Economic Impact of NextEra Energy's Duane Arnold Energy Center

A report by the Nuclear Energy Institute

May 2014

Nuclear Energy Institute

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CEDAR RAPIDS METRO ECONOMIC ALLIANCE

May 5, 2014

To Whom It May Concern:

The programs and initiatives at the Cedar Rapids Metro Economic Alliance are designed to serve as the catalyst for economic growth and prosperity for our region. One of our members, NextEra Energy Duane Arnold, has supported these priorities for nearly 40 years.

A recently commissioned report on the economic impact of the facility reminds us that NextEra Energy Duane Arnold, Iowa's only nuclear power plant, is of considerable benefit to not only Eastern Iowa but to the entire state. The report reinforces benefits of the facility like clean, emissions-free energy, hundreds of well-paying jobs and an impressive $246 million of local economic growth stemming from support of its daily operations.

The Economic Alliance applauds initiatives that maintain and improve economic activity in Iowa, and this report is a clear reminder the Duane Arnold facility's continued safe and reliable operations bring great economic benefit to the greater Cedar Rapids region and to the state of Iowa. We look forward to our continued partnership with this facility.

Sincerely,

Dee Baird, Ph.D.
President & CEO

VISION:

TO BE THE TOP ECONOMIC GROWTH REGION IN THE COUNTRY.

MISSION:

TO SERVE AS THE CATALYST FOR ECONOMIC DIVERSITY, GROWTH AND PROSPERITY FOR OUR REGION.

VALUES:

WE VALUE OUR CUSTOMERS AND STRIVE TO EXCEED THEIR EXPECTATIONS.

WE EMBRACE INNOVATION IN OUR WORK.

WE FOCUS ON COLLABORATIVE RELATIONSHIPS IN EVERYTHING WE DO.

WE ARE COMMITTED TO A HIGH-PERFORMANCE CULTURE, CENTERED ON CORE COMPETENCIES.

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From the desk of
John L. Solow

Professor of Economics
Tippie College of Business
The University of Iowa

April 29, 2014

To Whom It May Concern:

I am a Professor of Economics in the Tippie College of Business at the University of Iowa, where I have been employed for 33 years; however, the opinions expressed here are my own and should not be taken to represent the opinions of the Tippie College of Business or the University of Iowa. I have been asked by NextEra Energy Duane Arnold, the operator of the Duane Arnold Energy Center nuclear power facility in Palo, Iowa, to provide an independent review of a report by the Nuclear Energy Institute (NEI) that details the economic impact of the Duane Arnold Energy Center. I have published several papers on the economics of nuclear power, and have on several occasions been engaged to review analyses of nuclear power for the U.S. Department of Energy. I also have experience with the economic impact study methodology utilized in this report, and am familiar with input-output analysis generally and the IMPLAN model used in this analysis specifically, having used it myself in a similar but unrelated economic impact study.

The NEI report carefully documents the role of nuclear power in America's portfolio of electricity generating technologies, and the improvements in operational reliability and safety that have taken place over the last two decades. Due to the low fuel costs but relatively large initial investment requirements for nuclear power plants, operating reliability is critical to the cost of electricity generated by nuclear power, and the industry has achieved very high capacity factors in the last twenty years. The report documents that the Duane Arnold facility has performed at or above the industry average since 1986; as a result, the facility has been a reliable provider of clean, low-cost electricity for the Midwest.

I have paid particular attention to the economic methodology used to calculate the economic impact of the Duane Arnold Energy Center on the local (Benton and Linn counties), state and national economies. Total impacts by region are calculated as the sum of regional direct, indirect, and induced effects. Direct effects are the value of the electricity generated by the Duane Arnold facility. Indirect effects are production changes in backward-linked industries which supply the input needs of the Duane Arnold Energy Center (e.g., additional purchases to produce additional output such as services of regional businesses that the Duane Arnold Energy Center employs). Induced effects are the changes in regional household spending patterns caused by household income generated from the direct and indirect effects. An example of the latter is the increased spending of the incomes earned by power plant workers. These impacts were calculated using IMPLAN, a micro-computer-based program that allows construction of regional input-output models for areas ranging in size from a single zip code region to the entire United States. IMPLAN was originally developed for the US Department of Agriculture and is maintained and supported by the Minnesota IMPLAN Group, Inc. Stillwater, Minnesota. IMPLAN is a widely recognized and respected tool for economic impact analysis.

In my view, the NEI report provides a sensible and credible estimate of the substantial and positive impacts the Duane Arnold Energy Center has on our local, regional and national economies.

Sincerely,

John L. Solow
Professor of Economics
Tippie College of Business
The University of Iowa

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Executive Summary

The Duane Arnold Energy Center, located just outside Cedar Rapids, Iowa, has been a fixture in the community for four decades. Whether one looks at the tremendous amount of emissions-free energy generated by the plant, the jobs and economic stimulus it offers to the local, state and even national economy, or involvement in the community, there is no doubt that the entire state of Iowa significantly benefits from Duane Arnold's continued operation.

To help quantify the economic impact of this facility, the Nuclear Energy Institute conducted an independent analysis of Duane Arnold's ongoing economic, fiscal, and social impact based on data provided by NextEra Energy, the majority owner of the facility.

Key findings of this study include the fact that Duane Arnold's operation supports:

- **Safe, reliable, clean energy for Iowa:** Duane Arnold produces approximately 8 percent of Iowa's total electricity and generally operates at a capacity factor above industry average. Because the energy produced at Duane Arnold is emissions-free, its operation prevents the emission of nearly 4 million tons of carbon dioxide annually, which is the equivalent of taking 800,000 cars off the road.
- **Hundreds of local jobs with higher-than-average wages:** The jobs supported by Duane Arnold's operation are typically higher-paying than many others in the region. In Benton and Linn counties, Duane Arnold employees can make up to double the average amount for other workers.
- **A local economic "ripple" effect:** The plant's continued operation stimulates $246 million of economic activity locally, $255 million within Iowa, and $514 million within the entire United States economy. For every $1 of output from Duane Arnold, the local economy produced $1.23, while Iowa's economy produced $1.27.
- **Affordable energy prices:** Because of relatively low production costs, Duane Arnold helps keep electricity prices affordable for Iowa consumers.

In addition to the direct economic impacts of the facility, Duane Arnold provides many indirect benefits including being an active corporate leader in the local region, offering support for educational initiatives, nature and wildlife centers, leasing land for agricultural purposes to local residents, and donating to a variety of charitable organizations.

NextEra Energy and NEI cooperated in developing this study. NextEra Energy provided data on employment, operating expenditures and tax payments for the existing units during a year when there was not a refueling outage so a baseline could be established. NextEra also provided expenditure totals specific to the counties around the surrounding plants.

NEI conducted the project by applying a nationally recognized model to estimate the direct and indirect impacts of the existing plant on the local community. MIG, Inc., developed the IMPLAN (Impact Analysis for Planning) economic impact modeling system, which is the methodology employed in this analysis.

Section 1: Background and Generation History

First date of operation

Duane Arnold began commercial operation on Feb. 1, 1975, and is the only nuclear plant operating in Iowa.

Location

Duane Arnold is located about 9 miles northwest of Cedar Rapids, Iowa, and encompasses 500 acres near Palo, Iowa.

License Expiration Year

2034

Reactor Type

Boiling water

Total Electrical Capacity

615 megawatts

Owned By

70 percent: NextEra Energy

20 percent: Central Iowa Power Cooperative

10 percent: Corn Belt Power Cooperative

Duane Arnold provides about 8 percent of the electricity generated in Iowa each year. In 2013, the plant generated more than 5 billion kilowatt-hours of electricity, functioning at 101 percent capacity factor.

Duane Arnold provides power for the Midwest Reliability Organization (MRO) power area. Because of Duane Arnold's high standards for efficiency, the power plant is extremely efficient and affordable within the region with a production cost of 2.72 cents/kilowatt-hour (kWh). This price makes it more cost-effective than other energy sources including oil, natural gas, and even other nuclear plants elsewhere in the country. (Production costs represent the operations, maintenance and fuel costs of the plant.)

The below table illustrates other energy sources and their comparative production costs.

Table 1.1 MRO Production Cost and Generation in 2012

	Average Production Cost (in cents per kilowatt-hour)	**Generation** (in million megawatt-hours)
Duane Arnold	2.72	4.3
Other Nuclear	3.10	22.3
Coal	2.45	132.4
Natural Gas	4.29	11.5
Oil	45.80	0.04
Renewables and Other	1.05	40.2
MRO Total	**2.36**	**210.8**

Source: Ventyx Velocity Suite

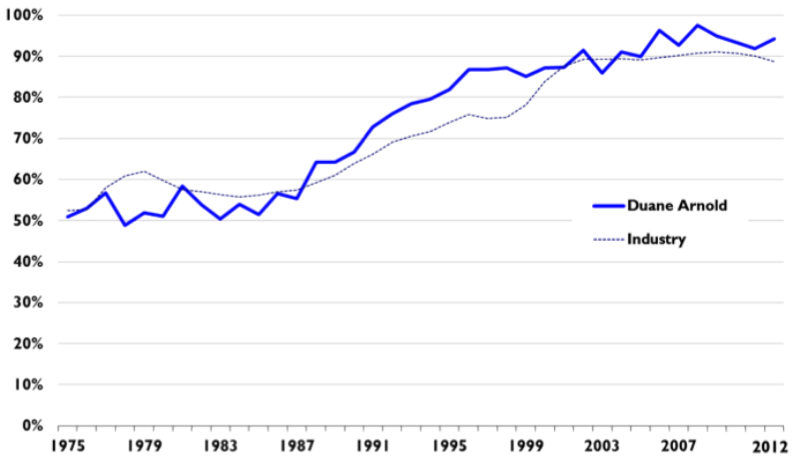
Meeting and Exceeding Generating Capacity

Since 1986, Duane Arnold has maintained capacity factors at or above the industry average. Capacity factor, a measure of production efficiency, is the ratio of actual electricity generated compared with the maximum possible generation if the plant were to operate at full capacity for one year.

In 2008, Duane Arnold had its best year, with a capacity factor of 104 percent. The 100 percent level was exceeded because the plant generated slightly more electricity than its rated capacity for a portion of the year.

Since 1986, Duane Arnold has maintained capacity factors at or above the industry average.

Figure 1.1 Three-Year Average Capacity Factors



Source: Energy Information Administration

Section 2: Economic and Fiscal Impacts on Local, State and National Economies

Job Growth in Iowa

Besides helping to stabilize electricity costs in Iowa, Duane Arnold has contributed significantly to job creation. The plant employs nearly 600 full-time workers, approximately 175 of whom reside within Benton County and nearly 400 within Linn County.

Jobs provided by the plant are also typically higher-paying than most jobs in the area. Full-time Duane Arnold employees who live in Benton County earn, on average, about $75,680 per year. This is substantially higher than the average earnings of workers in the county, which is about $32,060 per year.

Full-time plant employees who live in Linn County earn, on average, about $82,620 per year, compared to the average earnings of workers in the county, which is about $45,690 per year.

Other Economic Benefits

Duane Arnold's economic and fiscal contributions extend well beyond jobs and incomes. In fact, the plant's economic contribution ripples beyond the counties in which it resides and into the state economy, and even the U.S. economy.

In order to have a full and comprehensive analysis of the real economic and fiscal impact of the plant, there are a few terms that should first be defined. NEI applied the Impact Analysis for Planning (IMPLAN) model to expenditure data provided by NextEra Energy to develop estimates of these effects (more information on IMPLAN in Section 5).

- **Direct Spending:** This measures the total amount of spending directly from Duane Arnold to a specific entity or industry. For the purposes of this study, it encompasses total compensation for plant employees – benefits, salaries, and wages – as well as outside industries that receive direct expenditures from Duane Arnold.
- **Economic Impact:** The full economic impacts of the plant can be assessed through direct effects and secondary effects. The variables used to analyze these effects are:
    - **Output:** the value of production of goods and services – e.g., sales
    - **Labor income:** workers' earnings
    - **Employment:** measured in jobs provided

  Direct Effects: The direct effects (or direct output) measure the estimated value of the power produced from Duane Arnold, which for 2011 was $200 million. It does not include subsequent spending effects. The value includes plant purchases, salaries, earnings and taxes, which reflects the total output associated with the plant.

  Secondary Effects: The secondary effects (or secondary output) include subsequent spending effects. These effects are divided into two categories: indirect and induced.

    - **Indirect effects** cover how Duane Arnold's spending alters subsequent spending among suppliers.
    - **Induced effects** measure how changes in labor income (those employed by Duane Arnold) influence the final demand for goods and services within a particular community. This induced effect has a subsequent effect on all sectors producing basic, intermediate and final goods and services. Since Duane Arnold's direct output for 2011 was $200 million, the secondary effects (indirect and induced) on local private hospitals was a boost of $3.1 million. This study evaluated how each of these effects changed economic activity at the local, state and national level.

Local Expenditures

In 2011, Duane Arnold's expenditures within the local counties of Benton and Linn totaled $66 million, or 45 percent of the plant's total spending for that year nationally ($148 million), and 91 percent of the plant's $72 million spent in Iowa. The below table (2.1) illustrates the various industries that benefited from Duane Arnold's direct economic input.

Much of the immediate local spending is seen in the amount of labor the plant employs. As expected, much of the local impact is seen in plant employee wages and benefits – about $64 million (or 80 percent of the expenditures within the counties). Much of this stays "home" within the respective counties, further stimulating the economy.

NextEra Energy provided the expenditure totals for the local counties that appear in Table 2-1, which detail the 10 sectors receiving the largest amounts of plant spending. The categories, from among IMPLAN's 440 sectors, are listed according to the IMPLAN description. Total compensation, which includes benefits, salaries and wages, is listed separately.

Other sectors that are touched locally involve mostly specialized work – equipment and machinery rental, plant maintenance and consulting.

For every $1 of output from Duane Arnold, the local economy produced $1.23.

Table 2.1 Duane Arnold Expenditures in Benton and Linn Counties (dollars in thousands)

Description	Amount
All other miscellaneous professional, scientific, and technical services	$453
Nonresidential maintenance and repair construction	$338
Office administrative services	$261
Other state and local government enterprises	$223
Travel arrangement and reservation services	$210
Business support services	$202
Other electronic component manufacturing	$186
Industrial gas manufacturing	$80
Telecommunications	$72
Facilities support services	$70
Other	$106
Subtotal	**$2,202**
Total Compensation[a]	**$63,989**
Total	**$66,191**

[a]*Total compensation includes wages, salaries and fringe benefits based on data provided by NextEra Energy.*

Local Comprehensive Economic Effect

The economic investment of Duane Arnold in the local community has a multiplier effect across nearly every sector of its economy. While the plant's direct output value was $200 million, the study found the total impact on the local region was $246 million. That puts the output multiplier at 1.23, so for every dollar of output from Duane Arnold, the local economy produced $1.23.

Most notably (and unsurprisingly), Duane Arnold affected power generation and supply – which also includes the electricity produced by the plant – the greatest.

The second largest effect was seen in a sector called "owner-occupied" dwellings, a designation designed by the U.S. Department of Commerce that estimates what homeowners would have to pay in rent if they did not own their home. It essentially measures the benefit of increased home values that are caused by increased labor from the plant's operation.

Other sectors that benefit from Duane Arnold include private hospitals, doctor's offices, insurance, real estate, and others. A full depiction of the local industries that benefit from the plant is below in Table 2.2.

Table 2.2 Direct and Secondary Effects on the Most-Affected Industries in the Local Counties (dollars in thousands)

Industry Description	Output	Labor Income	Employment
Power generation and supply	$201,316	$64,184	570
Owner-occupied dwellings	$6,031	$0	-
Private hospitals	$3,110	$1,423	25
Offices of health practitioners	$2,867	$1,928	20
Real estate establishments	$2,630	$478	20
Food services and drinking places	$2,370	$843	46
Monetary authorities	$2,106	$374	6
Wholesale trade businesses	$1,827	$771	11
Telecommunications	$1,707	$226	4
Insurance carriers	$1,610	$427	6
Other	$20,416	$9,277	271
Total	**$245,991**	**$79,931**	**978**

State Expenditures

Similar to the effect locally was the effect of Duane Arnold's statewide spending. The plant spent $72 million for products and services (including labor) throughout the state of Iowa, and that spending represents approximately 48 percent of the nuclear plant's total expenditures of $148 million.

In terms of statewide spending, investigation and security services claimed the largest spending category after employee compensation. Other notable categories reflect the need for specialized workers including spending for scientific and technical services.

Table 2.3 Duane Arnold Expenditures in Iowa (dollars in thousands)

Description	Amount
Investigation and security services	$889
All other miscellaneous professional, scientific, and technical services	$642
Other state and local government enterprises	$411
Nonresidential maintenance and repair construction	$338
Office administrative services	$261
Business support services	$235
Travel arrangement and reservation services	$221
Other electronic component manufacturing	$210
Telecommunications	$150
Industrial gas manufacturing	$139
Other	$500
Subtotal	**$3,997**
Total Compensation[a]	**$68,345**
Total	**$72,341**

[a]*Total compensation includes wages, salaries and fringe benefits based on data provided by NextEra Energy.*

State Comprehensive Economic Effect

Duane Arnold stimulates the Iowa state economy in an even broader way than at the local level. In fact, this study found that the total economic impact for the state was $255 million. That places the output multiplier at 1.27. In other words, for every dollar of output from Duane Arnold, the state economy produced $1.27.

Table 2.4 Direct and Secondary Effects on the Most-Affected Industries in Iowa (dollars in millions)

Industry Description	Output	Labor Income	Employment
Power generation and supply	$201.2	$68.5	612
Owner-occupied dwellings	$6.8	$0.0	0
Monetary authorities	$3.1	$0.6	8
Offices of health practitioners	$2.9	$1.8	23
Wholesale trade businesses	$2.5	$1.0	16
Food services and drinking places	$2.6	$0.8	52
Private hospitals	$2.6	$1.2	21
Real estate establishments	$2.0	$0.2	17
Telecommunications	$1.6	$0.2	3
Insurance carriers	$1.4	$0.4	5
Other	$28.3	$11.4	357
Total	**$254.9**	**$86.1**	**1,114**

National (U.S.) Expenditures

In 2011, total expenditures for products and services (including labor) by Duane Arnold totaled $148 million in the United States. Besides the $72 million of spending in Iowa – which was previously discussed – the plant spent an additional $76 million elsewhere in the United States, largely for specialized products and services unique to the nuclear industry.

The largest non-labor spending category at the national level for Duane Arnold is for inorganic chemical manufacturing, which represents expenditures for nuclear fuel and related services. The second largest spending category is for business support services, which include payments to specialized contractors who are hired to come in and perform nuclear services when the plant shuts down for planned refueling outages.

Table 2.5 Duane Arnold Expenditures in the United States (dollars in millions)

Description	Amount
All other basic inorganic chemical manufacturing	$48.2
Business support services	$10.8
Other federal government enterprises	$5.1
All other miscellaneous professional, scientific, and technical services	$4.2
Other electronic component manufacturing	$1.8
Nonresidential maintenance and repair construction	$1.0
Investigation and security services	$0.9
Other computer related services, including facilities management	$0.9
Plastics material and resin manufacturing	$0.8
Other support services	$0.8
Other	$4.5
Subtotal	**$78.9**
Total Compensation[a]	**$69.2**
Total	**$148.1**

[a]*Total compensation includes wages, salaries and fringe benefits based on data provided by NextEra Energy.*

National (U.S.) Comprehensive Economic Effect

Duane Arnold's total effect on the U.S. economy was $514 million. Given that the total output from the plant was $200 million, this means the output multiplier for the U.S. economy was an outstanding 2.57. For every dollar of output from the plant, the U.S. economy reaped $2.57.

Table 2.6 Direct and Secondary Effects on the Most-Affected Industries in the U.S (dollars in millions)

Description	Output	Labor Income	Employment
Electric power generation, transmission, and distribution	$$206.8	$70.2	622
All other basic inorganic chemical manufacturing	$50.1	$6.7	58
Imputed rental activity for owner-occupied dwellings	$12.6	$0.0	0
Business support services	$11.9	$7.0	191
Petroleum refineries	$10.4	$0.2	1
Real estate establishments	$9.7	$0.9	62
Wholesale trade businesses	$8.4	$3.6	46
Monetary authorities and depository credit intermediation activities	$7.5	$1.4	20
Food services and drinking places	$6.6	$2.5	114
Private hospitals	$6.0	$3.0	44
Other	$183.5	$64.8	1,191
Total	$513.6	$160.5	2,348

As this study has shown, Duane Arnold's impact on the local, state, and national economies of which it is a part is absolutely critical. By producing affordable, reliable energy, the plant is a hub of economic activity for Benton and Linn counties, a major stimulus of economic activity for Iowa, and a boost to the national economy in a variety of ways.

The table below summarizes the total effects for each region discussed.

Table 2.7 Impact of the Duane Arnold Nuclear Plant on the Local, State and National Economies (dollars in millions)

Description	Direct	Secondary[a]	Total
Local Counties			
Output	$200.0	$46.0	$246.0
Labor Income	$64.0	$15.9	$79.9
Employment	568	410	978
Iowa			
Output	$200.0	$54.9	$254.9
Labor Income	$68.3	$17.8	$86.1
Employment	610	504	1,114
United States			
Output	$200.0	$313.6	$513.6
Labor Income	$69.2	$91.3	$160.5
Employment	614	1,734	2,348

[a]*Secondary effects include indirect and induced impacts. Indirect impacts measure the effect of input suppliers on expenditures while induced impacts measure the effects produced by the change in household income resulting from expenditures.*

Economic Stimulus through Taxes

Duane Arnold contributed $3 million in direct state and local property taxes. The tax revenue contributed by the plant extends beyond the direct property tax revenue, which is along the same lines as the secondary effects and output just discussed.

Spending from the plant has direct impacts on income and value creation, which in turn affects taxes paid on that income and value. Additionally, the plant expenditures explored earlier increase economic activity, leading to additional income and value creation, and therefore higher tax revenue.

In total, the study calculated the plant contributed $25.6 million in tax revenue, with most of the additional revenue coming from taxes paid on income and Social Security.

Table 2.8 Total Tax Impacts[a] of Economic Activity by the Duane Arnold Nuclear Plant (dollars in millions)

Government	Taxes Paid	Secondary Taxes	Total Tax Impact[a]
Federal	-	$19.3	$19.3
State and Local	$3.0	$3.2	$6.2
Total Taxes	$3.0	$22.6	$25.6

[a]*The total tax impact includes taxes paid by Duane Arnold and other entities because of economic activity created by expenditures made by the plant.*

Summary

As this study has shown, Duane Arnold's impact on the local, state, and national economies of which it is a part is absolutely critical. By producing safe, affordable and reliable energy, the plant is a hub of economic activity for Benton and Linn counties, a major stimulus of economic activity for the state, and a boost to the national economy in a variety of ways.

At the local level, Duane Arnold contributed $246 million. At the state level, the plant contributed $255 million. And at the national level, the plant contributed a total of $514 million.

Section 3: Duane Arnold in the Community and the Environment

Duane Arnold is an active corporate leader in the local community and throughout Iowa. The plant is dedicated to educational progress, environmental support and community involvement.

To ensure that Duane Arnold remains a leader in reliable, safe energy production for eastern Iowa for many years to come, NextEra Energy and the plant are committed to significant investment, continually improving equipment and systems, and incorporating new designs, safety features and training programs.

How Duane Arnold Encourages Education

Duane Arnold takes an active role assisting many local schools, civic groups, and charitable organizations. It annually sponsors the Eastern Iowa Science and Engineering Fair, which is an opportunity for local young people in various scientific fields to showcase their imagination and creativity.

Every winter, the plant also collaborates with the Cedar Rapids Science Center and hosts a Nuclear Energy Merit Badge Camp. This popular event includes 60 local Boy Scouts and their families, who are given a day-long interactive educational workshop that focuses on the science behind — and the environmental benefits of — nuclear energy.

Duane Arnold also recently established a scholarship for Iowa residents to enroll in a Missouri college program focused on nuclear technology. This program is designed to help highly qualified new employees join the Duane Arnold team.

Duane Arnold's Environmental Support

Duane Arnold has a long-standing commitment to environmental stewardship. The plant is located on more than 500 acres on the banks of the Cedar River, and much of the site is leased to local farmers for agricultural use.

The plant also has a sustained commitment to Wickiup Hill Outdoor Learning Center, a regional education facility.

Duane Arnold also provides benefits to the local area in terms of air quality. Because nuclear energy can provide large-scale amounts of electricity without emitting greenhouse gases, it is recognized by state and federal policymakers as being clean, safe and reliable.

Duane Arnold prevents the emission of nearly 4 million tons of carbon dioxide (CO_2) annually, which is the equivalent of taking more than 800,000 cars off the road.

Duane Arnold as a Community Leader

Duane Arnold is a leading corporate citizen in eastern Iowa. Members of the plant's team serve their communities as volunteer firefighters and emergency medical technicians, serve on charitable boards of directors, and serve in other influential roles. They provide thousands of hours of volunteer time to dozens of civic and community organizations, and make significant contributions to United Way agencies each year. This work is supplemented through a strong United Way campaign, which annually contributes nearly $100,000 to the local chapter and its affiliated organizations.

The plant is focused on giving to other nonprofits as well. More than 85 percent of the giving budget comes from funds generated through land-lease agreements with local residents who farm the unoccupied portion of the station's property. The revenue Duane Arnold receives from these leases is given back to the community in the form of charitable contributions.

This process has been in place since NextEra Energy purchased the plant, and recent local benefactors of this outreach effort have included:

- Wickiup Hill
- Four Oaks
- Variety - the Children's Charity
- Eastern Iowa Science and Engineering Fair
- St. Luke's Child Protection Center
- Diversity Focus
- Lion's Club
- Make-A-Wish Foundation
- Several local volunteer fire departments
- Quota Club
- Cedar Rapids Science Center
- Rebuilding Palo Fund

Duane Arnold is also recognized for its strong support and partnership with local emergency response agencies. For example, all nuclear power plants are required to have an alert and notification system in place to alert the public in the unlikely event of an emergency at the plant. The Duane Arnold system currently includes 144 sirens in Linn and Benton counties. Duane Arnold has responsibility for the cost of maintenance of all 144 sirens in the Duane Arnold area, but they are controlled and activated primarily by Linn and Benton County Emergency Management Agencies and used to help inform the public of other emergencies such as severe weather. Duane Arnold recently upgraded these sirens, investing an additional $25,000 per siren. Additionally, Duane Arnold plans and organizes four emergency preparedness drills each year to help prepare the local community to respond to potential emergencies.

The revenue Duane Arnold receives from land leases is given back to the community in the form of charitable contributions.

This community investment was recently nationally recognized when the National Academy of Sciences reported that the regular emergency preparedness drills conducted by Duane Arnold Energy Center — in conjunction with local police, fire and first responder organizations — helped Cedar Rapids and eastern Iowa cope with the record-setting floods the region experienced in 2008.

Section 4: Duane Arnold and the U.S. Nuclear Energy Industry

The Duane Arnold nuclear power plant plays a vital role in helping eastern Iowa and the state as a whole meet its demand for affordable, reliable and sustainable energy.

In 2013, electricity production from U.S. nuclear power plants was about 790 billion kilowatt-hours—nearly 20 percent of America's electricity supply.

Over the past 20 years, America's nuclear power plants have increased output and improved performance significantly. Since 1990, the industry has increased total output equivalent to that of 26 large power plants, when in fact only five new reactors have come on line.

U.S. nuclear power plants achieved an industry-leading performance capacity factor of 91 percent in 2013, while producing electricity at one of the lowest costs of any fuel source used to generate electricity. Duane Arnold's performance has exceeded the industry average for many years.

Nuclear Energy's Value Proposition

Nuclear energy's role in the nation's electricity portfolio was especially valuable during the 2014 winter, when record cold temperatures gripped the United States and other sources of electricity were forced off the grid. Nuclear power plants nationwide operated at an average capacity factor of 96 percent during the period of extreme cold temperatures. During that time, supply volatility drove natural gas prices in many markets to record highs and much of that gas was diverted from use in the electric sector so that it could be used for home heating.

Some of America's electricity markets, however, are structured in ways that place some nuclear energy facilities at risk of premature retirement, despite excellent operations. It is imperative that policymakers and markets appropriately recognize the full strategic value of nuclear energy as part of a diverse energy portfolio.

That value proposition starts with the safe and reliable production of large quantities of electricity around the clock.

Renewable energy, while an emerging part of the energy mix, is intermittent (the sun doesn't always shine and the wind doesn't always blow when generation is needed) and therefore unreliable; natural gas-fired generation depends on fuel being available (both physically and at a reasonable price); and on-site coal piles can freeze. One of nuclear energy's key benefits is the availability of low-cost fuel and the ability to produce electricity under virtually all weather conditions. Nuclear power plants also provide clean-air compliance value. In any cap-and-trade system, nuclear energy reduces the compliance burden that would otherwise fall on carbon-emitting generating capacity.

Nuclear plants provide voltage support to the grid, helping to maintain grid stability. They have portfolio value, contributing to fuel and technology diversity. And they provide tremendous local and regional economic development opportunity, including large numbers of high-paying jobs and significant contributions to the local and state tax base.

Affordable Energy for Consumers

In addition to increasing electricity production at existing nuclear energy facilities, power from these facilities is affordable for consumers. Compared to the cost of electricity produced using fossil fuels—which is heavily dependent on fuel prices—nuclear plant fuel prices are relatively stable, making costs to consumers more predictable. Uranium fuel is only about one-third of the production cost of nuclear energy, while fuel costs make up 78 percent to 88 percent of coal-fired and natural gas production costs.

Emphasis on Safety

Safety is the highest priority for the nuclear energy industry. Based on more than 50 years of experience, the industry is one of the safest industrial working environments in the nation. Through rigorous training of plant workers and increased communication and cooperation between nuclear plants and federal, state and local regulating bodies, the industry is keeping the nation's 100 nuclear plants safe for their communities and the environment.

The U.S. Nuclear Regulatory Commission (NRC) provides independent federal oversight of the industry and tracks data on the number of "significant events" at each nuclear plant. (A significant event is any occurrence that challenges a plant's safety system.) The average number of significant events per reactor declined from 0.45 per year in 1990 to 0.06 in 2012, illustrating the emphasis on safety throughout the nuclear industry.

General worker safety also is excellent at nuclear power plants—far safer than in the manufacturing sector. U.S. Bureau of Labor Statistics show that in 2012, nuclear energy facilities achieved an incidence rate of 0.3, per 200,000 work hours, compared to 2.1 for fossil-fuel power plants, 2.8 for electric utilities and 4.3 for the manufacturing industry.

Industry Trends: License Renewal and New Plants

The excellent economic and safety performance of U.S. nuclear power plants has demonstrated the value of nuclear energy to the electric industry, the financial community and policymakers. This is evidenced by the increasing number of facilities seeking license renewals from the NRC.

Originally licensed to operate for 40 years, nuclear energy facilities can operate safely for longer. The NRC granted the first 20-year license renewal to the Calvert Cliffs plant in Maryland in 2000. As of May 2014, 73 reactors had received license extensions and operators of 30 additional reactors either had submitted applications or announced that they will seek renewal. License renewal is an attractive alternative to building new electric capacity because of nuclear energy's low production costs and the return on investment provided by extending a plant's operational life.

Besides relicensing nuclear plants, energy companies also are building new, advanced-design reactors. Georgia Power and South Carolina Electric and Gas are building two advanced reactors each, near Augusta, Ga., and Columbia, S.C. These facilities are nearly halfway through the construction program and are approximately on schedule and on budget. These projects will employ more than 5,000 workers each during the peak of construction. In addition, Tennessee Valley Authority is completing construction of the Watts Bar 2 reactor in Tennessee.

Section 5: Economic Impact Analysis Methodology

The methodology used to estimate the economic and fiscal impacts of the NextEra Energy's Duane Arnold plant is commonly referred to as an input/output analysis. Several operational input/output models are available in the marketplace. The market leaders are Impact Analysis for Planning (IMPLAN), Regional Economic Models Inc. and Regional Input-Output Modeling System II. The study's authors selected the IMPLAN model for use in this study, primarily because of the availability of the model and data sets. Other important factors were its relevance to the particular application, as well as its transparency and ease of use.

This section presents typical applications of input/output analysis and explains the methodology and its underpinnings. It also describes how NextEra's data and the IMPLAN model were used to estimate local, state and national economic and fiscal impacts of the plant's operations.

Use of Input/Output Models

Input/output models capture input, or demand, and output, or supply, interrelationships for detailed business, industry and government sectors in a geographic region. They also capture the consumption of goods and services for final demand by these sectors and by the household sector.

The basic geographic region is a county, but model results can be developed at the multi-county, state, multi-state and national levels. These results are particularly useful in examining the total effects of an economic activity or of a change in the level of that activity.

These models are typically used when the following key questions need to be addressed:

- How much spending does an economic activity (such as a power plant) bring to a region or local area?
- How much of this spending results in sales activity by local businesses?
- How much income is generated for local businesses and households?
- How many jobs does this activity support?
- How much tax revenue is generated by this activity?

These models also are useful in addressing related questions, such as the geographic and industry distribution of economic and fiscal impacts. Typical applications of these models include facility or military base openings and closings, transport or other public infrastructure investments, industrial recruitment, relocation and tourism.

Overview of the Input/Output Methodology

Input/output models link various sectors of the economy—e.g., agriculture, construction, government, households, manufacturing, services and trade—through their respective spending flows in a reference year. These include geographic linkages, primarily at national, state, and county levels.

As a result of these linkages, the impact of an economic activity in any sector or geographic area on other sectors and areas can be modeled. These impacts can extend well beyond the sector and area in which the original economic activity is located. They include not only the direct, or initial, effects of the economic activity, but also the secondary, or "ripple," effects that flow from this activity. Direct effects are analogous to the initial "splash" made by the economic activity, and ripple effects are analogous to the subsequent "waves" of economic activity (new employment, income, production and spending) triggered by the splash. A full accounting of the effect of the splash must include the waves as well as the splash itself.

The sum of the direct and ripple effects is called the total effect, and the ratio of the total effect to the direct effect is called the "total effect multiplier," or simply the multiplier effect. Multipliers can be developed for any of the model outputs, such as earned income, employment, industry output and total income (which includes the effect of transfers between institutions).

"Multipliers" also can be developed for any industry/business sector or geographic area in the model. Multipliers for a county are smaller than for a larger area, such as the state in which the county is located, because some spending associated with an economic activity migrates from the small area into the larger area. At the local area level, multipliers are larger if the local area tends to produce the types of goods and services that the plant requires.

Secondary effects include two components—indirect and induced effects—modeled separately within input/output models. Indirect effects are those influencing the supply chain that feeds into the business/industry sector in which the economic activity is located. For example, when a nuclear plant buys a hammer for $5, it contributes directly to the economy.

Consequently, the company that makes the hammer also has to increase its purchases of steel and wood to maintain its inventory, increasing output in the steel and wood industries. The steel and wood industries then will have to purchase more inputs for their production processes, and so on. The result will be an economic impact that is greater than the $5 initially spent for the hammer.

The increased income of plant employees and other regional workers leads to higher spending at the household level. That increased spending is called the induced effect. To illustrate, when a nuclear plant pays $5 for a hammer, a portion of the $5 goes to pay wages of employees at the company that makes the hammer. This portion contributes to labor income, which provides an additional contribution to the economy through its effects on household spending for goods and services.

This purchase also will affect labor income in the wood and steel industries, and the resulting household spending on goods and services. Duane Arnold's wage and salary expenditures at the plant create induced effects as well, primarily in the plant's host and surrounding counties.

As with any model, input/output models incorporate some simplifying assumptions to make them tractable. There are several key simplifying assumptions in input/output models, including the assumption of a fixed commodity input structure. In essence, the "recipe" for producing a product or service is fixed, and there is no

substitution of inputs, either of new inputs (which were not in the mix before) for old inputs, or among inputs within the mix.

Input substitution does not occur if technical improvements in some inputs make them relatively more productive. Nor does input substitution occur if there are relative price changes among inputs. Were any of these types of substitutions to be allowed, they might dampen the multiplier effects, especially for larger geographic areas.

Another key simplifying assumption is constant returns to scale. A doubling of commodity or service output requires a doubling of inputs, and a halving of commodity or service output requires a halving of inputs. There is no opportunity for input use relative to commodity or service production levels to change, as those levels expand or contract, so there are no opportunities for either economies or diseconomies of scale. This will not dramatically alter the overall results as long as the economic activity whose effects are being modeled is not large relative to the rest of the sectors.

In other words, the models assume that for every dollar of output, the same dollar amount is required for the various input categories. Returning to the hammer example, if a $5 hammer requires $3 of steel, then two hammers would require $6 of steel.

Although that works for steel and hammers, some inputs do not vary directly with output. For instance, if an oil refinery's efficiency and output increases, a corresponding increase in personnel operating the plant is unlikely. The constant-return-to-scale assumption considers such differences and is necessary for modeling.

Input/output models assume no input supply or commodity/service production capability constraints. This simplifying assumption is related in part to the constant-returns-to-scale assumption, for if there were supply constraints, diseconomies of scale likely would result. As in the case of the constant-returns-to-scale assumption, this "no supply constraints" assumption is not a major concern as long as the economic activity of interest is not large relative to the rest of the sectors.

To illustrate, the assumption presupposes that a hammer manufacturer would purchase all the steel for the same price. If not, doubling the number of hammers sold could mean that the dollar value of the steel might more than double if the manufacturer had to buy more steel at a higher price. This would violate the constant-returns-to-scale assumption, which simplifies modeling.

Homogeneity, another key simplifying assumption, characterizes firms and technologies within sectors as very similar. Although the model allows some editing of its sector files to characterize specialized firms, there is no ability to reflect full diversity of firms within sectors.

The IMPLAN Model and Its Application to the Duane Arnold Energy Center

IMPLAN was originally developed by the U.S. Department of Agriculture's Forest Service in cooperation with the Federal Emergency Management Agency and the U.S. Department of the Interior's Bureau of Land Management to assist in land and resource management planning. IMPLAN has been used since 1979 and is supported by the Minnesota IMPLAN Group Inc.

The IMPLAN system consists of two components: the software and the database. The software performs the necessary calculations, using the study area data, to create the models. It also provides an interface for the user to change the region's economic description, create impact scenarios and introduce changes into the local model. The software is described in a user's guide provided by the Minnesota IMPLAN Group.

The IMPLAN software was designed to serve the following functions: data retrieval, data reduction, model development and impact analyses.

The IMPLAN database consists of two major parts:

- national technology matrices, and
- estimates of regional data for institutional demand and transfers, value added, industry output, and employment for each county in the United States, as well as state and national totals.

The model's data and account structure closely follow the accounting conventions used in the input/output studies of the U.S. economy by the Department of Commerce's Bureau of Economic Analysis. The comprehensive and detailed data coverage of the entire United States by county, and the ability to incorporate user-supplied data at each stage of the model-building process, provides a high degree of flexibility in terms of both geographic coverage and model formulation.

In applying the IMPLAN model to the plant, NextEra Energy provided three basic types of data: purchase order expenditures by purchase order code, employee compensation expenditures and tax payment data for 2011.

The purchase order data mapped IMPLAN's 440 sector codes by identifying the spending at each geographic level and assigning them an industrial classification code within IMPLAN sector codes. The purchase order and compensation data then were augmented by an estimate of revenues from electricity sales from the nuclear plant into the wholesale market in 2011. This augmentation was necessary because purchase orders and compensation do not reflect all the economic value of the nuclear plant, while total output (approximated by total revenues) better reflects the full economic impacts of the plant.

The estimated revenues were above the expenditure data provided by the nuclear plant, indicating a nuclear generation profit margin that was incorporated into IMPLAN as profits associated with the operation of the plant.

These data then were incorporated into the IMPLAN model, which combined specifics of the local economy with data on economic activity of the nuclear plants to provide estimates of the plant's total impacts. IMPLAN then developed the economic and fiscal impact estimates for this report.

Conclusion

As seen in the course of this study, the Duane Arnold Energy Center is a leader economically, fiscally, environmentally, and socially within Iowa. Its contributions to Benton and Linn counties are substantial. Statewide, Duane Arnold's contributions in terms of labor, income, and the demand for goods and services in various industries multiplies even further from $246 million to $255 million. And when the total economic effects are studied nationwide, Duane Arnold contributes $514 million.

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