Climate Strategy Development KIT

By Glenn Weinreb

Dear Climate Activist,

Does your nation have a climate strategy?

If not, this document might be helpful. It is a climate strategy development kit. It provides an example climate strategy, and it is written in a way that is fun and easy-to-understand for the general public.

Also, the original Microsoft Word file for this document is open-source. Subsequently, you can copy it, place your own name on your version, edit in any way, and use this to help you publish your own climate strategy. All for free. To download free files, visit www.APlanToSaveThePlanet.org/strategykitfiles

You might not agree with everything in this document, and you might want to add your own material. You can do as you wish.

This document is written in a format that is a manuscript for a video. However, one could rework this into a different format, such as a pdf report, an article, or a series of articles. The advantage of video is one can add interesting visuals, to help keep the public entertained. This has myself as the narrator; however, your version would have someone that better fits your audience.

Many lawmakers have stated climate has a "packaging problem". They are referring to a lack of materials that explain how to press forward. This document does it's best to package the climate solution. Perhaps your version can improve on what we have here, and do better?

Best Regards,

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The Climate Solution

Introduction

Hi, my name is Glenn Weinreb and today we're going talk about how to solve the climate problem.

I am the director of a think tank that studies climate solutions, and I have published practically more than anyone on this topic.

Four Sections

This video is divided into four sections.

Section one looks at how much it cost to transition to a green economy.

Section two provides concrete steps for how to do this in a politically acceptable manner.

Section three explores climate economics.

And section four explores climate politics.

The first two sections are the most important, and the latter sections are for those who want a more in depth understanding.

Section I: What does a Green Economy Cost?

Section I

What does a Green Economy Cost?

It seems like we are bombarded every day with reports on record setting temperatures, droughts, wild fires, receding glaciers, etc.

And we also inundated with reports that imply the problem is being handled. These include reports on solar farms, electric vehicles, and new climate legislation.

Given all of this information, it is difficult to assess if our society is responding reasonably to the climate problem. And if not, what to do about it.

Four Climate Questions

We are going to examine this by exploring four climate questions.

Four Climate Questions

1) Is our society adequately tackling the climate problem?
2) If not, what do we need to do to resolve this at the lowest cost?
3) How much would this cost?
4) How does one gain majority support for such action?

- One, is our society adequately tackling the climate problem?
- Two, if not, what do we need to do to resolve this at the lowest cost?
- Three, how much would this cost?
- And four, how does one gain majority support for such action?

The Climate Problem

First, let's look at the problem.

The Climate Problem

1) We currently burn coal, natural gas, and oil to generate electricity, move vehicles, make things, and heat buildings.
2) The exhaust contains CO_2, which warms the planet.
3) Heat dries out land, reduces food production, increases wildfires, increases storms, and increases sea level.

We currently burn coal, natural gas, and oil to generate electricity, move vehicles, make things, and heat buildings.



The exhaust contains carbon dioxide, a greenhouse gas that warms the planet.

Why Heat is a Problem

Unfortunately, warming causes problems.

For example, heat dries out soil, which leads to less food production, which leads to higher food prices.

And heat causes ice to melt, which leads to a rising sea, which eventually threatens coastal areas.

Decarbonization

Decarbonization

Transition to a green economy that emits less carbon dioxide.

The solution is to transition to a green economy that emits less carbon dioxide.

This is commonly referred to as "decarbonization".

Green Electricity

Let's look at how one might do this with electricity.

There are two ways to generate electricity.

Electrical Power Generation	
Green Electricity	Solar, wind, hydro, nuclear
Carbon-based	Burn coal or natural gas

One is to burn natural gas or coal, and emit carbon dioxide.

And the other is to not emit carbon dioxide, and make electricity with solar power, wind power, hydroelectric power, or nuclear power. This is referred to as "green electricity".

To decarbonize electricity, one replaces carbon-based electricity with green electricity.

In other words, build more solar farms, more wind farms and more hydroelectric dams.

When these produce electricity, one can reduce the amount of electricity generated at power plants that burn coal or natural gas.

Climate Question #1: Is our Society Adequately Tackling the Climate Problem?

Climate Question #1

Is our society adequately tackling the climate problem?

Ok, back to our climate question. "Is our society adequately tackling the climate problem?"

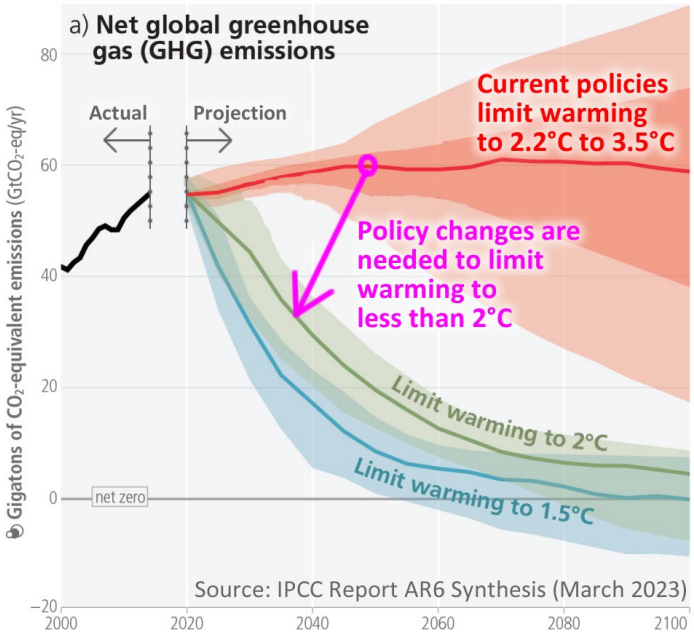
This is difficult to assess, since some reports say the problem is terrible, whereas others imply it is being handled.

Ultimately we want to know, **in total**, "How are we doing?"

To answer that question we need to aggregate the impact of all efforts, and estimate future CO_2 emissions based on existing government policies and society's behavior.

Doing this responsibly is a tremendous amount of work. More specifically, it requires a team of economists that study all aspects of the problem.

Global CO_2 Emissions Projection



An example team is one that was put together United Nations. A summary of their findings is shown here. This is one of the more important graphs published in 2023.

The red plot is an estimate of CO_2 emissions from the world, over the next 75 years, based on existing national laws and consumer behavior.

This shows CO_2 emissions increasing over the next 50 years, not decreasing.

This would cause the average global temperature in the year 2100 to be approximately 3 degrees warmer than that what we had 100 years ago. Also, it would keep going up, and be 5 degrees warmer, 100 to 200 years from now. This would be catastrophic.

Also shown is a green plot that indicates what the world would need to do to limit warming to 2 degrees, with no further warming.

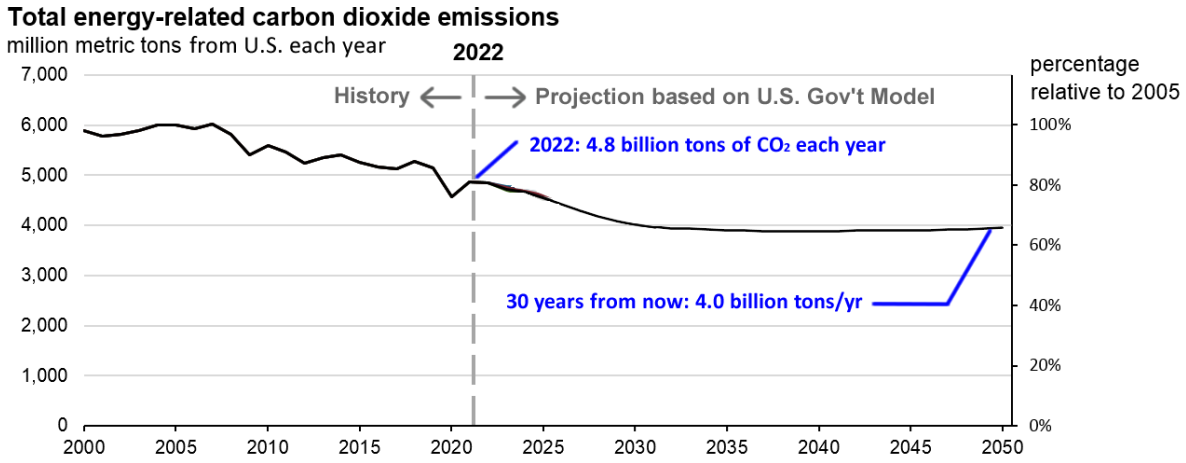
To do the green plot, nations would need to enact new laws that require transitioning to a green economy.

This is not happening.

However, there is evidence that political support exists for this, if done at lowest cost. We'll explain what we mean by that in a moment.

U.S. CO_2 Emissions Projection

But first, let's look at future CO_2 emissions from the United States, based on current government policies and consumer behavior.



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)

U.S. government economists expect annual U.S. CO_2 emissions from burning fossil fuels to decrease from 4.8 billion tons this year, to 4.0 billion tons, 30 years from now.

This is only a 20% reduction over 30 years, and is far short of our planet's needs.

Climate Remedies Are Small

Both of these projections take into consideration the building of solar farms, the decrease in solar farm cost over time, the impact of R&D, entrepreneurial ventures, national climate policies, consumer behavior, etc.

And they do not see the world tackling the climate problem.

The Climate Problem

Our so-called climate remedies are small relative to problem size.

In other words, our so-called remedies are small relative to the problem size.

What is Problem Size?

What is problem size?

Ok, so what is problem size?

The world consumes 580 exajoules (EJ) of energy each year, and one can calculate how many large wind farms, large dams, or large solar farms one would be needed to replace this energy if it were converted to electricity.

According to the math, this energy corresponds to 22,000 London Array wind farms, 17,000 hover dams, and 44,000 Topas solar farms. Shown here are pictures of these facilities.

This might seem like a lot, and it is.

Also, it works economically, kind of.

If these were built globally, over several decades, less money would be spent on fossil fuel production.

Today's Jobs **Tomorrow's Jobs**

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In other words, workers would do green stuff, **instead of** non-green stuff.

And the new infrastructure would be paid for with borrowed money that is repaid with electricity revenue.

Economically, this is similar to what happens in the fossil fuel industry. They borrow, and repay with proceeds from fuel sales.

It turns out the difference between a carbon-based economy, and a green economy is not large in terms of the impact on the cost of goods and services, and the **total** number of jobs.

17,000 Hoover dams might sound like an impossible number. However, we are talking about worldwide construction over several decades. And we are talking about doing this **instead of** having a fossil fuel industry.

Replace, Not Add

Replace Fossil Fuel with Green Energy

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In other words, we are looking at **replacing** carbon-based industries with those that do not emit carbon dioxide.

The key word is **Replace**. Not **Add**.

Climate Question #2: How do we resolve climate change at the lowest cost?

Climate Question #2

How do we resolve climate change at the lowest cost?

And this brings us to our second climate question, "How much does this cost, if we implement at the lowest cost?"

Switch to Green Electricity to Reduce CO_2 at the Lowest Cost

There are many things that one can do to reduce CO_2, yet only a few of them reduce a lot of CO_2 for relatively little money. These typically include building new solar farms, building new land based wind farms, and building new hydroelectric dams. When they come online, they produce electricity, and this causes less coal and less natural gas to be burned at nearby power plants. And this causes less carbon dioxide to be dumped into atmosphere.

Tackling Climate One House at a Time

Ok, back to the issue of cost.

Let's initially examine one U.S. home, and later we will look at an entire nation, such as the United States.

On most home electric bills, the amount of electricity consumed is specified in units of kilowatt-hours.

The typical U.S. home consumes 10,000 of these each year at 14 pennies each, for a total cost of 1400 dollars over a year.

This is the retail price, and this covers generation and distribution. Generation refers to making electricity at a power plant. And Distribution refers to the network of wires between the plant and buildings. Typically 7 pennies goes to generation and 7 pennies to distribution. Again, these are retail numbers.

Also, we can look at wholesale generation costs. This is what it cost to generate a large volume of electricity at the front gate of the power plant. When one does this by burning natural gas, typical wholescale cost is 3 pennies, and most of this pays for natural gas fuel.

We work with approximations and typical numbers to make this easier to follow.

Now let's assume a nearby solar farm produces electricity too; however, it cost a little more. It costs 4 pennies. When the sun is shining, the consumer sees 4 pennies for green electricity; however, 3 pennies are saved due to not buying natural gas. Ultimately, the consumer ends

up paying an additional 1 penny for the green electricity. And when the sun goes down, the consumer is back to 3 penny carbon-based electricity.

The difference between retail price and wholesale price does not change when you flip between green sources and carbon-based sources. So the consumer sees the difference between two wholesale costs.

The Green Premium

The Green Premium
Additional cost of green product.

The difference between the green option and the non-green option is referred to as the "green premium." In our example, this is 1 penny per kilowatt-hour.

One House One Year

Now let's look at what happens to one U.S. home over one year.

Approximately 40% of U.S. electricity is already green, and 60% is not green. So already 40% is made with wind, solar, hydro and nuclear. And 60% is made with natural gas can coal.

We mentioned total annual consumption is 10,000 kilowatt-hours; therefore 60% of this is 6,000, and this is what we are looking at replacing with green electricity.

So the home owner is looking at paying an addition 1 penny for 6,000 kilowatt-hours each year. 6000 times 1 penny works out to $60. However, this does not occur in year #1 since that many solar farms cannot be built in one year.

	Year 1	Year 2	Year 3	…	Year 10
Cost/House/Yr	$6	$12	$18	…	$60
Carbon Electricity kWh	54,500	5,000	4,500	…	0
Green Electricity kWh	4,500	5,000	5,500	…	10,000
Green Electricity %	45%	50%	55%	…	100%

Instead, decarbonizing electrical power over 10 years is more reasonable. For example, 45% of U.S. electricity might be green after 1 year, 50% after 2 years, 55% after 3 years, etc.

This works out to additional cost per house of 6 dollars during year 1, 12 dollars during year 2, and $60 dollars during year 10.

These numbers are additional costs per house, per year.

If the green premium was 2 pennies instead of 1 penny, these additional costs would be twice as high.

The Power Company

Notice the homeowner does not reduce CO_2 emissions. Instead, the power company does it. The homeowner just pays additional costs.

The power company has the ability to reduce CO_2 at large scales, and at relatively low costs.

Who Reduces CO_2 Emissions?	
The Power Company	o Low decarbonization costs o Large scale decarbonization
Everyone Else	o High decarbonization costs o Small scales in total

Unfortunately, practically everyone else is terrible at reducing CO_2.

Notice we do **not** encourage homeowners to install portable electricity generators in their basements. Instead, we let the power company generate electricity. They can do it for less cost, due to low overhead costs per unit electricity.

Also, power companies use markets to minimize costs. For example, they have builders of solar farms and wind farms compete with each other to drive down costs.

This is tackling climate change at low costs and high scales.

The Residential Solar Problem

Placing solar panels on a house might seem nifty. However, it is expensive relative to solar farms. This is due to overhead costs at each house.

The Residential Solar Problem
Electricity from solar panels on homes cost more than that from solar farms

Imagine trying to place 20 solar panels onto **one million** different homes. One would incur project overhead cost one million times. For example, for **each** house, one would need customer acquisition, system design, permitting, inspection, etc. Alternatively, if one installs 20 million panels at a large solar farm, they do not see overhead costs every 20 panels.

Consumers do not Want to Pay the Green Premium

If a consumer has a choice between buying a product that emits CO_2, and buying a product that does not, they often ignore the CO_2, and select the lower cost option.

In other words, most consumers will not pay a green premium, unless forced to do so.

Climate is a Prisoner's Dilemma Problem

Climate is a Prisoner's Dilemma Problem
Consumers prefer everyone else to reduce CO_2

I turns out consumers have a good reason to avoid green premiums, sort of.

If a homeowner emits 1 billionth of the world's CO_2, then everyone else's CO_2 is what will do them harm. Not their own 1 billionth. Therefore, they want everyone else to reduce CO_2. Their own CO_2 is irrelevant.

Economists refer to this as a "prisoner's dilemma" problem.

This means that transitioning to a green economy does not occur unless government intervention pushes it forward.

Power Companies Governance

Power Company Governance
Utilities required to provide electricity at lowest cost independent of CO_2.

Ok, so how does government push on power companies?

These companies have monopoly power, and are therefore set up as utility companies. This means they are overseen by government. And government mandates that they provide electricity at the lowest cost, independent of CO_2. Also, government can update this mandate and require carbon-based electricity be replaced with green electricity at a specific pace.

In other words, government makes electricity policy decisions, not the power company.

The Climate Solution is a Phone Call

So the climate solution, **in a sense**, is a phone call from government, to the CEO of the power company, requiring them to decarbonize the grid at a specified rate.

https://mixkit.co/free-sound-effects/phone-ring/

The Climate Solution
Metaphorically, this is a phone call

That's a metaphor. In practice, the climate solution is a federal or state law that requires the power company to go green at a reasonable pace.

However, in many cases, this law does not exist.

This is due to a variety of reasons that we will explore momentarily.

Climate Question #3: How much does it cost to decarbonize a nation?

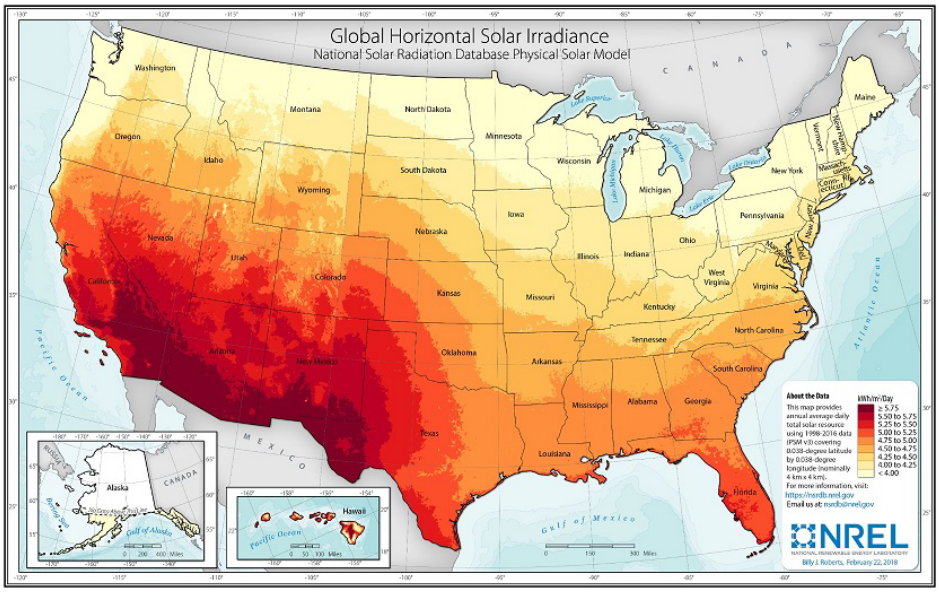
Climate Question #3

How much does it cost to decarbonize a nation?

Ok, so back to our climate questions.

"How much does it cost for a nation to transition to a green economy?"

Solar Farm Economics



The cost of electricity from a solar farm varies depending on the region. This is due to the fact that some regions are sunnier than others. For example, the U.S. South West is often sunny, whereas the North West is more cloudy.

Solar Farm Electricity Cost[1]

Resource Class	Heat Energy (kWh/m²/ Day)	Mean AC Capacity Factor	U.S. Area (sq. km)	2022 NREL LCOE Cost $0.01/kWh
1	> 5.75	33%	216,551	3.3¢
2	5.5–5.75	32%	349,894	3.4¢
3	5.25–5.5	30%	372,764	3.5¢
4	5–5.25	29%	497,444	3.7¢
5	4.75–5	27%	779,720	3.9¢
6	4.5–4.75	26%	870,218	4.1¢
7	4.25–4.5	25%	727,918	4.2¢
8	4–4.25	23%	828,438	4.4¢
9	3.75–4	22%	794,496	4.6¢
10	< 3.75	20%	163,120	5.0¢

Cost of Natural Gas fuel used to Generate Electricity[2]

($0.01/kWh)	2017	2018	2019	2020	2021
USA avg	2.6¢	2.8¢	2.2¢	1.9¢	3.9¢
Calif.	2.8¢	3.5¢	2.9¢	2.5¢	4.2¢
Utah	2.6¢	2.4¢	2.4¢	2.0¢	3.5¢

Cost of Coal fuel used to Generate Electricity[3]

($0.01/kWh)	2017	2018	2019	2020
USA avg	2.2¢	2.2¢	2.2¢	2.0¢

1) US, wholesale, no tax credits, includes $0.005/kWh for power wires., US NREL 2022, https://atb.nrel.gov/electricity/2022/index
2) US, wholesale, power plant already built, 44% eff. elect. gen., https://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_SCA_a.htm
3) US, wholesale, coal delivered to power sector, EIA 2022, https://www.eia.gov/energyexplained/coal/prices-and-outlook.php

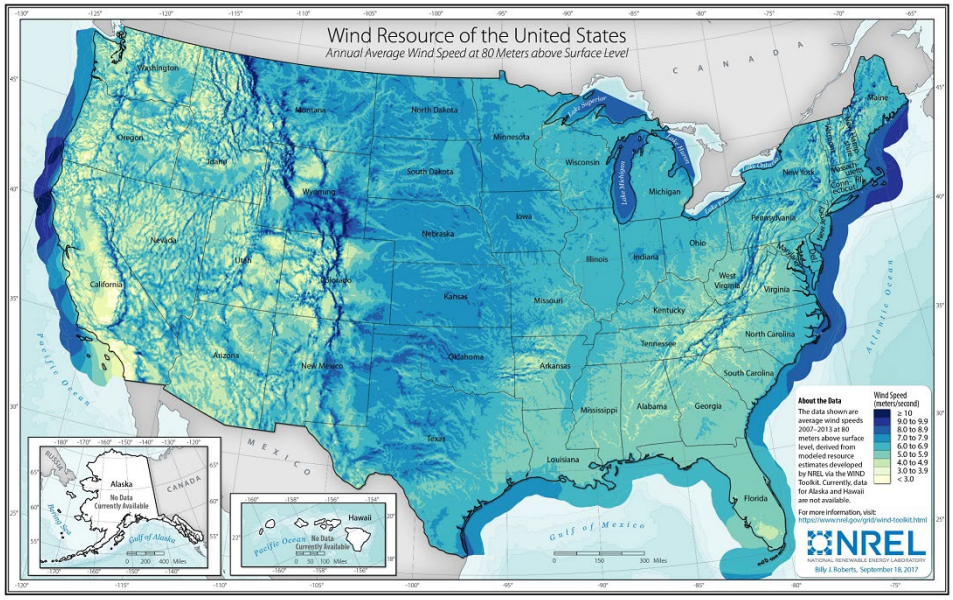
To calculate the **additional** cost of green electricity, one needs look at the difference in the cost of green electricity and carbon-based electricity.

The table on the left shows the cost of solar farm electricity. And the table on the right shows the cost of fuel that is not burned when one switches over. As one can see, solar farm electricity varies depending on the amount of sun a region receives each day. And fuel cost varies between regions, and over time.

To calculate the Green Premium, which is the additional cost of the green product, one subtracts a red value from a green value.

As one can see, Green Premiums for electricity vary from 1 penny to 3 pennies per kilowatt-hour.

Wind Farm Economics



We can also do this with wind power.

Some regions are windier than others, and the cost of electricity goes down, when wind speed goes up.

Wind Farm Electricity Cost[1]

Resource Class	Wind Speed Range (m/s)	2022 NREL LCOE Cost $0.01/kWh
1	> 9.0	3.2¢
2	8.8 - 9.0	3.4¢
3	8.6 - 8.8	3.5¢
4	8.4 - 8.6	3.5¢
5	8.1 - 8.4	3.6¢
6	7.6 - 8.1	3.8¢
7	7.1 - 7.6	4.1¢
8	6.5 - 7.1	4.6¢
9	5.9 - 6.5	5.4¢
10	0 - 5.9	8.1¢

Cost of Natural Gas fuel used to Generate Electricity[2]

($0.01/kWh)	2017	2018	2019	2020	2021
USA avg	2.6¢	2.8¢	2.2¢	1.9¢	3.9¢
Calif.	2.8¢	3.5¢	2.9¢	2.5¢	4.2¢
Utah	2.6¢	2.4¢	2.4¢	2.0¢	3.5¢

Cost of Coal fuel used to Generate Electricity[3]

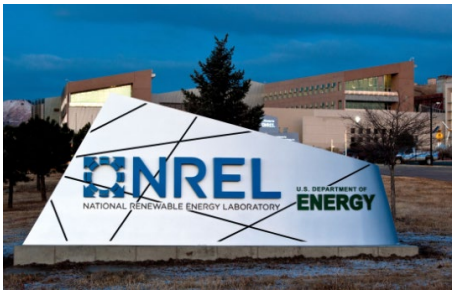
($0.01/kWh)	2017	2018	2019	2020
USA avg	2.2¢	2.2¢	2.2¢	2.0¢

1) US, wholesale, no tax credits, includes $0.005/kWh for power wires., NREL 2022, https://atb.nrel.gov/electricity/2022/index
2) US, wholesale, power plant already built, 44% eff. elect. gen., https://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_SCA_a.htm
3) US, wholesale, coal delivered to power sector, EIA 2022, https://www.eia.gov/energyexplained/coal/prices-and-outlook.php

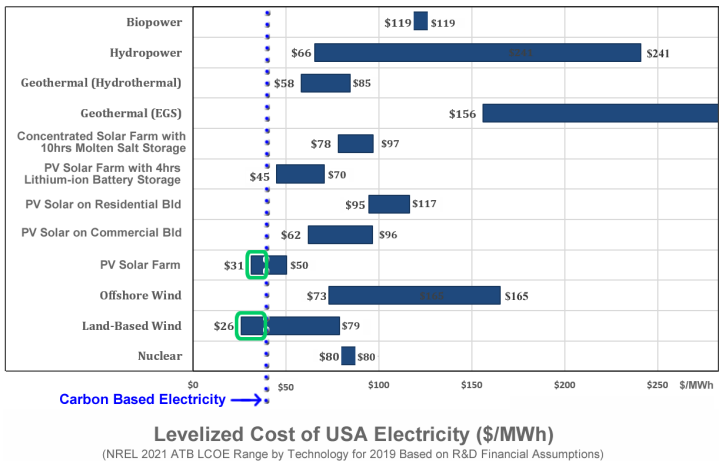
To calculate the green premium with U.S. land-based wind power, one also selects a red value from a green value in these tables.

As one can see, the green premium with land-based wind farms and solar farms is similar.

Green Electricity Cost



Thousands of people study how to make green electricity at the United States National Renewable Energy Laboratory, and a summary of their findings is shown here.

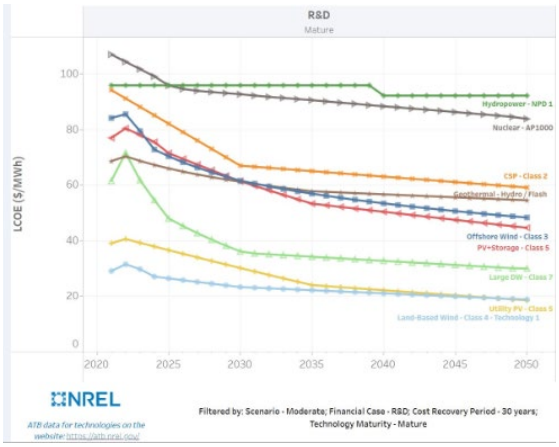


In general, land-based wind farms and solar farms are the lowest cost way to go green.

However, in actuality, lowest cost depends on region.

For example, wind is low cost in the middle of the U.S. Solar is low cost in the U.S. South West. Dams are low cost in Eastern Canada. And nuclear power is low cost in China.

Future Green Electricity Cost



Shown here is an estimate of green electricity cost in the U.S. over the coming decades.

Solar farms and land-based wind farms are expected to remain the lowest cost sources of green electricity over this duration.

Costs are expected to come down, as shown here. However, U.S. government economists do not expect the U.S. grid to decarbonize without additional government intervention.

Decarbonization Cost

In business school, they teach that understanding cost is at the heart of business.

Also, with climate, this is a bit confusing since the cost to transition from non-green to green is the difference between two costs. And, as mentioned previously, this difference is referred to as the green premium.

The difference can be represented in different units.

For example, it can be described as pennies per kilowatt hour, as done in our previous example.

Decarbonization Cost
Dollars required to reduce emissions by one metric ton of CO_2 ($/mt$CO_2$)

Or it can be described in units of dollars needed to reduce CO_2 emissions by one metric ton of CO_2.

This later method is sometimes referred to as "decarbonization cost", and it is extremely important.

For reference, a metric ton is 1000 kilograms, or approximately 2200 Lbs. This is how much a typical car weighs.

When building a solar farm, land-based wind farm, or hydroelectric dam in Canada; decarbonization cost are typically between 10 and 50 dollars per ton of CO_2 reduced.

However, many other so-called called climate remedies have higher decarbonization costs.

Decarbonization Cost is at the Heart of the Climate Debate

It seems this is at the heart of the political debate over climate.

This is because many lawmakers are not inclined to pay $100 to reduce CO_2 by one ton, when they can pay $10.

Especially at large scales.

Decarbonization Cost Calculation

Fuel Replaced	Decarbonization Cost ($/mtCO$_2$)	Green Premium ($/kWh)	Green Premium (¢/kWh)
Coal	$5	$0.005	0.5¢
	$10	$0.010	1¢
	$20	$0.020	2¢
	$30	$0.030	3¢
	$40	$0.040	4¢
Natural Gas	$12	$0.005	0.5¢
	$24	$0.010	1¢
	$48	$0.020	2¢
	$73	$0.030	3¢

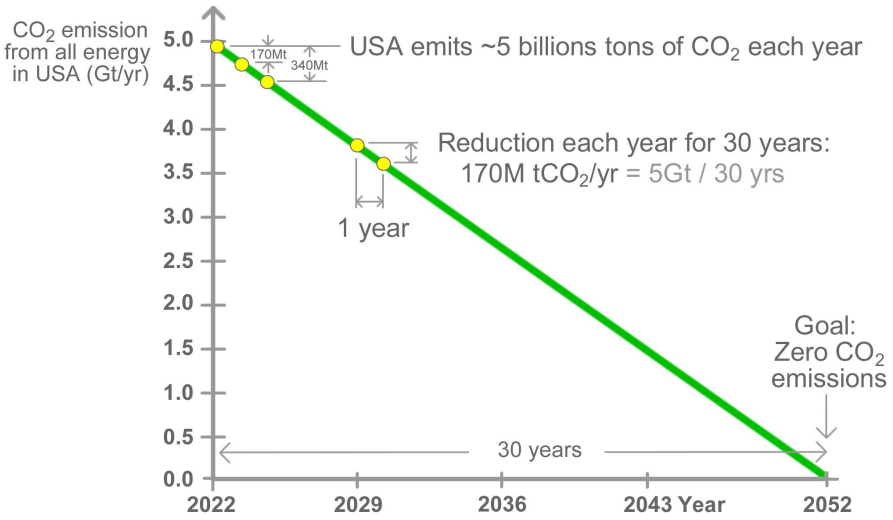
This table shows how to calculate decarbonization cost when working with green electricity.

For example, Decarbonization Cost is $20 per ton of CO_2 reduced when green electricity cost 2 pennies more than the coal it replaces. And Decarbonization Cost is $24 per ton of CO2 reduced when green electricity cost 1 penny more than the natural gas it replaces.

The Green Line

Now let's look at what happens when an entire nation such, as the United States, decarbonizes at the lowest cost.

The U.S. burns natural gas, coal and oil to produce approximately 5 billion tons of carbon dioxide each year.



Add to graph "The Green Line"

In theory, this could be reduced 1/30th each year, over 30 years, to arrive at zero emissions in the year 2052.

1/30th of 5 billion works out to 170 million tons a year.

In other words, we are looking at reducing U.S. CO_2 emissions from fossil fuels by 170 million tons of CO_2 a year.

We refer to this as "The Green Line".

How Much Does the Green Line Cost?

United States Decarbonization Cost - Year #1	
$4 billion	= 170 million tons of CO_2 x $24 per ton
$12 per person	= $4 billion / 330 million population

In our house example, we decarbonized at 24 dollars additional cost per ton of CO_2 reduced. We can apply this same decarbonization cost to a nation.

If we reduced U.S. CO_2 emissions at 24 dollars per ton, this would costs 4 billion dollars in year #1, 8 billion in year #2, 12 billion in year #3, etc.

	Year 1	Year 2	Year 3	…	Year 10
Cost/Person/Yr	$12	$24	$36	…	$120
Cost/Yr	$4B	$8B	$12B	…	$40B
CO_2 Reduced	170Mt	340Mt	510Mt	…	1.7Bt

And if we divide these numbers by the U.S. population, we see this costing Americans 12 dollars in year #1, 24 dollars in year #2, 36 dollars in year #3, and so forth and so on.

Also, if we decarbonized at $48 dollars per ton, instead of $24 dollars, these costs would be twice as high.

About 1/5th of these additional costs would show up on the typical residential electric bill, and the rest would show up as an increase in the cost of goods and services.

Tolerance of Decarbonization Costs

Tolerance of Decarbonization Costs
Costs needs to stay below Tolerance-of-Costs as one goes through time.

As one can see from the previous tables, the cost of decarbonization goes up each year.

Also, evidence of climate change increases each year. And this causes the public's **tolerance-of-costs** to also increase.

In other words, to get through this, one needs to **costs** to stay below **tolerance-of-costs** as one goes through time.

For example, we need the public to accept 12 dollars this year, when they are moderately nervous about climate.

And accept 120 dollars ten years from now, when they are more nervous.

International Competition

Unfortunately, if one increases costs incurred by domestic manufacturers, they become less competitive against foreign manufacturers.

This might seem trivial. However, this is a big deal. In many cases, lawmakers prioritize domestic manufacturers, and their workers, over climate change.

Let's look at some numbers to get a better sense of how much a green economy might harm domestic manufacturers.

International Competition	
Inflation increase per Year:	0.02% = $4B / $24T
Price Increase in Year #10:	0.2% = $40B / $24T

In the above example, costs go up 4 billion dollars a year. The total U.S. GDP is 24 trillion dollars. Therefore this would increase inflation by 0.02% a year for 10 years.

Ultimate, in year #10, domestic manufacturers would see their costs be higher by 1 part in 500, or 0.2%.

It seems many lawmakers would accept this.

The Decarbonization Dividend

The Decarbonization Dividend

Decarbonization reduces consumption of fossil fuels, which leads to lower fuel prices, which leads to consumer savings.

When one decarbonizes electricity, less natural gas is burned, and this reduces the demand for this fuel. This is likely to lead to a lower price, which consumers would save money. Consumers are also looking at paying more for greener electricity. Therefore, they can subtract lower fuel price savings from the additional cost of green electricity, to calculate net additional cost.

This is especially true in regions with local natural gas shortages. In other words, in some cases, pipes carrying natural gas are undersized and this causes local natural gas prices to be especially high. If consumption of natural gas in these regions decreases 10% to 30%, for example, local natural gas prices would come down nicely.

Fossil Fuels

Fossil Fuels

Use	Example Fuel	Form
Make Heat	Natural Gas	Gaseous
	Coal	Solid
Push Vehicles	Oil-based	Liquid

Fossil fuel comes in three forms. Solid, liquid and gaseous.

Coal is solid, oil-based fuels such as gasoline are liquid, and natural gas is gaseous.

Coal and natural gas are used to make **heat**. And **heat** is used to heat buildings, make electricity, make materials and make chemicals.

And liquid based fuels are typically used to push vehicles.

Transportation, Materials and Chemicals

We have talked about decarbonizing electrical power generation; however, we have not talked about decarbonizing other areas, such as transportation, making materials, and making chemicals.

These other areas have a problem that is rarely talked about.

These other areas have a high decarbonization costs, and many lawmakers will not pay $100 to reduce CO_2 by one ton when they can pay $10.

In other words, in many cases, these other areas do not have political support for government intervention that push them forward at large scales.

Two Phase Decarbonization

Fortunately, one can still do the Green Line by focusing on electrical power decarbonization for roughly 10 years. And then tackle the other areas at large scales later.

Also, while decarbonizing electricity, one can do R&D and other cost reduction measures to reduce the cost of further decarbonization.

Two Phase Decarbonization	
Phase I	Decarbonize electricity, and reduce cost of other areas with R&D
Phase II	Decarbonize other areas

What we are talking about is a two phase decarbonization strategy.

Phase I lasts approximately 10 years and focuses on electrical power decarbonization and more R&D.

While phase II occurs later, and decarbonizes other areas at large scales.

This is how one might do the Green Line at the lowest cost, and in lowest cost order.

Climate Question #4: How does one Gain Majority Support for the Green Line?

Climate Question #4

How does one gain majority support for the Green Line?

Now let's examine our 4th climate question, "How does one gain majority support for the Green Line?"

At first glance, it might appear this does not exist. However, there is evidence this is not accurate.

Fuel Importers and Exporters

There are some regions that produce and export carbon-based fuels, and there are those that import. One might think of these as *fuel exporters* and *fuel importers*.

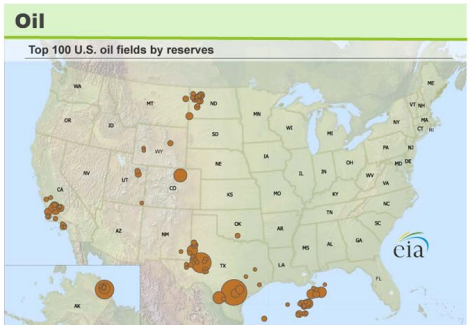
Fuel Importers Benefit from Decarbonization

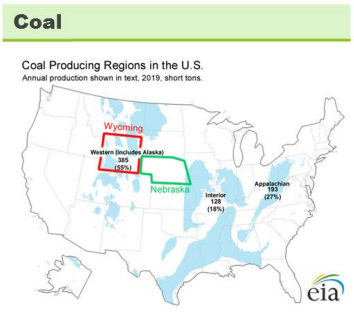
1) Gain green jobs while carbon jobs are lost elsewhere.
2) Pay less for natural gas when price drops due to less consumption.

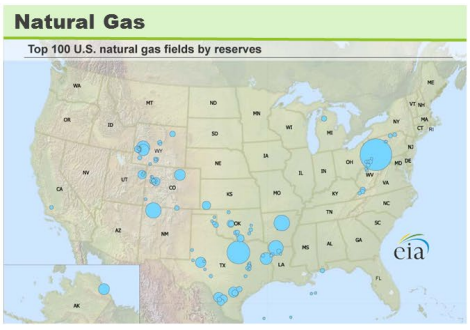
Fuel exporters are hurt by decarbonization. However, the opposite is true for importers. They benefit in two ways:

- One, they gain local green jobs when nearby wind farms and solar farms are constructed. And this occurs while carbon jobs are lost elsewhere.
- And two, they save money when decarbonization causes fuel prices to decrease, due to less fuel consumption, due to transitioning to sources that do not emit CO_2.

Fuel Exporters in the United States







To get a better sense of political interests, one can look at where fossil fuels are produced.

Only 35% of U.S. states produce coal or natural gas; both of which are used to make electricity.

U.S. Fuel Exporters
35% of U.S. states produce coal or natural gas.

In other words, two-thirds of the U.S. states are more inclined to support a green grid.

Three Climate Groups

One can also look at how people feel about the climate problem, and how they feel about decarbonization costs.

This leads us to three climate groups.

Three Climate Groups	
Group I	Concerned about climate change, and supports most remedies.
Group II	Concerned about climate, yet only supports low decarbonization cost remedies.
Group III	Not concerned about climate.

Group I is concerned about climate change; however, are not too concerned about decarbonization costs.

Group II is concerned about climate too, yet is only willing to go green with low decarbonization cost remedies. This typically entails building more solar farms, more land-based wind farms, and more hydroelectric dams. However, this does not include solar panels on homes or electric vehicles due to high decarbonization costs.

And **Group III** is not concerned about climate.

In effect, Group II is looking to decarbonize in lowest cost order. In other words, tackle $10 per ton first, followed by $15 per ton, etc.

According to survey, 95% of U.S. Democrats are concerned about climate, and almost all Democrats in congress supported the U.S. Inflation Reduction Act. This is not lowest cost decarbonization; therefore, this is Group I.

According to survey, 40% of U.S. Republicans are concerned about climate, and none of the Republicans in congress supported the Inflation Reduction Act due to high decarbonization costs. This is Group II.

And the remaining Republicans are not concerned about climate. This is Group III.

You might be wondering where I stand politically. It turns out I am not a member of any politically party, and I do not vote.

Group II are the Swing Voters

Group II are the swing voters.

Group I is not large enough to form a majority in the U.S.

Therefore, to tackle climate change in the U.S., one needs support from Group II.

In other word, Group II are the swing voters.

Journalist tend to focus exclusively on Group I, since most journalist belong to this group. However, Group II are the swing voters, which means they are more interesting.

What does Group II want?

So what does Group II want?

Senator Kennedy Video

To answer that question we can listen to Group II lawmakers.

For example, we can listen to Republican Senator John Kennedy converse with the second highest official at the U.S. Department of Energy.

https://www.youtube.com/watch?v=8s_aVsNCpMg

https://www.kennedy.senate.gov/public/2023/5/kennedy-to-biden-official-you-want-us-to-spend-50t-and-you-don-t-know-if-it-s-going-to-reduce-world-temperatures

Kennedy: "Give me your best estimate, just an estimate, of how soon you think the United States of America will be carbon neutral?" ….

Kennedy: "And, how much will that cost?" (5:51)

Turk: "So, the cost that I focus on even more is all the costs that are going to happen if we don't get our act together."

Kennedy: "No—the total cost: How much will it cost to get us carbon neutral?" ….

Kennedy: "How about $50 trillion? Is that right?"

Turk: "It's going to cost trillions of dollars. There's no doubt about it." ….

Kennedy: "If we spent $50 trillion to become carbon neutral by 2050 in the United States of America, how much is that going to reduce world temperatures?" (8:36) ….

Turk: "This is a global problem so we need to reduce our emissions" (8:38) ….

Kennedy: "You don't know do you? You just want us to spend $50 trillion, and you don't have the slightest idea whether it's going to reduce world temperatures. Now I'm all for carbon neutrality, but you're the Deputy Secretary of the Department of Energy, and you're

> advocating we spend trillions of dollars to seek carbon neutrality…. and you can't tell me how much it's going to lower world temperatures ….

The U.S. Department of Energy does not have a plan with cost numbers, since cost is a function of policy, and they are not sure what policy has majority support in congress.

We'll talk more about that in a moment.

Senator Romney Video

Now let's hear from another Group II lawmaker.

Senator Romney was the Republican nominee for President of the United States in 2012, and he is considered a leader among Republicans. Also, he was the Vice President of an investment company in the 1980's, and is therefore familiar with markets and money.

This is him in 2023.

> https://www.romney.senate.gov/romney-we-must-get-serious-about-reducing-global-emissions
>
> **Romney**: I have no question about the impact of climate change. It's going to be significant—devastating in some areas more than others. ….
>
> The U.S. is not the big contributor to emissions in the world. ….
>
> China's emissions are greater than the U.S., the EU, and Japan combined. So we do things here that are very expensive and disruptive to our economy, they don't change what's happening globally. We have to do things that have global impact.

Kennedy and Romney Requirements

Kennedy and Romney Requirements
Plan, cost numbers, global strategy, and lowest cost.

As we can see, both Kennedy and Romney are concerned about climate. And they are concerned about global CO_2 emissions, not just the United States.

Also they are looking for plan, cost numbers, global strategy, and lowest cost approach.

How Gain Majority Support?

So, back to our original question, "How does one gain majority support for the Green Line?"

In theory, one can give Group II what they want.

However, in practice, this is more complicated.

Five More Climate Questions

This brings us to five more climate questions

More Climate Questions
5) At what rate are nations increasing the production of green electricity?
6) Are CO_2 emissions being reduced at a low decarbonization cost?
7) If not, why not?
8) Why does it matter if someone else wastes their own money?
9) How does government implement the Green Line at the lowest cost?

- One, at what rate are nations increasing the production of green electricity?
- Two, are CO_2 emissions being reduced at a low decarbonization cost?
- Three, if not, why not?
- Four, why does it matter if someone else wastes their own money?
- And five, how does government implement the Green Line at the lowest cost?

Climate Question #5: At what rate are nations increasing the production of green electricity?

Climate Question #5

At what rate are nations increasing the production of green electricity?

Ok, so let's begin with the initial question, "At what rate are nations increasing the production of green electricity?"

As mentioned previously, there are two ways to generate electricity. One is to burn natural gas or coal, and emit CO_2. And the other is to not emit CO_2, and make energy with solar, wind, hydro and nuclear.

Green Electricity Growth Rate

		2016	2020	Growth over 4yrs	Growth per year
USA		34.8%	37.9%	3.1%	0.8%
China		28.0%	32.2%	4.2%	1.1%
Germany		31.6%	50.9%	19.3%	4.8%

To see what a nation is actually doing with climate, one can look at the growth rate of green electricity over the last few years.

For example, the United States moved from 35% to 39% over 4 years, which is a 1% per year growth rate.

And China moved from 28% to 32% over 4 years, which is also a 1% per year growth rate.

Germany, on the other hand, advanced 5-times faster.

Germany is on track to produce a green grid within 10 years, and is showing the world this is possible.

What does U.S. President Biden Want to do with Green Electricity?

Ok, that is past data.

We can also look at what President Biden **wants**.

The Washington Post
Democracy Dies in Darkness

GlennSW_

Biden calls for 100 percent clean electricity by 2035. Here's how far we have to go.

https://www.washingtonpost.com/climate-environment/2020/07/30/biden-calls-100-percent-clean-electricity-by-2035-heres-how-far-we-have-go

Approximately 40% of U.S. electricity is currently green, and Biden wants it to be 100% green by the year 2035. This would entail advancing 60% over 12 years, or 5% per year.

At this time, his proposal does not have majority support due to several reasons we will discuss shortly.

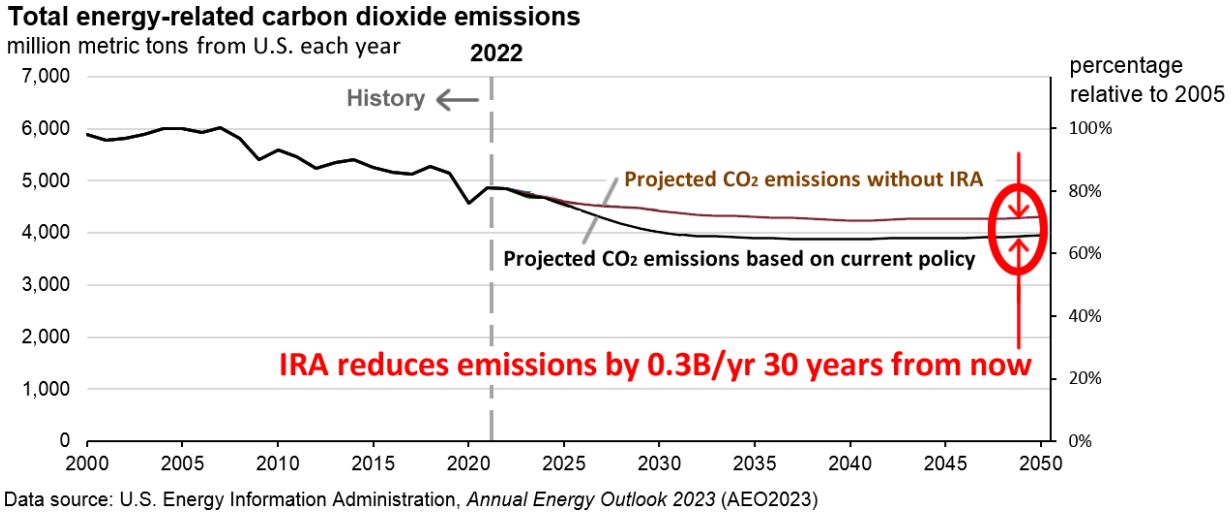
(add graph next to Washington Post article, 2023, 2035, 40%, 100%, 5%/yr)

The U.S. Inflation Reduction Act

That's what Biden **wants**.

Now let's look at what he **has**.

At the center of U.S. climate policy is legislation called the "Inflation Reduction Act", or "IRA" for short. This was enacted in 2022.



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)

U.S. government economists expect the IRA to reduce annual CO_2 emissions, in the U.S., from 4.3 to 4.0 billion tons, 30 years from now.

In other words, the IRA does little.

U.S. Green Electricity Policy

U.S. Green Electricity Policy

30% subsidy on green electricity

Now let's look at what the U.S. government is doing to decarbonize the grid.

The centerpiece is a government subsidy that pays 30% of the cost to build a solar farm or wind farm. This has been in place since 2006 and the 30% size has never changed.

In other words, the size of government intervention that pushes solar farms forward has been constant over the last 17 years.

The subsidy was set to expire in 2026. However, the IRA extended it so it expires later. The IRA did not change the 30% size; therefore, it does increase the rate of decarbonization.

Instead, the IRA made it so the rate of decarbonization does not decrease after the scheduled 2026 subsidy expiration date.

Presidents Obama and Trump had a similar green electricity policy. That is, a 30% subsidy on green electricity.

However, Biden weakened it significantly by not allowing this subsidy to be used with foreign-made solar panels. Ironically, this provision reduces the number of solar farms build each year.

The Media and Climate Change

The media failed to explain what the IRA does, and what it does not do.

Not because journalist are not smart. They are definitely smart.

The problem is more a lack of understanding of energy, energy economics, and decarbonization costs.

If these things were betting understood by journalist and lawmakers, our society would be better at tackling climate change.

Climate Question #6: Are CO_2 emissions being reduced at a low decarbonization cost?

Climate Question #6

Are CO_2 emissions being reduced at a low decarbonization cost?

Ok, so back to our climate questions. "Are CO_2 emissions being reduced at a low decarbonization cost?"

The answer is yes, and no.

As noted previously, decarbonization cost are often referenced in units of dollars spent to reduce CO_2 emissions by one ton of CO_2.

Low decarbonization cost remedies typically cost less than 50 dollars per ton of CO_2 reduced, while high decarbonization cost remedies go for more.

And, as mentioned previously, political support for high decarbonization cost activity is low.

Examples of low decarbonization cost activity is building solar farms, building land-based wind farms, and building hydroelectric dams.

And examples of high decarbonization cost activity is electric cars in the U.S. and Europe, nuclear reactors in the U.S. and Europe, solar panels on buildings, carbon capture and sequestration, direct air capture, blocking fossil fuel pipelines, and blocking fossil fuel drilling. All of these things reduce CO_2; however, their decarbonization cost is often greater than 50 dollars per ton of CO_2 reduced.

Climate Question #7: Why might a nation reduce CO_2 at a high decarbonization cost?

Climate Question #7

Why might a nation reduce CO_2 at a high decarbonization cost?

Ok, so why might a society engage in high decarbonization cost activity?

Or put a little differently, why might one pay $100 dollars to reduce emissions by one ton of CO_2, when they can pay $10?

There are several reasons, which we will now explore.

Decarbonization Cost Ignorance

In many cases, money is wasted due to a lack of understanding of energy, energy economics, and decarbonization costs.

The Delegation of Decarbonization

We encourage individuals, companies, cities, and states to reduce CO_2 emissions. At first glance, this might seem reasonable. However, this strategy is flawed since these entities rarely have the physical ability to do this with a low Decarbonization Cost.

This is like asking a city mayor to build a car from scratch in the local shop. Can he do it? Yes. However, it might cost him 100 times more than factory mass production. Instead, the mayor should let the automobile industry handle mass production in the same way we should let power companies decarbonize at massive sales and at low costs.

The Selling of Climate

Another problem is "the selling of climate".

The Selling of Climate

Entities promote climate efforts,
to improve their standing with the public

This is when companies, universities, and governments talk about the things they are doing to help the climate problem, to improve their standing with the public.

However, their efforts are rarely quantified. More specifically, cost, number of tons of CO_2 reduced, and cost-per-ton are rarely specified.

Unfortunately, the selling of climate causes the public to feel like the problem is being handled, when it is not.

Climate Question #8: Why does it matter if someone else wastes their own money?

Climate Question #8

Why does it matter if someone else wastes their own money?

This begs the question, why does it matter if someone else wastes their own money?

In some cases, decarbonization costs are placed squarely on the shoulders of an individual. For example, if someone buys a 100,000 dollar electrical car, they might see a 1000 dollar per ton of CO_2 reduced decarbonization cost.

However, in many cases, decarbonization costs increase the cost of goods and services. Or they increase government debt. Or they are paid for with tax payer money. And in these cases, wasted money eventually hits the citizen's wallet, even if slightly.

Political Sensitivity to Decarbonization Costs

Political Sensitivity to Decarbonization Costs

Political support goes down when Decarbonization Costs go up

For this reason, lawmakers are sensitivity to decarbonization costs.

In other words, political support goes down when Decarbonization Costs go up.

Ultimately this means that transitioning to a green economy probably needs to be done in lowest decarbonization cost order.

For example, tackle areas that cost less than 50 dollars per ton of CO2 reduced, before tackling more costly areas.

Especially when working at large scales.

Climate Question #9: How does Government implement the Green Line at the Lowest Cost?

Climate Question #9

How does Government implement the Green Line at the Lowest Cost?

And this brings us to our last climate question, how does government implement the Green Line at the lowest cost?

The three main ways government can influence behavior. These are taxes, subsidies and requirements.

In some cases, requirements are better than taxes and subsidies since they can decarbonize at the lowest cost to society, and can produce a Green Line.

Let's look at an example case to get a better sense of this.

Electricity Example

Cost is shown in units of $ per Megawatt-Hour

$40	Solar farm electricity	*"Green"*
$30	Carbon-based electricity	*"Carbon"*
$10	Difference	*"Green Premium"*

Let's assume electricity from a solar farm cost $40 per unit electricity, and the natural gas it replaces cost $30.

In this example, the *"Green Premium"*, which is the additional cost of the green product, is 10 dollars.

Taxes, Subsidies and Requirements

Government Options

1) Tax	$11 tax on Carbon option
2) Subsidy	$11 subsidy on Green option
3) Requirement	Power Company required to buy Green

Now let's compare taxes, subsidies and requirements. Government can push consumers to go Green three different ways:

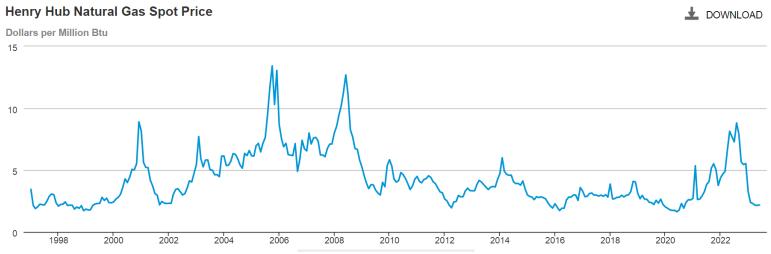
- Method 1 is to add an $11 tax on the carbon-based electricity, and make it cost $1 more than Green electricity.

- Method 2 is to subsidize the Green electricity by $11, and make it cost $1 less than Carbon.
- And method 3 is to require the Power Companies to buy Green.

At first glance, these might seem similar. However, in practice, they are different.

Taxes and Subsidies will not produce a Green Line

In the real world, the $30 carbon-based electricity does not have a stable price since it is mostly determined by the price of fuel, which varies from region-to-region, and over time.



https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm

For example, the price of natural gas in the U.S. varied between $3 and $13 per million BTU over the last 25 years.

In other words, when working with carbon taxes and green subsidies, government does not control the rate of decarbonization.

For example, if a tax or subsidy is sized to make the green product cost $1 less than the carbon product, and the price of the carbon product drops $5 due to lower fuel cost, then the subsidy will lose its bite.

Requirements, on the other hand, do not have this problem.

For example, if the power company is required to reduce CO_2 emissions by $1/12^{th}$ each year, over 12 years, and pass additional costs onto consumers, then a beautiful 12 year Green Line will appear, independent of fuel price fluctuations.

Requirements Cost less than Taxes

Another problem with carbon taxes is they are not the lowest cost way to tackle climate change. This is because most companies who incur a carbon tax will not reduce CO_2, and instead will pass additional costs onto consumers.

Requirements, on the other hand, do not have this problem. With Requirements, the only additional cost to consumers is the Green Premium, which is the additional cost to make the Green product.

Economists refer to this as “efficiency”. Taxes have an efficiency problem, whereas Requirements do not.

The Problem with Requirements

The only problem with Requirements is you need someone to require.

With electricity, this is easy, for four reasons:

- One, power companies already exists.
- Two, they know how to handle requirements.
- Three, grid monitoring equipment is already in place.
- And four, tampering with this equipment is illegal.

Unfortunately, requirements are more complicated with other areas of the economy, such as the making of materials and chemicals.

This is due to the fact that they don't have the equivalent of the power company.

However, in theory, this could be set up. And then materials and chemicals could be put onto a beautiful green line.

We'll talk more about this shortly.

Section II: The Climate Solution

Section II

The Climate Solution

That completes our review of green economy costs.

Now let's look at concrete steps that would move this forward.

Solution 1: Grand Climate Bargain

Climate Solution #1

Grand Climate Bargain

Group I lawmakers have a basket of so-called climate remedies, where some have high decarbonization costs and others low.

Group II lawmakers, on the other hand, prefer baskets with *only* low decarbonization cost items. And they are open to running some of those at large scales.

Group I likes their basket, and is fond of its contents.

However, some Group I lawmakers might be open to a grand climate bargain, where high decarbonization cost items are reduced, in return for increasing the size of low decarbonization cost items.

Ultimately, more CO_2 would be reduced, at less cost.

Basic Climate Principles

Lawmakers occasionally reach consensus on a few basic principles, and then have their staff research implementation.

Basic Climate Principle

Enact federal law that requires transitioning to a green economy, over 30 years, at a constant rate, at lowest cost, and in lowest cost order.

For example, Group I and II lawmakers might agree to:

> *Enact a federal law that requires transitioning to a green economy, over 30 years, at a constant rate, at lowest cost, and in lowest cost order.*

Assignment for Government Economists

Assignment for Government Economists

Calculate effect on natural gas price, amount of money saved due to lower gas price, additional cost of greener electricity, number of green jobs gained, and number of carbon jobs lost.

And they might have government economists study how to achieve this objective.

Also, after they identify a suggested approach, government economists would need to calculate the effect on natural gas price, the amount of money saved due to lower natural gas

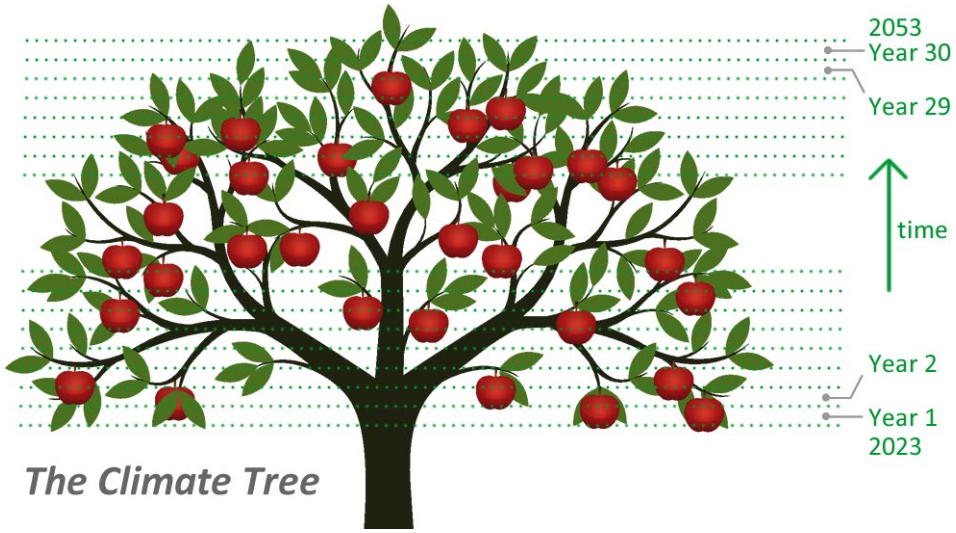
price, the additional cost of greener electricity, the number of green jobs gained, the number of carbon jobs lost, and the number of manufacturing jobs gained or lost due to a greener economy.

The Climate Tree

As noted previously, Group II lawmakers are requiring us to approximately decarbonize in lowest cost order.

If one uses the fruit analogy, this entails consuming the lowest hanging fruit first, followed by the layer above.

In this analogy, consuming fruit refers to doing things that reduce CO_2, such as building a solar farm, or building a wind farm.



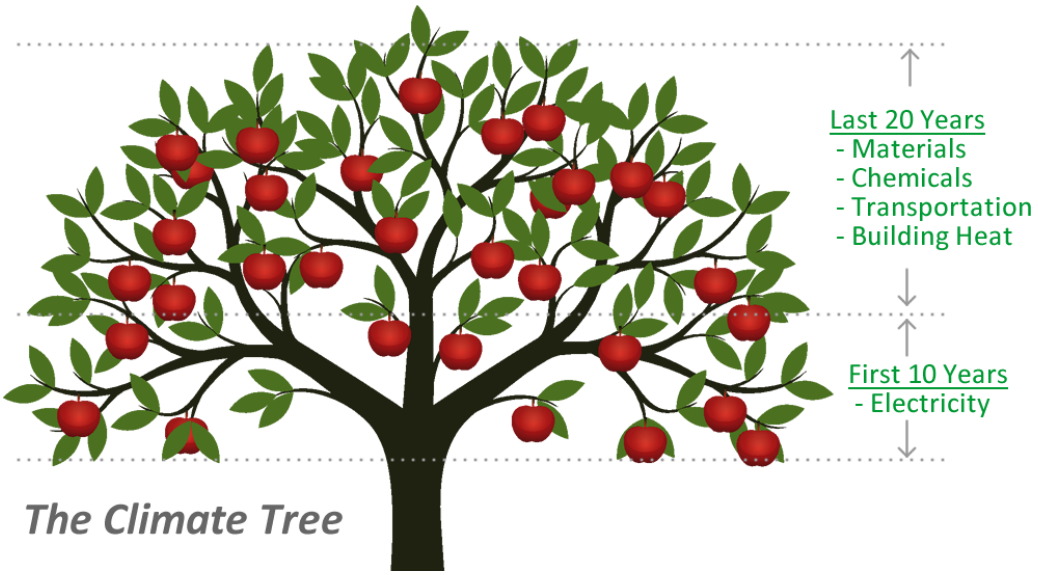
The lowest hanging fruit is the easiest to get to, and therefore has the lowest decarbonization cost. For example, the lowest layer might be 10-dollars-per-ton-of-CO_2 activity, and the layer above 15-dollars-per-ton.

For example, the lowest layer might involve building a solar farm in a region with lots of sun, and lots of cleared unused land.

The Bottom Third of the Tree

The easiest way to do this during the initial years is to increase the number of solar farms, wind farms and hydroelectric dams built each year.

In theory, laws can require power companies to do this, with additional costs passed onto consumers. Builders of solar farms and wind farms would then compete with each other to drive down costs and decarbonize at the lowest cost.



If a nation decarbonizes over 30 years, for example, the lowest third of the tree is approximately ten years of electricity decarbonization.

And one can reduce the cost of other areas with R&D, while decarbonizing electricity.

Higher areas in the tree include decarbonizing the making of materials, the making of chemicals, transportation, and the heating of buildings.

During the first ten years, these other areas would see some decarbonization; however, not at large scales.

One might want more scale; however, these other areas are already experiencing high decarbonization costs at small scales. And economists do not believe this will change in the near future.

Climate Plan

Senator Kennedy is the top Republican on the energy appropriations committee, and this means he works with plans that are reviewed and improved.

Also, plans contain cost numbers, and these are audited for accuracy.

From his perspective, this is how one manages money responsibly.

He might come across as a bit grumpy; however, his behavior is consistent with people who manage capital.

Climate Plan Example

For an example climate plan, one can refer to the book shown here.

Free Climate Plan
www.APlanToSaveThePlanet.org

This is open-source, which means anyone can copy and edit the original Microsoft word file, and produce their own plan. All for free.

For a free pdf, visit the link shown here.

7000 of these were given out for free during the first half of 2023.

Shown here is a pallet with 2000 free climate books.

Solution 2: Save the Planet with a Website

Climate Solution #2

Save the Planet with a Website.

In a sense, confusion over decarbonization costs is at the core of the climate problem.

One might refer to this as "the fog of climate."

In theory, this fog could be lifted by a website that documents decarbonization costs for each so-called climate remedy.

Government Economists

Government economists have access to decarbonization cost data and tend to be the most unbiased. Therefore, they are the logical choice to build this website.

We talked about how society wastes money, in part due to ignorance regarding energy economics and decarbonization costs. Government energy economists are the few people that have a deep understanding of these things; therefore, they are important elements of the climate solution.

There are two things that are needed. One is better tools that explain decarbonization costs and the other is tools that explain what is involved in transitioning to a green economy.

Decarbonization Cost Tools

As we mentioned previously, each so-called climate remedy has a cost and a specific amount of CO_2 that is reduced. And one can divide these two values to calculate the number of dollars needed to reduce CO_2 emissions by one metric ton of CO_2.

Cost is really the sum of component costs. And CO_2 emissions is really the sum of component emissions.

One might reduce CO_2 in some ways, and increase in others. Therefore, one would need to sum all CO_2 components to get net CO_2.

After summing two lists, one can divide to get Decarbonization Cost.

Also, each climate remedy can often be more fully characterized with several parameters.

In theory, for each climate remedy, one should be able to visit a website managed by government economists to get this information.

In other words, the website user would set parameters that characterize a climate remedy, click calculate, see a list of costs, see a list of CO2 reduction/addition components, see the summation, and then see the final decarbonization cost.

What we are talking about is adding a website user interface to a mathematical model that calculates decarbonization cost. In many cases, these models already exist; however, the website user interface is missing.

Climate Policy Making Tools

Most lawmakers worldwide are not going to be comfortable transitioning to a green economy without a detailed report on exactly how this works economically.

They are going to want to know the number of manufacturing jobs lost due to cost increase, number of jobs lost due to less fossil fuel production, and number of green jobs gained. One can sum these to get net number of jobs gained or lost.

Also, lawmakers are going to want to know the net cost to society. For example, one can subtract savings due to lower fuel prices from additional cost of greener electricity to get an estimate of this.

Government economist already have models that calculate these things. However, a website user interface is needed to make these more useful.

Climate Policy Making Tools
www.APlanToSaveThePlanet.org/study

For details, see the link shown here.

Grand Climate Bargain Needs Help from Government Economists

As we mentioned previously, Group I has a basket with climate remedies, some of what have high decarbonization costs, and some with low. Also, Group II has a suggested basket too.

In theory, government economists could evaluate all items in all baskets, and also sum the cost and CO_2 impact of each basket.

This is important since Group I is not going to want to let go of their basket unless they have detailed reports on a better way.

And, Group II is not going to accept transitioning to a green economy unless they have detailed reports on exactly what this entails economically.

In other words, these websites, which do not currently exists, are important.

Don't Blame the Journalists

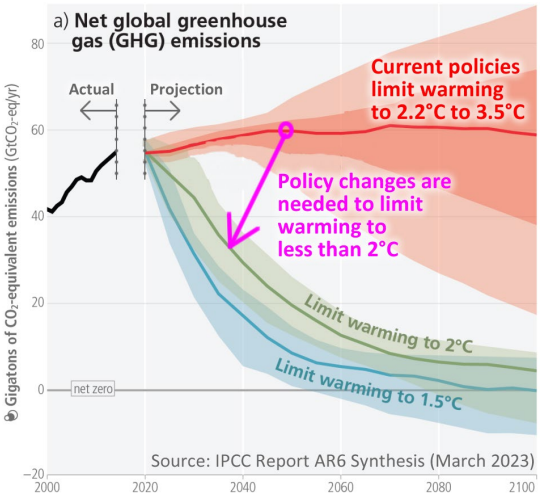
One might blame journalists for the fog of climate, since, in theory, they are the ones that should clearly explain how to deal with the climate problem. However, they are as good as their sources. Which is another way of saying we need better climate tools that are overseen by unbiased economists.

Solution 3: More R&D

Climate Solution #3

More R&D

Both Groups I and II want to reduce global CO_2 emissions via R&D, and other cost reduction techniques.

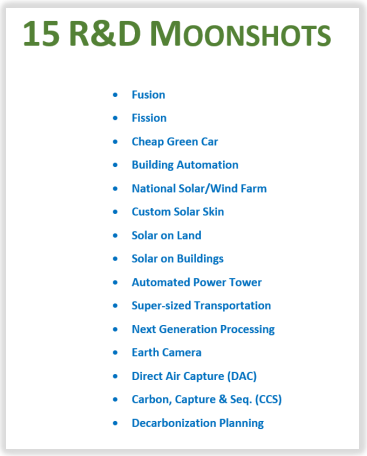


However, economists that project CO_2 emissions assume this is occurring, and they do not see it solving the climate problem.

In other words, economist do not believe we are doing **enough** R&D.

This begs the question, "How do we do we do more?"

15 Climate Moonshots



www.APlanToSaveThePlanet.org

The free climate book mentioned previously refers to 15 large R&D initiatives that are currently **not** being done, and have potential for significant impact.

It refers to these as “Climate R&D Moonshots”.

Climate Moonshot: Spend Billions to Save Trillions

Climate R&D Moonshots

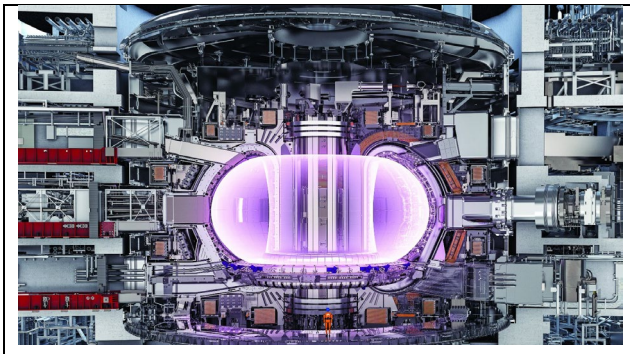
Spend billions on R&D to save trillions on infrastructure.

We are looking at new green infrastructure costing the world on the order of 100 trillion dollars over the next 30 years. Therefore, spending hundreds of billions of dollars on additional R&D, to potentially save trillions of dollars on decarbonization costs, is reasonable.

Fusion Moonshot

Here's an example climate R&D moonshot.

Scientists are currently studying how to generate energy with a hot plasma inside a donut shaped structure.



Fusion Moonshot (proposed)

Achieve commercial fusion within 5 to 10 years.

This is referred “Tokamak fusion” and it is not expected to be commercially available for another 20 years.

However, a fusion moonshot could potentially get this done sooner.

How does one approach large R&D reasonably?

How does one approach large R&D reasonably?

This begs the question, “How does one approach large R&D reasonably?”

In general, one spends small money before medium money, and medium money before big money. And one only advances if the initiative is economically and technically feasible.

Proposal Writing Funds can get this Started

Proposal writing funds can get climate moonshots started.

Small money entails paying scientists and engineers to write proposals to do R&D.

These might cost 10,000 dollars each, and one might be able to get each moonshot started with one to two dozen proposals.

In other words, one can potentially get the balling rolling for several hundred thousand dollars per moonshot.

After proposals are written, initial R&D might cost several million dollars, to several tens of millions of dollars.

After that, funding sources can continue, or not.

Centers for Climate R&D Moonshot

Centers for Climate R&D Moonshot*

- Pay scientists and engineers to write open-source proposals to do initial R&D for climate moonshots.
- Place proposals on internet, for further consideration by governments and foundations.

*Reference: www.APlanToSaveThePlanet.org/Lab

In theory, nations could set up Centers for Climate R&D Moonshots, with an annual budget of several million dollars. These would *not* need to fund the actual moonshots, only the proposal writing. After proposals are written, consideration for more funding would be done by governments and foundations.

Does the U.S. need a new Decarbonization R&D Laboratory?

The U.S. government currently operates dozens of national laboratories, an example of which is shown here. This is the Jet Propulsion Laboratory (JPL), and they develop gadgets that explore outer space.

In theory, the U.S. government could do something similar with climate by setting up a new national laboratory that oversees climate moonshots.

In theory, foundations could also set up laboratories. For example, Bill could set up the Gates Decarbonization Laboratory, and Elon could set up the Musk Decarbonization Laboratory.

Decarbonization R&D Laboratory
www.APlanToSaveThePlanet.org/Lab

And to get these started, a foundations and governments could set up proposal writing funds.

For details on how this might work, visit the link shown here.

Task the Best and Brightest with Managing R&D Money

Governments and foundations occasionally waste money on R&D.

In some cases, this is due to administrators who claim R&D is more valuable than it is, to attract money, to pay people.

To defend against wasting money, a lab could potentially task the best and brightest engineers and scientists to oversee multiple projects, and reasonably throttle money up or down, to each, over time.

In other words, if one project is given more money, another project is given less, and the total laboratory budget stays the same.

Climate Money vs. Investment Money

R&D Money	
Climate	Maximize reduction of CO_2 emissions. Open-source requirement is more likely.
Investment	Maximize return on investment. Materials are rarely shared with public.

There are two types of R&D money. Climate Money and Investment Money.

Climate Money tries to reduce CO_2 emissions, whereas Investment Money tries to make more money.

Each has constraints. For example, Investment Money will not participate if too complicated or too risky.

And Climate Money might require engineers to share their work with others for free, to maximize the utilization of developed material.

Governments and foundations are potential sources of Climate Money.

Whereas companies and investment funds are sources of Investment Money.

Investment and Climate R&D Money are already tackling climate change; however, as noted previously, economists do not believe this will solve the climate problem at their current levels.

Solution 4: Decarbonize Materials and Chemicals

Climate Solution #4

Decarbonize
Materials and Chemicals

We currently burn fossil fuels to make things.

https://en.wikipedia.org/wiki/Steel#/media/File:Allegheny_Ludlum_steel_furnace.jpg

This includes making materials such as metals, plastics, and cement.

https://en.wikipedia.org/wiki/Oil_refinery#/media/File:Anacortes_Refinery_31911.JPG

And this includes making chemicals such as soap and fertilizer.

Carbon Intensity

Carbon Intensity

Number of grams of CO_2 emitted per unit of material, chemical, or electricity made.

There is a parameter called "Carbon Intensity" that refers to the number of grams of CO_2 that are emitted into atmosphere for each item manufactured.

Items include electricity, materials such as copper, and chemicals such as ammonia.

For example, one typically emits 4 grams of carbon dioxide for each gram of copper that is produced.

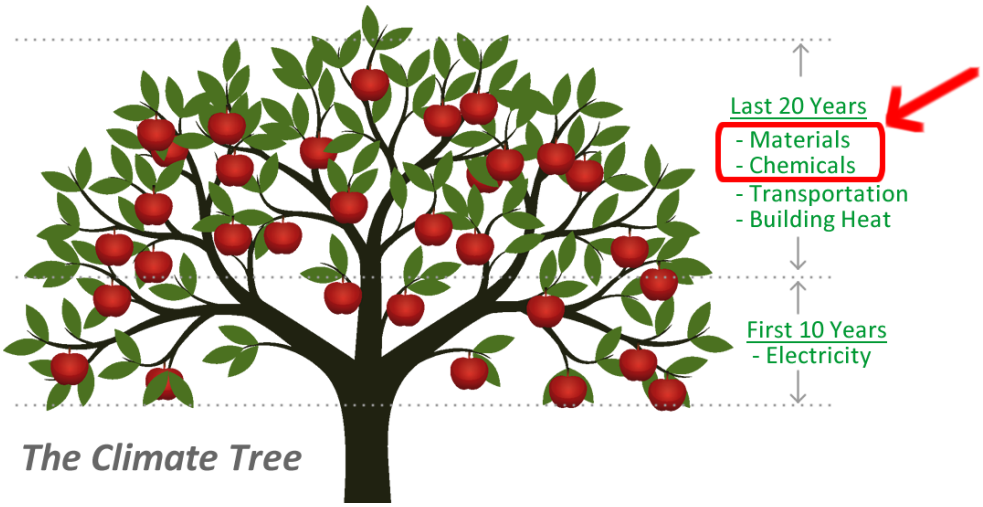
When a nation decarbonizes, average carbon intensity decreases.

Materials and Chemicals are higher in the Climate Tree

Decarbonization Costs	
Materials/Chemicals	\$70 to \$150 per ton of CO_2 reduced
Electrical Power	\$10 to \$50 per ton of CO_2 reduced

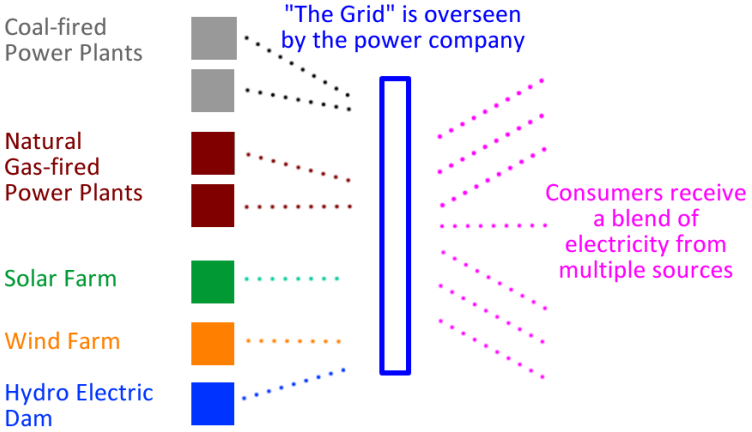
It typically costs more to decarbonize materials and chemicals than it cost to decarbonize electrical power generation.

More specifically, it typically costs \$10 to \$50 to reduce CO_2 emissions by one ton when decarbonizing electricity. And it typically cost \$70 to \$200 per ton when making green materials and chemicals.



This is another way of saying materials and chemicals are higher in the climate tree than electricity; and therefore will probably see large scale decarbonization later.

Electrical Power Aggregators



The power company aggregates electricity from solar farms, wind farms, natural gas-based power plants, and coal based power plants. And then distributes it to customers via the grid.

Each source has a carbon intensity, which is the amount of CO_2 emitted per unit of electricity made.

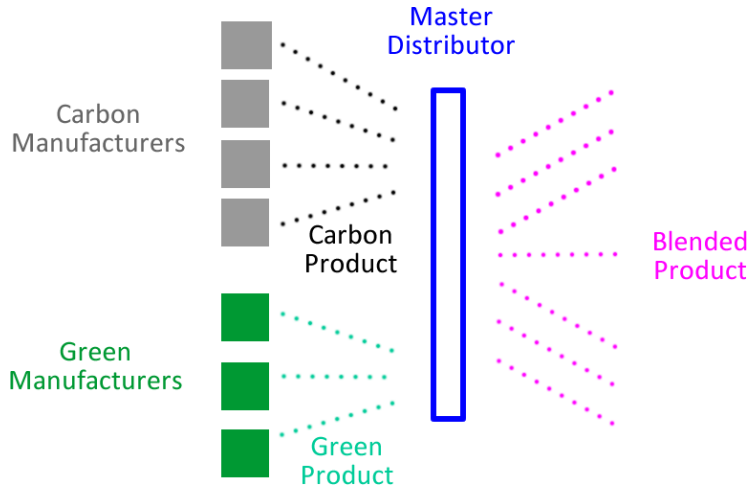
Customers receive a blend with a carbon intensity that is the average intensity of the sources.

If government requires the power company to decrease average carbon intensity, the power company would buy less from high intensity sources such as coal, and buy more from low intensity sources such as solar farms.

Builders of solar farms and wind farms would then compete with each other, and drive down costs.

This is lowest-cost decarbonization.

Master Distributors



In theory, one could do the same with chemicals and materials using master distributors that aggregate products from multiple suppliers. The resulting blend would have a carbon intensity that is the average of the sources.

And government could require this intensity to decrease over time, to decrease demand for higher intensity sources, and increase demand for lower.

In other words, government could use carbon intensity requirements to put materials and chemicals on a Green Line.

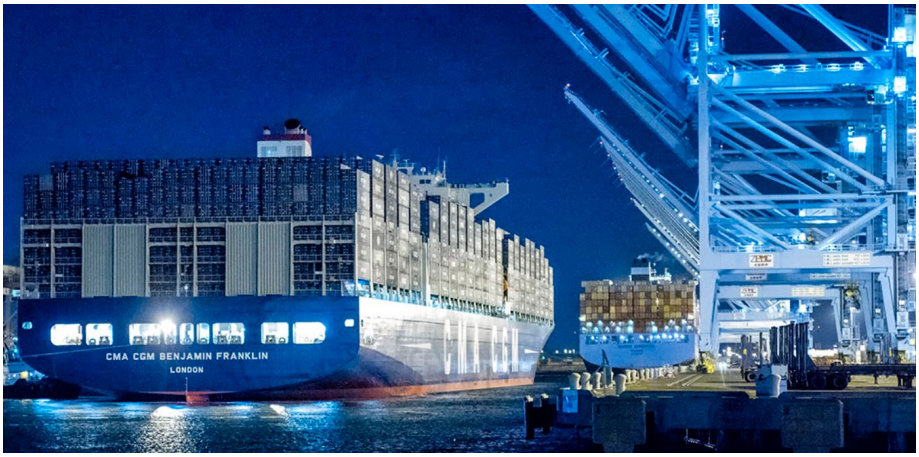
Master distributors such as these do not exist; however, in theory, they could be set up.

The Shuffle Problem

> It is easier to climate a product is Green than to make a Green product.

Products made without emitting CO_2 are sometimes referred to as "Green". And it is easier to claim a product is Green, than to actually make a Green product. In other words, in the

middle of the night, entrepreneurs will move non-Green products to Green warehouses, to make money.



https://en.wikipedia.org/wiki/Port_of_Los_Angeles#/media/File:CMA_CGM_Benjamin_Franklin.jpeg

Or a ship will appear with a mislabeled product.

Economists refer to this as “shuffle”.

Tracking System

International Tracking System (proposed)

Track production, transportation, storage and consumption of materials and chemicals.

The only way to resolve this is an international system that tracks the production, transportation, storage and consumption of materials and chemicals.

This does not exist; however, in theory, it could also be developed.

Master Tracking Distributor

Master Distributors might be defined as corporations that receive tracked products and produce tracked blends with an average carbon intensity. For this reason, they might be referred to as "Master Tracking Distributors", or MTD for short.

Initially, their use would not be required by government. In other words, manufacturers would not be required to sell to MTD's, and downstream consumers would not be required to buy from them. Subsequently, the size of these distributors would be determined by the demand for tracked product. Initially this would be small, since consumers buy lowest cost independent of CO_2, unless forced to do otherwise.

Also, one could expect non-required MTD's to appear all over the world, since they would not threaten existing companies.

Then, at some point in time, when government wanted to put materials and chemicals on a Green Line, they would need to require four things:

- One, manufacturers must sell to MTD's.
- Two, downstream customers must buy from MTD's.
- Three, average carbon intensity must decrease over time.
- And four, if an MTD receives an untracked product, it must assume the highest carbon intensity, which is that associated with burning coal.

Government Oversight is Required

Government oversight is required.

To get this to work, it would need to be overseen by government, and laws would need to make tampering illegal. Otherwise, people lie to make money, and the honest person finishes last.

Material and Chemical Decarbonization Strategy

Material/Chemical Decarbonization Strategy	
Phase I	**o** Set up tracking systems **o** Set up non-required Master Tracking Distributors (MTD) **o** Reduce cost via R&D
Phase II	**o** After electricity is decarbonized, require MTD's **o** Decarbonize at large scales and at lowest costs

What we are talking about is a two phase material and chemical decarbonization strategy. During Phase I, while electricity is being decarbonized, tracking systems and MTD's are set up, yet not required. And later, when materials and chemicals have become the lowest hanging fruit on the climate tree, MTD's are required by government.

Material Politics

Material Politics
Phase I would have political support since it cost little. However, Phase II would conflict with domestic manufacturers.

Phase I would receive political support since it does not threaten existing companies or jobs, and it cost little.

However, transitioning to Phase II requires Climate concerns to outweigh International Competition concerns.

For example, if a United States farmer is required to buy expensive green fertilizer.

And a farmer in China can buy low-cost non-green fertilizer, the U.S. farmer is put at a disadvantage.

Most nations prioritize domestic manufacturers over Climate; therefore, this is a **big** issue.

Also, as evidence of climate change increases each year, political support for a green economy increases.

Green Heat

Setting up non-required MTD's and tracking systems is the easy part.

The hard part is getting sources of heat without emitting CO_2.

This is sometimes referred to as “green heat”, and potential sources are electricity from renewables, hydrogen gas made with green electricity, and heat made directly by a nuclear reactor.

Cheap Green Heat

Cheap Green Heat

Nations who do not accept nuclear power might not be competitive against those that do.

Heat from a nuclear reactor in China is likely to cost 3-times less than heat made with a photovoltaic solar farm in the U.S. or Europe. In other words, nations who are not receptive to nuclear power are likely to be at a competitive disadvantage in a green new world.

For this reason, more R&D is needed to develop low cost sources of green heat.

Don't Blame the Factory

The guy who owns the cement factory might point out that the electricity entering his building is not green, and that a pipe with cheap green hydrogen gas is not buried under the street in front of his building.

Don't Blame the Factory

- Utility companies needs to supply green electricity and/or green hydrogen gas.
- Laws are needed that require consumers pay the additional cost of the greener product.

He might state, **correctly**, two things.

- One, is that decarbonization has little to do with his factory, and instead, has more to do with the utility company. They are the ones that need to supply green electricity and/or green hydrogen gas.

- And, two, new laws are needed that require consumers pay the additional cost of the greener product.

And the owner might state that without these two things, change will not occur.

In other words, if a nation is not decarbonizing materials and chemicals at large scales, don't blame the factory.

Instead, this involves the utility company, and laws that require a green economy.

Solution 5: Cheap Green Car

Climate Solution #5

Cheap Green Car

As mentioned previously, some nations import oil, whereas others export.

And oil importers are transitioning to electrical vehicles, in part, to gain energy independence.

Conversely, oil exporters are less supportive of green cars.

To change this, electric cars would need to cost less than gas cars.

This is currently the case in China, yet not in the U.S. or Europe.

This tells that green cars costing less than gas cars is possible.

https://www.findmyelectric.com/blog/electric-car-prices
https://www.carscoops.com/2022/11/evs-are-affordable-in-china-but-remain-quite-expensive-in-europe-and-the-us/ **(very good)**
https://www.autoevolution.com/news/byd-dolphins-prices-would-make-it-the-cheapest-car-for-sale-in-the-us-167545.html
https://www.findmyelectric.com/blog/electric-car-prices
https://www.motortrend.com/reviews/2023-byd-dolphin-first-drive-review/
https://www.arenaev.com/byd_dolphin_2023-190.php#60

An example of a low cost EV is shown here. This has a 250 mile range and sells for $17K in China without the government subsidy.

Alternatively, the average EV in the U.S. sells for approximately $64K without government subsidies.

This indicates there is an opportunity to sell a low-cost green car in the U.S.

Let's explore how this might work.

The Easy EV Market

The Easy EV Market

- Owner drives little each day (e.g. < 70 miles)
- Can easily plug-in at night to slow charge
- Fast charging is not needed
- Owner has access to a gas car for long trips

Currently, 8% of cars sold in the U.S. are EV's and if one increased this to 38%, for example, they might pursue the easy EV market.

This would be owners who drive little, do not fast charge, can easily plug in at night, and have access to a gas car for long trips.

Again, these are cases where EV's fit the best, and are therefore the easiest to sell to.

Fast EV Charging

Fast EV Charging Challenges
Requires costly charging station, grid connection, and EV battery system.

Most EV's can fast charge, which means they can fully charge in 30 minutes. This might sound nifty. However, it requires significant grid power, expensive conversion electronics at the charging station, and a more expensive EV battery system.

Also, if a fast charging station is rarely used, which is typically the case, then station equipment-costs-per-charge is high. For this reason, most fast charging stations lose money. And most will not charge in 30 minutes since stations intentionally undersize their equipment to save money.

Charging in 30 minutes is like taking the electrical power from 100 houses and feeding it into one EV battery. This is a lot of power, and requires an expensive grid connection.

Cheap Green Car

There is probably a place for a cheap green car in the U.S.

There are many ways this could happen. One is a low cost car that does not fast charge, and does not have a long range.

Americans typically favor more car for more money. However, a price in the neighborhood of 20 thousand dollars would cause some to reconsider.

U.S. auto-makers might prefer to keep their average selling price high.

Therefore, a new car company might be needed to move this forward.

Solution 6: Improve Gas Car MPG with Tiny Motor and Battery

Climate Solution #6

Improve gas car MPG with tiny motor and battery

If one is looking to improve gas cars, consider exploiting the HEV miracle.

HEV refers to gasoline and diesel-powered cars that include a tiny electric motor that improves fuel mileage by approximately 30%. This adds approximately 1,500 dollars to the initial price of the car; however, this additional cost is paid back within one to three years due to savings at the gas station. This is an example of negative Decarbonization Cost, which is when consumers are paid money to reduce CO_2.

Typical Cars with an Electric *and* Gas Motor

Type	Additional Cost	Electric Motor	Battery Size
HEV	+ $1.5K	20 HP	1.5 kWh
PHEV	+ $12K	100 HP	20 kWh

Gas cars with tiny electric motors are referred to as "Hybrid Electric Vehicles" (HEV) and are often misunderstood due to having a name similar to "Plugin Hybrid Electric Vehicle" (PHEV). The plug-in cost approximately twelve thousand dollars more than the gas car and has a large electric motor that enables it to run exclusively on electricity for 15 to 50 miles.

Alternatively, the non-plugin HEV has a regular-sized gasoline engine. And it has a tiny electric motor and a tiny battery that recovers energy while braking and pushes the car while coasting. Most of the time, cars do not accelerate, and a tiny electric motor can maintain a constant speed.

If one wanted to reduce emissions from new vehicles in a way that is politically feasible, they could enact a law that requires this tiny electric motor be added to gasoline engines in the next generation of each car. Car generations typically lasts five years, so this would kick in for each model within one to five years.

The alternative is to let market forces push HEV forward at a natural pace. However, giving HEV a shove is reasonable if one is looking to reduce CO_2 more quickly.

Solution 7: National Climate Strategy

Climate Solution #7

National Climate Strategy

Many nations are looking for a climate strategy that meets the satisfaction of a majority of lawmakers.

An example is to decarbonize in lowest cost order, and let government economist calculate exactly what this entails.

Decarbonize in Lowest Cost Order

Reasons to Decarbonize in Lowest Cost Order

1) Group II lawmakers require it
2) Increase in costs incurred by factories needs to be kept low
3) Increase in costs incurred by the public needs to be kept low

As mentioned previously, decarbonizing in lowest cost order is likely for three reasons.

- One, Group II lawmakers require it.
- Two, Climate concerns need to outweigh International Competition concerns, which entails minimizing additional costs incurred by domestic manufacturers.
- And three, additional costs incurred by the public needs to be kept below what they are willing to tolerate as one goes through time.

U.S. Climate Strategy (proposed)

U.S. Climate Strategy (proposed)

1) **Electricity:** Do the Green Line via power company requirements.
2) **Materials/Chemicals:** Set up master distributors and tracking systems while decarbonizing electricity.
3) **Transportation:** Reduce the cost of green cars while decarbonizing electricity.

There are roughly three areas that need to be decarbonized. These are electrical power generation, material and chemical fabrication, and transportation. And decarbonizing in lowest cost order determines **when** each of these are tackled at large scales.

Electrical power has the lowest decarbonization costs, and therefore would be tackled first. Also, this would probably be supported by both Group I and II lawmakers who hail from regions that do not produce coal or natural gas.

Materials fabrication, chemical fabrication, and transportation have higher decarbonization costs, and would therefore see large scale decarbonization **after** electricity is decarbonized.

And while decarbonizing electricity, nations can set up non-mandatory master distributors, set up tracking systems for materials and chemicals, and take steps to reduce the cost of green cards.

Solution 8: The Club of Green Nations

Climate Solution #8

The Club of Green Nations

CO_2 emissions from the United States are approximately one-eighth of total and this is causing Senators Kennedy and Romney to ask "What is our global climate strategy?"

In theory, multiple nations could all agree to reduce CO_2, to help themselves, and to help others.

However, in practice, this does not occur.

Most lawmakers throughout the world are not comfortable with requiring their economy to transition to a green economy. Many are concerned about reducing the ability of domestic manufacturers to compete internationally. However, as we noted previously, if decarbonization costs are kept low, this is minimal.

So what can be done globally that is also politically feasible?

The Club of Green Nations (proposed)

In theory, a group of nations could agree to reduce CO_2 in a way that conflicts minimally with other national interests.

The Club of Green Nations (proposed)

- Each member enacts laws that require transitioning to a green economy over not more than 40 years, at a constant rate, at lowest cost, in lowest cost order, with additional costs passed onto consumers.
- Each member sets up the following programs: decarbonization cost tool development, climate policy tool development, moonshot proposal writing fund, tracking system development, and master distributor development.

For example, they might agree to:

> *Enact laws that require transitioning to a green economy over not more than 40 years, at a constant rate, at lowest cost, in lowest cost order, with additional costs passed onto consumers.*

Initially, this would entail building solar farms and wind farms, which have a low decarbonization cost.

Also, they might agree to several programs that cost several million dollars each. This includes decarbonization cost tool development, climate policy tool development, moonshot proposal writing funds, tracking system development, and master distributor development.

Club Participation

Club Participation
From time to time, Green Club members might increase import tariffs from non-members, to encourage them to reduce CO_2.

From time to time, club members might increase import tariffs to non-members, to encourage participation.

Exporters would then compare the additional cost of greener electricity, with the cost of those tariffs, to see if they benefit from membership.

China benefits from cheap domestic coal, and therefore might refrain from joining the club.

However, members would buy solar panels and windmills made in China; therefore China would benefit, even if not a member.

https://www.istockphoto.com/photo/city-night-view-of-nanchang-city-riverside-in-jiangxi-china-gm1292273909-387128654?phrase=china+Drought

At some point, China might observe low water levels in key Chinese rivers, panic, and join the club.

Germany would probably join, since they are already doing similar things.

President Biden would probably want to join too. However, he would need majority support from congress. And to get this, club requirements would need to meet the satisfaction of Group II lawmakers, which is possible.

Summary: The Climate Solution

Summary
The Climate Solution

How Crazy Do We Want Our Planet?

Our planet has experienced a 1 degree Celsius increase relative to 100 years ago, and life seems to move along ok.

However, if the world continued with business as usual, it would probably see a 5 degree increase somewhere between 100 and 200 years from now.

Yet what does a 5 degree increase look like?

Average Temperature		
New York	8.1°C	46.6°F
New Mexico	12.5°C	54.6°F
Difference	4.4°C	8°F

https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/statewide/time-series/29/tavg/ann/5/2022-2022?base_prd=true&begbaseyear=1901&endbaseyear=2000
https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/statewide/time-series/30/tavg/ann/5/2022-2022?base_prd=true&begbaseyear=1901&endbaseyear=2000

The average temperature of New York and New Mexico states differ by approximately 5 degrees. Therefore this would be like transforming New York's forests into the drier terrain found in New Mexico.

Average Temperature		
Germany	8.4°C	47.1°F
Spain	13.3°C	56°F
Difference	4.9°C	8.9°F

https://en.wikipedia.org/wiki/List_of_countries_by_average_yearly_temperature

Germany and Spain also differ by approximately 5 degrees. Therefore, this would be like turning Germany's forests into the parched tundra resembling Spain.

A fundamental question we face is, "How crazy do we want our planet?"

A Quickly Changing Planet is a Bad Planet

In theory, civilization could move to areas that are more suitable. However, this entails a race between a changing planet, and the builders of metropolitan areas. If the planet changed faster than the civilization could build, there would be suffering.

A quickly changing planet is a bad planet.

In other words, a quickly changing planet is a bad planet.

Save the Planet with a Website

A nation typically favors itself, over its future self.

Yet to what extent?

As evidence of climate change increases, real action, such as the Green Line, becomes more likely.

Yet **when** might this occur?

It probably will not occur in the near future without out good climate policy tools overseen by unbiased economists.

It might seem crazy that a few computer programmers are needed to save the planet.

However, this seems to be the case.

The Climate Solution

The Climate Solution	
Economics	Decarbonize at the lowest cost, and in lowest cost order.
Politics	Give swing voters who favor decarbonization what they want.
Priority	Focus on the phone call to the Power Company CEO.
Costs	Develop decarbonization cost websites
Policy	Develop climate policy websites
R&D	Set up proposal writing fund for climate R&D moonshots.
Materials	Set up tracking systems and master distributors for materials.
Global	Set up the International Club of Green Nations

So let's summarize the Climate Solution.

We need to decarbonize at the lowest cost, and in lowest cost order, for multiple reasons, as stated previously.

We need to give swing voters who favor decarbonization what they want.

A big priority is requiring power companies to decarbonize the grid quickly.

We need to develop websites that document decarbonization cost for each so-called climate remedy.

We need to develop websites that explain what happens economically when a nation transitions to a green economy.

We need to set up proposal writing funds for climate R&D moonshots.

We need to develop tracking systems and master distributors for materials and chemicals.

And we need to set up an International Club of Green Nations.

Climate does not need to be Crazy

Ok, so that's it.

That's the climate solution.

In closing, we can do much better if we refocus our efforts.

Section III: Climate Economics

Section III

Climate Economics

We are now going to review climate economics.

Climate Economics #1: Infrastructure Financing

Climate Economics #1

Infrastructure Financing

Most infrastructure is paid for with money borrowed from banks and bonds. Later, these are repaid with revenue generated by the infrastructure. For example, a bank loan might initially fund solar farm construction, while electricity revenue repays the loan over 30 years.

Mortgages Build Up Over Time

Economically, decarbonization is like a nation buying one new house each year, where the house represents all green infrastructure built that year. The nation ends up with one "house" after year #1, two after year #2, etc.

Also, each house has a mortgage. Therefore, the nation pays one mortgage after year #1, two mortgages after year #2, etc. These mortgage payments show up as an increase in the costs of goods and services. And one can calculate this increase in units of dollars-per-person-per-year.

If one decarbonizes in lowest-cost order, each house is more expensive than the previous.

Climate Economics #2: Green Electricity Cost

Climate Economics #2

Green Electricity Cost

Ok, so if we are **replacing**, what is the lowest cost way of getting energy without emitting CO_2?

The national renewable energy laboratory in the United States has several thousand people and they study this, and their findings is summarized in this chart.

Cost is shown on the horizontal axis, and this is saysing

s

s

We'll explain this in further detail in a moment.

Climate Economics #3: Carbon Offsets

Climate Economics #3

Carbon offsets

Many companies want to report they emit little or no CO_2. To do this, they pay organizations to supposedly reduce CO_2 emissions, to offset their own emissions. These are referred to as "carbon offsets", and they often sell for $3 to $5 per metric ton of CO_2 reduced.

Unfortunately, there are many offset schemes that are economically invalid, scientifically invalid, or fraudulent.

For example, if someone is paid to not do tree farming on one parcel of land, to supposedly reduce CO_2, tree farming will be done elsewhere.

Basic Economic Principle

Production satisfies demand.

This is due to lumber production being set by demand. In other words, if one parcel of land is blocked, the home builder will get his 2x4 boards from a different parcel of land.

Climate Economics #4: Corporations and CO_2

Climate Economics #4

Corporations and CO_2

Some companies buy carbon offsets that match their own CO_2 emissions. This is referred to as "net zero," and it is often done to appear more socially responsible. Also, these companies must decide if they want to pay more, and be at real net zero, or pay less and be at less than net zero.

Carbon Offset Example			
Real:	$15/ton	x 10M tons	= $150M
Fake:	$3/ton	x 10M tons	= $30M

For example, a company that emits 10 million tons of CO_2 each year might be able to buy $15-per-ton real offsets for $150M each year, or $3-per-ton fraudulent offsets for $30M. In both cases, they report net zero. However, in the latter case, their profit is $120M higher.

People invest money in corporations to make more money. More specifically, they require company leadership to maximize return on investment. This is our economic system.

The value of a company is proportional to net profit. And if a company spends its own money to reduce CO_2, net profit decreases,

And this conflicts with the company's mandate to maximize shareholder value.

In other words, if a company is under pressure to tackle the climate problem, the CEO's job is to claim net zero at the lowest cost.

Which is another way of saying he or she needs to buy phony low-cost carbon offsets.

We should not expect corporations to tackle the climate problem for two reason.

- One, is they physically do not have the ability to reduce CO_2 with a low decarbonization cost.
- And two, if we push them toward offsets, they will finagle.

Instead, we just need laws that require the power company to decarbonize electricity, and pass additional costs onto the consumers, which are companies and homeowners.

Climate Economics #5: Fossil Fuel Restrictions

Climate Economics #5

Fossil fuel restrictions

So-called environmentalists sometimes advocate restricting the production of carbon-based fuels. For example, they might advocate reducing the number of drilling permits for natural gas, or restricting pipelines. At first glance, this might seem reasonable. However, it does not reduce CO_2 at the lowest cost. Instead, it leads to fuel shortages, high fuel prices, inflation, high-interest rates, and lost money in the bond market.

To decarbonize at the lowest cost, one must build a solar farm or a wind farm *before* reducing the output of the nearby carbon-based power plant. In other words, replace carbon, not block carbon.

Replace carbon, not block carbon

Let's look at an example to see how this works.

Suppose we block carbon and create an oil shortage that causes the price to increase by $10 per barrel. The U.S. consumes 7 billion barrels each year; therefore, this would cost 70 billion dollars each year.

Alternatively, one could use the 70 billion to build solar farms. This would reduce CO2 by 60 million tons a year, and also generate 4 billion dollars' worth of electricity each year.

What would you rather do, spend 70 billion dollars with little benefit?

Or spend 70 billion to reduce CO_2 significantly, and receive 4 billion dollars a year for 30 years?

Creating a shortage is almost always a terrible way to solve a problem.

Creating a shortage that increases price is almost always at terrible way to solve a problem.

Climate Economics #7: Electric Vehicles

Climate Economics #7

Electric Vehicles

In order to decarbonize transportation, one needs to understand a little about electric vehicle economics.

As mentioned previously, EV's are more popular in nations that import oil due to their desire to be energy independent.

So let's look at a nation that exports oil, such as the United States.

U.S. Transportation Decarbonization Scale

First, let's look at U.S. electric vehicles through the lens of Decarbonization Scale.

U.S. Transportation Decarbonization Scale	
10M tons/yr	= 3M vehicles x 3.6 tons/yr
1/500th	= 10M tons/yr ÷ 5000M tons/yr

Approximately 3 million EVs were sold in the U.S. between 2010 and 2022.

Each EV reduces CO_2 by approximately 3 tons a year. Therefore, total CO_2 reduction due to all these EV's is approximately 10 million tons each year.

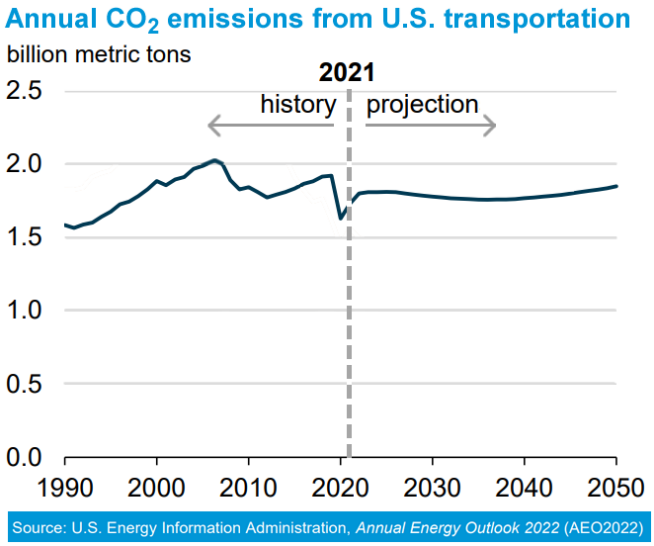
The U.S. emits approximately 5 billion tons each year. Therefore, EV production has only reduced it by 1-part-in-500.

In other words, U.S. transportation currently has a Decarbonization Scale problem.

U.S. Transportation Decarbonization Projection

Ok, so that's past data.

What about the future?



U.S. government economists do not expect the U.S. to decarbonize transportation over the next 30 years, as shown in their projection.

Their outlook is bleak due to EV charging challenges, EV rare earth challenges, high EV costs, cheap domestic oil, and a lack of laws that require green cars.

U.S. Transportation Decarbonization Cost

Now let's look U.S. transportation through the lens of Decarbonization Cost.

This is the number of dollars needed to reduce emissions by one ton of CO_2 when one buys an EV instead of a gas car.

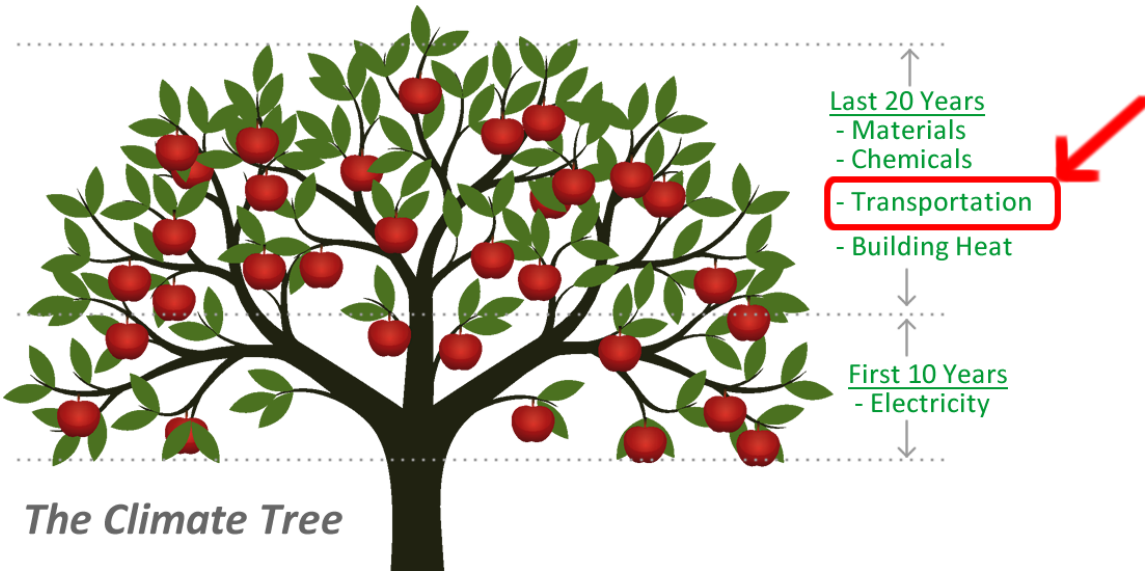
According to the U.S. Government, the average EV cost $0.47-per-mile, the average gas car cost $0.30-per-mile, the average EV emissions is 180 grams of CO_2 per mile, and the average gas car emissions is 420 grams per mile. One can do a little math to calculate decarbonization cost of $690 per ton of CO_2 reduced when one buys an average EV in the U.S. instead of an average gas car. This is much higher than that associated with building a solar farm.

U.S. Decarbonization Costs	
Transportation	$100 to $1000 per ton of CO_2 reduced*
Electrical Power	$10 to $50 per ton of CO_2 reduced

*$691/mt$CO_2$ = (($0.47 - $0.30) / ((425e-6 - 179e-6)))
Reference: https://atb.nrel.gov/transportation/2020/data

In other words, U.S. transportation currently has a Decarbonization Cost problem.

And this is why Group II lawmakers do **not** support government intervention that favors EV's.



Also, this means EV's are higher in the climate tree than electrical power.

Which means the U.S. can ignore large-scale transportation decarbonization while decarbonizing electricity, and still stay on the Green Line.

Climate Economics #8: Reduce CO_2 with Plants

Climate Economics #8

Reduce CO_2 with plants

Our society sometimes uses plants to supposedly reduce CO_2.

Basic Plant Chemistry

Plants absorb CO_2 while living, and they release that CO_2 when they die and decay.

However, basic plant chemistry dictates that plants absorb CO_2 while living, and then release that CO_2 when they die and decay.

To reduce CO_2 with plants, one needs a new plant to last imperium.

In other words, the offspring needs to persist for thousands of years, to continuously keep CO_2 out of atmosphere.

https://www.alamy.com/milan-italy-may-31-2019-bosco-verticale-or-vertical-forest-are-a-pair-of-residential-towers-in-milan-the-buildings-contain-more-than-900-trees-image327629195.html

The building shown here might seem like a beautiful way to reduce CO_2. However, CO_2 is emitted when concrete is made, and the planters shown here require additional concrete. In other words, this building makes the CO_2 situation worse, not better.

Section IV: Climate Politics

Section IV

Climate Politics

We are now going to review climate politics.

Climate Politics #1: Climate Etiquette

Climate Politics #1

Climate Etiquette

Companies that produce fossil fuels have some political power, yet not as much as one might think.

Conservative state Texas produces more wind power than any other state. And conservative state North Carolina is one of the largest producers of solar power.

Carbon companies did not block their green electricity. They are not strong enough.

Carbon Consumers are Stronger than Carbon Companies

Carbon *consumers* are politically stronger than carbon *companies*.

Carbon's political power is mostly derived from its consumers.

People need to get to work in the morning, and they need to cook their chicken in the evening. And this almost always involves fossil fuels.

And if one criticizes fossil fuels, they are criticizing the people that use them, which is practically everybody.

In other words, being negative about carbon is not helpful. Nor is it necessary.

Here's an example. On Monday a guy watches TV using electricity created with coal. And on Tuesday, he does the same, yet the electricity comes from a new solar farm. Does he notice the difference? No.

However, if you criticize the gasoline in his truck, he will get annoyed.

Climate Etiquette

Climate Etiquette

Be nice to fossil fuel producers and consumers *while* transitioning to a green economy.

In other words, to get majority support, consider being nice to fossil fuel producers and consumers, *while* transitioning to a green economy.

Green and Non-Green Can Co-exist Nicely

Let's look at example to get a better sense of how this works.

The U.S state of Texas produces oil, coal, and natural gas. And among all states, it is the largest producer of electricity from wind power, and 2nd largest from solar power.

Texas lawmakers are not negative about oil. They've built a beautiful state with oil money.

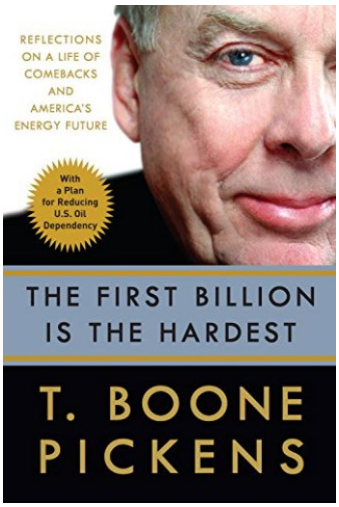
Also, they consider Texas to be an energy state, not a fossil fuel state.

Their strategy is to produce energy over hundreds of years, and evolve as the world evolves. To do this, they diversify. In other words, they produce both green and non-green energy. And if one area decreases in size, workers can move to an area that is growing.

Texans know oil is not going to be around forever, and have responded with diversification, which is reasonable.

Also, they have done this without being aggressive toward fossil fuel companies.

This is smart, because Texans would find that annoying, and then be less inclined to support green initiatives.



https://www.amazon.com/First-Billion-Hardest-Reflections-Comebacks-ebook/dp/B0017SUYWS

It turns out the first wind power pioneer in Texas was Boone Pickens, a man who initially made billions of dollars drilling for oil.

Climate Politics #2: Political Coalitions

Climate Politics #2

Political Coalitions

Decarbonization legislation is often drafted by a political coalition of environmentalist, labor unions, domestic manufacturers, and the automobile industry. At first glance, this might seem reasonable. However, it is fundamentally flawed since these entities focus on their own financial interests, not reducing CO_2 at the lowest cost.

Alternatively, to decarbonize for real, at lowest cost and at large scales, one needs a coalition of lawmakers that benefit from exactly that.

For the most part, these are lawmakers from regions that do not produce coal or natural gas.

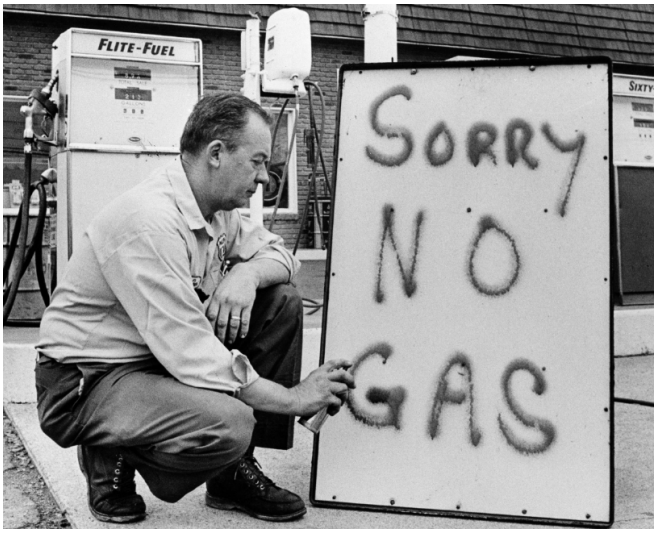
They can add **local** green jobs, while carbon jobs are lost elsewhere.

Therefore, they are more supportive of a green grid.

Climate Politics #3: Energy Security

Climate Politics #3

Energy Security



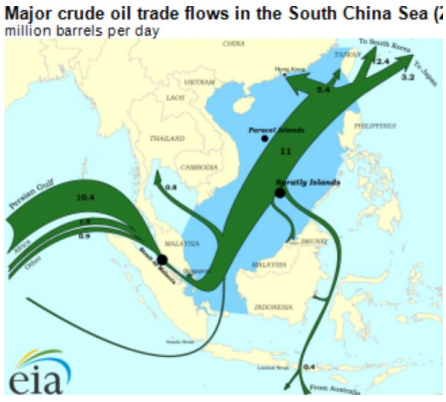
https://www.npr.org/sections/parallels/2013/10/15/234771573/the-1973-arab-oil-embargo-the-old-rules-no-longer-apply

Nations that import fossil fuels are concerned about potential supply disruptions. This is sometimes referred to as Energy Security.

An example disruption is the 1973 oil embargo against the United States. Arab oil producers stopped selling to the U.S. in retaliation for the U.S providing weapons to the Israelis during the Arab-Israeli war. The resulting shortage led to cars waiting in lines at gas stations.

In the 1970's, the U.S. was an oil importer. However, today, the U.S. exports oil due to advances in oil drilling. More specifically, the U.S. does fracking and horizontal drilling in shale rock to better pull oil out of the ground.

For this reason, the U.S. is less concerned about oil supply than oil importers China and Germany.



https://www.eia.gov/todayinenergy/detail.php?id=10671

China receives most of its oil through long ocean trade routes, and they are concerned these might be blocked for some odd reason.

Germany receives fuel from Russia, and they are also concerned about potential, or actual, disruptions.

Energy Security and Climate

Now let's look at how this relates to climate.

Oil importers are more inclined than exporters to support electric vehicles since EV's can often be powered by electricity generated locally.

Percent of Cars Sold that are Electric*

Oil Importers	China	30%
	Germany	32%
Oil Exporters	USA	8%
	Australia	5%

*Reference: https://en.wikipedia.org/wiki/Electric_car_use_by_country

https://english.www.gov.cn/news/topnews/202202/24/content_WS6216e221c6d09c94e48a569e.html
https://en.wikipedia.org/wiki/Electric_car_use_by_country

For example, electric car sales as a percentage of total are approximately 30% in China and Germany, and 8% in the U.S.

Summary

In summary, decarbonization is easier when climate interests align with other interests.

And, when they oppose, one needs to minimize conflict.

And minimizing conflict often entails decarbonizing at the lowest cost.

Document History

This document draws its inspiration from a book entitled “A Plan to Save the Planet” by Glenn Weinreb.

For a free PDF file of this book, visit www.APlanToSaveThePlanet.org/pdf

For a TEDx video summary, search “KIJsu2n5j1w” at YouTube.

For YouTube videos by Weinreb, see www.YouTube.com/@GlobalClimateSolutions

Ownership

To the author's knowledge, the concepts discussed in this document are public knowledge and no patents are pending.

For original files, visit www.APlanToSaveThePlanet.org/strategykitfiles

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Climate Strategy Development Kit

Google Drive with Files www.APlanToSaveThePlanet.org/strategykitfiles

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