

The Economic and Fiscal Impacts of Fermilab on Illinois

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I. Executive Summary

PURPOSE OF REPORT Fermi National Accelerator Laboratory (Fermilab) is a science research facility specializing in high-energy particle physics. Fermilab is located in Batavia, Illinois. The laboratory is managed by Fermi Research Alliance, a limited liability corporation formed by the University of Chicago and the Universities Research Association. Fermi Research Alliance retained Anderson Economic Group (AEG) to quantify the economic and fiscal impacts of Fermilab operations and visitors on the Chicago metropolitan area and the state of Illinois. We also describe how Fermilab’s research contributes to advancements in our understanding of physics, and discuss the civic contributions of Fermilab’s education and outreach initiatives.

OVERVIEW OF APPROACH

In this report, we estimate the net economic and fiscal impacts of Fermilab operations in Illinois and the Chicago region, which we define as the counties of Cook, DeKalb, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will.

Net Economic Impact

Our analysis quantifies the “net new” economic activity that occurs in the Chicago region and Illinois due to Fermilab operations. In other words, we count only the portion of expenditures and tax revenues that occur in each region as a result of Fermilab. We exclude economic activity and tax revenue that would occur even if Fermilab did not exist.

Our economic impact analysis consists of two parts. The first estimates the impact of Fermilab operations, while the second estimates the impact of visitor spending associated with Fermilab.

Part I: Net Economic Impact of Operations

We took the following steps to quantify the economic impact of Fermilab operations.

- We collected data on payroll and nonpayroll spending by Fermilab in Illinois and the Chicago region for Fiscal Year 2018.
- After collecting the data, we determined the net new direct spending by Fermilab in Illinois and the Chicago region. We define the total operations spending by Fermilab in each region as the direct net economic impact of the laboratory.
- We then applied U.S. Bureau of Economic Analysis RIMS II multipliers to these direct spending totals to determine the indirect net economic impact of Fermilab spending. Indirect impacts occur as money spend by Fermilab recirculates throughout Illinois and the Chicago region. This recirculation occurs as Fermilab vendors spend money on inputs, and those suppliers spend money on other inputs, and so on.

Part II: Net Economic Impact of Visitor Spending

We took the following steps to determine the net economic impact of Fermilab visitor spending.

- We collected data on Fermilab visitors, including information such as length of stay and location, where visitors come from, and average hotel costs. We also collected data on per-diem expenditures from the General Service Administration.
- After collecting this data, we calculated the net new spending by visitors in each region to determine their direct net economic impact.
- We then applied U.S. Bureau of Economic Analysis RIMS II multipliers to this net new spending to determine the indirect net economic impact of visitors.

We summed the direct and indirect net economic impacts of Fermilab operations and visitor spending to obtain the laboratory's total net economic impact on Illinois.

Net Fiscal Impact

After quantifying the total net new economic activity caused by Fermilab, we built a custom tax impact model to quantify new tax revenues that occur as a result of this economic activity. Our tax impact model quantifies additional income, sales, and hotel tax revenues generated by the lab.

For a full description of our methodology, see "Appendix A. Methodology" on page A-1.

OVERVIEW OF FINDINGS

Using the information available to us and the methodology described above, we concluded the following:

- 1. In 2018, Fermilab employed over 1,900 people in Illinois, spent \$205 million on Illinois payroll and benefits, and purchased \$63 million in goods and services from Illinois businesses.*

Fermilab is a major scientific research center that occupies a 6,800-acre site with dozens of buildings, employs hundreds of scientists and engineers, and develops and operates state-of-the-art particle physics research equipment. The lab spent a total of \$63 million on procurement of goods and services from Illinois businesses, along with \$205 million on payroll while employing 1,922 staff members. Nearly all of this economic activity occurred in Northeastern Illinois,

as shown in Table 1.

TABLE 1. Fermilab Spending and Employment in Illinois and the Chicago Region

Area	Payroll Spending (millions)	Nonpayroll Spending (millions)	Employment
Illinois	\$205.2	\$63.2	1,922
Chicago Region	\$202.4	\$61.7	1,893

Source: Anderson Economic Group analysis of base data from Fermilab.

Fermilab’s procurement spending is expected to increase in the coming years as the laboratory begins major new research and construction projects, as described in “Key Research Initiatives” on page 8.

2. The total net economic impact of Fermilab on Illinois in 2018 was \$452 million in increased output, \$343 million in household earnings, and over 5,300 jobs.

We quantified Fermilab’s net economic impact using three different measures: output (sales by businesses), earnings, and employment. In Illinois, Fermilab operations and visitorship resulted in a net increase in sales by Illinois businesses of \$452 million in 2018. Fermilab’s activities also increased Illinois household earnings by \$343 million and created over 5,300 jobs, as shown in Figure 1.

FIGURE 1. Net Economic Impact of Fermilab, 2018



Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II multipliers, U.S. General Services Administration.

For a complete discussion of the economic impact of Fermilab, see “Net Economic Impact of Fermilab on Illinois” on page 16.

3. In 2018, Fermilab generated \$21.8 million in tax revenue for the State of Illinois, and \$100,000 for local governments.

Although Fermilab is a tax-exempt organization, the lab still generates tax revenue for state and local governments via income tax paid on household earnings, household earnings spent on taxable goods and services, and visitor spending on taxable accommodations and meals.

We show the net fiscal impact of Fermilab in Table 2 below.

TABLE 2. Net Fiscal Impact of Fermilab, 2018 (millions)

Revenue Source	State	Local
Income Tax	\$15.7	N/A
Sales Tax	\$5.9	N/A
Hotel Tax	\$0.1	\$0.1
Total:	\$21.7	\$0.1

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers, U.S. Bureau of Labor Statistics Consumer Expenditure Survey.

For a full discussion of the fiscal impacts of Fermilab, see “Net Fiscal Impact of Fermilab on Illinois” on page 22.

4. Fermilab functions as an international node of scientific research, attracting visitors from around the globe and advancing research in areas such as accelerator physics, particle physics, astrophysics, computing, and quantum science.

In 2018, Fermilab hosted nearly 2,000 visiting students, postdoctoral researchers, engineers, and scientists to conduct research at the lab. Of that number, 1,241 came from the U.S., representing 39 different states and Puerto Rico. International visitors totaled 721 and came from 41 countries. Fermilab researchers wrote 952 scientific papers in 2018, contributing to a total of more than 15,000 papers the laboratory has produced since 2000. Nearly 10,000 of these publications are peer-reviewed articles.

For more information about Fermilab’s operations and research impact, see “Fermilab Overview” on page 6.

**ABOUT ANDERSON
ECONOMIC GROUP**

Founded in 1996, Anderson Economic Group is a boutique research and consulting firm, with offices in East Lansing, Michigan, and Chicago, Illinois. The consultants at AEG have particular expertise in public policy and economic analysis, having conducted nationally-recognized economic and fiscal impact studies across the United States. Past clients of Anderson Economic Group include the University of Chicago, Fermilab and Argonne National Laboratory, Bank of America, Ford Motor Company, and Nestlé.

For more information, please see “Appendix C. About Anderson Economic Group” on page C-1 or visit www.AndersonEconomicGroup.com.

II. Fermilab Overview

HISTORY AND PURPOSE

Fermi National Accelerator Laboratory is one of 17 U.S. Department of Energy National Laboratories. These federally funded laboratories engage in long-term science and technology research that often goes beyond the scope and capacity of academic and private sector research.

Fermilab was founded in 1967 to pursue primary research in advanced physics. In 1974, the lab was renamed in honor of Enrico Fermi—the first physicist to create a controlled nuclear reaction. Fermilab is owned by the U.S. Department of Energy and operated by the Fermi Research Alliance—a partnership between the University of Chicago and the Universities Research Association.

Particle physicists aim to discover what the universe is made of and how it works. They study the smallest building blocks of matter using some of the largest and most complex machines in the world. Fermilab hosts a range of cutting-edge experiments and develops and builds technologies that support particle physics research at locations around the world, including deep underground laboratories in South Dakota and Canada, the Large Hadron Collider in Europe, and the South Pole Telescope.

One significant area of focus for Fermilab is neutrino research. Neutrinos are small sub-atomic particles that travel at or near the speed of light. They are created during large astrophysical events such as the explosion of stars or gamma ray bursts. Neutrinos have little to no mass or electric charge, and thus only interact weakly with matter when passing through it. As a result, neutrinos are very difficult to detect, despite the fact that 100 trillion of them pass through the human body every second.

The fact that neutrinos only weakly interact with matter allows scientists to see distant astrophysical phenomenon that could not otherwise be seen. Much of what occurs in distant parts of the galaxy is obscured from our vision by clouds of gas and other objects. Detecting neutrinos, which pass through matter in a direct line virtually unimpeded, could help scientists observe these phenomena.

In addition to neutrino research, Fermilab also has significant undertakings in the areas of quantum science, dark matter and dark energy, and muons. The laboratory also plays a key role in the Large Hadron Collider.

Fermilab Funding and Budget

Fermilab received a total of \$485 million in funding from the U.S. Department of Energy in fiscal year 2018. The laboratory purchased a total of \$63 million in goods and services from Illinois businesses and spent a total of nearly \$184 million on procurement across the U.S. Fermilab spent \$205 million on payroll for

its Illinois employees and employs nearly 2,000 people nationwide, almost all of whom are based in Illinois. We show Fermilab’s spending in Illinois and metropolitan Chicago in Table 3 below.

TABLE 3. Fermilab Spending in Illinois and Chicago Region, 2018 (millions)

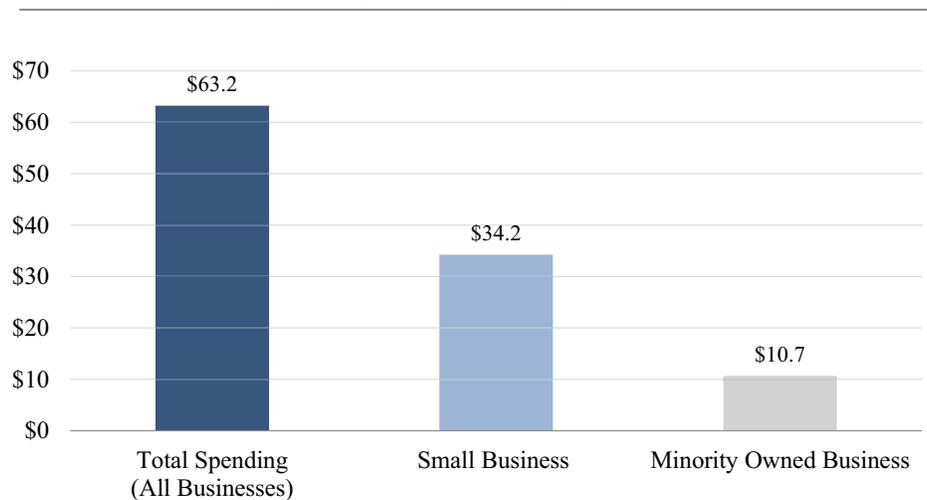
Expenditure Type	Illinois	Chicago Region
Payroll	\$205.2	\$202.4
Non-payroll	\$63.2	\$61.7
Total:	\$268.4	\$264.1

Source: Anderson Economic Group analysis of base data from Fermilab.

Spending at Small and Minority Owned Businesses

In accordance with the Department of Energy’s Small Business First Policy, Fermilab is committed to supporting small businesses through its procurement process. The laboratory also aims to support other categories of business, including Disadvantaged Businesses, Woman Owned Businesses, Veteran Owned Businesses, and Historically Underutilized Business Zone certified businesses. Of the \$63 million Fermilab spent on goods and services in Illinois in fiscal year 2018, \$34 million (54%) was spent at small businesses and \$11 million (17%) was spent at minority-owned businesses, as shown in Figure 2.

FIGURE 2. Fermilab Spending by Businesses Type in Illinois, 2018 (millions)



Source: Anderson Economic Group analysis of base data from Fermilab.

KEY RESEARCH INITIATIVES

Our report quantifies the economic impact of Fermilab’s operations and visitor spending in 2018. Fermilab’s operations spending is expected to grow as the laboratory invests in major research and construction projects that commenced in 2019. Together with its international partners, the laboratory broke ground on the Illinois portion of the Long-Baseline Neutrino Facility (LBNF) as well as the construction of the 700-foot-long Proton Improvement Plan II (PIP-II) particle accelerator on the Fermilab site in Batavia, Illinois. Construction crews also began preparations for the new Integrated Engineering Research Center. Additionally, the laboratory launched the Fermilab Quantum Institute and is managing U.S. contributions to upgrades to the international Compact Muon Solenoid (CMS) experiment.

Long-Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE)

LBNF/DUNE is an international project hosted by Fermilab, involving over 1,000 scientists from 30 countries aiming to increase our knowledge of neutrinos. These subatomic particles exist all around us but remain mysterious. DUNE is comprised of two particle detectors—one at Fermilab and the other at the Sanford Underground Research Facility in South Dakota. The Long-Baseline Neutrino Facility will produce the neutrino beam for the experiment and house the DUNE detectors. Roughly 800,000 tons of rock will be removed to construct the LBNF caverns that will house the DUNE far detector at Sanford Lab, one mile below the Earth’s surface. The facility will use advanced cryogenic technology to maintain temperatures of minus 300 degrees Fahrenheit.



Groundbreaking for Long-Baseline Neutrino Facility
Source: Fermilab

Once LBNF and DUNE are operational, Fermilab will send a high-energy beam of neutrinos directly through the Earth’s crust to the DUNE detectors in South Dakota, over 800 miles away. The DUNE detectors will allow researchers to learn about how these particles interact with matter, potentially changing our

understanding of the universe. Groundbreaking for the South Dakota portion of LBNF began in 2017.¹

At Fermilab’s facility in Batavia, Illinois, the LBNF/DUNE project will involve the construction of four buildings consisting of: a 58-foot-high hill made of compacted soil to support the beamline; a 680-foot-long tunnel to house the equipment to make the neutrinos; a 635-foot-long particle decay pipe; two 200-foot-deep access shafts; and an underground hall for the DUNE near detector. Groundbreaking for this portion of LBNF took place in November, 2019.

Proton Improvement Plan II (PIP-II)

Although Fermilab’s current particle accelerator complex already produces the most intense high-energy neutrino beam in the world, the DUNE experiment has led to plans for an even more powerful accelerator, known as “PIP-II.” In cooperation with partners across the globe, this new accelerator will be built with the latest superconducting radio-frequency technology developed at Fermilab. Construction on the PIP-II facility began in March 2019.²



Artist rendering of PIP-II Accelerator Complex
Source: Fermilab

Integrated Engineering Research Center (IERC)

The IERC will provide world-class facilities and infrastructure to advance two of Fermilab’s highest-priority projects—LBNF/DUNE and Large Hadron Collider (LHC) Upgrades—as well as the U.S. Department of Energy Office of Sci-

1. “LBNF/DUNE: An international flagship neutrino experiment” and “Construction begins on international mega-science experiment to understand neutrinos”, Fermilab, <https://fnal.gov>.
2. “Proton Improvement Plan-II (PIP-II),” Fermilab, <https://pip2.fnal.gov/>.

ence’s quantum information science initiative. On July 15, 2019, Fermilab received authorization from the Department of Energy to start construction of the IERC.

The IERC will be Fermilab’s largest purpose-built laboratory and office building since the laboratory’s main building, the 16-story Wilson Hall, was completed in 1974. The design of the 80,000-square-foot IERC building preserves and strengthens the iconic stature of Wilson Hall and provides state-of-the-art facilities that will enable the design and construction of high-performance particle physics detectors.

The mission of the building is to centralize engineers to the Wilson Hall footprint area by providing a collaborative environment of laboratory and office spaces to allow scientists and engineers to work together to advance Fermilab’s mission.



Artist rendering of Integrated Engineering Research Center
Source: Fermilab

Compact Muon Solenoid (CMS) Experiment

Fermilab plays an important role in one of the largest international scientific endeavors in history—the Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider at CERN. The CMS is a particle detector consisting of a large solenoid magnet with a magnetic field 100,000 times stronger than that of the Earth.³ It records the aftermath of particle collisions. Researchers hope that CMS will provide insights into the newly-discovered Higgs boson subatomic particle, the search for extra dimensions, and dark matter. Fermilab hosts a Remote Operations Center (ROC) at its facility in Batavia that enables scientists in the U.S. to directly participate in the CMS experiment from afar. The ROC makes Fermilab an important node in the global community of over 5,000 scientists from 50 different countries who collaborate on this experiment.

3. “CMS,” CERN, <https://home.cern>.

Publications

Fermilab researchers wrote 952 scientific papers in 2018, contributing to a total of more than 15,000 papers the laboratory has produced since 2000. Nearly 10,000 of these publications are peer-reviewed articles. These papers have made significant contributions to the fields of accelerator physics, particle theory, and astronomy and astrophysics. In fact, papers produced by Fermilab represent over 5% of all papers in the INSPIRE high-energy physics literature database that have been cited 500 or more times; there are over 200 Fermilab papers in this category.⁴

Fermilab Quantum Institute

Fermilab has become a major player in the rapidly expanding field of quantum science and technology. In November 2019, the laboratory announced the launch of the Fermilab Quantum Institute. This new enterprise signals Fermilab's commitment to this burgeoning field, working alongside scientific institutions and industry partners from around the world.

For more than 50 years, Fermilab has been at the forefront of particle physics and accelerator technology. The laboratory's scientists and engineers have used their scientific and technological expertise to probe the mysteries of the universe, discovering new insights about matter, energy, space and time at the smallest scales. Now they are applying their knowledge in other areas of quantum science as well.

The Fermilab Quantum Institute will enable the laboratory to bring all of its quantum projects together and to attract new people and new ideas. Scientists and engineers at Fermilab already work with companies and institutions at the vanguard of quantum research, and the Quantum Institute will aim to further strengthen the laboratory's support of those partnerships.⁵

Technology Transfer

Although Fermilab's primary focus is on basic science research, the laboratory also engages in applied research and development. For example, while the laboratory is well-known for its research into the building blocks of matter conducted with its Tevatron particle accelerator—the second most powerful accelerator in the world before it closed in 2011—it also pioneered practical applications for this technology when it built the first small proton accelerator designed for cancer treatment in a hospital in 1989.⁶

4. Data on publications and analysis of INSPIRE database provided to AEG by Fermilab.

5. Fermilab Quantum Institute, <https://qis.fnal.gov>.

6. Troy Rummeler, "50 years of discoveries and innovations," Fermilab, 2017, <https://news.fnal.gov>.

More recently, Fermilab engineers patented an innovative method of particle accelerator optimization in 2018 called ‘balloon tuning’ that utilizes special balloons to reshape a particle accelerator’s interior cavity more quickly and cost-effectively than traditional methods.⁷ And in 2018, Fermilab received an R&D 100 award from *R&D Magazine* for adapting its work on silicon strip cosmic-muon detectors — similar to X-ray detectors, but able to penetrate steel and concrete — for homeland security applications.⁸

The laboratory also encourages innovation beyond its typical focus on particle physics. In 2017, a Fermilab technical specialist invented a device intended to prevent vehicles from becoming stuck at railroad crossings. Called the Ghost Train Generator, the device uses magnets and wire to generate an electric current between rails, triggering existing ‘traffic lights’ on the tracks to alert oncoming trains that they should break.⁹ Fermilab also holds the patent for removing oil from water using electromagnets. Fermilab’s Office of Partnerships & Technology Transfer licensed this technology to Natural Science LLC in 2015. The agreement enabled the company to design and develop a novel electromagnetic technology for cleaning oil spills. It built a successful prototype and is now moving towards the commercialization of this technology.¹⁰

Fermilab engages in a variety of technology transfer activities with public and private sector partners. In 2018, the laboratory entered into 12 new Cooperative Research and Development Agreements (CRADAs) and three new Strategic Partnership Projects (SPPs)—tools that allow non-government collaborators to provide funding to and develop new intellectual property with federal research laboratories like Fermilab. The laboratory had a total of 37 active CRADAs and 12 active SPPs, with a combined total of \$870,000 in participant funds in 2018. The laboratory also has 126 income-bearing licenses and, in 2018, its researchers filed 10 patent applications and were granted eight patents.¹¹

VISITATION

Fermilab engages with a diverse group of visitors—from visiting scientists from around the world to members of the public and participants in its education and outreach programs. This engagement enables the laboratory to support both the

7. Bailey Bedford, “Under pressure: balloons for particle acceleration,” Fermilab, 2019, <https://news.fnal.gov>.

8. Steve Koppes, “Cosmic-muon detector technology earns R&D 100 Award for Fermilab and its partners,” Fermilab, 2019, <https://news.fnal.gov>.

9. Daniel Garisto, “Invention could help avert disaster on railroad crossings,” Fermilab, 2017, <https://news.fnal.gov>.

10. Aaron Sauers, “Meet the new prototype in electromagnetic oil spill remediation technology,” Fermilab, 2019, <https://news.fnal.gov>.

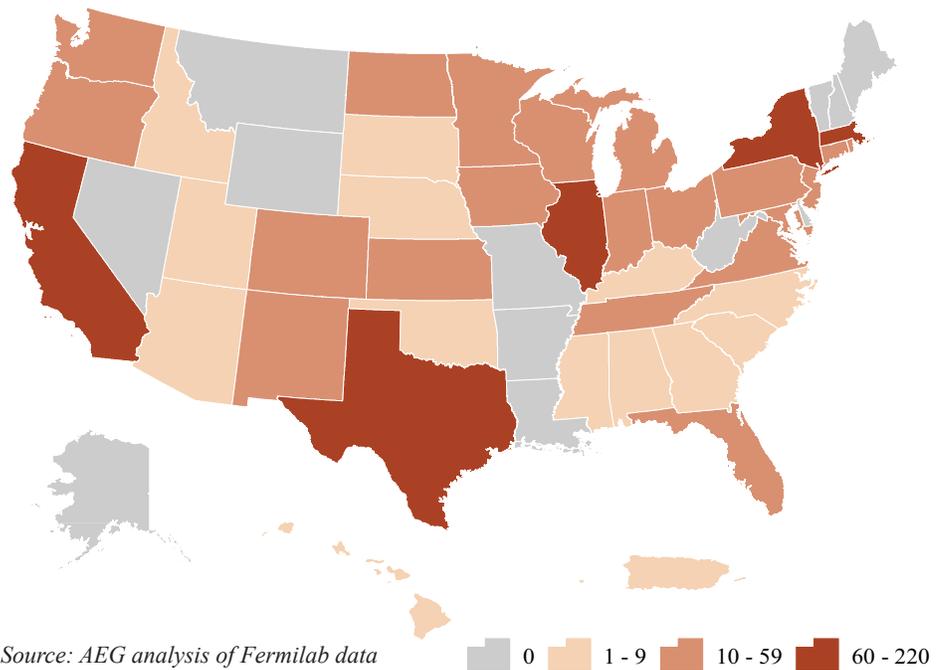
11. Technology transfer activity data provided to AEG by Fermilab.

advancement of particle physics research as well as public understanding of the field.

Visiting Researchers

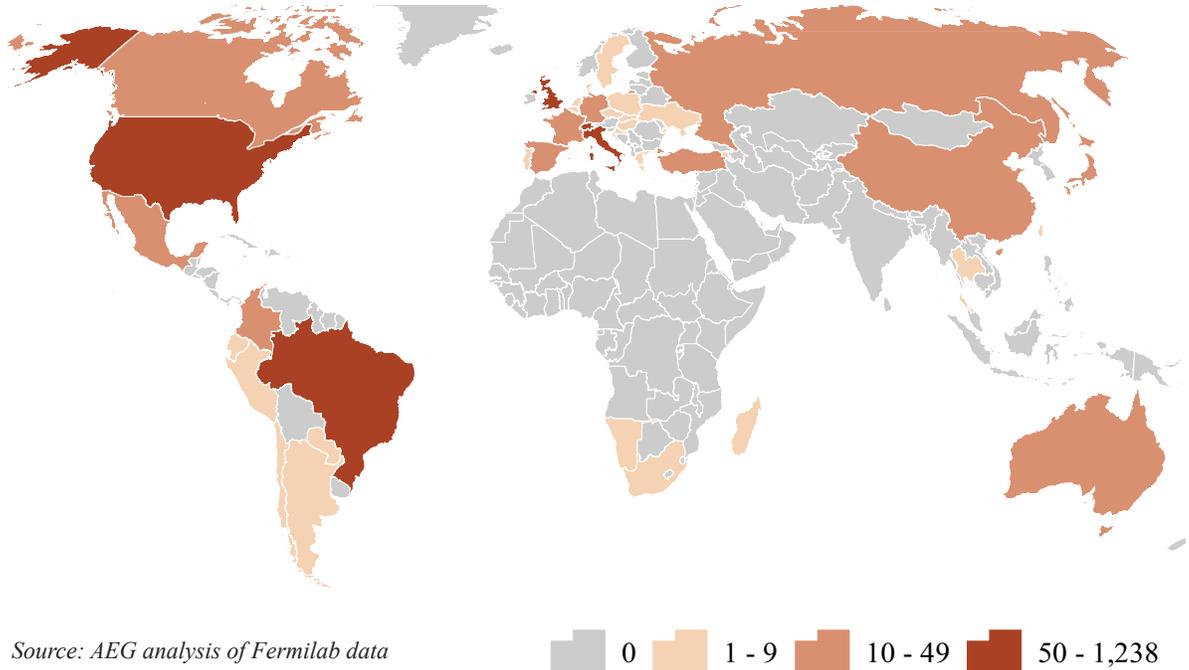
As one of the foremost laboratories in the world for particle physics research and other fields, Fermilab attracts visiting researchers from across the country and the globe. In 2018, the laboratory hosted nearly 2,000 visiting students, postdoctoral researchers, engineers, and scientists. Of that number, 1,241 came from 39 different U.S. states and Puerto Rico, as shown in Figure 3. International visitors numbered 721 and hailed from 41 different countries, as shown in Figure 4 on page 14.¹²

FIGURE 3. Fermilab Number of Visiting Researchers by State



12. Visitorship data provided to AEG by Fermilab.

FIGURE 4. Fermilab Number of Visiting Researchers by Country



Tourism

Fermilab offers guided tours to members of the public interested in learning about the laboratory, as well as the experiments and projects it oversees. The laboratory’s “Get-to-Know” tours for people ages ten and older allow participants to see Wilson Hall, learn about the history of the laboratory, and hear about the experiments and projects occurring at Fermilab today. The tour includes viewing the Fermilab complex from the 15th floor and seeing the Remote Operations Center for Neutrino Experiments and the CMS Experiment at CERN.



Fermilab 50th Anniversary Open House
Source: Fermilab

Education and Outreach

Fermilab's Education Office supports programming for educators, families, young people and the general public. Their programs provide avenues for technical staff to engage these audiences with Fermilab's science and technology. Themes include scientific discovery, practical applications, and scientific and engineering practices. Because the next generation STEM workforce is in school today, Fermilab is committed to strengthening teaching and learning in science, technology, engineering and mathematics. Its programs aim to be a catalyst for change and a resource to schools and districts nationwide.



Fermilab 2017 Family Open House
Source: Fermilab

In fiscal year 2018, Fermilab's Education and Outreach initiatives served over 32,000 students and 1,100 teachers. The laboratory also welcomed over 64,000 members of the public for special events and tours. This programming was organized and delivered by Fermilab's Education Office, along with other employees and volunteer docents who altogether contributed more than 30,000 hours to the laboratory's Education and Outreach efforts.¹³

13. Education and outreach data provided to AEG by Fermilab.

III. Net Economic Impact of Fermilab on Illinois

In this section, we discuss the net economic impact of Fermilab operations and visitorship on the Illinois and Chicago region economies.

NET ECONOMIC IMPACT DEFINED

We define the net economic impact of Fermilab as the new economic activity in Illinois and the Chicago region that is caused by laboratory operations and visitorship. In other words, we exclude from our analysis any economic activity that would occur even if Fermilab did not exist. We define this activity as “net new” economic activity. We quantify the economic impact of Fermilab in terms of increased output (sales by businesses), employment, and household earnings.

Because Fermilab’s operations are unique (there are not many major scientific research laboratories) and funded by federal funds specifically earmarked for this purpose, it is unlikely that this spending would take place in Fermilab’s absence. Therefore, we consider all of Fermilab’s spending in Illinois and the Chicago region to be net new.

Direct and Indirect Impacts

Fermilab has a *direct* impact on the economy by employing workers, purchasing goods and services for the laboratory, and by paying for local travel and lodging expenses for visitors. As the lab’s employees and vendors that sell goods and services to the lab receive payment from Fermilab, they increase their own expenditures and funds recirculate through the economy, generating *indirect* economic impacts. We account for both direct and indirect impacts in our analysis.

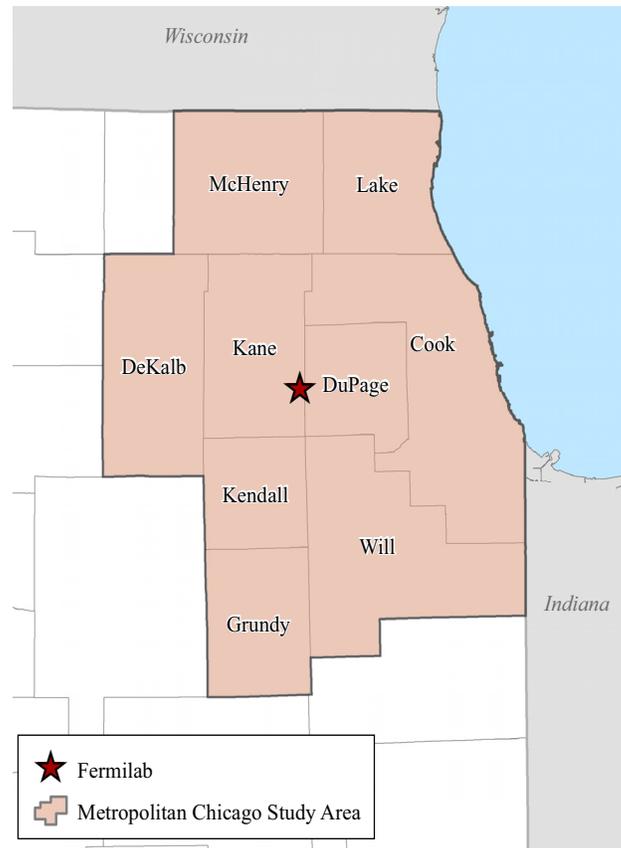
See “Net Economic Impact Analysis” on page A-1 for a complete description of our methodology.

Impact Areas

We estimate Fermilab’s net economic impact for two distinct geographic areas:

- The Chicago metropolitan area in Illinois, including the counties of Cook, DeKalb, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will (see Figure 5 on page 17); and
- Illinois.

FIGURE 5. Metropolitan Chicago Impact Area



**NET ECONOMIC
IMPACT OF
OPERATIONS**

Net Economic Impact of Operations in the Chicago Region

Fermilab’s operational expenditures in the Chicago area totalled over \$254 million in 2018, and the laboratory employed nearly 1,900 scientists, engineers, and other staff in the region. This spending resulted in an estimated indirect output of \$161 million, for a total impact of nearly \$416 million. Fermilab’s operations also increased the wages of Chicago area residents by almost \$330 million, and created nearly 4,700 jobs in 2018, as shown in Table 4 on page 18.

TABLE 4. Net Economic Impact of Fermilab Operations in the Chicago Region, 2018

Impact Type	Output (millions)	Earnings (millions)	Employment ^a
Direct	\$254.4	\$202.4	1,893
Indirect	\$161.4	\$127.4	2,775
Total:	\$415.8	\$329.8	4,668

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers.

a. Includes full-time permanent employees as well as fixed term, on-call, seasonal, and temporary employees.

Net Economic Impact of Operations in Illinois

Fermilab spent over \$258 million in Illinois and employed 1,922 staff across the state in 2018. This spending led to \$187 million in indirect output, resulting in a total impact of approximately \$445 million. The laboratory’s operations increased the earnings of Illinois residents by \$341 million, and created almost 5,300 jobs in the state, as shown in Table 5. The laboratory is located just 35 miles west of Chicago, and most of its Illinois spending occurs in the Chicago region. For this reason, Fermilab’s direct impact in Illinois is only slightly greater than its direct impact in the Chicago region. However, the lab’s indirect impact in Illinois is significantly higher due to the fact that a greater proportion of the money the laboratory spends remains in the state than in the Chicago region as it recirculates through the economy.

TABLE 5. Net Economic Impact of Fermilab Operations in Illinois, 2018

Impact Type	Output (millions)	Earnings (millions)	Employment ^a
Direct	\$258.1	\$205.2	1,922
Indirect	\$186.6	\$135.6	3,347
Total:	\$444.8	\$340.7	5,269

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers.

a. Includes full-time permanent employees as well as fixed term, on-call, seasonal, and temporary employees.

**NET ECONOMIC
IMPACT OF VISITOR
SPENDING**

Fermilab attracts visitors from across the country and around the world to tour its facilities, attend conferences and special events, and conduct physics experiments. The money that visitors from outside of the study areas spend on food and lodging constitutes an additional economic impact of Fermilab, because they would be unlikely to make these expenditures in either study area if the laboratory did not exist. We analyzed visitor hotel stay data provided by Fermilab to estimate the total amount spent by overnight visitors on lodging. We also estimated spending on food using data provided by Fermilab and the U.S. General Services Administration.

Net Economic Impact of Visitor Spending in the Chicago Region

We estimate that overnight visitors to Fermilab spent \$3.2 million on food and lodging in the Chicago region in 2018. This spending resulted in an estimated indirect output impact of \$3.5 million, for a total impact of \$6.7 million. Visitor spending also indirectly increased the earnings of Chicago-area households by \$2 million and created 58 jobs, as shown in Table 6.

TABLE 6. Net Economic Impact of Fermilab Visitorship in the Chicago Region, 2018

Impact Type	Output (millions)	Earnings (millions)	Employment
Direct	\$3.2	\$0	0
Indirect	\$3.5	\$2.0	58
Total:	\$6.7	\$2.0	58

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers.

Net Economic Impact of Visitor Spending in Illinois

All estimated visitor spending took place in the Chicago region. As a result, the estimated direct impact of visitorship is the same for both Chicago and the state of Illinois. However, the indirect impacts in Illinois are greater due to the fact that a greater proportion of the money spent remains in the state as it recirculates through the economy. The indirect output resulting from Fermilab visitorship in Illinois was \$3.8 million, for a total estimated output of \$7 million. Visitor spending was also associated with \$2 million in increased earnings for Illinois residents and 67 jobs, as shown in Table 7 on page 20.

TABLE 7. Net Economic Impact of Fermilab Visitor Spending in Illinois, 2018

Impact Type	Output (millions)	Earnings (millions)	Employment
Direct	\$3.2	\$0	0
Indirect	\$3.8	\$2.0	67
Total:	\$7.0	\$2.0	67

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers.

TOTAL NET ECONOMIC IMPACT

The total net economic impact of Fermilab consists of the impacts associated with its operations and visitor spending.

Net Economic Impact in the Chicago Region

The total direct output associated with Fermilab’s activities exceeded \$257 million in the Chicago region in 2018. This spending resulted in an estimated indirect output of \$165 million, for a total impact of over \$422 million. Fermilab also increased the earnings of Chicago-area residents by nearly \$332 million, and created more than 4,700 jobs, as shown in Table 8 below.

TABLE 8. Net Economic Impact of Fermilab in the Chicago Region, 2018

Impact Type	Output (millions)	Earnings (millions)	Employment ^a
Direct	\$257.7	\$202.4	1,893
Indirect	\$164.8	\$129.4	2,833
Total:	\$422.5	\$331.7	4,726

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers.

a. Includes full-time permanent employees as well as fixed term, on-call, seasonal, and temporary employees.

Net Economic Impact on Illinois

In Illinois, the direct output associated with Fermilab operations and visitorship totalled \$261 million in 2018. This spending led to indirect output of \$190 million, for a total impact of almost \$452 million. Fermilab's activities also increased Illinois residents' earnings by nearly \$343 million, and created over 5,300 jobs, as shown in Table 9.

TABLE 9. Net Economic Impact of Fermilab in Illinois, 2018

Impact Type	Output (millions)	Earnings (millions)	Employment^a
Direct	\$261.4	\$205.2	1,922
Indirect	\$190.4	\$137.6	3,413
Total:	\$451.8	\$342.8	5,335

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers.

- a. Includes full-time permanent employees as well as fixed term, on-call, seasonal, and temporary employees.

IV. Net Fiscal Impact of Fermilab on Illinois

In this section, we discuss the net tax revenue impact of Fermilab on income, sales, and hotel tax revenues.

Although Fermilab is a tax exempt organization, the lab and its visitors generate tax revenue through:

- State income taxes paid by Fermilab employees and workers in other industries whose jobs are indirectly supported by Fermilab;
- State sales taxes paid by employees and visitors;¹⁴
- State lodging taxes paid by Fermilab visitors; and
- Local lodging taxes paid by Fermilab visitors.

NET FISCAL IMPACT DEFINED

In our analysis, we measure the *net* fiscal impact of Fermilab. We define the net fiscal impact as the amount of additional income, sales, and hotel taxes collected by the State of Illinois and local governments because of Fermilab’s existence.

NET INCOME TAX IMPACT

Fermilab employees generate tax revenue for the state by paying income tax on their salaries. The State of Illinois assesses a flat 4.95% income tax rate on personal income. In 2018, Fermilab spent \$179.4 million on payroll in Illinois, creating a direct tax revenue impact of \$8.9 million. Fermilab operations and visitor spending also led to indirect statewide earnings of \$135.6 million, resulting in a \$6.8 million indirect income tax impact. Fermilab’s total income tax impact on Illinois was \$15.7 million in 2018, as shown in Table 10 below.

TABLE 10. Fermilab Income Tax Impact in Illinois, 2018 (millions)

Impact Source	Total Earnings	Income Tax Rate	Income Tax Revenue
Direct	\$179.4*	4.95%	\$8.9
Indirect	\$137.6	4.95%	\$6.8
Total:	\$314.9	4.95%	\$15.7

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers.

**Salaries only, does not include benefits.*

14. In our analysis we quantify the sales tax impact on Illinois. Employee and visitor spending on local goods and services also generates revenue for municipalities, however detailed information on the geographic location of spending is not available. Therefore, we do not quantify the local sales tax impact.

NET SALES TAX IMPACT

Fermilab has a positive impact on state sales tax revenue as employees spend their earnings on taxable goods and services, and visitors spend money on taxable goods and services during their visit. We estimate that Fermilab employees spend approximately 80% of their salaries in Illinois, and that 43.7% of this amount of their spending goes toward taxable goods and services. Illinois' sales tax rate is 6.25%, resulting in a \$3.9 million direct sales tax impact.

We estimate that approximately 53% of indirect earnings are spent in Illinois, resulting in an indirect sales tax impact of \$2.0 million. The total sales tax impact from increased earnings is \$5.9 million, as shown in Table 11 below.

TABLE 11. Fermilab Sales Tax Revenue Impact from Increased Earnings, 2018 (millions)

Impact Source	Increase in Household Earnings	Percent of Earnings Spent	Spending Subject to Sales Tax	Total Sales Tax Revenue
Direct	\$179.4	79.0%	43.7%	\$3.9
Indirect	\$137.6	53.0%	43.7%	\$2.0
Total:	\$314.9	68.7%	43.7%	\$5.9

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers, U.S. Bureau of Labor Statistics Consumer Expenditure Survey.

Fermilab visitors also spend money on taxable goods and services. We estimate that Fermilab visitors in 2018 spent \$1.5 million on prepared food, which is taxable at 6.25%, for a net tax impact of \$94,000.

The overall sales tax revenue impact of Fermilab is \$6.0 million, as shown in Table 12 below.

TABLE 12. Fermilab Net Sales Tax Revenue Impact, 2018 (millions)

Tax Impact Source	Amount
Employee Spending	\$3.9
Indirect Earnings	\$2.0
Visitor Spending	\$0.1
Total:	\$6.0

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. General Service Administration, U.S. Bureau of Economic Analysis RIMS II Multipliers, U.S. Bureau of Labor Statistics Consumer Expenditure Survey.

**LODGING TAX
IMPACT**

In addition to generating sales and income tax for the state, Fermilab and its visitors pay hotel taxes to the state (6.0%) and local municipalities that levy a lodging tax, including Naperville (4.4%), Geneva (5.0%), and Warrenville (5.0%).

During 2018, visitors spent 22,500 nights at hotels near the lab.¹⁵ This translates to roughly \$2.0 million spent on hotels. These nights generated \$117,000 in accommodations tax revenue for the state, and \$93,000 for local governments.

**OVERALL NET FISCAL
IMPACT**

We show the net fiscal impacts of Fermilab on income, sales, and hotel tax revenue in Table 13. The overall fiscal impact Fermilab on Illinois and local governments in 2018 was \$117,000 and \$93,000, respectively.

TABLE 13. Net Fiscal Impact of Fermilab (millions)

Revenue Source	State	Local
Income Tax	\$15.7	N/A
Sales Tax	\$5.9	N/A
Hotel Tax	\$0.1	\$0.1
Total:	\$21.7	\$0.1

Source: Anderson Economic Group analysis of base data from Fermilab, U.S. Bureau of Economic Analysis RIMS II Multipliers, U.S. Bureau of Labor Statistics Consumer Expenditure Survey.

15. Fermilab also has a dormitory on-site. This number does not include stays at the dormitory.

Appendix A. Methodology

In this section we provide a detailed discussion of our economic and fiscal impact analyses.

NET ECONOMIC IMPACT ANALYSIS

We measured the net economic impact of Fermilab's operations and visitorship by analyzing employment counts, payroll and non-payroll expenditures, and hotel stay data provided by Fermilab. We also consulted per-diem spending data from the U.S. General Service Administration.

Fermilab provided us with the following data:

- Headcount of Fermilab employees by geography and type of employee (i.e. part-time, temporary, permanent, etc.);
- Total payroll spending by geography;
- Purchase order spending by geography and vendor industry;
- Non-purchase order spending by internal accounting category and geography;
- Estimated number of visitor nights spent at nearby hotels for which Fermilab has a negotiated rate; and
- Information on technology transfer, lab research projects, and local visitors.

Employee headcount, earnings, hotel stay, and local visitor data were provided for calendar year 2018, while the remaining spending data were provided for fiscal year 2018.

Methodology

In our analysis, we identify two distinct impacts of Fermilab: direct and indirect. Direct impacts are those caused directly by Fermilab. This includes payments made by Fermilab to suppliers and employees directly hired and paid by Fermilab, as well as payments for lodging and food made by visitors. Indirect impacts occur as money spent by Fermilab recirculates throughout the region and state economies.

Direct Impact of Operations. We took the following steps to assess the direct economic impact of Fermilab operations.

1. Identified expenditures that occurred in each study area. We used location information provided in Fermilab expenditure data to quantify payroll and nonpayroll expenditures that took place in metropolitan Chicago or Illinois—our two study areas for analysis. We excluded some categories of expenditures, such as employee travel reimbursements, for which the actual spending was unlikely to have taken place in the study areas.
2. Determined the trade margins for wholesale and retail spending. We used trade margin data from the U.S. Bureau of Economic Analysis Use Tables to calcu-

late the portions of Fermilab spending on wholesale trade and retail goods that we believe occurred in each study area.

3. Summed employment and expenditure numbers to determine direct economic impact. We summed employment and expenditure data to determine the direct output, earnings, and employment associated with Fermilab operations in each area.

Indirect Impact of Operations. We took the following steps to estimate the indirect economic impact of Fermilab operations.

1. Assigned Fermilab expenditures to economic impact multipliers. We used expense categories and vendor NAICS codes provided by Fermilab to assign Fermilab expenditures in each study area to an appropriate economic impact multiplier.
1. Applied multipliers to determine indirect impact. After assigning multipliers to each type of Fermilab expenditure, we multiplied the total direct impacts by each multiplier, and then subtracted out the direct impact to determine the total indirect economic impact of Fermilab operations.

Direct Impact of Visitorship. We took the following steps to estimate the direct impact of Fermilab visitorship.

1. Determined total spending on hotel stays. We multiplied Fermilab's negotiated hotel rates by the number of nights spent at each hotel (as estimated by Fermilab) to calculate the total amount spent by Fermilab visitors on lodging.
2. Subtracted duplicate spending. We subtracted a portion of hotel expenditures from our total to avoid double counting, as Fermilab pays for some of its guests' travel expenses.
3. Determined visitor spending on meals. We multiplied the number of room nights for visitors by a per diem meal and incidental rate from the U.S. General Services Administration to estimate visitors' additional spending on food. We then added visitor hotel and meal spending estimates to determine the total direct impact of Fermilab visitors in the Chicago region and the state of Illinois.

Indirect Impact of Visitorship. We took the following steps to estimate the indirect economic impact of Fermilab visitors.

1. Assigned visitor expenditures to economic impact multipliers. We assigned economic impact multipliers for lodging and food expenditures to total visitor spending.
2. Applied multipliers to determine indirect impact. After assigning multipliers, we multiplied the total direct impacts by each multiplier, and then subtracted out the direct impact to determine the total indirect economic impact of spending for visitors.

NET FISCAL IMPACT ANALYSIS

We measured the net fiscal impact of Fermilab on income and sales tax revenue. We also quantified the impact of visitor spending on state sales tax and state and local lodging taxes.

Methodology

Income Tax Impact. We took the following steps to estimate the direct and indirect income tax impact of Fermilab:

1. Estimated the amount of new household earnings that are generated because of Fermilab. Using data provided by Fermilab, we summed all Fermilab payroll spending in Illinois and the total indirect earnings impact from our economic impact study.
2. Applied income tax rates to determine income tax impact. We then applied the Illinois income tax rate of 4.95% to the total new earnings to determine the direct and indirect income tax impact of the lab.

Direct Sales Tax Impact. We took the following steps to estimate the direct sales tax impact of Fermilab:

1. Estimated the percentage of net new earnings that are spent by employees. We used U.S. Bureau of Labor Statistics Consumer Expenditure Survey (CES) data and payroll spending data provided by Fermilab to estimate the proportion of earnings spent by employees. Fermilab's \$179.4 million in payroll is distributed across 1,922 employees, for an average earnings of \$93,357 per employee. We consulted CES data and determined that individuals earning \$70,000 to \$99,999 annually spend 79% of their income.
2. Determined the proportion of spending subject to sales tax in Illinois, and then multiplied by consumer spending. We estimate that 43.7% of this spent income is subject to sales tax, based on our expert knowledge of taxes in Illinois.¹⁶ We then multiplied the proportion of spending that is subject to sales tax by the state sales tax rate of 6.25% to estimate the total direct sales tax impact.
3. Determined the proportion of visitor spending on taxable goods and services, and multiplied by the sales tax rate. We used data on per-diem expenditures from the General Service Administration to estimate that visitors spent \$1.5 million on food while visiting Fermilab. In Illinois, prepared food is taxable at 6.25%, resulting in a sales tax impact of \$94,000.

Indirect Sales Tax Impact. We took the following steps to estimate the indirect sales tax impact of Fermilab:

1. Estimated the percentage of indirect earnings that are spent. Estimating the percentage of indirect earnings that are spent is more difficult since we have less information about the industries that the new indirect earnings go to. If indirect earnings creates new jobs, then a larger portion of earnings will be spent, as opposed to indirect earnings adding to the income of individuals who are

16. Jason Horwitz and Judy Zhang, "2018 State Business Tax Burden Rankings," 2018.

already employed. Since we cannot determine how indirect earnings are distributed, we made the simplifying assumption that the new indirect incremental earnings attributed to Fermilab would go to middle income households. For households making \$50,000 to \$99,999. For this income bracket, we estimated that approximately 53% of these new marginal earnings would be consumed.

2. Multiplied the portion of new indirect earnings spent by the portion of spending subject to sales tax, and the sales tax rate. We multiplied total indirect earnings by 43.7% to determine total taxable spending, and then multiplied this amount by the state sales tax rate of 6.25% to determine a total indirect sales tax impact of \$2.0 million.

Hotel Tax

We took the following steps to determine the impact of visitor spending on hotel tax revenue.

1. Estimated total visitor nights. We used hotel stay data provided by Fermilab to estimate total visitor nights.
2. Applied State and local tax rates to total spending on hotels. According to Fermilab, most visitors stay at hotel in Naperville, Warrenton, or Geneva. Illinois levies a 6% tax on the cost of each hotel stay. Naperville levies a 4.4% tax, and Warrenton and Geneva levy a 5.0% tax. We multiplied total hotel spending by each respective rate to determine total state and local tax revenue attributed to hotel stays.

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Appendix C. About Anderson Economic Group

Anderson Economic Group is a boutique consulting firm founded in 1996, with offices in East Lansing and Chicago. We specialize in strategy, valuation, public policy, and market analyses. Our team has a deep understanding of advanced economic modeling techniques and extensive experience in multiple industries in multiple states and countries.

The consultants at Anderson Economic Group are often published on topics within their respective fields of expertise. Publications from our team include:

- *Economic, Social, and Cultural Contributions of Chicago's Colleges and Universities*, published in 2014 and 2018.
- *Economic Impact of Michigan Technological University*, published in 2018.
- *Economic and Fiscal Impact of the McDonald's Headquarters Relocation and Economic Footprint of Chicago Restaurant Operations*, 2018.
- *Economic and Fiscal Impact of Fort Custer Industrial Park*, 2018.
- *Economic Impact of Fermilab's Long-Baseline Neutrino Initiative*, published in 2016.
- *Economic Impact of the Barack Obama Presidential Library in Chicago*, published in 2015.
- *Economic Impact of Fermilab and Argonne National Laboratory*, published in 2011.

Past clients of Anderson Economic Group include:

- *Governments*: The government of Canada; the states of Michigan, North Carolina, and Wisconsin; the cities of Detroit, Cincinnati, and Sandusky; counties such as Oakland County, and Collier County; authorities such as the Detroit-Wayne County Port Authority; and government-affiliated institutions such as Fermilab and Argonne National Laboratory.
- *Corporations*: Bank of America Merrill Lynch, InBev USA, ITC Holdings Corp., Ford Motor Company, First Merit Bank, Labatt USA, Lithia Motors, Meijer, Inc., National Wine & Spirits, Nestle, and Relevant Sports; automobile dealers and dealership groups representing Toyota, Honda, Chrysler, Mercedes-Benz, General Motors, Kia, and other brands.
- *Nonprofit organizations*: Convention and visitor bureaus of several major cities; higher education institutions including Michigan State University, Wayne State University, University of Michigan, and the University of Chicago; trade associations such as the Michigan Manufacturers Association, Service Employees International Union, Automation Alley, and Business Leaders for Michigan.

Please visit www.AndersonEconomicGroup.com for more information.

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