

The Paris Process and the Role of Integrated Assessment

October 12, 2016

Jae Edmonds

JGCRI Integrated Assessment Workshop
College Park, MD

The Paris Agreement of 2015

- ▶ The Paris Agreement of 2015 created a new architecture for addressing greenhouse gas emissions mitigation, but, left many questions unanswered.
- ▶ Integrated assessment can potentially inform many of the difficult questions left unanswered by Paris



The Implications of Paris Project

- ▶ The Joint Global Change Research Institute with UMD and PNNL partners has begun a project to better understand the implications of the December 2015 Paris Agreement
- ▶ The Implications of Paris Project has three goals:
 - Identify research priorities
 - Conduct research to inform the process
 - Communicate results
- ▶ The 1st workshop was advised by a prestigious Steering Committee

1st WORKSHOP STEERING COMMITTEE

- ▶ Ghassem Asrar (JGCRI/PNNL)
- ▶ **Rosina Bierbaum (U. Mich/UMD)**
- ▶ Leon Clarke (JGCRI/PNNL)
- ▶ Armond Cohen (Clean Air Task Force)
- ▶ Jae Edmonds (JGCRI/PNNL)
- ▶ Allen Fawcett (U.S. EPA)
- ▶ **Dirk Forrister (IETA)**
- ▶ Nate Hultman (JGCRI/UMD)
- ▶ Nathaniel Keohane (Environmental Defense Fund)
- ▶ Toshi Masui (Nat. Inst. for Env. Studies, Japan)
- ▶ **Nakicenovic, Nebojsa (IIASA)**
- ▶ **Robert Orr (JGCRI/UMD)**
- ▶ **Jonathan Pershing (U.S. DOS)**
- ▶ Rich Rosenzweig (former, COO, Natsource; former COS, U.S. DOE)
- ▶ John Weyant (Stanford U.)
- ▶ Tom Wilson (EPRI)



The May Implications of Paris Workshop

- ▶ The first workshop of the Implications of Paris project was held at the University of Maryland May 3-4, 2016.
- ▶ The goal: Identify the highest priority research questions needed to facilitate the successful implementation of the Paris agreement.



Five broad research questions from the first Implications of Paris workshop



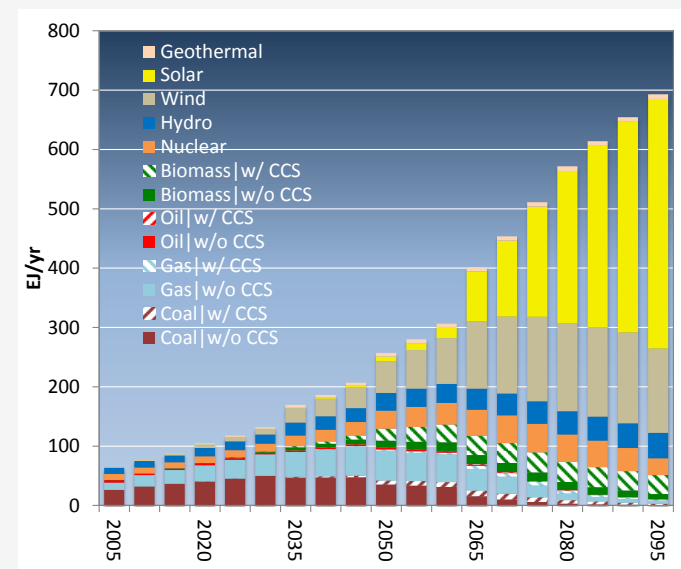
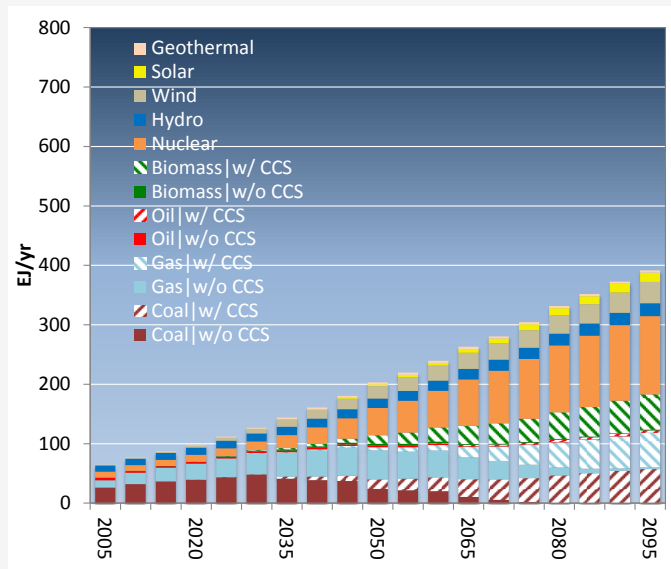
PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

1. *How will national circumstances, institutions and goals influence the implementation of NDCs and what are their emissions implications?*
2. *What roles will technology and control of non-energy emissions play in achieving NDCs and the long-term Paris goals?*
3. *What are the best measures of progress toward long-term objectives for the Global Stocktake?*
4. *Can new international institutions make NDCs more effective?*
5. *Can Sustainable Development Goals be achieved simultaneously with the goals of the Paris Agreement?*

Emissions Mitigation—Researchable Questions for IA

1 How will national circumstances, institutions and goals influence the implementation of NDCs and what are their emissions implications?

Energy systems shaped by regulatory instruments can look very different than energy systems shaped by a carbon tax alone

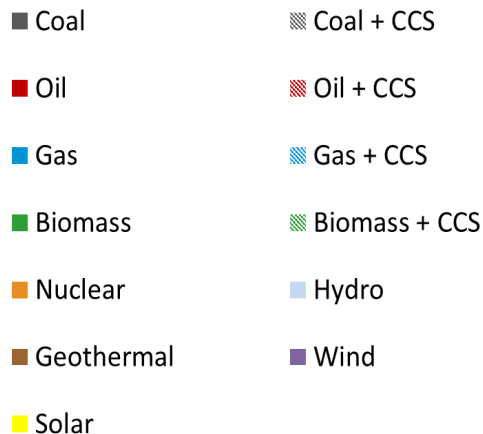
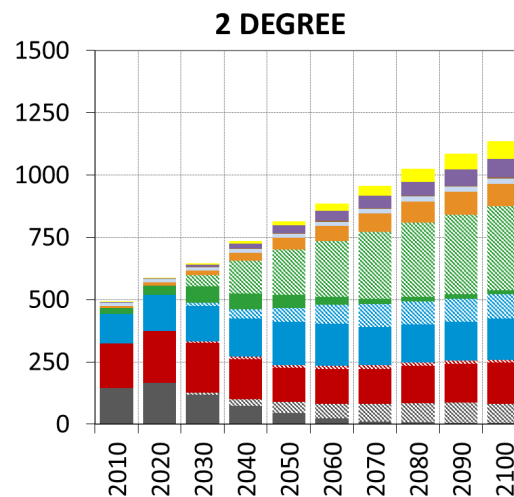
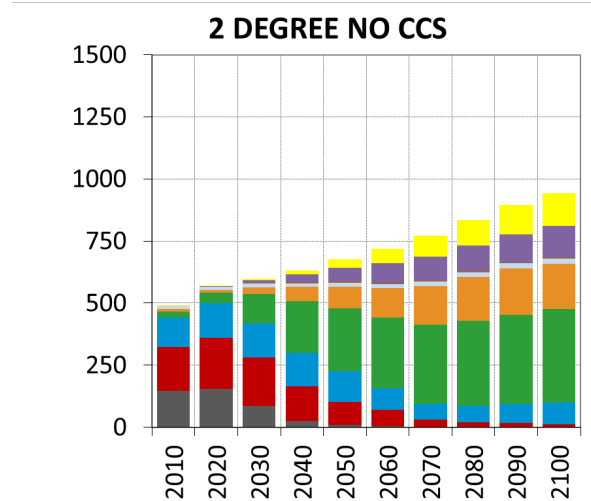
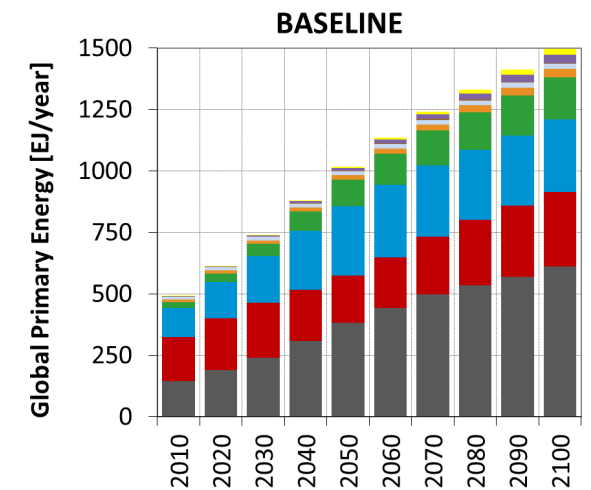


Source: Calvin, et al. , 2014.

Emissions Mitigation—Researchable Questions for IA

2 What roles will technology and control of non-energy emissions play in achieving NDCs and the long-term Paris goals—well below 2 degrees?

Energy systems consistent with 2 degrees have fundamentally different technology than those that are not



Source: Muratori, et al., 2016.

Five Strategy Element IAMs Us to Get Emissions to Zero

- ▶ Energy efficiency—reduce demand for energy as much as economical
- ▶ Decarbonize power generation
 - Renewable power
 - Nuclear power
 - Bioenergy
 - Fossil fuel with CCS
 - Bioenergy with CCS
- ▶ Electrify Buildings and Industry
- ▶ Decarbonize transport
 - Electrify
 - Biofuels
 - H2
- ▶ Halt deforestation/afforestation and continue improving crop yields

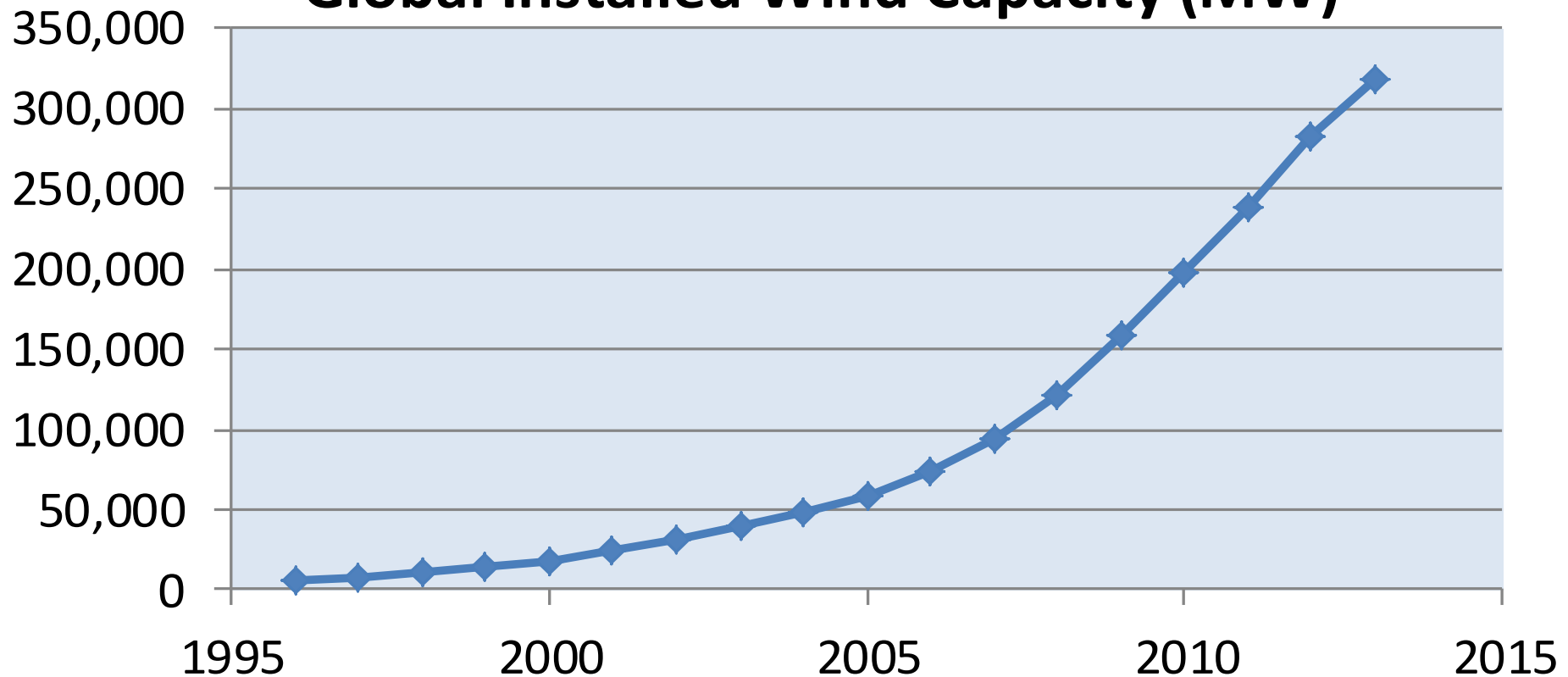


Source: <http://www.energy.gov/science-innovation/energy-sources/renewable-energy/wind>

The challenge of scale should not be underestimated

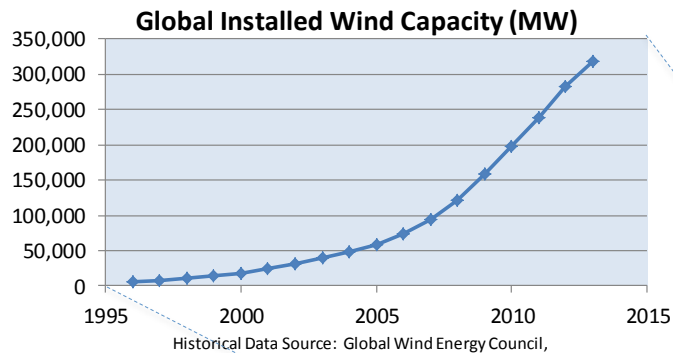
► Historical Growth in Wind Installed Capacity: 1996-2013

Global Installed Wind Capacity (MW)

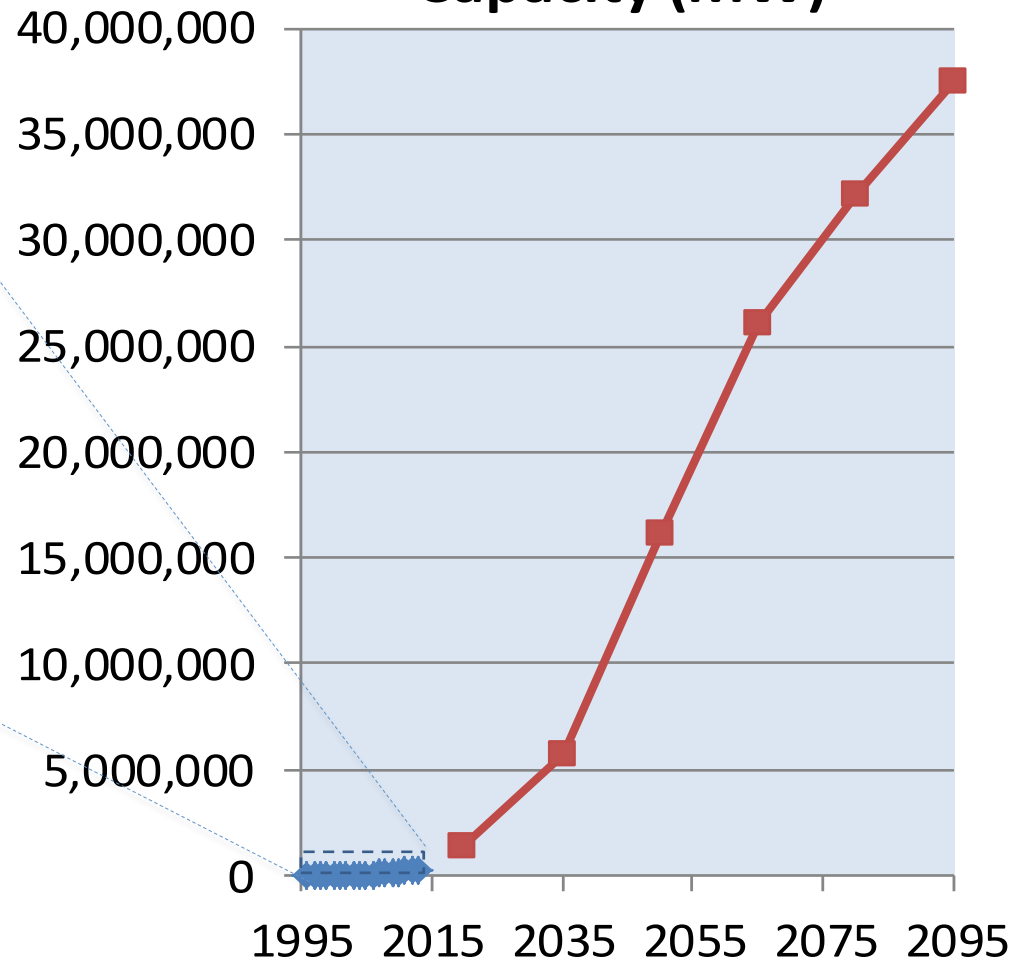


Historical Data Source: Global Wind Energy Council,

Installed Wind Capacity: 450 ppm CO₂-e Limit (No Nuclear and No CCS)



Global Installed Wind Capacity (MW)



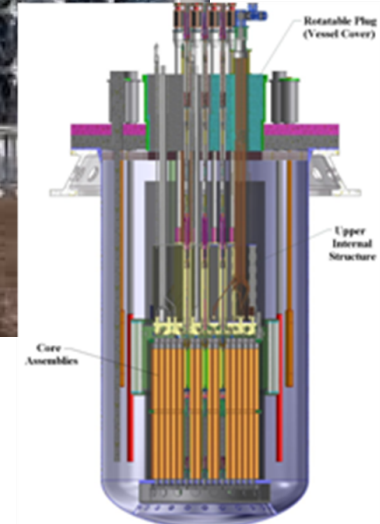
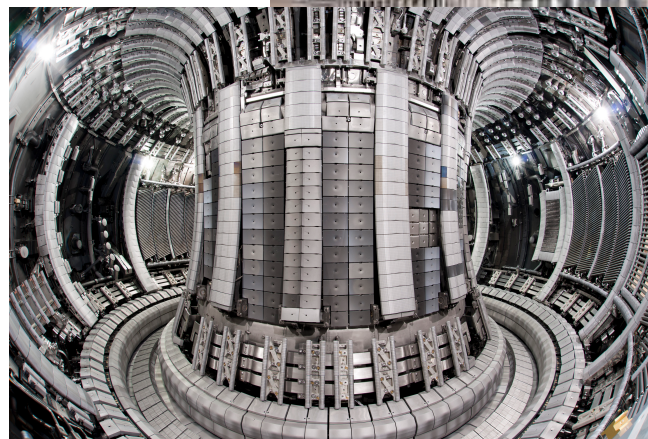
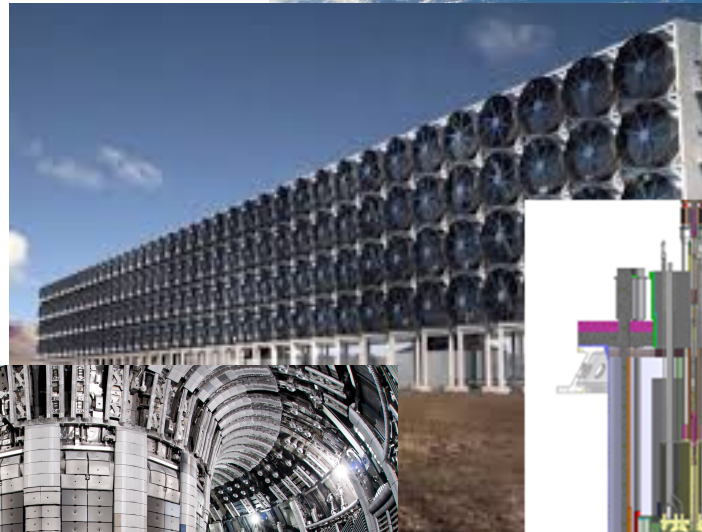
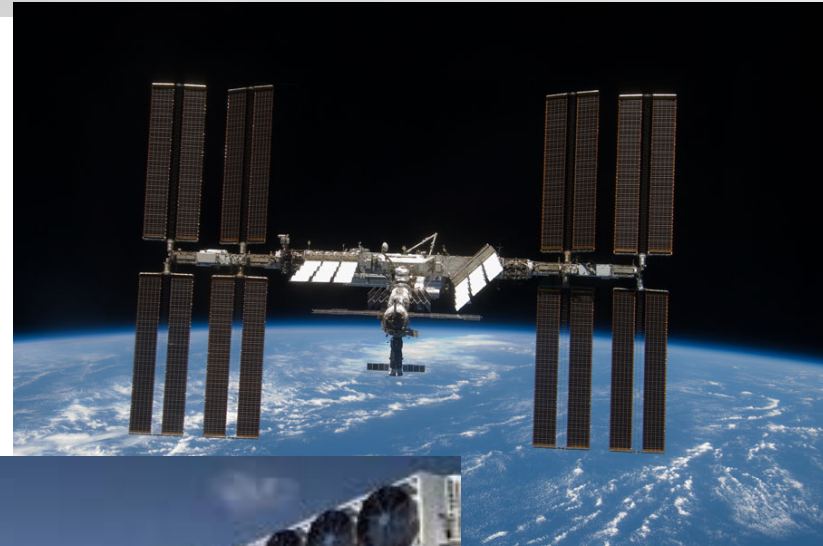
Future Scenario Source:
Calvin, , et al., 2009.

Historical Data Source: Global Wind Energy Council,
<http://www.gwec.net/global-figures/graphs/>

Technology Wild Cards

- Some technologies that scenarios may or may not include, but which could make a large contribution include:

- Advanced Nuclear Reactor (HTGR, SFR, FHRs, aSMR)
- Hydrogen
- Nuclear Fusion
- Space Solar Power
- Free air capture



Advanced Sodium-cooled Fast Reactor (AFR-100)

Emissions Mitigation—Researchable Questions for IA

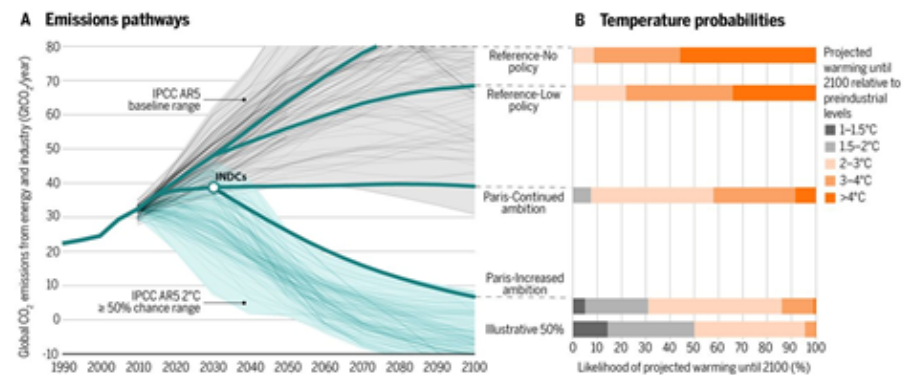
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What are the best measures of progress toward long-term objectives—2 degrees /1.5 degrees—for the Global Stocktake?

- ▶ Emissions along will be inadequate as a measure of progress toward long-term goals

Can Paris pledges avert severe climate change?

Reducing risks of severe outcomes and improving chances of limiting warming to 2°C



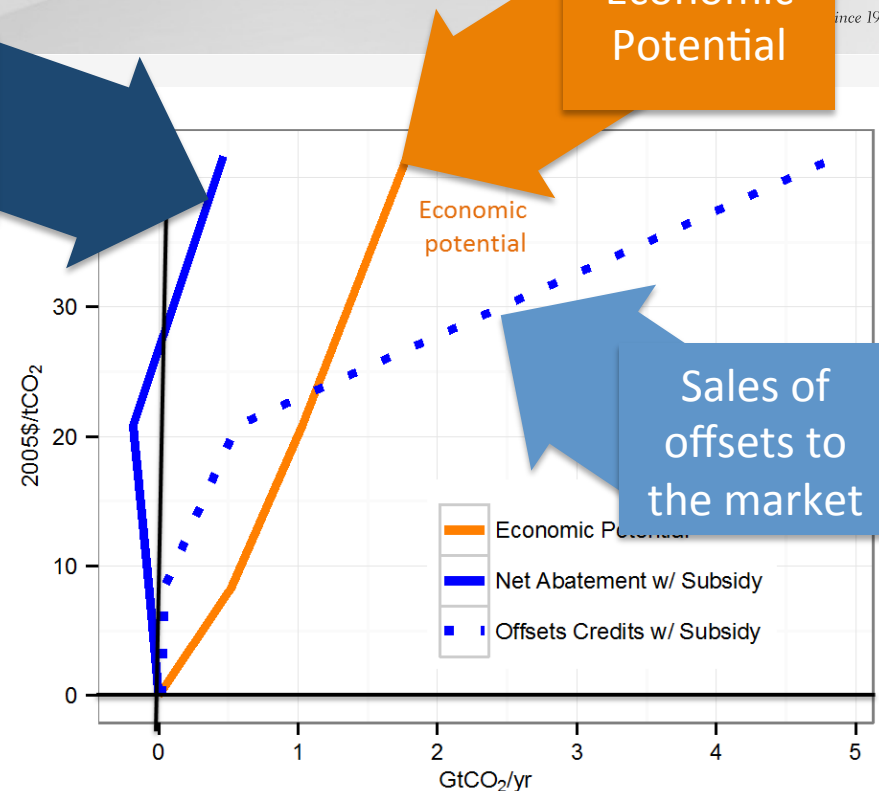
Global CO₂ emissions and probabilistic temperature outcomes of Paris. (A) Global CO₂ emissions from energy and industry (includes CO₂ emissions from all fossil fuel production and use and industrial processes such as cement manufacture that also produce CO₂ as a byproduct) for the four emissions scenarios explored in this study. The IPCC AR5 emissions ranges are from (12). The IPCC AR5 baseline range comprises scenarios that do not include new explicit GHG mitigation policies throughout the century. The IPCC AR5 2°C is 50% range comprises scenarios that limit global warming until 2100 to less than 2°C with at least a 50% chance. The teal lines within the IPCC ranges represent the actual emissions trajectories that determine the range (12). (B) Likelihoods of different levels of increase in global mean surface temperature change during the 21st century relative to preindustrial levels for the four scenarios. Although (A) shows only CO₂ emissions from energy and industry, temperature outcomes are based on the full suite of GHG, aerosol, and short-lived species emissions generated by the GCAM (8) simulations (see SIV). The illustrative 50% scenario in (B) corresponds to an emissions pathway that achieves a 50% chance of maintaining temperature change below 2°C until 2100 (see SIV). Other 50% pathways could lead to a range of temperature distributions depending on cumulative CO₂ emissions and representations of other GHGs.

Published by AAAS Allen A. Fawcett et al. *Science* 2016;352(6282):1122 www.sciencemag.org/content/352/6282/1122

Can new international institutions make NDCs more effective?

- ▶ Article 6 and other elements of the Paris Agreement provide for joint implementation and emissions trading without saying how.
- ▶ Careful analysis is needed to ensure that the new institutions reduce costs and increases ambition.

Net change
in global
emissions



The net effect of offset trades depends strongly on the rules. It is not simply a fraction of economic potential. If the rules are constructed poorly, they can even result in an increase in emissions. (Calvin, et al. 2015)

Paris and the Sustainable Development Goals

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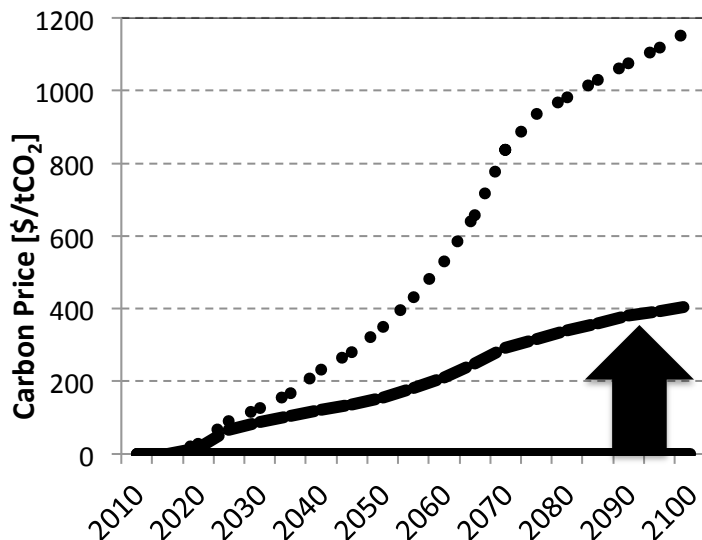
Can Sustainable Development Goals be achieved simultaneously with the goals of the Paris Agreement?

- ▶ The assumption that climate policies can be assessed independently of other human goals and objectives is no longer tenable
- ▶ Interaction effects are likely too large to ignore
- ▶ Policies that pursue multiple objectives—violating the one objective, one policy rule—need to be assessed

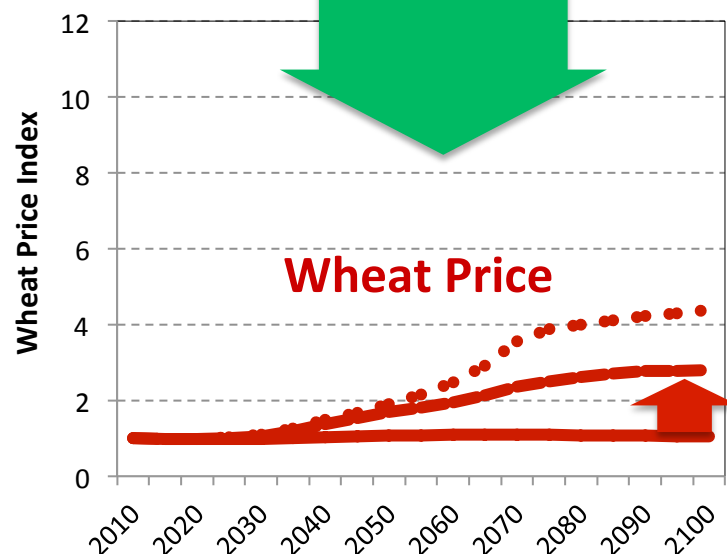
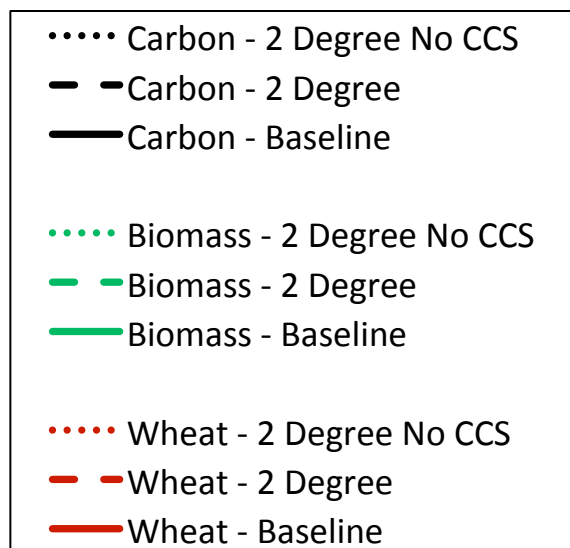
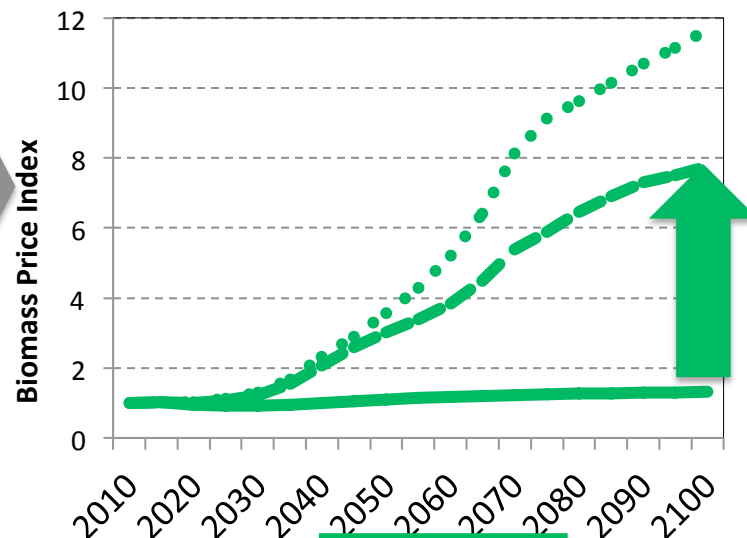


Bioenergy Use (and/or afforestation) Produces Upward Pressure On Food Prices

Carbon Price

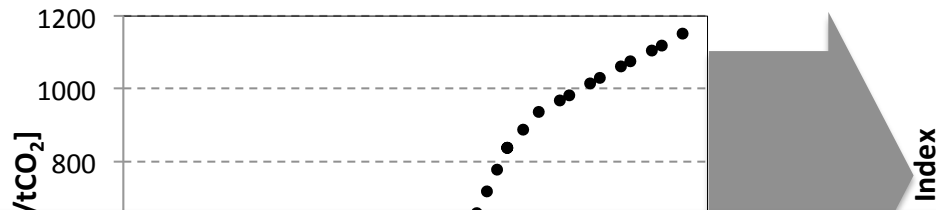


Biomass Price



Bioenergy Use (and/or afforestation) Produces Upward Pressure On Food Prices

Carbon Price

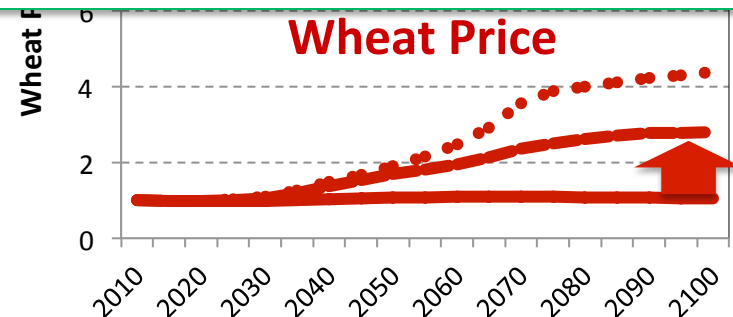


Biomass Price



The rate at which crop yields improve will have an important effect on deforestation rates and crop price interaction with mitigation

- Biomass - 2 Degree
- Biomass - Baseline
- Wheat - 2 Degree No CCS
- - - Wheat - 2 Degree
- Wheat - Baseline

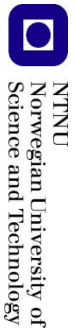


The Implications of Paris is an Ongoing Project

- ▶ We at the JGCRI are hard at work on many of these topics
 - Mid-century Strategy work
 - The role of technology
 - Climate and SDG interactions

- ▶ Two more workshops are in preparation:
 - March 7, 2017 Trondheim, Norway with an outreach event March 9 in Oslo

 - October 2-3, 2017 Tokyo, Japan





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Discussion