Accelerating Carbon Emission Reductions:

Local Actions are Required to Effectively Address the 68% of Annual Carbon Emissions that Come from the Buildings and Transportation Sectors

By: Richard Anderson, Director
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SUMMARY

The Conference of Mayors adopted climate policies since 2005, and elevated climate change action to "national emergency" status in 2019. In synch with international action, Conference policies call for urgent reductions in carbon emissions to mitigate global warming. We are already witnessing a growing clean energy transition in the electric utility sector, and the energy future of American cities will be quite different from the current reliance on fossil fuels. Local governments are leading this transition through a host of activities in an all-of-the-above strategy addressing electric vehicles (EVs); distributed energy systems that utilize on-site renewable technologies including energy storage; and a focus on electrifying consumer end-use categories and simultaneously increase utility-consumer energy efficiency and conservation programs.

Getting to that future, and how long it takes, should not rely solely on top-down command and control strategies because the vast majority – 68% – of annual carbon emissions do not come from electric utilities, they come from a wide and diverse set of buildings and transportation end-uses. The timing and success of achieving temperature stabilizing reductions of carbon emissions will be determined by local actions, and that is why there is an urgent need for the federal government to support cities providing the programs necessary to address the variety of emissions reductions possible in each end-use sector.

Accelerating the pace of the clean energy transition and carbon emissions reductions can be bolstered with localized programs like the Energy Efficiency and Conservation Block Grant program (EECBG), (a national program operated by the DOE that provided one-time grants and technical assistance to local governments, states and territories to support a wide variety of energy efficiency and renewable energy activities). Recent experience with the EECBG Program demonstrated the ability of local government to make and guide investment decisions that favor efficiency, conservation and renewable energy, with a long reach into the community to provide the support needed to succeed. The EECBG was successful because the grant program was flexible, recognizing that local actions need to be strategic but also be flexible and match local priorities to address the vast number of hard to get at carbon emission sources in our communities. The EECBG program performed groundbreaking work demonstrating what needs to be done to reduce carbon emissions in our communities and how to do it.

This report provides a review of how the electric power sector and its carbon emissions profile is changing; followed by a discussion of energy end-users and their contribution to annual carbon emissions, and how local action can accelerate carbon reductions. Data published by the U.S. Energy Information Administration (EIA) is used in this review.

Electricity purchased from the grid is increasing slowly, up 3% in 2019 compared to 2017. Fossil fuels used to generate electricity is responsible for one-third of annual carbon emissions. **Fossil fuel use** has only decreased by one-tenth of one percent from 2017 to 2019, however, the amount of carbon emissions has changed because natural gas carbon emissions are about 44% less than coal on average, and natural gas units are growing and replacing coal units. **Coal-fired utilities** had a 23.4% share of electricity generation in 2019, (965 billion kWh), down from a 30.1% share in 2017. Coal commanded a 44% share of electricity generation in 2009. The number of coal-fired power plants has declined 26% from 884 in 2016 to 668 in 2019, and in 2009 there were 1,436 plants. The MW capacity for coal-fired utilities declined 17% during the same period. **Natural gas utilities** had a 38.4% share in 2019 (1,585 billion kWh), increasing from a 31.7% share in 2017. The increase in electricity generation from natural gas is nearly identical to the decline in coal-fired electric generation (7%). The number of natural gas utility generators increased a little over 3% from 5,833 in 2016 to 6,020 in 2019. Electric generation capacity increased about 5.5%. The number of natural gas utilities in 2009 was 5,470.

Clean Energy Fuels (renewables as categorized by EIA) had a 17.6% share of electricity generation in 2019, up from 17.1% in 2017. The major contributors in this category are wind at a 7.1% share and hydro with a 7% share. Solar thermal and photovoltaics experienced the fastest growing technology deployment with a 43% growth in installations from 2016 to 2019. Worth noting, nuclear has a 20% share of electricity generation, and when combined with renewable electricity they rival the natural gas share.

A sectoral analysis of energy end-user groups indicates the single largest share of carbon emissions, some 37%, is from the transportation sector where the consumption of primary fuels for non-electric energy produces more carbon emissions than the entire electric utility sector. The industrial sector contributes 19.6% of annual carbon emissions from primary fuel use.

About 35% of annual carbon emissions come from combined residential (18.7%) and commercial (16.2%) activity. These sources were targeted by local governments in their EECBG energy programs. Roughly half of the grant allocations addressed building energy efficiency and conservation activities that lowered energy bills and retained or created jobs. These EECBG programs grew from a longstanding interest in local government to provide reliable and affordable energy for the city and its activities. Interest in energy efficiency and conservation activities in these sectors date back to the 1970s when national policy was established to boost energy independence and save consumers money. More recent experience with the (EECBG) Program demonstrated the ability of local government to make and guide investment decisions that favor efficiency, conservation and renewable energy, with a long reach into the community to provide the support needed to succeed.

One-time funding of the EECBG Program, some $2.8 billion, was used by local governments on a wide variety of projects and activities that are embedded in our communities: energy efficiency retrofits, financial incentive programs, buildings and facilities, lighting, on-site renewable technology, energy conservation planning grants, reduction/capture of methane, codes and inspections, etc.

An evaluation of the EECBG Program conducted for the Department of Energy and supervised by Oak Ridge National Lab was published in June 2015 and reported positive findings on energy activities funded by the program, including: substantial energy savings; generated electricity from on-site renewable energy projects; produced 62,902 job-year gains; avoided 25.7 million metric tons of carbon emissions; and produced $5.2 billion of total cumulative savings on energy bills, 70% of which were realized by residential consumers, 29% in the public institutional sector, and 1% in the commercial and industrial sectors.

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U.S. Conference of Mayors - Energy Committee

The Conference of Mayors adopted climate policies since 2005, and elevated climate change action to “national emergency” status in 2019, and reiterated support for a clean energy transition. The major objective is to reduce energy related carbon emissions with an overriding goal of limiting global temperature rise to less than 1.5°C - 2.0°C. A major question is – will carbon emission reductions be timely to save the planet from crossing what the United Nations suggests is an atmospheric warming-induced point of no return? Transitioning the national inventory of utility scale electricity generators to a clean energy power sector can effectively reduce about one-third of annual domestic carbon emissions over time. The other two-thirds of carbon emissions are related to non-electric consumption of primary fuels and present a different suite of reduction challenges because the emissions are related to a widely diffuse set of fuel end-user groups identified by the Energy Information Agency (EIA): transportation, industry, residential and commercial. While each of these sectors are more or less reliant on purchasing wholesale electricity from the grid they also emit carbon from on-site activities. The sheer number of activities in these end-use groups involving direct fuel consumption, (e.g., gasoline and electricity for vehicles, natural gas and home heating oil, etc.), suggests that any effective carbon reduction strategy addressing the 68% of annual carbon emissions will have to involve local government, local actions and consumer behavior changes, (recognizing that 70% of the nation’s economy is consumer driven).

A review of key EIA data on carbon emissions from the energy sector and major end-user groups provides a snapshot of progress on the clean energy transition. The electric power sector is responsible for about one-third of annual carbon emissions in 2019 according to the EIA. This report examines three key indicators in this sector that effect carbon emission profiles: (1) the amount of electricity generated by utilities using different fuels or energy sources; (2) the number of active electric generating utilities; (3) the electric generation capacity of active electric utilities.

This report also includes a discussion of the clean energy transition and end-user groups responsible for the other 68% of the annual carbon emissions related to electric use and consumption of fossil fuels for non-electric applications. Addressing the remaining 68% of carbon emissions from the transportation and buildings sectors requires immediate local action, and federal support for new and existing local actions can leverage local investments to quicken the pace. EIA reports 5.1 billion metric tons of carbon emissions in 2019 from four end-user groups and their reliance on electric/non-electric energy use. Carbon emissions reductions strategies that can be applied to these end-user groups requires consumer interface with electric utilities but also with coordinated local government actions that involve public education and consumer energy choices, partnering with the industrial and commercial sectors, increasing local public investments in clean energy infrastructure, and use of local governance authority where appropriate.

I. The Electric Power Sector: *Changing Share of Electricity Generation by Major Fuels and Energy Sources*

EIA estimates that utility scale electricity generation in 2019 was up 3% from 2017. More than a dozen fuels tracked by EIA are used for electricity and power but only five of them are major fuel sources for electricity generation at utilities, (Figure 1, Table 1).

Fossil fuel sources used by utilities to generate electricity are shifting:

- *Fossil fuels* have declined in use by electric utilities by one-tenth of one percent from 2017 to 2019, (62.7% in 2017 and 62.6% in 2019).
- *Coal-fired utilities'* share of electricity generated in 2019 declined 7% from 30.1% in 2017 to 23.4%, (a 23% decline). The long-term trend for coal shows a sharp decrease since 2009 when coal fuel supplied 44% of electricity and was the major electricity fuel source.
- *Natural gas utilities* increased from a 31.7% share as fuel for utility electric generation in 2017 to 38.4% in 2019. The increase in electricity generation from natural gas is nearly identical to the decline in coal-fired electric generation (7%). Natural gas had a 23.3% share of electricity generated in 2009.
    - The shift to natural gas from coal also changes the annual carbon emissions profile which lowers rather than eliminates utility carbon emissions.
- *Petroleum liquids* and coke are still in use by some utility scale electric generators but overall they comprise less than half of one percent of total share, and declined from 21 to 18 billion kWh from 2017 to 2019.

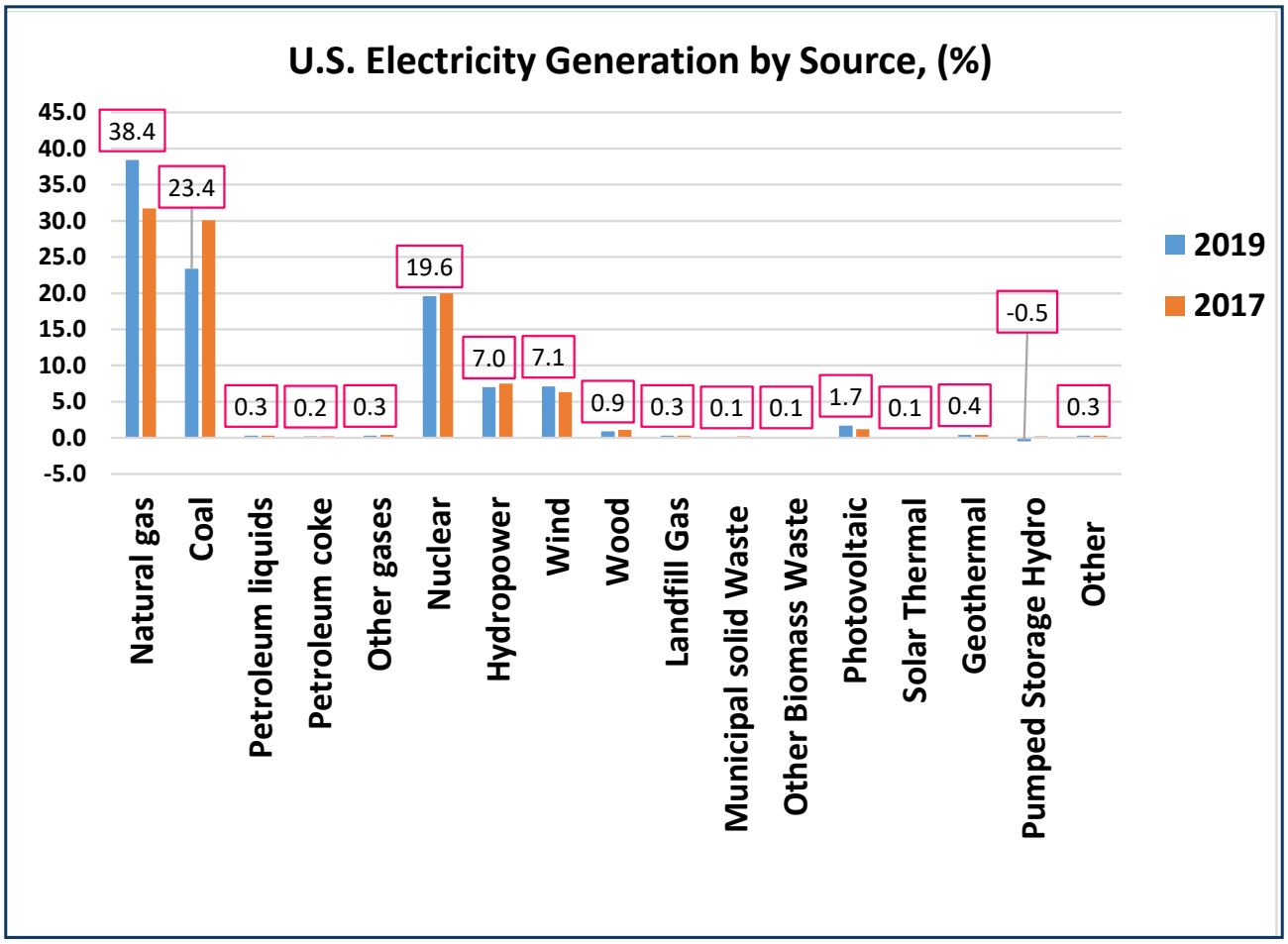
Non-fossil energy source for electricity generation:

- *Non-fossil fuels* have a 37.2% share of utility electricity generation.
- *Nuclear* generated electricity experienced a minor increase from 805 billion kWh in 2017 to 809 billion kWh in 2019; but nuclear accounts for a 20% share of total 2019 electricity generation. Nuclear has maintained a roughly 20% share since 2009.
- *Renewable* electricity generation share grew from 17.1% in 2017 to 17.6% in 2019 accounting for 728 billion kWh.
    - Renewables are driven by wind at 7.1% in 2019 (down from a 7.5% share in 2017); and up from 1.9% in 2009, and conventional hydropower at 7% in 2019, up from 6.3% in 2017, and up from 6.9% in 2009.
- *Solar Thermal and Photovoltaics* electricity is up from 1.4% share in 2017 to a 1.8% share in 2019, (in 2009 the share was less than one-half percent). The reader is cautioned here because this report pertains to utility scale electricity

generators, and as reported above, this technology has a small share of annual electricity domestically. The non-utility solar power installations are growing among end use sectors like single family residences, commercial buildings and other applications. While the amount of electricity generated and consumed by end users from solar sources is relatively minor now the trend introduces important new power sector dynamics: a growing number of consumers are getting a growing amount of their daily electricity independent from the grid using a non-carbon energy source. This trend helps to reduce demand for electricity provided by fossil fuel sources.

- **Combined non-fossil sourced electricity** including nuclear, hydropower and wind supplied 29% of the electricity to the grid in 2009, when coal had a 44% share and natural gas had a 23% share.
- Fast-forward to 2019 and combined nuclear, hydropower and wind had a 33.7% share, while coal had a 23.3% share and natural gas led with a 38.4% share.

Figure 1



Adapted from Table 1 on next page.

Table 1

Utility-Scale Electricity Generation by Fuel Source, 2017 and 2019

Energy Source	2019		2017	
Total – all sources	**Billion kWh 4,127**	**Share of total**	**Billion kWh 4,015**	**Share of total**
Fossil fuels (total)	2,582	62.6%	2,516	62.7%
Natural Gas	1,586	38.4%	1,273	31.7%
Coal	965	23.4%	1,208	30.1%
Petroleum (total)	18	0.4%	21	0.5%
Petroleum liquids	12	0.3%	13	0.3%
Petroleum coke	7	0.2%	9	0.2%
Other gases	13	0.3%	14	0.4%
Nuclear	809	19.6%	805	20.0%
Renewables (total)	728	17.6%	687	17.1%
Wind	295	7.1%	300	7.5%
Hydropower	288	7.0%	254	6.3%
Solar (total)	72	1.7%	64	1.6%
Photovoltaic	69	1.7%	43	1.1%
Solar thermal	3	0.1%	11	0.3%
Biomass (total)	58	1.4%	7	0.2%
Wood	39	0.9%	3	0.1%
Landfill gas	10	0.3%	53	1.3%
Municipal solid waste (biogenic)	6	0.1%	50	1.2%
Other biomass waste	2	0.1%	3	0.1%
Geothermal	15	0.4%	16	0.4%
Pumped storage hydropower	-5	-0.1%	3-6	0.2%
Other sources	13	0.3%	13	0.3%

SOURCE: Electric Power Annual 2019 and 2017, Release Date: October 21, 2020, U.S. Energy Information Administration.
Table 1.1. Total Electric Power Industry Summary Statistics, 2019 and 2018
Table 3.1.A Net Generation by Energy Source: Total (All Sectors), 2009 - 2019

II. The Changing Inventory of Electric Generating Utilities by Fuel Source and Capacity, 2016-2019

Utility scale electric generation facilities are expensive capital investments commonly financed with long-term borrowing and debt service obligations. Thus, changes in new utility project investments combined with decommissioning existing utilities signals what the technology/fuel inventory trend will be over the next 20-30 years and what the likely carbon emissions profile will be.

There appears little change in nuclear and conventional hydropower generators and their capacity (in MW), (Table 2). Changes in the fossil and renewable categories suggest a lower but persistent carbon emissions future from utility scale electricity generation.

Fossil Fuel Electric Utilities:

Coal-fired utilities have the highest concentration of carbon emissions (in general), and the number of electric utility generators declined 26% from 884 in 2016 to 668 in 2019. The MW capacity for coal-fired utilities declined 17% during the same period. The number of coal plants in 2009 was 1,436 with a generator capacity of 338,723 MW.

Natural gas utility generators increased a little over 3% from 5,833 in 2016 to 6,020 in 2019, and electricity generation capacity increased 5.5%. The number of natural gas utilities in 2009 was 5,470.

Petroleum fuels play a minor but persistent role in utility scale electricity generation. Petroleum plays a significant role in annual carbon emissions as a non-electric primary fuel widely consumed in the transportation sector and where oil is used for industrial purposes, residential and commercial space heating, etc.

Renewable Energy:

Wind electricity generation capacity increased 27% from 1,177 generators in 2016 to 1,354 in 2019. Previously, in 2009 there were only 620 utility scale wind electricity generating units. Wind increased by 21.4% in capacity. There is a high degree of government and private developer interest in accelerating significant offshore wind electric generation. It is already the renewables driver since surpassing conventional hydropower that exhibits slow positive growth in electricity generation.

Solar photovoltaics (PV) electric utility scale generators were the fastest growing number of generators at 43.3%, going from 2,237 in 2016 to 3,948 in 2019. In 2009 there were only 110 utility scale generators of solar and photovoltaic units. Solar photovoltaic grew 43.5% in capacity. Non-utility scale use of solar energy is not included in this review, but is a significant future factor in the energy and carbon emission reduction strategies used by local governments including planned distributed energy systems powered by hybrid solar/wind/storage, and residential and commercial solar application. Due to the 90-percent decline in the price of solar PV, there are literally thousands of non-utility scale Community Solar projects underway across the U.S.

Table 2: Existing Capacity by Energy Source

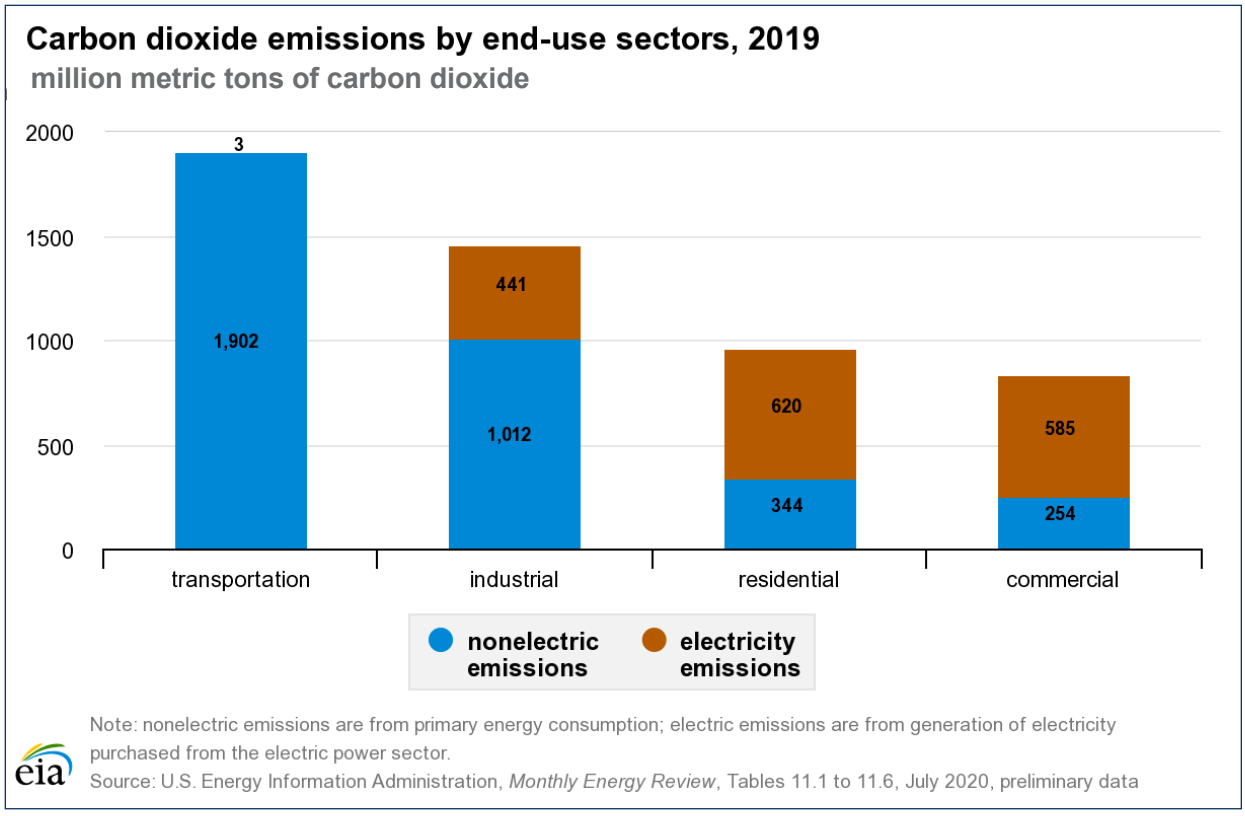
	2019		2016	
	Number of Generators	**Capacity MW**	**Number of Generators**	**Capacity MW**
Coal	668	248,286.3	844	290,426.3
Petroleum	3,691	36,120.0	3,541	39,447.8
Natural Gas	6,020	542,413.2	5,833	512,535.4
Other Gases	91	2,863.3	96	2,759.0
Nuclear	96	102,877.3	99	104,791.1
Hydroelectric Conventional	4,014	79,787.1	4,050	79,376.3
Wind	1,354	104,333.6	1,177	82,048.0
Solar Photovoltaic	3,948	36,013.4	2,237	20,347.3
Solar Thermal	19	1,774.6	19.1	1,774.6
Wood and Wood-Derived Fuels	333	9,519.1	367	10,163.7
Geothermal	172	3,849.3	195	3,804.6
Other Biomass	1,917	5,382.7	1,960	5,829.6
Hydroelectric Pumped Storage	153	21,871.3	153	21,643.3
Other Energy Sources	255	2,825.9	153	2,236.3
Total	22,731	1,197,917.1	20,724	1,177,183.3

SOURCE: Adapted from - Electric Power Annual 2019, Table 4.3 Existing Capacity by Energy Source, 2019 (Megawatts) U.S. Energy Information Administration

III. Carbon Emissions and End-User Groups - 2019

The EIA reports an estimated 5.1 billion metric tons of carbon dioxide emissions in 2019 from four major end-use sectors; and that information is further quantified by emissions related to electricity and non-electric energy consumption, (Figure 2). Carbon emissions related to electricity (for example - purchase of wholesale/retail electricity from the grid) makes up about a third of 2019 annual carbon emissions, contributing 1.6 billion metric tons, and residential (620 million metric tons, or MM tons), commercial (585 MM tons) and industrial (441 MM tons) sectors are responsible. An estimated 3.5 billion metric tons of annual carbon emissions (68%) are related to non-electric primary fuel consumption activities, mostly in the transportation and industrial sectors (a combined 2.9 billion tons). The residential and commercial sectors are responsible for about 598 MM tons of carbon emissions from non-electric fuel uses.

Figure 2



Carbon Emissions and Electric Utilities

Changes in the electric utility inventory and their energy sources impact some of the one-third of annual anthropomorphic carbon emissions from this sector. EIA estimates that in 2019 the electric power sector accounted for about 37% of total U.S. primary energy consumption and produced 32% of total U.S. energy-related carbon emissions. The larger share of annual carbon emissions, an estimated 68%, are related to energy consumption activities for non-electric uses. The EIA provides 2019 estimates of associated annual carbon emissions from utilities and those from primary fuel consumption – non-electric carbon emissions. These differences –electric vs. non-electric carbon emissions – are reviewed below to provide quantitative perspective.

Fossil Fuels:

Coal: Coal is currently the dominant carbon emissions source in electric utilities and accounts for 60% of electric power sector carbon emissions, therefore, coal used by electric utilities contributes 19.2% of total carbon emissions: (32% multiplied by 60% = 19.2%). EIA estimates total annual carbon emissions from coal across all four end-use categories (add transportation, residential, commercial and the non-utility electricity generation by industrial users) raises the 2019 estimated annual carbon emissions from coal to a 21% share.

The amount (kWh) of coal-fired electricity generation, the number of active coal-fired utilities and their electricity generation capacity is declining. Reliability concerns in the wholesale electricity market that powers the economy still favor fossil fuels and are supported by the Federal Energy Regulatory Commission (FERC) in rulings and policies overseeing the nations' grid and power transmission. Carbon emissions from coal can be reduced by alternative fossil fuels such as natural gas that generates about 56% (117 pounds per million Btu) of carbon emissions than average coal use generating 208 lbs/MMBtu, (Table 3). The carbon emissions from coal-fired utilities is changing – declining – right at the time of this writing, and those reductions on the part of utilities to switch fuel sources and develop utility scale renewable energy continues to mark progress in the effort to reduce domestic carbon emissions to limit global temperature rise.

Table 3

	Pounds of Carbon Dioxide emitted per million Btu
Coal (anthracite)	228.6
Coal (bituminous)	205.7
Coal (lignite)	215.4
Coal (subbituminous)	214.3
Diesel fuel and heating oil	161.3
Gasoline (without ethanol)	157.2
Propane	139.0
Natural gas	117.0

SOURCE: FREQUENTLY ASKED QUESTIONS (FAQS),
How much carbon dioxide is produced when different fuels are burned?, EIA, https://www.eia.gov/tools/faqs/faq.php?id=73&t=11

Natural gas accounts for 38% of the electric utility sector carbon emissions and 12.2% of annual carbon emissions across all four end-user groups. While there are considerable and quantifiable carbon reduction benefits from switching to gas from coal, 44% lower carbon emissions, concern has been expressed that long-term investments in natural gas-fired electric utilities commits resources to continued carbon emissions due to the finance and debt service obligations that last 20-30 years. The clean energy transition faces a growing debate over a no-carbon litmus test, and the role of natural gas as a "bridge" fuel. The argument in current policy for reliable electricity is a powerful one; and natural gas proponents point to the lower than coal carbon emissions and the potential of technology advances in carbon capture at natural gas utilities as justification for continued use of the fossil fuel. Proponents stress the importance of reliability of natural gas over intermittency of renewable electricity. Opponents counter that new battery or energy storage technology is emerging, deployed and demonstrated to be effective, and can bridge the gap in reliability by effectively addressing intermittency. Local and State governments like New York City and California, and indeed a growing number of cities and states, are imposing restrictions or bans on natural gas use, such as adopting local ordinances to ban new gas hookups.

Fossil Fuel and Clean Energy Fueled Electricity

Clean energy fuels include a mix of non-carbon energy sources like hydropower, geothermal, wind and utility scale solar PV, and carbon containing fuels such as biomass, landfill gas and municipal solid waste to energy technology and others. The carbon based fuels emit carbon dioxide and other contaminants when utilized via combustion processes to generate electricity, steam or heat. The EIA estimates of electricity generation and the inventory of capacity suggests these are minor but not negligible carbon emission sources. These energy generators are subject to Clean Air Act standards, are regulated via permits (state/federal) and employ operations and combustion controls to limit emissions. Municipal waste combustors, for example, continue to produce lower emissions of standard air pollutants per Btu than coal- or natural gas-fired electric utilities. The resulting carbon emissions are relatively small compared to the emissions generated from the larger utilities.

Carbon Emissions and Primary Fuel Consumption for Non-Electric Energy Uses

Electric utilities account for 32% of annual carbon emissions, the other 68% of annual carbon emissions identified by EIA are related to fuel consumption for non-electric activities among the four end-user groups, (Table 4, adapted from Figure 2 above).

The EIA estimates that 46% of U.S. energy related carbon dioxide emissions are from petroleum fuels across all end-use groups. About 36.8% of annual carbon emissions are related to the *transportation sector.* There is growing consensus that electric vehicles (EVs) are a critical solution that can achieve substantial carbon reductions in a much shorter period than waiting two or more decades for fossil fuel electricity utilities to amortize long-term debt and be decommissioned. Change in EV use spurs the demand for charging infrastructure (especially major transportation corridors), but local government needs a financial stimulus to boost financing and deployment of charging stations and provide incentives to consumers to switch to EVs. An effort of this magnitude (phasing out use of internal combustion vehicles) can yield substantial carbon emission reductions in a short period since consumers change vehicles every 9-14 years on average. Carbon emissions associated with EVs occur at the electric utility, and transitioning to low- or no-carbon energy sources serves to attenuate current and future EV carbon emissions.

The *industrial sector* generates an estimated 28% of domestic carbon emissions in 2019, about 70% of that amount is related to non-electric fuel consumption and 30% related to electricity purchase from the grid. This sector is diverse and includes independent power producers and organizations that generate their own steam power, electricity or combined heat and power plants to provide energy for manufacturing and building power load.

The *residential sector* accounts for an estimated 964 million metric tons (18.6%) of carbon emissions in 2019. Fuels used in this sector for electrical purposes makes up 64% of the total and their associated carbon emissions can be addressed through energy efficiency and conservation programs directly with utilities, and by installing residential unit renewable solar retrofits. A little more than a third of annual carbon emissions from this sector can be addressed by the household in the choice of fuels for space and water heating. Consumer financial incentives and technology rebates are especially helpful in changing consumer carbon emissions contributions.

The commercial sector accounts for an estimated 839 million metric tons (16.2%) of carbon emissions in 2019. 70% of those carbon emissions are related to electricity purchased from the grid, and 30% result from non-electric fuel consumption. The non-electric fuel uses in this category are similar to those in the residential sector; space and water heating, etc. This sector can increase carbon emission reductions through energy efficiency and conservation programs, and fuel switching at the consumer level and the utility level. Both the residential and commercial sectors at the local level can benefit from solar installations and distributed energy systems. Additionally, appliance efficiency standards, building energy efficiency codes, and weatherization retrofits have proven effective in reducing energy demand.

Table 4: 2019 Annual Carbon Emissions by End-Use Sector

	Transportation	Industrial	Residential	Commercial	Totals
	Million Metric Tons of Carbon Emissions				
Electric	0	441	620	585	1,646
Non-electric	1,902	1,012	344	254	3,512
	1,902	1,453	964	839	5,158
	Percent of Annual Carbon Emissions 2019				
Electric	0.0	8.5	12.0	11.3	31.9
Non-electric	36.9	19.6	6.7	4.9	68.1
	Percent of Electric vs. Non-Electric Energy by Sector				
Electric	0.0	30.4	64.3	69.7	na
Non-electric	100.0	69.6	35.7	30.3	na

SOURCE: Adapted from Figure 2.

IV. Clean Energy Transition and Non-Electric Energy Carbon Emissions

Strategies to limit global warming through domestic actions must address the one-third of annual carbon emissions from the electric utility sector. The larger 68% of annual non-electric carbon emissions must be addressed at the local level because of the diffuse direct and indirect emission sources in our communities, our homes, offices and apartments, government buildings, street lighting, our cars and trucks and busses, appliances and growing "plug-load", on and on. Top-down command and control models lack the flexibility needed to address the hard to get at carbon emission sources in these carbon emissions end-user groups.

A sectoral analysis of energy end-user groups indicates the single largest share of carbon emissions, some 37%, is from the transportation sector where the consumption of primary fuels for non-electric energy produces more carbon emissions than the entire electric utility sector, (Table 4). The industrial sector contributes 19.6% of annual carbon emissions from primary fuel use.

About 35% of annual carbon emissions come from combined residential (18.7%) and commercial (16.2%) activity. Many of the carbon sources in these sectors, and the public sector, began energy efficiency and conservation activities dating back to the 1970s to boost energy independence and save consumers money. More recent experience with the Energy Efficiency and Conservation Block Grant (EECBG) Program demonstrated the ability of local government to make and guide investment decisions that favor efficiency, conservation and renewable energy, with a long reach into the community to provide the support needed to succeed. The EECBG is a national program operated by the U.S. Department of Energy (DOE) from 2009 to 2015 that provided grants and technical assistance to local governments, states and territories to support a wide variety of energy efficiency and renewable energy activities. It was funded by Congress in the American Reinvestment and Recovery Act (ARRA or Recovery Act) and was a one-time program.

One-time funding of the EECBG Program, some $2.8 billion, was used by city and county governments on a wide variety of projects and activities that are embedded in our communities: energy efficiency retrofits, financial incentive programs, buildings and facilities, lighting, on-site renewable technology, energy conservation planning grants, reduction/capture of methane, codes and inspections, etc. These are the hard to get at carbon emission sources in our communities, and the EECBG program performed groundbreaking work demonstrating what needs to be done and how to do it.

An evaluation of the EECBG Program conducted for the Department of Energy and supervised by Oak Ridge National Lab was published in June 2015 and reported positive findings on energy activities funded by the program, including:

- Energy savings and renewable generation from EECBG projects produced a combined attributable energy savings from all EECBG activities of 409 million source MMBtu for the 2009 to 2050 period.
- EECBG generated 4.2 MMBtu from on-site renewable energy projects.
- EECBG produced a net total job gain of 62,902 job years.
- EECBG avoided 25.7 million metric tons of carbon equivalent due to energy savings and renewable generation.
- EECBG saved $1.7 billion in social costs of carbon due to energy savings alone and an additional $62 million in social costs avoided from displaced energy as a result of renewable generation.
- Bill Savings and cost-effectiveness – EECBG produced $5.2 billion of total cumulative savings on energy bills, 70% of which were realized by residential consumers, 29% in the public institutional sector, and 1% the commercial and industrial sectors.