COMMON SENSE INSTITUTE ARIZONA

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ARIZONA'S ENERGY COMPETITIVENESS INDEX

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ABOUT THE AUTHOR

Steven L. Byers, Ph.D. is the Common Sense Institute Chief Economist. Steven spent three years working for the Coalition for a Prosperous America, a nonprofit organization. Steven's experience as an economist spans twenty-three years, including work at federal regulatory agencies (SEC, CFTC, PCAOB) and quantitative economic analysis supporting international trade litigation cases brought before the U.S. International Trade Commission. His Ph.D. dissertation topic was based on a computable general equilibrium model (CGE) he developed to evaluate the economic impact of regional tax incentives in a small city (Fort Collins, CO).

Zachary Milne is the Senior Economist and Research Analyst for the Common Sense Institute AZ. Zachary works with the Arizona research team to craft important and thoughtful research concerning the Arizona economy.

Prior to CSI, Zachary attended Arizona State University, where he first attained a bachelor's in economics and statistics, followed by a master's degree in economics. Zachary has also worked in the Arizona Governor's budget office, where he served as an economist. In this capacity he developed the state's revenue forecasts and advised a team of budget analysts on the creation of K-12 and Medicaid caseload figures for the State's annual budget. He also advised the Executive policy and leadership teams on fiscal policy, and regularly presented detailed analyses on each of the dozens of tax bills introduced in the Arizona Legislature each year.

ABOUT COMMON SENSE INSTITUTE

Common Sense Institute is a non-partisan research organization dedicated to the protection and promotion of Arizona's economy. CSI is at the forefront of important discussions concerning the future of free enterprise and aims to have an impact on the issues that matter most to Arizonians. CSI's mission is to examine the fiscal impacts of policies, initiatives, and proposed laws so that Arizonians are educated and informed on issues impacting their lives. CSI employs rigorous research techniques and dynamic modeling to evaluate the potential impact of these measures on the economy and individual opportunity.

TEAMS & FELLOWS STATEMENT

CSI is committed to independent, in-depth research that examines the impacts of policies, initiatives, and proposed laws so that Arizonians are educated and informed on issues impacting their lives. CSI's commitment to institutional independence is rooted in the individual independence of our researchers, economists, and fellows. At the core of CSI's mission is a belief in the power of the free enterprise system. Our work explores ideas that protect and promote jobs and the economy, and the CSI team and fellows take part in this pursuit with academic freedom. Our team's work is informed by data-driven research and evidence. The views and opinions of fellows do not reflect the institutional views of CSI. CSI operates independently of any political party and does not take positions.

INTRODUCTION

Electricity in the modern age is a necessity. Without it, nearly all the life sustaining features of our modern society would cease to operate. Electricity powers everything from the irrigation of the crops that make the food we eat, to powering the air-conditioning that provides a respite from the Phoenix summer.

Historically, electricity in Arizona has come at an affordable price which has added to the state's attractiveness for both businesses and households alike. Cheap commercial and industrial power reduces the costs of production, supporting Arizona's growing manufacturing sector, while affordable residential rates make Arizona attractive to new residents. The state has also enjoyed a reliable power grid, ranking at or near the top of its peers in terms of outage minutes each year. This historic success is at least partly attributable to the presence of Palo Verde Nuclear Generating Station just outside of the greater Phoenix area – the largest nuclear power plant in the country.

However, in the last decade and a half, power providers have been enticed by a combination of mandates, incentives, and economics to transition their grids away from traditional, reliable base-load energy sources such as coal and natural gas to renewable but intermittent sources such as solar and wind.[iii] This goal of achieving a greener electrical grid has come at the cost of higher electricity rates and lower reliability, especially nationally, as evidenced by a rise in both the number of outages and the average duration of those outages.

California, a state that has a targeted a 100% clean energy transition by 2045, has seen its share of energy production from wind and solar rise from just 4.3% in 2011 to 26.8% in 2022. The result has been skyrocketing energy prices, rising 127% in the last ten years.[iv] Arizona to-date has been relatively insulated from these changes, though, as CSI Arizona discusses at length in our 2023 report.

Given the importance of electricity to the economy, states should take great care to evaluate the tradeoffs between traditional, base-load energy production and renewable sources like solar and wind. Protecting the environment and lowering emissions is a noble goal, but it is not without costs. To remain competitive, states should seek to balance affordability and reliability with their environmental aims, and manage the pace of their transition to ensure it is orderly and not economically disruptive.

KEY FINDINGS

- Arizona's energy grid remained competitive between 2011 and 2023 and appears to be gaining ground relative to its peers. Arizona's ranking in overall energy competitiveness rose two places to 21st, with six out of the ten component indices showing improvement relative to other states.
- The reliability of energy grids across the country is on the decline, although Arizona remains one of the more reliable grids in the country. On average, a user of electricity in Arizona faced 136.9 minutes of interruption in 2022 – up from 73.9 minutes in 2013, but nearly 59% less than the duration faced by the average customer across the U.S. (333 minutes). Despite falling slightly in the two reliability competitiveness indices, Arizona still ranks 5th in reliability.
- Both the electricity and natural gas prices faced by residential, commercial, and industrial customers in Arizona have increased in the last 13 years, but have also become more competitive as other states experienced larger increases. Arizona now ranks 21st in residential electric affordability, up from 28th in 2011.

CSI issues a Free Enterprise Report annually. The report assesses the state's competitiveness relative to forty-nine other states and the District of Columbia and provides data and analysis on eight policy areas: education, energy, healthcare, housing, infrastructure, public safety, state budget, and taxes and fees. This report is intended to provide additional details on the state budget competitiveness not covered in the Free Enterprise Report.

The competitiveness indices should be interpreted as follows: an increase (decrease) in an index indicates increased (decreased) competitiveness relative to the other forty-nine states and District of Columbia. Arizona's individual performance may deteriorate, for example, its cost of residential electricity may increase, however, other states may have seen greater increases, causing Arizona's competitiveness to rise.

STATE ENERGY COMPETITIVENESS INDEX

CSI's annual Free Enterprise Report assesses a state's competitiveness relative to its national peers across nine subject areas, including energy. The goal of this assessment is to indicate how well a state's policy in these areas (and in its overall economy) conforms to free-market principles, and given that conformity, how well the sector itself performs.

A reliable and affordable supply of energy is critical for an economy to function. Expensive energy costs leave consumers with less capacity to spend within their local economy and can potentially increase the costs of goods and services through higher production costs. Additionally, outages and other reliability issues halt economic production and can leave households out in the cold, or in the case of the Valley, out in the heat. Outages in particular carry a significant economic cost. According to the Department of Energy, power outages cost the U.S. economy $150 billion annually.[v]

To gauge how well states are performing regarding energy, CSI produces a State Energy Competitiveness Index for all 50 states and the District of Columbia consisting of ten metrics that capture distinct aspects of the energy sector, these include: Nameplate Capacity (Megawatts) per 100,000 Residents, Electricity Reliability (via the Customer Average Interruption Duration Index, or CAIDI, which details the minutes interruption in the supply of electricity)W/O Major Event Day (MED) per Capacity, Electricity Reliability – CAIDI (minutes of interruption) With Major Event Day (MED) per Capacity, Electricity Price (cents/kWh) – Residential, Electricity Price (cents/kWh) – Commercial, Electricity Price (cents/kWh) – Industrial, Residential Natural Gas Price, Commercial Natural Gas Price, Industrial Natural Gas Price, and Share of Electricity Produced by Clean Energy. Each metric is ranked relative to all fifty states and the District of Columbia. Then the ten ranked metrics are equally weighted and summed. This value is ranked again to produce an aggregate measure of energy competitiveness as shown in **Figure 1**. Arizona's Energy Competitiveness Index was 77 in 2011, peaked in 2022 at 83, and then declined to 79 in 2023. An increase in the Energy Competitiveness Index is a positive qualitative change – i.e., **the state is more competitive as the index approaches one hundred.** While the headline index extends through 2023, data for some of the individual component metrics are not available for the entirety of the period covered. For those metrics, we present the results through the latest year of data available.

FIGURE 1 – ENERGY COMPETITIVENESS INDEX – ARIZONA

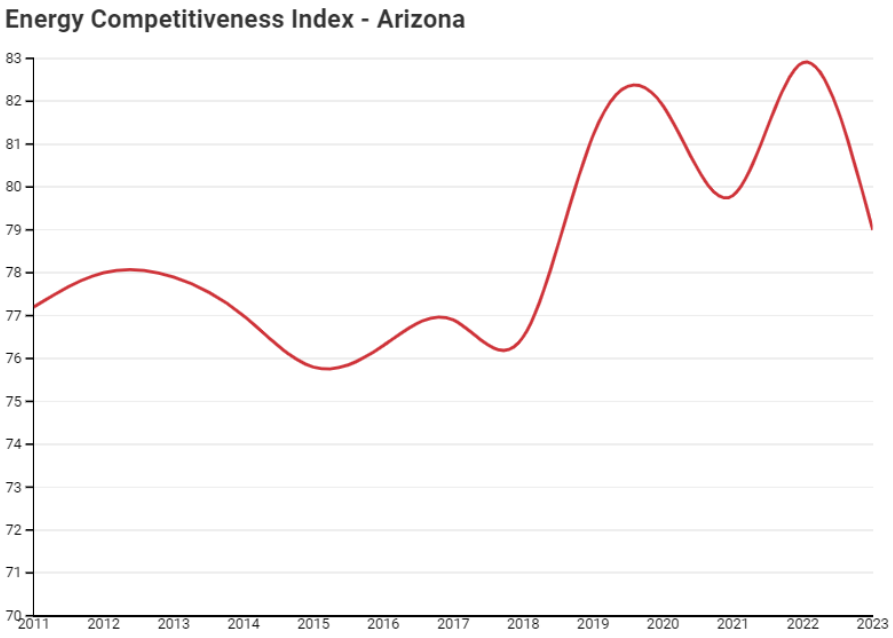


FIGURE 2 – ENERGY COMPETITIVENESS INDEX COMPONENTS - ARIZONA

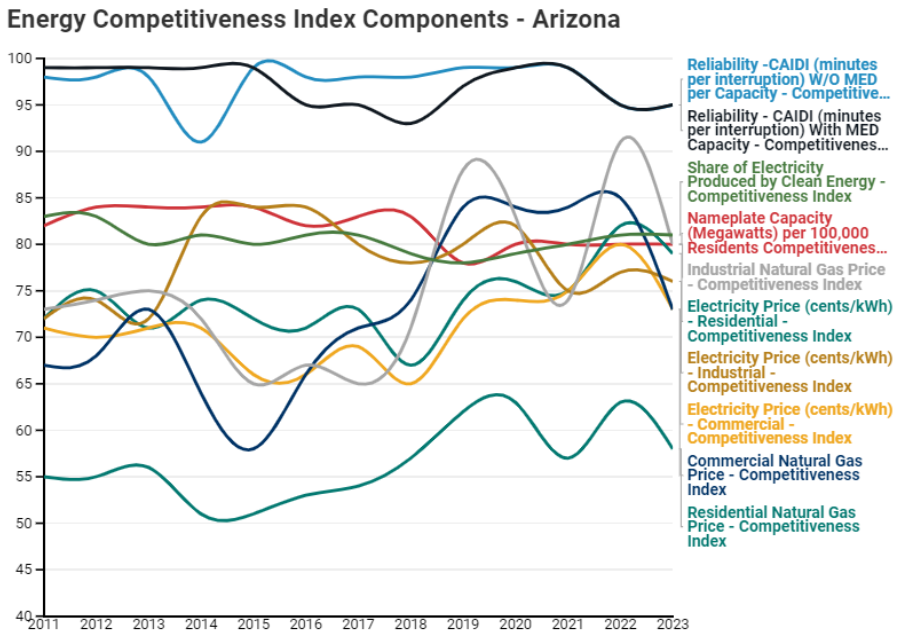


Figure 2 shows the evolution of the ten components included in the Energy Competitiveness Index.

The slight increase in the Energy Competitiveness Index from 2011 through 2023 was the result of declines in four of the component competitiveness indices and increases in six. Declines occurred in the following Component Indices:

- Nameplate Capacity (Megawatts per 100,000 Residents), 82 to 80
- Electricity Reliability – CAIDI (minutes per interruption without Major Event Day (MED) per capacity), 98 to 95
- Electricity Reliability – CAIDI (minutes per interruption with Major Event Day (MED) per capacity), 99 to 95
- Share of Electricity Produced by Clean Energy, 83 to 81

Increases occurred in the following Component Indices:

- Residential Electricity Price (cents per kWh), 72 to 79
- Commercial Electricity Price (cents per kWh), 71 to 73
- Industrial Electricity Price (cents per kWh), 72 to 76
- Residential Natural Gas Price, 55 to 58
- Commercial Natural Gas Price, 67 to 73
- Industrial Natural Gas Price, 73 to 80

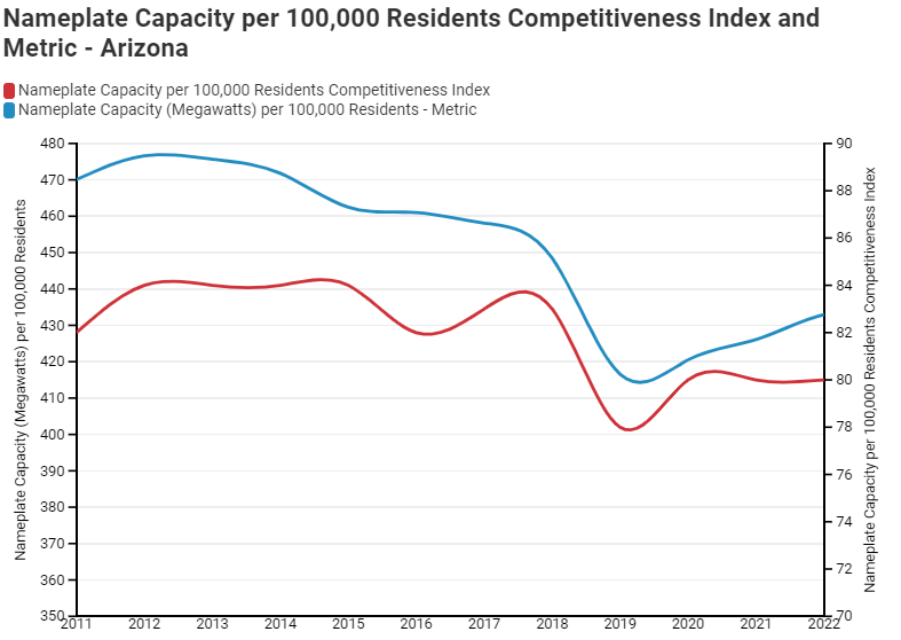
NAMEPLATE CAPACITY (MEGAWATTS PER 100,00 RESIDENTS) - COMPETITIVENESS INDEX COMPONENT

Figure 3 presents the change in the nameplate capacity index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

Nameplate capacity is the maximum amount of electricity that can be generated without exceeding design thermal limits and is typically expressed in megawatts (MW).[vi] CSI divides the nameplate capacity for a state by the state's population times 100,000 to get nameplate capacity per 100,000 residents. In doing so a comparison across states can be performed. The higher the nameplate capacity per 100,000 residents is the more potential there is for economic growth, and thus the more competitive a state is.

The index fell from 82 in 2011 to 80 in 2022. This was primarily the result of decreased nameplate capacity per 100,000 residents, falling from 470.07 in 2011 to 432.95 in 2022, which was a larger decrease than in many other states. Arizona has experienced a large increase in its population in recent years due to high levels of net migration. Because power plants typically take several years, if not a decade or more to complete, nameplate capacity has not increased as much, thus the decrease in nameplate capacity per 100,000 residents.

FIGURE 3 – NAMEPLATE CAPACITY PER 100,000 RESIDENTS COMPETITIVENESS INDEX AND METRIC - ARIZONA



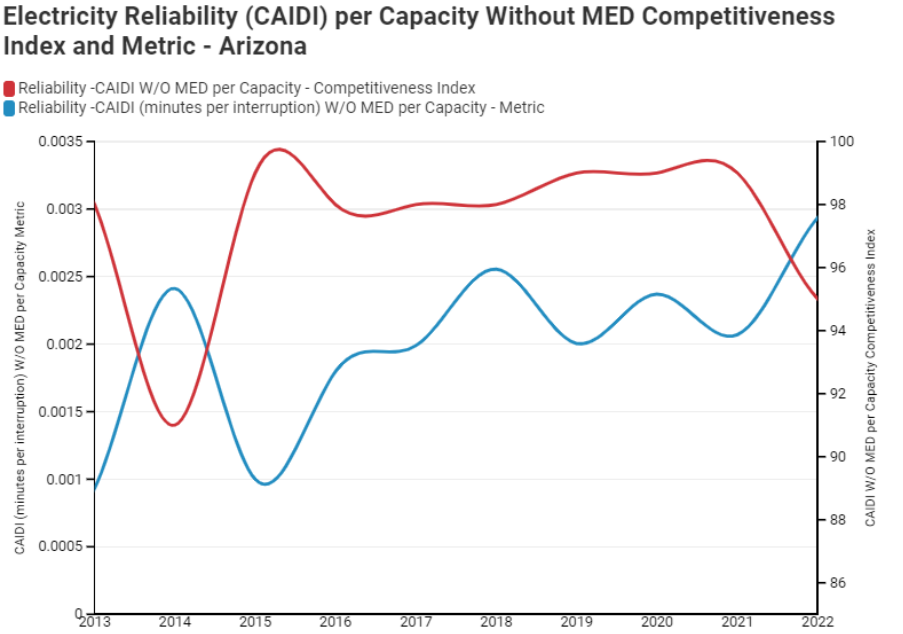
ELECTRICITY RELIABILITY – CAIDI (MINUTES PER INTERRUPTION WITHOUT MED PER CAPACITY) - COMPETITIVENESS INDEX COMPONENT

Figure 4 presents the change in the electricity reliability – CAIDI W/O MED per Capacity index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

Electricity system reliability is a measure of the ability of the electrical system to continue to deliver electricityw continuously. CSI uses CAIDI without Major Event Days (MED) which is defined as the number of minutes it takes to restore non-momentary electric interruptions when there are no catastrophic events that exceed reasonable design or operational limits of an electric power system.

The index began at 98 in 2013 and declined to 95 in 2022. The metric itself increased between 2011 and 2022 due to an increase in the number of minutes per outage, growing from 61.6 minutes per customer in 2013 to 69.1 minutes in 2022.

FIGURE 4 - ELECTRICITY RELIABILITY (CAIDI) PER CAPACITY WITHOUT MED COMPETITIVENESS INDEX AND METRIC - ARIZONA



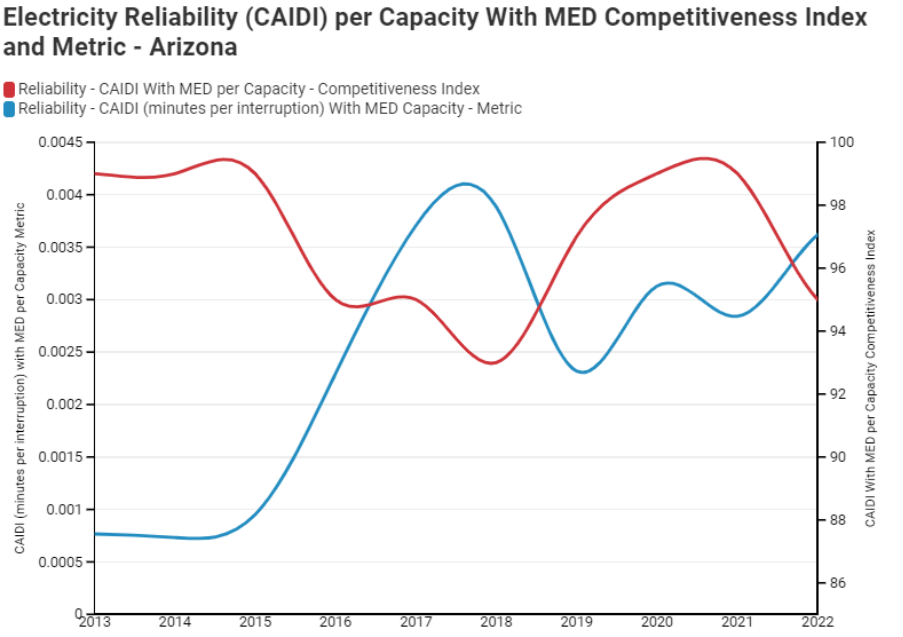
ELECTRICITY RELIABILITY – CAIDI (MINUTES PER INTERRUPTION WITH MED PER CAPACITY) - COMPETITIVENESS INDEX COMPONENT

Figure 5 presents the change in the electricity reliability – CAIDI with MED per Capacity index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

Electricity system reliability is a measure of the ability of the electrical system to continue to deliver electricity continuously. CSI uses CAIDI with Major Event Days (MED) which is defined as the number of minutes it takes to restore non-momentary electric interruptions when there are catastrophic events that exceed reasonable design or operational limits of an electric power system.

The index declined from 99 in 2013 to 95 in 2022. The metric itself increased between 2011 and 2022 due to an increase in the outage minutes per customer, growing from 73.9 minutes in 2011 to 136.9 minutes in 2022.

FIGURE 5 – ELECTRICITY RELIABILITY (CAIDI) PER CAPACITY WITH MED COMPETITIVENESS INDEX AND METRIC - ARIZONA

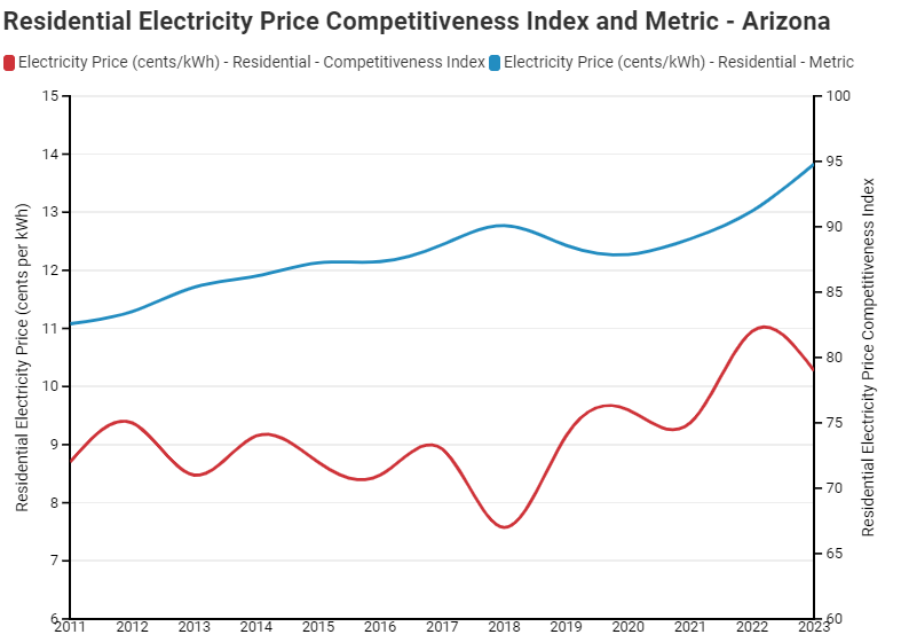


RESIDENTIAL ELECTRICITY PRICE - COMPETITIVENESS INDEX COMPONENT

Figure 6 presents the change in the residential electricity price competitiveness index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

The index increased from 72 in 2011 to 79 in 2023 despite the increase in the average price of residential electricity increasing from 11.08 cents per kilowatt hour in 2011 to 13.83 cents per kilowatt hour in 2023 – a 24.8% increase. Despite the increase in price, the increase in Arizona fell below the 36.0% average increase across all states and D.C., resulting in an improvement in Arizona's residential electricity price competitiveness relative to its peers.

FIGURE 6 – RESIDENTIAL ELECTRICITY PRICE COMPETITIVENESS INDEX AND METRIC - ARIZONA

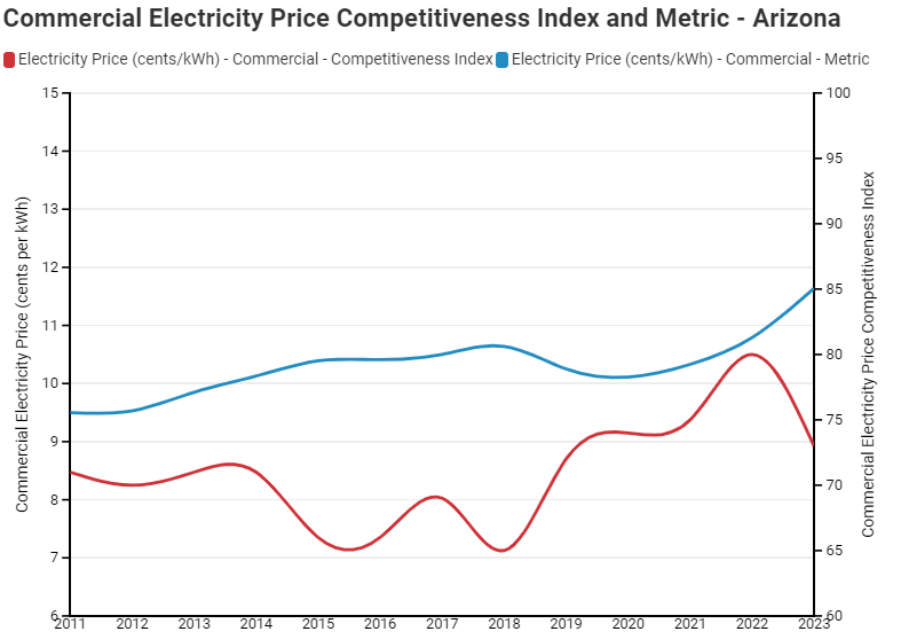


COMMERCIAL ELECTRICITY PRICE - COMPETITIVENESS INDEX COMPONENT

Figure 7 presents the change in the commercial electricity price competitiveness index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

The index increased from 71 in 2011 to 73 in 2023 despite the increase in the average price of commercial electricity increasing from 9.50 cents per kilowatt hour in 2011 to 11.64 cents per kilowatt hour in 2023 – a 22.6% increase. Despite the increase in price, the increase in Arizona fell below the 26.4% average increase across all states and D.C., resulting in an improvement in Arizona's residential electricity price competitiveness relative to its peers.

FIGURE 7 – COMMERCIAL ELECTRICITY PRICE COMPETITIVENESS INDEX AND METRIC – ARIZONA

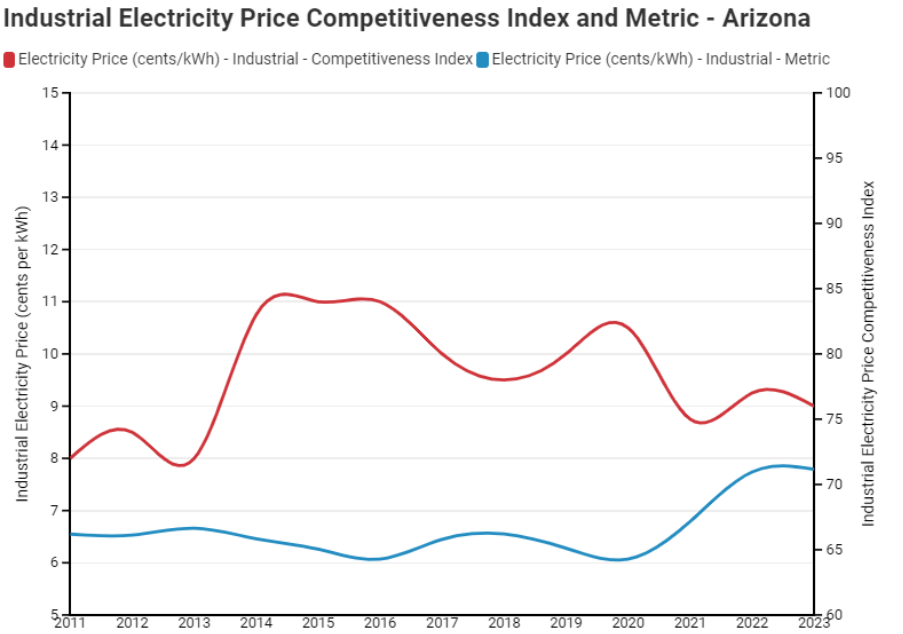


INDUSTRIAL ELECTRICITY PRICE - COMPETITIVENESS INDEX COMPONENT

Figure 8 presents the change in the Industrial electricity price competitiveness index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

The index increased from 72 in 2011 to 76 in 2023 despite the increase in the average price of commercial electricity increasing from 6.55 cents per kilowatt hour in 2011 to 7.79 cents per kilowatt hour in 2023 – an 18.9% increase. Despite the increase in price, the increase in Arizona fell below the 23.5% average increase across all states and D.C., resulting in an improvement in Arizona's residential electricity price competitiveness relative to its peers.

FIGURE 8 – INDUSTRIAL ELECTRICITY PRICE COMPETITIVENESS INDEX AND METRIC – ARIZONA

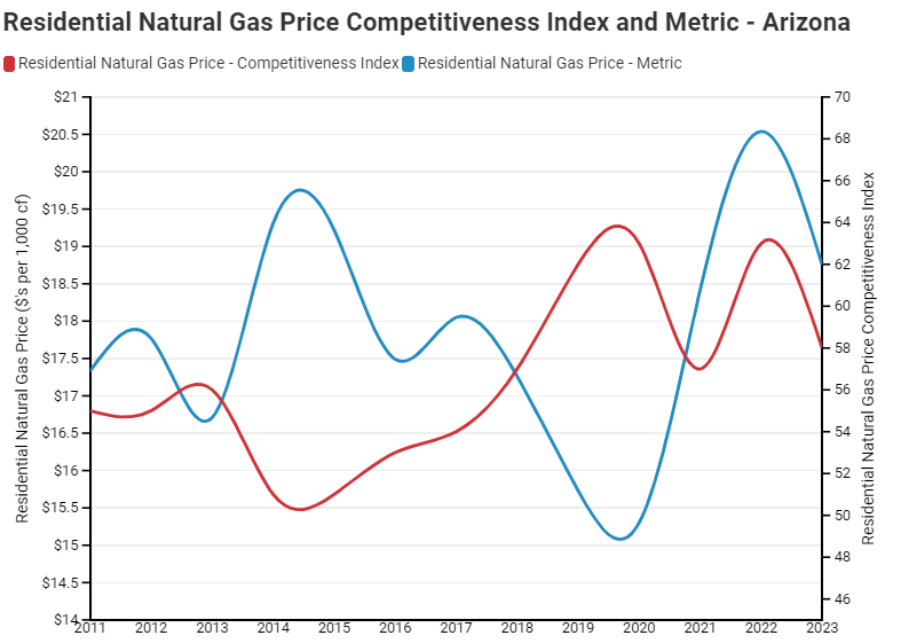


RESIDENTIAL NATURAL GAS PRICE - COMPETITIVENESS INDEX COMPONENT

Figure 9 presents the change in the residential natural gas price competitiveness index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

The index increased from 55 in 2011 to 58 in 2023 despite an 8.2% increase in the average price of residential natural gas from $17.33 per 1,000 cubic feet in 2011 to $18.75 per 1,000 cubic feet in 2023. This increase in price was smaller than the average state (+14.85%), resulting in an increase in Arizona's residential natural gas competitiveness index.

FIGURE 9 – RESIDENTIAL NATURAL GAS PRICE COMPETITIVENESS INDEX AND METRIC - ARIZONA

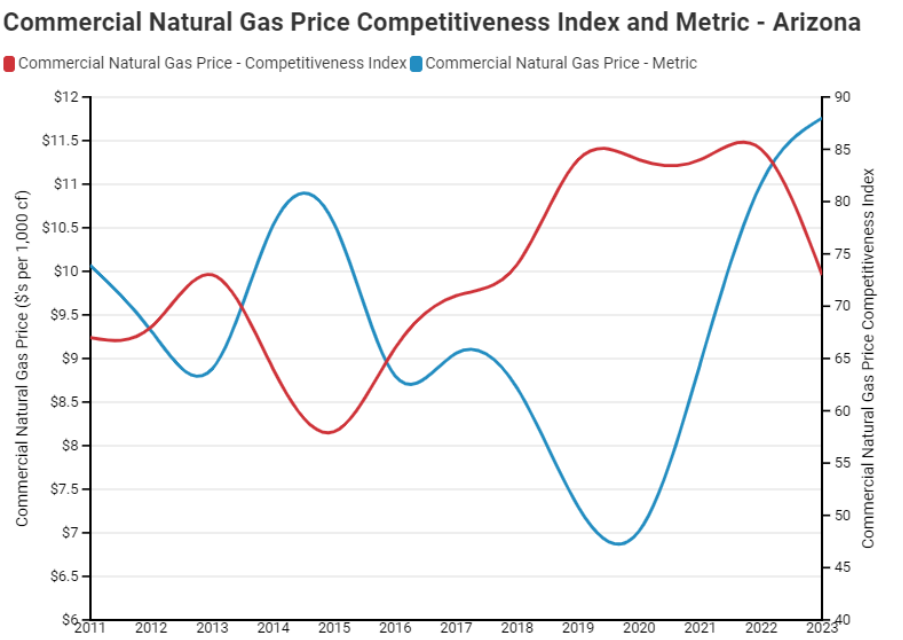


COMMERCIAL NATURAL GAS PRICE – COMPETITIVENESS INDEX COMPONENT

Figure 10 presents the change in the commercial natural gas price competitiveness index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

The index increased from 67 in 2011 to 73 in 2023 despite a 16.8% increase in the average price of commercial natural gas from $10.07 per 1,000 cubic feet in 2011 to $11.76 per 1,000 cubic feet in 2023. This increase in price was smaller than the average state (+23.2%), resulting in an increase in Arizona's residential natural gas competitiveness index.

FIGURE 10 – COMMERCIAL NATURAL GAS PRICE COMPETITIVENESS INDEX AND METRIC - ARIZONA

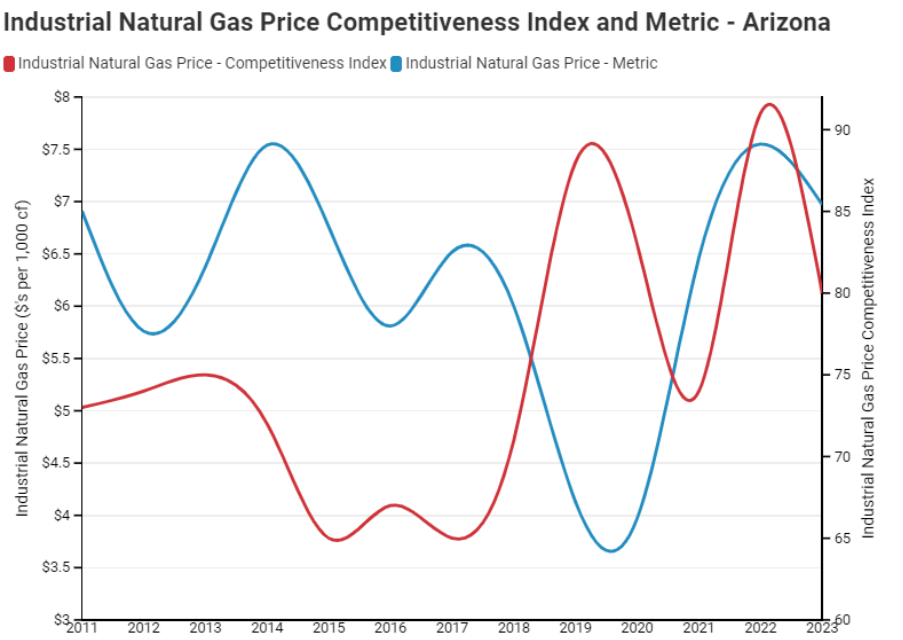


INDUSTRIAL NATURAL GAS PRICE - COMPETITIVENESS INDEX COMPONENT

Figure 11 presents the change in the industrial natural gas price competitiveness index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

The index increased from 73 in 2011 to 80 in 2023 due to a marginal 0.9% increase in the average price of commercial natural gas from $10.07 per 1,000 cubic feet in 2011 to $11.76 per 1,000 cubic feet in 2023. This increase in price was much smaller than the average state (+14.7%), resulting in an increase in Arizona's residential natural gas competitiveness index.

FIGURE 11 – INDUSTRIAL NATURAL GAS PRICE COMPETITIVENESS INDEX AND METRIC - ARIZONA

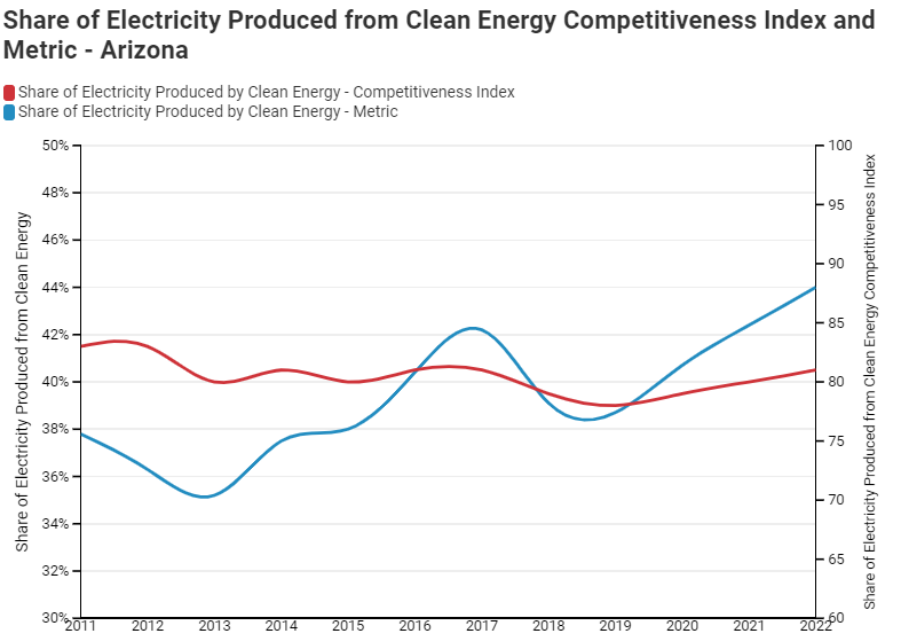


SHARE OF ELECTRICITY PRODUCED BY CLEAN ENERGY – COMPETITIVENESS INDEX COMPONENT

Figure 12 presents the change in the share of electricity produced by clean energy competitiveness index against the change in the underlying metric itself. This enables us to better assess whether the change in Arizona's performance was the result of a change in its own performance, or a change in the performance of its peers (or both).

The index decreased from 83 in 2011 to 81 in 2023 despite the share of electricity produced from clean energy increasing from 37.8% in 2011 to 44.0% in 2023 (+6.2 percentage points). This slight decline in the index was a result of other states increasing their reliance on renewable, "green" energy sources at a faster pace than Arizona, with all states and D.C. averaging an increase of 6.2 percentage points.

FIGURE 12 – SHARE OF ELECTRICITY PRODUCED BY CLEAN ENERGY COMPETITIVENESS INDEX AND METRIC - ARIZONA



THE BOTTOM LINE

The Arizona economy has remained competitive over the years in part due to the availability of cheap, reliable energy. However, as with the rest of the nation, political and social tailwinds have gradually pushed energy production in the state towards renewable sources such as wind and solar.[vii]

While the goals of implementing a more environmentally friendly energy system have merit, policymakers should take caution not to recklessly transition their energy grids to renewable sources too quickly, and without appropriate supporting infrastructure. Renewable transition elsewhere, namely in states like California and Texas, has proven to be both costly and at a detriment to reliability and competitiveness. The challenge for Arizona moving forward will be managing the renewable transition while maintaining the cheap and reliable energy the economy depends on.

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