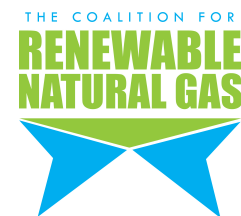




Economic Analysis of the US Renewable Natural Gas Industry

December 2021



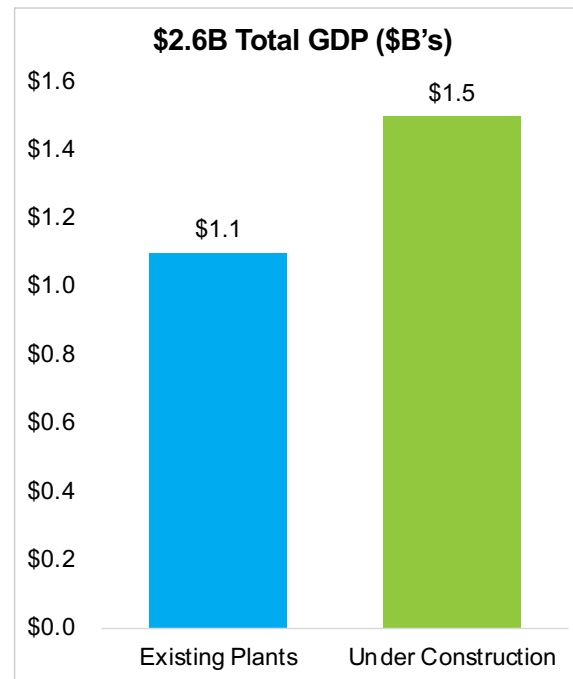
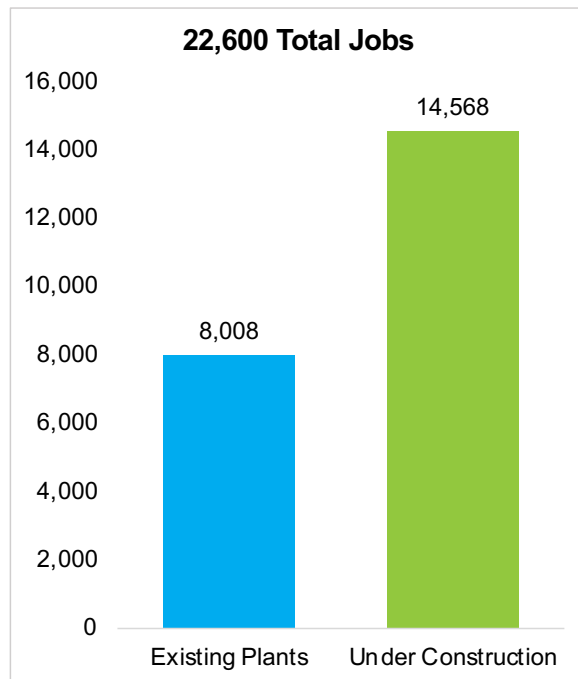


Contents

| | |
|---|----|
| Study Highlights | 3 |
| Introduction | 6 |
| Renewable Natural Gas (RNG) Overview | 7 |
| Renewable Natural Gas Value (RNG) Chain | 15 |
| Expenditure Analysis | 18 |
| Economic Impact | 34 |

Renewable Natural Gas (RNG) is Estimated to Contribute 22,600 Jobs, \$2.6B in GDP, and \$5.4B in Total Business Sales for Operations and Capital Expenditures in 2021

These numbers include the direct, indirect, and induced effects of existing RNG facilities and facilities currently under construction. Construction jobs require the approval of additional RNG facilities to continue to contribute to the economy.



RNG Has Potential to Grow into a Formative Green Industry

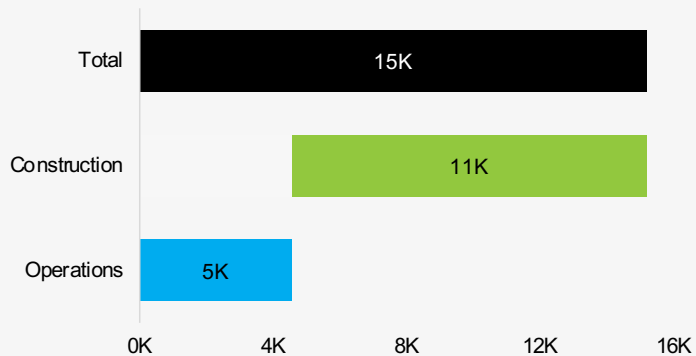
These numbers demonstrate the employment potential of RNG should it grow as expected based on RNG Coalition scenarios.

12 Jobs created for every \$1 million spent on RNG in 2021

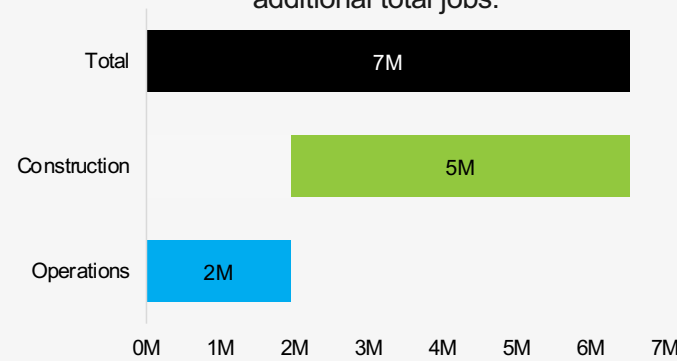
278 Jobs created per 1 million MMBTU of RNG in 2021

24 Jobs created per 1 million EGE¹ of RNG in 2021

Each additional **100 RNG facilities** creates an average 4,550 operations jobs and 10,634 construction jobs



If RNG Coalition's SMART² Initiative goal of **43,000 facilities** is met by 2050, this would create an estimated 6,528,938 additional total jobs.



¹ Ethanol Gallon Equivalent

² Sustainable Methane Abatement and Recycling Timeline

Employment Levels Vary Based on RNG Feedstock

A single Wastewater project creates an average of 141 total jobs, a single Livestock Waste project creates an average of 79 total jobs, a single Food Waste Project creates an average of 297 total jobs, and a single MSW project creates an average of 343 jobs.³



Adding an additional Wastewater project would create an average of 50 direct, 37 indirect, and 54 induced jobs – for 141 total jobs



Adding an additional Livestock Waste project would create an average of 25 direct, 22 indirect, and 32 induced jobs – for 79 total jobs



Adding an additional Food Waste project would create an average of 116 direct, 158 indirect, and 238 induced jobs – for 297 total jobs



Adding an additional MSW project would create an average of 115 direct, 94 indirect, and 134 induced jobs – for 343 total jobs

This Study Sets Out to Analyze the Current Economic Contribution of RNG to the US Economy in 2021

This report is comprised of four sections:

1

RNG Overview

Introduces renewable natural gas (RNG)

2

RNG Value Chain

Overview of the RNG value chain from waste collection to final use

3

Expenditure Analysis

Calculates the spending associated with RNG 1) existing plants and 2) plants under construction

4

Economic Impact

Estimates jobs, GDP, and sales associated with RNG 1) existing plants and 2) plants under construction

This study answers the following questions:

1 What is RNG and how is it produced?

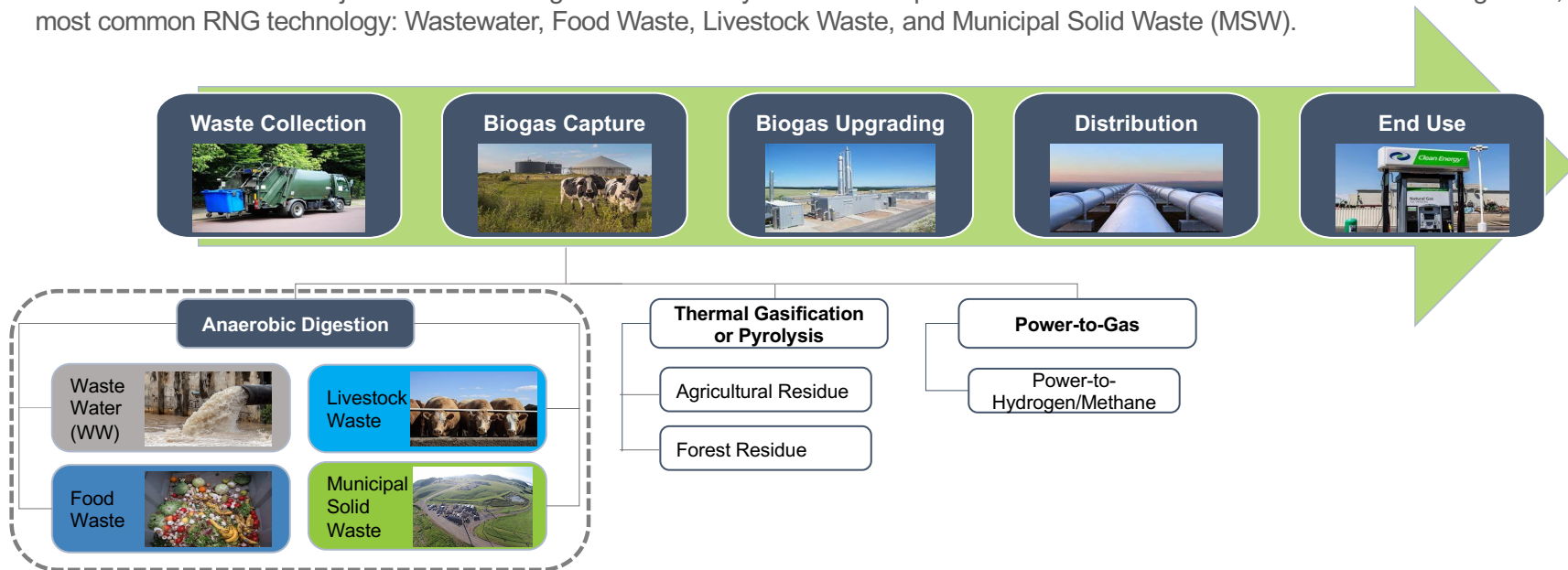
3 What are the costs of RNG?

2 What are the stages within the RNG value chain?

4 What impact does RNG have on the U.S. economy?

1 RNG Overview: RNG is a Clean, Affordable, and Reliable Waste-Derived Fuel that can be Used as Transportation Fuel for Vehicles, Generation of Electricity, and Thermal Heating Applications

RNG is a type of fuel that comes from a variety of waste sources. As that waste breaks down, biogas is captured through Anaerobic Digestion, Thermal Gasification, Pyrolysis, or Power-to-Gas technologies. The biogas is refined into biomethane (another name for RNG) after carbon dioxide, hydrogen sulfide, and other gases are removed. Crucially, biomethane is fully interchangeable with natural gas and can be used for local uses or injected into natural gas distribution systems. This report will cover the four feedstocks of Anaerobic Digestion, the most common RNG technology: Wastewater, Food Waste, Livestock Waste, and Municipal Solid Waste (MSW).

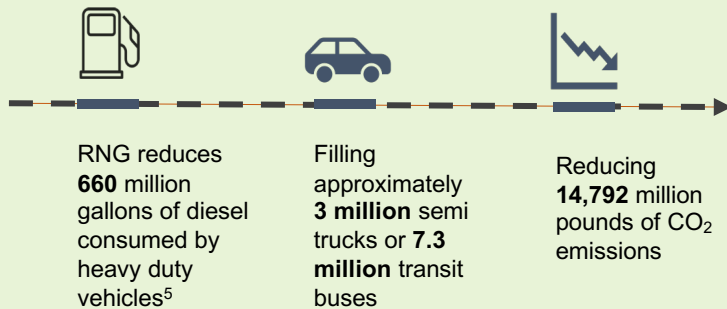


1 RNG Overview: Because of its Greenhouse Gas (GHG) Reducing Potential, RNG is Considered a Low-Carbon Fuel Under the Federal Renewable Fuel Standard and State Low-Carbon Fuel Standards

All sectors of the U.S. economy will need to decarbonize dramatically to reach mid- to long-term GHG emissions targets set by a growing number of states, enabling new business opportunities for RNG. RNG from organic wastes leads to GHG reductions in two ways:

1. Displacing the use of diesel in vehicles

RNG can facilitate the displacement of life-cycle GHG emissions from fossil fuel use in vehicles⁶



2. Reducing emissions from waste

Waste accounts for one third of U.S. methane production and 3 percent of total U.S. GHG emissions.⁴ Food waste is often sent to a landfill where methane is released or burned (e.g., turned into carbon dioxide) which enters the atmosphere. Other types of organic waste are placed in an open lagoon and release methane. To produce RNG, these gases are captured and cleaned rather than being released directly into the atmosphere

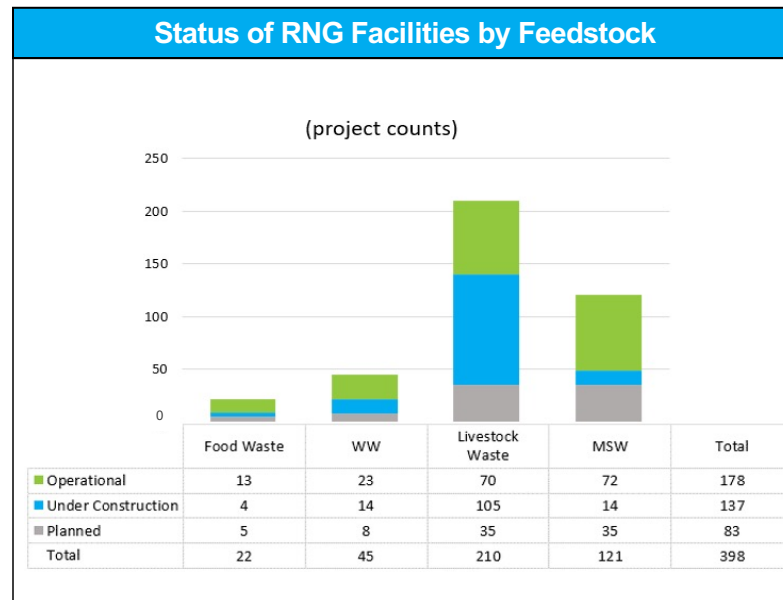
⁴RNG's life-cycle net impact on GHG emissions also depends on the feedstock used, how much GHG would have otherwise been produced from fossil fuels, and how much methane escapes during RNG capture & upgrade

⁵Total RNG volume as of 2021 converted from RNG in Ethanol Gallon Equivalents (EGE) to Diesel Gallon Equivalents (DGE) using conversions found at: <https://nhcleancities.org/2017/04/can-compare-energy-content-alternative-fuels-gasoline-diesel/>

⁶World Resources Institute, 2015

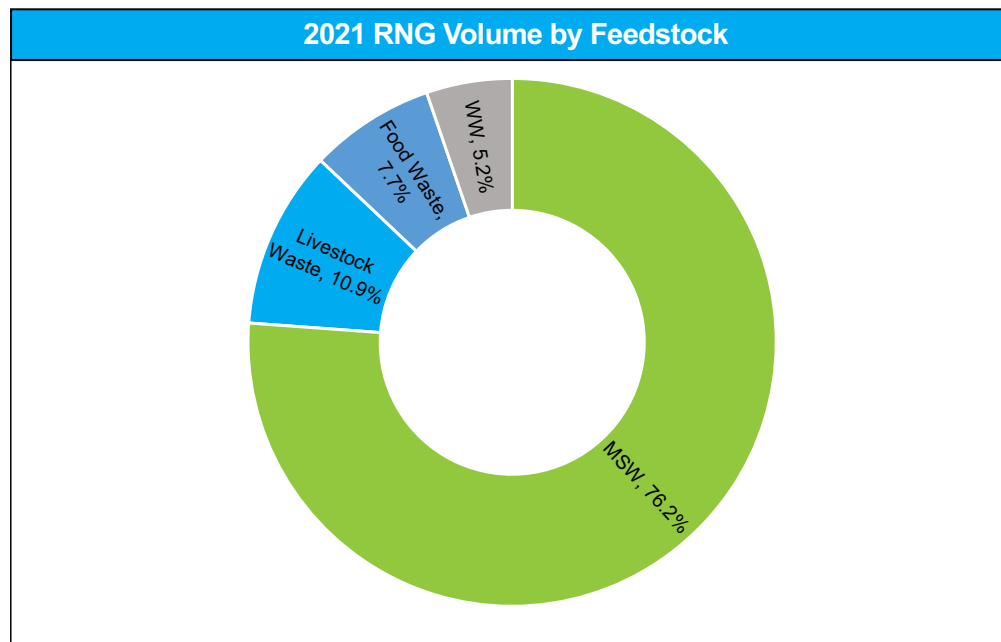
1 RNG Overview: State of RNG Supply

RNG capacity in 2021 is nearly 74 trillion BTU's. RNG equates to nearly 870 million gallons of ethanol gallon equivalent (EGE) or 660 million gallons of diesel gallon equivalent (DGE). At the mid-point of 2021, there are 176 operational RNG facilities and 220 facilities that are under construction or planned. The agriculture sector has the most projects under construction for collecting and upgrading biogas into RNG.⁷



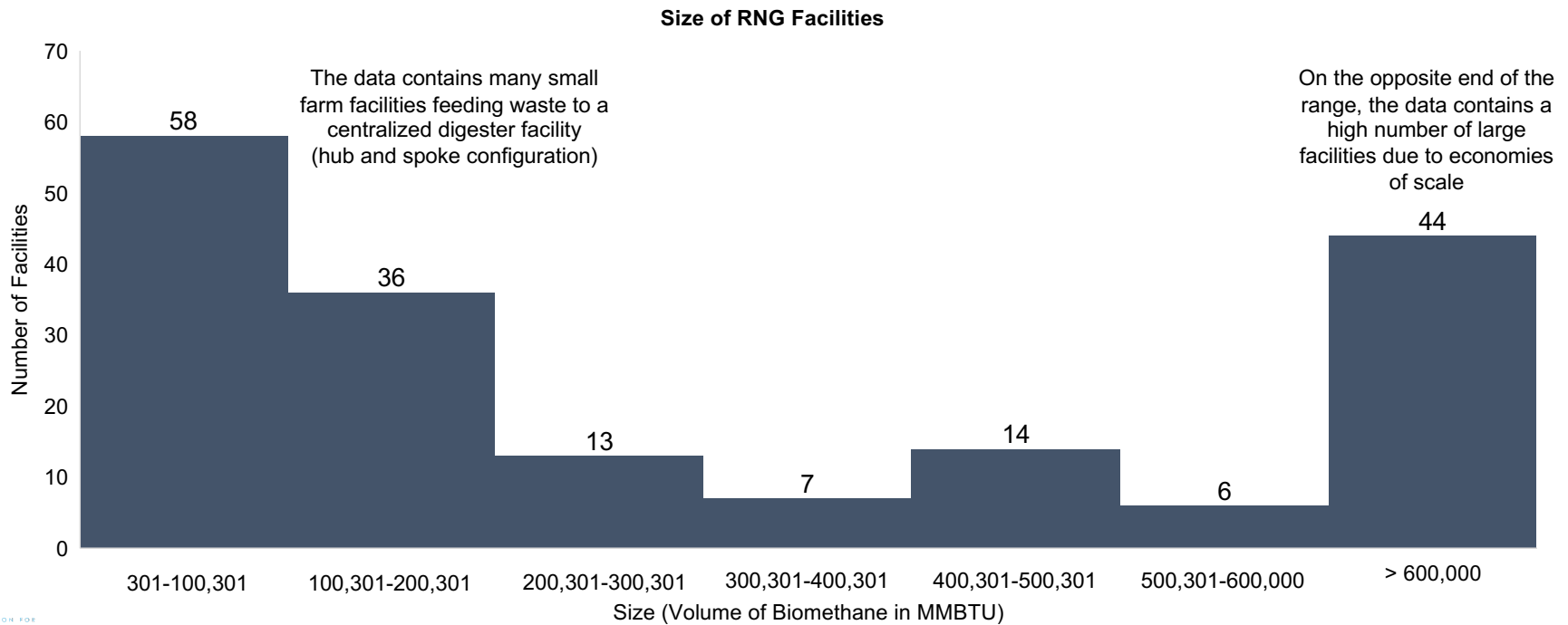
1 RNG Overview: The Vast Majority of RNG Comes from Municipal Solid Waste

Nearly 74 trillion British thermal units (BTU) of biomethane will be produced from waste in 2021. Of this, three quarters could come from municipal solid waste.⁸



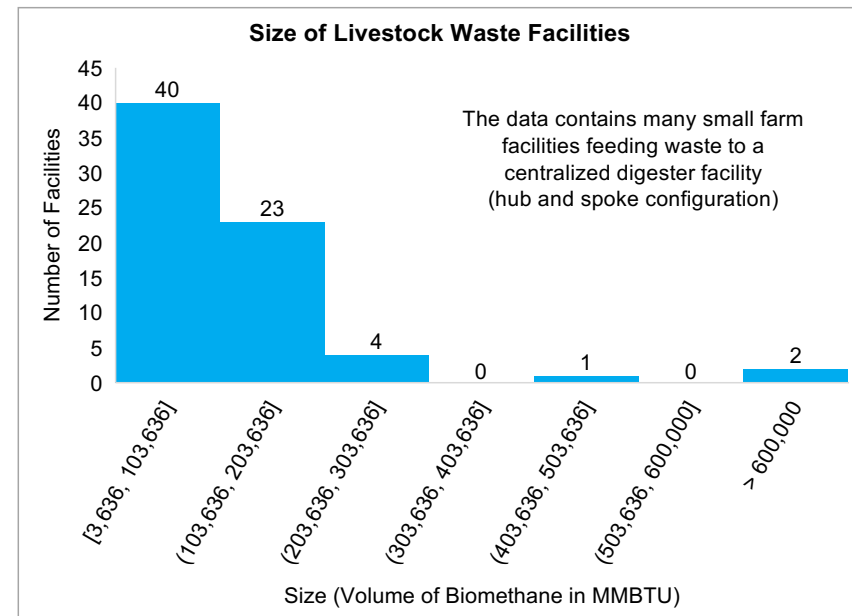
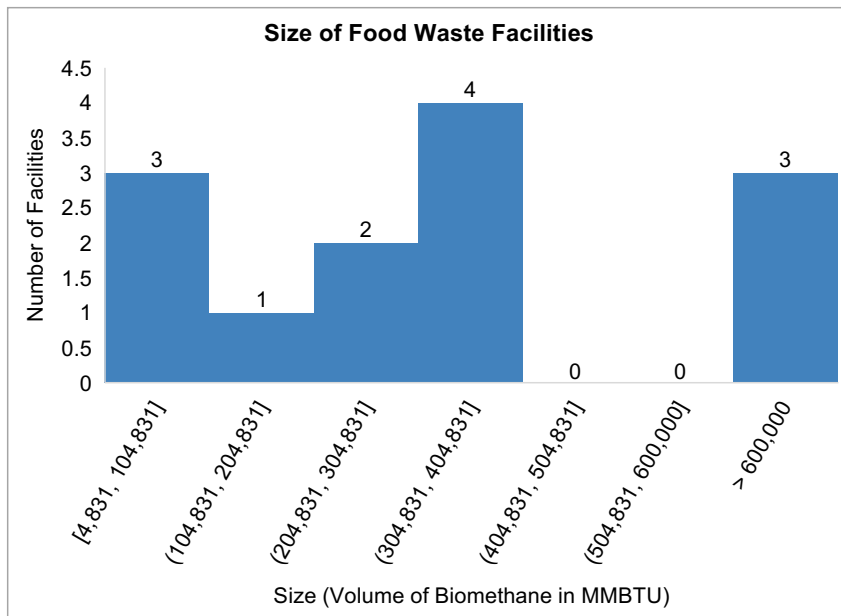
1 RNG Overview: RNG Facilities Vary in Size

The distribution of the size of RNG facilities looks like an inverse normal distribution because of two reasons; small farms use a hub and spoke configuration for the disposal of agricultural waste, and – on the other end of the spectrum – larger dedicated facilities bring economies of scale at sizes greater than 600,000 MMBTU.



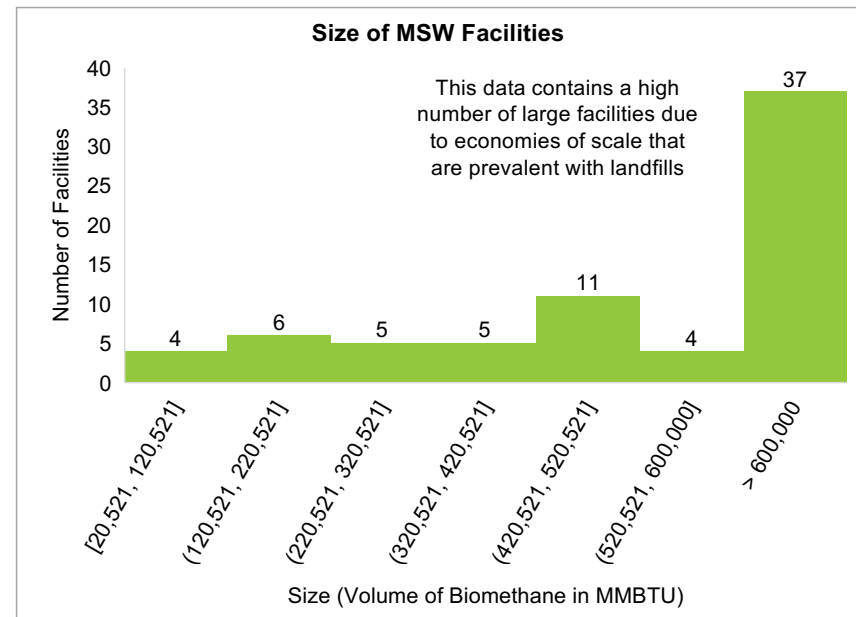
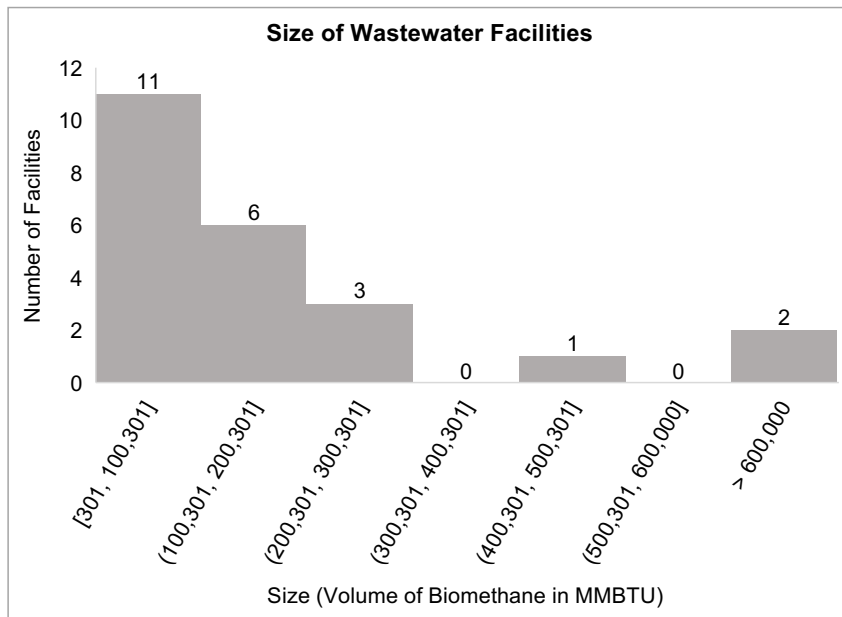
1 RNG Overview: Food Waste and Livestock Waste Facilities are Predominantly Smaller-Scale

Below are the histograms for Food Waste Facilities and Livestock Waste Facilities showing the facility counts that fall within a range of MMBTU volume by feedstock. For Food Waste, facilities varied widely in size while most Livestock Waste Facilities fall within 100,000 MMBTU's of RNG.



1 RNG Overview: Wastewater Facilities are Smaller in Size, MSW Facilities are Largest

Below are the histograms for wastewater facilities and MSW facilities showing the facility counts that fall within a range of MMBTU volume by feedstock. For wastewater, most facilities fall within 100,000 MMBTU's of RNG whereas the majority of MSW facilities produce over 600,000 MMBTU's of RNG.



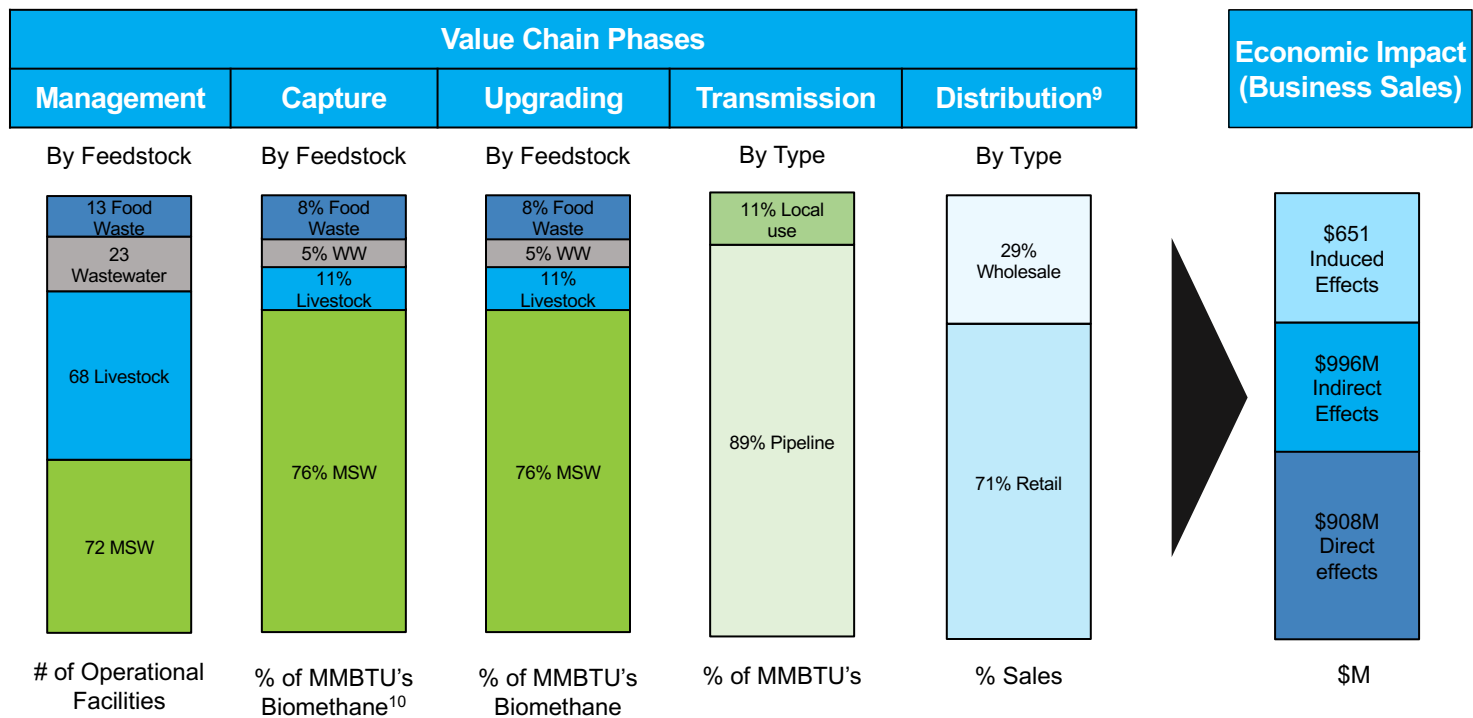
2 RNG Value Chain: The RNG Value Chain Comprises 6 Stages

Each stage of the value chain plays a role in the capture and upgrade of RNG ranging from management (waste collection) to distribution. A portion of RNG is transported via local pipeline for local usage while the remaining portion is injected into the natural gas pipeline system. The value chain is important to understanding the operation costs associated with RNG which is used to calculate its economic impact.

| | | Value Chain Phases | | | | | |
|---|---|---------------------|--|---|---|--|--|
| Size | Description | Management | Capture | Refinement | Transmission | Distribution | End Use |
| Small Ops (aggregate waste to larger facility) | On/Off site anaerobic digestion (hub & spoke) | Collection of waste | Anaerobic digestion of waste (on-site or off-site) | Biogas is upgraded to biomethane by removing CO ₂ , H ₂ S, and other trace gasses | Use of local pipeline or injection of RNG into the natural gas pipeline network | Vehicle fuel is distributed to end users via local pipeline or through wholesale / retail channels | Vehicle fuel, electricity generation, home heating and industrial uses |
| Large Ops (on-site capture) | Onsite anaerobic digestion (pipeline) | | Anaerobic digestion of waste (on-site) | | | | |

2 RNG Value Chain: Each Stage of the Value Chain Creates Economic Impact

This diagram details the different components associated with each phase of the value chain and how they ultimately feed into the economic impact of the RNG industry.

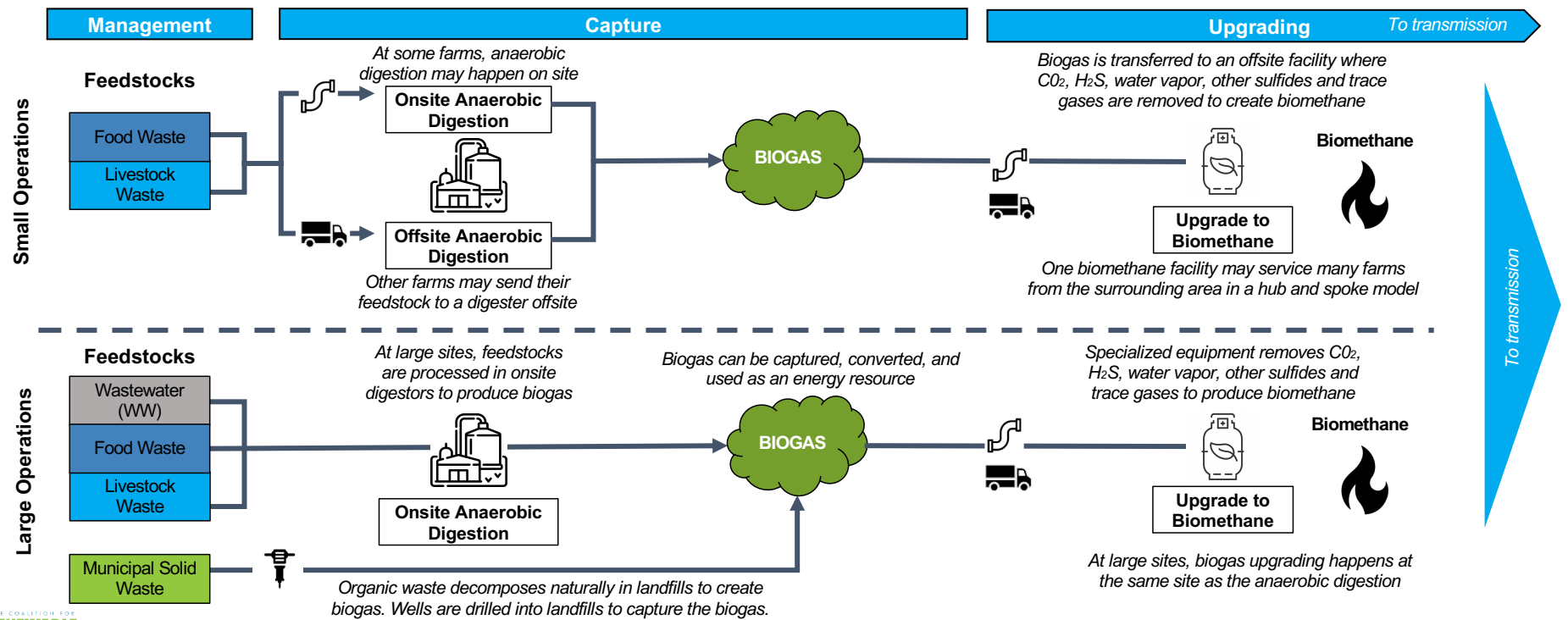


⁹ Distribution types for vehicle fuel

¹⁰ RNG Coalition data only included MMBtu volumes of Biomethane

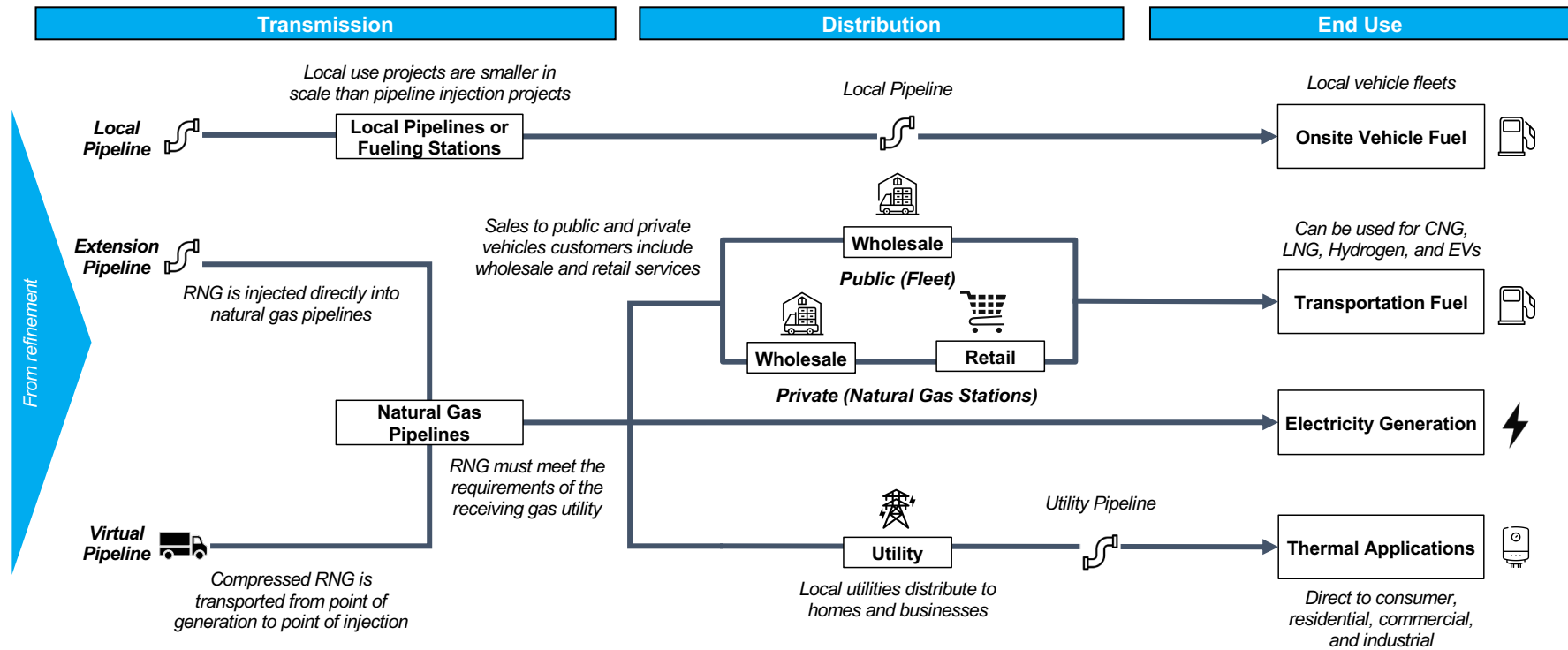
2 RNG Value Chain: Diagram Illustrates Management, Capture and Refinement Phases of Anaerobic Digestion Value Chain

There are generally two streams for the management, capture, and refinement phases of the value chain. Many small operations must capture and refine their biogas offsite, resulting in a hub and spoke model for upgrading, while many large operations can capture and refine biogas onsite.



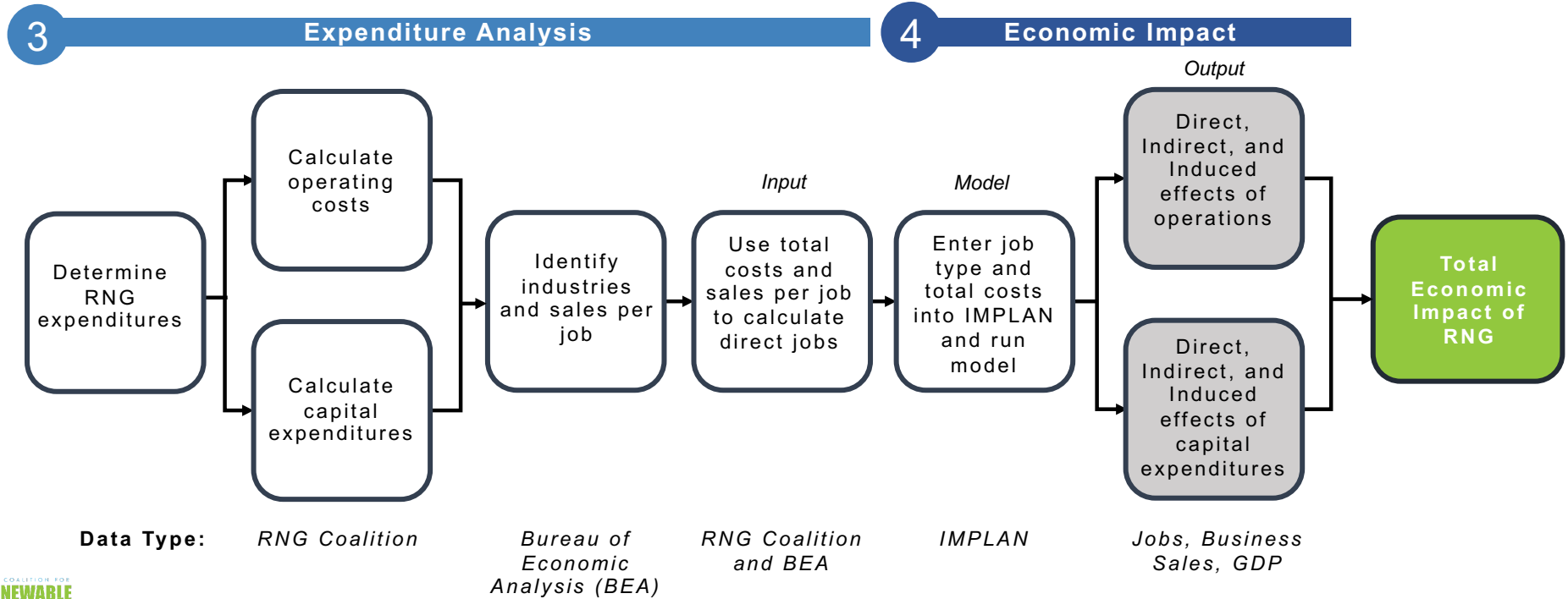
2 RNG Value Chain: Diagram Illustrates Transmission, Distribution and End Use Phases of Anaerobic Digestion Value Chain

All biomethane, whether produces onsite or at a centralized upgrading location, is transmitted through one of three ways:



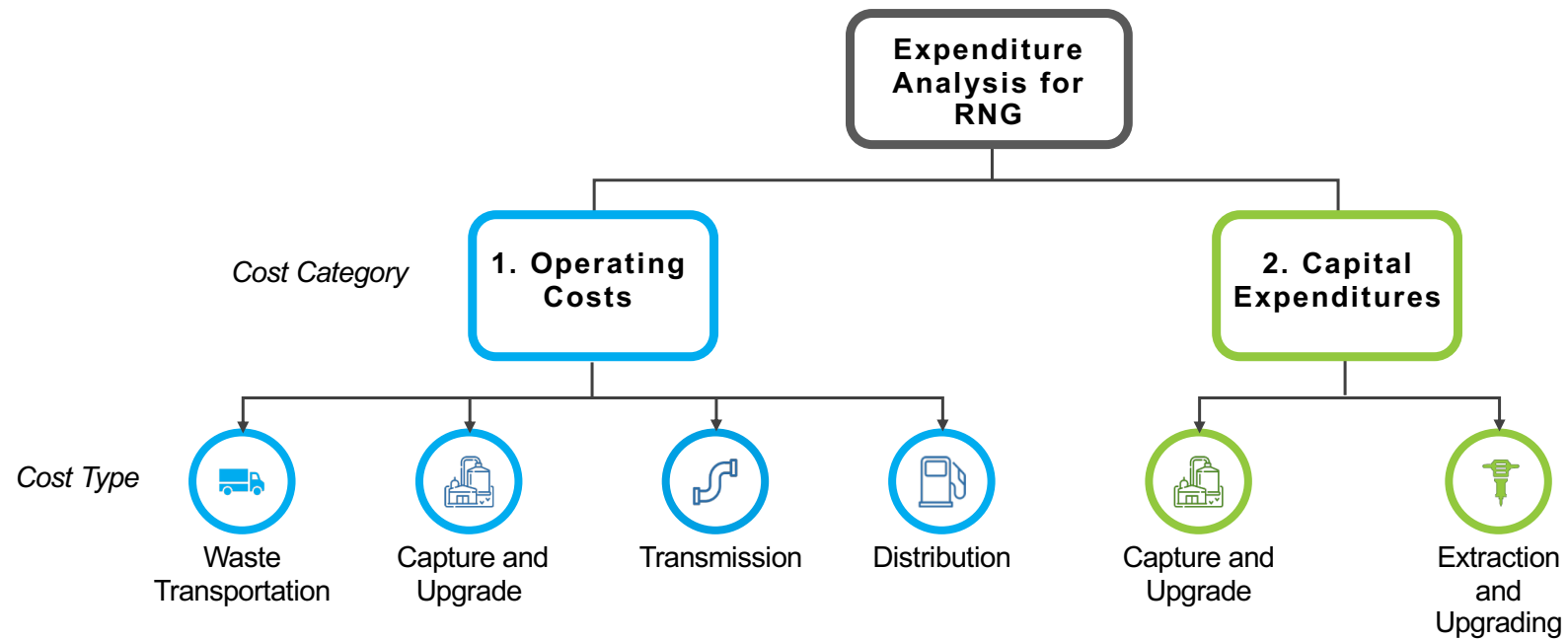
This Study Uses Input-Output Analysis Models to Analyze the Economic Impacts of RNG to the U.S. Economy in 2020

The study's primary focus is the economic impact of existing operating RNG plants and the building of new RNG plants on the U.S. economy. This analysis method is the most appropriate for this task. The diagram below illustrates the steps, outputs, and data types used to calculate the total current economic impact of RNG.



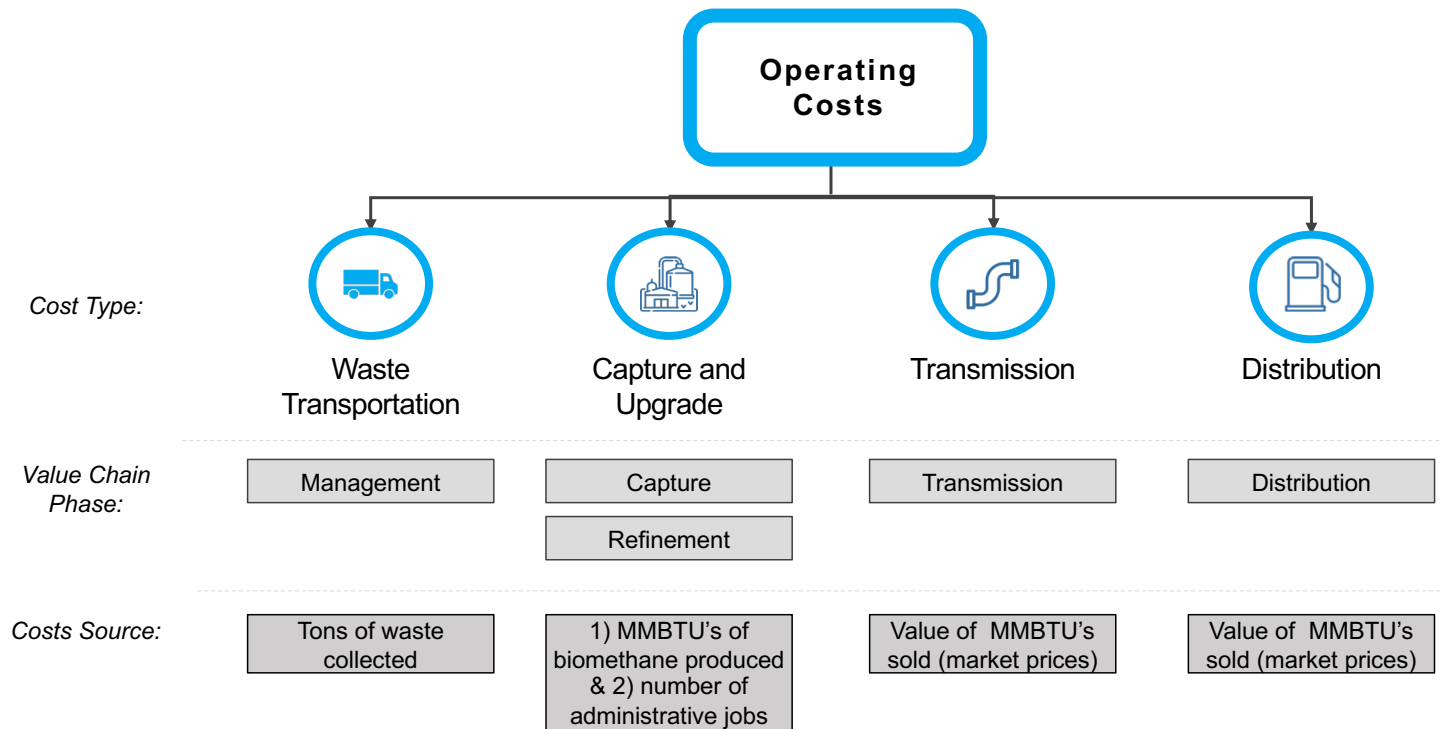
3 Expenditure Analysis: To Understand the Economic Impact of RNG, this Study First Identified its Two Major Cost Categories: 1) Operating Costs and 2) Capital Expenditures

Operating costs refer to the ongoing expenses incurred from the normal day-to-day of running of the waste transportation, capture and upgrade, transmission, and distribution phases of the value chain. Capital expenditures refers to the construction costs for the extraction, capture, or upgrade of biogas into RNG. Each cost category can be further broken into cost types as depicted below:



3 Expenditure Analysis: The First Step of the Expenditure Analysis is Understanding the Operating Costs of RNG

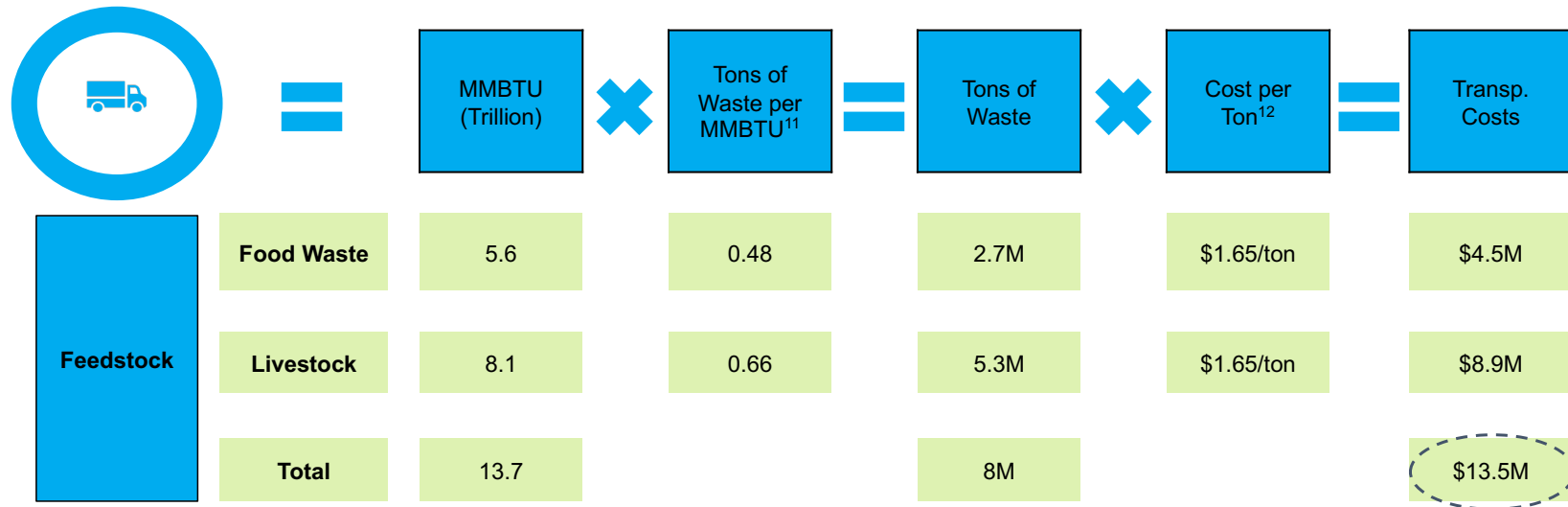
The first cost category for RNG is operating costs. Within operating costs, there are four types of costs that can be mapped onto the six phases of the value chain as depicted below. This diagram also provides information on the sources that were used to calculate costs for each cost type.



3 Expenditure Analysis: Total Waste Transportation Costs are \$13.5M

Waste collection is the first cost type within the operating costs category. Using data from the Argonne National Lab and the RNG Coalition's own data sources, transportation costs were estimated by multiplying the MMBTU's by tons of waste per MMBTU for the food waste and livestock feedstocks. Wastewater and municipal solid waste were not included in this calculation because waste collection would have occurred even without the biogas capture and upgrade process. The final transportation cost for the two feedstocks multiplies tons of waste by the cost per ton.

Waste Transportation Costs

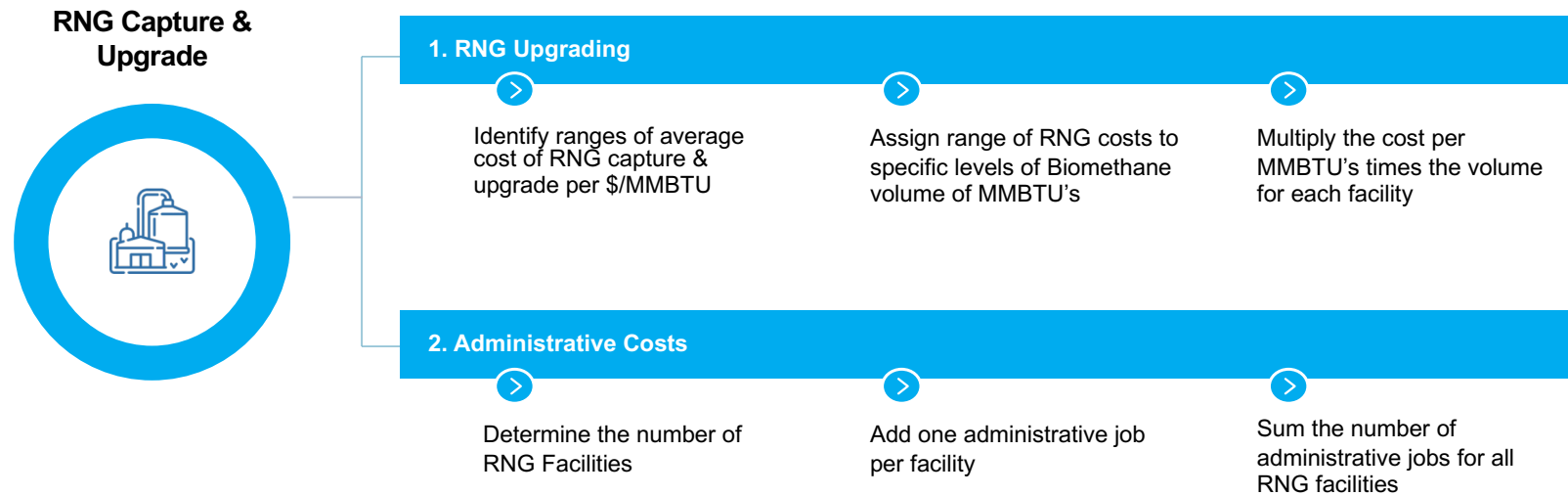


¹¹ Based on feedstock weighted average from Argonne National Labs database.

¹² Bioenergy Supply in Ireland 2015 – 2035. Sustainable Energy Authority of Ireland.

3 Expenditure Analysis: Capture and Upgrade Costs for RNG Have Two Components: 1) Costs Associated with Upgrading Biogas to RNG and 2) Associated Administrative Costs





RNG upgrading is the second cost type within the operating costs category. This slide outlines the steps taken to calculate both types of costs associated with RNG capture and upgrade.



3 Expenditure Analysis: The Average \$/MMBTU Cost of Upgrading Biogas to RNG Ranges from \$7 Per MMBTU up to \$23 Per MMBTU

The first step of calculating RNG upgrading costs is determining the average \$/MMBTU cost of upgrading biogas to RNG. Guidehouse identified ranges of the average cost of RNG capture & upgrade (\$/MMBTU) using a variety of sources. Across all sources, costs ranged from \$7 per MMBTU up to \$23 per MMBTU. Guidehouse then assigned these costs (\$/MMBTU) to the various volumes of biomethane detailed in the EPA report. The EPA Report provided the biogas flow output in SCFM associated with each \$/MMBTU output amount. With the volume and average cost per MMBTU, Guidehouse estimated the overall RNG capture and upgrade costs for each facility, resulting in the RNG Cost/Volume Matrix.

Averaging the ranges of \$/MMBTU from the reports resulted in an average cost range of \$7.24 to \$22.97

| Sources |
|---|
|  <p>WORLD RESOURCES INSTITUTE</p> <p>WORKING PAPER</p> <p>THE PRODUCTION AND USE OF RENEWABLE NATURAL GAS AS A CLIMATE STRATEGY IN THE UNITED STATES</p> |
|  <p>United States Environmental Protection Agency</p> |
| <p>A Report to the Washington State Legislature</p> <p>December 2018</p> <p>Energy Program Department of Commerce</p> |
|  <p>Study on the Use of Biofuels (Renewable Natural Gas)</p> <p>at the Greater Washington, D.C. Metropolitan Area</p> <p>March 2020</p> |
|  <p>Guidehouse</p> <p>Proprietary Research</p> |

| RNG Cost/Volume Matrix | | | |
|----------------------------|---------------------------------------|------------------|-----------------|
| Biogas Output Volume Range | | Costs (\$/MMBTU) | Operating Costs |
| SCF/Min | MMBTU/Year (Biomethane) ¹¹ | Average | Average |
| 50 | 13,600 | \$22.97 | \$312.4K |
| 100 | 27,200 | \$17.30 | \$470.4K |
| 200 | 54,400 | \$12.22 | \$664.8K |
| 300 | 81,599 | \$12.22 | \$997.1K |
| 475 | 129,199 | \$10.63 | \$1,373.4K |
| 650 | 176,799 | \$9.04 | \$1,598.3K |
| 1,125 | 305,998 | \$7.45 | \$2,279.7K |
| 1,600 | 435,197 | \$7.24 | \$3,152.1K |
| 2,300 | 625,595 | \$7.24 | \$4,531.1K |

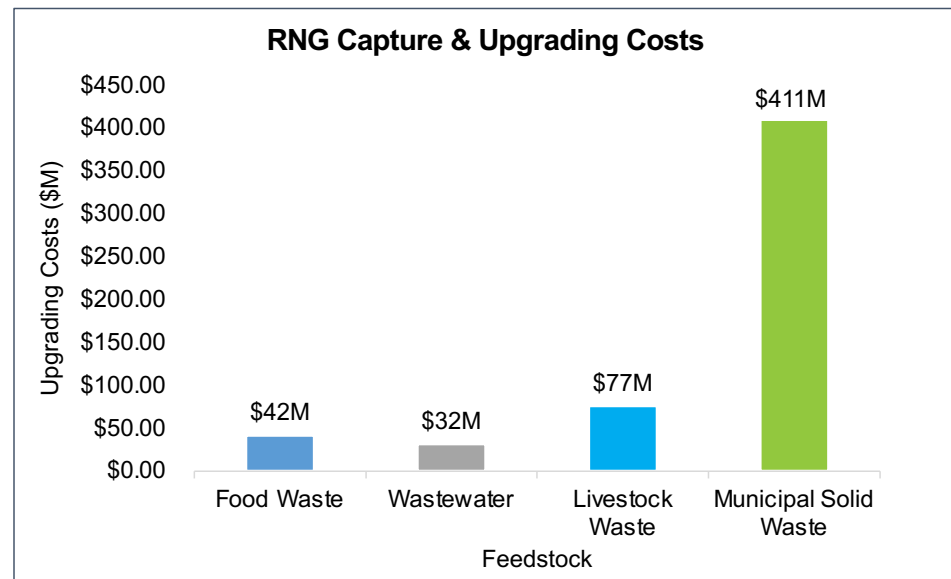
¹¹Guidehouse used the Argonne National Lab Methodology to convert SCFM to MMBTU/Year: SCFD *.001 * 365 *.9 = MMBTU (Assumes 1000 BTU/SCFD, 90% run time, 365 days)

3 Expenditure Analysis: Total Cost of RNG Upgrading is \$561.8M

Guidehouse used the RNG Cost/Volume Matrix to estimate capture and upgrading costs by multiplying the MMBTU's produced times the \$ per MMBTU for each facility and then aggregated across all feedstock types.¹³ These values represent the costs of capturing the biogas and upgrading it into biomethane.

| Total Cost of RNG Upgrading | | | |
|-----------------------------|---------------------|-------------------|-----------------|
| Feedstock(s) | Volume (MMBTU/Year) | \$ per MMBTU | Upgrading Costs |
| Food Waste | 5,692,689 | \$7.24 to \$22.97 | \$42.2M |
| Wastewater | 3,885,970 | | \$32.3M |
| Livestock Waste | 8,080,104 | | \$76.5M |
| Municipal Solid Waste | 56,474,133 | | \$410.9M |
| Total | 74,132,896 | | \$561.8M |

Municipal solid waste has the largest volume of RNG and therefore has the highest associated costs of \$410.9 million. The total cost for upgrading RNG across all four feedstocks is \$561.8 million.



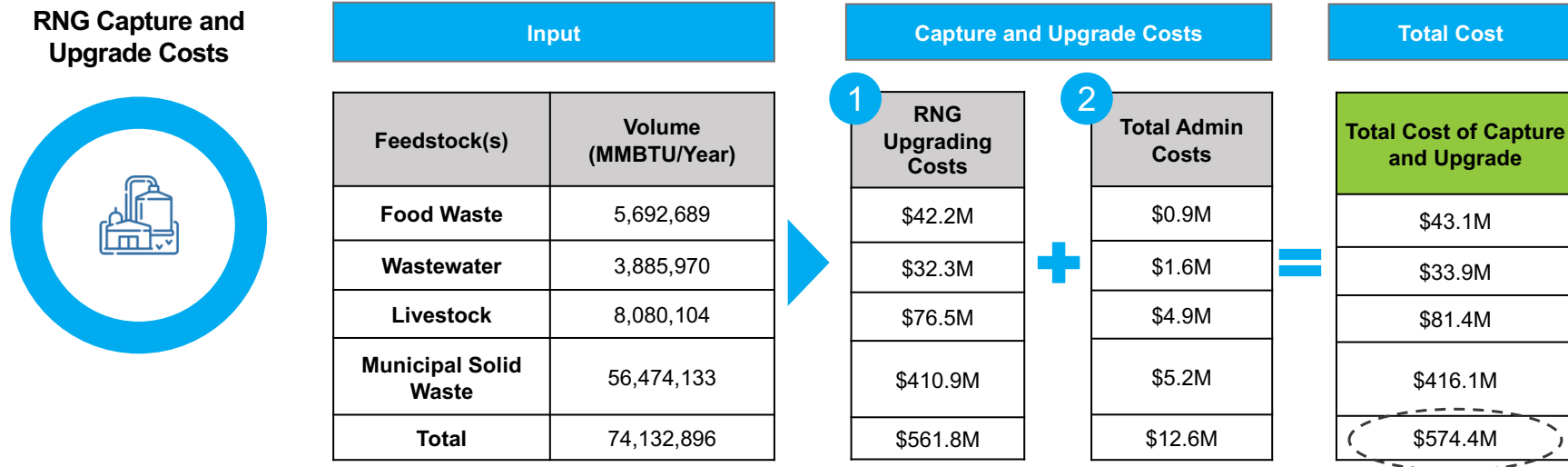
3 Expenditure Analysis: The Total Administrative Costs for RNG Capture and Upgrade are \$12.6M

The second cost component for capture and upgrade is administrative jobs. These jobs include overseeing financial transactions, bookkeeping, transactions, and other needed support. To account for these activities, Guidehouse estimated 1 administrative job per facility based on guidance from the RNG Coalition. Assuming an average income of \$72k per admin job (U.S. Bureau of Economic Analysis) Guidehouse then estimated the total administrative costs for each feedstock.

| Total Administrative Costs | | | | | |
|----------------------------|----------------------|-------------------------|----------------------|-----------------------------|-------------------|
| Feedstock(s) | Number of Facilities | Admin Jobs per Facility | Number of Admin Jobs | Sales Per Job ¹⁴ | Total Admin Costs |
| Food waste | 13 | 1 | 13 | \$71,642 | \$0.9M |
| Wastewater | 23 | 1 | 23 | \$71,642 | \$1.6M |
| Livestock | 68 | 1 | 68 | \$71,642 | \$4.9M |
| Municipal Solid Waste | 72 | 1 | 72 | \$71,642 | \$5.2M |
| Total | 176 | | 176 | | \$12.6M |

3 Expenditure Analysis: Adding Upgrading Costs and Administrative Costs Together, the Total Cost for RNG Capture and Upgrade for All Four Feedstocks is \$574.4M

This diagram shows RNG capture and upgrade costs combined. RNG upgrading costs are added to total administrative cost for each feedstock to determine the total cost.



3 Expenditure Analysis: The Total Cost of Transmission for RNG is \$284M

Transmission is the third cost type within the operating costs category. Of the 74 trillion BTU's of RNG produced in 2021, 66 trillion (89%) are injected into the natural gas pipeline transmission system. Guidehouse used the U.S. Energy Information Administration (EIA) to find the natural gas pricing information for each of the final uses. Guidehouse then estimated the revenues for transmission of RNG using natural gas prices by category of final use and the volume (1,000 SCF) of RNG.



| Final Use | MMBTU's ¹⁵ | % of Total | Volume (1,000 SCF) | Natural Gas Price | Sales |
|-------------------|-----------------------|-------------|--------------------|-------------------|---------------|
| Vehicle (Public) | 32,841,043 | 50% | 34,056,162 | \$4.01 | \$136M |
| Vehicle (Private) | 26,503,298 | 40% | 27,483,920 | \$4.01 | \$110M |
| Electricity | 5,275,053 | 8% | 5,470,230 | \$3.10 | \$17M |
| Thermal | 1,318,763 | 2% | 1,367,557 | \$8.90 | \$12M |
| Total | 65,938,157 | 100% | 68,377,869 | | \$276M |

Definitions

Vehicles (Public) Government Agency Fleets

Vehicles (Private) Retail Natural Gas Stations

3 Expenditure Analysis: The Total Cost of Distribution (Wholesale and Retail) for RNG is \$34.1M

Distribution is the fourth cost type within the operating costs category. Of the four final uses, sales to public and private vehicles customers include wholesale and retail services. In addition to the transmission sales, wholesale (4%) and retail (22%) markup percentages were applied to account for distribution services provided. Wholesale services cost an additional \$9.9M and retail services cost an additional \$24.2M to get RNG to its final users (e.g., public fleets and private natural gas retail stations).

Distribution



| Final Use | Sales | Wholesale margin | Wholesale Sales | Retail Margin | Retail Sales | Total Sales |
|--------------------|--------|------------------|-----------------|---------------|--------------|-------------|
| Vehicles (Public) | \$136M | 4% | \$5.5M | | | \$5.5M |
| Vehicles (Private) | \$110M | 4% | \$4.4M | 22% | \$24.2M | \$28.6M |
| Total | \$246M | | \$9.9M | | \$24.2M | \$34.1M |

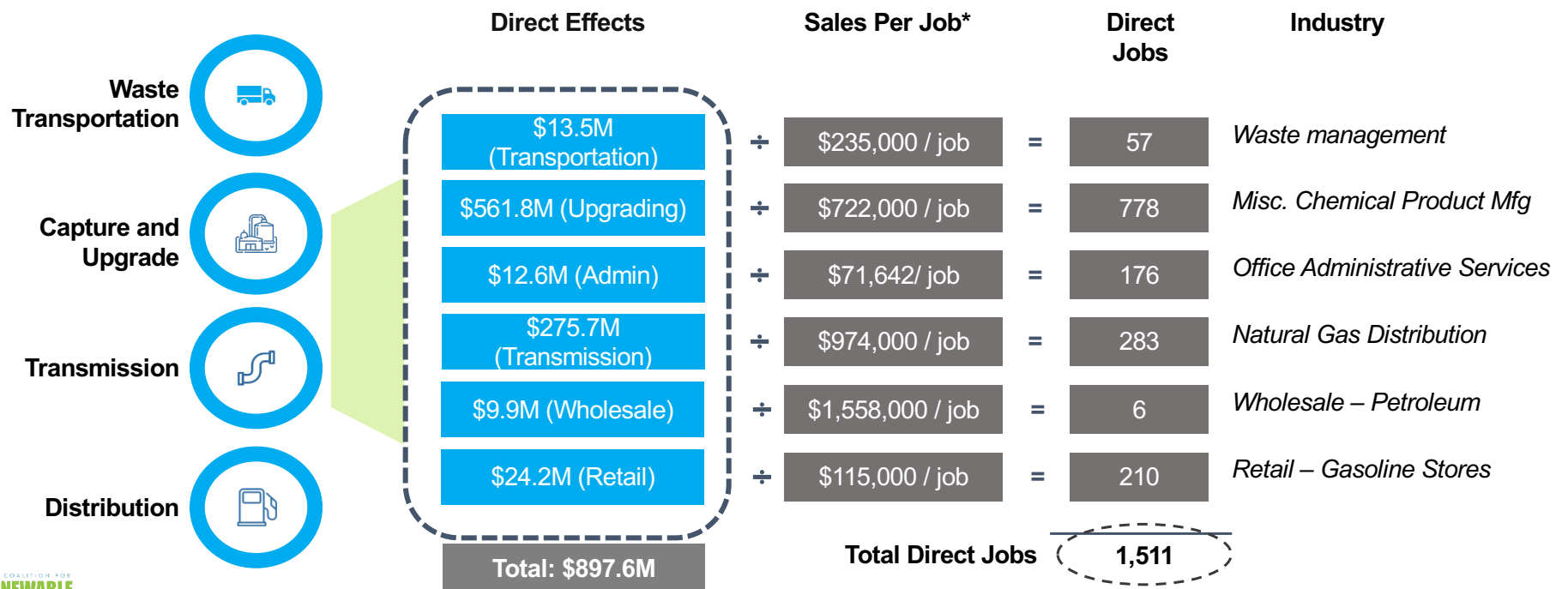
Definitions

Retail Margin The margin (e.g., mark-up) added to T&D (Transmission & Distribution) sales to reflect associated retail costs

Wholesale Margin The margin (e.g., mark-up) added to T&D sales to reflect associated wholesale costs

3 Expenditure Analysis: Total Direct Jobs from Operating RNG Projects

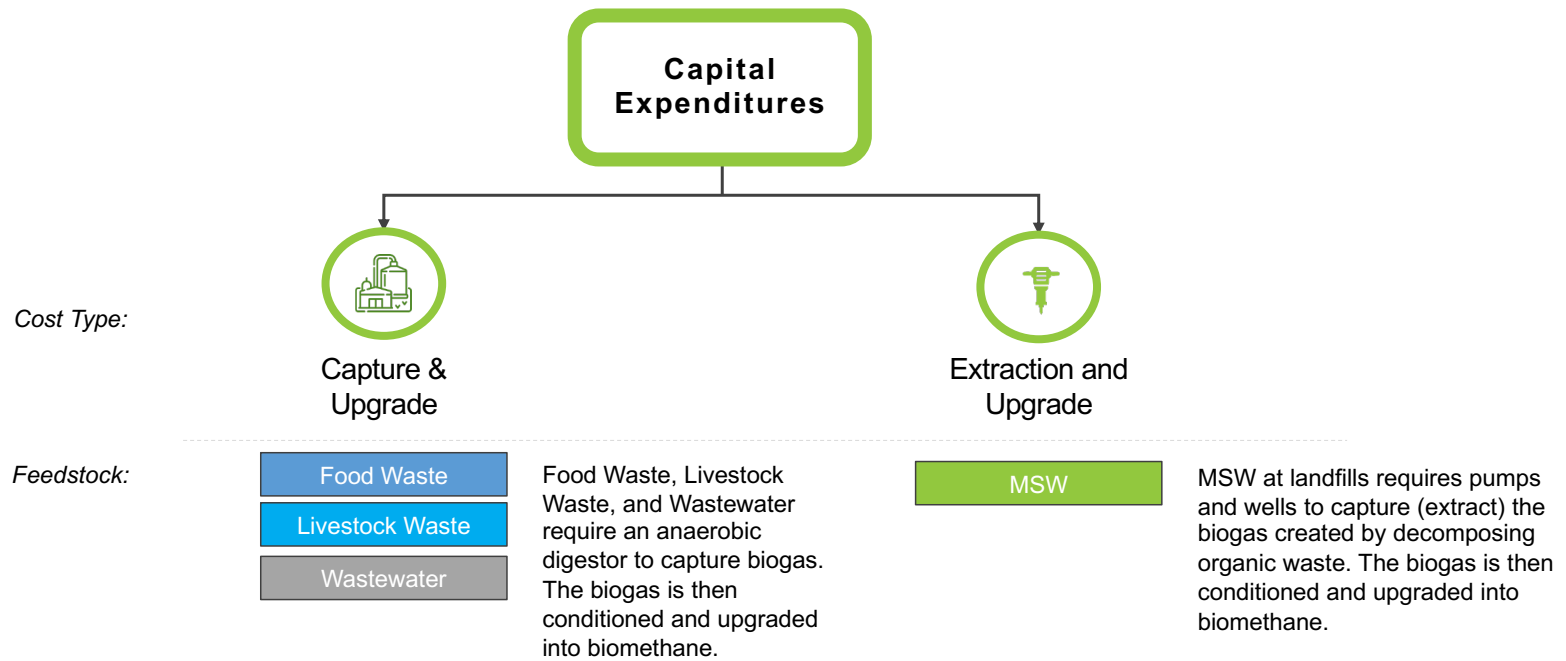
The total costs from the four major cost categories of the value chain can be used to estimate the direct number of jobs for RNG. Total costs are divided by the industry productivity ratios (e.g., sales per job) provided by the BEA. The graphic below illustrates this calculation as well as the industries associated with the direct job counts.



*Provided by Bureau of Economic Analysis

3 Expenditure Analysis: Understanding RNG Capital Expenditures

The second cost category for RNG is capital expenditures. There are two capital expenditures types: 1) Capture and Upgrade and 2) Extraction and Upgrade. These type of costs vary depending on the type of feedstock.



3 Expenditure Analysis: Total Capital Expenditures is 1.03B

For food waste, livestock waste, and wastewater, capturing and converting biogas into biomethane requires a digester and upgrading facilities. For municipal solid waste, the landfill acts as the digester and collection pipes are installed in the landfill cap to extract the biogas that naturally is generated. Construction costs for each expenditure type were multiplied by the volume of gas for each feedstock.

Capture and Upgrade



Extraction and Upgrading



| Feedstock | Expenditure Type | Expenditure (\$) |
|-----------------------|--------------------------------|------------------|
| Food Waste | Capture (Digester) and Upgrade | \$129.2M |
| Livestock Waste | Capture (Digester) and Upgrade | \$385.5M |
| Wastewater | Capture (Digester) and Upgrade | \$101.6M |
| Municipal Solid Waste | Extraction and Upgrade | \$413.6M |
| Total | | \$1.03B |

Definitions

Capture and Upgrade

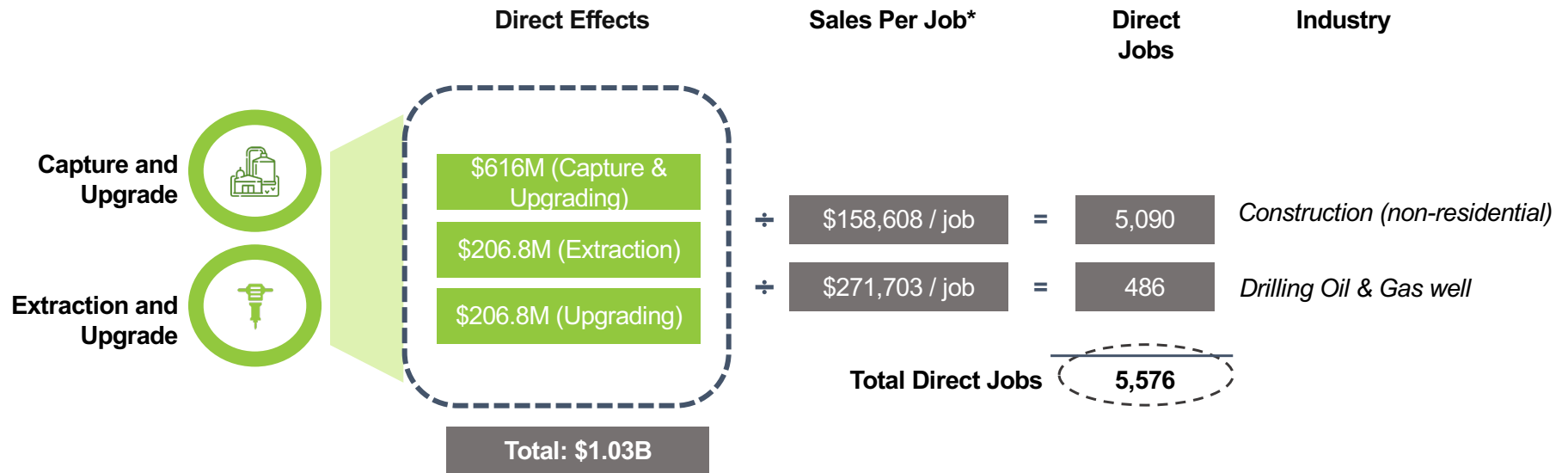
The cost of capture via anaerobic digester and biomethane upgrading

Extraction and Upgrade

The cost of capture via wells and biomethane upgrading

3 Expenditure Analysis: Using RNG Capital Expenditure Costs, We Can Estimate an Additional 5,576 of Direct Jobs

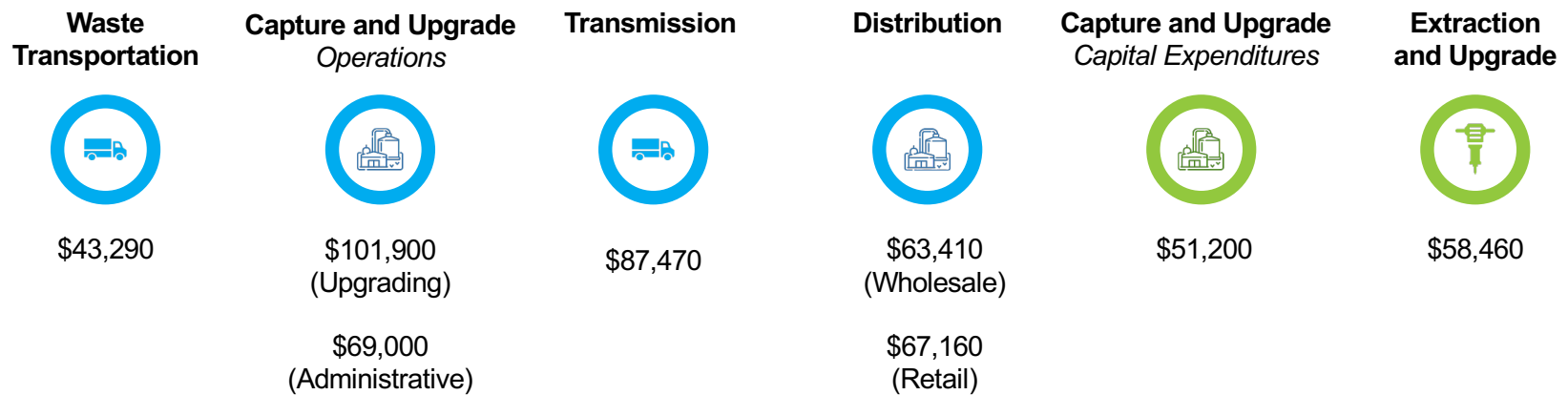
Total capital expenditures across all feedstocks amount to over \$1.03B. To estimate the direct number of construction jobs, the costs are divided by the industry productivity ratios (e.g., sales per job) provided by the BEA (within IMPLAN). The graphic below illustrates this calculation as well as the industries associated with the direct job counts. Total direct construction jobs amount to 5,576 assuming one year of construction.



3 Expenditure Analysis: Most Jobs Associated with RNG are High Paying ¹⁶

Below are the average mean salaries for the industries associated with each cost category.¹⁷

Average Wages by Cost Category

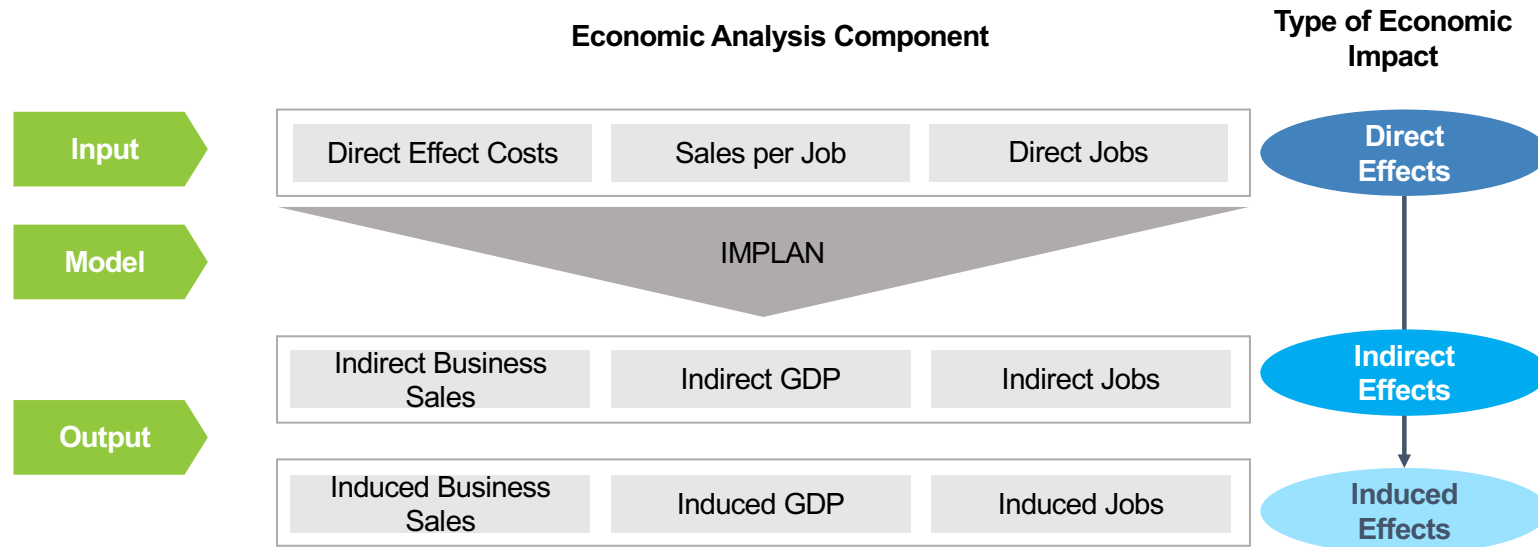


¹⁶ Based on Average Income of \$36,000/yr reported by Federal Reserve of St. Louis

¹⁷ Wages come from the Quarterly Census of Employment and Wages published by the U.S. Bureau of Labor Statistics

4 Economic Impact: The Modeling Tool IMPLAN Calculates Direct, Indirect, and Induced Effects of RNG

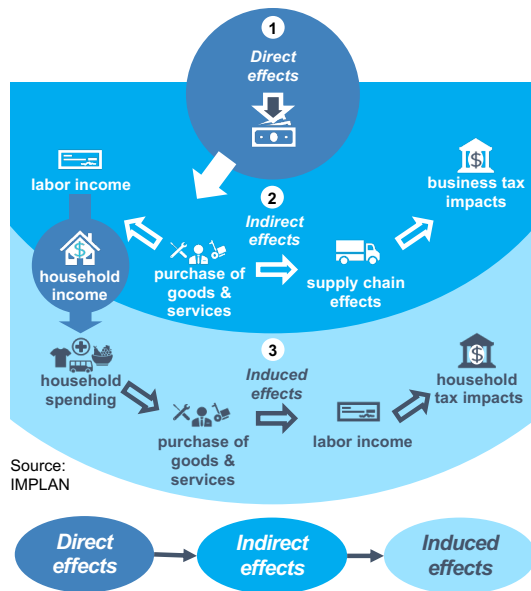
The expenditures analysis produced three values for the operating costs and the capital expenditures of RNG – RNG Business Costs, Average Sales per Job, and the Number of Direct Jobs. This information is used as inputs in the economic modeling tool IMPLAN to calculate indirect and induced effects. This modeling indicates how much additional economic activity is supported by supplier purchases (indirect) and employee spending (induced) beyond the initial RNG capture and upgrade.



4

Economic Impact: Understanding Direct, Indirect, and Induced Effects of RNG

Input-output models estimate how money moves through the economy based on supply chain relationships; the effects are categorized into direct, indirect, and induced.



Type of impact

RNG Example

| | |
|--|--|
| Direct Effects resulting from direct spending | Spending within the RNG value chain |
| Indirect Effects resulting from industries purchasing from each other | Spending on materials, components, and services |
| Induced Effects resulting from household spending of labor income | Spending on housing, healthcare, transportation, food, retail and entertainment by workers |

Metrics used in this report

Business Sales

Sales of goods and services across the supply chain.

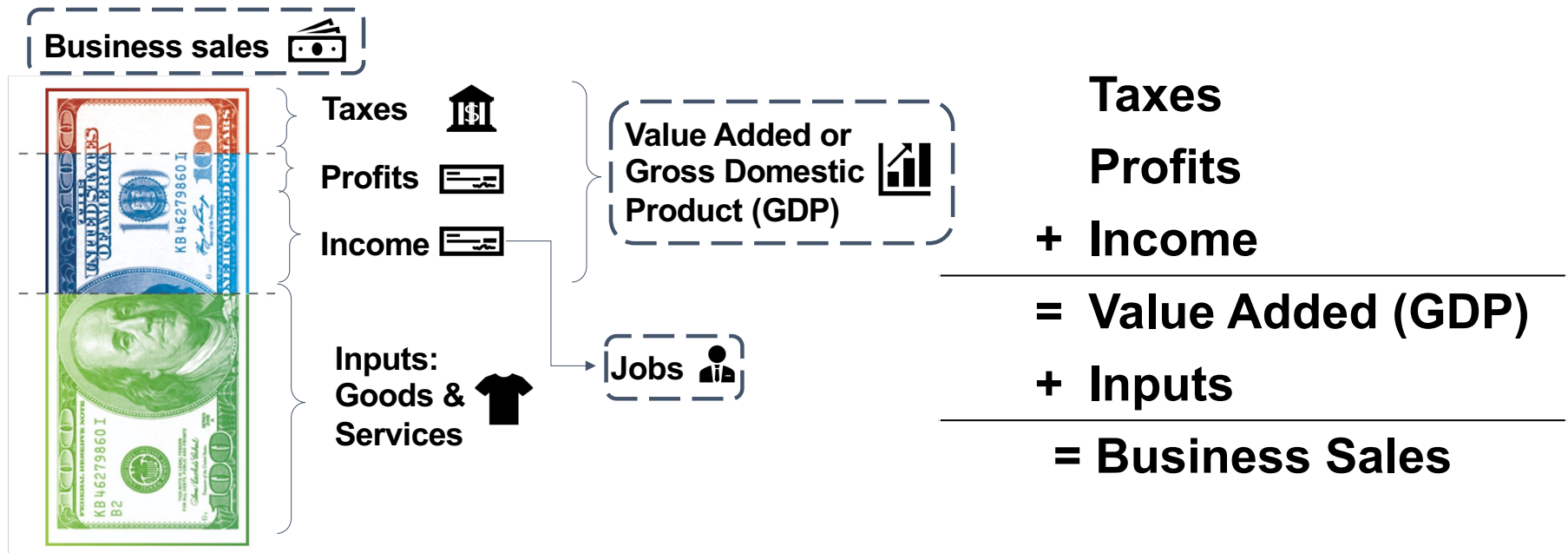
Gross Domestic Product (GDP)

The sum of the value added or 'premium' created from each stage of the supply chain

Jobs

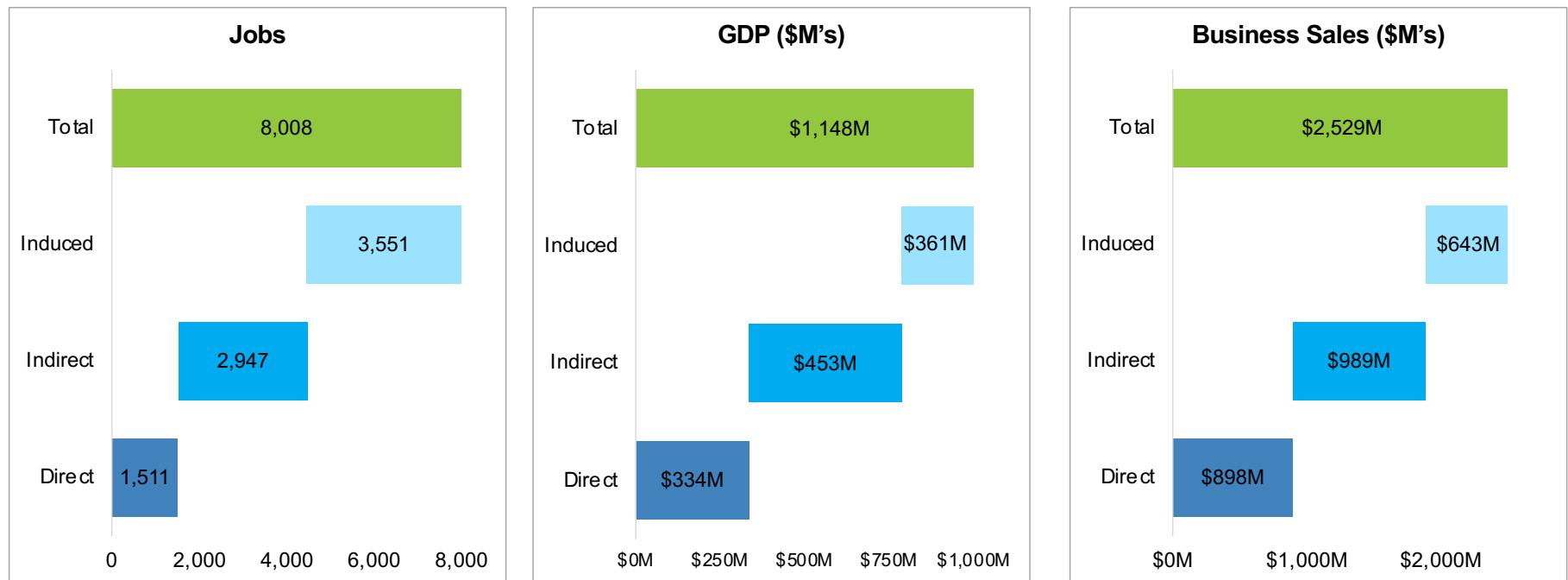
The number of jobs created from the supply chain activity stimulated through expenditure

4 Economic Impact: Economic Impact Measures Reflect Changes in the Economy but are Subsets of One Another, Meaning They Should Not be Added Together



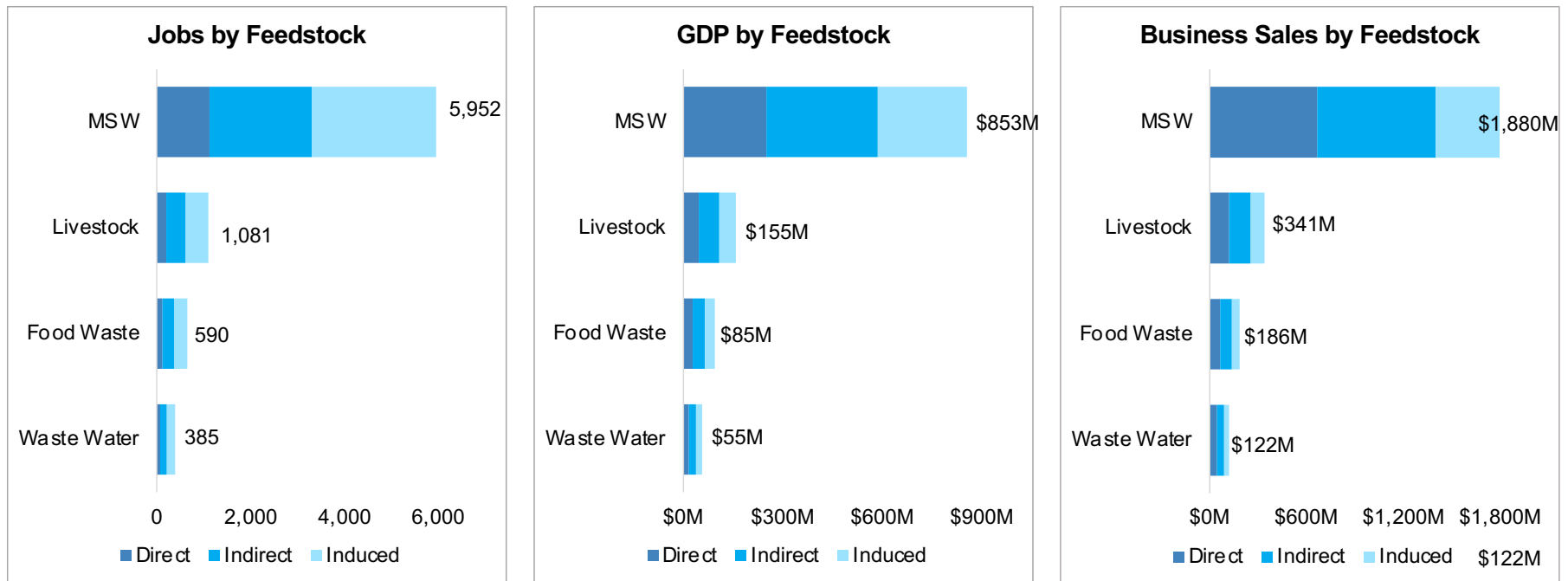
4 Economic Impact (Existing Plants): RNG Operations Create 8,008 Jobs, Support \$1.1B in GDP and Over \$2.5B in Sales in 2021

Based on the spending for RNG operations, the direct, indirect, and induced economic impacts are presented below. Over 1,500 direct jobs are attributed to activities within the RNG value chain with a total of 8,008 jobs. In 2021, RNG supports a total of \$1.1B in GDP and over \$2.5B in business sales.



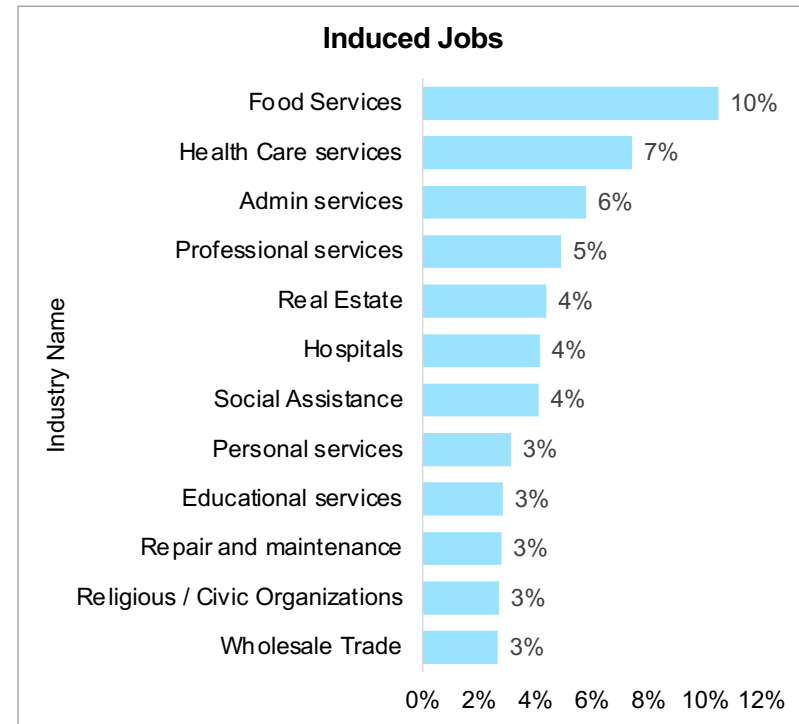
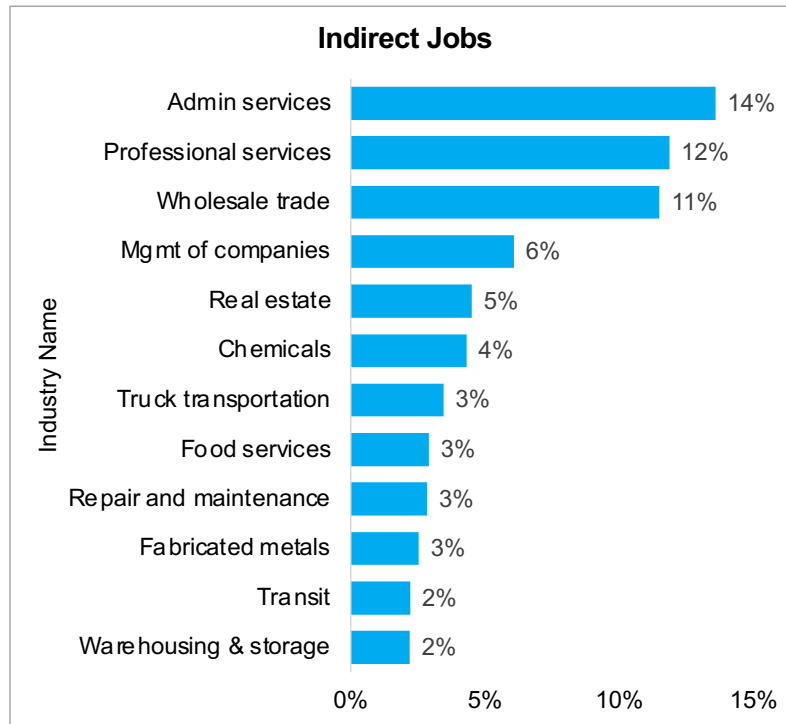
4 Economic Impact (Existing Plants): Municipal Solid Waste Has the Greatest Economic Impact from Operations of the Four Feedstocks, Accounting for 5,952 Jobs, Supporting \$853M in GDP and \$1,880M in Sales

The economic impacts by feedstock type are presented below with most impacts supported by RNG produced from municipal solid waste (MSW) with nearly 6,000 jobs. The remaining 27% of all jobs are spread across the other three feedstocks.



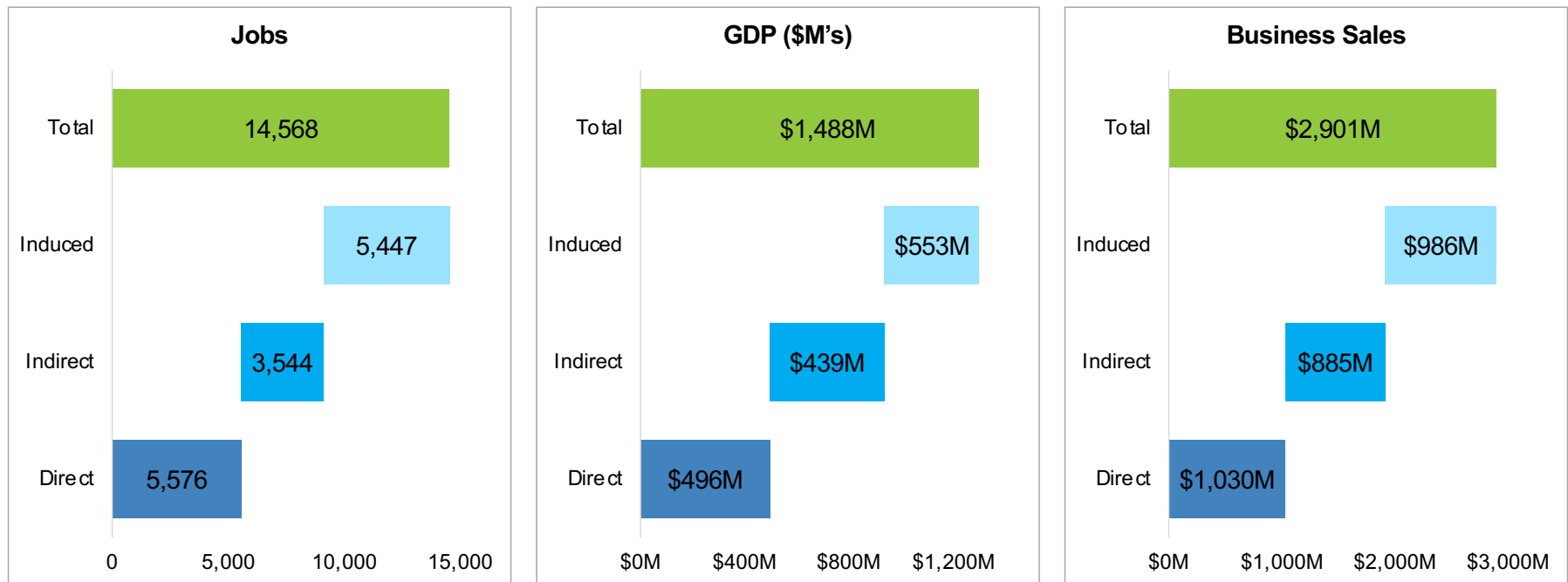
4 Economic Impact (Existing Plants): RNG Supports Jobs Across a Spectrum of Industries

The industries with the most indirect jobs are administrative services, professional services, and wholesale trade. The industries with the most induced jobs are food services, health care services, and administrative services.



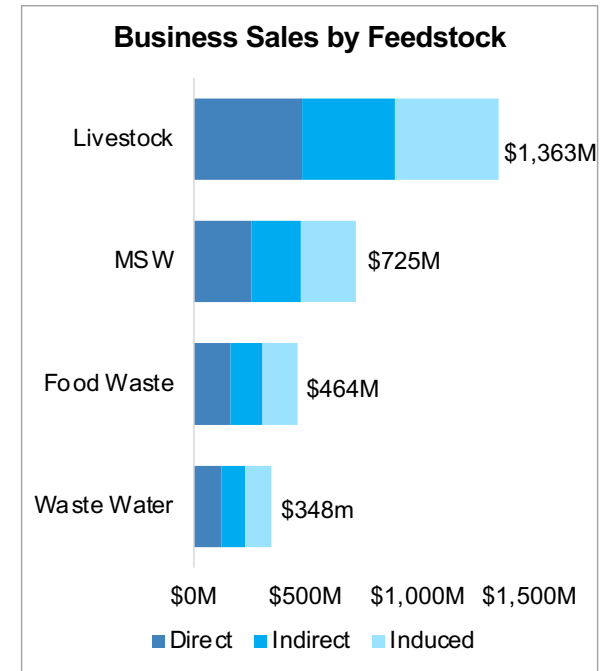
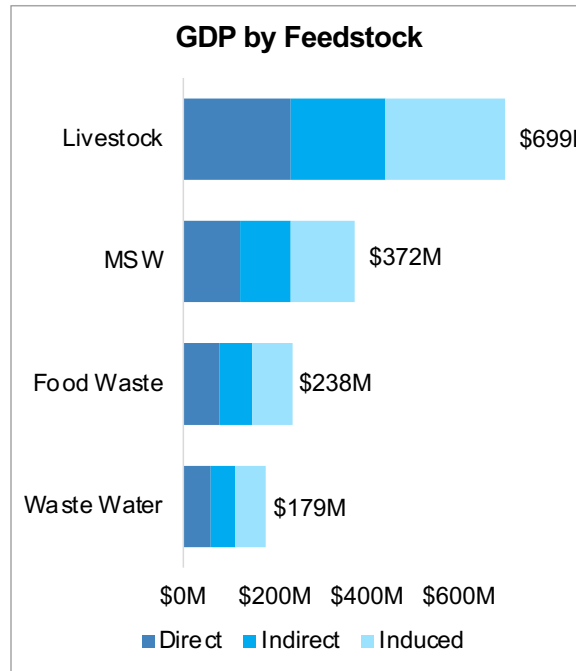
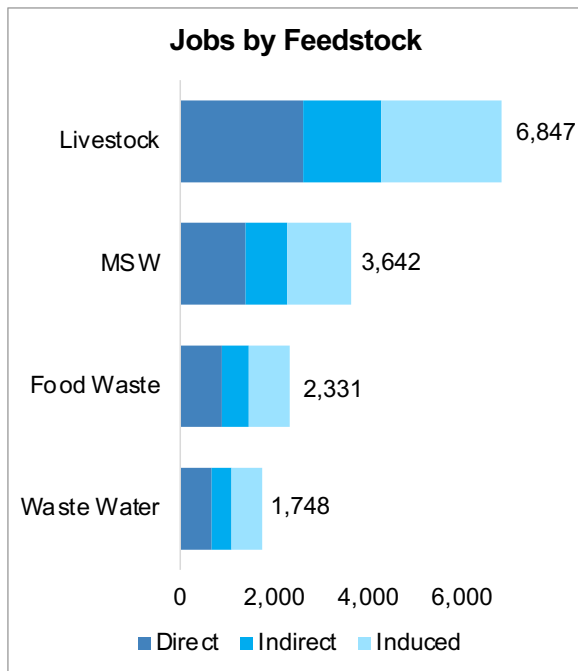
4 Economic Impact (Under Construction): RNG Capital Expenditures Create a Total of 14,568 Jobs and Support a Total of \$1.5B in GDP and Over \$2.9B in Sales

Based on the spending for RNG Capital expenditures, the direct, indirect, and induced economic impacts are presented below in terms of jobs, GDP, and Business Sales.



4 Economic Impact (Under Construction): Livestock Waste Has the Greatest Economic Impact from Capital Expenditures of the Four Feedstocks, Accounting for 6,847 Jobs and Supporting \$699M in GDP and \$1,363M in Sales

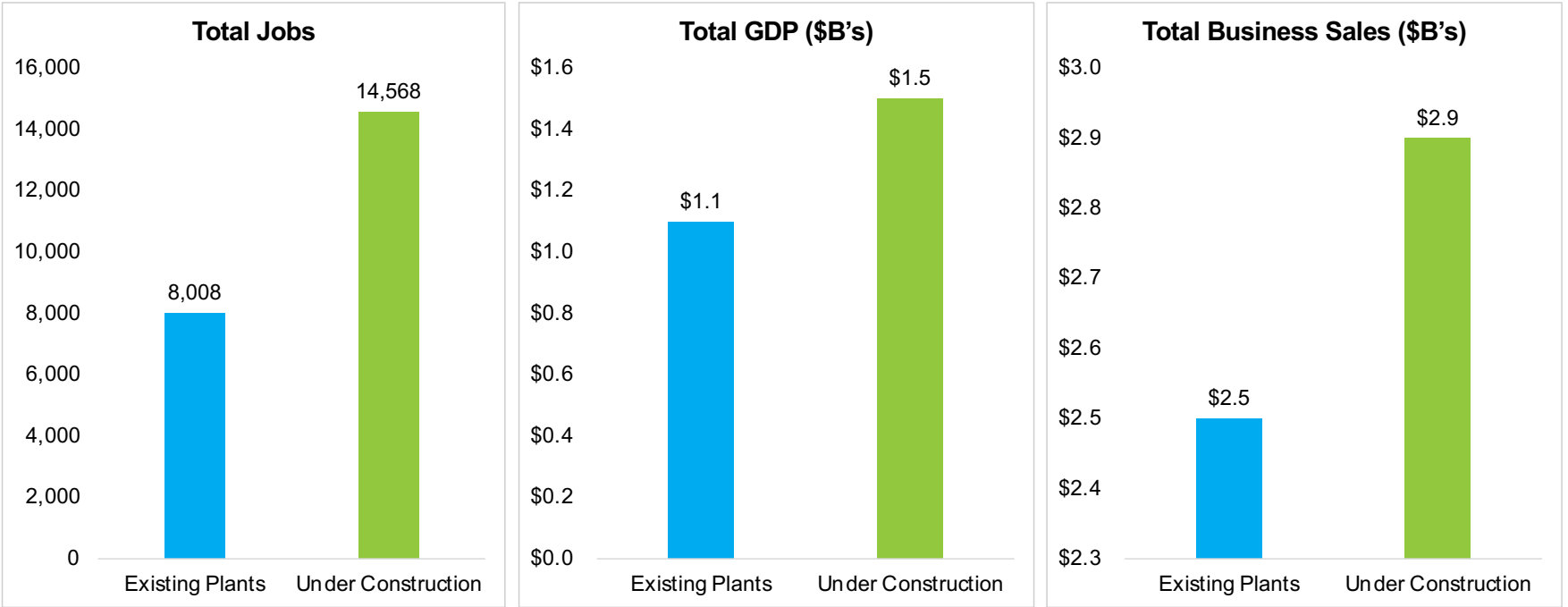
The economic impacts by feedstock type are presented below with most impacts supported by RNG produced from Livestock Waste with 6,847 jobs. The remaining 28% of all jobs are spread across the other three feedstocks.



4

Economic Impact: RNG Contribution in Jobs, GDP and Total Sales

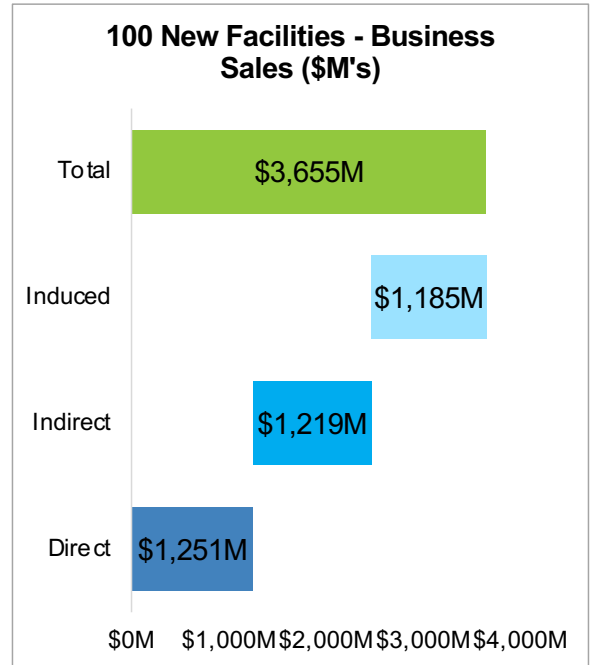
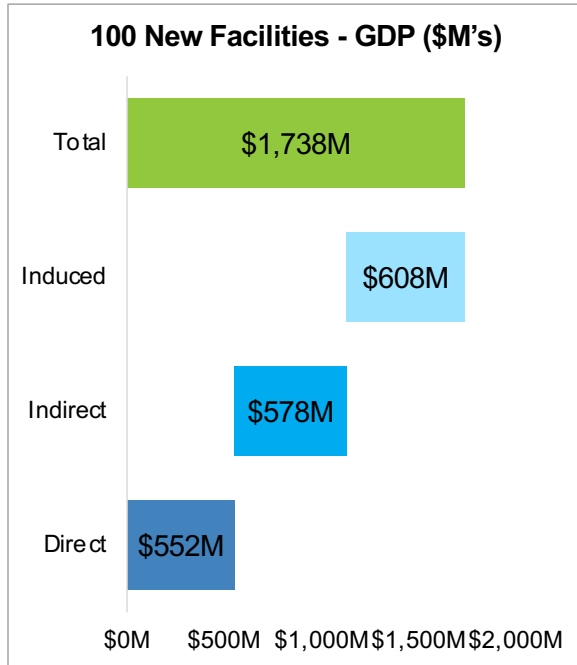
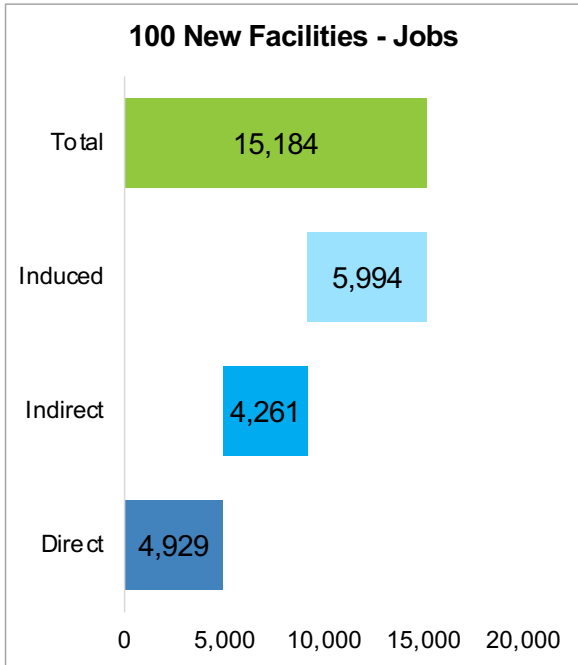
These numbers include the direct, indirect, and induced effects of RNG. Operations jobs are ongoing at completed RNG facilities; capital expenditure or construction jobs last approximately one year and are renewed as additional projects are developed in this growing industry.



4

Economic Impact of 100 New RNG Facilities

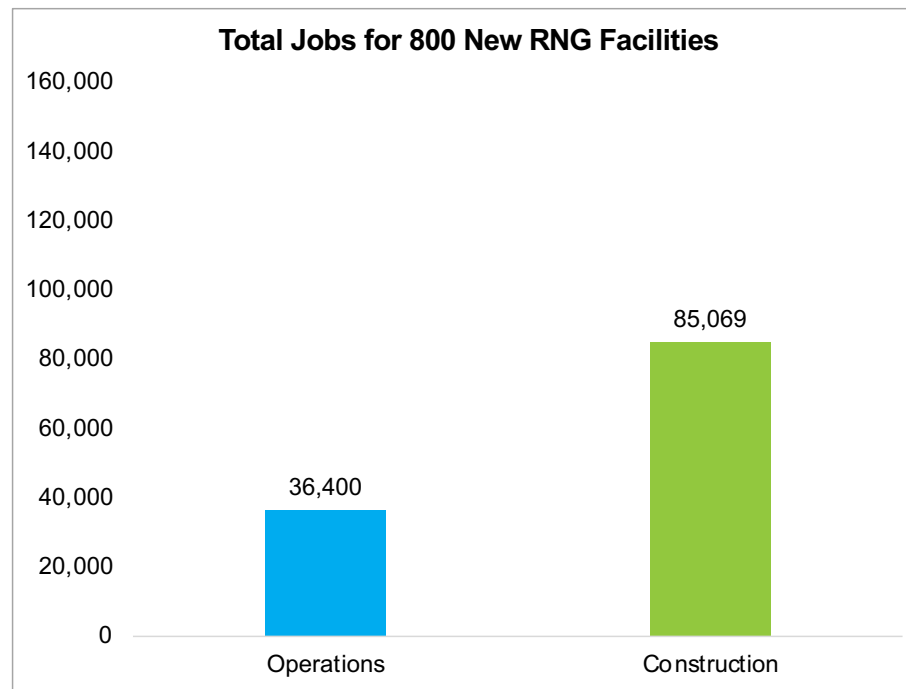
Over 4,929 direct jobs could be attributed the construction and operations and maintenance of 100 new RNG facilities with a total of 15,184 jobs. 100 new facilities could also support a total of \$1.1B in GDP and over \$2.5B in business sales.¹⁸



¹⁸ Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operational facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by the RNG Coalition.

4 Economic Impact: Projected Jobs from RNG Industry Growth by 2030

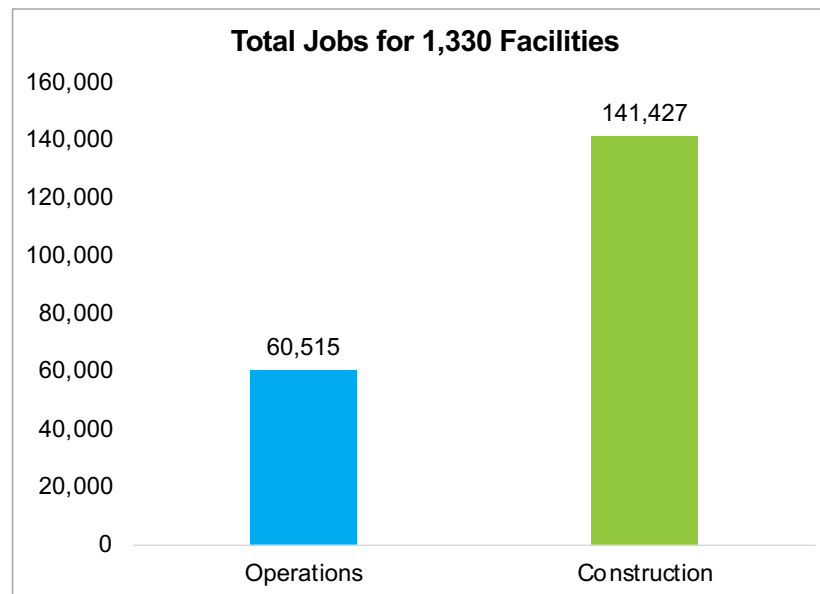
An additional 800 new facilities, the growth target for 2030 under RNG Coalition's SMART initiative, would create an estimated 121,469 total jobs.¹⁹



¹⁹ Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operation facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by RNG Coalition and are based on the Sustainable Methane Abatement and Recycling Timeline (SMART Initiative) Goals. These calculations do not take into consideration yearly economic changes that might affect RNG job numbers.

4 Economic Impact: RNG Jobs Growth if U.S. Follows a Net Zero Pathway

According to the International Energy Agency's (IEA) Net Zero by 2050 scenario*, if the world follows a pathway to prevent the worst impacts of climate change, global RNG volume could increase sevenfold in the next decade. In the US, this could result in 1,330 RNG facilities. An additional 1,330 facilities would create an estimated 201,578 jobs.²⁰

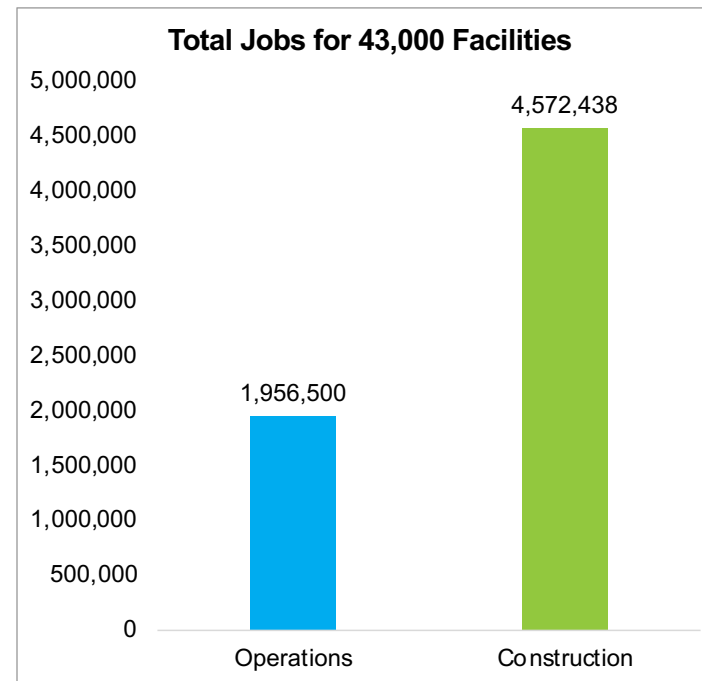
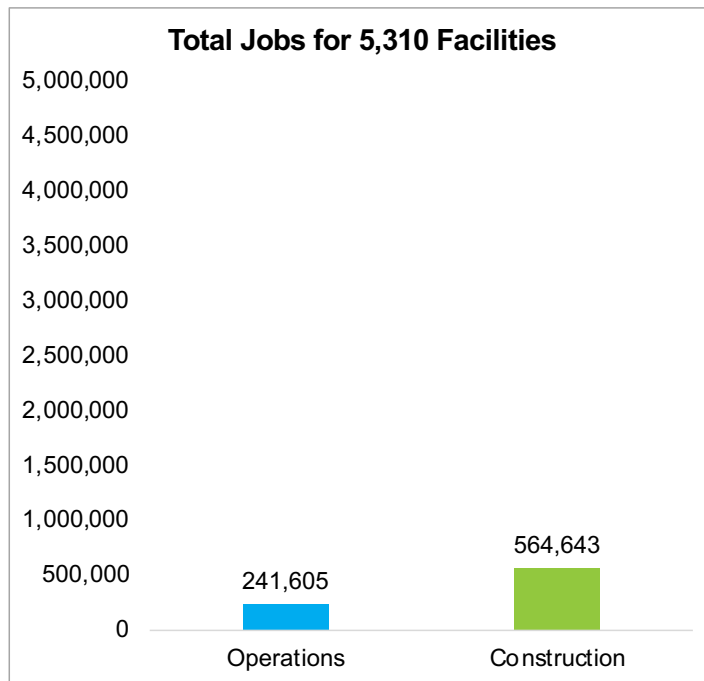


²⁰ Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operation facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by RNG Coalition. These calculations do not take into consideration yearly economic changes that might affect RNG job numbers.

* Source: International Energy Agency, [Net Zero by 2050 A Roadmap for the Global Energy Sector \(2021\)](#)

4 Economic Impact: RNG Industry Jobs Growth by 2050

The IEA Net Zero by 2050 scenario estimates 5,310 new facilities by 2050, which could create an estimated 806,248 jobs. If, however, RNG reaches total buildout under the SMART Initiative, this could result in 43,000 facilities by 2050, which would create an estimate 6,528,938 jobs.²¹



²¹ Calculations are based on the average jobs per facility for each feedstock in 2021. Operations jobs ratios were calculated using current operation facilities in 2021 while construction job ratios were calculated using the number of facilities currently under construction in 2021. These numbers were provided by the RNG Coalition. This calculations do not take into consideration yearly economic changes that might affect RNG job numbers.

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