To EV or not EV, that is the question

According to a table of general USA electrical consumption provided by EIA (next page), nearly 60% of electricity is still generated with fossil fuel, split almost evenly between coal and natural gas, with natural gas having an edge. This is for Y2021, in quadrillion BTUs (odd units, in my opinion). Since there are 2.931 X 10^8 MWh of energy in 1 quadrillion BTUs, I have done the conversion to tWh.

So, looking at the table, about 4115 tWh of electricity was produced in 2021, or an average power of 469 gW. Gasoline holds about 32,317 MJ/m^3, (33.98 kWh/gal) and we use about 143 billion gallons a year in the US, so that is 33.98 x 143 x 10^9 kWh worth of energy. The cars that burn it get at best 30% efficiency of that energy, say 25% , so is an equivalent mechanical work of 969,895 gWh. You can work backwards with an EV along the same line of reasoning, where EV efficiency is 90%, and line losses between 5% and 8%. So, the amount of electricity needed to be supplied from generation is 969,895/(0.9 x 0.92) gWh, or 1.2 tWh. This comes out to 134 gW average power. We now do 469 gW, more or less, so 134 / 469 = 28%, which means we would need to step up power by 28% to power EVs.[1]

Since about 60% of that power is now made from coal and natural gas, you can further go back up the efficiency chain all the way back to the combustor at the power plants. The table shows about 37% efficiency overall (including non-fossil fuel sources; some combined cycle fossil fuel plants can get as high as 60%). The other sources (nuclear, hydro, and alternative) presumably have higher efficiencies, but not shown separately here, so that implies an optimistic fossil fuel plant efficiency of 37%. 0.9 x 0.92 x 0.37 = 0.31 EV efficiency, which is virtually the same as the ICE alternative. Since this EIA data shows 58.1% coming from fossil fuel sources, a better estimate might use a weighted average of 1 X (1 – 0.581) + 0.37 X (0.581), or 0.634. Using this factor times the EV estimated efficiency of 0.9 X 0.92 gives 52.5% efficiency back to the fundamental energy sources (e.g. coal, sun, gas, etc.). This is a 69% improvement, but does it justify a complete revamp of the transportation system?

Installed power of wind and solar would be considerably more than 28% (that is, 134 gW), because the utilization factor is low (solar can't ever be better than 0.5, for example; it's more like 0.1 or 0.2). As a rough estimate, if a typical wind generator is 5 MW, that implies at least 134 gW/5 MW number of units required, or 26,800 of these things additionally, at a bare minimum. Assuming they're spaced about 3 or 4 acres per 5 MW machine, that's about 167 mi^2. That is about a 13 mi by 13 mi square, but of course they won't all be bunched up like that, and certainly this is a bare minimum number, since there is no utilization factor applied. Admittedly, this aspect certainly should be matched to what is currently done with land to extract oil and gas.

Two other things to consider is the astronomical number of batteries required (there is something on the order of 290 million cars registered in the US now), and the yet unsolved problem of energy storage and stability in an electric grid with no fossil fuel plants in it (nor nuclear, since it is not considered "green", whatever that is). Probably technically feasible, but does it achieve its goal, which seems to be to reduce CO_2 in the air? It's the classic action of coming up with a remedy for a specific problem, without considering all the other effects, some of which are not knowable beforehand.

It might be wise to consider EVs might be a good solution for a specific locale, say population dense metropolitan areas. But why does the media never publicize an analysis like this one?

[1] As details come out about ramifications of EVs, we could expect a huge backlash if everyone was told to cut back 28% on electricity use so they could power EVs instead. Especially if told to do so by 2030, 8 years from now.

U.S. electricity flow, 2021 https://www.eia.gov/totalenergy/data/flow-graphs/electricity.php
quadrillion Btu

Sources: U.S. Energy Information Administration (EIA), Monthly Energy Review (April 2021), Tables 7.1, 7.2a, 7.3a, 7.6, and A6; and EIA, Form EIA-923, "Power Plant Operations Report."

	10^{15} BTU	subtot		dbl check				tW-hr	subtot
consumption of coal for electricity generation, all sectors	9.483419		43.7%					2,779	
consumption of natural gas for electricity generation, all sectors	11.93766		55.0%					3,499	
consumption of petroleum for electricity generation, all sectors	0.203038		0.9%					60	
consumption of other gases (1) for electricity generation, all sectors	0.066471		0.3%					19	
consumption of fossil fuels for electricity generation, all sectors		21.690585		21.69059	58.1%	<= fossil fuel portion			6,357
consumption of nuclear electric power for electricity generation, all sectors	8.129062				21.8%			2,382	
consumption of renewable energy for electricity generation, all sectors	7.346143				19.7%			2,153	
consumption of other (2) energy for electricity generation, all sectors	0.180806				0.5%			53	
total consumption of energy for electricity generation, all sectors		37.346597		37.3466		37.6%	<= efficiency		10,945
conversion losses from energy consumed for electricity generation	22.60287			22.60287				6,624	
electricity gross generation, total, all sectors	14.74373			14.74373					4,321
electricity plant use (3)	0.701502							206	
net generation of electricity, total, all sectors	14.04222			14.04222					4,115
electricity transmission and distribution losses (4) and unaccounted for (5)	0.766371					5.5%	<= losses	225	
net imports of electricity	0.134178							39	
total electricity end use, all sectors	13.41003		13.41003						3,930
electricity retail sales to the residential sector	5.038052							1,477	
electricity retail sales to the commercial sector	4.520155							1,325	
electricity retail sales to the industrial sector	3.366953							987	
electricity retail sales to the transportation sector	0.021808				tot losses			6	
electricity direct use (6)	0.463063			plant & losses	35.5%			136	
				90% EV	32.0%				469.469