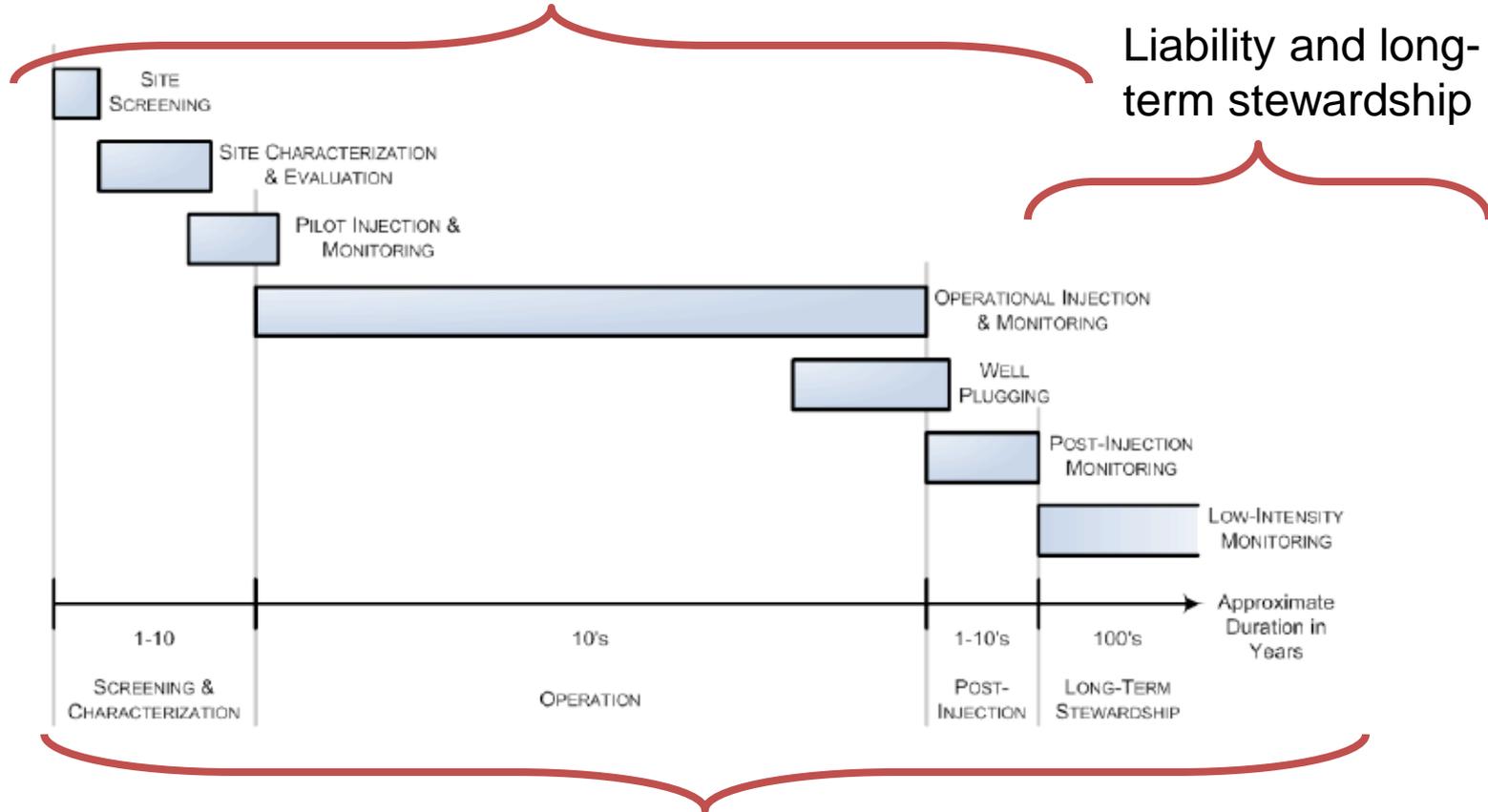
Funding for this project was provided by the Doris Duke Charitable Foundation

Details at:
www.CCSReg.org

Different stages require different approaches

Legal access to and use of pore space

Liability and long-term stewardship

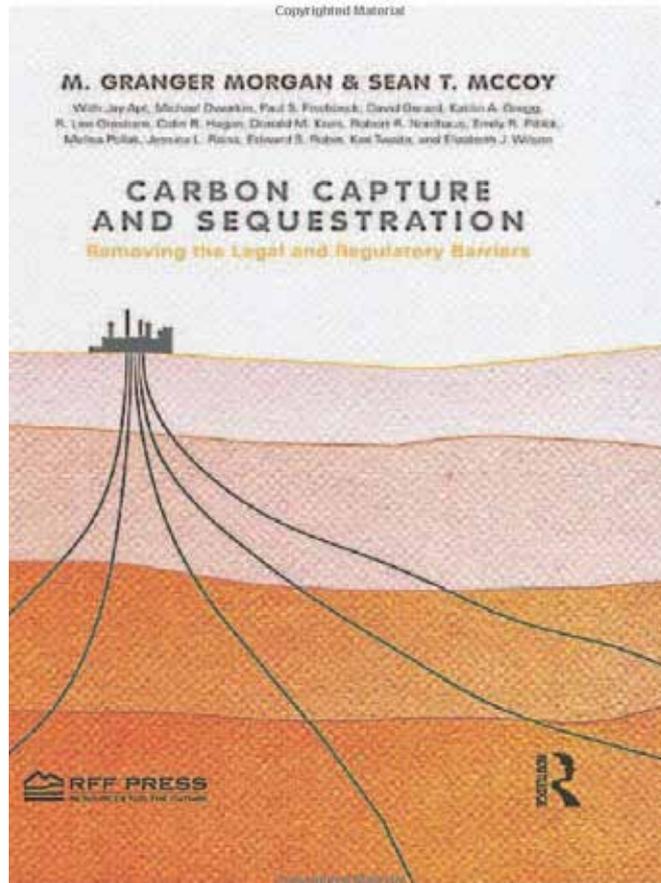


Need for an adaptive approach

Over the course of the project...

...we produced an interim report, a variety of policy briefs, and many presentations and briefings.

At the project's conclusion we published a book with RFF Press:



1. Importance of CCS
 2. Technology for CCS
 3. Siting CO₂ pipelines
 4. Permitting CCS sites
 5. Learning/adapting from CCS sites
 6. Access to pore space
 7. Liability and long-term management
 8. GHG accounting for CCS
 9. Making CCS a reality
- Appendix



Recommendations on Adaptive Regulation

- Congress should enact new GS legislation that mandates periodic review and revision of the regulatory framework for geologic sequestration.
- New legislation should create an independent technical advisory committee that is charged with learning from experience and advising the EPA and the FGSB* (proposed in Chapter 7) and other agencies on ways to improve the regulatory framework for GS.
- The EPA should contract with the National Research Council (NRC) to establish an independent GS Technical Advisory Committee (GSTAC) that will meet at least once every seven years to advise the EPA, the FGSB, and other agencies involved in the regulation of GS.

* Federal Geological Sequestration Board

Industry response

1 **TITLE II—ADAPTIVE AND PERFORMANCE-**
2 **BASED APPROACH**

3 **SEC. 201. NEED FOR AN ADAPTIVE AND PERFORMANCE-**
4 **BASED APPROACH TO REGULATING THE**
5 **GEOLOGIC SEQUESTRATION OF CARBON**
6 **DIOXIDE.**

7 (a) THE CONGRESS FINDS AND DECLARES:

8 (b) IN GENERAL.—Because at present there is limited experi-
9 ence with large-scale geologic sequestration of carbon dioxide, regula-
10 tions developed to govern GS site permitting operation, and issuance
11 of a certificate of closure, including criteria for a transition to long-
12 term stewardship, should emphasize the promulgation of adaptive and
13 performance-based rules and standards to encourage flexibility and
14 learning, and mandate a systematic process to regularly review and
15 improve the regulation of GS.

16 (c) DEVELOPMENT OF PERFORMANCE-BASED RULES AND
17 STANDARDS.—The objective of rules and standards developed by the
18 Environmental Protection Agency for permitting and monitoring the
19 operation of GS Projects shall be to assure that these activities are
20 conducted in a manner that provides reasonable protection to health,
21 safety and the environment. Similarly, the objective of the standards or
22 criteria developed by the Federal Geologic Sequestration Board for
23 accepting GS sites into long-term stewardship and managing those
24 sites once they have entered long-term stewardship shall be to assure
25 that these standards, criteria and management activities continue to
26 provide reasonable protection to health, safety and the environment.
27 Consistent with those objectives, both the Environmental Protection
28 Agency and the Federal Geologic Sequestration Board shall, to the ex-
29 tent practicable, promulgate rules and formulate standards that are per-
30 formance-based such that compliance strategies may evolve with in-

For years, folks from U.S. industry have complained bitterly about the inflexibility of environmental regulation.

However, when we briefed these ideas to an industry group they were dismayed... "Give us a regulation that is fixed that we can plan to..."

However, once we explained that in most cases existing permits would not be affected by the revised regulations but only apply to new permits, they became supportive.

2. Metallic Additive Manufacturing (MAM) applied to the aircraft industry

With EPP PhD student Jaime Bonnin Roca, Prof. Erica Fuchs, and Dr. Parth Vaishnav, we have been exploring the use of MAM in the aircraft industry.

FAA regulation and certification is a major issue. Jaime has conducted 33 interviews with stakeholders and we ran a two-day invitational workshop with government and industry players this past Fall.



PhD student Jaime Bonnin Roca...

...has used Process-Based Cost Modeling to evaluate how FAA policy approaches could influence MAM's production costs and competitiveness (one part per machine; recertify whenever switching to a new part).

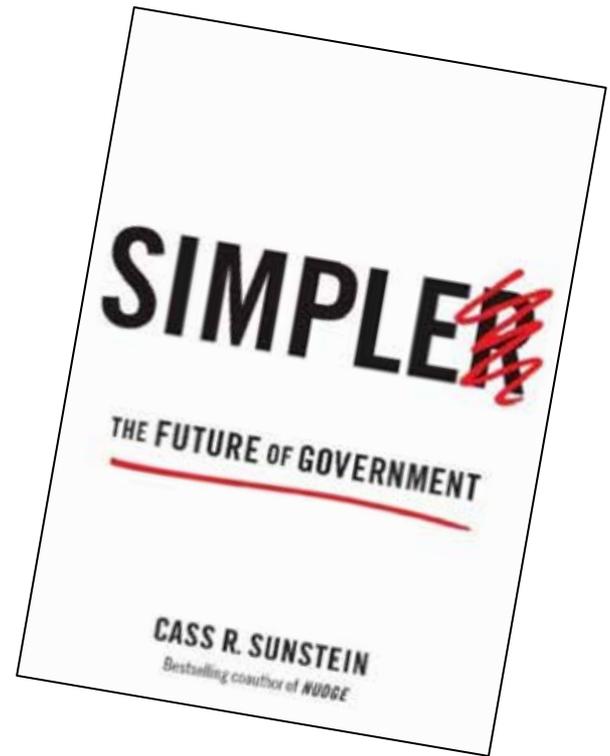
We conclude that while this FAA approach is likely appropriate for the immature stage of the technology, policymakers should be careful to avoid regulatory lock-in so as not to neutralize key advantages of MAM.

Three U.S. policy recommendations to bridge the "valley of death"

- 1) Congress should provide significantly larger, sustained funding to improve understanding of the materials and processes involved in additive manufacturing.
- 2) Strategies should be developed to allow U.S. industry to "learn by doing" without compromising safety, in the same way that was vital to the advance of composite materials.
- 3) While early regulatory approaches will inevitably reflect the technology's immaturity, regulators should be careful to avoid lock-in and ensure that rules are written so that they can become less onerous as knowledge improves and the technology becomes more predictable. For example, rules could be accompanied by sunset provisions that require that the regulatory strategy be substantially rethought at some specified future time.

Cass Sunstein...

...who ran the Office of Information and Regulatory Affairs in the U.S. OMB from 2009 to 2012, has been a strong proponent of "retrospective analysis" that is designed to learn how policies have performed with a view to improving them in the future.



He argues that regulations should be "...written and implemented so as to facilitate reliable evaluation." He institutionalized these views by adding Section 6 to Executive Order 13563 that reads...

EO 13563

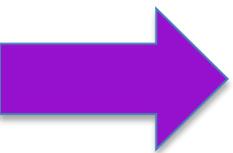
Sec. 6. Retrospective Analysis of Existing Rules. (a) To facilitate the periodic review of existing significant regulations, agencies shall consider how to promote retrospective analysis of rules that may be outmoded, ineffective, insufficient, or excessively burdensome, and to modify, streamline, expand or repeal them in accordance with what has been learned...

(b) Within 120 days of the date of this order, each agency shall develop and submit to the Office of Information and Regulatory Affairs a preliminary plan...under which the agency will periodically review its existing significant regulations...

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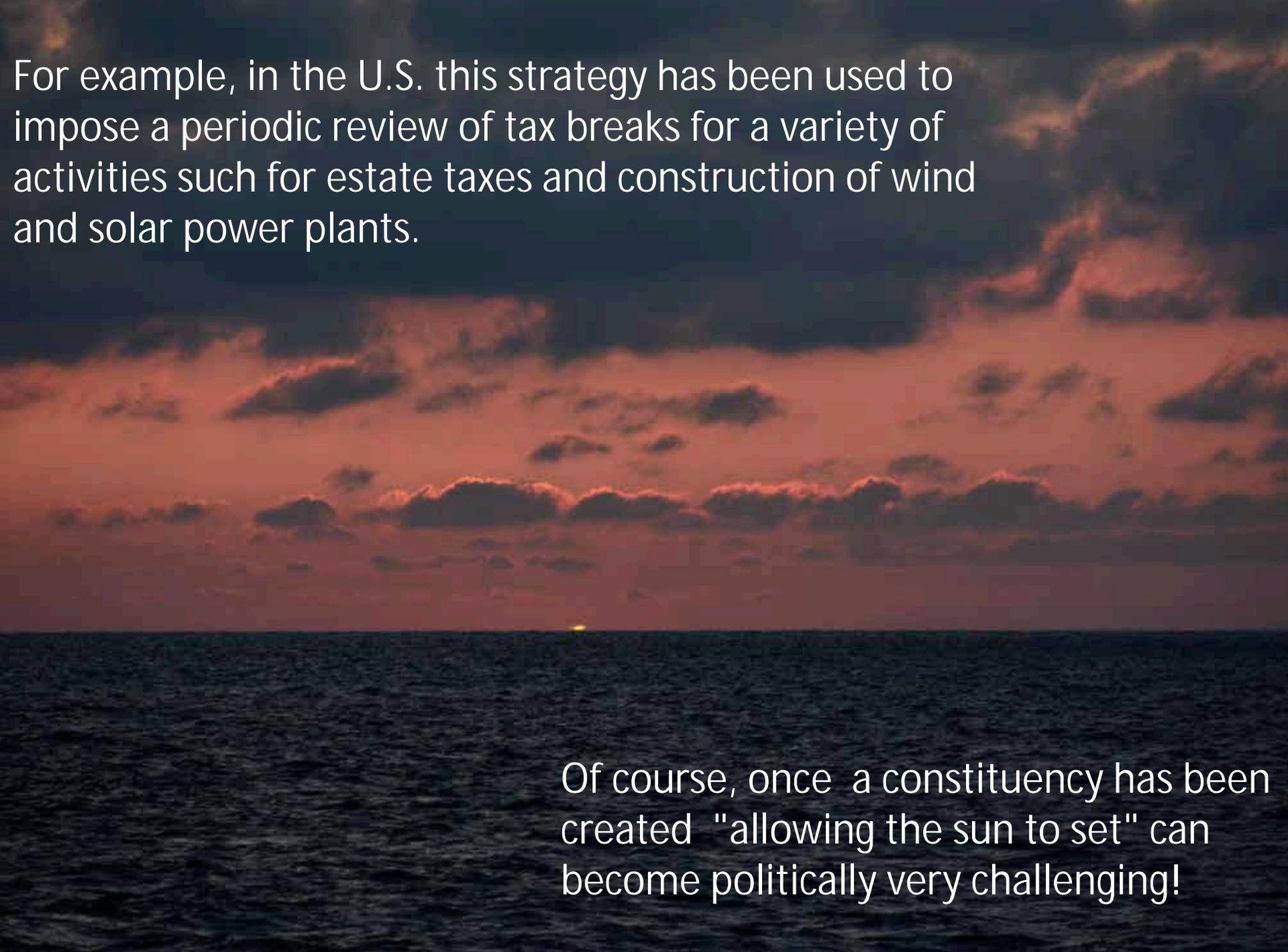
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One powerful tool that legislators and agencies can use to assure that regulations and other policies do not become outmoded is to specify a "sunset" date at which a regulation or piece of enabling legislation ceases to exist unless it is revisited and renewed.

A sunset over the ocean. The sky is filled with dark, dramatic clouds, some of which are illuminated from below by the setting sun, creating a warm, orange and red glow. The horizon line is visible, with a small, bright light source (the sun) just below it. The water in the foreground is dark and textured with small waves.

For example, in the U.S. this strategy has been used to impose a periodic review of tax breaks for a variety of activities such for estate taxes and construction of wind and solar power plants.

Of course, once a constituency has been created "allowing the sun to set" can become politically very challenging!



End

In developing the ideas discussed in this talk, I have been fortunate to have generous support from the National Science Foundation (SES-9209783; BCS-9218045; SES-034578; SES-0949710 and others), the Electric Power Research Institute, the Gordon and Betty Moore Foundation, the Doris Duke Charitable Foundation, the MacArthur Foundation, the IRGC, Carnegie Mellon University and a number of others. Thanks also to my many colleagues and students, who have worked with me in these projects especially to Jay Apt, Inês Azevedo, Wändi Bruine de Bruin, Hadi Dowlatabadi, Baruch Fischhoff, Max Henrion, David Keith, Lester Lave and Ed Rubin.