IOWA, A RENEWABLE ENERGY JUGGERNAUT: WIND AND SOLAR ECONOMIC IMPACTS 1992-2025

Produced for:

Iowa Conservative Energy Forum

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Iowa, a Renewable Energy Juggernaut:
Wind and Solar Economic Impacts, 1992-2025

Preface

This report was prepared for Iowa Conservative Energy Forum and is intended to estimate the economic impact of Iowa's wind and solar energy expansion since 1992 using commercially and widely accepted IMPLAN multipliers. Findings remain the sole property of Iowa Conservative Energy Forum and may not be used without prior approval of this organization. This study, while funded by Iowa Conservative Energy Forum, was developed independently of this organization.

Specific Goals of the Study are:

- Compare and contrast Iowa's development of wind and solar electricity development to that of its neighbors, and to that of the nation. Iowa has experienced a surge in utility-scale solar investments during the past few years; however, the industry is still in development with several projects in the pipeline. Thus, to understand the impact of both the construction and operational phases of Iowa's solar investment, this study uses 2025 as a more appropriate representation of Iowa's solar electricity production relative to the US and to Iowa's neighbors.
- Provide a comprehensive analysis of the economic impact of construction and operation of wind and solar electricity development on Iowa and its counties.
- Quantify the spillover effects in terms of impacts by industry of wind and solar energy development in the state.
- Estimate state and local tax collections produced by wind and solar energy development in the state.

This report was produced independently by the principal investigators. Any errors or misstatements contained in this study are solely the responsibility of the authors. Please address all correspondence to: Dr. Ernest Goss, Scott Strain, and Monique Devillier, Principal Investigators[1]

Goss & Associates, Economic Solutions[2]
Voice-(402) 598-3198
E-mail - ernieg@creighton.edu www.gossandassociates.com
600 17th Street Suite 2800 South
Denver, Colorado 80202-5428

[1] Copies of the principal investigators' biographies are contained in Appendix D.

[2] This study was completed independent of Creighton University. Creighton bears no responsibility for findings or statements by Ernest Goss or Goss & Associates

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Glossary

Correlation coefficient	A correlation coefficient measures the association between two variables or factors. A correlation coefficient varies from -1.0 to + 1.0. A correlation coefficient of 0.0 indicates that there is no correlation between the two variables. A +1.0 indicates that two variables are perfectly and positively related (i.e. as one variable goes up by 10%, the other variable goes up by 10%. Likewise, a -1.0 indicates that two variables are perfectly and inversely related.
Direct jobs or wages and salaries	Round 1 impacts. The initial impacts, or spending applied to the multiplier system. Does not include spillover, or indirect impacts.
Discounted	Unless stated otherwise, all financial data in this report are expressed in 2022 dollars.
EIA	Energy Information Agency of the U.S. Department of Energy
IMPLAN Multipliers	Widely used input-output economic impact software, due to their documented effectiveness and relatively low cost. The I-O multipliers used in this study are those produced by the U.S. Forestry Service and marketed by the IMPLAN Group Inc. (www.IMPLAN.com).
Iowa Utilities Board (IUB)	The source of all direct solar construction and operations is the IUB.
KWH	Kilowatt (1,000) hours
Labor income	Wages and salaries plus self-employment income
MWH	Megawatt (1,000,000) hours
MMt Co2e	Million metric tons of carbon dioxide equivalents.
Neighboring states (border states)	States sharing a border with Iowa. The states are Illinois, Minnesota, Missouri, Nebraska, South Dakota and Wisconsin.
Region	Iowa and its neighboring states.
Self-employment income	Represents current-production income of sole proprietorships, partnerships, and tax-exempt cooperatives, such as real estate firms, lawyers, and dry cleaners.
Spillover economic impacts	Jobs, output, or wages and salaries in industries linked to a direct impact industry. It is equal to indirect plus induced impacts.
TIPU	Combined industries of transportation, information, public utilities, and private utilities.
Total impact	Impact includes wages & salaries, self-employment income, profits, interest payments, and tax collections.

Iowa, a Renewable Energy Juggernaut: Wind and Solar Economic Impacts, 1992-2025

Major Findings of the Study

In terms of wind energy generation, Iowa continues to lead the U.S. with current wind production as a share of total electricity generation six times that of the nation with the gap growing. In terms of solar energy production, Iowa's share of solar electricity production is significantly below the nation, but the gap between Iowa and the U.S. average has closed dramatically since 2012. In terms of installed electricity capacity, Iowa is second only to Texas in wind energy but 30th in the nation in solar installations.:

Wind Impacts

Between 1992 and 2021, wind investment and **construction** produced $34.5 billion in total impacts, $9.7 billion in wages & salaries, $3.7 billion in self-employment income, and supported an average of 8,961 jobs each year. For 2021, wind energy **operations** supplied total impacts of $2.9 billion, wages & salaries impacts of $296.8 million, self-employment income of $32.8 million, and supported 5,481 jobs. For the 30-year period, 1992 - 2021, wind energy construction will increase state & local tax collections by $1.2 billion and operations in 2021 will increase state & local tax collections by an additional $99.6 million.

In terms of wind energy generation, Iowa continues to lead the U.S. with current wind production as a share of total electricity generation, six times that of the nation with the gap growing.

Solar Impacts

Between 2020 and 2025 solar investment and **construction** produced $3.0 billion in total impacts, $669.6 million in wages & salaries, $352.5 million in self-employment income, and supported an average of 3,238 jobs each year. For 2025, solar energy **operations** are estimated to supply total impacts of $467.3 million, wages & salaries impacts of $125.6 million, self-employment income of $25.3 million, and to support 2,721 jobs. For the 6-year period, 2020-2025, solar energy construction will increase state & local tax collections by $93.3 million and operations in 2025 will increase state & local tax collections by an additional $21.8 million.[3]

[3] Unless stated otherwise, all dollar estimates are in 2022 values.

Executive Summary

I. Iowa Wind Development

A. Iowa's Potential Wind Electricity Generation in 2021

1. Iowa ranked 14th in the nation in potential wind electricity generation. Texas' wind potential was almost five times that of Iowa.
2. Compared to its border states, Nebraska and South Dakota exceeded Iowa in terms of wind potential.
3. Compared to other states, no state took advantage of its wind potential more than Iowa.

B. Iowa's Wind Electricity Production, 2021

1. Iowa produced a higher share of its electricity from wind than any other state.
2. Iowa expanded its share of total wind electricity production from 1.2% in 2001 to 55.3% in 2021, the highest in the nation.
3. Iowa's share of electricity from wind was approximately six times that of the U.S. average.
4. Among its border states, Iowa's 55.3% share exceeds that of South Dakota's 52.3%, Nebraska's 25.3%, Minnesota's 21.7%, Wisconsin's 19.4%, Illinois' 10.3%, and Missouri's 8.5%.

C. Wind Energy Development Among Iowa Counties, 2020

1. Among Iowa's 99 counties, 56 produced electricity via wind.
2. As a share of total state electricity from wind turbines, the top three counties were: Adair with 8.8% from 617 turbines, O'Brien with 4.9% from 319 turbines, and Adams with 4.9% from 303 turbines.
3. The top three counties in terms of *per capita* MWH of electricity production from wind were: Adams at 463.2, Adair at 426.5, and Audubon at 167.7.

4. In terms of installed wind electricity capacity, the top five Iowa counties in 2020 were: Adair with 1,361 MWH, O'Brien with 755 MWH, Adams with 752 MWH, Winnebago with 683 MWH, and Cass with 624 MWH.

At build-out of Iowa's solar projects in the pipeline (2025 for purposes of this analysis), the combined impact of wind and solar investments to Iowa landowners and farmers is estimated to be $86.2 million, with $50.3 million related to wind projects, and $35.9 million related to solar projects.

II. Iowa's Solar Energy Development

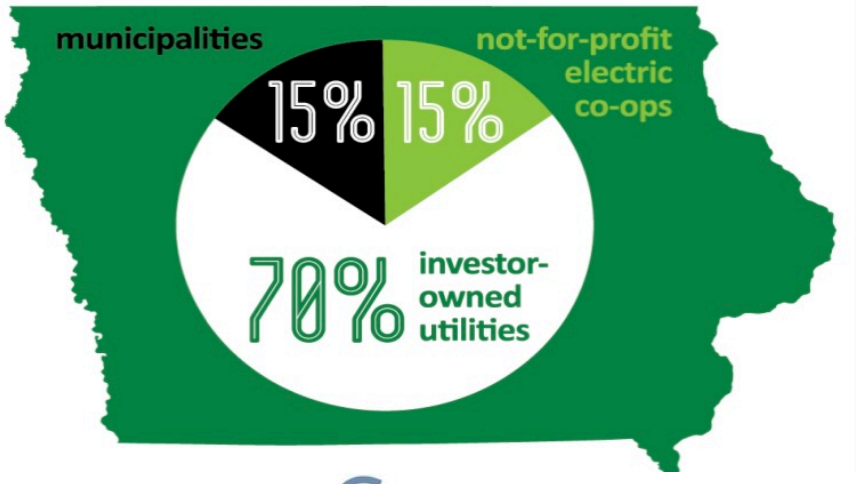
A. Iowa's Solar Energy Potential

1. Among its neighbors, Iowa, Missouri, and South Dakota were ranked equally in terms of solar potential, while Nebraska was ranked more highly, and Illinois, Minnesota, and Wisconsin were categorized with less solar potential than Iowa.
2. Compared to its solar potential ranking of 22, Iowa's actual solar production ranking of 33 indicates that Iowa has lagged in its solar electricity production.

B. Iowa's Share of Solar Electricity Production

1. In 2021, Iowa produced a lower share of its electricity from solar than the U.S. average. However, Iowa's solar growth exceeded that of U.S. average growth between 2012 and 2021.
2. In 2021, Iowa supplied 0.72% of its total electricity from solar compared to 4.00% for the U.S.
3. In terms of share of total electricity generated from solar, Iowa at 0.72% ranked 33rd in terms of heaviest use of solar with DC at 79.8% and California at 27.5%.

Figure 1: Iowa's Associations of Electric Cooperatives, 2020 (Source Iowa Utilities Board)



4. Among its neighbors, three states, Minnesota, Wisconsin and Illinois, made greater use of solar, while the other three neighbors, Missouri, Nebraska and South Dakota, made less use of solar for electricity generation.

C. Iowa's Solar Investment, 2021

1. Iowa, with $178 of solar investment per capita was ranked number 30 among states and D.C. New York the number one in the U.S. at $6,564 per capita.
2. Among Iowa and its neighbors, only Minnesota at number 21 exceeded Iowa in solar investment per capita with $421.
3. Iowa with 17.2 solar residences per 1,000 population was ranked number 28 in the nation. Hawaii with 245.5 solar residences per 1,000 population was ranked number one. Only Minnesota at number 17 exceeded Iowa in solar residences per 1,000 population in the region.

D. Solar Energy Among Iowa Counties, 2025

1. In terms of solar investments (actual plus planned) the top 3 counties were Linn County with $550.8 million, while Winnebago County, and Clinton County had $307.2 million and $171.1 million respectively. Howard and Mitchell counties will share a facility with an estimated investment of $205.3 million.
2. In terms of the untapped solar potential in MW, the top 7 counties with the highest untapped solar potential at 350 MWH were Butler, Decatur, Humboldt, Monona, Page, Ringgold, and Wayne.

Among Iowa & its neighbors, only Minnesota at number 17 exceeded Iowa in solar residences per 1,000 population.

Figure 2: Iowa's Power Generation Capacity in % in 2020 (Source: EIA)

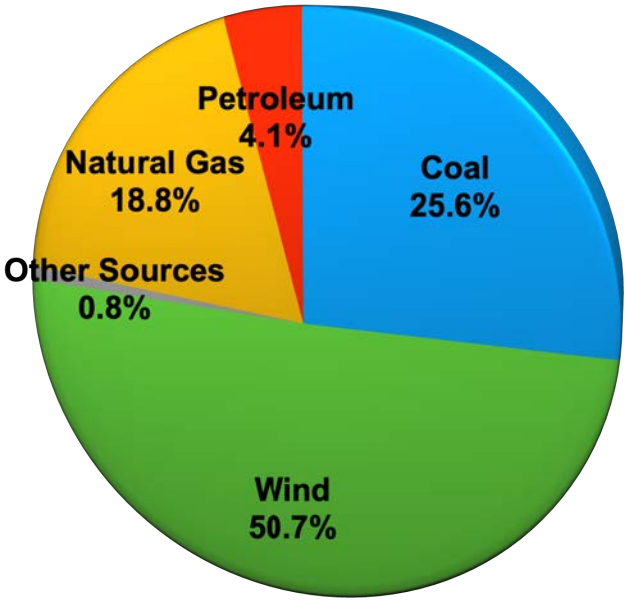
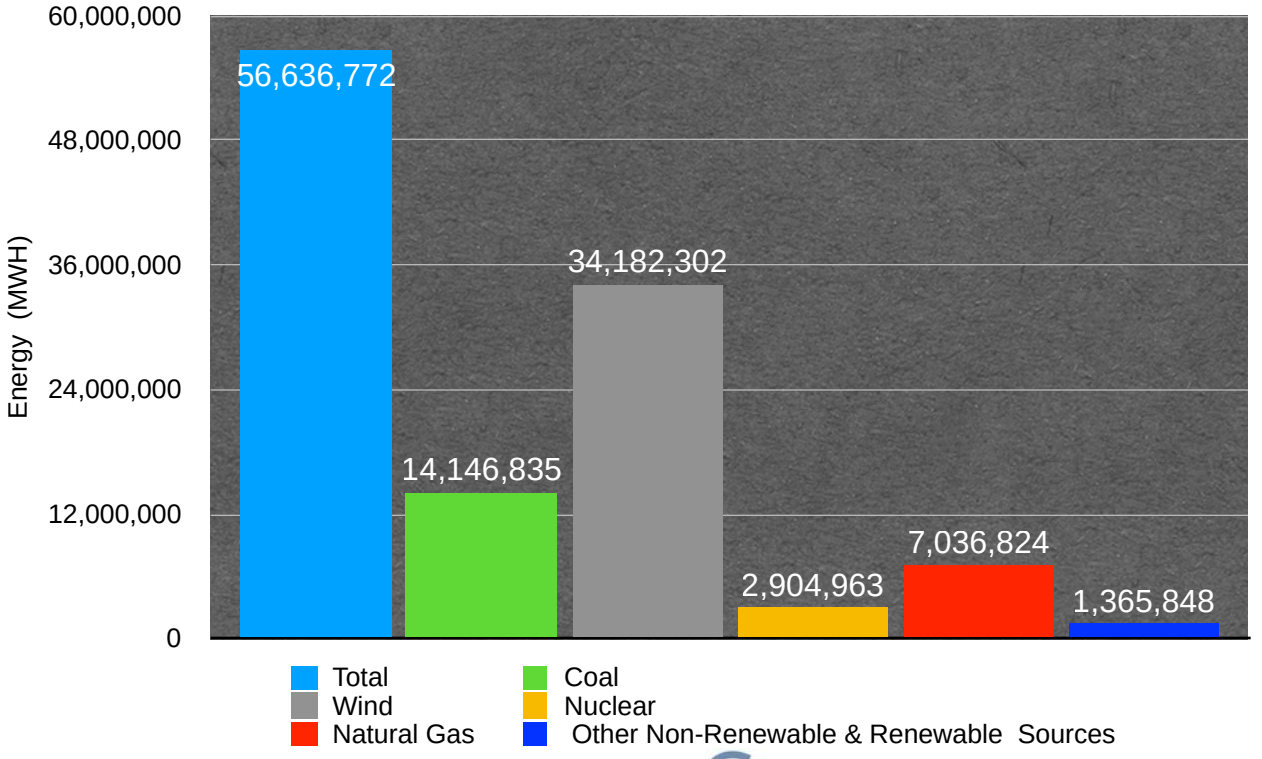


Figure 3: Iowa's Actual Energy Production by Different Sources in 2020 in MWH. (Source: Iowa Utilities Board)



III. The Economic Impacts of Wind & Solar Development

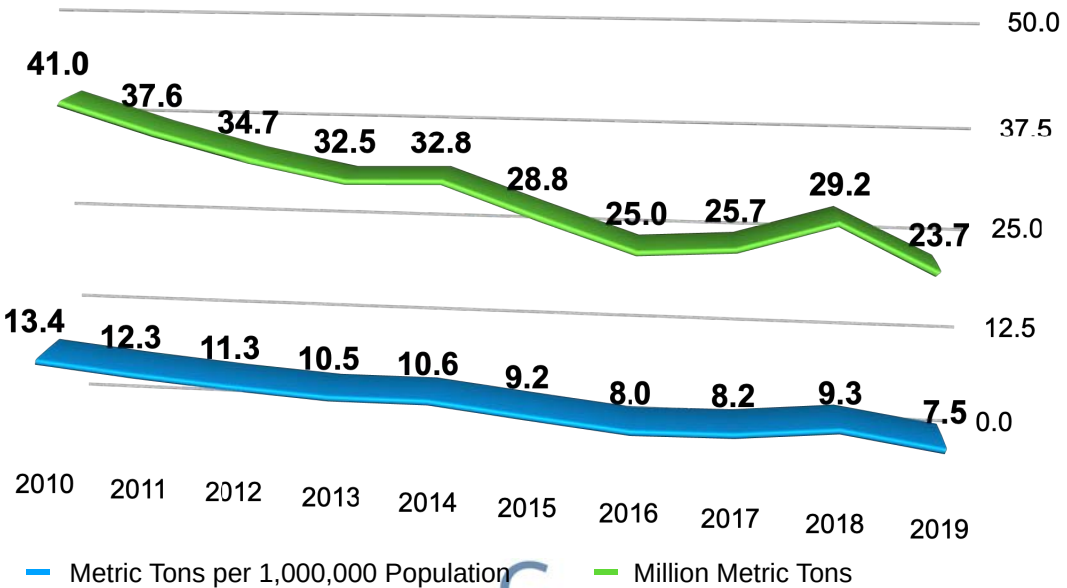
A. Due to the state's expansion of renewable electricity production:

1. The state's total CO2 emissions have fallen by 17.3 million metric tons from 2010 to 2019, for a 42.2% reduction.
2. Likewise, per capita emissions have fallen 5.9 metric tons, or a 44.1% reduction between 2010 and 2019.

> The increased use of renewable energy sources and the diminished reliance on fossil fuels in the generation of electricity resulted in $882.3 million in social cost reduction for the ten years ending in 2019

3. The increased use of renewable energy sources, and the diminished reliance on fossil fuels in the generation of electricity, resulted in $882.3 million in social cost reduction for the ten-year period ending in 2019.

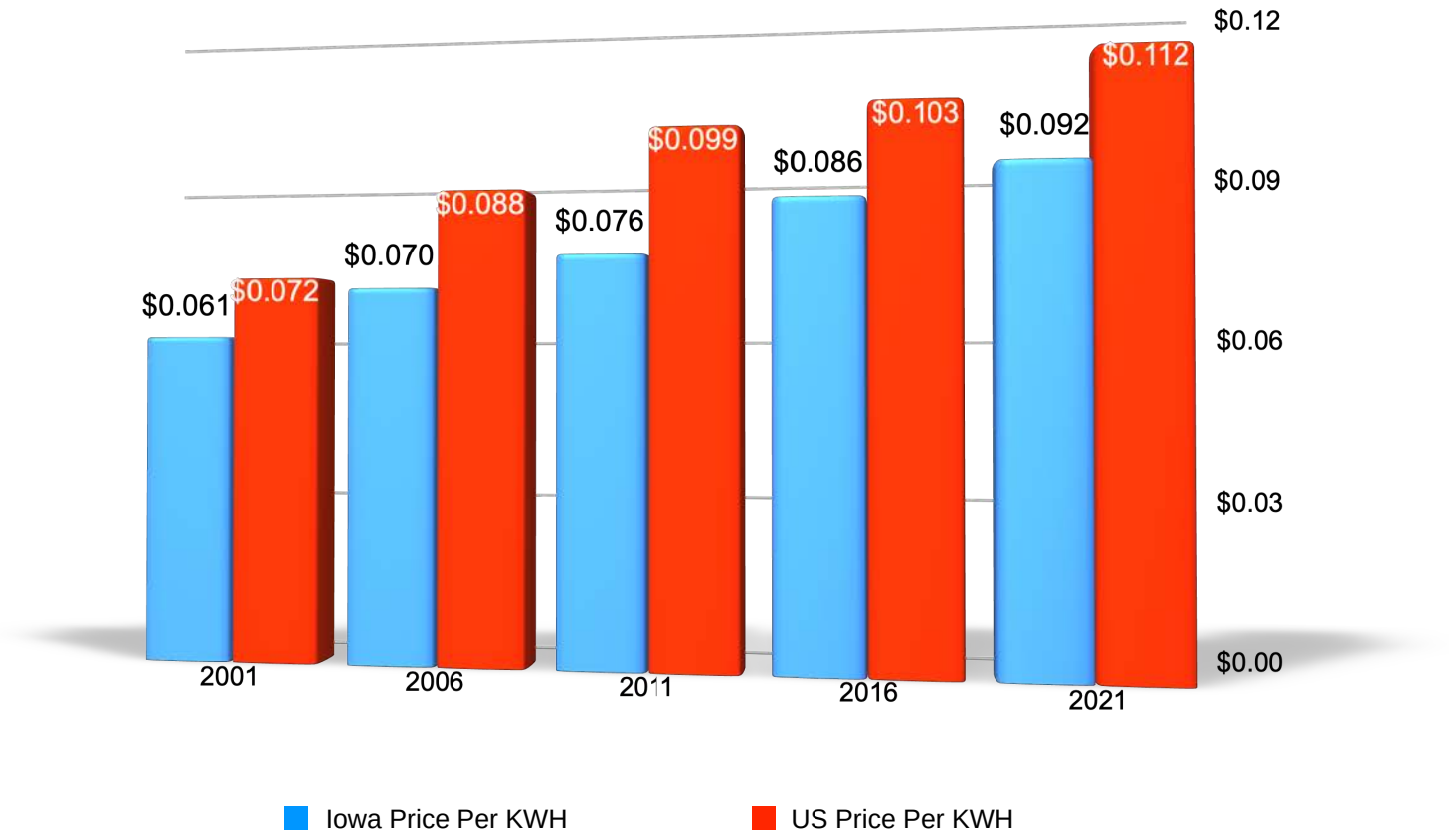
Figure 4: Iowa's GHG Emissions Status from 2011 to 2020 (MMtCO2e)
(Source: Iowa Department of Natural Resources)



B. Iowa's rapid renewable electricity expansion has contributed to its lower electricity costs. In 2021, Iowa's electricity price at $0.092 per KWH was 82.0% of the U.S. average. Figure 5 profiles Iowa's electricity prices and United States' electricity prices. Note that Iowa's prices relative to the U.S. declined as Iowa increased its share of electricity from wind.

Iowa's rapid renewable electricity expansion has contributed to its lower electricity costs. In 2021, Iowa's electricity price at $0.092 per KWH was 82.0% of the U.S. average.

Figure 5: Iowa Electricity Prices per KWH and U.S. Price per KWH, 2001-21 (Source: EIA)



C. Figures 6 - 11 Summarizes Wind & Solar Economic Impacts

Figure 6: Average Yearly Wind Construction Impacts, (Yearly Average from 1992 - 2021) and Operations Impact, 2021 (Millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)

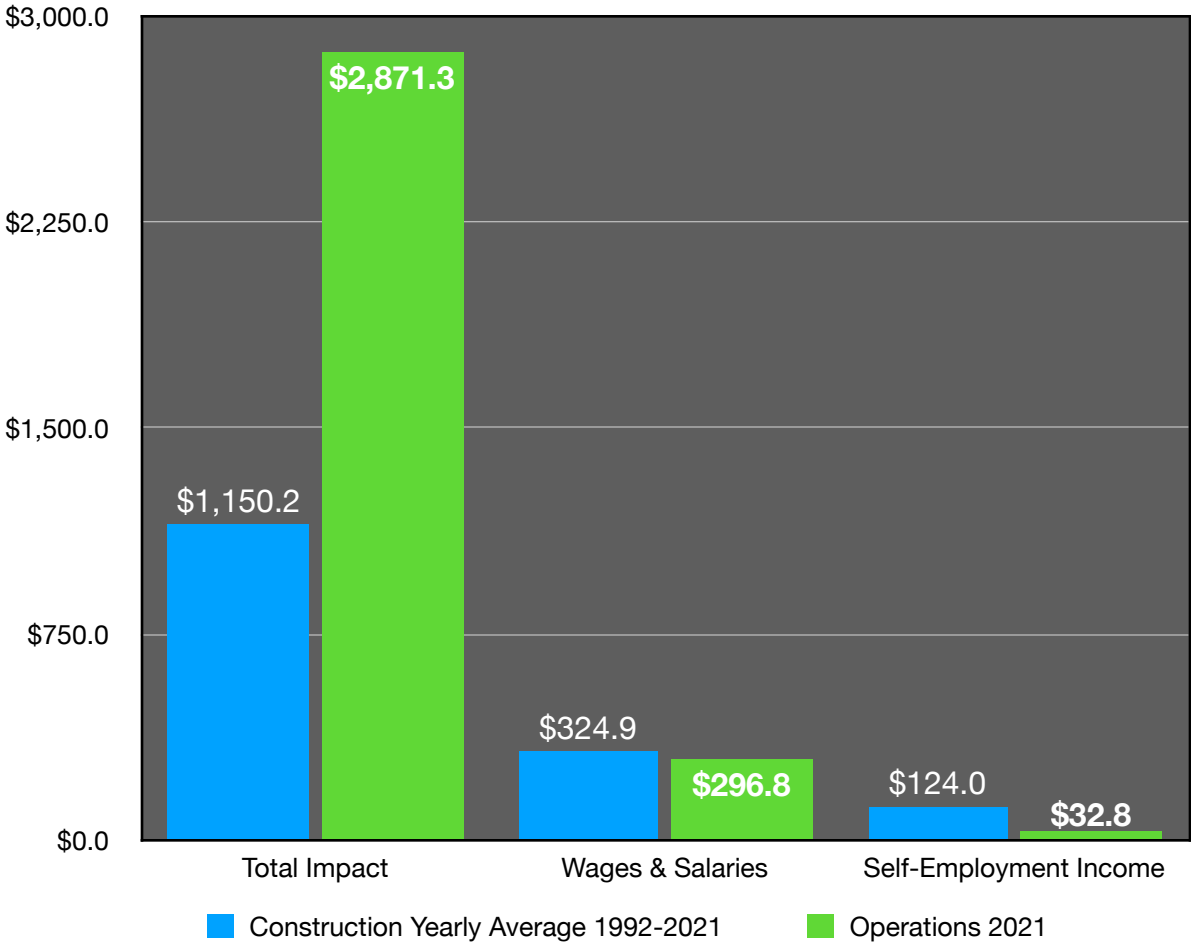


Figure 7: Average Yearly Solar Construction Impacts, (Yearly average from 2020 - 2025) and Operations Impact, 2025 (Millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)

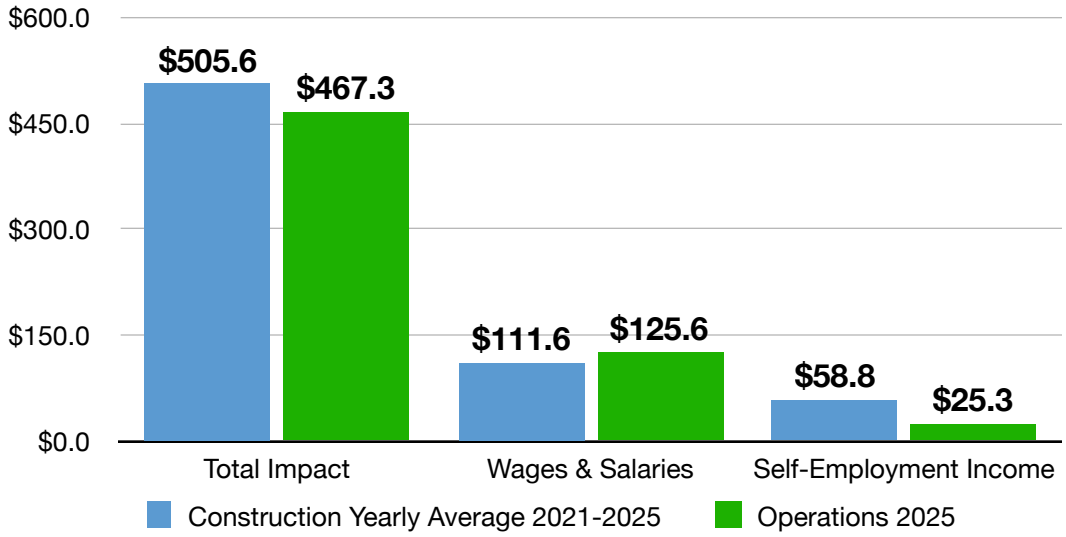


Figure 8: Iowa State & Local Tax Collections Produced by Wind Energy Operation for 2021 (Millions of 2022 Dollars) - (Source: Goss & Associates based on IMPLAN Models)

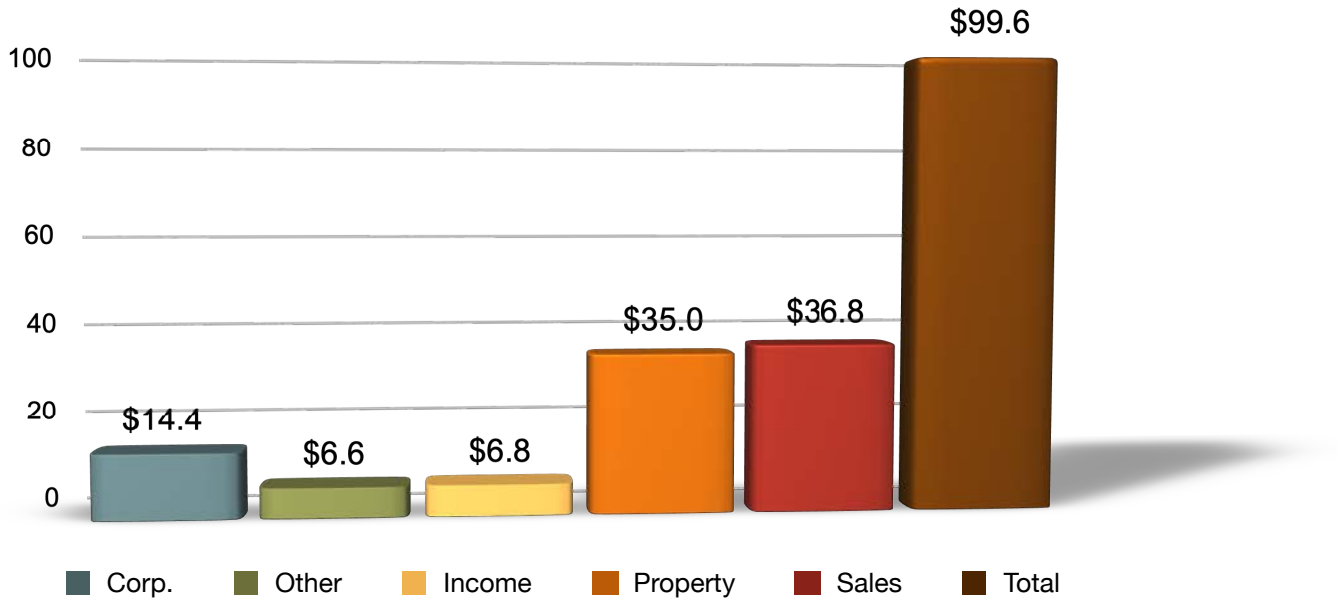


Figure 9: Iowa State & Local Tax Collections Produced by Solar Energy Operation for 2025 (in Millions of 2022 Dollars) - (Source: Goss & Associates based on IMPLAN Models)

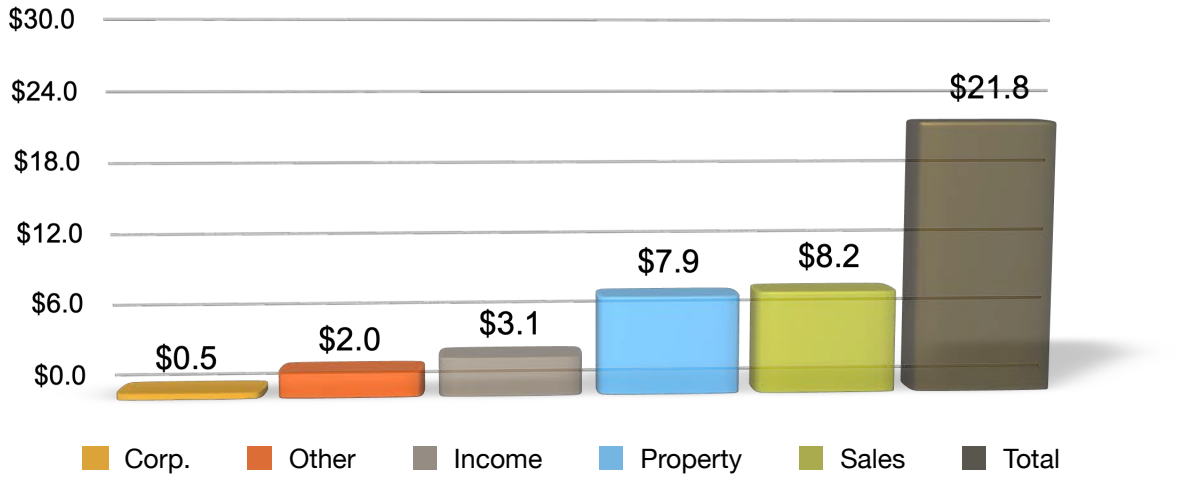


Figure 10: Job Impacts, Wind Construction 1992 - 2002, Operations 2021; Solar Construction 2020 - 2025 Operations 2025 (Source: Goss & Associates based on IMPLAN Models)

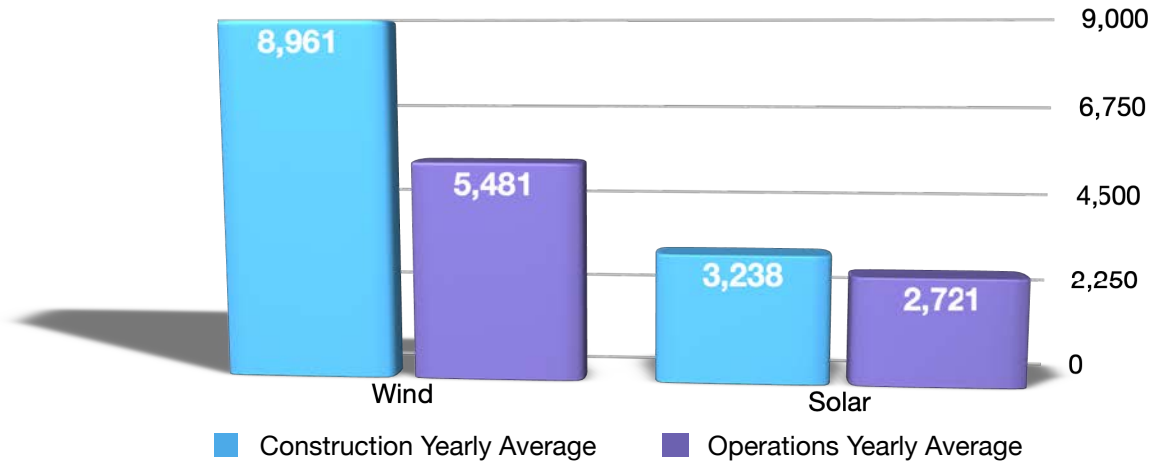
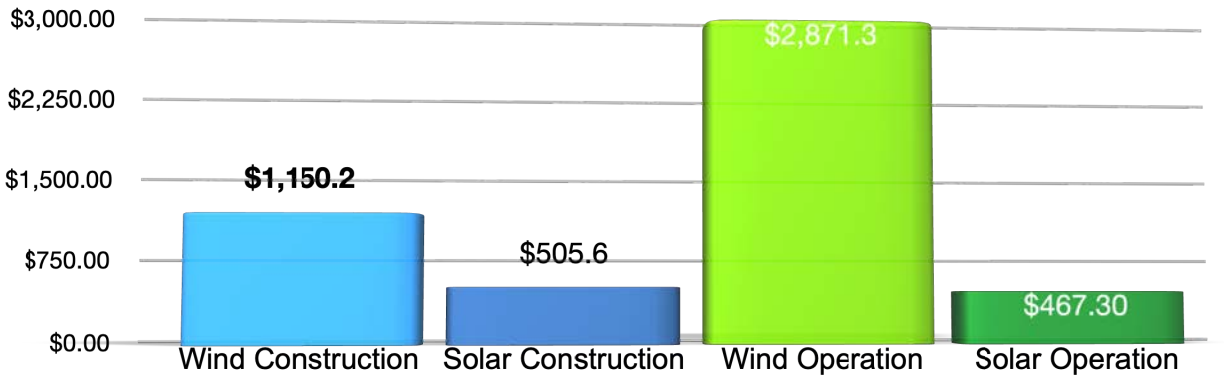


Figure 11: Average Yearly Total Impacts for Wind Construction (Yearly Average 1992 - 2021), Solar Construction (Yearly Average 2020 - 2025) Wind Operations 2021, & Solar Operations 2025 (Millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)



Section 1: Iowa Wind Electricity Generation

In 2021, Iowa produced a higher share of its electricity from wind than any other state. Iowa expanded its share of total electricity production from wind from 1.2% in 2001 to 55.3%, the highest in the nation in 2021. Figure 12 compares Iowa's share of electricity generation from wind to the nation's average share of electricity production from wind, 2001 - 2021..

In 2021, Iowa's share of electricity from wind was approximately six times that of the U.S. average. Figure 13 compares Iowa to the its neighbors. In terms of the proportion of electricity generation from wind in 2021. Among its border states, Iowa's 55.3% exceeds that of South Dakota's 52.3%, Nebraska's 25.3%, Minnesota's 21.7%, Illinois' 10.3%, Missouri's 8.5%, and Wisconsin's 19.4%.

In 2021, Iowa produced a higher share of its electricity from wind than any other state.

Figure 12: Percent of Total Electricity Generation from Wind 2001 - 2021
(Source: EIA 2021)

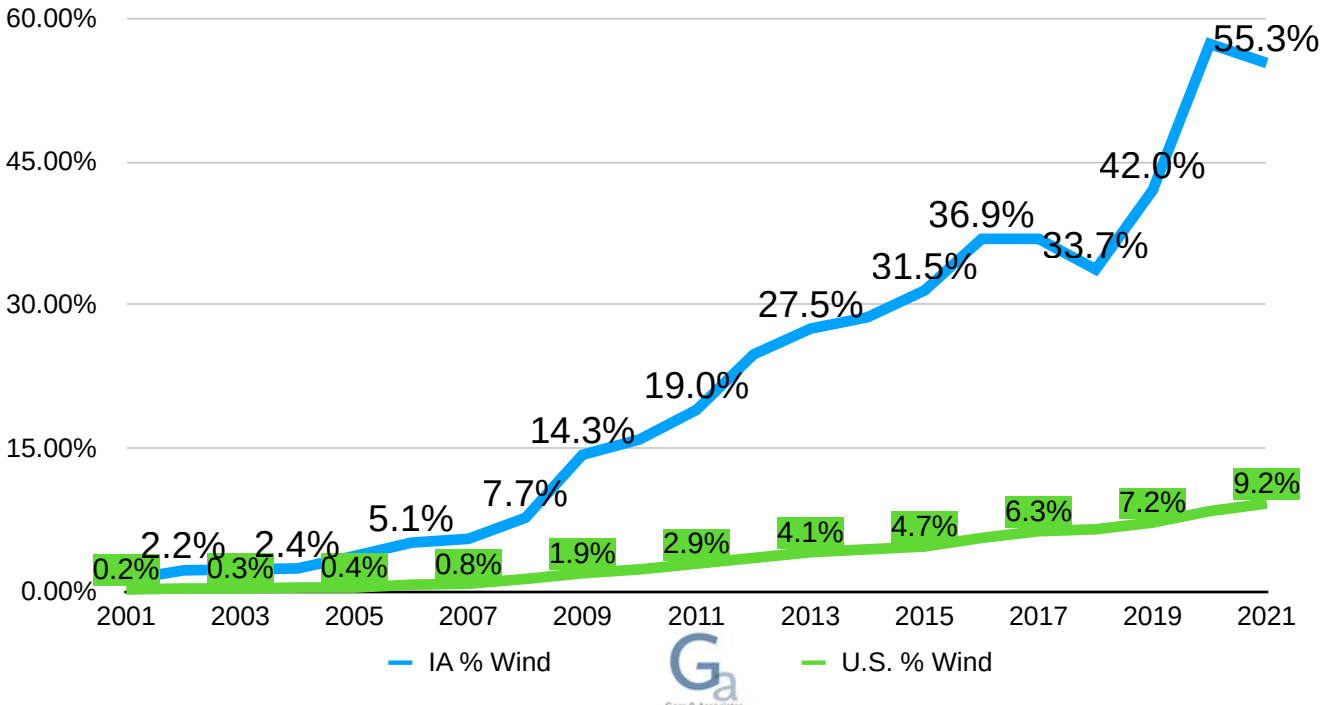
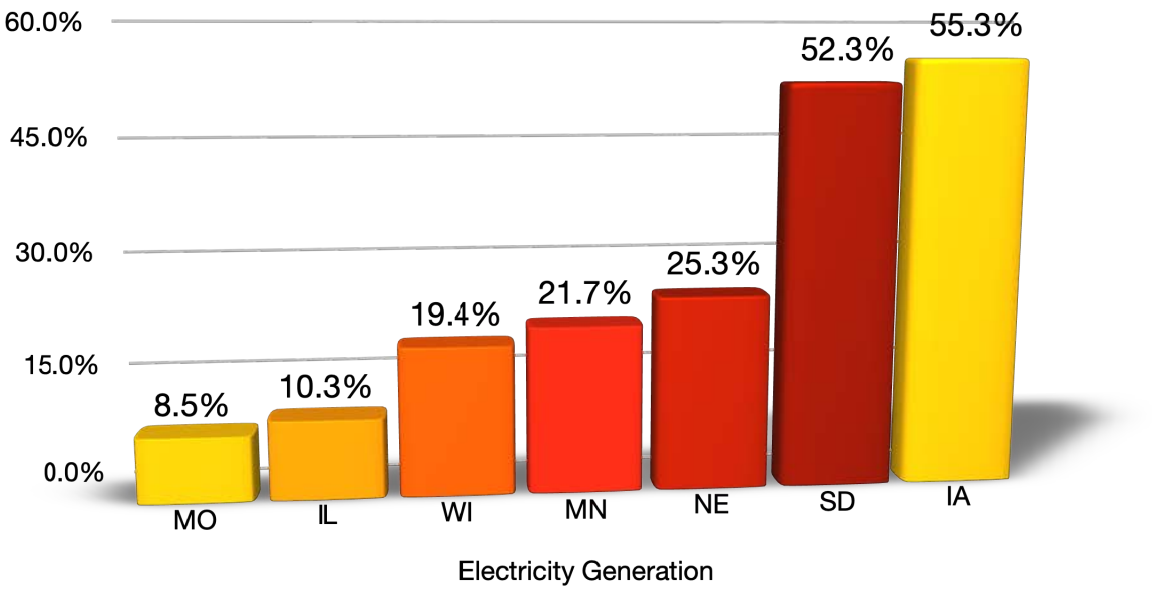


Figure 13: Percent of Total Electricity Generation From Wind, Iowa, and Neighbors, 2021 (Source: EIA 2021)

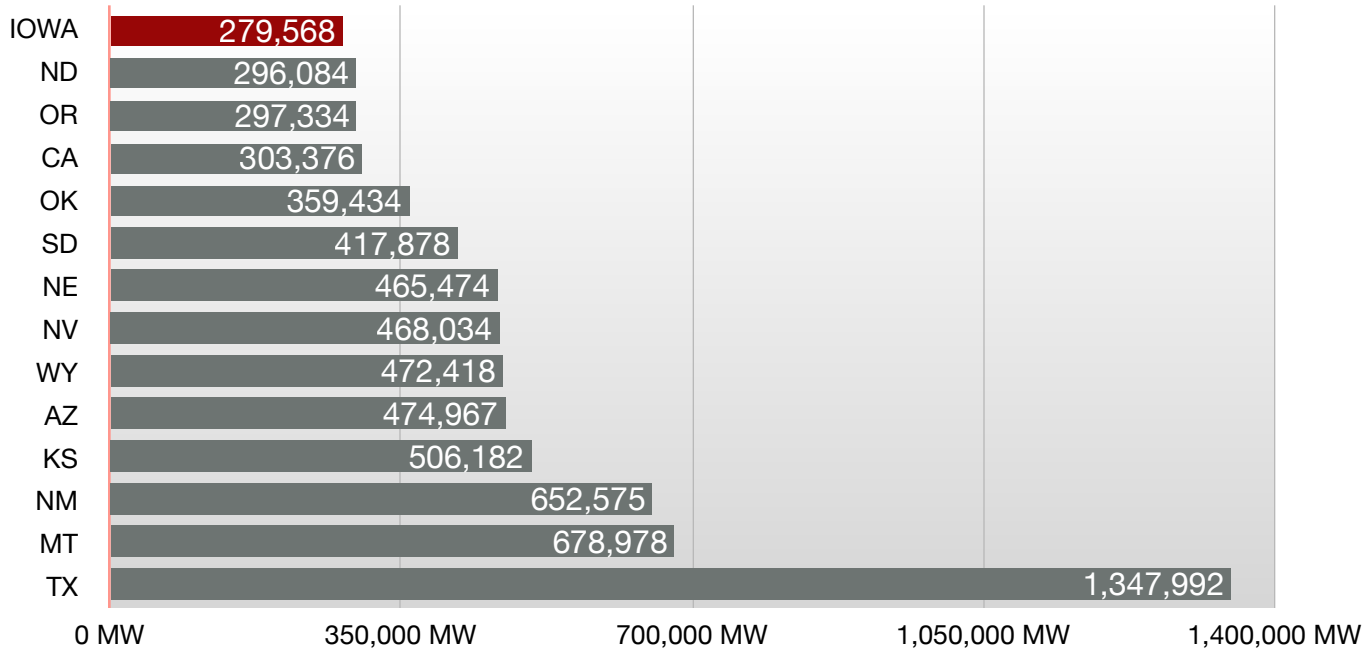


Wind Potential

Figure 14 compares the top 14 states in terms of wind energy potential. In terms of wind energy potential, Iowa ranked 14th in the nation. Texas' wind potential was almost five times that of Iowa. Compared to Iowa's border states, Nebraska and South Dakota exceeded Iowa in terms of wind potential.

Compared to other states, no state took advantage of its wind potential more than Iowa.

Figure 14: Wind Energy Potential in 2021 in MW (top 14 states) Source: EIA 2021



Electrical Energy Prices per KWH in Iowa

Iowa's rapid wind electricity expansion has contributed to its lower electricity costs. In 2021, Iowa's electricity price at $0.092 per KWH was 82.0% of the U.S. average. Figure 15 profiles Iowa's electricity prices and U.S. electricity prices. Note that Iowa's prices relative to the U.S. declined as Iowa increased its share of electricity from wind.

Figure 5: Iowa Electricity Prices per KWH and U.S. Price per KWH, 2001-21 (Source: EIA)

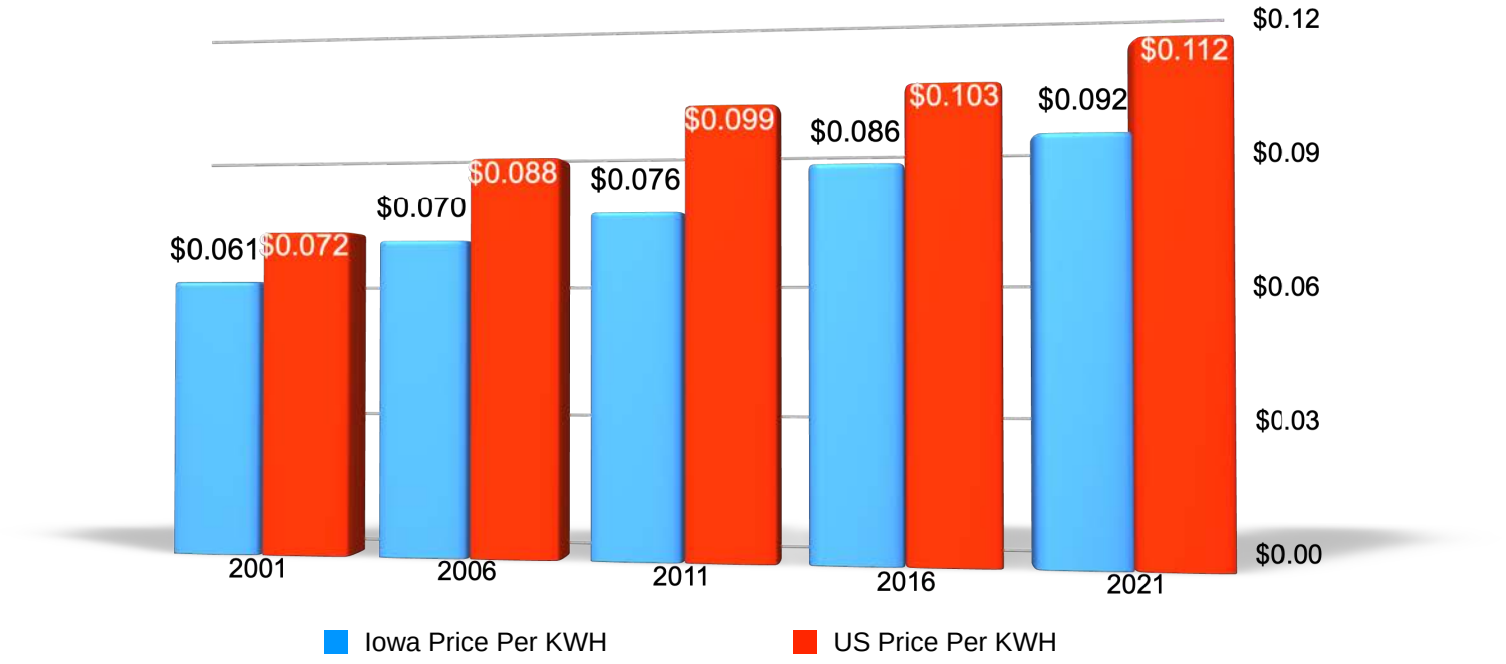


Table 1 lists electricity prices per KWH for the 50 states and D.C. in 2021. Note that only 13 states had cheaper electricity prices than Iowa, and only Nebraska among Iowa's neighboring states had cheaper electricity prices than Iowa.

The ten states with the least expensive electricity prices generated a median of 12.2% of total electricity from wind. The ten states with the most expensive electricity prices generated only 2.5% of total electricity production from wind.

Across the 50 states and D.C., the correlation coefficient between electricity prices and the share of total generation from wind was negative 0.19 in 2021. This indicates that as the share of wind increases, the price to consumers declines.

The ten states with the most expensive electricity prices generated only 2.5% of total electricity production from wind.

Table 1: Electricity Prices, 2021 Cents per KWH (Iowa and neighbors in red)

1	Idaho	8.17		**26**	**Illinois**	**10.20**
2	Wyoming	8.25		27	Alabama	10.31
3	Utah	8.39		28	Indiana	10.39
4	North Dakota	8.47		29	Kansas	10.44
5	Nevada	8.64		**30**	**South Dakota**	**10.47**
6	Washington	8.78		31	Delaware	10.56
7	Louisiana	8.82		32	Georgia	10.59
8	Oklahoma	8.83		33	Arizona	10.72
9	West Virginia	8.89		34	Florida	10.75
10	**Nebraska**	**8.93**		35	Colorado	10.92
11	Arkansas	9.07		**36**	**Wisconsin**	**11.02**
12	Oregon	9.10		**37**	**Minnesota**	**11.12**
13	Kentucky	9.15		38	Maryland	11.50
14	**Iowa**	**9.17**		39	D.C.	12.84
15	Virginia	9.28		40	Michigan	12.95
16	Texas	9.31		41	Maine	14.06
17	North Carolina	9.42		42	New Jersey	14.10
18	Montana	9.54		43	New York	16.14
19	Mississippi	9.67		44	Vermont	16.37
20	Ohio	9.78		45	New Hampshire	17.42
21	New Mexico	9.84		46	Rhode Island	18.52
22	Tennessee	9.86		47	Connecticut	18.78
23	**Missouri**	**9.90**		48	Massachusetts	19.17
24	Pennsylvania	10.00		49	California	19.76
25	South Carolina	10.16		50	Alaska	20.05`
				51	Hawaii	30.35
			U.S. Median			10.20
Source: EIA 2021						

Counties of Iowa

Among Iowa's 99 counties, 56 produced electricity via wind in 2020. Figures 16 and 17 map wind production by Iowa county in 2020. Of total state electricity from wind, the top three counties were: Adair produced 8.8% with 617 turbines, O'Brien generated 4.9% with 319 turbines, and Adams furnished 4.9% with 303 turbines. The top three counties in terms of per capita MWH of electricity production from wind were: Adams at 463.2 MWH, Adair at 426.5 MWH, and Audubon at 167.7 MWH.

In terms of wind electricity capacity, the top five counties in 2020 were: Adair with 1,361 MWH, O'Brien with 755 MWH, Adams with 752 MWH, Winnebago with 683 MWH, and Cass with 624 MWH.

Figure 16: Wind Energy Production in Iowa Counties, 2020 (Source: EIA)

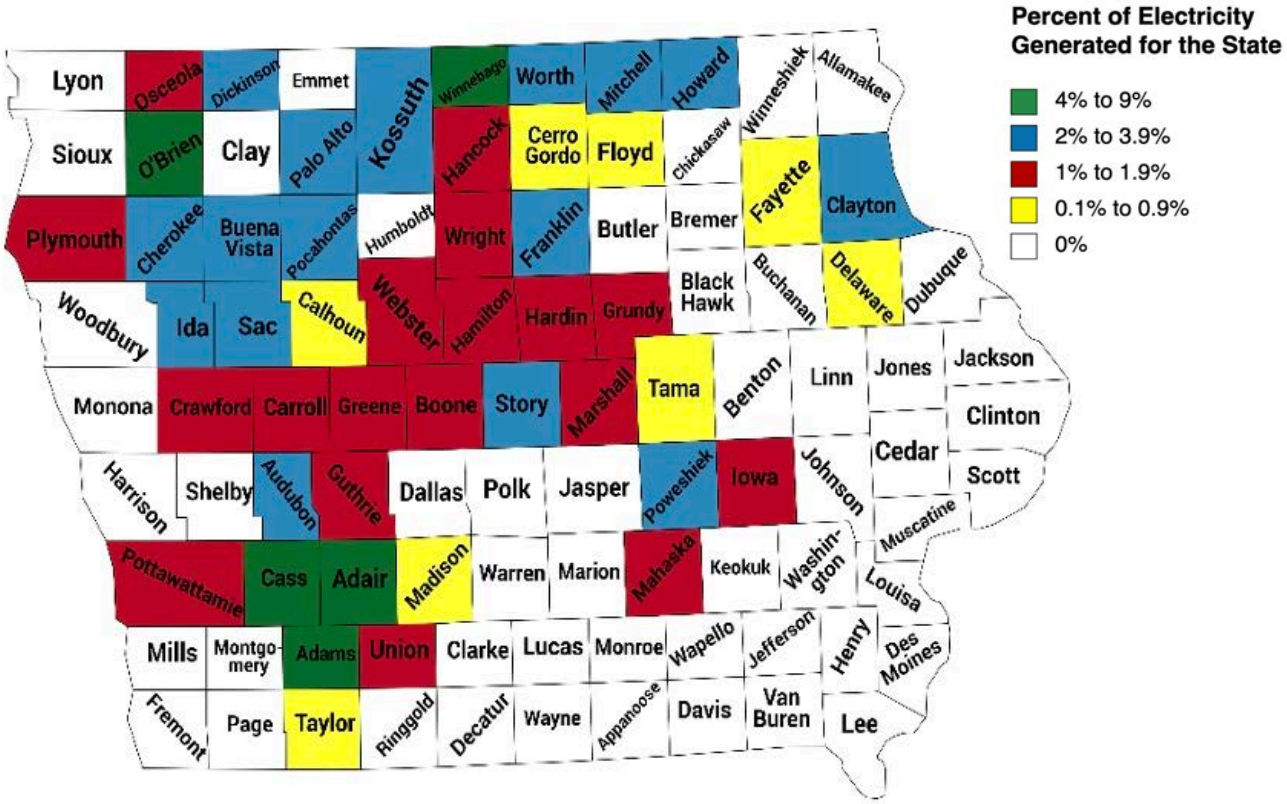


Figure 17: Wind Turbines by Iowa County, 2020 (Source: EIA)

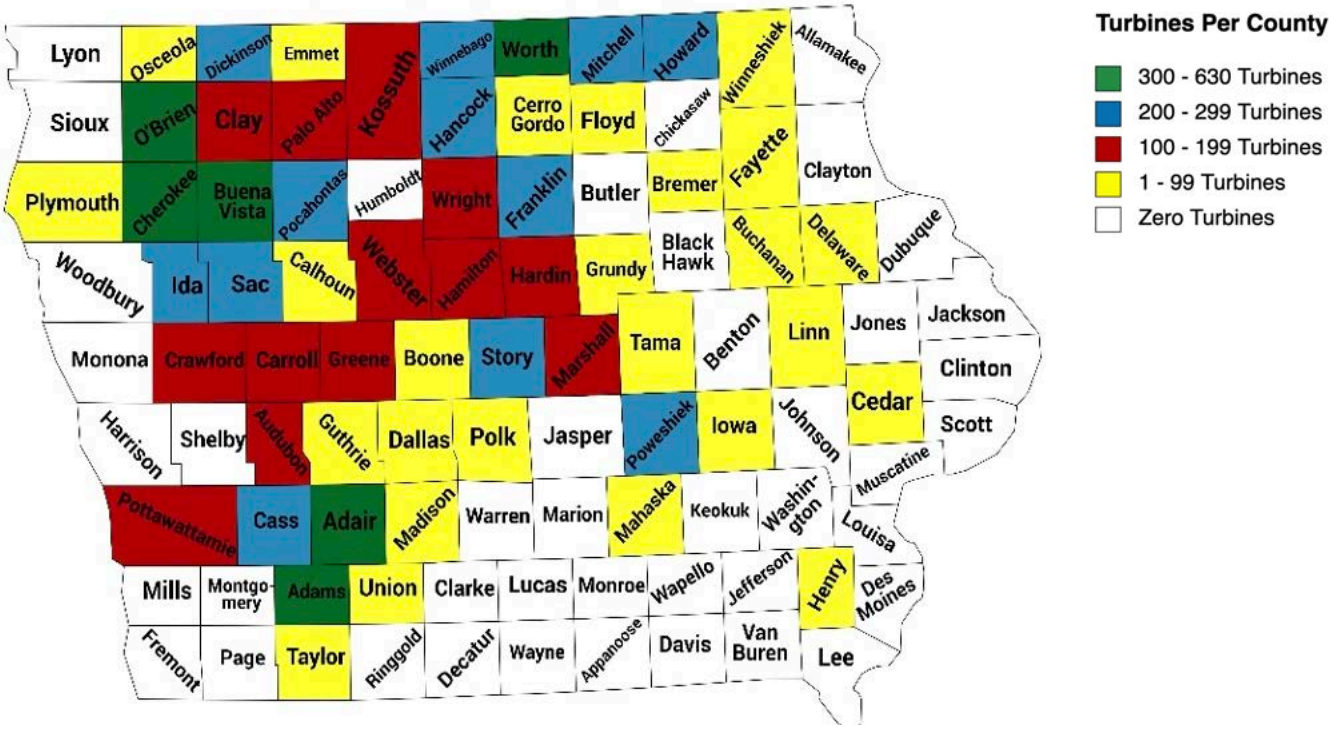


Table 2: lists Iowa counties with the greatest untapped wind potential. Untapped wind production is equal to total wind potential minus current wind production. As listed, among the 43 counties with no wind production in 2021, there were 12,725 MWH of untapped wind potential.

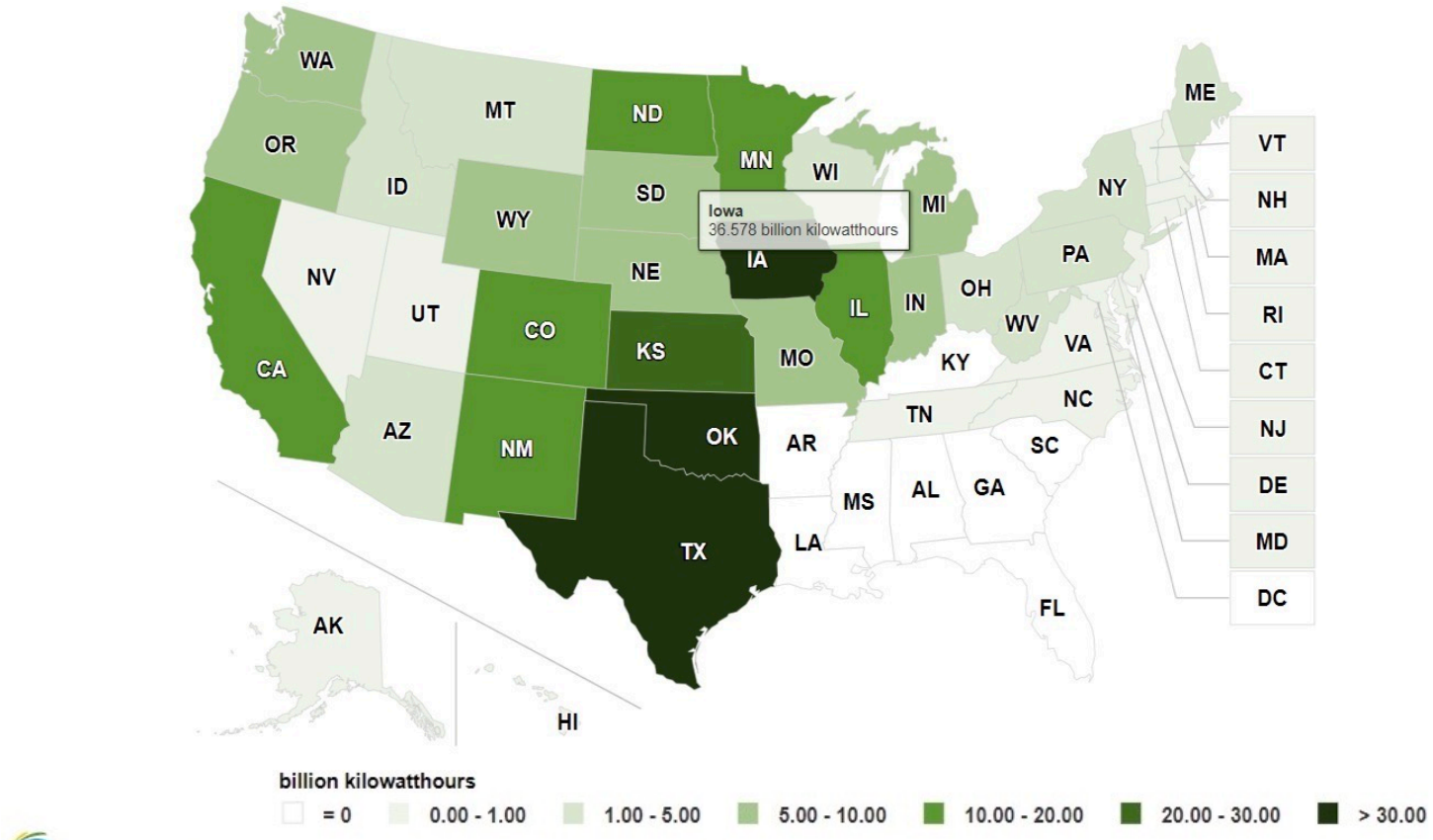
Table 2: Untapped Wind Production MW, 2021

County	MW	County	MW
Butler	350	Keokuk	300
Decatur	350	Louisa	300
Humboldt	350	Lucas	300
Monona	350	Mills	300
Page	350	Montgomery	300
Ringgold	350	Woodbury	300
Wayne	350	Des Moines	275
Benton	325	Fremont	275
Clay	325	Jasper	275
Clinton	325	Jefferson	275
Harrison	325	Johnson	275
Jackson	325	Sioux	275
Lyon	325	Appanoose	250
Monroe	325	Black Hawk	250
Shelby	325	Dubuque	250
Warren	325	Marion	250
Washington	325	Muscatine	250
Chickasaw	300	Scott	250
Clarke	300	Van Buren	250
Davis	300	Wapello	225
Jones	300	Allamakee	200
		Lee	200
Total untapped		12,725	

Source: (Goss & Associates Estimates Based on EIA data)

Figure 18 shows the wind generation of different states of U.S. among which the top states are Iowa (36.578 billion KWH), Oklahoma (33.338 billion KWH), and Texas (100.049 billion KWH) in 2021.

Figure 18: U.S. Utility-Scale Wind Power Generation by State in 2021
(Source: U.S. Energy Information Agency)



eia Data source: U.S. Energy Information Administration, *Electric Power Monthly*, Table 1.14.B, February 2022, preliminary data

Section 2: Iowa Solar Electricity Generation

Utility-scale solar concentration investment is a recent developing phenomenon in Iowa, with significant investment beginning in 2020. As such solar electricity generation remains a relatively small percentage of Iowa's energy portfolio (0.19% of total electric industry power generation (2022 thru March). That said, Iowa has 13 projects in the pipeline, representing nearly 2,500 MW in 2022. Thus, in order to capture the states more sustained development, 2025 is used as a more appropriate terminal year of analysis.

Solar's Increasing Importance

In 2021, Iowa produced a lower share of its electricity from solar than the U.S. average. However, Iowa's solar growth exceeds that of U.S. average growth. Figure 19 compares Iowa's percent of total electricity generation from solar to that of the U.S. average. In 2021, Iowa supplied 0.72% of its total electricity with solar compared to 4.00% for the U.S. That compares to a much lower share in 2014 of 0.04% for Iowa and 0.71% for the nation

Figure 19: Percent of Total Electricity 2014 - 2021 (Source EIA 2021)

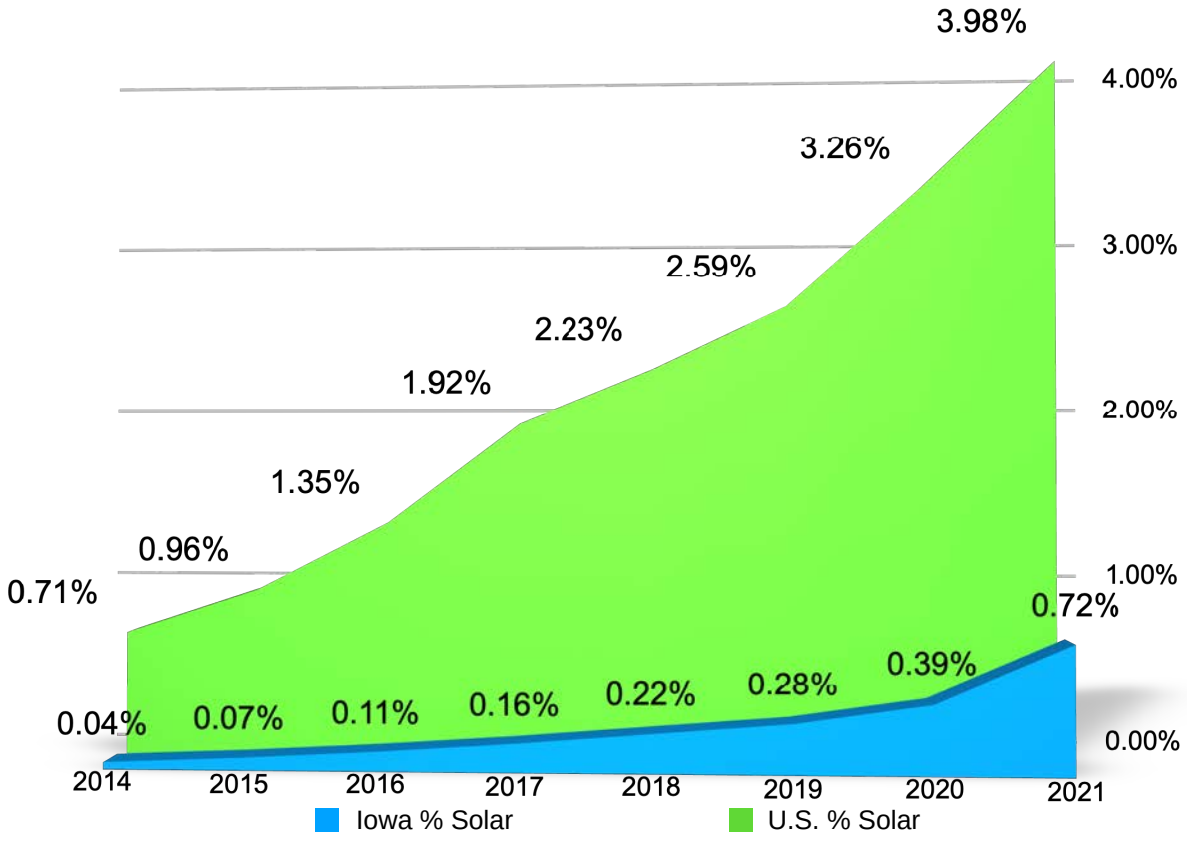


Figure 20 ranks the states in terms of solar electricity generation as a percentage of total electricity production in 2020. As presented, Iowa, at 0.72% in 2021, ranked 33rd in terms of heaviest use of solar with DC at 79.8% and California at 27.5%.

Figure 20: Solar Electricity Production as Share of Total Electricity Production, 2020 (Top 33 states) (Source: EIA 2021)

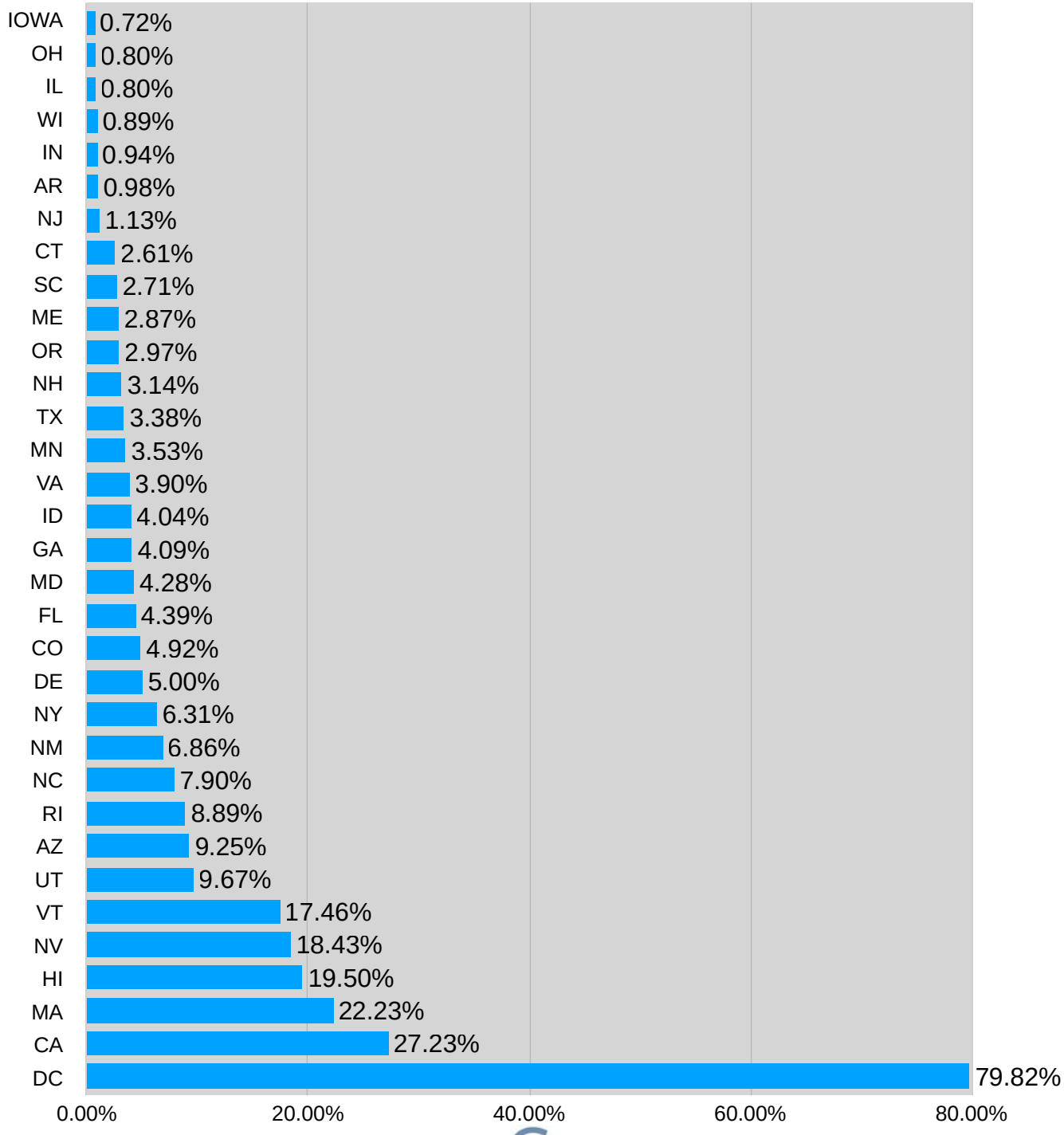
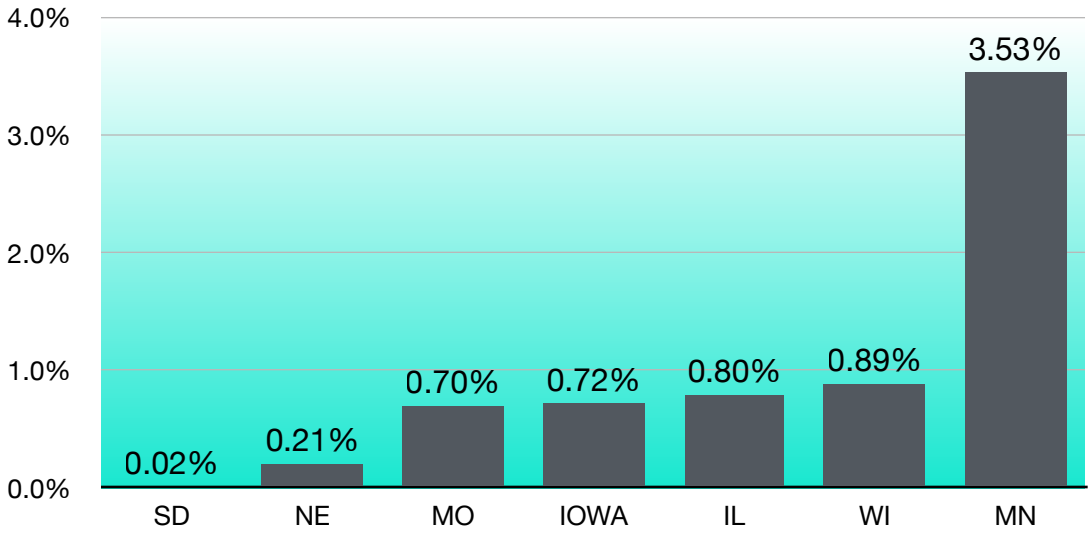


Figure 21 compares Iowa's percentage of solar generation to that of its neighbors. As presented, three states, Minnesota, Wisconsin and Illinois, made greater use of solar while the other three neighbors, Missouri, Nebraska and South Dakota, made lower use of solar.

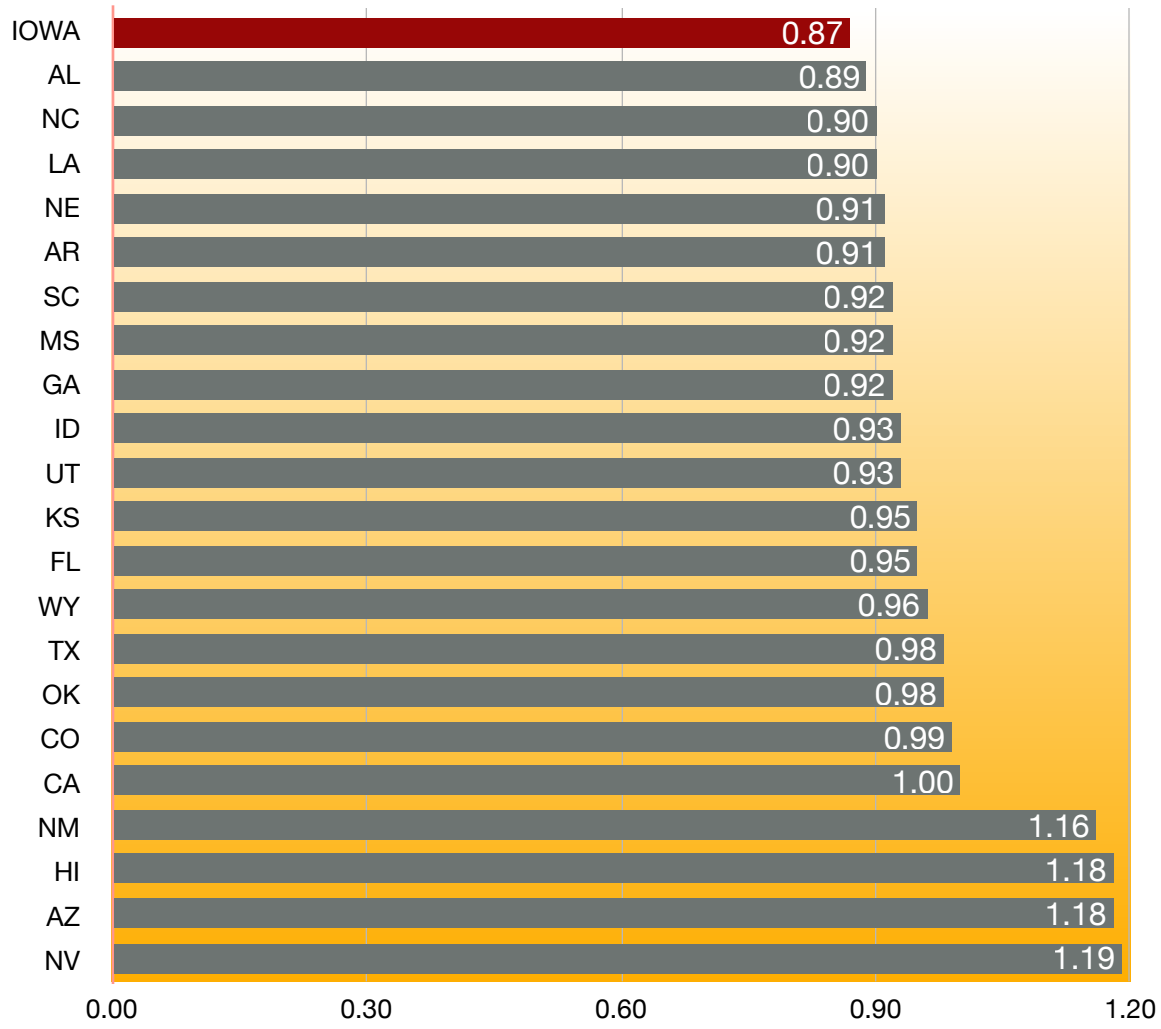
Figure 21: Solar Energy Generation as a Share of Total Electricity Production, Iowa Compared to Neighbors 2021 (Source: EIA)



Solar Potential

Figure 22 compares the top U.S. states in terms of sun energy potential. In 2021, Iowa's potential to produce electricity from solar was tied for 22nd in the U.S. among states and D.C. In the region, Iowa, Missouri and South Dakota were tied at 22nd with an index of 0.87, while Nebraska was ranked more highly. Illinois, Minnesota, and Wisconsin had less solar potential. Compared to its solar potential ranking of 22, Iowa's actual solar production ranking of 33 indicates that Iowa has lagged in its solar electricity production.

Figure 22: Solar Electricity Potential Index (Top 22 states)
(Source: EIA 2021)



Solar Investment

Figure 23 lists the top 30 U.S. states in terms of solar investment. In 2021, Iowa with $178 of solar investment per capita, was ranked number 30 among states and D.C. New York was ranked number one in the U.S. at $6,564 per capita. Only Minnesota at number 21, among Iowa's neighbors, exceeded Iowa in solar investment per capita at $421.

Figure 23: Solar Electricity Investment per Capita (Top 30 states)
Source: EIA 2021

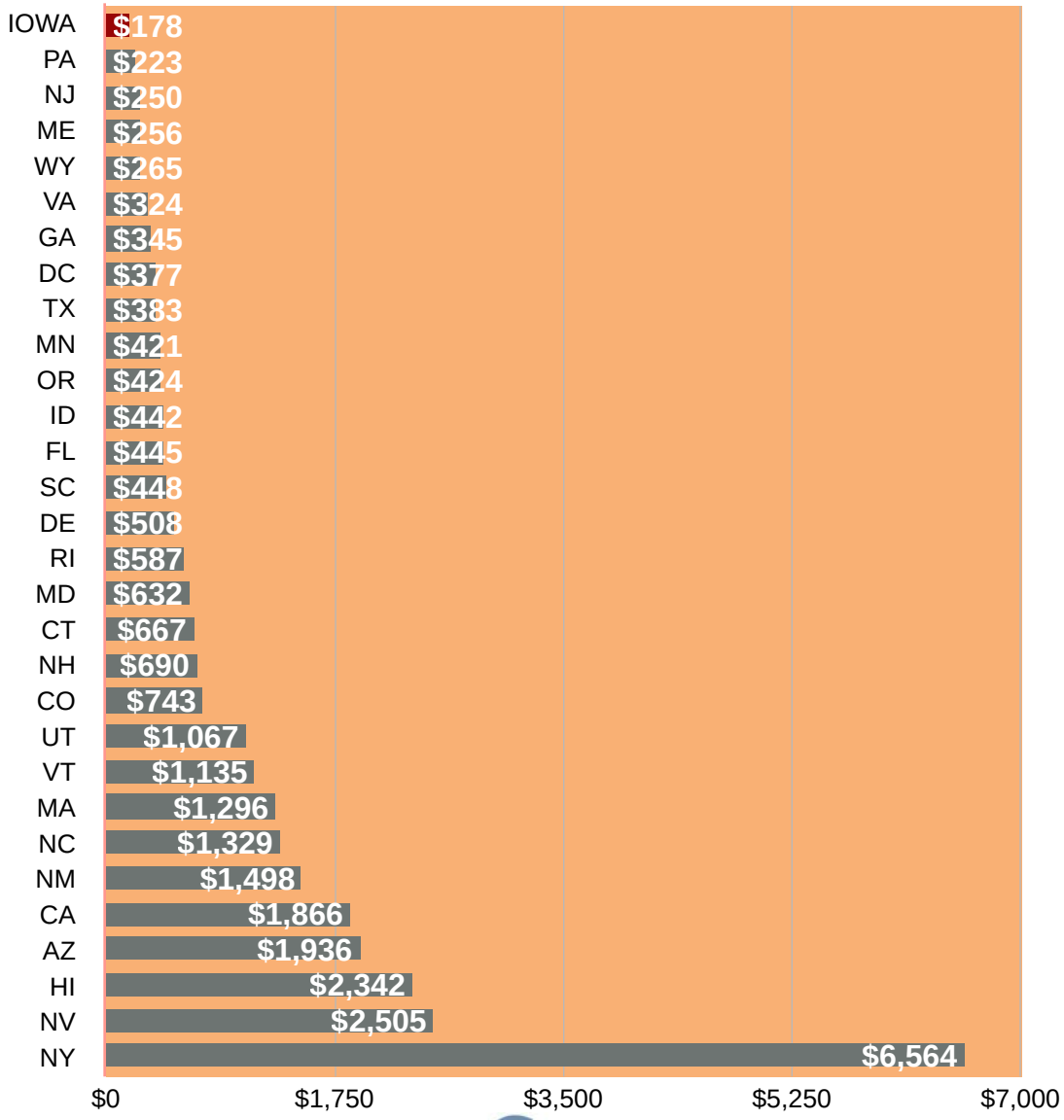


Figure 24 shows solar residences per 1,000 in population for Iowa versus its six geographic neighbors. As listed, only Minnesota exceeded Iowa in terms of solar residences per 1,000 in population.

Figure 24: Solar Residences per 1,000 in Population (Iowa Compared to Border States) (Source: EIA)

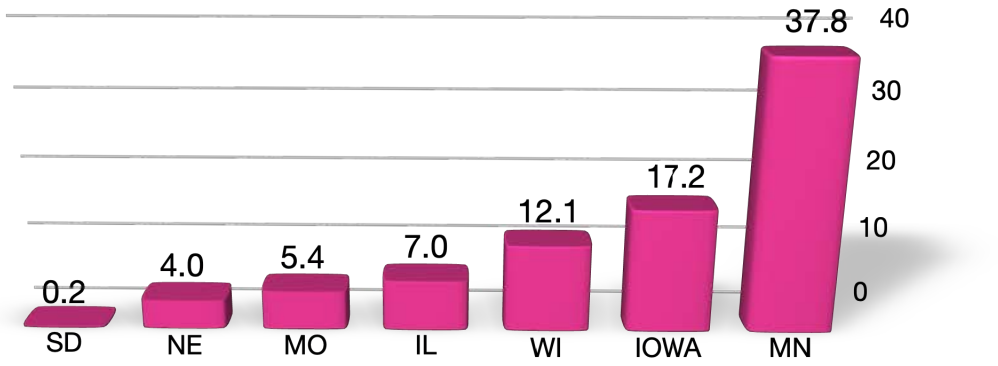


Figure 25 provides statewide solar energy production showing that Iowa's generation in 2021 was 0.2270 billion KWH.

Figure 25: Solar Power Generation in U.S. in Billions of KWH (Source:EIA)

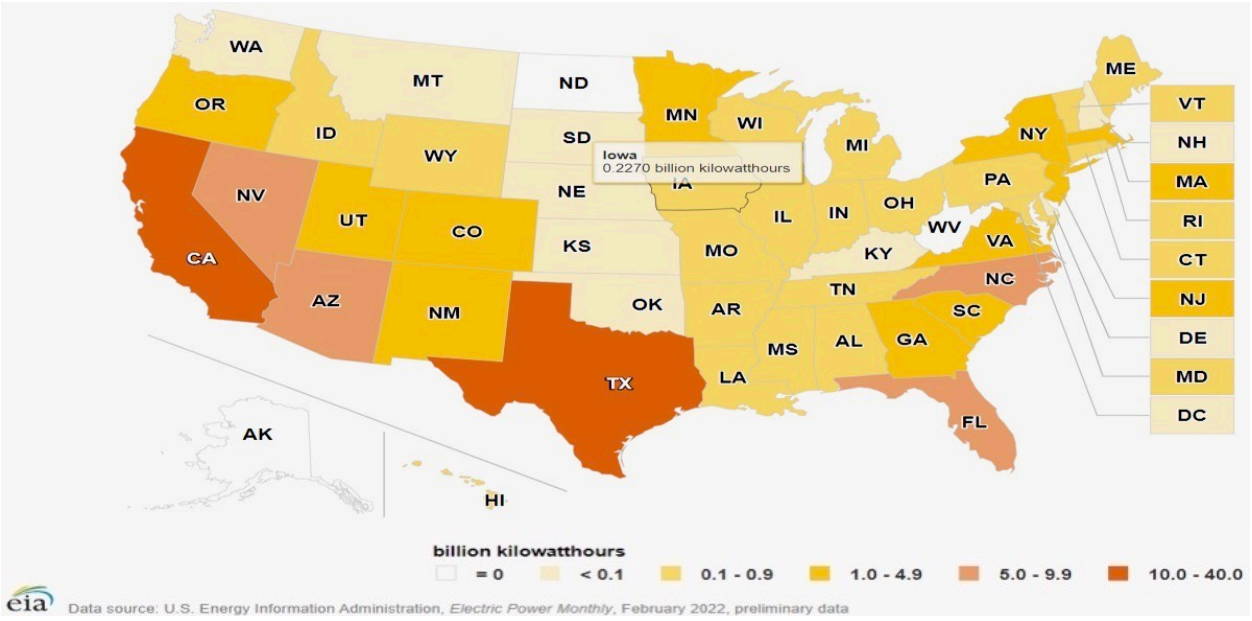


Figure 26 shows investments in millions in solar power plants in planned and operating plants among Iowa's counties. The top 3 counties were Clinton County with $224.5 million, while Webster County and Louisa County each had $179.6 million in investments in planned solar plants. The total investments in planned and in-operations for the 12 counties below were $697 million.

Figure 26: Iowa Counties with Solar Power Plant Investment Planned & Operating in Millions of 2022 Dollars (Source:EIA)

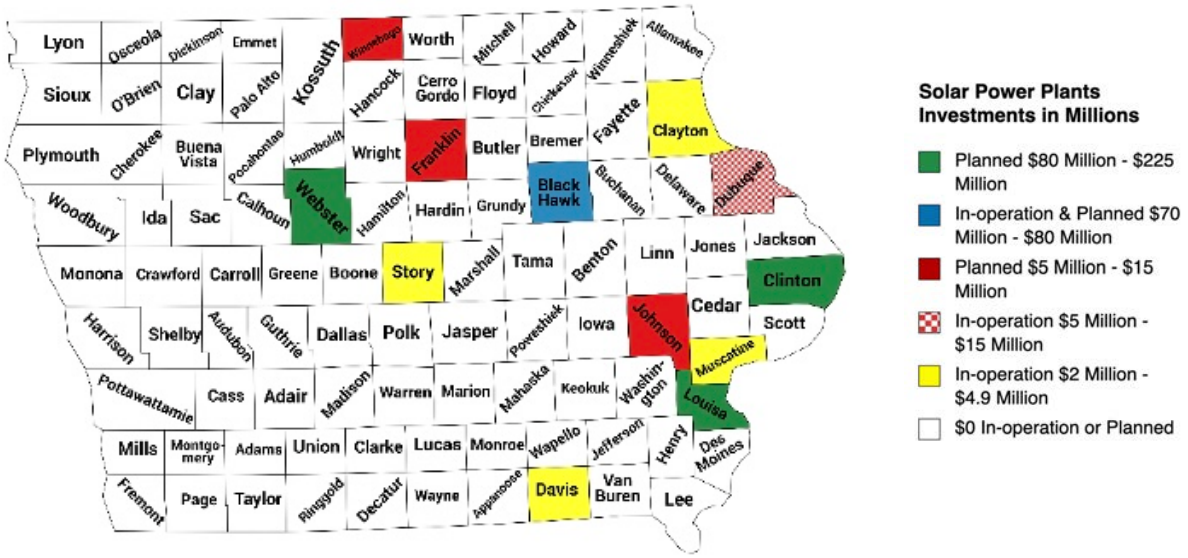


Figure 27 shows construction of solar power plants and residential solar construction expected in Iowa counties in 2025. The top three counties that will experience construction impacts will be: Polk County with $184.2 million in construction impacts, Clinton County with $119.8 million and Web County with $119.7 million in construction .

Figure 27:Solar Power Plant plus Residential Construction, 2012-25 in Millions of 2022 Dollars. (Source: EIA)

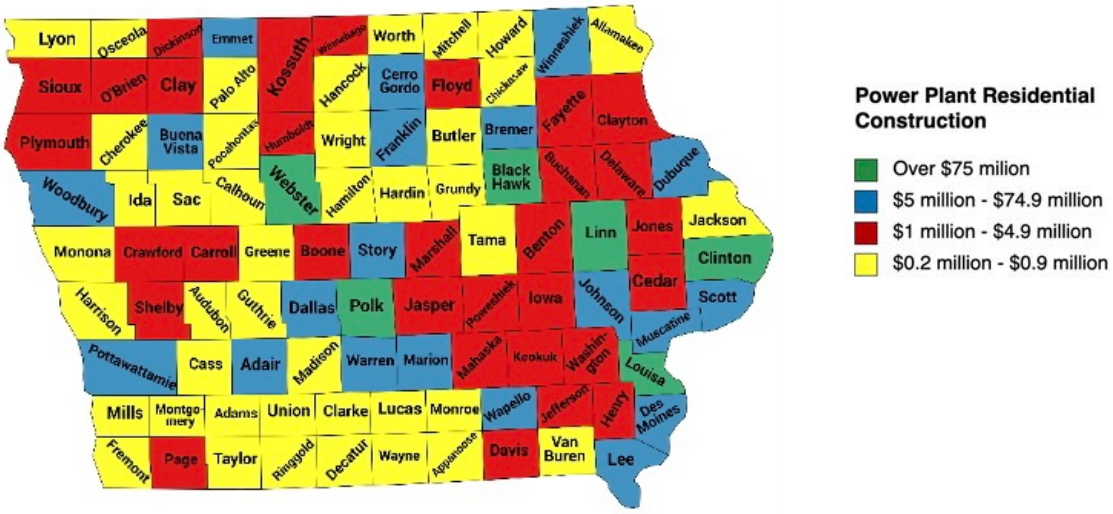
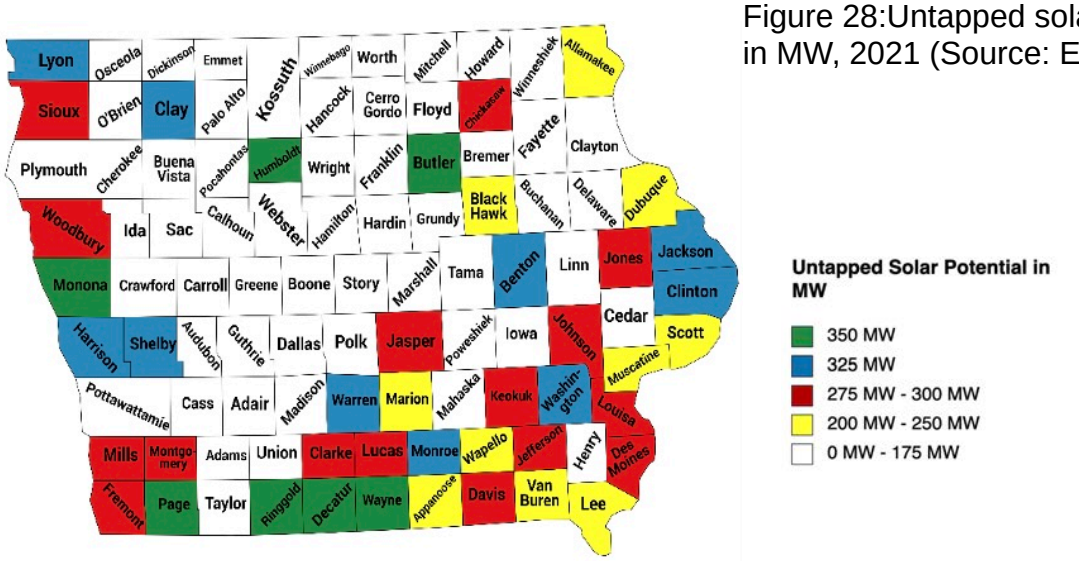


Figure 28 shows the untapped solar potential in MW in 2021. Untapped MW solar potential is equal to the solar intensity minus solar production. The top 7 counties with the highest untapped solar potential (350 MW) are Butler, Decatur, Humboldt, Monona, Page, Ringgold, and Wayne.

Figure 28:Untapped solar potential in MW, 2021 (Source: EIA)



Section 3: Iowa Economic Impacts of Wind & Solar

Introduction

A recent National Renewable Energy Laboratory (NREL)[4] report found that clean energy prices have fallen by as much as 80% in the last 10 years. Many others are doing better than average, including three where the renewable energy mix tops 50% in electric sales: Iowa at 69%, North Dakota at 61.7%, and Kansas at 61.5%. The report adds that the United States is "on track to get at least a third of our electricity from solar, wind and geothermal power by 2050."

This section of report estimates the impact of wind and solar development in Iowa. Utility scale solar concentration investment is a recent phenomenon in Iowa, with significant investment beginning in 2020. As such solar electricity generation remains a relatively small percentage of Iowa's energy portfolio (0.19% of total electric industry power generation 2022 - March). Due to the currently low level of solar energy development in Iowa and the explosive expansion planned, the year 2025 will be used as the terminal year for solar facility construction and the first year of full build-out operations.

To summarize the estimation technique direct spending such as wages paid to workers who install wind and solar facilities are input into the Implan Multiplier along with other data the economist enters. The Implan system then produces impacts which includes spillover impacts not in the renewable energy industries. The NREL system is based on user-entered project-specific data or default inputs (derived from industry norms), JEDI (Jobs and Economic Development Impact) estimates the number of jobs and economic impacts to a local area that can reasonably be supported by a power plant, fuel

[4] www..nrel.gov/news/features/2022/re-futures.html, June 2022
www.nrel.gov.docs/fy21osti/77324.pdf, January 2021

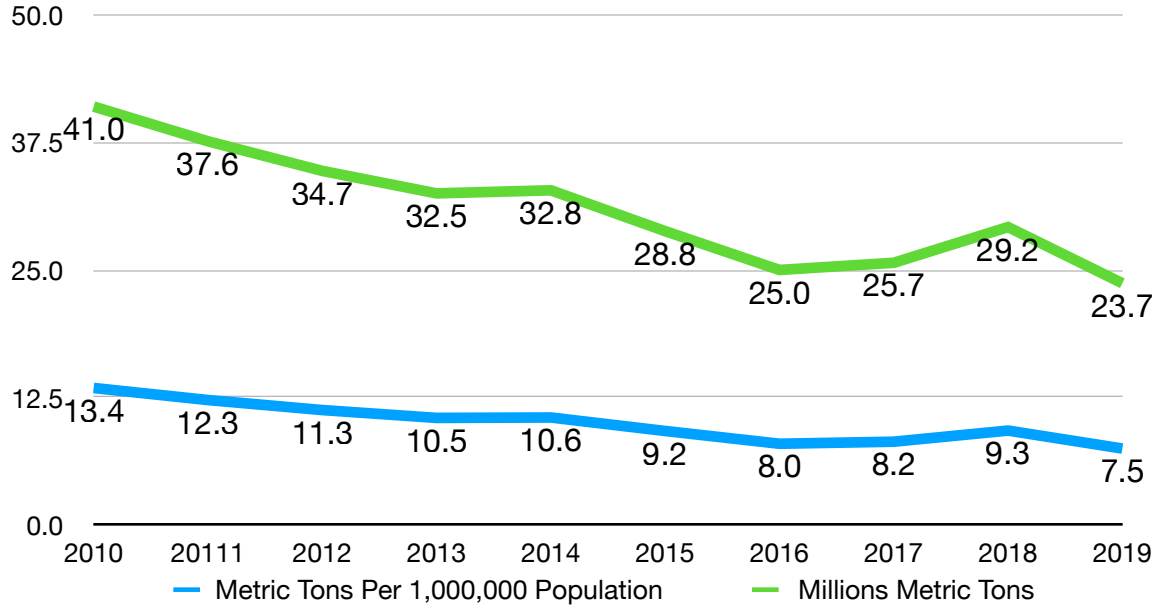
production facility, or other project. For example, JEDI estimates the number of in-state construction jobs from a new wind farm. A more detailed overview of the estimation methodology is contained in Appendix B.

Value of Iowa's Reduction in CO_2 Emissions

Renewable energy has become an important source of electricity generation in the state of Iowa. Figure 29 presents the most recent trends in carbon dioxide emissions from the generation of electricity showing the impact of the expansion of renewable electricity production.

Due to the state's expansion of renewable electricity production, the state's total emissions have fallen by 17.3 million metric tons- a 42.2% reduction. The increased use of renewable energy sources and the diminished reliance on fossil fuels in the generation of electricity resulted in $882.3 million in social cost reduction for the ten years ending in 2019.[5]

Figure 29: Value of Iowa's CO2 emissions reductions, 2010-19
(Sources: Environmental Protection Agency and Rand Corporation)



[5] Based on the Environmental Protection Agency estimate of $51 social cost per metric ton of carbon.

Economic Impact of Wind and Solar Generation

Round 1, or initial direct spending impacts, are listed in Appendix C, Table C2 These impacts are then input to the Implan Multiplier System to produce overall impacts, or Round 3 impacts (e.g. Round 1 plus spillover impacts) which are listed in subsequent tables and figures in this section.

The **construction** impacts are estimated for wind from 1992 to 2021, and for solar from 2020 to 2025. Iowa Conservative Energy Form estimates for solar construction from 2020 to 2025 are used as inputs to the IMPLAN model. Tables 3 and 4 summarize the impacts of wind and solar for construction and operations activity.

Table 3: Estimated Impacts for Iowa (Dollar Values in Millions of 2022 dollars)

Type	Construction		Operations	
	Wind 1992-2021	Solar 2020 - 2025	Wind 2021	Solar 2025
Total impact	$34,504.8	$3033.6	$2,871.3	$467.3
Wages & salaries	$9,748.1	$669.6	$296.8	$125.6
Self-employment income	$3,719.5	$352.5	$32.8	$25.3
Jobs (annual average)	8,961	3,238	5,481	2,721

Source: Goss & Associates from IMPLAN Multiplier System (see Appendix B for an overview of IMPLAN)Note: Due to the recent investment in solar energy & the number of projects, the year 2025 is used as the year of operations.

Table 4: Estimated Impacts on Iowa State and Local Taxes (in Millions of 2022 Dollars)

Type	Construction		Operations	
	Wind 1992-2021	Solar 2020 - 2025	Wind 2021	Solar 2025
Other taxes & fees	$132.1	$10.3	$6.6	$2.0
Corporate taxes	$44.6	$3.5	$14.4	$0.5
Individual income taxes	$282.4	$21.6	$6.8	$3.1
Property taxes	$350.0	$28.4	$35.0	$7.9
Sales taxes	$363.2	$29.5	$36.8	$8.2
Total	$1,172.4	$93.3	$99.6	$21.8

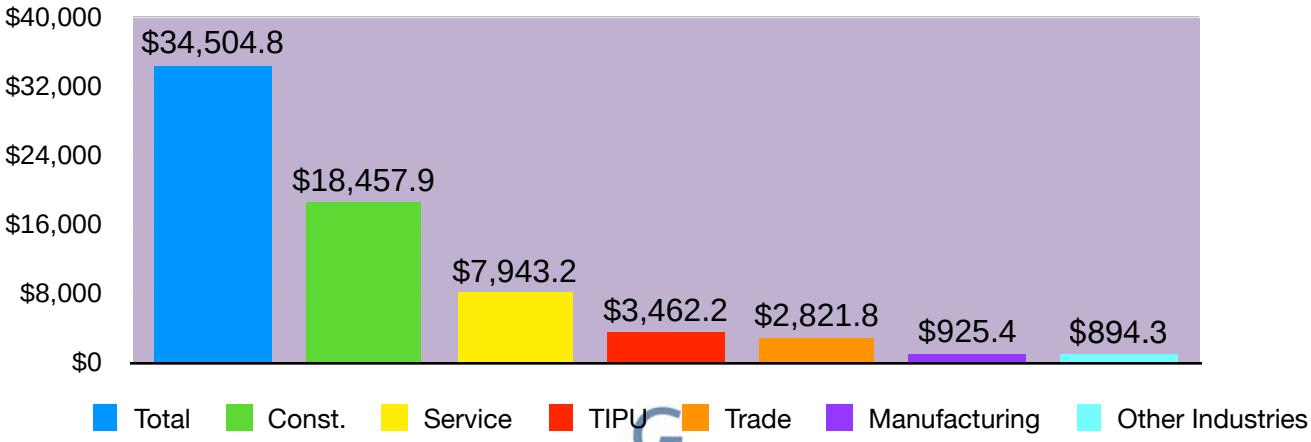
Source: Goss & Associates from IMPLAN Multiplier System (See Appendix B for an overview of IMPLAN)

Iowa Wind Impacts

Wind Construction

Total Impacts: Figure 30 compares impacts by 6 major industries related to wind construction expenditures. These 6 industries are broken down into smaller industries in table 5. As listed, total impacts for all industries were $34.5 billion with total impacts by industry of $18.5 billion for construction, $7.9 billion for services , $3.5 billion for

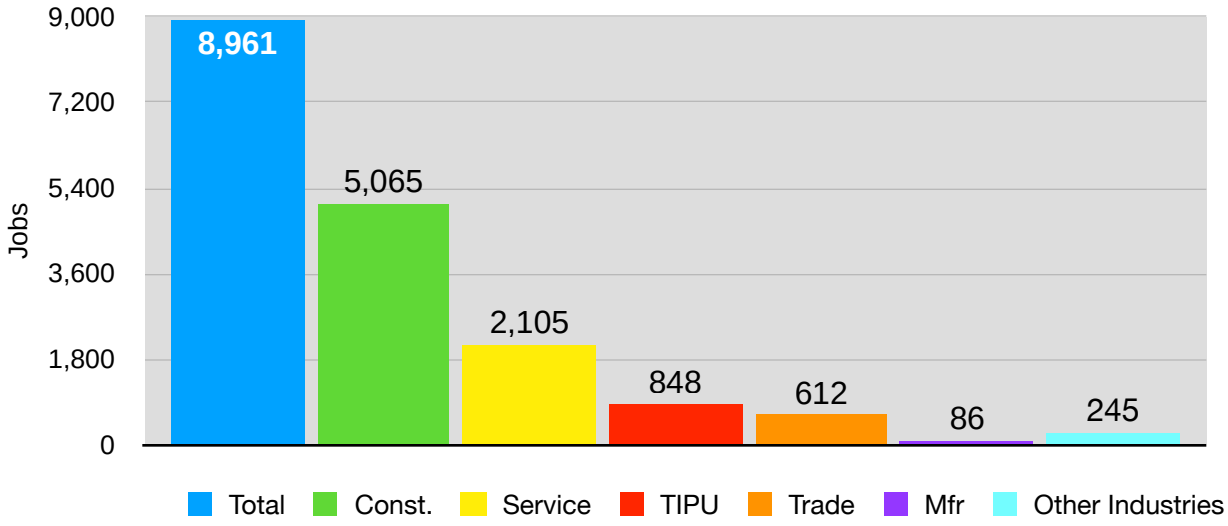
Figure 30: Total Construction Impacts by Industry of Wind Power on Iowa, (1992-2021) (in millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)



transportation, information, and utilities, $2.8 billion for wholesale and retail trade, $925.4 million for manufacturing, and $894.3 million for other industries.

Figure 31 compares job impacts in the 6 major industries. As listed, total average annual impacts for all industries were 8,961, for construction with 5,065 jobs, for services with 2,105 jobs, transportation, information, and utilities with 848 jobs, for wholesale and retail trade 612 jobs, manufacturing with 86 jobs, and other industries with 245 jobs.

Figure 31: Average Annual Job Impacts of Construction by Industry of Wind Power on Iowa, (1992-2021) (Source: Goss & Associates based on IMPLAN Models)



Impacts by Industry: Construction of wind structures had a $2.3 billion impact on the trucking industry, with wholesale trade receiving a $1.7 billion boost. Commercial bank sales or revenue activity has increased by $398.1 million; construction of wind structures had a $2.3 billion impact on the trucking industry, with wholesale trade receiving a $1.7 billion boost. Table 5 lists the industry impacts broken down into more specific industries. The top 20 specific industries experiencing wind construction impacts are listed below.

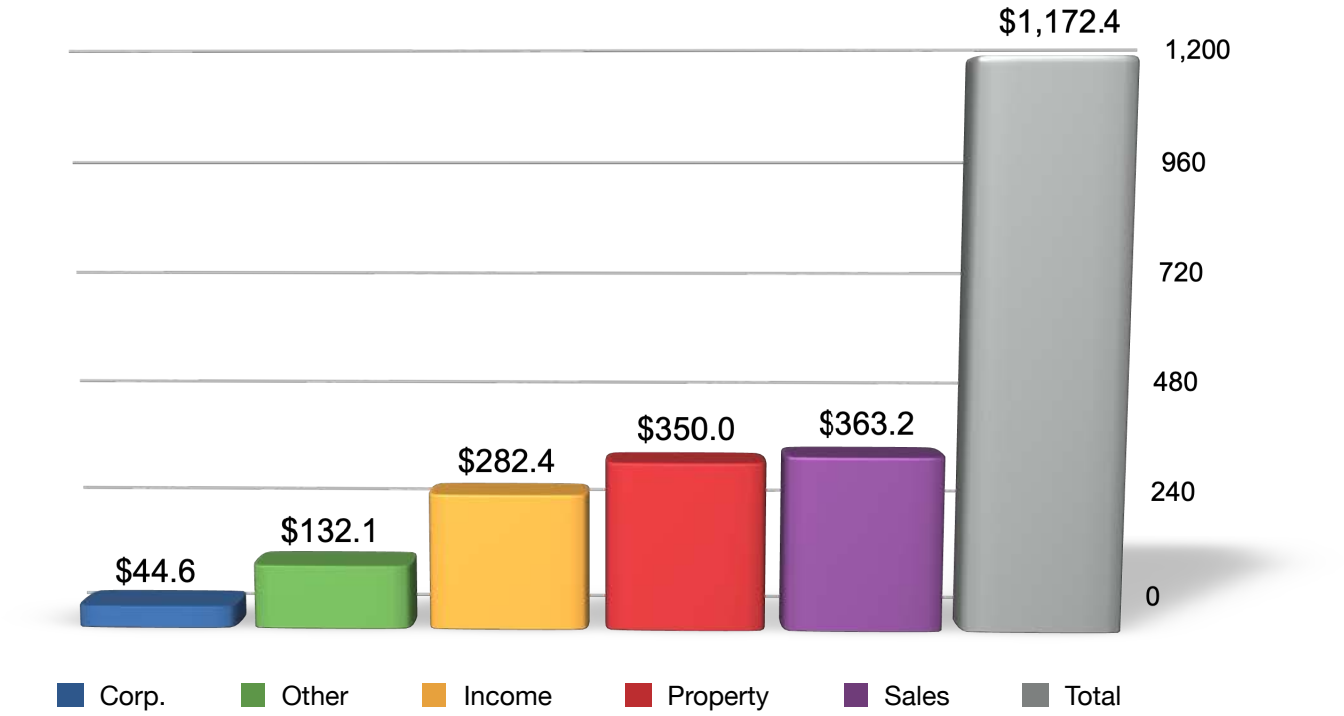
Table 5: Wind Construction Impacts (1992-2021), Top-20 Industries
(2022 Dollars in Millions)

Sector or Industry	Total or Sales	Wage & Salary	Self-Empl income	Jobs
Construction	$18,457.9	$5,269.3	$2,927.7	5,065
Truck transportation	$2,254.1	$608.0	$184.6	473
Wholesale trade	$1,713.1	$519.1	$68.7	263
Owner-occupied dwellings	$1,112.0	n.a.	n.a.	n.a.
Real estate*	$750.4	$34.7	$30.1	115
Architectural, engineering, and related services	$623.7	$295.7	$25.1	135
Hospitals	$426.2	$188.1	$0.2	99
Commercial banks	$398.1	$144.0	$1.3	70
Insurance carriers	$393.3	$69.9	$0.0	23
Commercial and industrial machinery and equipment rental and leasing	$352.7	$55.5	$36.8	46
Offices of physicians	$252.3	$183.3	$6.8	62
Limited-service restaurants	$249.3	$53.8	$3.4	122
Legal services	$243.0	$83.4	$18.2	57
Electric power transmission and distribution	$216.3	$19.4	$0.0	6
Management of companies and enterprises	$173.5	$83.1	-$0.2	30
Employment services	$164.4	$84.7	$1.2	86
Retail - General merchandise stores	$163.2	$67.8	$0.7	89
Retail - Nonstore retailers	$158.5	$11.7	$11.9	67
Ready-mix concrete manufacturing	$155.7	$27.3	$0.0	15
Wireless telecommunications carriers (except satellite)	$153.8	$4.5	$0.2	3
All other sectors	$6,093.2	$1,944.7	$402.8	2,133
Total (average yearly for jobs)	$34,504.8	$9,748.1	$3,719.5	8,961

** Includes an estimated $50.3 million in land lease payments, based on nameplate capacity (MW). Source: Goss and Associates using the IMPLAN multiplier system.

Tax impacts: Figure 32 lists the impact of wind construction on state & local tax collections. As presented, construction of wind production facilities from 1992 to 2021 produced $1.2 billion in state & local tax collections. Sales tax collections for the 30 years were $363.2 million, followed by property tax with $350 million.

Figure 32: Wind Construction Impacts on State & Local Tax Collections, 1992-2021 (millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)

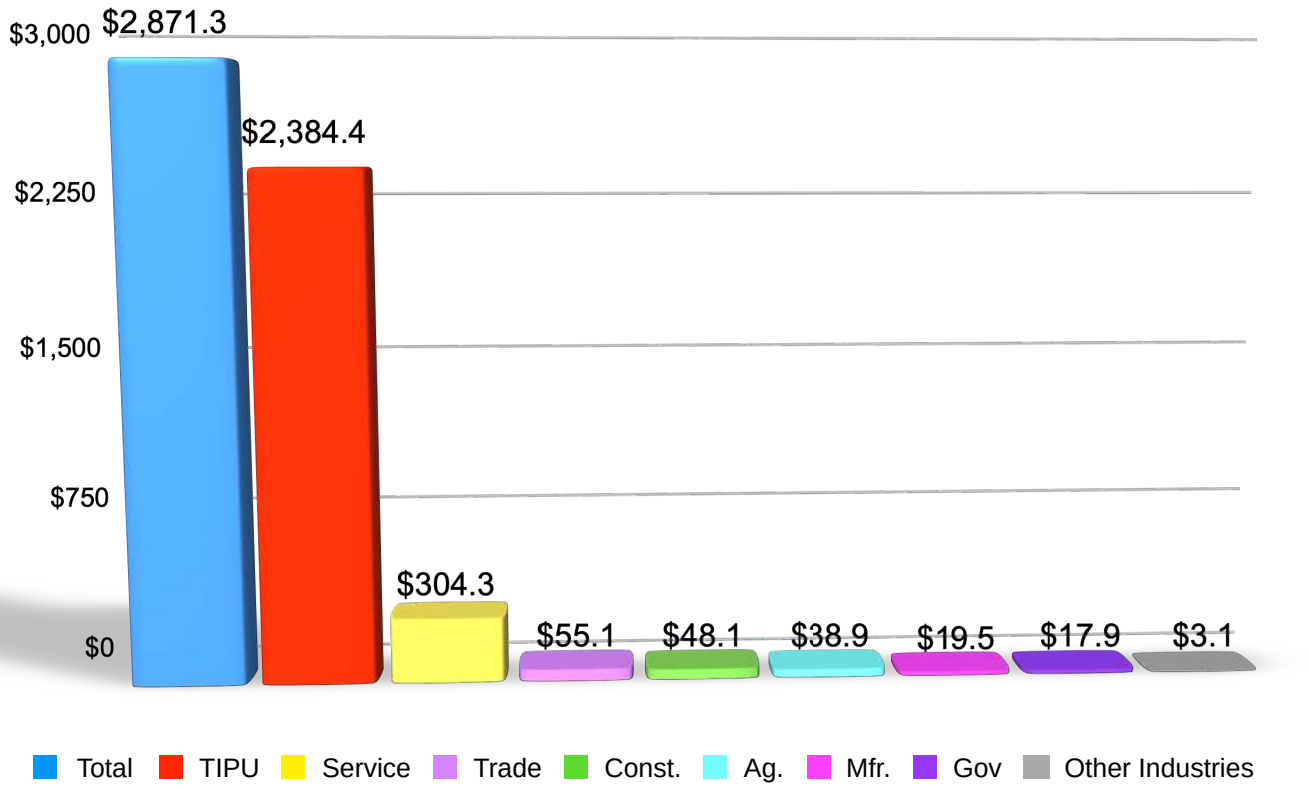


A VETERAN OWNED ORGANIZATION

Iowa Wind Operations & Maintenance, 2021

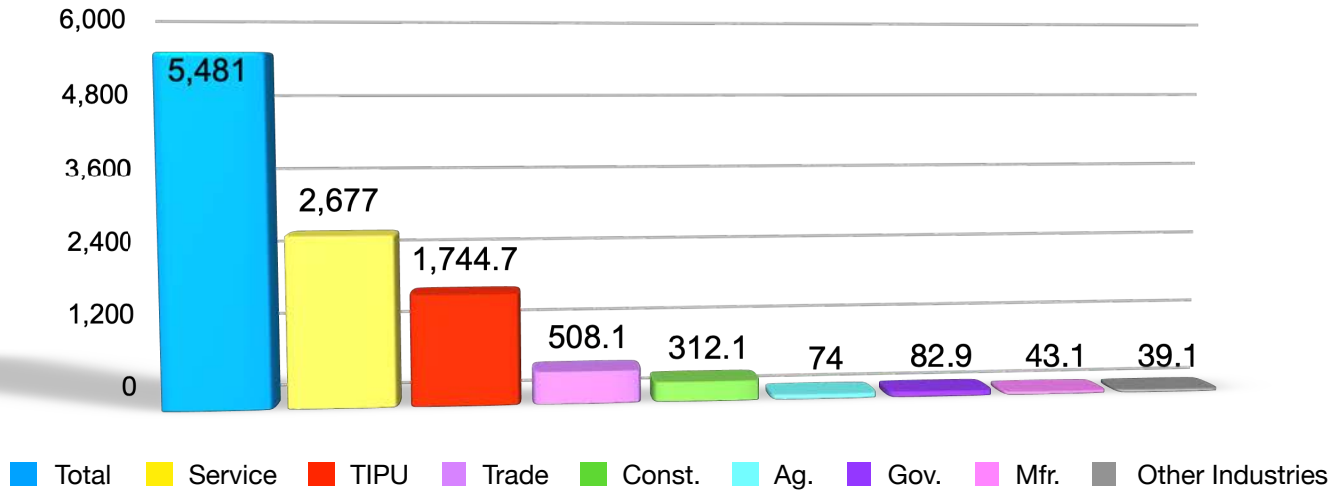
Total Impacts: Total operations and maintenance, impacts were estimated at $2.9 billion. Figure 33 lists the impacts into 8 major industries related to wind operations and maintenance. These 8 industries are broken down into 20 smaller industries in table 6. The 8 major industries benefiting from wind operation and maintenance are TIPU at $2.4 billion, services at $304.3 million, wholesale and retail trade at $55.1 million, construction at $48.1 million, agriculture at $38.9 million, manufacturing at $19.5 million, government at $17.9 million, and other industries at $3.1 million.

Figure 33: Total Operations Impact of Wind Power on Iowa, 2021
(in Millions of 2022 dollars) (Source: Goss & Associates based on IMPLAN Models)



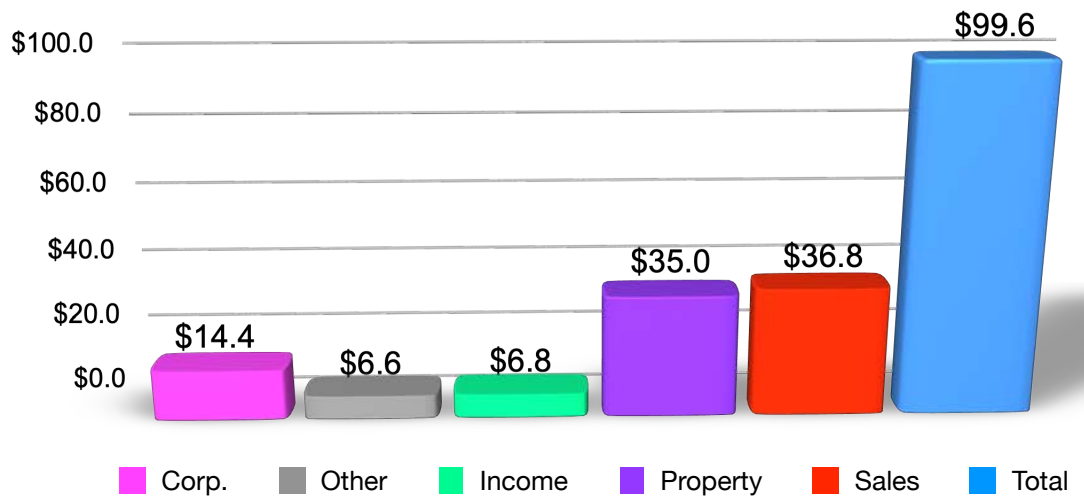
Job Impacts: Figure 34 lists the jobs supported by wind energy generation in Iowa for 2021 in the major 8 industries . As shown, 5,481 jobs were supported by wind generation in 2021 in 8 major categories. This estimate includes direct and spillover jobs.

Figure 34: Iowa Jobs Supported by Industry for Operations and Maintenance of Wind Generation, (2021) (in millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)



State & Local Tax Collections: For the 2021 year the operations and maintenance for the wind generation created $99.6 million in total state and local tax collections as illustrated in figure 35. Sales tax was impacted by $36.8 million and property taxes were increased by $35.0 million. Corporate tax was next with $14.4 million increase from wind generation. The income tax was increased $6.8 million and other tax was impacted by $6.6 million

Figure 35: Iowa State & Local Tax Collections Produced by Wind Energy Generation for 2021 (in Millions of 2022 Dollars) - (Source: Goss & Associates based on IMPLAN Models)



Impacts by Industry 2021: Ongoing wind operations and maintenance have a significant impact on the state of Iowa economy. Table 6 lists the industry impacts broken down into more specific industries. The top 20 specific industries experiencing wind operation impacts are listed below.The top three industries experiencing spillover economic impacts for 2021 were $47.0 million for maintenance and repair; $39.3 million for commercial banks, and $35.8 million for real estate. Table 6 lists impacts for the top 20 industries experiencing impacts for wind operations & maintenance in 2021.

Table 6: Wind Operations & Maintenance Impacts for 2021, Top-20 Industries
(in Millions, 2022 Dollars) (Source: Goss & Associates based on IMPLAN Models)

Industry	Total or Sales	Wages & Salaries	Self-Empl Income	Jobs
Electric power generation - wind	$2,264.5	$140.3	$0.0	1,291
Maintenance & repair (wind structures and equipment) / construction	$47.0	$11.8	$4.9	299
Commercial banks	$39.3	$14.1	$0.1	198
Real estate	$35.8	$0.5	$2.8	63
Wholesale trade	$27.5	$8.3	$1.1	121
Owner-occupied dwellings	$27.4	n.a.	n.a.	n.a.
Transportation activities	$22.3	$6.8	$1.1	148
Employment services	$18.6	$9.5	$0.1	278
Local electric utilities	$15.6	$1.4	$0.0	14
Legal services	$14.5	$4.9	$1.1	98
Pipeline transportation	$14.1	$3.8	$0.0	32
Professional, scientific, and technical services	$13.1	$1.3	$6.4	204
Other local government enterprises	$12.8	$3.3	$0.0	44
Full-service restaurants	$12.4	$5.0	$0.3	295
Insurance carriers	$11.6	$2.1	$0.0	20
Rail transportation	$11.0	$2.3	$0.0	20
Hospitals	$10.7	$4.7	$0.0	71
Data processing, hosting, and related services	$9.2	$2.4	$0.0	33
Limited-service restaurants	$7.7	$1.7	$0.1	107
Truck transportation	$6.8	$1.8	$0.5	41
All other sectors	$249	$71	$14	2,103
Total (average yearly for jobs)	$2,871.3	$296.8	$32.8	5,481
Source: Goss and Associates using the IMPLAN multiplier system.				

- **Tax base (property tax) and road and transportation expenditures:** Wind-industry counties grow their tax base more quickly than non-wind counties. The activity associated with wind electricity generation increases property tax revenue in wind counties. The analysis below provides a comparison between the top five wind-generation counties to non-wind generation counties with similar populations. Table 7 presents the counties used in the analysis.

Table 7: Wind vs. Non-Wind Counties: Population (2021)

Comparable Wind Iowa Counties	
County	**Population**
Adair	7,541
Adams	3,641
Cass	13,050
O'Brien	14,015
Winnebago	10,656
Total top 5 wind counties	48,903
Comparable Non-Wind Iowa Counties	
County	Population
Allamakee	13,926
Harrison	14,669
Keokuk	9,914
Ringgold	4,639
Van Buren	7,243
Total non-wind counties	50,391
Source: U.S. Census Department	

Table 8 provides a comparison of the compound annual growth rate for the selected counties. For the eleven years ending in 2021, the tax base in the wind counties grew at an annual rate of 4.61%; the non-wind counties grew at a 3.51% rate. The annual rate of growth achieved by the wind counties was 31.1% greater than the non-wind counties.

Table 8: Tax Base Growth: Wind Counties (2010 to 2021, Nominal Dollars)

Tax base growth: wind counties (2010 to 2021, nominal dollars)				
Geography	2010	2021	Base increase	CAGR
Adair	$3,035,786	$5,432,979	$2,397,193	5.43%
Adams	$2,503,878	$4,562,563	$2,058,685	5.61%
Cass	$4,362,957	$7,757,043	$3,394,086	5.37%
O'Brien	$5,197,759	$7,031,969	$1,834,210	2.79%
Winnebago	$4,127,268	$6,772,941	$2,645,673	4.61%
Total WIND	$19,227,648	$31,557,495	$12,329,847	4.61%
Tax base growth: non-wind counties (2010 to 2021, nominal dollars)				
Geography	2010	2021	Base increase	CAGR
Allamakee	$4,872,473	$7,901,987	$3,029,514	4.49%
Harrison	$6,371,784	$8,416,995	$2,045,211	2.56%
Keokuk	$4,306,864	$6,696,619	$2,389,755	4.09%
Ringgold	$2,632,400	$3,593,103	$960,703	2.87%
Van Buren	$2,324,176	$3,378,215	$1,054,039	3.46%
Total NON-WIND	$20,507,697	$29,986,919	$9,479,222	3.51%
Source: Iowa Department of Management				

Table 9 comprising of two sections presents a comparison of growth rates in road and transportation expenditures for the selected counties. Wind counties were able to increase road and transportation spending at a faster pace (7.8% per annum) than the non-wind counties.

Table 9: County Government Expenditures: Road & Transportation, Wind Counties (2010 to 2021, Nominal Dollars)

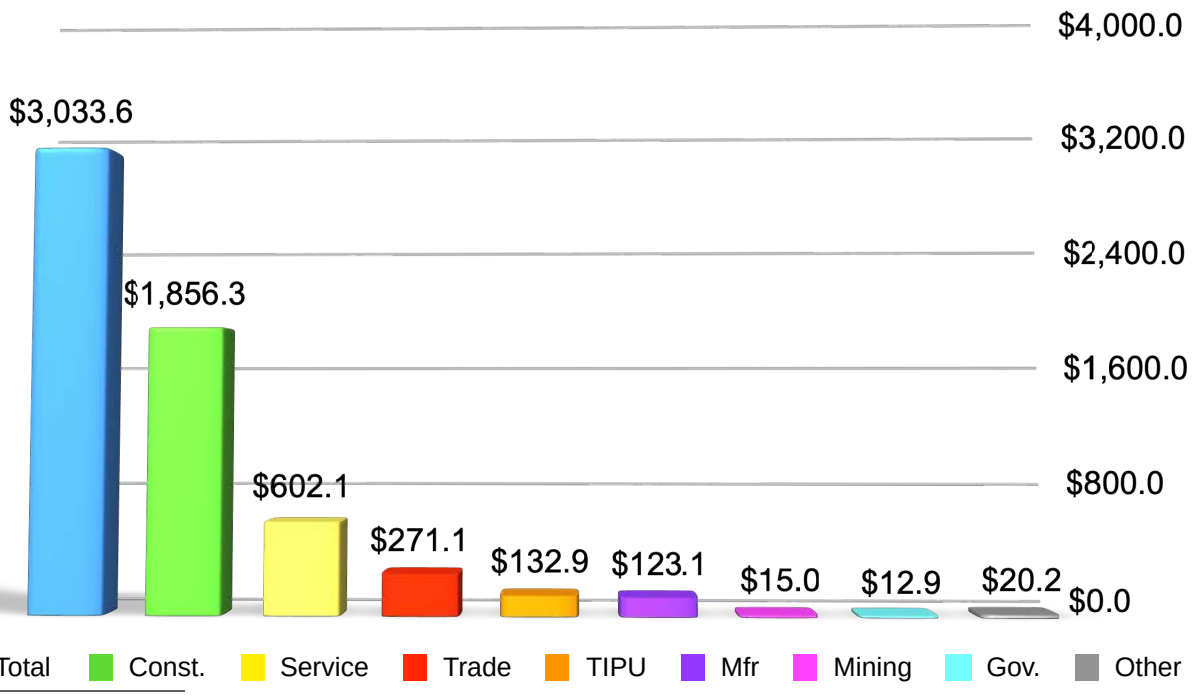
County government expenditures: road and transportation, wind counties (2010 to 2021, nominal dollars)				
Wind County	2010	2021	Expenditure Increase	CAGR
Adair	$3,775,903	$7,111,866	$3,335,963	5.92%
Adams	$2,767,500	$3,729,790	$962,290	2.75%
Cass	$4,399,000	$7,148,000	$2,749,000	4.51%
O'Brien	$3,715,300	$5,361,491	$1,646,191	3.39%
Winnebago	$3,006,754	$4,043,199	$1,036,445	2.73%
Total WIND	$17,664,457	$27,394,346	$9,729,889	4.07%
Non-Wind County	2010	2021	Expenditure Increase	CAGR
Allamakee	$4,754,547	$7,063,914	$2,309,367	3.66%
Harrison	$4,897,512	$6,965,000	$2,067,488	3.25%
Keokuk	$3,511,000	$5,405,900	$1,894,900	4.00%
Ringgold	$2,810,058	$3,394,229	$584,171	1.73%
Van Buren	$2,690,000	$5,230,000	$2,540,000	6.23%
Total NON-WIND	$18,663,117	$28,059,043	$9,395,926	3.78%
Source: Iowa Department of Management				

Iowa Solar Impacts[6]

Solar Construction

Total Impacts: Solar impacts on construction expenditures between 2020 and 2025 were significant. Figure 36 compares impacts by industry. As listed, total impacts for all industries were $3,033.6 million. Construction had the highest impact with $1.9 billion, services had $602.1 million, wholesale and retail trade had $271.1 million, transportation, information, and utilities had $132.9 million and manufacturing had $123.1 million., mining had $15.0 million, government had $12.9 million, and other industries including agriculture had $20.2 million .

Figure 36: Total Construction Impacts by Industry of Solar Power on Iowa, (2020- 2025) (in millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)

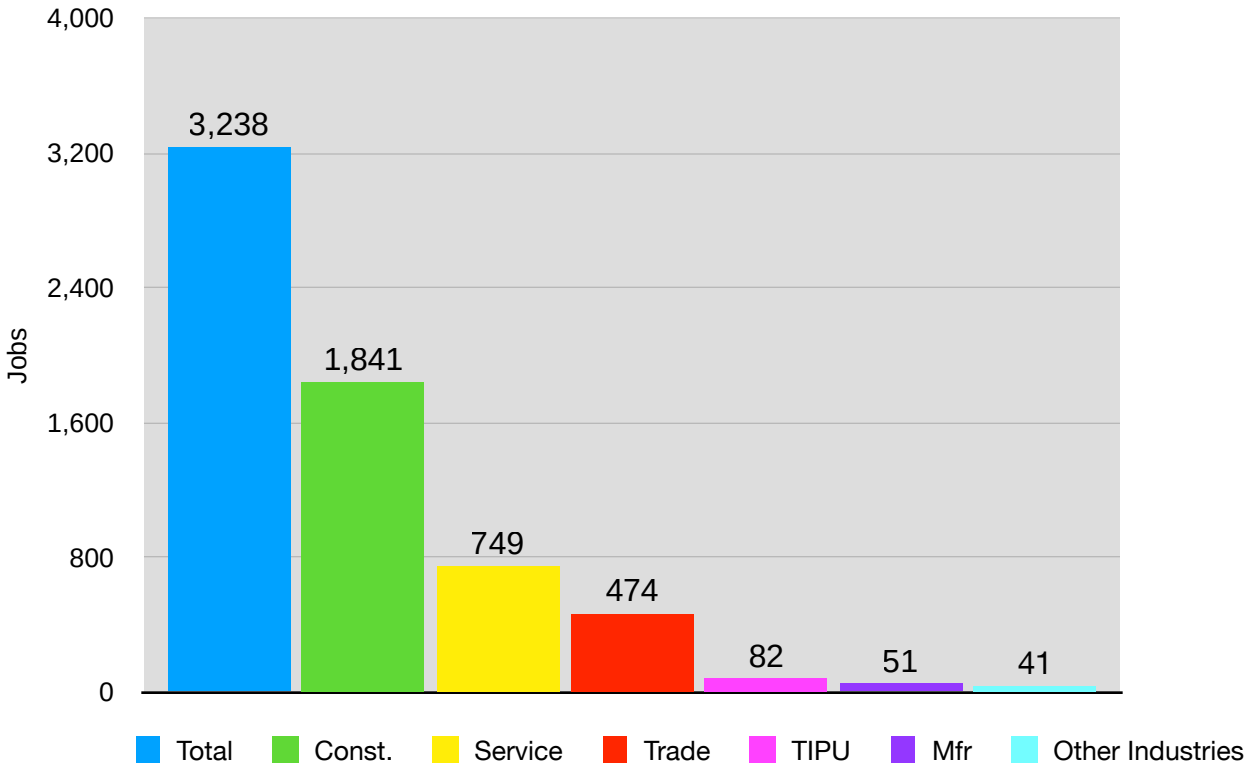


[6] Source of all projected solar spending is the Iowa Utilities Board (IUB).

Job Impacts: Solar construction impacts between 2020 and 2025 on jobs were significant. Figure 37 compares impacts in 6 major industries related to solar construction expenditures. These 6 industries are broken down into smaller industries in table 10 to show specific job impacts by industry. As listed, total average annual impacts for all industries were 3,238, construction 1,841, services 749, wholesale and retail trade 474, transportation, information, and utilities 82, manufacturing 51, and 41 jobs in other industries.

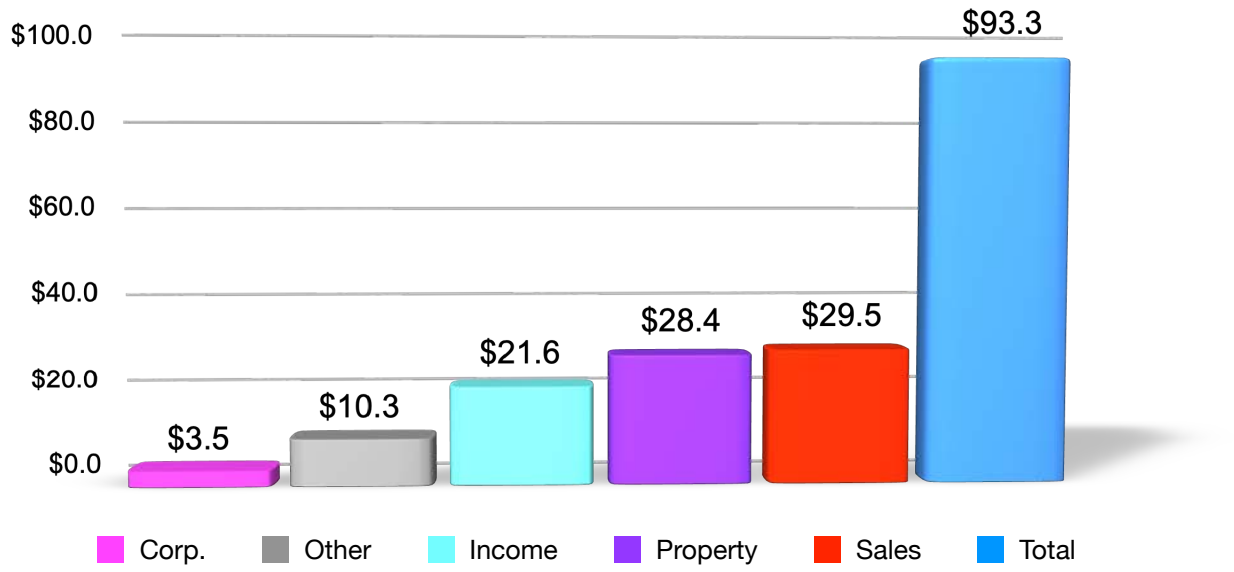
As Presented, solar investment and construction activity in the state is expected to produce a total of $93.3 million in total tax collections from 2020 to 2025.

Figure 37: Average Annual Job Impacts of Construction of Solar Power on Iowa, (2020 - 2025) (in millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)



Tax impacts (2020-25): Figure 38 lists solar investment and construction's contribution to state and local tax collections. As presented, solar investment and construction activity in the state is expected to produce a total of $93.3 million in total tax collections from 2020 to 2025 .

Figure 38: Solar Construction Impacts on State & Local Tax Collections (2020 - 2025) (in millions of 2022 dollars) (Source: Goss & Associates based on IMPLAN Models)



Impacts by Industry (2020-25): Table 10 breaks the main 6 industries down even further into the top 20 industries in order to get a more detailed view of what industries are impacted. The top four non-construction industries impacted by Iowa's solar investment are as follows: wholesale trade ($100.1 million); owner-occupied dwellings ($85.8 million); real estate ($58.0 million); and architecture and engineering firms ($35.1) are the top four impacted industries after construction.

Table 10: Solar Construction Impacts, Top-20 Industries (2020 - 2025) Millions of 2022 $

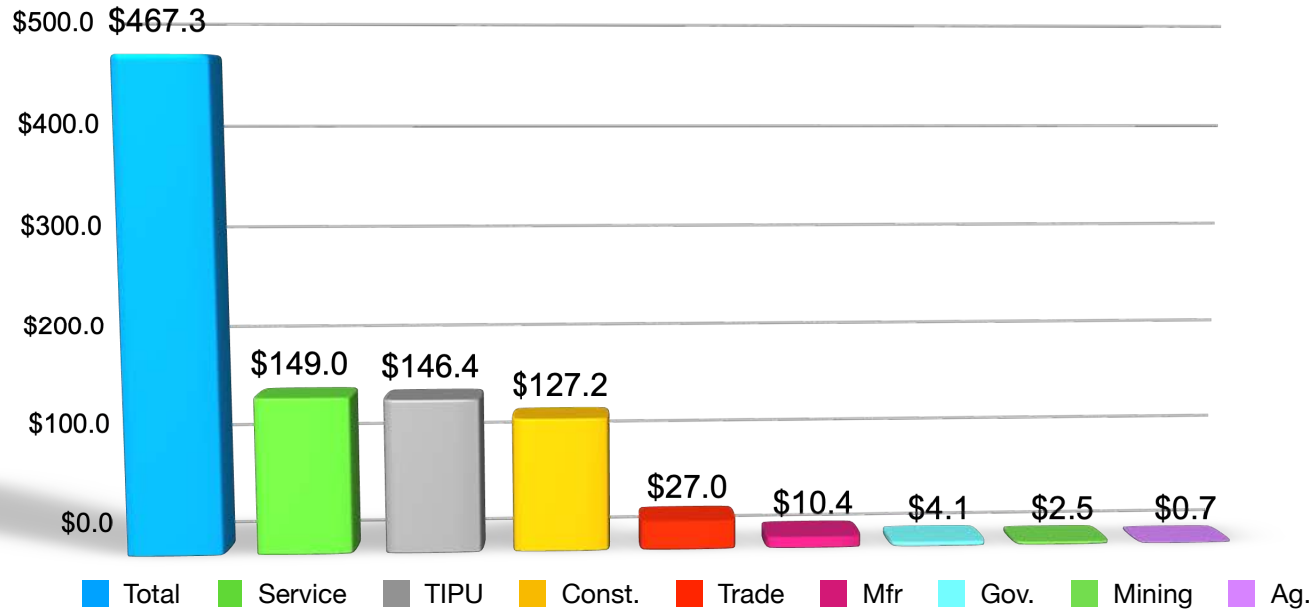
Industry	Total or Sales	Wage & Salary	Self-Empl Income	Jobs
Construction	$1,856.3	$349.4	$291.0	1,840.7
Wholesale trade	$100.1	$30.1	$3.9	70.1
Owner-occupied dwellings	$85.8	$0.0	n.a.	n.a.
Real estate*	$58.0	$2.7	$2.3	40.5
Ag., engineering, and related services	$35.1	$16.5	$1.4	34.7
Truck transportation	$33.1	$8.9	$2.6	31.6
Hospitals	$32.6	$14.3	$0.0	34.6
Commercial banks	$31.7	$11.4	$0.1	25.5
Ready-mix concrete manufacturing	$29.8	$5.2	$0.0	12.8
Commercial and industrial machinery and equipment rental and leasing	$26.1	$4.1	$2.6	15.5
Insurance carriers	$26.0	$4.6	$0.0	7.0
Retail - Building material and garden equipment and supplies stores	$25.9	$10.0	$0.7	44.8
Retail - Nonstore retailers	$21.3	$1.6	$1.5	41.1
Offices of physicians	$19.4	$13.9	$0.5	21.8
Limited-service restaurants	$19.3	$4.1	$0.3	42.9
Electric power transmission and distribution	$18.7	$1.7	$0.0	2.3
Retail - Health and personal care stores	$18.5	$8.0	$0.8	38.6
Retail - General merchandise stores	$14.7	$6.1	$0.1	36.5
Retail - Clothing and clothing access stores	$14.1	$3.6	$0.5	31.3
Management of companies and enterprises	$13.8	$6.5	$0.0	10.7
All other sectors	$553.4	$167.0	$44.2	855.4
Total (average yearly for jobs)	$3,033.6	$669.6	$352.5	3,238.4

* Includes an estimated $35.9 million in land purchases and lease payments, based on nameplate capacity (MW). Source: Goss and Associates using the IMPLAN multiplier system.

Solar Operations & Maintenance Impacts, 2025

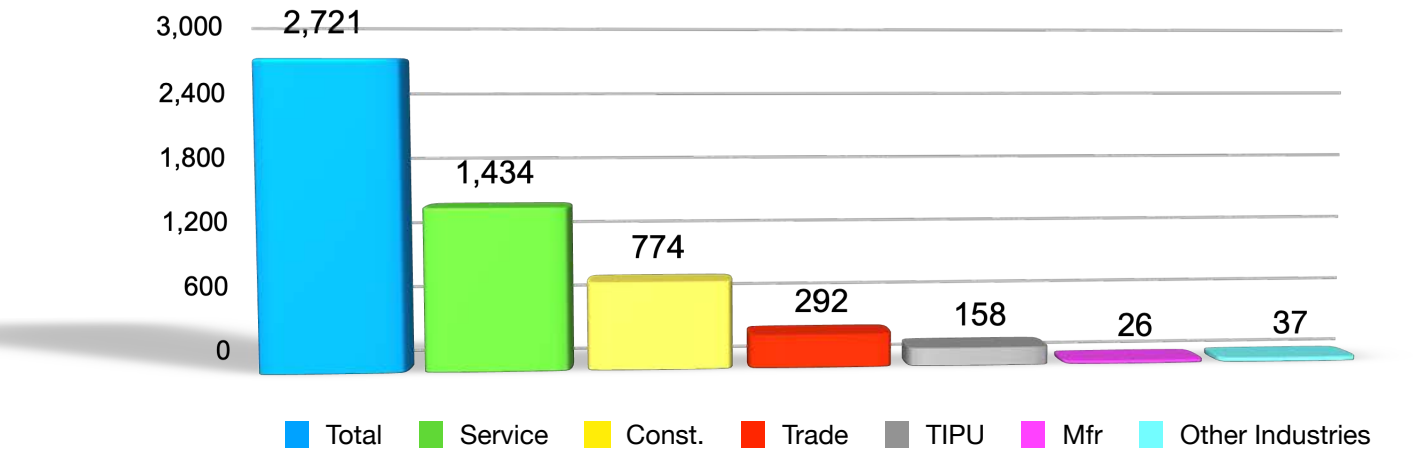
Total impacts: Total operations and maintenance impacts were estimated at $467.3 million for 2025. Figure 39 lists industries benefiting from operations.impacts into 8 major industries related to solar operation expenditures. These 8 industries are broken down into smaller industries in table 11. They were services at $149.0 million, TIPU at $146.4, construction at $127.2 million, wholesale and retail trade at $27.0 million, manufacturing at $10.4 million, government at $4.1 million, mining at $2.5 million, and agriculture at $700 thousand .

Figure 39: Total Solar Power Operations Impacts on Iowa, 2025 (in millions of 2022 dollars) - (Source: Goss & Associates based on IMPLAN Models)



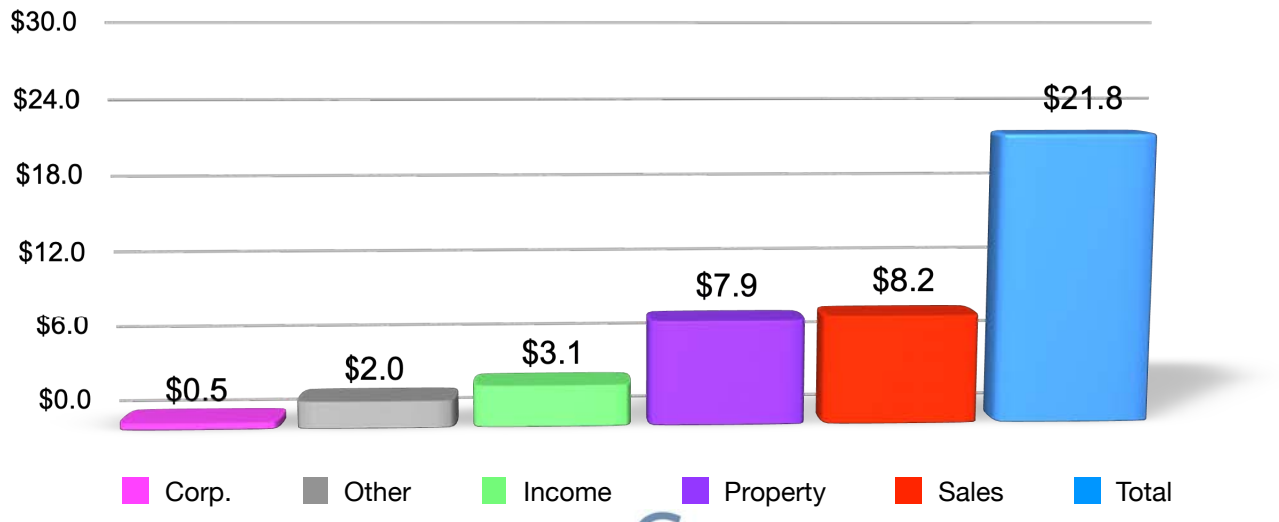
Job Impacts, 2025: Figure 40 provides operation job impacts of Iowa solar for 2025 into 6 major industries. Table 11 lists the jobs in more detailed specific industries. In 2025, operations of solar plants will provide 2,271 jobs of which 1,434 will be in the service sector.

Figure 40: Jobs supported by solar operations and maintenance in 2025 (Source: Goss & Associates based on IMPLAN Models)



State & Local Tax Collections: For the 2025 operations period, solar operations are expected to produce $21.8 million in state and local tax collection with $8.2 million in sales tax. Figure 41 details on these tax collections.

Figure 41: Solar Operations & Maintenance Impacts on State & Local Tax Collections , 2025 (in millions of 2022 dollars) (Source: Goss & Associates based on IMPLAN Models)



- **Impacts by Industry, 2025:** On-going solar operations and maintenance have a significant impact on the state of Iowa. Table 11 lists solar operation impacts from 2025 broken down into more specific 20 industries. The top three industries experiencing impacts were: maintenance & repair ($86.6 million); wholesale trade ($64.6); and real estate ($48.7 million). The top 20 industries impacted by Iowa's solar generation activity are presented in Table 11.

Table 11: Solar Operations and Maintenance Impacts by Industry, top-20 Industries, 2025 (in millions of 2022 dollars)

Industry	Total or Sales	Wage & Salary	Self-Empl Income	Jobs
Electric power generation - solar	$131.8	$12.5	$0.1	96.2
Maintenance. & repair (solar structures)	$86.6	$21.2	$11.9	597.1
Wholesale trade	$64.6	$42.6	$5.1	789.8
Real estate	$48.7	$13.0	$1.6	209.8
Owner-occupied dwellings	$12.6	$0.0	$0.0	0.0
Commercial banks	$9.3	$0.4	$0.4	39.0
Office administrative and management	$5.1	$1.8	$0.0	24.5
Hospitals	$4.9	$2.1	$0.0	31.1
Insurance carriers	$3.8	$0.7	$0.0	6.3
Truck transportation/transportation activities	$3.2	$0.8	$0.3	18.1
Limited-service restaurants	$2.9	$0.6	$0.0	38.6
Offices of physicians	$2.9	$2.1	$0.1	19.5
Retail - Building material and supplies	$2.5	$1.0	$0.1	25.9
Local electric utilities	$2.5	$0.4	$0.0	4.1
Retail - Nonstore retailers	$2.4	$0.2	$0.2	27.3
Employment services	$2.0	$1.0	$0.0	28.0
Retail - General merchandise stores	$2.0	$0.8	$0.0	29.1
Full-service restaurants	$1.9	$0.8	$0.0	43.5
Wireless telecommunications carriers	$1.9	$0.1	$0.0	0.9
Commercial and industrial machinery	$1.9	$0.3	$0.2	6.6
All other sectors	$74.0	$23.2	$5.4	686.0
Total	$467.3	$125.6	$25.3	2,721.2
Source: Goss and Associates using the IMPLAN multiplier system.				

Appendices

Appendix A: Impacts Wind and Solar on Iowa

Figures 42 to 49 - profile wages & salaries, and self-employment income impacts for wind and solar.

Figure 42: Wind Construction Impacts Wage & Salaries 1992 - 2021 (Source: Goss & Associates) (Millions of 2022 dollars)

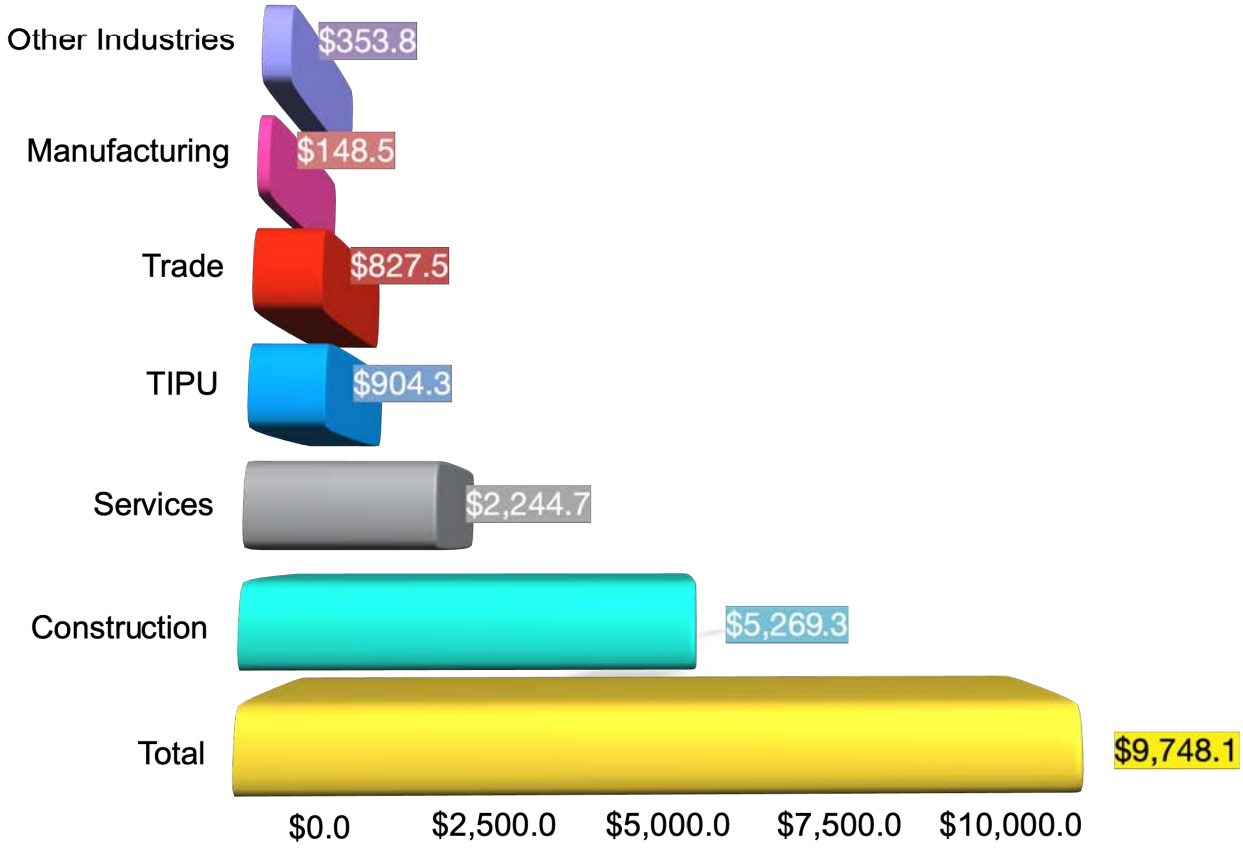


Figure 43: Wind Construction Impacts on Self Employment 1992 - 2021
(Source: Goss & Associates) (Millions of 2022 dollars)

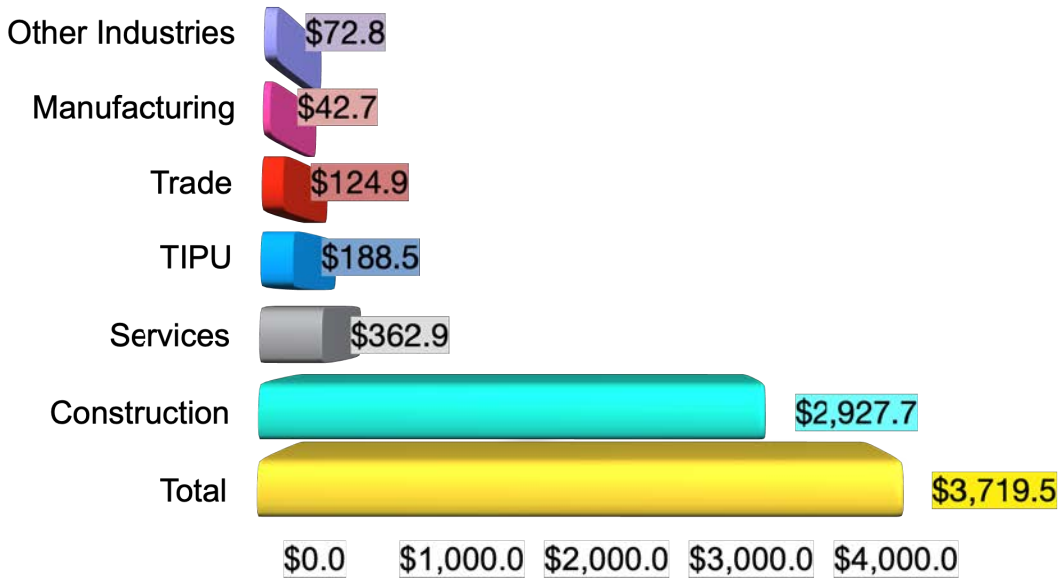


Figure 44: Wind Operation Impacts on Wages & Salaries 2021
(Source: Goss & Associates) (Millions of 2022 dollars)

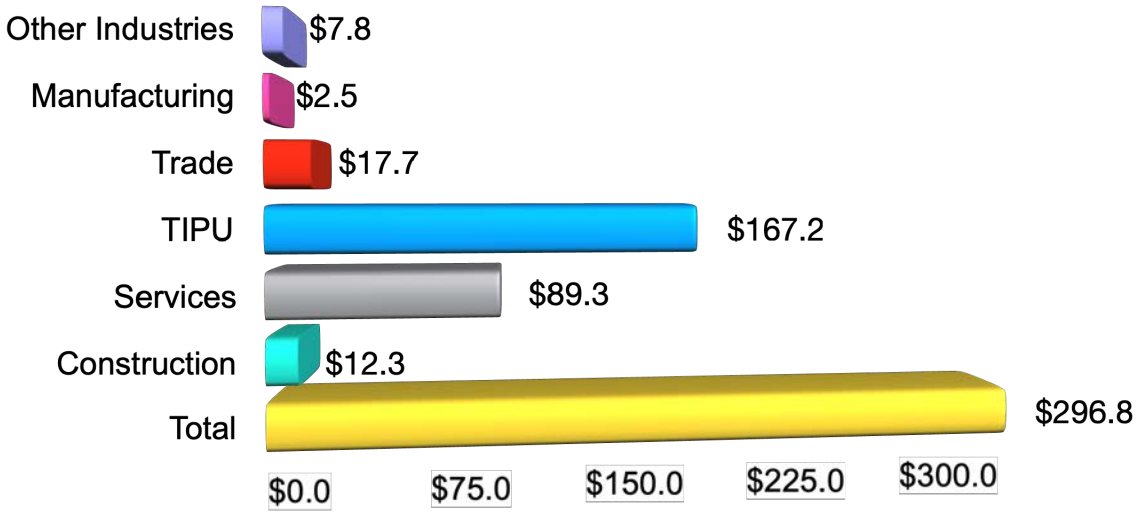


Figure 45: Wind Operations Impacts on Self Employment 2021 (Source: Goss & Associates) (Millions of 2022 dollars)

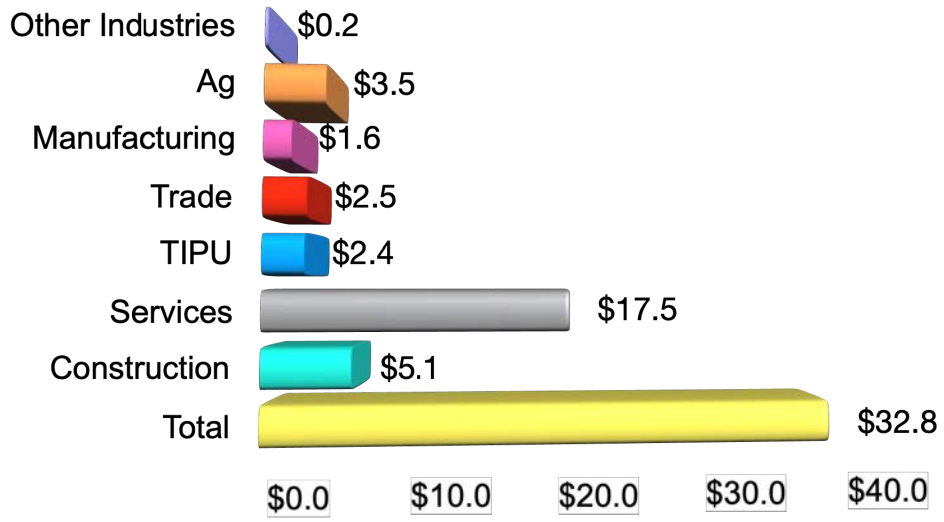


Figure 46: Solar Construction Impacts on Wage & Salaries 2020-2025(Source: Goss & Associates) (Millions of 2022 dollars)

Figure 47: Solar Construction Impacts on Self Employment Income 2020- 2025(Source: Goss & Associates) (Millions of 2022 dollars)

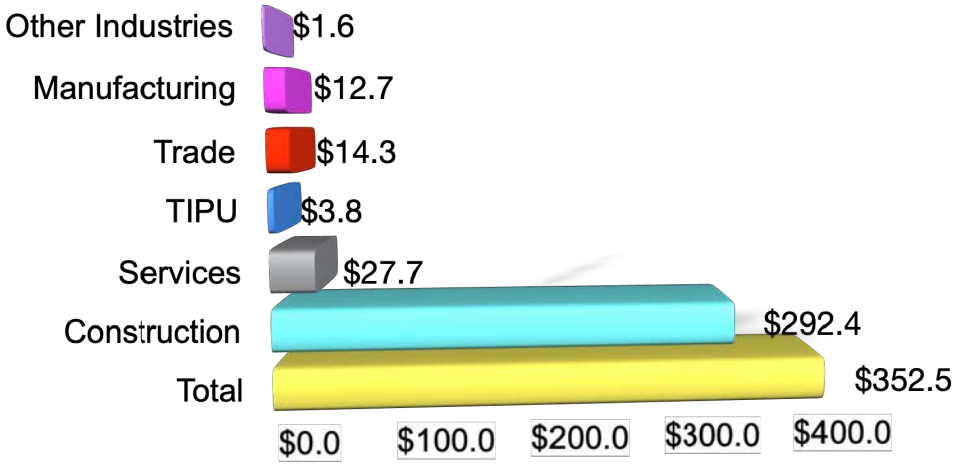


Figure 48: Solar Operation Impacts on Wages & Salaries 2025(Source: Goss & Associates) (Millions of 2022 dollars)

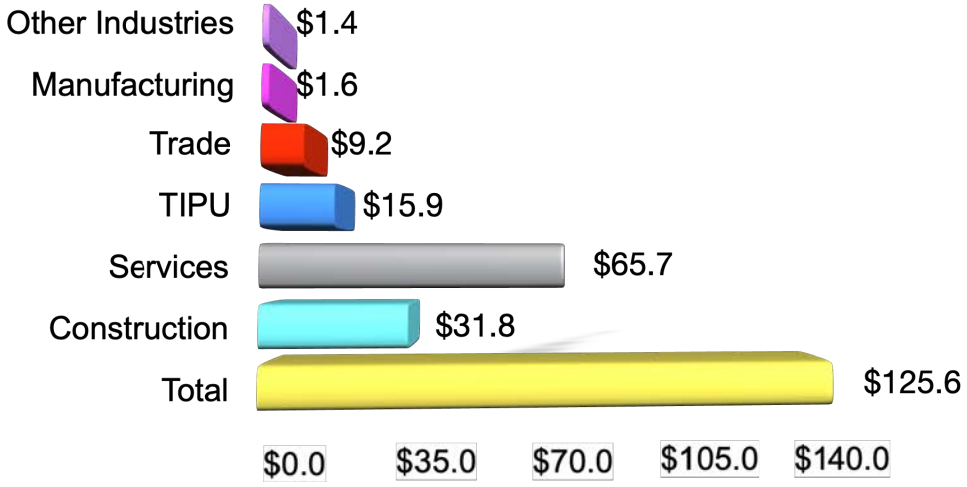


Figure 49: Solar Operation Impacts on Self Employment Income 2025(Source: Goss & Associates) (Millions of 2022 dollars)

Appendix B: The Multiplier Effect & IMPLAN Multipliers

When employees of wind and solar energy producers spend their salaries within the community, the spending filters through the local economy and causes increased overall spending greater than the initial spending. The impact of this re-spending is known as the multiplier effect.

Economic impacts that take place outside the local economy, for example wind and solar producer spending in Denver, are called leakages and reduce the multiplier and overall impacts. They are excluded when estimating regional economic impacts. While the direct effects of wind and solar spending can be measured by a straightforward methodology, the indirect and induced effects of the project's spending must be estimated using regional multipliers.

Many types of public and private sector decisions require an evaluation of probable regional effects. Since important impacts are often economic, this requirement has created a need for regional economic impact models. The three most common types of impact models are economic base, econometric, and input-output (I-O). The first two of the three impact models have inherent disadvantages that markedly reduce their viability for estimating the impact of energy generating companies spending on the Iowa economy.

Despite their weaknesses and somewhat restrictive assumptions, I-O multipliers are the tools most often used for impact analysis. Due to their documented effectiveness and relatively low cost, the I-O multipliers used in this study are those initially produced by the U.S. Forestry Service.

Input-Output (I-O) Models. I-O models are the most frequently used types of analysis tools for economic impact assessment. Input-output is a simple general equilibrium approach based on an accounting system of injections and leakages. Input-Output

analysis assumes that each sector purchases supplies from other sectors and then sells its output to other sectors and/or final consumers.

Historically, high costs precluded the extensive use of I-O models in regional impact analysis. However, with the advent of "ready-made" multipliers produced by third parties, such as the U.S. Forestry Service, I-O multipliers used in this study became a much more viable option for performing impact analysis.

All purely non-survey techniques or "ready-made" multipliers take a national I-O table as a first approximation of regional inter-industry relationships. The national table is then made region-specific by removing those input requirements that are not produced in the region.

Input-Output systems were originally developed by Wassily Leontief (1941) to assist in planning a national economy. Input-Output represents an effective method for depicting and investigating the underlying processes that bind industries of a region. It provides a technique to project into the future the magnitude of important additions or injections into the local economy.

Input-Output models are composed of three basic tables. The first, *the Transactions Table*, traces inter-industry sales and purchases within a defined region. The next table, the *Direct Requirements Table*, answers the question, "If a certain dollar value of intermediate requirements is present for a total dollar value of gross output, what are the intermediate requirements for each industry per dollar of gross output?" The manipulation of these two tables results in the final and most important of the tables, the *Industrial Multiplier Table*. This table is then used to calculate overall impacts.

Appendix C: Measuring the Impact of Wind and Solar Energy

An Overview

The energy industry is an engine of economic growth for the state of Iowa. Wind and Solar companies and their vendors contribute to the economy through their own employment and payroll, and through purchases from vendors. Payments to these vendors are an important source of growth for the state economy. Thus, energy companies produce benefits for the Iowa taxpayer, both directly and indirectly.

Additionally, renewal energy increase retail sales in the local area and the state, as employees and visitors who reside outside Iowa spend a portion of their wages in the state. In other words, energy companies and wind and solar companies contribute to the region's economy.

Large portions of renewal energy spending are made in the local economy. That portion spent locally adds to community income. Economic impacts that take place outside the local economy, for example, spending in Illinois are called leakages and reduce overall impacts. They are excluded when estimating economic impacts of the local area and the state.

As a result of the widespread distribution of wind and solar operations, the industry's existence in Iowa affects the state's economy in many ways. Importantly, as a high wage, stable industry, the presence of wind and solar companies along with energy companies increases the attractiveness of the community and, in the long run, encourages the startup and/or relocation of retail businesses and manufacturing firms to the state. Access to Insurance jobs also increases quality-of- life, helping the state to retain and attract individuals, thereby helping to create "brain gain."

In addition to these growth dynamics, there is also economic activity related to the direct expenditures by wind and solar vendors, such as payroll, local jobs, and income.

Renewable energy indirectly affects the overall level of state economic activity. For example, the office supplies industry provides jobs and income for workers in the state as a result of energy companies spending on computers and office supplies.

Table C1 lists the three components of the total economic impact: the direct economic impact, the indirect economic impact, and the induced economic impact. Spillover impacts equal the sum of indirect and induced impacts.

Table C1: The Three Components of the Total Economic Impacts	
Direct Economic Impacts	Spending by energy firms along with wind and solar companies flowing into the area has direct economic effects on the local economy via expenditures for goods and services and for employee salaries. The most obvious direct expenditures are payment of wages to workers employed by the energy sector. See table C2.
Indirect Economic Impacts	Second-round spending takes place as retailers and wholesalers that furnish energy companies including wind and solar with supplies purchase from other companies in the area, resulting in indirect economic impacts on the area and state economies by the renewable sector. Renewable energy firms encourage the expansion of other businesses in the state. Wind and Solar companies generate indirect effects by increasing: (a) the number of firms drawn to the community, (b) the volume of deposits in local financial institutions and, (c) economic development.
Induced Economic Impacts	Induced impacts in the region occur as the initial spending feeds back to industries in the region when workers in the area purchase additional output from local firms in a third round of spending. That is, renewable energy companies increase overall area income and population, which produces another round of increased spending adding to sales, earnings and jobs.
Source: Goss & Associates	

Table C2 lists the Round 1, or initial direct spending impacts. These impacts are input to the Implan Multiplier System to produce overall impacts, or Round 3 impacts (e.g. Round 1 plus spillover impacts) which are listed in tables and figures Section 3.

Table C2: Direct or Round 1 impacts, all dollar values in present, or 2022 amounts

Construction impact (2022 dollars)	**Jobs (annual average)**	**Labor Income**	**Output**
Solar (2020 to 2025, projection)	1,841	$640,445,458	$1,856,257,582
Wind (1992 to 2021)	5,703	$9,318,867,166	$21,385,318,445
Operations and maintenance (2022 dollars)	**Jobs (annual average)**	**Labor Income**	**Output**
Solar (2025, projection)	1,601	$98,517,050	$268,064,544
Wind (2021)	1,352	$143,389,007	$2,299,594,050
Sources: EIA and Iowa Utilities Board for solar projections beyond 2021			

Appendix D: Researcher's Biography

Ernie Goss is the Jack MacAllister Chair in Regional Economics at Creighton University and is the initial director for Creighton's Institute for Economic Inquiry. He is also principal of the Goss Institute in Denver, CO. Goss received his Ph.D. in economics from The University of Tennessee in 1983 and is a former faculty research fellow at NASA's Marshall Space Flight Center. He was a visiting scholar with the Congressional Budget Office for 2003-2004 and has testified before the U.S. Congress, the Kansas Legislature, and the Nebraska Legislature. In the fall of 2005, the Nebraska Attorney General appointed Goss to head a task force examining gasoline pricing in the state.
He has published more than 100 research studies focusing primarily on economic forecasting and on the statistical analysis of business and economic data. His book Changing Attitudes Toward Economic Reform During the Yeltsin Era was published by Praeger Press in 2003, and his book Governing Fortune: Casino Gambling in America was published by the University of Michigan Press in March 2007.

He is the editor of Economic Trends, an economics newsletter published monthly with more than 11,000 subscribers, produces a monthly business conditions index for the nine-state Mid-American region, and conducts a survey of bank CEOs in 10 U.S. states. Survey and index results are cited each month in approximately 100 newspapers; citations have included the New York Times, Wall Street Journal, Investors Business Daily, The Christian Science Monitor, Chicago Sun Times, and other national and regional newspapers and magazines. Each month 75-100 radio stations carry his Regional Economic Report.

Scott Strain is a senior research economist at Goss & Associates. He has worked as an economist and statistician for more than 20 years providing forecasts and analysis across a wide range of industries. Scott served as an industry economist, working in new product development regarding both quantitative and qualitative research. Scott was Senior Director of Research for an economic development agency, providing economic impact and tax incentive analysis to both private businesses and government entities. He served on the business advisory committee that worked with Nebraska state senators and the director of the state's Economic Development Department to develop the Nebraska Advantage Act – a comprehensive package of business incentives that has helped to add more than $6 billion in new capital investment and over 13,000 new jobs in the state of Nebraska since the Act's inception in 2006.

Monique Devillier is a Research Associate at Goss & Associates. She has a Bachelors of Liberal Studies from the University of Iowa. She was a small business owner in Omaha, Nebraska. She has worked for Higgins Law as a project coordinator and legal assistant as well as an office manager for PSC Construction. Monique was one of the original co-founders of a non-profit in Blair, Nebraska and served on the board for more than nine years. She was Sergeant At Arms for the 21-22 year at Suburban Rotary, where she has been a member for more than six years and currently serves on the board.

Appendix E: Goss Consulting Contracts 2017 – 2022

1. Summer 2022. “The Economic Impact of Cattlemen’s Heritage Beef Procession Plant on the State of Iowa,” produced for Ten Corporation.
2. Spring 2022. The Economic Impact of West Liberty Foods’ Proposed Facility, June 2023 to December 2038 West Liberty Foods, West Liberty, Iowa.
3. Spring 2022. “The Economic Impact of a Landfill RNG System on Winnebago County, Illinois, produced for EcoEngineers, Des Moines, Iowa.
4. Winter 2022. Iowa’s Insurance Industry a U.S. Leader: Generating Economic Returns for the State.
5. Fall 2021. The Pluses and Minuses of a Racino in Norfolk: Can It Emerge as a Destination Casino? Produced for Concerned Citizens of Norfolk.
6. Summer 2021. Leveraging Private Assets for the Public Good: The Economic Benefits of Omaha’s Missouri River Revitalization.
7. Summer 2021. Cattlemen’s Heritage Beef Plant: Its Economic Impact on Mills/ Pottawattamie Counites and Iowa, 2022-2028.
8. Spring 2021. The College World Series and the Omaha Economy: Impacts 2003 - 2019. Produced for College World Series, Inc.
9. Spring 2021. The Economic Impact of the Sustainable Beef Plant on the City of North Platte, Nebraska. produced for Sustainable Beef, LLC.
10. Winter 2020. Midtown Crossing: Transforming Midtown Omaha and Boosting the Overall Omaha Economy. Produced for East Campus Realty. Spring 2019.
11. Winter 2019. A Cost-Benefit Analysis: Options for Boone Central Middle School:Albion or Petersburg? Produced for Boone Central Schools Board of Education.
12. Winter 2019. The Economic and Fiscal Impact of the Council Bluffs Riverfront Development (River’s Edge). Produced for the Iowa West Foundation.
13. Winter 2019. Reducing the Property Tax Burden on Nebraska Farmland: An Evaluation of the Fair Nebraska Plan. Produced for Fair Nebraska.

14. Winter 2018. The Economic Contributions of Ho-Chunk, Inc. to the Winnebago Indian Reservation, Iowa, Nebraska, South Dakota and the U.S. Spring 2018. Wyoming. Produced for Ho-Chunk, Inc.
15. Winter 2018. The Economic Impact of the Streetcar on the City of Omaha. Produced for the City of Omaha.
16. Fall 2018. Nebraska's Independent Colleges and Universities: Spurring Economic Growth and Brain Gain for the State and Its Counties. Produced for Nebraska Association of Independent Colleges.
17. Winter 2017. Rural TIF Report: Tax Increment Financing Contributions to Economic Growth in Rural Nebraska. Produced for Nebraska Economic Developers Association.
18. Winter 2017. The Economic and Fiscal Impact of the Council Bluffs Riverfront Development. Produced for the Heritage Group.
19. Spring 2017 Economies of Good: Boys Town's Economic Impact on the Omaha Area and the State of Nebraska. Produced for Boys Town.
20. Spring 2017. The Net Benefits and Costs of Prestage Farms to the Mid Iowa Region, produced for Mid-Iowa Growth Partnership.
21. Spring 2017. The Impact of a Walkable, Workable, and Livable Midtown Omaha, produced for Turner Park North.
22. Summer 2017. Pet Ownership Boosts State and Local Economic Growth. Produced for PetSmart Charities.
23. Summer 2017. The Impact of Credit Union and Farm Credit Subsidies on the Banking Industry and Taxpayers in Nebraska. Produced for Nebraska Bankers Association and FEAI (Financial Education and Advocacy Initiative, Inc.