

## Building the Stabilization Triangle

We already have the technology we need to take the world off the path toward dramatic climate change

**Carbon emissions from fossil fuel burning are projected to double in the next 50 years** (Figure 1), keeping the world on course to more than **triple** the atmosphere's carbon dioxide (CO<sub>2</sub>) concentration from its pre-industrial level. This path (black line) is predicted to lead to significant global warming by the end of this century, along with decreased crop yields, increased threats to human health, and more frequent extreme weather events.

In contrast, **if emissions can be kept flat** over the next 50 years (orange line), we can steer a safer course. The flat path, followed by emissions reductions later in the century, is predicted to limit CO<sub>2</sub> rise to less than a doubling and skirt the worst predicted consequences of climate change.

Keeping emissions flat for 50 years will require **trimming projected carbon output by roughly 7 billion tons per year** by 2054, keeping a total of ~175 billion tons of carbon from entering the atmosphere (yellow triangle). We refer to this carbon savings as the **"stabilization triangle."**

To keep pace with global energy needs at the same time, the world must find energy technologies that emit **little to no carbon**, plus develop the capacity for carbon storage. Many strategies available today can be scaled up to reduce emissions by at least **1 billion tons of carbon per year** by 2054. We call this reduction a **"wedge"** of the triangle (Figure 2). By embarking on several of these wedge strategies now, the world can take a big bite out of the carbon problem instead of passing the whole job on to future generations.

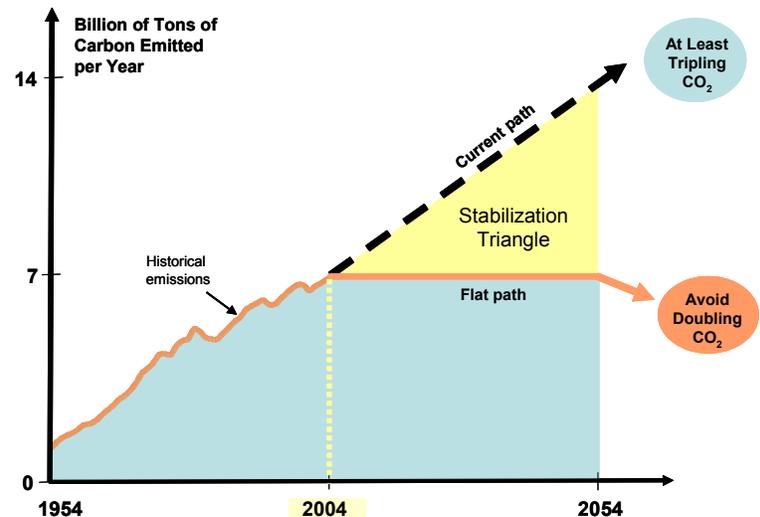


Figure 1

[High-resolution version](#)

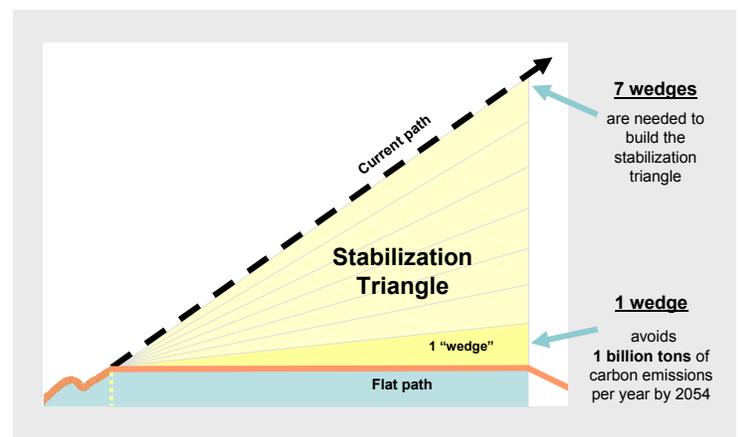


Figure 2

Based on "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies" by Steve Pacala & Rob Socolow in *Science*, August 13, 2004.

**The Carbon Mitigation Initiative (CMI)** is a 10-year program supported by BP and Ford Motor Company to find solutions to the greenhouse gas problem. Over 60 CMI researchers in science, engineering, and policy are developing strategies to reduce global carbon emissions safely, effectively, and affordably. CMI is a part of the Princeton Environmental Institute at Princeton University.

# We have the technology....

Each of the **15** strategies below has the potential to reduce global carbon emissions by at least **1 billion tons per year by 2054**, or **1 wedge**. A combination of strategies will be needed to build the **7 wedges** of the stabilization triangle.



## Efficiency

1. Double fuel efficiency of 2 billion cars from 30 to 60 mpg
2. Decrease the number of car miles traveled by half
3. Use best efficiency practices in all residential and commercial buildings
4. Produce current coal-based electricity with twice today's efficiency



## Wind

10. Increase wind electricity capacity by 50 times relative to today, for a total of 2 million large windmills



## Fuel Switching

5. Replace 1400 coal electric plants with natural gas-powered facilities



## Solar

11. Install 700 times the current capacity of solar electricity
12. Use 40,000 square kilometers of solar panels (or 4 million windmills) to produce hydrogen for fuel cell cars



## Carbon Capture and Storage

6. Capture AND store emissions from 800 coal electric plants
7. Produce hydrogen from coal at six times today's rate AND store the captured CO<sub>2</sub>
8. Capture carbon from 180 coal-to-synfuels plants AND store the CO<sub>2</sub>



## Biomass Fuels

13. Increase ethanol production 50 times by creating biomass plantations with area equal to 1/6<sup>th</sup> of world cropland

Credit: Warren Gretz



## Nuclear

9. Add double the current global nuclear capacity to replace coal-based electricity



## Natural Sinks

14. Eliminate tropical deforestation AND create new plantations on non-forested land to quintuple current plantation area
15. Adopt conservation tillage in all agricultural soils worldwide

Credit: David Parsons

Photos courtesy of USFWS (Carbon Capture and Storage), US DOE, US NRC

## No one strategy will suffice to build the entire stabilization triangle.

New strategies will be needed to address both fuel and electricity needs, and some wedge strategies compete with others to replace emissions from the same source. Still, there is a more than adequate **portfolio of tools already available** to build the stabilization triangle and **control carbon emissions for the next 50 years.**

## Carbon Mitigation Initiative

Princeton Environmental Institute  
Princeton University  
Princeton, NJ 08544  
USA

voice: (609)258-3832  
fax: (609)258-6818

<http://www.princeton.edu/~cmi>

For more information, contact  
Roberta Hotinski, CMI Information Officer  
Email: [hotinski@princeton.edu](mailto:hotinski@princeton.edu)  
Phone: 609-258-7523