

# Energy Wedges: CO<sub>2</sub> Emissions Reduction

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**Introduction:** As an overall goal, our wedge solution attempts to cut carbon emissions using a solid balance between increasing efficiency and using alternative energy sources. In addition, the estimated cost of our solution is on the moderate side, since we tried to avoid solutions that seem to be simply too expensive or impractical.

- (1) **Efficiency transport (T - \$):** This wedge seems quite feasible, since we have the existing technology to be able to increase the mpg of cars from 30 to 60. With hybrid engines and lighter, stronger materials, this increase seems reasonable. Nevertheless, perhaps one of the biggest obstacles to achieving this wedge would be politics and legislation. In order to successfully improve the mpg of planes, trains, and automobiles, laws must be made and enforced to ensure both manufacturers and consumers use more efficient vehicles.
- (2) **Efficiency electricity (E - \$):** The upside of this wedge is that an upgrade in relatively simple mechanical parts such as turbines and fuel cells can significantly increase the efficiency of coal plants. These upgrades would have a low initial cost, but in order to more evenly distribute electricity, the electrical grid would need to be reworked. In recent years, the issue of our outdated electrical grid has come up many times and an upheaval of the system could be

extremely expensive thereby resulting in more expensive electricity.

- (3) **CCS Synfuels (T, H - \$\$):** Of all of our wedges, this one seems the least practical simply because of its magnitude. Assuming much of the fuel in the future will come from coal instead of petroleum, we would need to capture the carbon from 180 coal to synfuel facilities. However, these facilities would be comparable to a current synfuels facility in South Africa which is the largest point source of carbon emissions in the world. If such facilities are not properly regulated, they could end up releasing even more emissions than gasoline.
- (4) **Fuel Switching (E - \$):** Switching from coal to natural gas not only increases efficiency of electricity production, but it also decreases carbon emissions significantly. One fair point of opposition to this wedge is the availability of natural gas. However, recently, at least in the U.S., we have continued to find more and more of the resource (i.e. Barnett Shale) so there could potentially be more natural gas than estimated. Ultimately, however, we do not want to go in this direction of simply replacing one expendable resource with another, because such a direction is not sustainable.
- (5) **Wind Electricity (E - \$\$):** Similar to nuclear energy, producing electricity from

wind produces no carbon emissions. It is currently growing at a rate of 30% per year so if it continued in this manner, one wedge could be achieved in only 13 years. However, this current rate of growth will obviously slow down as the industry enlarges. Nevertheless, mathematically it still seems reasonable that over a period of 50 years one wedge could be achieved. The biggest obstacles to wind are capital and public opposition. Electricity produced by wind is still more expensive than coal for instance, but with more tax incentives and investments in wind growth, this cost could go further down to become more competitive. Regarding the public opposition against wind energy, we find this problem to be a little ridiculous. The visual impact of large turbines can be significant, but advancing the future of mankind in a positive way is much more important than a view. Also, turbines can be used concurrently with farming and livestock and turbines kill very few birds.

(6) **Soil Storage (B - \$):** This final wedge involves simply applying more efficient agricultural practices such as reducing aeration and reducing the period of bare fallow. It seems like a good idea and very practical, although we do not know how such practices would affect crop yield, which is a very important factor particularly in poorer countries with rising populations.

(7) (8) **Nuclear (E - \$\$):** Replacing coal plants with nuclear power plants is a wedge with some of the most polarized potential positives and negatives. Due to the concrete production necessary to build these plants, there is some initial

carbon emission involved. However, after the plant is built, it produces electricity with no carbon emissions and insignificant amounts of radiation. The negatives involved revolve around public opinion. First, there is the paranoia that a plant could melt down a la Chernobyl, 3 Mile Island or now Fukushima. Although safety measures continue to improve, sometimes a natural disaster (like an earthquake/tsunami) can throw things off balance. In addition, what to do with nuclear waste is a tricky question, since that could easily be hazardous to the environment if simply released and it is expensive to vitrify. The last point of public opposition is that having more nuclear power plants means having more plutonium which has the potential to allow for a greater number of nuclear weapons (nuclear proliferation). Nevertheless, all factors considered, we believe we simply cannot achieve our carbon goals without nuclear energy being a significant part of the solution. Hence, we chose to use the two available wedges on this resource.

## REFERENCES

[1] Pacala, S.; Socolow, R. Stabilization wedges: solving the climate problem for the next 50 years with current technologies. Science 2004.