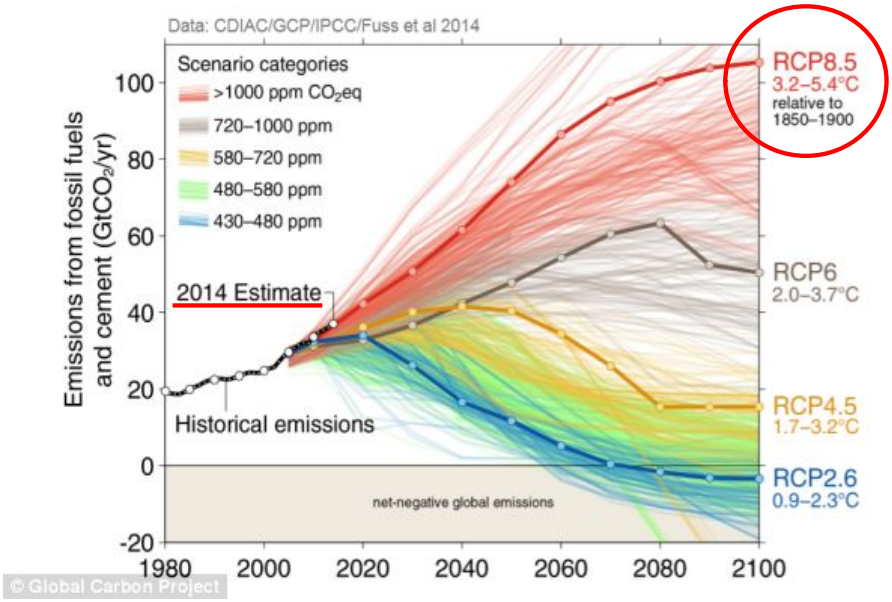
CO_2 Waste Disposal Fee

This is where we are on the atmospheric CO_2, according to the recent IPCC 5th Assessment Report.

The worldwide CO_2 emissions in 2013 were 36.1 Gt. The chart shown below models a full spectrum of scenarios included in the assessment along with a 2014 estimate. Currently, we appear to be tracking on the RCP8.5 trajectory.



This is where that CO_2 came from in 2011 and an associated forecast:

World carbon dioxide emissions by region, IEO2011 Reference case
(Million metric tons carbon dioxide)

Region/Country	2005	2008	2011	2015	2020	2025	2030	2035	Growth Rate (2008-2035)
OECD									
OECD Americas	**7079**	**6926**	**6665**	**6773**	**6924**	**7169**	**7431**	**7772**	**0.31%**
United States	5996	5838	5601	5680	5777	5938	6108	6311	0.17%
Canada	620	595	570	569	582	608	635	679	0.30%
Mexico/Chile	463	493	494	524	565	623	688	782	1.76%
OECD Europe	**4400**	**4345**	**4097**	**4115**	**4147**	**4156**	**4198**	**4257**	**-0.11%**
OECD Asia	**2172**	**2201**	**2112**	**2143**	**2181**	**2224**	**2253**	**2294**	**0.18%**
Japan	1241	1215	1114	1125	1142	1136	1110	1087	-0.44%
South Korea	494	522	539	553	562	597	634	678	1.06%
Australia/New Zealand	437	464	458	466	477	492	509	528	0.63%
Total OECD	**13651**	**13472**	**12873**	**13031**	**13252**	**13549**	**13882**	**14323**	**0.16%**
Non-OECD									
Non-OECD Europe and Eurasia	**2782**	**2832**	**2787**	**2803**	**2767**	**2782**	**2863**	**2964**	**0.21%**
Russia	1645	1663	1651	1648	1607	1603	1659	1747	0.20%
Other	1137	1169	1136	1154	1159	1179	1204	1217	0.23%
Non-OECD Asia	**8359**	**10100**	**11916**	**13238**	**14475**	**16475**	**18238**	**19688**	**2.90%**
China	5513	6801	8381	9386	10128	11492	12626	13441	3.02%
India	1182	1462	1633	1802	2056	2398	2728	3036	3.19%
Other	1665	1838	1901	2050	2291	2585	2884	3211	2.21%
Middle East	**1400**	**1581**	**1743**	**1889**	**2019**	**2199**	**2435**	**2659**	**2.16%**
Africa	**978**	**1078**	**1137**	**1209**	**1311**	**1430**	**1568**	**1735**	**1.93%**
Central and South America	**1011**	**1128**	**1184**	**1287**	**1386**	**1497**	**1654**	**1852**	**2.04%**
Brazil	365	423	468	528	579	644	739	874	2.95%
Other	646	705	716	759	807	853	916	978	1.39%
Total Non-OECD	**14530**	**16718**	**18766**	**20426**	**21958**	**24385**	**26758**	**28897**	**2.32%**
Total World	**28181**	**30190**	**31640**	**33457**	**35210**	**37932**	**40640**	**43220**	**1.44%**

31.6 Gt

The U.S. emissions from Electric Power were 2023 Mmt (2.023 Gt) in 2012. The overall U.S. total was 6363 Mmt (6.363 Gt) emitted, but a 979 Mmt (0.979 Gt) credit for land use is an applied, yielding a U.S net of 5383 Mmt (5.383 Gt).

Power plants accounted for 37.5% of the net, with the land use credit or 31.8% of the overall CO_2 produced.

There are those who advocate that renewables are the way forward, and they are correct, but appreciate neither the scale of the problem, nor the path toward that realization.

Consumption by fuel*

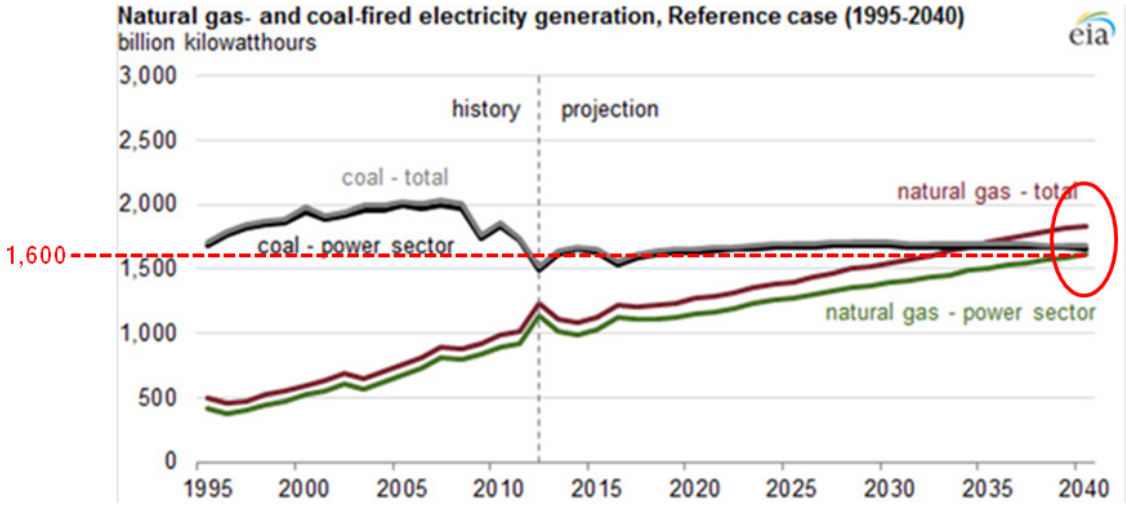
Million tonnes oil equivalent	Oil	Natural Gas	Coal	Nuclear Energy	Hydro electric	Renew-ables	2012 Total	Percent of 2012
US	819.9	654.0	437.8	183.2	63.2	50.7	**2208.8**	**17.7%**
Canada	104.3	90.6	21.9	21.7	86.0	4.3	**328.8**	**2.6%**
Mexico	92.6	75.3	8.8	2.0	7.1	2.0	**187.7**	**1.5%**
Total North America	**1016.8**	**820.0**	**468.5**	**206.9**	**156.3**	**57.0**	**2725.4**	**21.8%**
Brazil	125.6	26.2	13.5	3.6	94.5	11.2	**274.7**	**2.2%**
Total S. & Cent. America	**302.2**	**148.6**	**28.2**	**5.0**	**165.7**	**15.6**	**665.3**	**5.3%**
France	80.9	38.2	11.4	96.3	13.2	5.4	**245.4**	**2.0%**
Germany	111.5	67.7	79.2	22.5	4.8	26.0	**311.7**	**2.5%**
Italy	64.2	61.8	16.2	-	9.4	10.9	**162.5**	**1.3%**
Russian Federation	147.5	374.6	93.9	40.3	37.8	0.1	**694.2**	**5.6%**
Spain	63.8	28.2	19.3	13.9	4.6	14.9	**144.8**	**1.2%**
Turkey	31.5	41.7	31.3	-	13.1	1.6	**119.2**	**1.0%**
Ukraine	13.2	44.6	44.6	20.4	2.4	0.1	**125.3**	**1.0%**
United Kingdom	68.5	70.5	39.1	15.9	1.2	8.4	**203.6**	**1.6%**
Total Europe & Eurasia	**879.8**	**975.0**	**516.9**	**266.9**	**190.8**	**99.1**	**2928.5**	**23.5%**
Iran	89.6	140.5	0.9	0.3	2.9	^	**234.2**	**1.9%**
Saudi Arabia	129.7	92.5	-	-	-	-	**222.2**	**1.8%**
Other Middle East	81.4	39.6	0.2	-	2.2	^	**123.5**	**1.0%**
Total Middle East	**375.8**	**370.6**	**9.9**	**0.3**	**5.1**	**0.1**	**761.9**	**6.1%**
South Africa	26.9	3.4	89.8	3.2	0.4	0.1	**123.8**	**1.0%**
Other Africa	87.7	32.0	6.6	-	20.6	0.9	**147.8**	**1.2%**
Total Africa	**166.5**	**110.5**	**97.5**	**3.2**	**24.1**	**1.4**	**403.3**	**3.2%**
Australia	46.7	22.9	49.3	-	4.1	2.8	**125.7**	**1.0%**
China	483.7	129.5	1873.3	22.0	194.8	31.9	**2735.2**	**21.9%**
India	171.6	49.1	298.3	7.5	26.2	10.9	**563.5**	**4.5%**
Indonesia	71.6	32.2	50.4	-	2.9	2.2	**159.4**	**1.3%**
Japan	218.2	105.1	124.4	4.1	18.3	8.2	**478.2**	**3.8%**
South Korea	108.8	45.0	81.8	34.0	0.7	0.8	**271.1**	**2.2%**
Total Asia Pacific	**1389.4**	**562.5**	**2609.1**	**78.1**	**289.0**	**64.1**	**4992.2**	**40.0%**
Total World	**4130.5**	**2987.1**	**3730.1**	**560.4**	**831.1**	**237.4**	**12476.6**	**100.0%**
	33.1%	**23.9%**	**29.9%**	**4.5%**	**6.7%**	**1.9%**	**100.0%**	

Renewables represented less than 2.0% of the world energy consumption in 2012, while the U.S. alone is slightly higher at 2.2%. Natural gas and coal represented 50% of the U.S. total. We have to deal with these emissions as we transition to the renewables future, and we have a long way to go.

The gas industry and their advocates have “sold” the notion that natural gas is that “bridge” and therefore, the answer.

Natural gas is a fuel. When burned in a power plant it produces huge amounts of CO_2, albeit “½ of coal”, but huge amounts nonetheless.

The U.S Energy Information Agency produced a generation mix forecast for their Annual Energy Outlook 2014. Their Reference Case scenario shown below and indicates coal-fired resources producing approximately 1,600 billion kilowatt-hours, with natural gas-fired units producing at, more or less the similar level.



There are High & Low Resource companion cases, as well.

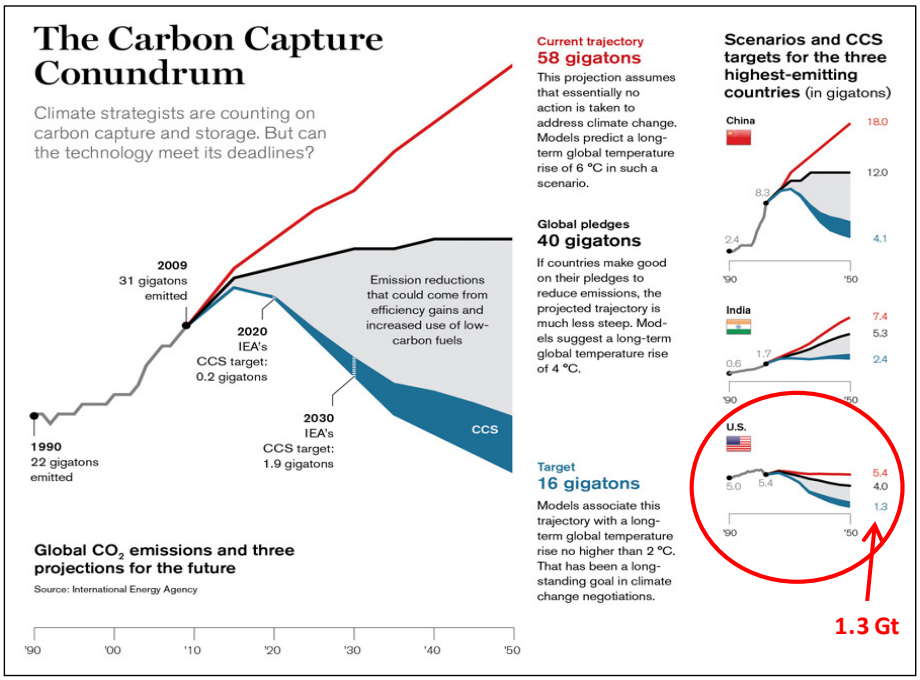
The following table approximates the Gt CO_2/year emissions by type of fuel and in total for each of the three cases. It also indicates the power produced for each case.

The estimates include the EPA emissions targets of 1000 lb-CO_2/MWh for Natural Gas Combined Cycle Power Plants and 1100 lb-CO_2/MWh for Simple Cycle variants, as well as the assumption that these NGCC power plants are "half of dirty coal". Coal is therefore approximately 2000 lb-CO_2/MWh.

In all three cases, the CO_2 emitted remain above 2.0 Gt per year in 2040, under the current & proposed regulatory framework.

	Billion KWh			2040 Gt CO2/year				
Case	Coal	Natural Gas	Total	vs. Reference	Coal	Natural Gas	Total	lb-CO2/MWh
Low Resource	1,750	1000	2750	0.86	1.64	0.48	2.11	1695
Reference	1,600	1600	3200	1.00	1.50	0.76	2.26	1556
High Resource	1,450	2000	3450	1.08	1.36	0.76	2.31	1476

If you believe the Carbon Conundrum, as presented below, the U.S. needs to limit CO_2 output to 1.3 Gt in total in order to meet the 2°C/450 ppm target according the Mike Orcutt, as published in the M.I.T Technology Review.



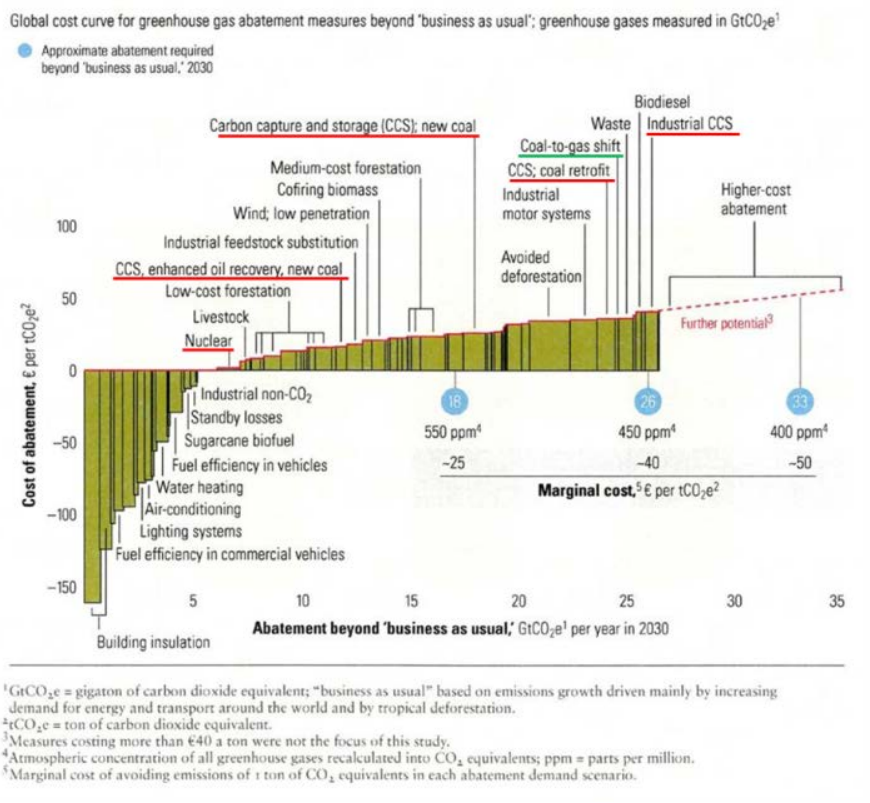
MIT Technology Review – Mike Orcott

Power Plants represented 37.5% of the net CO_2 output in 2012. At this rate, their 2040 contribution would need to be 0.5 Gt.

To make the 0.5 Gt target with any of these EIA 2040 projections, power plants of all types need to capture approximately 80% of their CO_2 emissions.

The “bridge” to a renewables future is Carbon Capture & Storage, not natural gas.

McKinsey Cost Curve, published in 2007, provides a useful roadmap for action. The curve presents a set of actions available to reach 450 ppm, including coal-to-gas conversions, underlined in green, CCS and nuclear, both underlined in red. It is important to notice that the magnitude of these other options dwarf the coal-to-gas shift.



Unfortunately, the current/proposed EPA Power Plant Standards, as described below, have effectively eliminated CCS and nuclear from consideration.

The IPCC AR5 report specifically indicates that many scenarios cannot reach 450 ppm CO_2 equivalent concentration by 2100 in the absence of Carbon Capture and Storage (CCS) and nuclear, reinforcing what the cost curve indicates.

We must address two overriding issues in order to meet any kind of Climate goal assuming there is one:

1. Any regulatory standards must be technology neutral and not distort the competitive balance with "pet ideas" or favored solutions, nor provide dispatch order preference. The market mechanisms must be allowed to work without biasing outcomes.
2. We need to establish a price/cost for CO_2. Today, the price/cost is zero.

There is a built-in assumption that if the EPA is involved, their requirements are likely to be way too stringent on behalf of the public interest. In this case, however, the EPA is implementing a set of regulations that appear to be little more than self-serving.

Based on the emission thresholds established in their recent regulatory initiatives, the EPA, with the help of "the Gas Team", has made it clear that they have no interest in capturing CO_2, most likely because they have no viable plan to deal with CO_2, if captured. Instead, the EPA has written a standard that is so obviously skewed toward natural gas-fired units without CCS, that they have effectively made <u>their</u> CO_2 problem "disappear". They have done very little about <u>our</u> CO_2 problem.

Specifically:

- The EPA levels of 1100 & 1000 lb-CO_2/MWh for Natural Gas Simple and Combined Cycle gas turbine power plants respectively, allow all these plants to be built without doing anything about their CO_2 emissions.
- These regulatory levels are the same levels of the current technology level Natural Gas powered units. They offer that these levels are consistent with the "Best Available Commercial Technology" or BACT, but this is the same thing as saying "Business as Usual".
- Under these standards, a coal-fired power plant would have to be equipped with CCS and would be 4-5x more expensive with half the efficiency of a natural gas-fired power plant without CCS, completely distorting any semblance of a "level playing field". The Gas Team likes this part.
- The EPA would have you believe that the price of natural gas is the underlying cause of the shift away from coal. Although convenient in deflecting criticism, such claims are disingenuous. The regulatory thresholds are the principal drivers.
- Neither the EPA New Source Performance Standard and nor its companion Clean Power Plan make mention of Climate Change, except in the abstract.
- There is no notion of a "CO_2 target" to act as a driving force for improvement.
- In addition, there is no mechanism to establish a cost for emitting CO_2.
- Unfortunately, this "Business as Usual" approach, is only dressed up to look like action and progress, but in that process, the approach is completely undermining the development of CCS and nuclear technologies, the very technologies essential to meeting a 2°C/450 ppm target .
- There is always discussion about driving the cost down with learning curve effects….We are not on the learning curve!

There is broad consensus among those that take Climate Change seriously that one of the most important actions we can take is to establish and allocate the true cost associated with CO_2 emissions.

Two commonly discussed options include:

- Cap and Trade
- Carbon Tax

Cap and Trade comes in two parts. The "Trade" is easy. The "Cap" is arbitrary, political and given to political influence. Does anyone really trust politicians to set "Caps" objectively and in a timely manner?

Really?

There are issues with the Carbon Tax approach, as well:

- What do we call it… and is it a "tax"?
- How is the tax established? By whom?
- Where in the process is the tax assessed?
- In addition, what do we do with the money?

The "Fee & Dividend" is one Carbon Tax approach. This concept returns any tax proceeds, minus any administrative costs, back to individuals and businesses in the form of a dividend or rebate. Politicians

favor this concept for the obvious reasons. Some variations on this theme can also include a disproportionate re-distribution of wealth element.

Unfortunately, the proceeds in the "Fee & Dividend" concept are not used to address the problem. The rebate is not an incentive to drive conservation efforts and in some cases may have the reverse effect. At best, the approach relies on some sort of politically contrived fuel price to influence behavior, but then only indirectly.

The approach is too complicated and requires political involvement to implement. We need to use the money to fix the problem.

I would like to propose an approach where the carbon tax is actually used address the problem directly. The principal elements of the approach are:

1. Implement a "CO_2 Waste Disposal Fee" that actually reflects the cost of dealing with the CO_2 life cycle.
2. Use the proceeds to build and operate CO_2 pipelines to remote locations for underground storage in perpetuity.
3. Federal Government assumes the role of Operator in Perpetuity using some form of a "Cemetery" business model.
4. The "CO_2 Waste Disposal Fees" are assessed where the CO_2 is generated, i.e., the power plant or refinery. These organizations have well document and proven cost models that can serve a basis to objectively assess cost and needed cost recovery fees.
5. The costs will be absorbed into the energy price, either in raw or converted form, and thereby influence both investment decision and consumer choice.
6. "CO_2 Off-take Agreements" for productive use of CO_2 are encouraged and become credit to system cost.
7. There is no such thing as "Clean CO_2". It is just CO_2. The Waste Disposal Fee has to be fuel agnostic…no favorites allowed.
8. The Renewable Energy Portfolio and accompanying dispatch order preferences must be earned in the competitive process, without subsidies or preferences, allowing load factors to be sorted out in the market place.

Professor David Victor, University of California made the comment:

> **"We are the first generation to experience the effects of Climate Change…..**
> **…..and, the last generation to be able to do something about it!"**

I believe that this approach is where we will end up. The only question is how long will it take us to get there and how many other approaches will we have tried first.

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