

# Renewable Energy in Ohio's Electricity Future

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The discredited Ohio HB6 should be repealed and replaced. The replacement energy policy legislation should be transparent to the community and outline ways for Ohio to increase renewable energy for electricity to reduce global warming. The following outline provides information to inform this recommendation:

1. Ohio only generates 2% of its electricity from renewable energy sources compared with the 18% national average. Ohio generates 82% of its electricity from fossil fuels compared with 62% national average.
2. Renewable energy cost is comparable to natural gas before considering environmental impacts and lower after including environmental and social costs.
3. There are many significant fossil fuel emissions from directly burning fossil fuels to generate electricity. These include carbon dioxide (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>) and nitrogen oxide (NO<sub>x</sub>) that damage the environment or are harmful to humans.
4. After implementing carbon sequestration technologies to neutralize the carbon footprint, the cost of fossil fuels is significantly higher than renewable energy.
5. Cadmium-Telluride vs Silicon Solar Panels.
6. Fossil fuel extraction and transport add another level of environmental degradation and damage. This pollution is not included in the fossil fuel costs.
7. Methane – 84 times more potent than carbon in global warming
8. Renewable energy should be a larger part of the Ohio electric energy future. Repeal and replacing the discredited HB6 should include community transparency.

## 1. Breakdown of the 2018 sources for electric energy for the US and for Ohio (Source -US Energy Information Agency)

Electric Energy Source	US	OH
Natural Gas	38%	29%
Coal	24	51
Petroleum		2
Sub-Total Fossil fuels	62%	82%
Hydroelectric	7%	0
Wind	8%	
Solar	2	
Biomass	1	
Subtotal Renewable	18%	2%
Nuclear	20%	16%
Total	100%	100%

Please note that Ohio only has 2 % renewable energy as a source for electricity compared with a national average of 18%. An increase in renewable energy in Ohio will create Jobs (Ohio University Study 2020)

## 2. Renewable vs. Fossil Fuel Costs

Global levelized cost of generation (US\$ per MWh)

Wind onshore	Wind offshore	Solar utility	Solar resid.	Geoth.	Nuclear	Coal	CCG	Gas
28-54	64-115	32-42	151-242	69-112	118-192	33-152	44-68	150-199

November 2019 Lazard Investment Bank research – utility scale solar along with onshore wind are comparable to fossil burning fuels coal and natural gas. This table does not account for the 1.) pollution and health impacts on the vulnerable populations; 2.) the carbon release impact on the environment (global warming); and 3.) the environmental destruction from extracting fossil fuels (such as fracking, drilling, spills, and coal mountain top removal. The carbon fossil fuel industry imposes a cost on society. The most vulnerable are the poor and future generations that do not have a voice. Technology advances will continue to increase solar panel efficiency and decrease costs.

## 3. Fossil Fuel Emissions

The next graph details Ohio 2018 emissions from electric power generation compiled by the US Energy Information Administration. It does not include pollution from extraction and transport of fossil fuels.

### Fossil Fuel Ohio 2018 Emissions

Sulfur dioxide (short tons)	116,311
Nitrogen oxide (short tons)	66,805
Carbon dioxide (thousand metric tons)	78,051
Sulfur dioxide (lbs/MWh)	1.8
Nitrogen oxide (lbs/MWh)	1.1
Carbon dioxide (lbs/MWh)	1,361

Sulfur dioxide and Nitrogen oxide cause health issues and carbon emissions cause global warming.

#### 4. Comparable electric energy cost after carbon sequestration

The carbon emitted through burning fossil fuels may be captured and sequestered but it is costly. A developing technology - Carbon Capture and Storage - CCS removes Carbon from burning fossil fuel for electric generation. The chart below is from the US Department of Energy 2019 Energy Outlook. The LCOE – Levelized Cost of Energy includes all costs for energy source from construction to (end of useful life) removal. It shows that carbon fuels with CCS technology are significantly more expensive than renewable energy (solar or onshore wind.) (Note prior study was cost per MWhr so conversion factor to cost per Kilowatt kWhr is to divide by cost per MWhr by 1000. Utility bills are denominated in kWhr.)

Power Plant Type	Cost (LCOE) \$/kW-hr
Coal with CCS	\$0.12-0.13
CC Natural Gas	\$0.043
CC with CCS	\$0.075
Nuclear	\$0.093
Wind onshore	\$0.037
Wind offshore	\$0.106
Solar PV	\$0.038
Solar Thermal	\$0.165
Geothermal	\$0.037
Biomass	\$0.092
Hydro	\$0.039

Adapted from US DOE<sup>2</sup>

#### Pollutant Damage

Carbon Capture and Sequestration from burning fossil fuels does not remove pollutants sulfur dioxide nitrogen dioxide that cause ozone, acid rain, hazy skies and nutrient pollution in water bodies. These pollutants can cause asthma and respiratory infections and are more harmful to children, the elderly and individuals with preexisting conditions.

#### 5. Cadmium-Telluride vs Silicon Solar Panels

Cadmium-Telluride thin film solar panels are about 5% of the solar panels currently in use and are toxic substances that are non-threatening when sealed in glass in solar panels but toxic during manufacturing or disposal of the panels. Silicon is essentially beach sand and not toxic. Processes are in testing to recycle up to 90 % of silicon solar panels after completing a useful life of 25-30 years. Efficiency for solar cells is increasing and normally is in a range from 10% to 25%. New technology will continue

to increase the efficiency and cost per MWh will continue to decline. (Also consider that fossil fuel plants also include construction and decommission costs.

### 6. Fossil Fuel Extraction and Transport

Natural gas drilling, fracking and coal mining (underground and surface) cause significant pollution and environmental damage. An example of fossil fuel extraction environmental impact is (Source: Research by The Environment Ohio Research and Policy Center):

Fracking in Ohio 2005 -2015

Fracking Wells	1,594
Hydrochloric Acid	105.5 million lbs.
Methanal	1,942,000 lbs.
Wastewater	313,000,000 gallons
Water	7,717,000,000 gallons
Methane	136,000,000
Land use	9,118 acres

Wastewater is often injected into the ground and could cause unknown problems for future generations. Not all environmentally dangerous chemicals used in fracking are disclosed so this graph is incomplete. When these chemicals are injected into the ground there is potential to damage future generations. Coal extraction with slag pools and mountaintop mining are detrimental to the environment. There are many environmental accidents as a result of improper handling of waste products from mining and extraction processes.

### 7. Methane

Natural Gas is 95% methane. Methane is 84 times more potent than carbon dioxide in causing global warming. There is leakage of methane-natural gas while fracking and transporting. Natural gas is used as a supplemental electric energy source and when firing up and turning off natural gas plants there are higher levels of methane pollution.

## 8. Summary

- Renewable energy (solar/wind) is less expensive, causes less environmental damage (no carbon emissions) and does not emit harmful pollutants (SO<sub>2</sub> and NO<sub>x</sub>).
- Technical developments in solar panels will cause an increase in efficiencies driving down the future cost for renewable power.
- The need to be carbon neutral will increase demand for renewable energy in Ohio. Renewable energy in Ohio will create jobs.
- Renewable energy is not sufficient to completely replace fossil fuels at this time. Fossil fuels will remain in the mix but at a lower percentage.
- Renewable energy should be a larger part of the Ohio electric energy future to reduce carbon emissions needed to reverse global climate change.
- Repealing and replacing the discredited HB6 should include a commitment by Ohio for community transparency in the process.