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MISSOURI PUBLIC SERVICE COMMISSION

FILE NO. ET-2018-0132

DIRECT TESTIMONY

OF

DAVID K. PICKLES

ON

BEHALF OF

UNION ELECTRIC COMPANY

d/b/a Ameren Missouri

p. 6, 7, 8, 9, 16 and 19
CORRECTIONS MARKED BY NANCY DIPPELL, SENIOR REGULATORY LAW JUDGE

St. Louis, Missouri
February, 2018

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Date 12-4-18 Reporter JM
File No. ET-2018-0132

TABLE OF CONTENTS

DIRECT TESTIMONY

OF

DAVID K. PICKLES

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I. INTRODUCTION

Q. Please state your name and business address.

A. My name is David K. Pickles. My business address is 7160 North Dallas Parkway, Suite 340, Plano, Texas 75024. I am employed by ICF Resources, LLC. ("ICF"), as Senior Vice President.

Q. On whose behalf are you submitting this testimony?

A. I am submitting this testimony to the Missouri Public Service Commission ("MPSC") on behalf of Ameren Missouri.

Q. Please state your education, professional and work experience.

A. I am a 1986 graduate of the University of Wyoming with a Bachelor of Science Degree in Economics and a 1988 graduate of the University of Wyoming with a Master of Science Degree in Regulatory Economics. I have 30 years of experience in the planning, implementation, and evaluation of utility Demand Side Management ("DSM") programs. I have been employed by ICF for approximately 13 years, and currently serve as Senior Vice President in the Commercial Energy Practice. Prior to joining ICF, I was employed by Navigant Consulting as Director in the energy efficiency practice; PHI Consulting, where I served as interim Chief Technology Officer for Honeywell's Energy Information Services business unit; Central and Southwest Utilities (now AEP) as Vice President of Marketing, Development, and Operations for the unregulated energy services

group; and Synergic Resources Corporation as a Director in the energy efficiency practice. I also have experience as a utility regulator, having previously held positions as Utility Specialist and Senior Utility Analyst with the Iowa Consumer Advocates Office, and Utility Analyst II with the Iowa Utilities Board, where I was responsible for helping develop positions and testimony regarding energy efficiency and integrated resource planning. I have led the development of over 100 individual demand side management programs, including: program design, establishment of incentives, forecasting of participation, cost-effectiveness testing, creation of marketing strategies, and estimation of implementation costs. I have also led the development of demand side potential studies for utility clients in Arizona, Arkansas, Delaware, Florida, Hawaii, Illinois, Iowa, Louisiana, Maryland, Michigan, Mississippi, Missouri, North Carolina, South Carolina, Texas, Virginia, Washington, D.C., and Wisconsin. A statement with additional details on my background and experience is provided as Schedule DP-D1.

Q. Please describe ICF.

A. Founded in 1969, ICF is a consulting and professional services firm supporting the energy, environmental, health, technology, and aviation sectors. Publicly traded (NASDAQ: ICFI) with over 5,000 staff and $1.2 billion in annual revenue, ICF currently implements more than 170 demand side management programs for 42 utilities in 28 states. ICF has also been the lead contractor for the Environmental Protection Agency's ("EPA") ENERGY STAR® program since its inception and also supports the U.S. Department of Energy's Better Buildings and Commercial Building Alliance programs.

Q. Have you previously testified before a regulatory commission?

A. Yes. I have testified before regulatory commissions in Arkansas, Iowa, Illinois, South Carolina, Virginia, Arizona, Nova Scotia, and Louisiana on issues related to demand side management program planning, design, and policy, and other ratemaking topics.

Q. Your testimony is being filed in a docket consisting of two new program offerings and a modification of Ameren Missouri's Distribution line extension policy. What part of Ameren Missouri's filings do you address?

A. My testimony addresses Beneficial Electrification, which for Ameren Missouri's filing, is referred to as its "Charge Ahead – Business Solutions" program. I do not address a second Charge Ahead program, referred to by Ameren Missouri as "Charge Ahead – Electric Vehicles," which I understand is addressed in the direct testimonies of Ameren witnesses Steven Wills and Patrick Justis.

II. POLICY IMPETUS FOR AMEREN MISSOURI'S BENEFICIAL ELECTRIFICATION PROGRAM

Q. Please define Beneficial Electrification.

A. As I use the term in the context of this testimony, Beneficial Electrification or "BE" is the practice of encouraging the adoption of electrically powered equipment in place of fossil-fuel powered equipment in a manner that reduces average rates to electric customers.

Q. Can you provide an illustrative example of a program?

A. Yes. A typical example would be a program that promotes electric forklifts in place of diesel or propane forklifts. Such a program might include some or all of the following:

- Marketing campaign, collateral material, and website describing the benefits of electric forklifts;
- Technical and financial assessment tools and services to help customers evaluate electric versus alternate fuel forklifts;
- Sales training and collateral materials for forklift dealers;
- Promotional events;
- Account managers to promote the program and provide technical and application support to dealers and customers;
- Call center support;
- Financial incentives for customers and/or dealers, and
- Demonstration projects, and Data tracking, reporting, and verification systems and procedures.

Q. Please provide a brief description of Ameren Missouri's proposed program.

A. Ameren Missouri's "Charge Ahead – Business Solutions" program includes marketing, technical support, and incentives to encourage adoption of qualifying electric technologies. These technologies would otherwise be powered by gasoline, diesel, or propane fuel, and include: material handling equipment (such as forklifts), and airport

ground support equipment (such as baggage tugs). A more complete description of the program and qualifying technologies is provided later in my testimony

Q. Why is Ameren Missouri's BE program good public policy?

A. As further discussed in the testimony of Ameren Missouri witness Steven Wills, Ameren Missouri's BE program will further several important public policy goals, including:

- Improving the efficiency of the Ameren Missouri electricity supply system;
- Reducing rates to all Ameren Missouri electric customers;
- Reducing net environmental emissions;
- Providing better service to Ameren Missouri customers through reduced equipment operating and maintenance costs;
- Improving the safety and productivity of Ameren Missouri customer facilities;
- Improving customer satisfaction, and
- Contributing to the financial health and stability of Ameren Missouri.

Further, the costs of the program will be more than offset by its benefits.

Q. Please describe these benefits in detail.

A. The benefits to Ameren Missouri customers include:

- Lower average rates for all Ameren Missouri customers;
- Lower cost of equipment ownership, fuel, operations, and maintenance for program participants;
- A typically safer, quieter, cleaner, and more efficient workplace for participants, and

- Improved customer productivity.

Lower rates are achieved because the additional revenue from participants is more than enough to offset program costs and the incremental costs of electricity supply. This incremental net revenue is now available to offset other costs of service. Further, the increase in sales permits fixed costs to be spread over a larger sales base, with the combined effect being a reduction in rates that would otherwise have to be charged to customers. As discussed later in my testimony, for each dollar spent on the program, customers are anticipated to see a benefit of ~~1.63~~ 1.81 dollars. Corrected 7/10

The participant benefits are specific to the individual technology, but will in all cases result in a participant benefit cost ratio greater than one. That is, the participant's cost of purchase (including any incentive), fuel, operations, and maintenance will be less with the electric option than they would be with the fossil-fuel alternative. In many cases, the electric technologies also provide:

- Reduced maintenance, typically having approximately 90% fewer moving parts with no engine fluids or hoses;
- Reduced exposure to fossil fuel price volatility;
- A safer and more efficient work environment, allowing strategic placement of chargers throughout the facility to avoid traffic congestion;
- Less noise since electric motors are much quieter than internal combustion engines making it easier for workers to communicate, and
- A cleaner and healthier work environment since electric motors produce zero site emissions, and do not add NOx, particulates, hydrocarbons, or carbon monoxide into the work area.

Q. What are the environmental benefits of beneficial electrification?

A. Environmental benefits accrue when the combination of the electric technology and electricity supply grid are more environmentally efficient than the fossil technology. For example, the electrification of on-road and off-road transportation and other goods movement equipment has favorable environmental results due to the relatively high energy efficiency of electric drives compared with internal combustion engines. According to the U.S. Department of Energy Alternative Fuels Data Center, all-electric vehicles produce 27% fewer greenhouse gas emissions than comparable internal combustion gasoline vehicles in the state of Missouri.[1] While these results pertain to on-road light duty vehicles, they are indicative of the performance of an electric motor drive operating on the local (i.e., Missouri) grid energy compared to gasoline. Electric drives have even greater environmental advantages when compared with diesel engines. Internal combustion engines are also a source of criteria pollutants such as nitrous oxides and particulate matter.

The net emissions reductions resulting from the proposed Ameren Missouri program over the life of the measures (including the effect of incremental emissions from electricity generation), are anticipated to be ~~152,536~~ 142,503 metric tons of CO_2 and ~~892~~ 893 metric tons of NOx. This is equivalent to the annual greenhouse gas emissions of over ~~32,663~~ 30,615 passenger vehicles, or the CO_2 from consuming ~~353,153~~ 331,017 barrels of oil.[2] Corrected

Q. What benefits do utilities accrue from beneficial electrification programs?

[1] "Emissions from Hybrid and Plug-In Electric Vehicles", Alternative Fuels Data Center, U.S. DOE, 5/18/2017, web site accessed 12/18/2017, https://www.afdc.energy.gov/vehicles/electric_emissions.php.
[2] Source: EPA Greenhouse Gas Equivalencies Calculator, September 2017.

A. Utilities can benefit from the increased system utilization and improved load factor that BE programs may provide. And the revenues from increased energy sales, to the extent that they exceed incremental cost (which is a requirement in the proposed program) serve to reduce the need for rate increases. Given that Ameren Missouri is forecasting negative load growth in the future, due in part to increasingly stringent energy codes and standards and the impact of Ameren Missouri's energy efficiency programs, carefully targeted BE programs may help Ameren Missouri demonstrate growth potential to investors and increase its ability to attract capital at competitive rates. Utilities may also benefit from the increase in customer satisfaction that can result from such programs.

Q. Is Ameren Missouri's proposed program consistent with its commitment to Energy Efficiency?

A. Yes. While the proposed BE program will result in increased electricity sales, those sales will also significantly reduce net emissions and promote more efficient grid utilization. Further, the sales will more than cover the increased cost of supply. In the language of energy efficiency program benefit cost testing, the program will pass the ratepayer impact measure or "RIM" test with a benefit cost ratio of ~~1.63~~ 1.81. Over the lifetime of the technologies, the program is anticipated to provide over $~~11.4~~ 13.9 million in net benefits to Ameren Missouri customers.

Finally, the program will also result in a decrease in the total resources (defined as the combination of electric, fossil-fuel, and customer resources) necessary to supply the customer. In other words, the program will pass the modified total resource cost or "mTRC" test[3] used for energy efficiency program testing with a benefit cost ratio of ~~3.47~~ 3.39.

[3] Although the TRC test is not typically applicable to BE programs, for the purposes of this testimony, the California Standard Practice Manual cost-effectiveness test procedure was modified such that total

Over the lifetime of the technologies, the program is anticipated to provide over ~~$74.9~~ 68.7 million in net total resource savings. These test results are discussed in more detail later in my testimony. Corrected

III. OVERVIEW OF UTILITYBENEFICIAL ELECTRIFICATION PROGRAMS

Q. Have other utilities responded to this impetus for BE programs?

A. Yes. A growing number of utilities are engaged in a variety of electrification initiatives. In a 2014 report, the Edison Electric Institute ("EEI") proposed electric utilities "lead by example" in transportation electrification.[4] In July of 2015, 38 electric utility holding companies representing 77 total operating companies joined EEI's Fleet Electrification Commitment list, including Ameren Missouri. In addition, over 30 utilities (including Ameren Missouri) are investigating or pursuing beneficial electrification programs with assistance from the Electric Power Research Institute's ("EPRI's") beneficial electrification research initiative.

Utilities that have moved beyond research and introduced programs include: CenterPoint Energy, Entergy, Southern Company, TVA, Jacksonville Electric Authority, Alliant Energy, and SRP. Collectively, their programs support adoption of a variety of technologies, including forklifts, truck refrigeration units, truck stop electrification, pipeline compression, port electrification, irrigation pumps, mining equipment, cooking equipment, airport ground support equipment, cranes, and custom industrial processes such as metal treating and manufacturing.

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resources include the impact on the gasoline, diesel, or propane provider instead of the regulated natural gas utility. We denote this test as the modified or "mTRC" test.

[4] Edison Electric Institute, "Transportation Electrification – Utility Fleets Leading the Charge," Edison Electric Institute (June 2014), www.eei.org

In addition, in its draft manual on rate design for distributed energy resources, NARUC noted that electric vehicles "can be responsive to price or demand response signals" and could potentially provide a power source to the grid when they are connected and not in use.[5] At least one utility is employing this strategy today - Great River Energy offers a load management program which targets electric vehicle charging for cars, forklifts, golf carts, and other technologies found in beneficial electrification programs.[6]

IV. ANALYSIS OF THE OPPORTUNITIES FOR BENEFICIAL ELECTRIFICATION

Q. Have you performed an analysis of opportunities for Beneficial electrification at Ameren Missouri?

A. Yes. Ameren Missouri retained ICF to screen a variety of electric technologies and assess their likely impact on the Ameren Missouri system. This included evaluation of: the load shape of each technology, the impact on Ameren Missouri's revenue and cost of supply, emissions impacts, customer acceptance of the technologies, and program delivery costs. The analysis included extensive market research to validate the assumptions used. Based on this analysis, a recommended program design was developed and evaluated for cost-effectiveness. The analysis was done by me or under my direct supervision, and is provided as Schedule DP-D2, which is attached to my testimony.

Q. Which technologies were included in the analysis?

A. The analysis considered the following technologies:

Material Handling Equipment

[5] "Manual on Distributed Energy Resources Compensation," NARUC, (2016), https://pubs.naruc.org/pub.cfm?id=88954963-0F01-F4D9-FBA3-AC9346B18FB2.

[6] http://greatriverenergy.com/we-innovate/smart-energy-use/demand-response/great-river-energy-load-management-programs/

- Forklifts
- Electric Standby Truck Refrigeration Units
- Truck Stop Electrification

Airport Ground Support Equipment

- Pushbacks
- Tugs
- Belt loaders
- Ground power units ("GPUs")

Port Equipment

- Cranes
- Drayage Trucks

Mining Equipment

- People Movers
- Drills
- Load Haul Dump Trucks ("LHD")
- Roof Bolters

Q. Please briefly describe each electric technology.

A. **Forklifts** can be found in a variety of logistical applications, and are primarily used for lifting and moving heavy loads. They are commonly found in facilities such as distribution warehouses and shipping depots. Electric forklifts rely on an integrated industrial battery system for motive power. Batteries are sized to provide sufficient power for specific lifting capacity and duty cycle each day. The battery may be charged by one of two methods – conventional charge or rapid/opportunity charge (also referred to as fast

charge). Conventional charge batteries typically run for 8 hours, charge for 8 hours, and cool for 8 hrs. Rapid charge batteries charge for 1-2 hours throughout the day and remain 20-80% charged, with an 8 hour equalization charge once a week.

Truck Refrigeration Units ("TRUs") are used by food distribution and cold storage companies to maintain temperature in trailers. On-road power typically comes from onboard auxiliary diesel engines. Electric stand-by or "E/S TRUs" have the ability to directly plug in to the power grid to maintain temperatures overnight or while loading/unloading (as opposed to idling the diesel engine during those times).

Truck Stop Electrification ("TSE") provides infrastructure for heavy duty trucks to connect to the grid to charge or power cab appliances while parked temporarily or overnight at a truck stop or travel center, rather than idling the diesel engine. The technology can also be found at some distribution warehouses, shipping depots, and intermodal shipping operations.

Pushbacks are used to push or tow aircraft on the ground at airports.

Tugs are used to pull trains of baggage carts to and from aircraft to baggage rooms or connecting flights at an airport.

Belt Loaders are used to load or unload baggage and cargo onto and off of aircraft at an airport using a moving belt on a ramp.

Ground Power Units supply aircraft electricity while parked at an airport facility.

Cranes are commonly used to move or stack goods at warehouses, ports, railyards, and intermodal shipping facilities. Crane capacity, size, and cost varies greatly from small overhead cranes inside warehouses to large dockside container cranes at ports.

Drayage Trucks are commonly used to transport goods (typically in a shipping container) over short distances at ports, intermodal shipping facilities, and railyards.

People Movers are used to transport personnel throughout a mine.

Drills are used for drilling shot-holes for explosive charges that loosen material for extraction in underground mines.

Load Haul Dump Trucks are used to move heavy mining loads underground over short distances.

Roof Bolters are used to install roof support bolts in underground mines.

Q. How was the suitability of each technology for inclusion in a possible Ameren Missouri program determined?

A. The first consideration was cost-effectiveness of the technology, which can be evaluated using different perspectives or tests. For this analysis, the Ratepayer Impact Measure ("RIM"), Participant ("PCT"), and Modified Total Resource Cost ("mTRC") tests were used to characterize the cost-effectiveness of each technology. These tests incorporate different costs and benefits. Each test is summarized in Table 1 below.

Table 1.

Test	Question	Benefits	Costs
Ratepayer Impact Measure (RIM)	Will utility rates decrease?	Incremental Revenue	Program Incentives Program Operations Costs Incremental Electricity Supply Costs
Participant (PCT)	Will a participant benefit over the measure life?	Incentives Fuel Savings O&M Savings	Incremental Equipment Cost Electricity Bills
Modified Total Resource Cost (mTRC)	Will the total cost of supplying the service across all fuels decrease?	O&M Savings Value of Saved Fuels	Net Participants Elec. Supply Costs Net Participants Incr. Capital Cost Program Operations Cost Program Incentives Paid to "Free Riders"

Necessary to the calculation of these tests are the impacts on load (peak demand and annual energy), customer bills, and Ameren Missouri supply costs.

Q. How was the load impact of each technology determined?

A. The demand and energy impact of each technology was developed from a variety of sources including previous technology metering studies, impact studies, manufacturer information, and engineering calculations. For each technology, the kW impact on customer billing demand and on Ameren Missouri system peak demand was determined separately, as illustrated starting on page 20 of Schedule DP-D2.

Q. How was the impact of Ameren Missouri Peak Demand determined?

A. The average hourly load of each technology was calculated during the hours of Ameren Missouri system peak. For this analysis, the hours of Ameren Missouri system peak were defined as any time that the load exceeds 85% of the annual system peak hour load. In general, the Ameren Missouri system peak period is most likely to occur between 1 p.m. and 7 p.m. on weekdays in June through September.

Q. How was the impact on customer bills and Ameren Missouri Revenue determined?

A. The load associated with adding each technology to a representative customer load profile was priced out using actual tariffs. In contrast to using average rates, this approach has the effect of accurately capturing impacts on customer demand charges and energy billing blocks.

Q. How were the incremental costs of supplying electricity determined?

A. Ameren Missouri provided capacity and energy cost values for each of the next 20 years. This included separate costs for transmission, distribution, capacity, and

energy. In addition, capacity reserve margins and line losses were accounted for. The costs used are the same as the avoided costs used in Ameren Missouri's 2017 Integrated Resource Plan.

Q. What are the cost effectiveness test results for each technology?

A. Table 2 summarizes the cost-effectiveness of each individual technology.[7] As shown in Table 2, every technology has a RIM and mTRC benefit cost ratio greater than 1.0. That is to say, every technology evaluated will reduce average rates and will reduce the total amount of resources necessary to provide the service.

[7] For the purposes of Table 2, no program costs or incentives are assumed, and a 1.0 net-to-gross ratio is assumed. The overall program cost-effectiveness results presented later in this testimony include these items.

Hearing Exhibit 10 See Revised Table 2 for Revised Table 2

Table 2.

Sector	Technology	Benefit Cost Ratio			Net Benefit		
		RIM	PCT	mTRC	RIM	PCT	mTRC
Material Handling	Forklift-Conventional	1.6	2.9	4.4	$3,395	$24,925	$33,239
	Forklift-Rapid	3.1	1.2	3	$18,885	$5,767	$28,879
	TRUs	4.4	2.3	9.2	$11,263	$25,685	$43,234
	TSE	3.6	4.7	18.4	$6,288	$46,318	$77,495
Airport	Push-backs	5	1.5	9.3	$9,614	$9,045	$30,529
	Tug/Tow Tractors	3.8	1.7	5.4	$10,502	$10,962	$25,367
	Belt Loaders	2.5	2.9	15.2	$989	$10,201	$14,656
	GPUs	1.9	1	1.8	$49,686	$1,218	$66,673
Port	Port Cranes	1.9	1.1	1.8	$323,721	$51,269	$549,401
	50T Crane	2.2	0.9	2.9	$92,922	($27,854)	$256,013
	Drayage Trucks	5.1	1	10.5	$38,883	$7,104	$135,335
Mining	People Movers	3.5	2.8	7.4	$23,686	$72,901	$87,873
	Drills	2	2	4.8	$233,685	$655,164	$1,501,476
	LHD	3	1.2	5.8	$64,720	$49,996	$219,637
	Roof Bolters	2.4	0.8	4.1	$70,168	($84,065)	$239,638

Table 2 also sets forth the net benefits provided by a single technology. For example, a single conventional forklift can be expected to provide $3,395 worth of net benefits to Ameren Missouri and its customers, to reduce the owner's net costs by $24,925, and to reduce the total amount of resources used by that forklift by $33,239 over its lifetime. Note that at this time, Ameren Missouri is proposing to include only Material Handling

and Airport technologies in order to test customer acceptance of the program and to build the infrastructure necessary to manage the program.

Q. Please describe the method used to forecast program participation.

A. Program participation depends primarily on the size of the existing market, the rate of retirement of existing equipment, the growth rate of the market, the incremental cost of electric equipment compared with fossil fuel equipment, the impact of incentives in driving down cost of ownership, and the impact of program sales, marketing, and technical support.

The program participation was estimated for each electric technology based on the incremental cost, the incentive level, and the current market penetration of the electric version of the technology. In addition, experience from participation in similar programs was factored into the estimates.

To inform this analysis, 9 local forklift dealers were interviewed regarding the forklift market, and 3 of the local dealers provided county level forklift sales data from the Industrial Truck Association ("ITA") for counties within Ameren Missouri's service territory. These county sales data were prorated by an estimated percent of each county served by Ameren Missouri. In addition, local TRU dealers were interviewed about the local TRU market, and company fleet data was purchased from FleetSeek for companies located within Ameren Missouri's service territory. TRU participation was informed by similarly prorated data from the Federal Highway Administration Freight Analysis of Truck Body Types and 2012-2015 Federal Highway Administration state truck tractor registration data. Interviews were conducted with St. Louis International Airport and Doe Run mine, and truck stop information sites were used to obtain a list of truck stops within

Ameren Missouri's service territory and a count of overnight parking spots. The lists were cross referenced with Google maps satellite images to verify locations and parking spot counts. In addition, the Department of Energy Alternative Fuels Data Center list of U.S. Truck Stop Electrification Locations was used to determine existing TSE within Ameren Missouri's service territory. Finally, the port executive director at the Southeast Missouri Regional Port and the U.S. Army Corps of Engineers at the St. Louis Port were interviewed for information regarding existing port equipment.

Q. What participation rates do you forecast?

A. It is anticipated that approximately 177 pieces of equipment will participate in year 1, ramping up to 703 pieces in years 4 and 5. The total number over 5 years is anticipated to be 2,465.

Q. Did you assume that all participants in the program would not have chosen an electric technology without the program?

A. No. Although the program requirements are designed to limit participation by participants who receive an incentive but would have chosen the electric option even without an incentive, the program analysis only includes the benefits of 80% of the participants.

Customers who are replacing existing electric equipment with new electric equipment are not eligible to participate. Only customers who are replacing fossil fuel units, expanding a fleet, or buying their first piece of the equipment are eligible to participate.

Q. What customer incentives will the program offer?

A. The initial incentives take into consideration two factors: 1) the incremental cost of the electric technology over the alternate technology, and 2) the value of incremental sales to Ameren Missouri and its customers. For budgetary purposes, the incentives have been set by averaging "40% of the incremental cost" and "incremental annual kWh x $0.05". This results in the average incentive across all technologies being equivalent to 30% of the incremental cost. Ameren Missouri will continuously monitor the effectiveness of this incentive strategy and revise as necessary.

Q. What is the overall impact and cost effectiveness of the proposed program?

A. The program is anticipated to increase: total sales over 20 years by ~~630,488~~ 596,774 Corrected MWh; peak demand by a maximum of 1.9 MW; and annual revenue by $5.3 million. As earlier, noted, the RIM benefit cost ratio is ~~1.63~~ 1.81 and the mTRC benefit cost ratio is ~~3.47~~ 3.29. Details of these impacts are provided in Schedule DP-D2.

Q. Does this conclude your direct testimony?

A. Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Approval of Efficient Electrification Program.	))))	File No. ET-2018-0132

AFFIDAVIT OF DAVID K. PICKLES

STATE OF MISSOURI)
) **ss**
CITY OF ST. LOUIS)

David K. Pickles, being first duly sworn on his oath, states:

1. My name is David K. Pickles; my office is located in Plano, Texas and I am Senior Vice President of ICF Resources, LLC.

2. Attached hereto and made a part hereof for all purposes is my Direct Testimony on behalf of Union Electric Company d/b/a Ameren Missouri consisting of 19 pages and Schedule(s) DP-D1 and DP-D2, all of which have been prepared in written form for introduction into evidence in the above-referenced docket.

3. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded are true and correct.

DAVID K. PICKLES

Subscribed and sworn to before me this 16 day of February, 2018.

Notary Public

DAVINA TAYLOR
Notary Public, State of Texas
Comm. Expires 11-14-2021
Notary ID 131361044

My commission expires

David Pickles

ICF

SENIOR VICE PRESIDENT

EDUCATION

Master of Science Degree in Regulatory Economics, University of Wyoming, Laramie, Wyoming, 1988
Bachelor of Science Degree in Economics, University of Wyoming, Laramie, Wyoming, 1986

EXPERIENCE OVERVIEW

Mr. Pickles serves as a Senior Vice President for the Commercial Energy Practice, where he is responsible for project execution, business development, and management. He also oversees all ICF projects related to beneficial electrification. Mr. Pickles has over twenty five years experience as a regulator, utility senior executive, and industry consultant focused on demand side management. Experienced with DSM program design and management, product assessment and business planning, marketing, operations, rate making, and regulatory policy he has helped numerous pubic and private sector clients evaluate and implement over 100 individual DSM programs and provided testimony as an expert witness on over 20 occasions.

PROJECT EXPERIENCE

DEMAND SIDE MANAGEMENT PROGRAMS, POLICY, AND IMPLEMENTATION

Oversaw the analysis, development, and introduction of beneficial electrification programs at Centerpoint, Entergy, JEA, Alliant, and SRP.

For a confidential Southwestern electric utility, provided a detailed assessment of DSM cost recovery mechanisms including financial modeling of alternative DSM cost recovery, lost margin, and shareholder incentive mechanisms.

For Entergy, provided an overview of energy efficiency shareholder incentive and lost margin recovery mechanisms, developed regulatory filing documents and represented the company in stakeholder and regulatory meetings.

For the Maryland Energy Administration, provided an analysis of DSM program cost recovery and rate making practices, including assessment of potential models and utility oversight practices.

For, Hawaii Electric Light Company, provided screening of potential DSM programs and rate designs, detailed cost-effectiveness analysis, program design and implementation guidelines, review of cost recovery and incentive mechanisms, and preparation of regulatory filing documents.

For Arizona Public Service, provided testimony regarding the appropriate recovery of DSM program cost, lost margins, and shareholder incentives.

For Oncor and CenterPoint provided DSM cost recovery and shareholder incentives programs design for submission to the Public Utility Commission of Texas.

For SCANA, provided DSM potential analysis and testimony regarding the ability of DSM to defer the need for a nuclear power plant.

Developed DSM program filings (including DSM potential, detailed program designs, regulatory filing and benchmarking documents) for the Southern Maryland Electric Cooperative.

Developed DSM program filings (including DSM potential, detailed program designs, regulatory filing and benchmarking documents) for the electric and gas service territories of We Energies (Wisconsin).

For Progress Energy Carolinas, developed a DSM market potential study in North and South Carolina.

Drafted the energy efficiency chapters of Texas state energy plan on behalf of the Texas Governor's Office.

Developed DSM program filings (including DSM potential, detailed program designs, regulatory filing and benchmarking documents, and full implementation services) for Baltimore Gas and Electric.

Facilitated the efforts of the North American Energy Standards Board to develop ANSI certified standards for DSM planning and evaluation.

Supported the State of Delaware in the analysis and introduction of a Sustainable Energy Utility.

For Delmarva Power and Light, estimated achievable DSM savings potential over a 25 year planning horizon and prepared the IRP filing, answered data requests, and participated in regulatory proceedings.

For Potomac Energy Power Company, developed three-year DSM implementation plans for service territories in Maryland and the District of Columbia. Assistance included evaluating programs for cost effectiveness by accounting for customer counts, demographics, and avoided costs unique to each territory and assisting in the preparation of budget estimates and forecasting of participation and load impacts. Prepared regulatory filing documents and participated in hearings before the Maryland Public Service Commission.

For Exelon, Mr. Pickles provided detailed energy efficiency program design guidelines and implementation plans for a commercial lighting rebate program and a residential air conditioning tune-up program.

For Maui Electric, Mr. Pickles provided DSM program screening, cost effectiveness evaluation, and program design and implementation guidelines.

For Centerior DSM Collaborative Mr. Pickles provided a review and analysis of the structure and procedures of a diverse collaborative, developing recommendations for process improvements.

For Iowa-Illinois Gas & Electric, reviewed all DSM implementation activities. Mr. Pickles analyzed Iowa-Illinois' implementation activities for consistency with administrative rules and regulatory expectations.

For Peoples Natural Gas, developed an energy efficient customer financing program. Provided program design and analysis for a customer financing program in multiple states, including program design, solicitation of banks and other financial institutions, contract negotiation, and implementation procedures.

For a consortium of utilities, including: Consolidated Edison, Southern Indiana Gas and Electric, Tucson Electric, and Hawaiian Electric, reviewed energy efficiency financing programs. Included an analysis of the structure and risk profiles of potential financing techniques, a best practices review of the financing programs of other utilities and other industries, market research including conjoint analysis, and development of program design recommendations.

Assessed energy efficiency new business opportunities, including financing and leasing. Assisted in the market research (focus groups, conjoint survey) and managed a project to determine competitive activities in financing, new business planning methodologies, and forecasted profitability for new business ventures.

For Florida Power Corp, developed a DSM financing program including financial structure and process flows.

For Carolina Power and Light, surveyed energy efficiency financing programs. Provided a survey and best practices review of utility financing programs.

For a confidential Midwestern utility, assessed the potential for customer financing programs to provide customer acceptance consistent with that of simple subsidies and rebates. This project included an analysis of the DSM and marketing goals of the utility, an analysis of the change in economic benefit under financing, a review of acceptance experienced by other utilities, and recommendations for program design.

For multiple clients, prepared an analysis of innovative DSM in a competitive environment. Mr. Pickles provided a summary and analysis of innovative approaches to allocating and collecting the economic costs of DSM programs from program participants and non-participants. This project includes a survey of all state regulatory commissions and selected utilities, and a comparative analysis of rate impacts, effectiveness and equity.

For Wisconsin Public Service, Mr. Pickles provided a comparative analysis of DSM rebate and DSM loan programs to assess the ability of each to address regulatory goals and to identify the optimal design elements of DSM financing programs.

For Indiana Municipal Power Agency, assessed the rate and revenue impacts of DSM programs. Mr. Pickles provided revisions to IMPA's DSM programs, and provided detailed analysis of the timing and level of rate impacts and revenue fluctuations.

For Hawaii Electric Company, provided a screening of various potential energy efficiency rate designs (including time-of-use rates, interruptible rates, and stand-by generation rates.) Based on the results, Mr. Pickles developed detailed rate designs and implementation plans for the selected rates, and prepared regulatory filings.

For Guam Power Authority, provided an analysis and design of avoided cost based time-of-use and interruptible rates. Mr. Pickles designed and evaluated TOU rates for all customer classes and large customer interruptible rates based on application of avoided costs.

NEW BUSINESS AND PRODUCT PLANNING

In more than 10 assignments for energy and utility companies, Mr. Pickles performed new product ideation, characterization, screening, business model creation, market assessment, business plan creation, and provided varying levels of support in obtaining funding, negotiating joint ventures, creating operating plans, identifying acquisition targets, and related start-up activities.

For, Electric Power Research Institute (EPRI) provided an analysis of potential new revenue opportunities for electric utilities. Principal author of the EPRI report *New Service Opportunities for Electric Utilities.*

For a large utility holding company, helped redefine the product development and funding process, developing new standards and procedures for business model assessment and new enterprise management.

For Commonwealth Edison, Mr. Pickles provided an analysis and market potential screening for a wide range revenue and load growth technologies and programs.

For a confidential client, Mr. Pickles developed an assessment of new business opportunities. Performed market research (focus groups, conjoint survey) and managed a project to determine competitive activities in non-traditional service, to assess new business planning methodologies, and forecast profitability for new business ventures.

For a large municipal energy organization, provided an overview of the market potential and business requirements for a wide range of new products and services. Created an operating framework for the selected new venture and helped identify and negotiate with a joint venture partner.

For Ameren, Mr. Pickles provided a redesign of their new business development process and investment decision making process. He established decision criteria, stage gates, hurdle rates and standards for

investment. He also institutionalized this process by assessing two potential new products, performed due diligence and participated in senior management evaluation process of acquisitions.

For a private equity fund, provided an assessment of their investment in an energy management outsourcing company and recommended a revised business model and infrastructure.

For a large real estate investment trust, Mr. Pickles represented senior management in negotiations with a utility to form a joint venture to provide facilities management outsourcing. He assessed core capabilities, contract structure, allocations of risk, control, dissolution, and related issues.

For a confidential utility, conceived and introduced a new product offering involving energy equipment ownership, maintenance, and energy supply. Developed an innovative program wherein price is indexed to measures of customer profitability. Established procedures for managing risk and for sharing benefits of retail access with customers while retaining rights to commodity supply.

For a utility affiliate, developed and introduced end-use pricing (chauffage) program. Obtained $50 million equity commitment from holding company for customer premise equipment and negotiated two such contracts. Integrated energy rights marketing into such contracts providing for agency rights over energy supply.

For a confidential real-estate holding company, established strategy for entering energy services business and performed target identification and acquisition analysis of energy service and energy information companies. Also determined bid price(s) and negotiation strategy.

For a consortium of utilities, managed a multiclient study of customer financing programs, including an analysis of the structure and risk profiles of potential financing techniques, a best practices review of the financing programs of other utilities and other industries, market research including conjoint analysis, and development of program design recommendations.

For a confidential utility Client, developed a business plan for two-way customer communications, CATV, telephony, and other information services in conjunction with utility service. This project included an analysis of the costs and operational savings of potential system configurations, customer acceptance, and related items.

For a confidential client, participated in the valuation and development of a revised business model and growth plan for an energy service subsidiary. Assessed strategic issues (such as product line, sectors, etc.) and tactical issues (e.g., cash management, pricing, etc.) Provided assessment of energy information and automation markets, distributed generation, and related products. Developed new management and staffing structure.

For a water heater manufacturer, developed a business plan for a turn-key financing program. Developed a water heater financing/leasing program to be offered nationally in conjunction with participating utilities. This project included program design, role of financial institutions, marketing approach, and related tasks.

For a utility affiliate, developed integration and bidding strategy for combining commodity supply (in deregulated markets), performance contracting, financing, consolidated billing, and energy information services. Managed the development of joint bids with power marketing subsidiary and secured contracts.

DEAL FLOW & DUE DILIGENCE

For a private equity fund, provided an investigation of potential investments in energy sector technology and outsourcing ventures. Provided business assessment and development, market research, deal structuring, and start-up services.

For a large holding company, prepared for entry into the electrical contracting business. Developed business model, identified acquisition targets, performed valuation and due diligence, participated in negotiations, and developed integration and operations procedures.

For a $600 million venture capital investment fund, provided energy sector investment advice and deal-flow. Provided analyses of energy markets and business plans. Developed investment processes, provided analysis of management teams, and supported due-diligence and deal structuring. Assisting portfolio companies with start-up issues and keiretsu relationships.

For an investment bank, obtained additional investors for spin-out of an energy and home automation subsidiary. Reviewed Offering Memorandum, solicited investors in the U.S. and Europe, and helped structure the deal.

For a confidential client, provided identification of potential acquisition targets, profiling, analysis of potential synergies, assessment of integration issues, recommended deal terms.

For a utility, defined the approach and led a client team in an assessment of a potential acquisition. Activities included analysis of management team, process mapping, competitive analysis, development of comparables and deal structure, strategic review, due diligence (legal, HR, IT), customer interviews, and related activities.

For a large energy sector investment advisor, assisted in the establishment of a new fund to acquire distressed energy sector assets. Assessed potential strategic partners, market potential, fund structures, and acquisition targets.

BUSINESS UNIT EXECUTIVE MANAGEMENT

Led turn around team for a $100M/year struggling energy services business. Performed valuation, management assessment, developed new strategic plan, assessed business processes and funds management. Developed new processes for guarantee management and bonding and assessed growth path and ability to make and integrate acquisitions.

Led turn around team for a $30M/year energy services businesses. Developed new value propositions, marketing plan, sales processes, and contracting procedures. Prepared business plan and developed partners and equity sources for an MBO.

For a confidential utility client, conceived and led a 16-member team in the development of a business plan, securing of funding, development, and introduction of an advanced energy information system. Negotiated profit sharing venture with leading information technology provider and brought product from concept to commercial availability in 11 months.

For a private Internet company, determined all aspects of an aggregation and building portal designed to create purchasing communities for the occupants of large office and multi-family buildings. Raised funding, negotiated venture capital agreements, set requirements, oversaw development, and supervised sales.

OPERATIONS

For a confidential energy client, determined market channel strategy and negotiated sales alliances and distributorships with several companies, including power marketers, one of the nation's largest property management companies, a telecommunications company specializing in the office building market, and an electrical contractor. Established wholesale and shared margin relationships.

For a confidential energy client, developed all aspects of corporate marketing strategy including print, television and radio. Introduced disciplined market research into business planning and operations process. Pioneered use of conjoint studies and competitive intelligence in establishing pricing. Introduced observational market research for purposes of identifying new product opportunities.

Determined wholesale marketing strategy and identified competitive targets for the economic development and wholesale marketing rates of a confidential client. This project included a high level

analysis of approximately 400 potential targets based upon prices currently paid, the cost structure of their current supplier, potential receptiveness to energy services, and other criteria.

For a utility affiliate, established channel strategy and led negotiations with the world's largest manufacturer of HVAC equipment to co-market energy information systems both domestically and abroad. Relationship includes integration of complementary information systems and co-branding.

For a confidential client, established branding strategy and led negotiations with the world's largest manufacturer of building controls to private label energy systems in certain market segments. Relationship provides for extensive support services (implementation, training, and operations), profit sharing, market exclusivity, and product co-development.

For a utility affiliate, oversaw transition of previously regulated National Account Managers to unregulated business. Developed training program and established code of conduct. Developed market based compensation structures.

For a utility affiliate, developed, in conjunction with an investment bank, bidding strategy and acquisition analysis of large independent energy service company. Extended framework to perform ongoing shareholder value analysis of the acquirer and used this model to establish business planning guidelines.

For a utility affiliate, recruited and trained sales staff from outside the utility industry, set and administered sales goals and methods. Oversaw the development of a lead identification, sales tracking, and contact management system.

For a utility affiliate, led team of business analysts and attorneys in development of contracts for performance contracting, energy information services, chauffage, distributorships, joint ventures, and other business structures.

EMPLOYMENT HISTORY

ICF International	Senior Vice President	2010-date
ICF Consulting	Vice President	2004-2010
Navigant Consulting	Director, Market Strategy	2000-2003
PHI Management Consultants/Honeywell	Principal, Chief Technology Officer	1999–2000
EnerShop, Subsidiary of Central & South West Services	Vice President Marketing, Development, and Operations (Officer)	1996–1999
Synergic Resources Corporation	Director, Pricing & Product Development	1992 - 1995
Iowa Office of Consumer Advocate/Iowa Utilities Board	Utility Specialist/Senior Analyst	1988-1992

Ameren Missouri
Beneficial Electrification

Opportunity Assessment: Cost Benefit Analysis & Implementation Plan

Prepared for:
Ameren Missouri

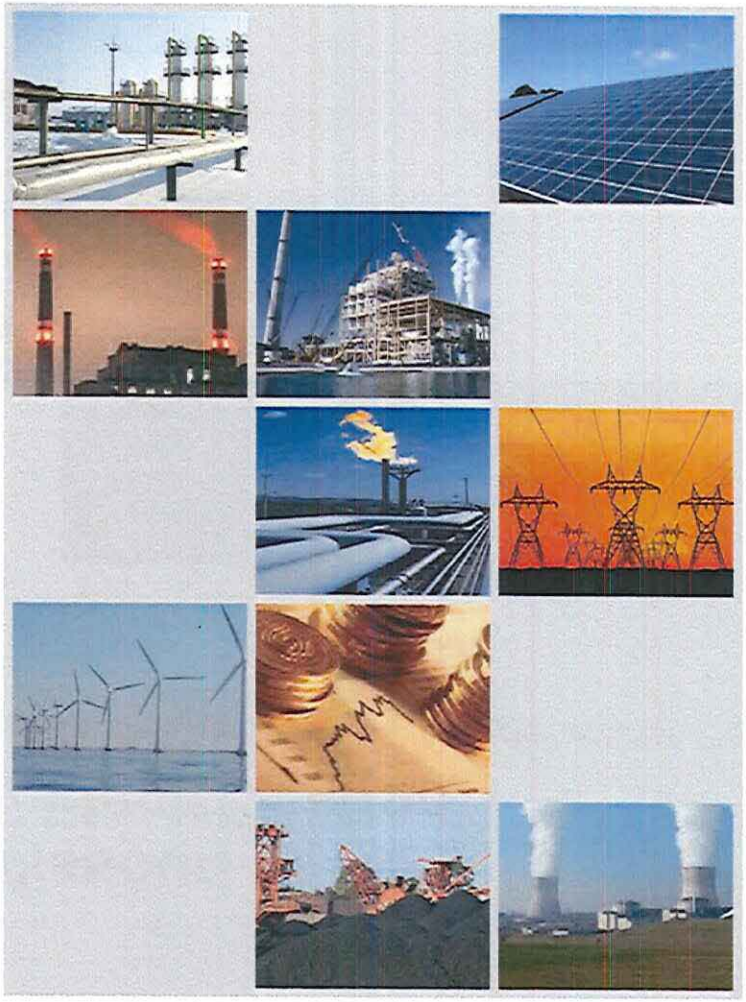
Prepared by:
ICF

02/12/18

SCHEDULE DP-D2-1

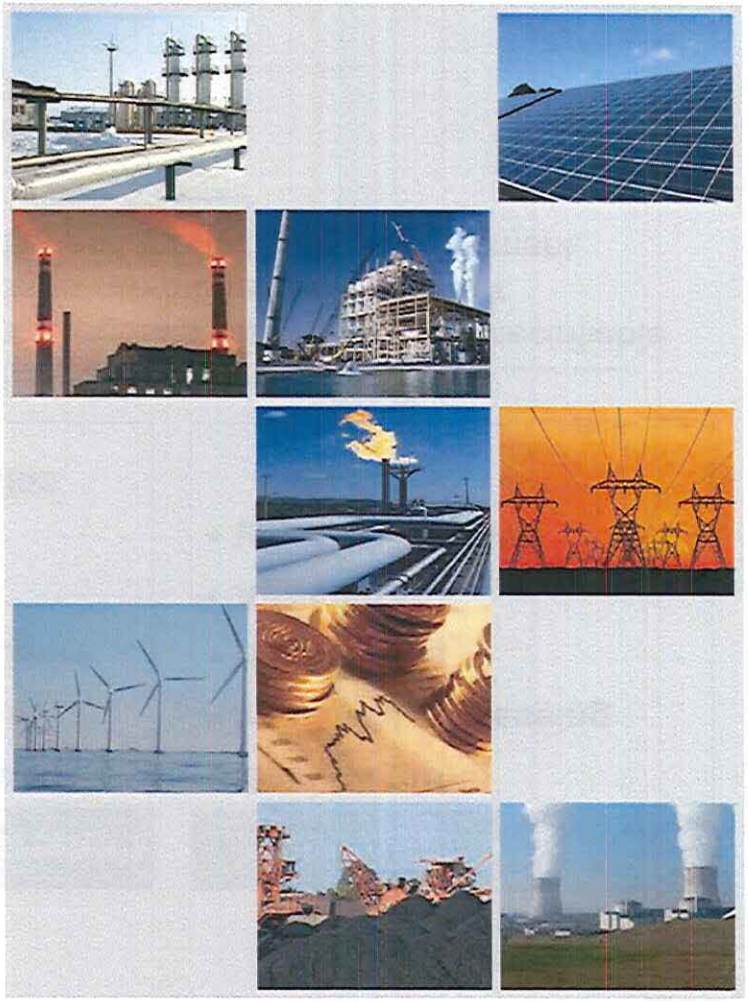
Agenda

- Beneficial Electrification Overview
- Market Assessment
- Cost Benefit Analysis
- Implementation Plan
- Technology Appendix



Agenda

- **Beneficial Electrification Overview**
- **Market Assessment**
  - Updates & Results
- **Cost Benefit Analysis**
  - Cost Benefit Analysis Process and Tests
  - Technology Load Profiles
  - Single Unit Impacts
  - Incentives and Penetration Rates
  - High Level Program Budget Estimates
  - Net to Gross Ratio
  - Potential Program Results
- **Implementation Plan**
  - Program Launch Schedule
  - Program Implementation Strategy
  - Marketing Plan
  - Data Integrations
  - Pipeline Development
  - Stakeholder Training
  - Ongoing Program Operations
- **Technology Appendix**



WHAT IS IT?

Electrification Opportunities

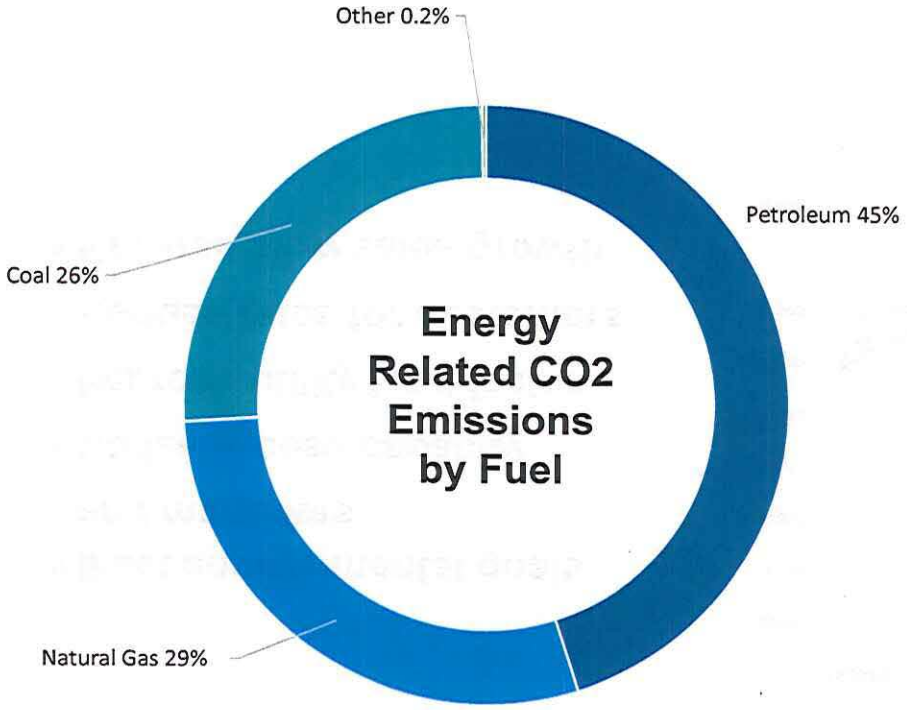
On Road Transportation	Non-Road Transportation	Other Applications
▪ Battery electric vehicles	▪ Marine/port equipment	▪ Manufacturing
▪ Plug-in hybrid vehicles	▪ Industrial equipment	▪ Industrial processing
▪ Transit vehicles	▪ Airport ground support equipment	▪ Heat pumps
▪ Goods movement	▪ Material handling	▪ Agriculture
	▪ Recreational Vehicles	▪ Lawn and garden

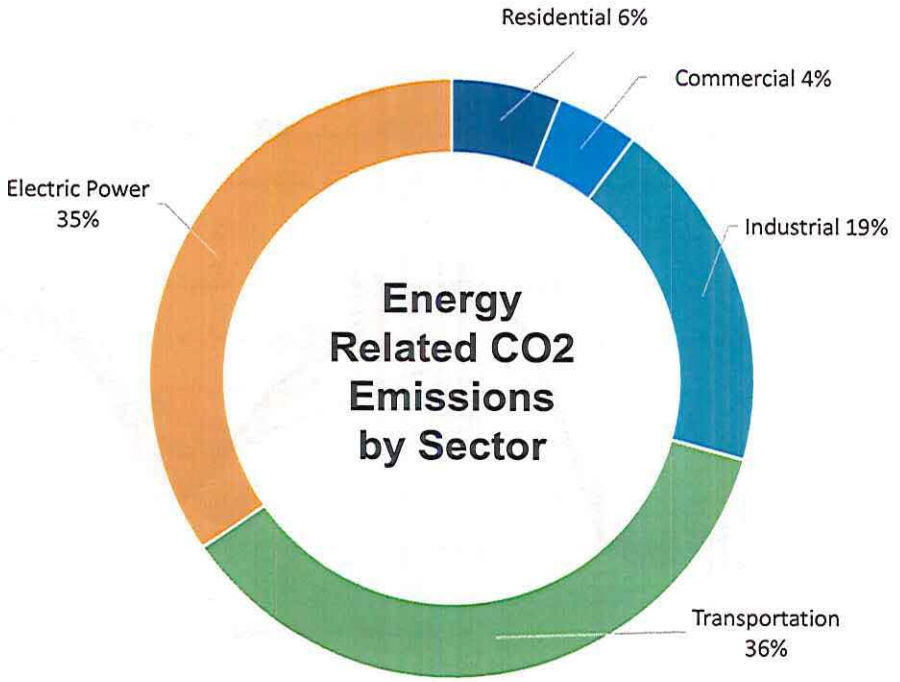
Off-road transportation categories with the highest electrifiable potential are forklifts, ports/intermodal facilities, truck refrigeration units, and airport ground support equipment.

Source: Environmental Assessment of a Full Electric Transportation Portfolio: Volume 2: Greenhouse Gas Emissions. EPRI, Palo Alto, CA: 2015

WHAT IS DRIVING IT FROM A NATIONAL PERSPECTIVE?

Emissions by Fuel Type and Sector





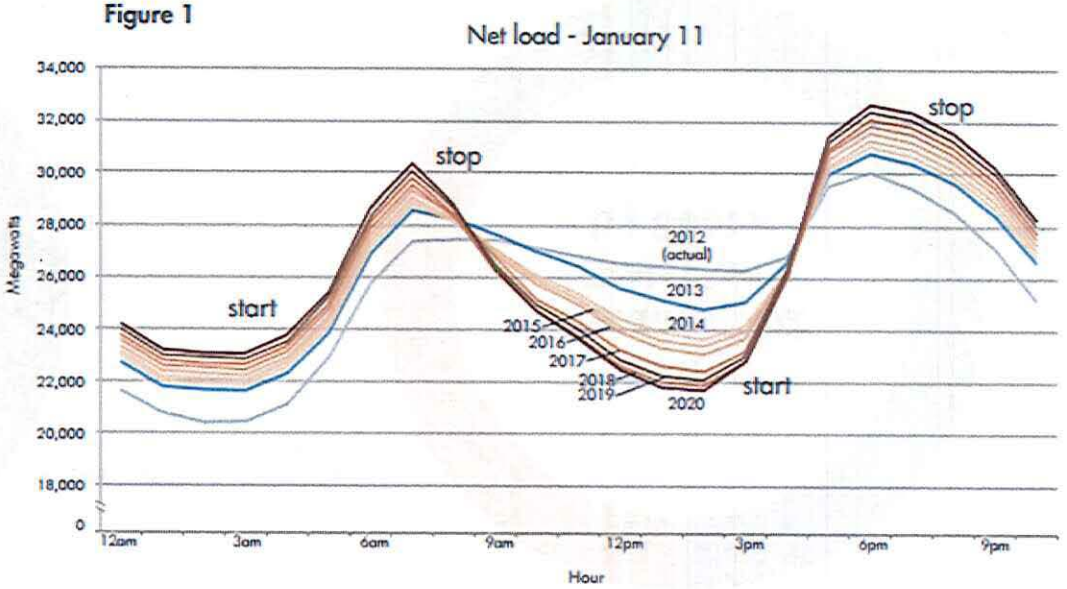
"Energy Related CO2 Emissions by Fuel" Source: Energy-Related Carbon Dioxide Emissions by Sector and Source, U.S. Energy Information Agency, 2016
"Energy Related CO2 Emissions by Sector" Source: U.S. Energy Information Agency, Monthly Energy Review, Energy Consumption by Sector, July 2017

HOW DOES IT ALIGN WITH UTILITY BUSINESS DRIVERS?

Utility Perspective

- **Meet environmental goals and mandates**
- **Utilize excess capacity**
- **Improve utility load factor**
- **Reduce rates for customers**
- **Reverse slow sales growth**

Figure 1



"Figure 1" Source: What the duck curve tells us about managing a green grid, California ISO, 2016

CASE STUDY: NON-ROAD TRANSPORTATION

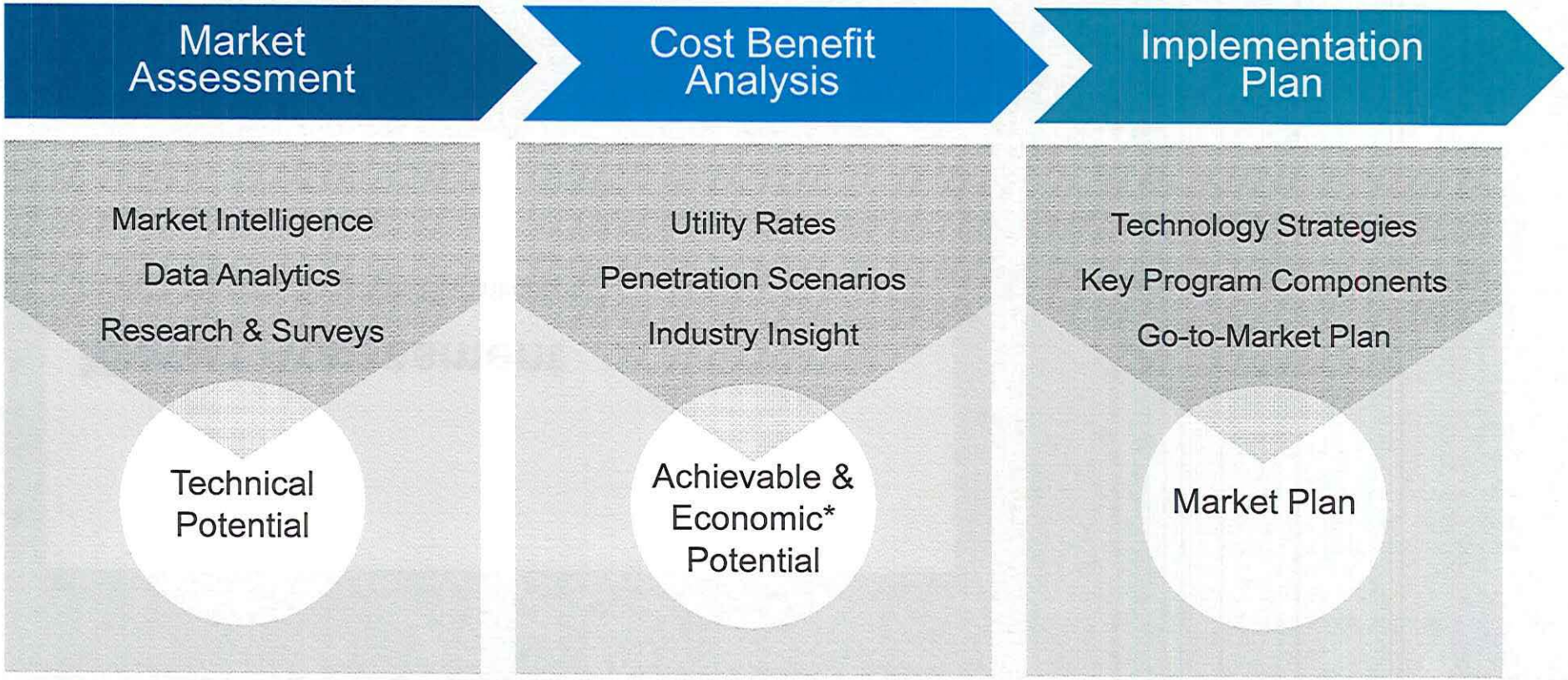
Non-road Electrification Opportunities

- **Battery electric power for on-site mobile equipment**
- **Continuous power for stationary material handling equipment**
- **Auxiliary power for vehicles and vessels at the dock or in port**

Electrification programs across the U.S.

Company	Territory	Program Type
CenterPoint Energy	TX	Forklifts, pipeline compression, port electrification
Entergy	AR, TX, LA, MS	Electric irrigation pumps
Southern Company	AL, GA, MS, FL	Forklifts, irrigation, mining equipment, commercial cooking
TVA	AL, GA, KY, MS	Forklifts, airport ground support equipment (GSE)
JEA	FL	Forklifts, truck refrigeration units, truck stop electrification, airport (GSE), marine/port cranes
Alliant Energy	IL, WI	Truck refrigeration units, forklifts

Beneficial Electrification Opportunity Assessment Process



Market Assessment

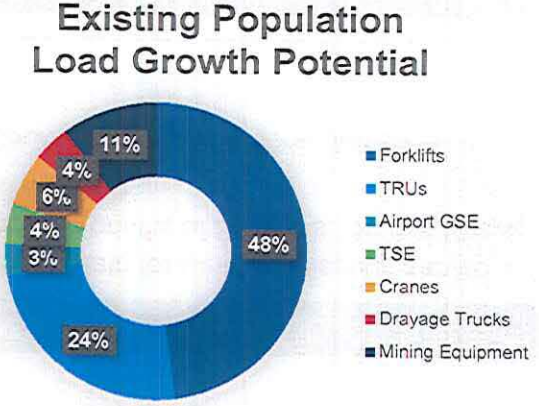
Ameren Missouri Beneficial Electrification

Updates and Results

- **Truck Stop Electrification**
  - Applied a max % of parking spots typically converted at electrified truck stops: 30% (source: DOE Alternative Fuels Data Center Data)
- **Mining Equipment**
  - Adjusted deemed demand and electricity values (source: purchased InfoMine data for underground mine equipment)
- **Airport GSE**
  - Original table was pulling value from total population, not total population less the equipment that is already electric

Updated Technical Potential Summary

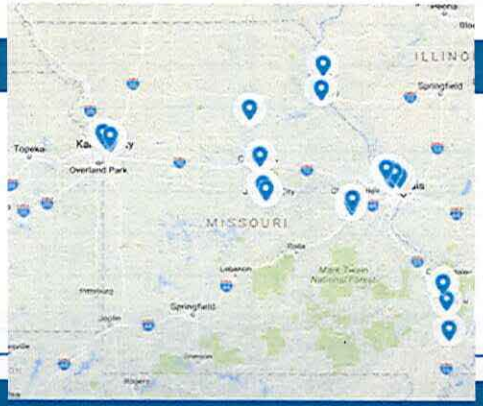
	Existing Population			
	Units	Demand (MW)	Annual Electricity (MWh)	Lifetime Electricity (MWh)
Forklifts	3,448	40	93,441	1,121,290
TRUs	3,169	29	47,535	570,420
Airport GSE	176	2	6,543	65,425
TSE	1,237	4	8,585	171,696
Cranes	56	7	11,100	166,500
Drayage Trucks	150	2	7,500	75,000
Mining Equip.	146	11	20,310	219,800
TOTAL	**8,382**	**93**	**195,013**	**2,390,130**



Forklifts Analysis Summary

FORKLIFT DEALERS

- 17 Dealers
- 26 Locations
- 9 Interviewed
- 3 Provided ITA Data



DATA SOURCES

- ITA 2016 Forklift sales data for Ameren Missouri served Counties (provided by Forklifts of St. Louis, Heubel Shaw, and Wiese Forklift dealers)
- Estimated % of County Served by Ameren Missouri

RESULTS

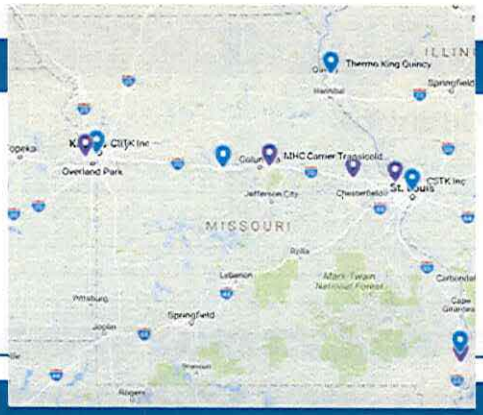
	Annual Sales - Technical Potential				Exisiting Population - Technical Potential		
Forklift Fuel	Units	Convertible Population	Demand (kW)	Annual Electricity (kWh)	Convertible Population	Demand (kW)	Annual Electricity (kWh)
Electric	594						
IC	507	431	4,956	11,678,745	3,448	39,647	93,429,960
TOTAL	1,101						

LOCAL FORKLIFT POPULATION

Truck Refrigeration Unit (TRU) Analysis Summary

TRU DEALERS

- 2 Manufactures
- 10 Dealerships
- 3 Interviewed



DATA SOURCES

- TRU fleet data (FleetSeek)
- 2012-2015 Federal Highway Administration State Truck Tractor Registrations
- 2011 Federal Highway Administration Freight Analysis of Truck Body Types
- Estimated % of Served by Ameren MO

RESULTS

		Annual Sales - Technical Potential			Existing Population - Technical Potential			
	TRUs	100% Diesel TRUs	Demand (kW)	Annual Electricity (kWh)	Electric-Standby TRUs	100% Diesel TRUs	Demand (kW)	Annual Electricity (kWh)
Units	3,360	307	2,763	4,605,000	291	3,069	27,621	46,035,000

LOCAL TRU POPULATION

Airport GSE Analysis Summary

DATA SOURCES

- Saint Louis International Airport Interview
  (STL airport is the only Medium hub in Ameren Missouri's service territory that accounts for between 0.25% and 1% of total U.S. passenger enplanements. Airports with less than 0.25% of total U.S. passenger enplanements will not have significant technical potential)
- EPRI Airport Electrification Report

RESULTS

	Exisiting Population - Technical Potential (assuming all current equipment=diesel)				
	Electric Units	IC Units	Demand (kW)	Annual Electricity (kWh)	Lifetime Electricity (kWh)
Pushbacks/Tugs	-	31	278	399,193	3,991,932
Tow/Baggage Loaders	-	74	692	1,488,251	14,882,510
Belt Loaders	6	54	405	195,912	1,959,120
Ground Power Units (GPUs)	16	17	680	4,460,800	44,608,000
TOTAL	22	176	2,055	6,544,156	65,441,562

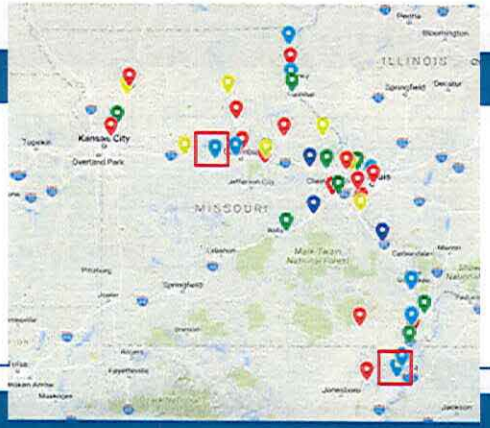
STL AIRPORT GSE FUEL TYPE

Truck Stop Electrification (TSE) Analysis Summary

PARKING SPOTS

- 4 - 25 (17)
- 27 - 67 (11)
- 70 - 95 (10)
- 99 - 150 (10)
- 160 - 450 (5)

Existing TSE (2)



DATA SOURCES

- Truck Stop Information Sites: truckstopinfoplus.com truckstopguide.com
- Google Maps satellite images
- DOE Alternative Fuels Data Center: US Truck Stop Electrification Locations

RESULTS

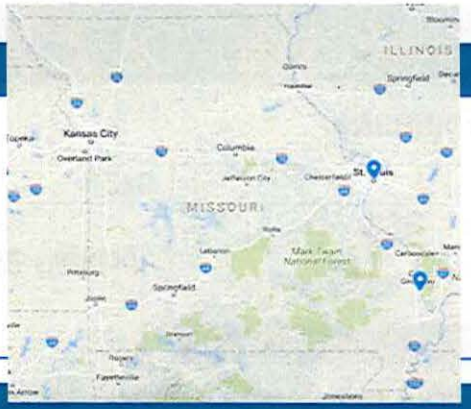
	Existing Population - Technical Potential			
Potential TSE Parking Spots	TSE	NO TSE	Demand (kW)	Annual Electricity (kWh)
1,276	39	1,237	3,711	8,584,780

OVERNIGHT SPOTS WITH TSE

Port Analysis Summary

MAJOR PORTS

- Southeast MO Regional Port (SEMO)
- St. Louis Port



DATA SOURCES

- Southeast Missouri Regional Port:
  - Interviewed Port Executive Director
  - Very limited potential for electrification
- St. Louis Port:
  - Interviewed U.S. Army Corps of Engineers

RESULTS (ST. LOUIS)

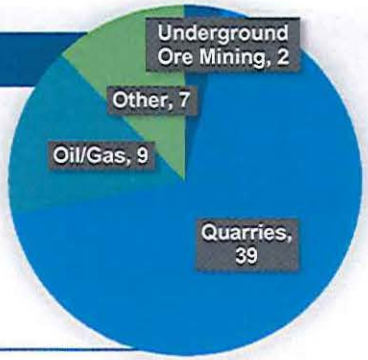
	Exisiting Population - Technical Potential			
	Units	Demand (kW)	Annual Electricity (kWh)	Lifetime Electricity (kWh)
Port Cranes	6	2,100	3,600,000	72,000,000
50T Crane	50	5,000	7,500,000	112,500,000
Drayage Trucks	150	1,500	7,500,000	75,000,000
TRUs	100	900	1,500,000	18,000,000
TOTAL	306	9,500	20,100,000	277,500,000

PORT EQUIPMENT

100% IC

Mining Analysis Summary

Types of Ameren Missouri Mining Customers



AMEREN MO MINING CUSTOMERS

- Doe Run makes up 68% of Ameren Missouri's Mining Customer Electric Usage and has the greatest beneficial electrification technical potential
- 68% of Ameren Missouri Mining customers are quarries with little potential for electric equipment

DATA SOURCES

- Interview and site visits with Doe Run
- Purchased data to determine more accurate deemed equipment values from Infomine, a Global Mining Resource

RESULTS (DOE RUN)

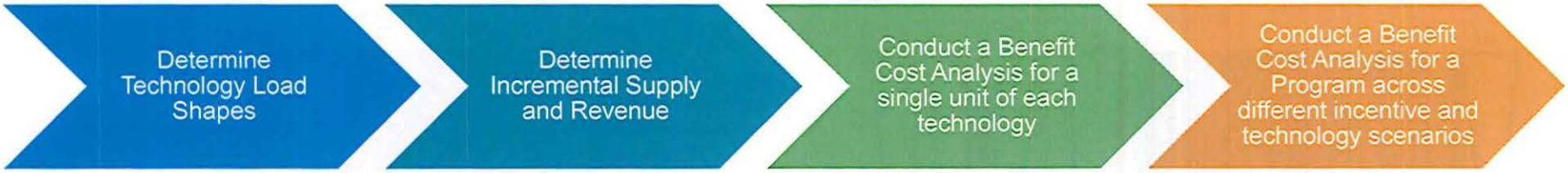
	Exisiting Population - Technical Potential			
	Units	Demand (kW)	Annual Electricity (kWh)	Lifetime Electricity (kWh)
People Movers	100	3,000	5,000,000	40,000,000
Drills	19	4,750	9,500,000	142,500,000
LHD	16	2,080	4,160,000	20,800,000
Roof Bolters	11	1,045	1,650,000	16,500,000
TOTAL	146	10,875	20,310,000	219,800,000

DOE RUN MINING EQUIPMENT

Cost Benefit Analysis

Ameren Missouri Beneficial Electrification

Cost Benefit Analysis Process & Tests



Benefit Cost Tests	Key Question Asked	Benefits	Costs
Ratepayer Impact Measure (RIM)	Will utility rates increase?	Incremental Revenue	Program Incentives Program Overhead Incremental Electricity Supply
Participant (PCT)	Will participants benefit over the measure life?	Incentives Fuel Savings O&M Savings	Incremental Equipment Cost Incremental Electricity Supply
Modified Total Resource Cost (mTRC)	Will the total cost of energy in the utility service territory decrease?	O&M Savings Cost of IC Energy Supply	Net Participants Electric Supply and Net Participants Incremental Capital Cost Program Overhead Program Incentives Paid to "Free Riders"

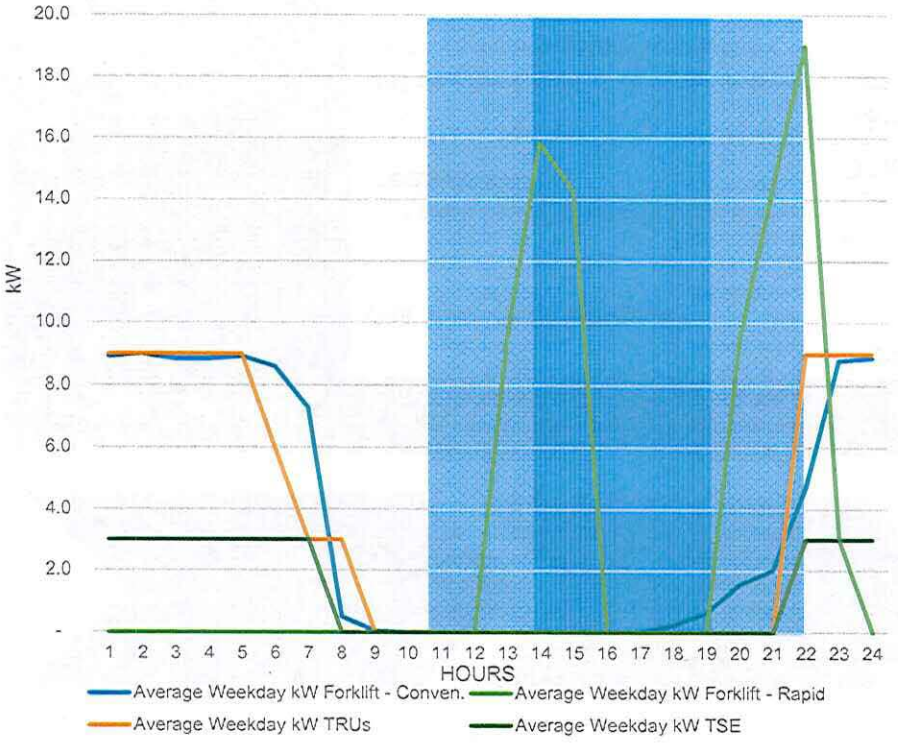
COST BENEFIT ANALYSIS

Technology Load Profiles

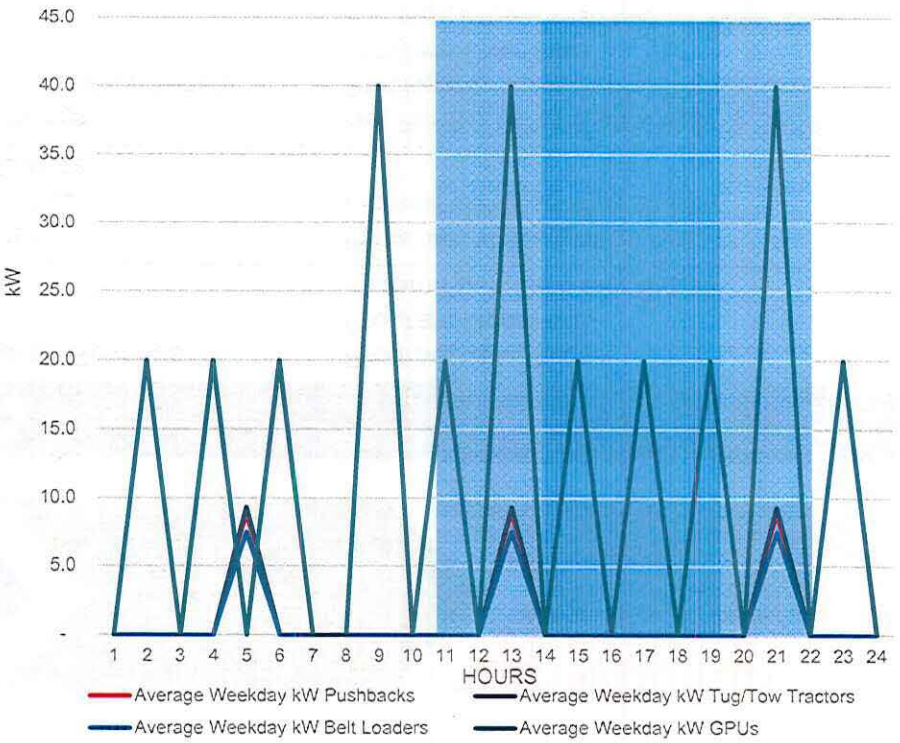
Ameren Missouri Peak

Customer Billing Peak

Material Handling, TRUs, TSE



Airport Ground Support Equipment

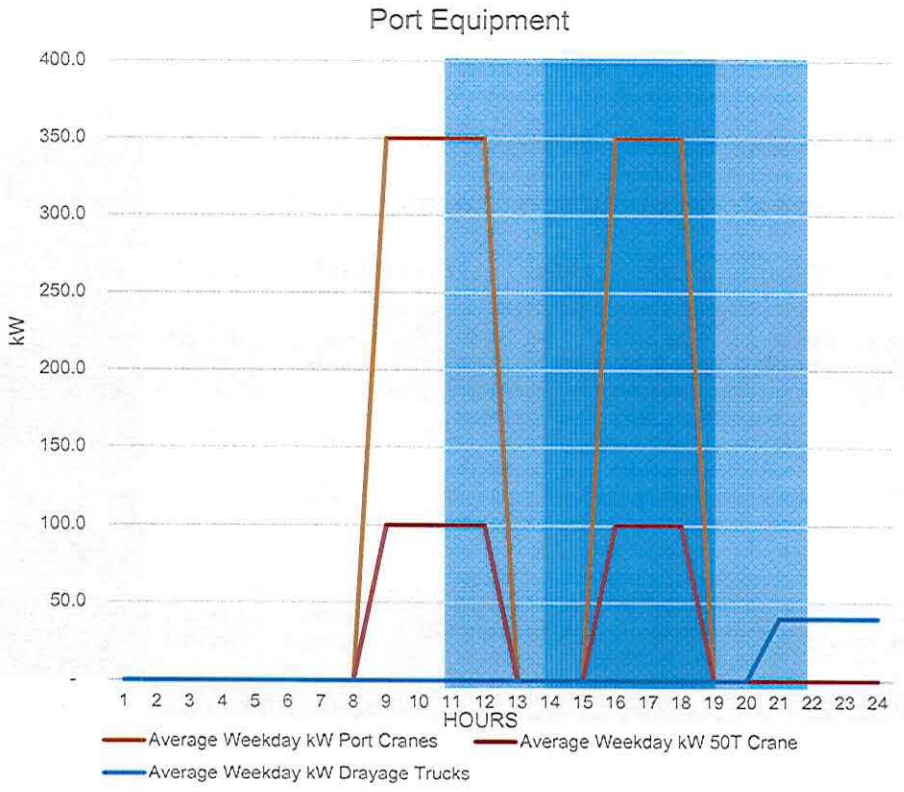


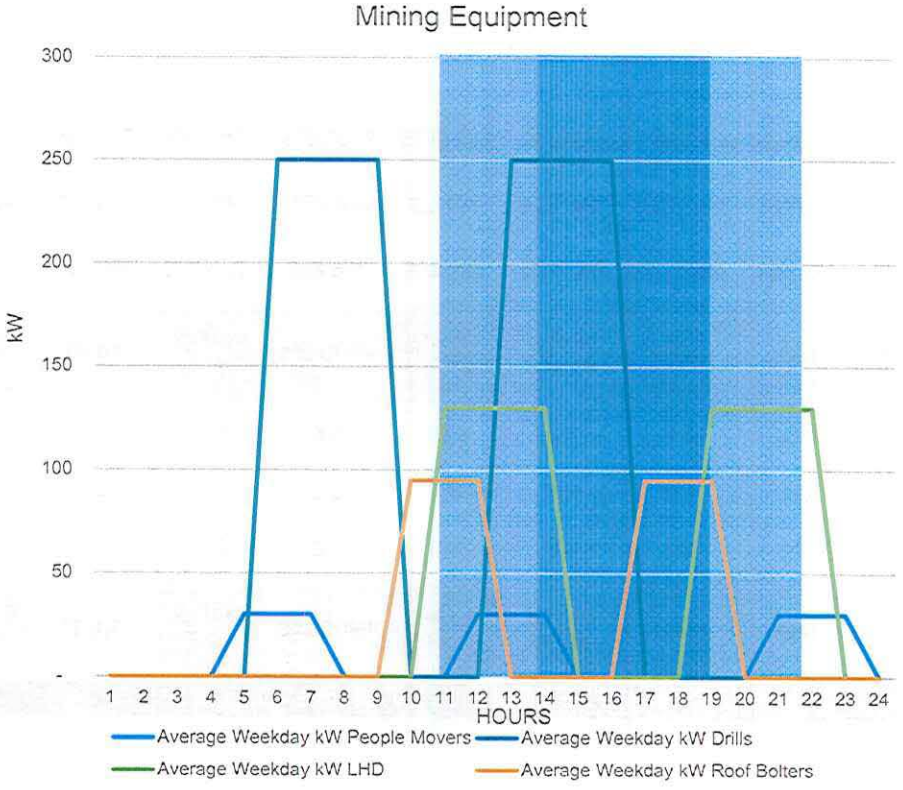
COST BENEFIT ANALYSIS

Technology Load Profiles

Ameren Missouri Peak

Customer Billing Peak





COST BENEFIT ANALYSIS

Single Unit Impacts (no incentive/no program)

	Material Handling				Airport GSE				Port Equipment			Mining Equipment			
Benefit Cost Ratio	Forklift - Conven.	Forklift - Rapid	TRUs	TSE	Push-backs	Tug/Tow Tractors	Belt Loaders	GPUs	Port Cranes	50T Crane	Drayage Trucks	People Movers	Drills	LHD	Roof Bolters
RIM	1.6	3.1	4.4	3.6	5.0	3.8	2.5	1.9	1.9	2.2	5.1	3.5	2.0	3.0	2.4
Participant	2.9	1.2	2.3	4.7	1.5	1.7	2.9	1.0	1.1	0.9	1.0	2.8	2.0	1.2	0.8
mTRC	4.4	3.0	9.2	18.4	9.3	5.4	15.2	1.8	1.8	2.9	10.5	7.4	4.8	5.8	4.1
Net Benefit	Forklift - Conven.	Forklift - Rapid	TRUs	TSE	Push-backs	Tug/Tow Tractors	Belt Loaders	GPUs	Port Cranes	50T Crane	Drayage Trucks	People Movers	Drills	LHD	Roof Bolters
RIM	$3,395	$18,885	$11,263	$6,288	$9,614	$10,502	$989	$49,686	$323,721	$92,922	$38,883	$23,686	$233,685	$64,720	$70,168
Participant	$24,925	$5,767	$25,685	$46,318	$9,045	$10,962	$10,201	$1,218	$51,269	-$27,854	$7,104	$72,901	$655,164	$49,996	-$84,065
mTRC	$33,239	$28,879	$43,234	$77,495	$30,529	$25,367	$14,656	$66,673	$549,401	$256,013	$135,335	$87,873	$1,501,476	$219,637	$239,638

Incentives & Penetration Rates

Incentives are based on:

- Market Assessment Feedback
- Implementation experience
- Incremental capital cost
- Annual Load growth (kWh)

Penetration rates factor in:

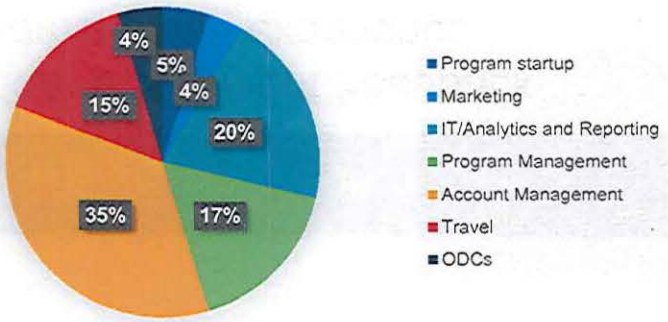
- Implementation experience
- Incremental cost of annual sales
- Incremental cost of existing population conversions
- 3 year program ramp up

COST BENEFIT ANALYSIS

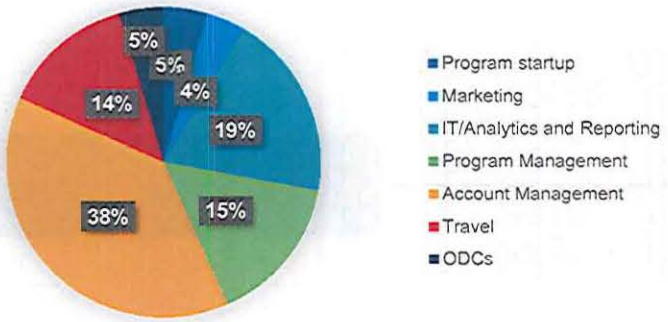
High Level Program Budget Estimates

PROGRAM TYPE	START-UP	IMPLEMENTATION				
	Year 1 (Q1)	Year 1 (Q2-Q4)	Year 2	Year 3	Year 4	Year 5
Material Handling Program	243,000	419,000	549,000	559,000	559,000	559,000
Airport Program	15,000	29,400	42,200	42,200	42,200	42,200
Port Program	15,000	29,400	42,200	42,200	42,200	42,200
Mining Program	15,000	29,400	42,200	42,200	42,200	42,200

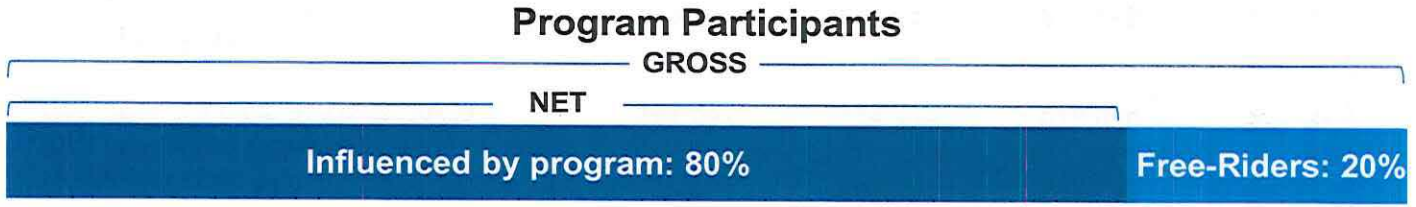
Material Handling Program Budget Distribution



Material Handling and Airport Program Budget Distribution



Net to Gross (NTG) Ratio



Net to Gross Ratio

- 80% default rate based on implementation experience, current forklift market mix, and reduced free-ridership tactics
- Also provided 60% comparison and programs are still favorable

Reduced Free-Ridership Tactics

- Electric-to-electric conversions not allowed to participate
- Applications must be submitted within certain window of invoice date

Program Results (All technologies, 80% NTG)

	FULL TECHNOLOGY PROGRAM RESULTS (80%NTG)			
	NO INCENTIVE	LOW INCENTIVE	MEDIUM INCENTIVE	HIGH INCENTIVE
Benefit Cost Ratio				
RIM	0.96	1.57	1.57	1.33
mTRC	2.51	2.85	2.75	2.70
Net Benefit				
RIM	$ (252,081)	$ 7,878,224	$ 15,828,288	$ 13,135,071
mTRC	$ 14,801,446	$ 49,048,389	$ 90,409,289	$107,939,545
5 Year Program Expenditure				
Incentives	$ -	$ 1,007,500	$ 7,318,100	$ 16,566,200
Implementation	$ 3,497,600	$ 3,497,600	$ 3,497,600	$ 3,497,600
TOTAL	$ 3,497,600	$ 4,505,100	$ 10,815,700	$ 20,063,800
Load Growth				
Max Annual Gross Demand (MW)	0.2	2.0	5.4	6.5
Gross Electricity over 20 Years (MWh)	176,984	468,397	840,788	1,046,075
Max Annual Net Demand (MW)	0.2	1.6	4.3	5.2
Net Electricity over 20 Years (MWh)	141,587	374,718	672,630	836,860
Emission Reductions				
CO2 (Lifetime, On-Site, Tons)	142,162	465,893	822,455	973,092
NOx (Lifetime, On-Site, Tons)	12,489	28,420	49,121	61,960

COST BENEFIT ANALYSIS

No Incentive Program Results (All technologies, 80% NTG)

	NO INCENTIVE
Benefit Cost Ratio	
RIM	0.96
mTRC	2.51
Net Benefit	
RIM	$ (252,081)
mTRC	$ 14,801,446
5 Year Program Expenditure	
Incentives	$ -
Implementation	$ 3,497,600
TOTAL	$ 3,497,600
Load Growth	
Max Annual Gross Demand (MW)	0.2
Gross Electricity over 20 Years (MWh)	176,984
Max Annual Net Demand (MW)	0.2
Net Electricity over 20 Years (MWh)	141,587

	Incentives	Program Implement. Cost	TOTAL Program Expenditure
Year 1	$ -	$ 795,200	$ 795,200
Year 2	$ -	$ 675,600	$ 675,600
Year 3	$ -	$ 675,600	$ 675,600
Year 4	$ -	$ 675,600	$ 675,600
Year 5	$ -	$ 675,600	$ 675,600
TOTAL	**$ -**	**$ 3,497,600**	**$ 3,497,600**

No Incentive

Program Results	Material Handling				Airport GSE				Port Equipment			Mining Equipment			
	Forklift - Conven.	Forklift - Rapid	TRUs	TSE	Pushbacks	Tug/Tow Tractors	Belt Loaders	GPUs	Port Cranes	50T Crane	Drayage Trucks	People Movers	Drills	LHD	Roof Bolters
Incentive per unit	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Year 1	32	1	4	4	0	1	0	0	0	0	0	2	0	0	0
Year 2	64	2	8	8	0	1	0	0	0	0	0	3	0	0	0
Year 3	96	2	11	12	0	2	0	0	0	0	0	5	0	0	0
Year 4	128	3	15	16	0	2	0	0	0	0	0	6	0	0	0
Year 5	128	3	15	16	0	2	0	0	0	0	0	6	0	0	0
Gross Program Participants	448	11	53	56	0	8	0	0	0	0	0	22	0	0	0

COST BENEFIT ANALYSIS

Low Incentive Program Results (All technologies, 80% NTG)

	LOW INCENTIVE
Benefit Cost Ratio	
RIM	1.57
mTRC	2.85
Net Benefit	
RIM	$ 7,878,224
mTRC	$ 49,048,389
5 Year Program Expenditure	
Incentives	$ 1,007,500
Implementation	$ 3,497,600
TOTAL	$ 4,505,100
Load Growth	
Max Annual Gross Demand (MW)	2.0
Gross Electricity over 20 Years (MWh)	468,397
Max Annual Net Demand (MW)	1.6
Net Electricity over 20 Years (MWh)	374,718

	Incentives	Program Implement. Cost	TOTAL Program Expenditure
Year 1	$ 71,900	$ 795,200	$ 867,100
Year 2	$ 157,000	$ 675,600	$ 832,600
Year 3	$ 215,600	$ 675,600	$ 891,200
Year 4	$ 281,900	$ 675,600	$ 957,500
Year 5	$ 281,900	$ 675,600	$ 957,500
TOTAL	**$ 1,008,300**	**$ 3,497,600**	**$ 4,505,900**

Low Incentive	Program Results														
	Material Handling				Airport GSE				Port Equipment			Mining Equipment			
	Forklift - Conven.	Forklift - Rapid	TRUs	TSE	Pushbacks	Tug/Tow Tractors	Belt Loaders	GPUs	Port Cranes	50T Crane	Drayage Trucks	People Movers	Drills	LHD	Roof Bolters
Incentive per unit	$500	$500	$500	$300	$500	$300	$200	$4,900	$18,500	$11,500	$5,700	$800	$16,300	$9,900	$14,900
Year 1	51	7	23	24	0	1	1	1	0	1	1	2	0	0	0
Year 2	101	14	46	49	0	2	1	1	1	2	2	4	0	0	0
Year 3	152	20	68	73	0	3	2	2	1	2	3	5	0	0	0
Year 4	202	27	91	97	0	4	2	2	1	3	4	7	0	0	0
Year 5	202	27	91	97	0	4	2	2	1	3	4	7	0	0	0
Gross Program Participants	708	95	319	340	0	14	8	8	4	11	14	25	0	0	0

Medium Incentive Program Results (All technologies, 80% NTG)

	MEDIUM INCENTIVE
Benefit Cost Ratio	
RIM	1.57
mTRC	2.75
Net Benefit	
RIM	$ 15,828,288
mTRC	$ 90,409,289
5 Year Program Expenditure	
Incentives	$ 7,318,100
Implementation	$ 3,497,600
TOTAL	$ 10,815,700
Load Growth	
Max Annual Gross Demand (MW)	5.4
Gross Electricity over 20 Years (MWh)	840,788
Max Annual Net Demand (MW)	4.3
Net Electricity over 20 Years (MWh)	672,630

	Incentives	Program Implement. Cost	TOTAL Program Expenditure
Year 1	$ 551,700	$ 795,200	$ 1,346,900
Year 2	$ 1,086,400	$ 675,600	$ 1,762,000
Year 3	$ 1,620,200	$ 675,600	$ 2,295,800
Year 4	$ 2,029,900	$ 675,600	$ 2,705,500
Year 5	$ 2,029,900	$ 675,600	$ 2,705,500
TOTAL	**$ 7,318,100**	**$ 3,497,600**	**$ 10,815,700**

Medium Incentive	Program Results														
	Material Handling				Airport GSE				Port Equipment			Mining Equipment			
	Forklift - Conven.	Forklift - Rapid	TRUs	TSE	Pushbacks	Tug/Tow Tractors	Belt Loaders	GPUs	Port Cranes	50T Crane	Drayage Trucks	People Movers	Drills	LHD	Roof Bolters
Incentive per unit	$1,500	$1,700	$1,600	$1,200	$1,900	$900	$800	$15,600	$65,000	$43,800	$21,900	$2,300	$57,500	$35,600	$57,200
Year 1	71	23	44	36	0	1	1	1	0	2	4	3	1	1	0
Year 2	142	46	87	71	1	3	2	2	1	3	8	5	1	1	1
Year 3	212	69	131	107	1	4	2	2	1	5	12	8	2	2	1
Year 4	283	92	174	142	1	5	3	3	1	6	16	10	2	2	1
Year 5	283	92	174	142	1	5	3	3	1	6	16	10	2	2	1
Gross Program Participants	991	322	610	498	4	18	11	11	4	22	56	36	8	8	4

High Incentive Program Results (All technologies, 80% NTG)

	HIGH INCENTIVE
Benefit Cost Ratio	
RIM	1.33
mTRC	2.70
Net Benefit	
RIM	$ 13,135,071
mTRC	$ 107,939,545
5 Year Program Expenditure	
Incentives	$ 16,566,200
Implementation	$ 3,497,600
TOTAL	$ 20,063,800
Load Growth	
Max Annual Gross Demand (MW)	6.5
Gross Electricity over 20 Years (MWh)	1,046,075
Max Annual Net Demand (MW)	5.2
Net Electricity over 20 Years (MWh)	836,860

	Incentives	Program Implement. Cost	TOTAL Program Expenditure
Year 1	$ 1,203,200	$ 795,200	$ 1,998,400
Year 2	$ 2,523,200	$ 675,600	$ 3,198,800
Year 3	$ 3,585,200	$ 675,600	$ 4,260,800
Year 4	$ 4,627,300	$ 675,600	$ 5,302,900
Year 5	$ 4,627,300	$ 675,600	$ 5,302,900
TOTAL	**$ 16,566,200**	**$ 3,497,600**	**$ 20,063,800**

High Incentive	Program Results														
	Material Handling				Airport GSE				Port Equipment			Mining Equipment			
	Forklift - Conven.	Forklift - Rapid	TRUs	TSE	Pushbacks	Tug/Tow Tractors	Belt Loaders	GPUs	Port Cranes	50T Crane	Drayage Trucks	People Movers	Drills	LHD	Roof Bolters
Incentive per unit	$2,900	$3,200	$3,000	$2,200	$3,600	$1,800	$1,600	$30,000	$123,800	$82,500	$41,100	$4,400	$109,400	$67,600	$107,600
Year 1	97	32	44	38	1	2	1	1	0	2	5	4	1	1	0
Year 2	194	65	87	77	1	4	2	2	1	3	11	7	2	1	1
Year 3	291	97	131	115	2	5	3	2	1	5	16	11	2	2	1
Year 4	388	129	174	153	2	7	4	3	1	6	21	14	3	2	1
Year 5	388	129	174	153	2	7	4	3	1	6	21	14	3	2	1
Gross Program Participants	1358	452	610	536	8	25	14	11	4	22	74	50	11	8	4

RECOMMENDED PROGRAM:
Material Handling and Airport GSE, Medium Incentive Program (80%NTG)

		FULL TECHNOLOGY PROGRAM				MATERIAL HANDLING/AIRPORT GSE TECHNOLOGY PROGRAM			
Benefit Cost Ratio	SUGGESTED PROGRAM RESULTS	NO INCENTIVE	LOW INCENTIVE	MEDIUM INCENTIVE	HIGH INCENTIVE	NO INCENTIVE	LOW INCENTIVE	MEDIUM INCENTIVE	HIGH INCENTIVE
RIM	1.63	0.96	1.57	1.57	1.33	0.94	1.53	1.63	1.42
mTRC	3.47	2.51	2.85	2.75	2.70	2.50	3.43	3.47	3.33
Net Benefit									
RIM	$ 11,447,683	$ (252,081)	$ 7,878,224	$ 15,828,288	$ 13,135,071	$ (345,124)	$ 5,632,103	$ 11,447,683	$ 10,739,186
mTRC	$ 74,877,703	$ 14,801,446	$ 49,048,389	$ 90,409,289	$ 107,939,545	$ 13,561,136	$ 45,558,974	$ 74,877,703	$ 88,205,487
5 Year Program Expenditure									
Incentives	$ 3,811,700	$ -	$ 1,007,500	$ 7,318,100	$ 16,566,200	$ -	$ 707,200	$ 3,811,700	$ 8,820,000
Implementation	$ 3,071,200	$ 3,497,600	$ 3,497,600	$ 3,497,600	$ 3,497,600	$ 3,071,200	$ 3,071,200	$ 3,071,200	$ 3,071,200
TOTAL	$ 6,882,900	$ 3,497,600	$ 4,505,100	$ 10,815,700	$ 20,063,800	$ 3,071,200	$ 3,778,400	$ 6,882,900	$ 11,891,200
Load Growth									
Max Annual Gross Demand (MW)	1.9	0.2	2.0	5.4	6.5	0.1	0.7	1.9	2.6
Gross Electricity over 20 Years (MWh)	630,488	176,984	468,397	840,788	1,046,075	168,184	384,647	630,488	798,675
Max Annual Net Demand (MW)	1.5	0.2	1.6	4.3	5.2	0.1	0.5	1.5	2.1
Net Electricity over 20 Years (MWh)	504,390	141,587	374,718	672,630	836,860	134,547	307,718	504,390	638,940
Emission Reductions									
CO2 (Lifetime, On-Site, Tons)	639,088	142,162	465,893	822,455	973,092	128,326	391,389	639,088	753,623
NOx (Lifetime, On-Site, Tons)	44,983	12,489	28,420	49,121	61,960	12,213	26,736	44,983	57,098

COST BENEFIT ANALYSIS

RECOMMENDED PROGRAM:
Material Handling and Airport GSE, Medium Incentive Program (60%NTG)

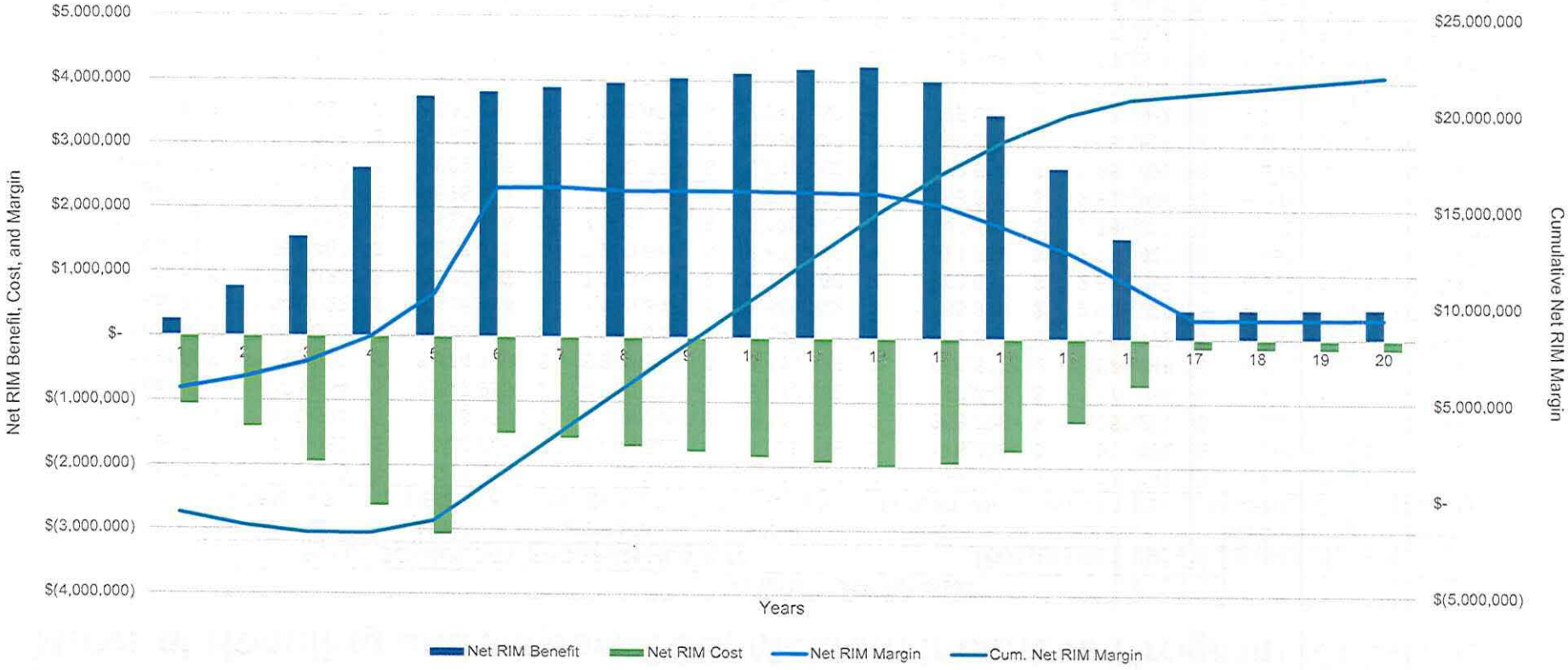
		FULL TECHNOLOGY PROGRAM				MATERIAL HANDLING/AIRPORT GSE TECHNOLOGY PROGRAM			
Benefit Cost Ratio	SUGGESTED PROGRAM RESULTS	NO INCENTIVE	LOW INCENTIVE	MEDIUM INCENTIVE	HIGH INCENTIVE	NO INCENTIVE	LOW INCENTIVE	MEDIUM INCENTIVE	HIGH INCENTIVE
RIM	1.47	0.83	1.44	1.42	1.17	0.82	1.39	1.47	1.26
mTRC	4.33	3.01	3.61	3.44	3.28	3.01	4.31	4.33	4.05
Net Benefit									
RIM	$ 7,157,594	$ (929,718)	$ 4,962,210	$ 9,635,021	$ 5,726,648	$ (909,461)	$ 3,429,140	$ 7,157,594	$ 5,604,728
mTRC	$ 80,847,098	$ 16,431,477	$ 54,621,804	$ 100,833,561	$ 119,140,424	$ 15,103,650	$ 49,355,972	$ 80,847,098	$ 94,903,693
5 Year Program Expenditure									
Incentives	$ 3,811,700	$ -	$ 1,007,500	$ 7,318,100	$ 16,566,200	$ -	$ 707,200	$ 3,811,700	$ 8,820,000
Implementation	$ 3,071,200	$ 3,497,600	$ 3,497,600	$ 3,497,600	$ 3,497,600	$ 3,071,200	$ 3,071,200	$ 3,071,200	$ 3,071,200
TOTAL	$ 6,882,900	$ 3,497,600	$ 4,505,100	$ 10,815,700	$ 20,063,800	$ 3,071,200	$ 3,778,400	$ 6,882,900	$ 11,891,200
Load Growth									
Max Annual Gross Demand (MW)	1.9	0.2	2.0	5.4	6.5	0.1	0.7	1.9	2.6
Gross Electricity over 20 Years (MWh)	630,488	176,984	468,397	840,788	1,046,075	168,184	384,647	630,488	798,675
Max Annual Net Demand (MW)	1.1	0.1	1.2	3.2	3.9	0.1	0.4	1.1	1.5
Net Electricity over 20 Years (MWh)	378,293	106,191	281,038	504,473	627,645	100,911	230,788	378,293	479,205
Emission Reductions									
CO2 (Lifetime, On-Site, Tons)	639,088	142,162	465,893	822,455	973,092	128,326	391,389	639,088	753,623
NOx (Lifetime, On-Site, Tons)	44,983	12,489	28,420	49,121	61,960	12,213	26,736	44,983	57,098

RECOMMENDED PROGRAM:
Material Handling and Airport GSE, Medium Incentive Program (80%NTG)

	Annual Gross Revenue							
	FULL TECHNOLOGY PROGRAM RESULTS				Material Handling/GSE Program Results			
	NO INCENTIVE	LOW INCENTIVE	MEDIUM INCENTIVE	HIGH INCENTIVE	NO INCENTIVE	LOW INCENTIVE	MEDIUM INCENTIVE	HIGH INCENTIVE
Year 1	$ 70,810	$ 214,620	$ 480,700	$ 567,390	$ 58,370	$ 175,140	$ 312,130	$ 385,060
Year 2	$ 208,060	$ 706,605	$ 1,449,522	$ 1,775,718	$ 176,338	$ 519,190	$ 956,474	$ 1,178,998
Year 3	$ 418,501	$ 1,408,774	$ 2,938,568	$ 3,548,347	$ 353,788	$ 1,053,207	$ 1,932,751	$ 2,385,991
Year 4	$ 703,454	$ 2,347,955	$ 4,880,782	$ 5,932,269	$ 597,842	$ 1,775,688	$ 3,275,981	$ 4,045,336
Year 5	$ 999,637	$ 3,324,138	$ 6,899,509	$ 8,410,130	$ 851,517	$ 2,526,646	$ 4,672,167	$ 5,770,099
Year 6	$ 1,019,630	$ 3,390,621	$ 7,006,662	$ 8,547,495	$ 868,547	$ 2,577,179	$ 4,765,610	$ 5,885,501
Year 7	$ 1,040,022	$ 3,458,434	$ 7,115,342	$ 8,686,992	$ 885,918	$ 2,628,722	$ 4,860,922	$ 6,003,211
Year 8	$ 1,060,823	$ 3,527,602	$ 7,193,483	$ 8,796,566	$ 903,637	$ 2,681,297	$ 4,958,141	$ 6,123,276
Year 9	$ 1,067,464	$ 3,583,579	$ 7,250,041	$ 8,877,897	$ 921,709	$ 2,734,922	$ 5,057,304	$ 6,245,741
Year 10	$ 1,066,513	$ 3,625,516	$ 7,291,116	$ 8,936,663	$ 940,143	$ 2,789,621	$ 5,158,450	$ 6,370,656
Year 11	$ 1,047,214	$ 3,628,471	$ 7,316,746	$ 8,958,256	$ 956,228	$ 2,822,959	$ 5,238,848	$ 6,470,288
Year 12	$ 1,018,983	$ 3,602,155	$ 7,235,755	$ 8,848,262	$ 972,580	$ 2,853,420	$ 5,292,062	$ 6,545,359
Year 13	$ 919,285	$ 3,366,307	$ 6,772,335	$ 8,256,520	$ 919,285	$ 2,686,504	$ 5,007,298	$ 6,194,892
Year 14	$ 795,038	$ 2,987,352	$ 5,965,428	$ 7,243,292	$ 795,038	$ 2,332,968	$ 4,345,522	$ 5,369,632
Year 15	$ 603,187	$ 2,418,288	$ 4,776,513	$ 5,748,837	$ 603,187	$ 1,790,612	$ 3,308,250	$ 4,071,489
Year 16	$ 338,149	$ 1,712,523	$ 3,332,706	$ 3,955,938	$ 338,149	$ 1,098,538	$ 1,958,656	$ 2,368,621
Year 17	$ 62,270	$ 950,791	$ 1,802,468	$ 1,989,743	$ 62,270	$ 378,065	$ 553,754	$ 596,009
Year 18	$ 63,515	$ 915,198	$ 1,554,072	$ 1,745,093	$ 63,515	$ 385,626	$ 564,829	$ 607,929
Year 19	$ 64,785	$ 849,949	$ 1,267,169	$ 1,386,570	$ 64,785	$ 393,339	$ 576,126	$ 620,087
Year 20	$ 66,081	$ 781,725	$ 968,168	$ 1,013,008	$ 66,081	$ 401,206	$ 587,648	$ 632,489

COST BENEFIT ANALYSIS

RECOMMENDED PROGRAM:
Material Handling and Airport GSE, Medium Incentive Program



RECOMMENDED PROGRAM:
Material Handling and Airport GSE, Medium Incentive Program

	SUGGESTED PROGRAM RESULTS
Benefit Cost Ratio	
RIM	1.63
mTRC	3.47
Net Benefit	
RIM	$ 11,447,683
mTRC	$ 74,877,703
5 Year Program Expenditure	
Incentives	$ 3,811,700
Implementation	$ 3,071,200
TOTAL	$ 6,882,900
Load Growth	
Max Annual Gross Demand (MW)	1.9
Gross Electricity over 20 Years (MWh)	630,488
Max Annual Net Demand (MW)	1.5
Net Electricity over 20 Years (MWh)	504,390
Emission Reductions	
CO2 (Lifetime, On-Site, Tons)	639,088
NOx (Lifetime, On-Site, Tons)	44,983

	Incentives	Program Implement. Cost	TOTAL Program Expenditure
Year 1	$ 276,500	$ 706,400	$ 982,900
Year 2	$ 553,000	$ 591,200	$ 1,144,200
Year 3	$ 811,600	$ 591,200	$ 1,402,800
Year 4	$ 1,085,300	$ 591,200	$ 1,676,500
Year 5	$ 1,085,300	$ 591,200	$ 1,676,500
TOTAL	$ 3,811,700	$ 3,071,200	$ 6,882,900

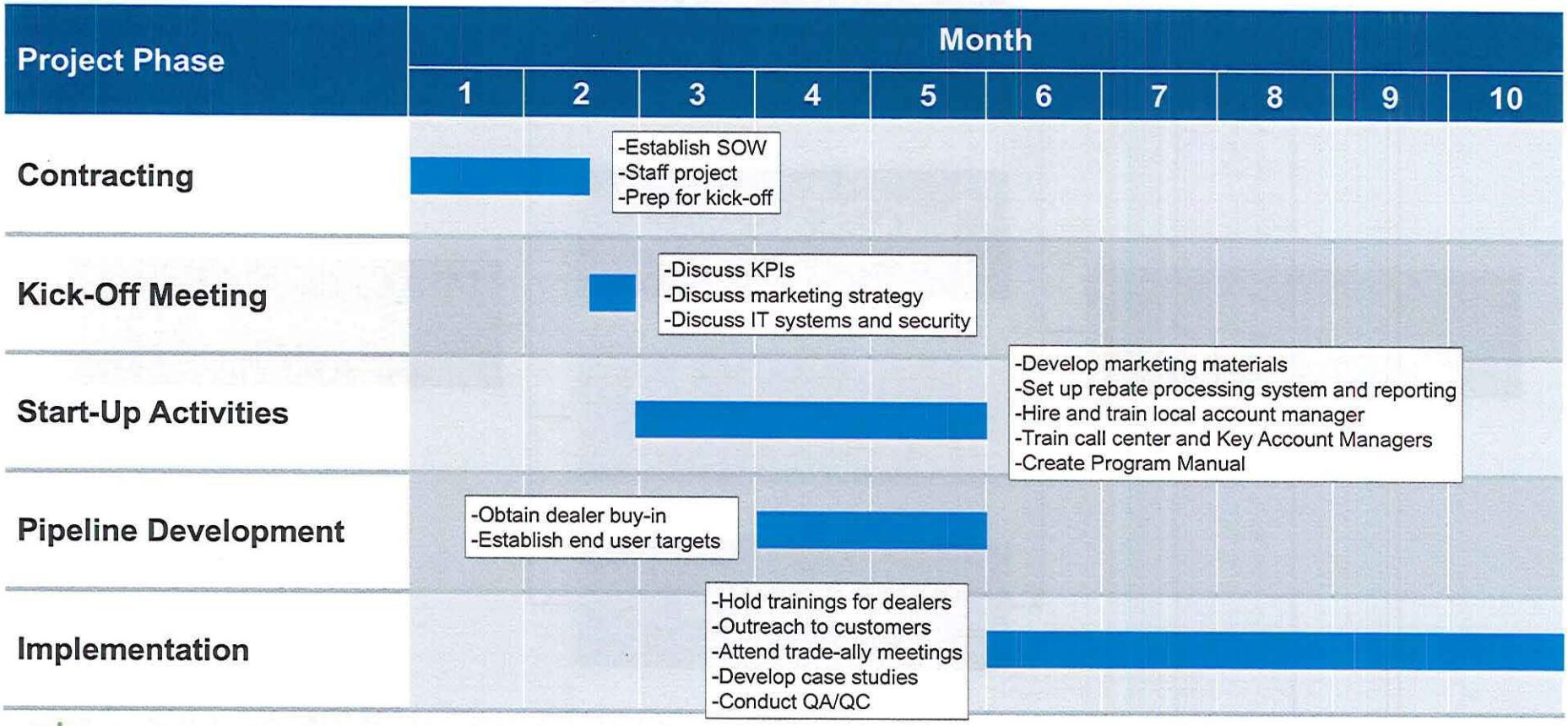
	Material Handling				Airport GSE			
	Forklift - Conven.	Forklift - Rapid	TRUs	TSE	Pushbacks	Tug/Tow Tractors	Belt Loaders	GPUs
Incentive per unit	$1,500	$1,700	$1,600	$1,200	$1,900	$900	$800	$15,600
Year 1	71	23	44	36	-	1	1	1
Year 2	142	46	87	71	1	3	2	2
Year 3	212	69	131	107	1	4	2	2
Year 4	283	92	174	142	1	5	3	3
Year 5	283	92	174	142	1	5	3	3
Gross Program Participants	991	322	610	498	4	18	11	11
Lifetime On-Site Emission Reductions (Tons CO2)	194,855	63,313	166,585	201,937	374	2,011	910	9,103
Lifetime On-Site Emission Reductions (Tons NOx)	23,784	7,728	11,053	1,494	2	155	40	727

Implementation Plan

Ameren Missouri Beneficial Electrification

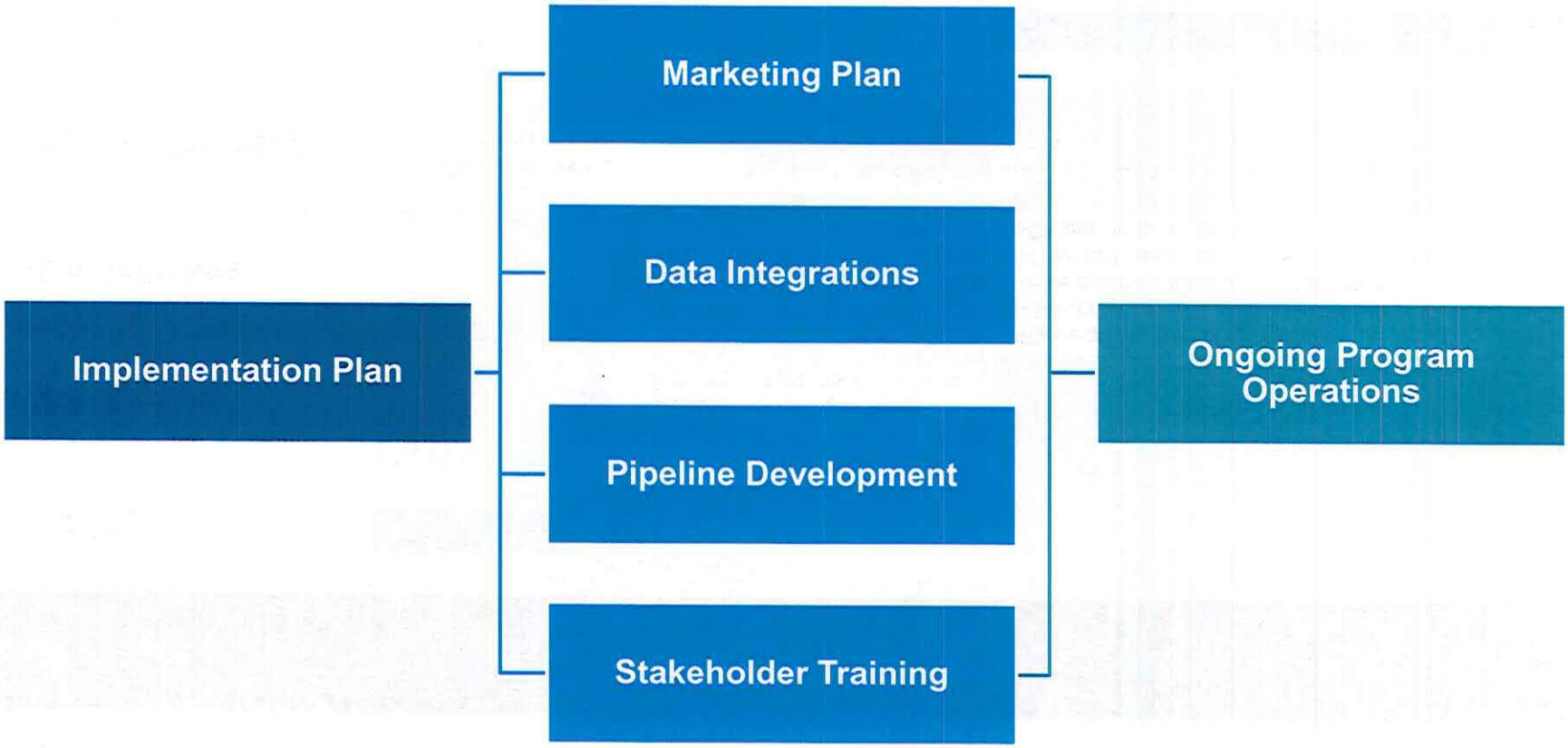
IMPLEMENTATION PLAN

Program Launch Schedule



SCHEDULE DP-D2-37

Program Implementation Strategy



Implementation Plan

- **Finalize incentives and delivery (whether upstream, midstream or downstream)**
- **Establish addressable market and goals**
- **Quick Start Go-To-Market**
  - Target customers and market segments
  - Geographic concentrations (county or city)
  - Key equipment providers, trade allies and dealers
  - Primary marketing channel
  - Health and safety
- **Customized outreach plan**

IMPLEMENTATION PLAN

Marketing Plan

Participation Enablement

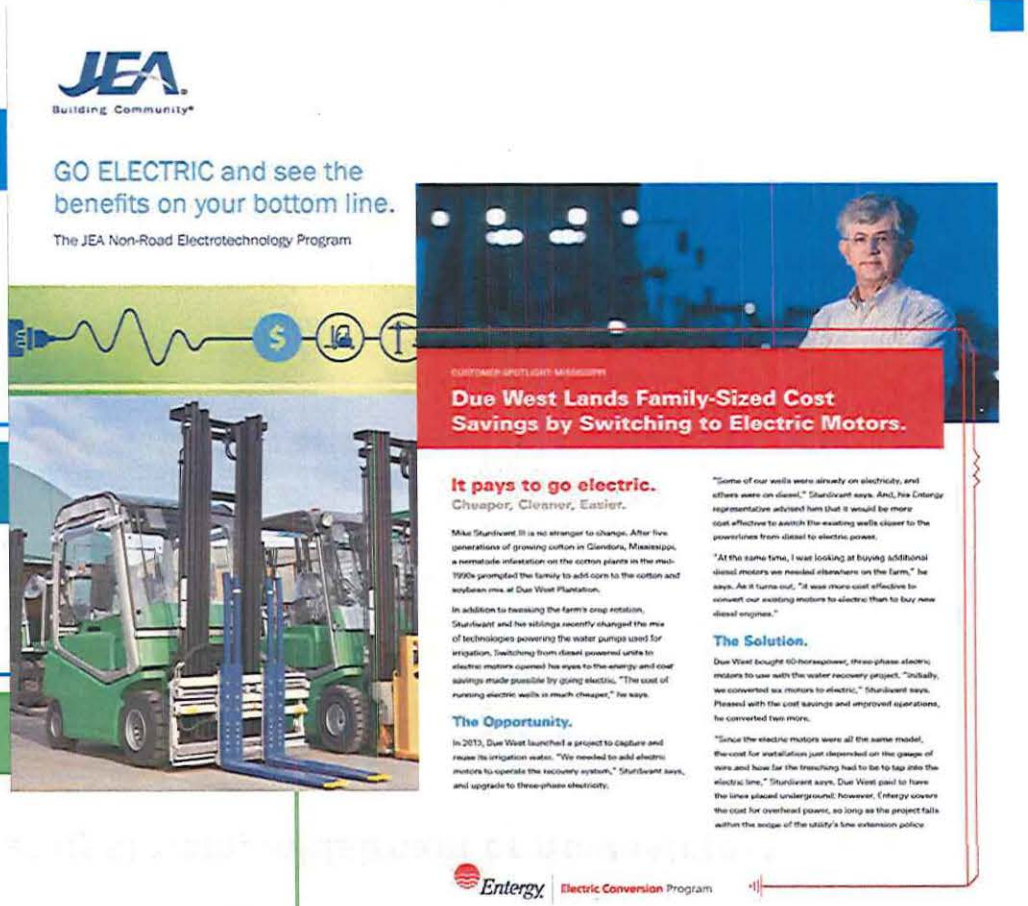
- Informational packet
- Case studies
- Program website
- Customer savings calculator
- Training tools

Event Marketing Support

- Event sponsorship
- Program exhibits
- Branded giveaways

Customer Outreach

- Ameren Missouri engagement channels
- Email blasts
- Key Account Manager relationships

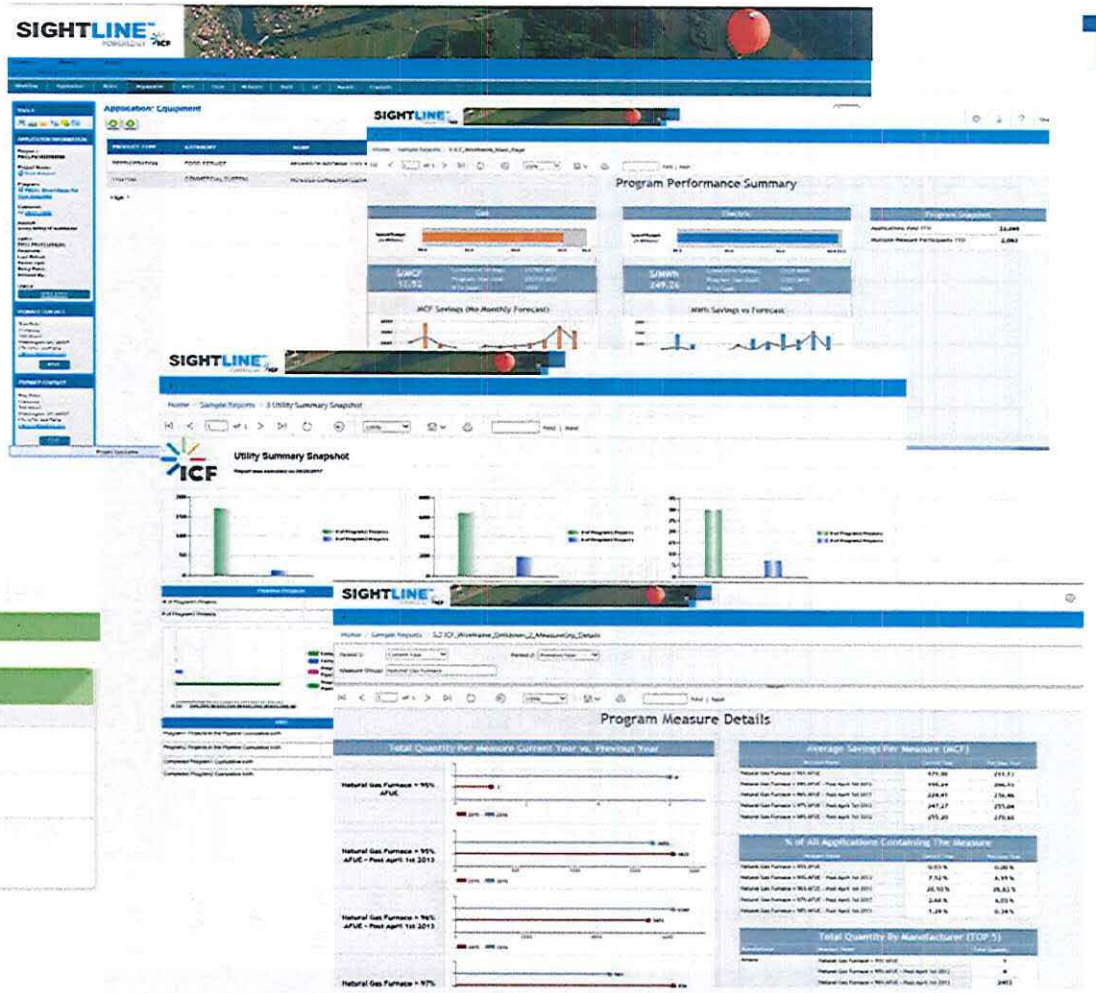


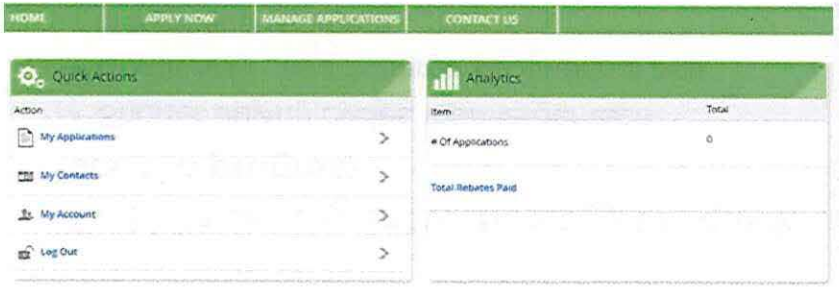
SCHEDULE DP-D2-40

IMPLEMENTATION PLAN

Data Integration

- **Important to track pipeline, customer contact, applications, and key program indicators (KPIs) to measure program success**
  - Leads Tracking System
  - Internal Rebate Processing System
  - External Rebate Processing System
  - Reporting System





SCHEDULE DP-D2-41

Pipeline Development: *Customer Targets*

- **Forklifts are a great technology to "quick start" a program**
  - Shorter buying cycles than larger tech
  - Commonly used by large commercial and industrial customers
  - Conduct initial forklift assessment to determine additional opportunities for electrification
- **Top Forklift Target Sectors**
  - Manufacturing
  - Wholesale Trade
  - Retail Trade
  - Transportation and Warehousing
- **Treat larger equipment (cranes, mining drills) as custom opportunities to maximize customer and utility benefits**

Sample Customer Targets

Forklifts	TRUs	TSE	Airport	Port.	Mining.	Company
F	TR					Bunzl Distribution USA
F	TR					Hogan Transports, Inc.
F	TR					Schnuck Markets Inc.
F	TR					LTI Trucking Services Inc.
F	TR					TTS Logistics LLC
F	TR					Anheuser-Busch Companies, Inc.
F	TR					Climate Express, Inc.
F	TR					Witte Brothers Exchange Inc.
F	TR					Panera Bread & St. Louis Bread Co.
F	TR					S & H Transportation Inc.
F	TR					Save-A-Lot, Ltd.
F	TR					US Foods (Allen Div.)
F	TR					Artur Express Inc.
F	TR					Edwards Transportation Co.
F	TR			P		DNJ Intermodal Services
F	TR			P		FGM Logistics
F				P		U.S. Army Corps of Engineers
F				P		Green Plains
F				P		Phillips 66
F				P		Apex Oil
F				P		Cargill Steel
F				P		U.S. Steel
F					M	Doe Run
F			A			St. Louis International Airport
		TS				Love's Travel Stop
		TS				Pilot Travel Center

Pipeline Development: *Equipment Dealers*

- **Local MO Dealer Strategies:**
  - Offer to hold a sales training for each dealers' sales team to educate them on how to work the benefits of electric equipment into their sales pitch
  - Provide them program promotional materials that they can hand out to their customers and train dealers how to use customer savings calculator
  - Offer to go on sales calls with sales staff
  - Provide a dealer incentive for quick buy in

Sample Local Dealer Targets		
Forklifts	TRUs	Company/ Organization
F		FSL - Forklifts of Central Missouri
F		Gammon Equipment
F		Allied Industrial Equipment Corporation
F		Connell
F		Forklift America
F		Missouri Industrial Equipment
F		Wiese
F		A.D. Lift Truck
F		G.W. Van Keppel Company
F		Gammon Equipment
F		Heubel Shaw
F		RDS Equipment, Inc.
F		SBH Sales Co. Inc
F		Sugar Creek
F		Union Machinery, A G&J Industrial Company
F		MH Equipment
F		Bublitz Material Handling
	TR	CSTK Inc
	TR	Gateway Truck & Refrigeration
	TR	MHC Carrier Transicold
	TR	Thermo King Midwest

Pipeline Development: *Trade Association Targets*

- Members of relevant trade organizations typically can be leveraged to produce key customer targets for marketing the program.
- Can provide events or means of communication for the outreach
- Reach out to applicable trade associations during program launch and implementation to participate in upcoming meetings or events

Sample Trade Ally Targets

Forklifts	TRUs	TSE	Airport	Port.	Mining.	Company/ Organization
F	TR	TS	A	P	M	Cape Girardeau Area Chamber of Commerce
F	TR	TS	A	P	M	Chesterfield Chamber of Commerce
F	TR	TS	A	P	M	Farmington Regional Chamber of Commerce
F	TR	TS	A	P	M	Jefferson City Area Chamber of Commerce
F	TR	TS	A	P	M	Missouri Chamber Of Commerce & Industry
F	TR	TS	A	P	M	St. Louis Chamber of Commerce
F	TR	TS	A	P		Transportation Club of St. Louis
F	TR	TS				Missouri Trucking Association
F	TR					Missouri Grocers Association
F	TR					Ozark Empire Grocers Association
F					M	Mining Industry Council of Missouri
F				P		Port Authority Commission of the City of St. Louis
F				P		Southeast Missouri Regional Port Authority
F				P		St. Louis Port Authority
F						Farm Equipment Manufacturers Association
F						Missouri Association of Manufacturers
F						Missouri Merchants & Manufacturers Association
F						National Tooling and Machining Association
F						Southwest Area Manufacturers Association
F			A			Missouri Airport Managers Association
F			A			Missouri State Aviation Council
		TS				Owner-Operator Independent Drivers Association

Stakeholder Training

Call Center Staff

- Program overview
- General information
- Customer eligibility

Large Account Managers

- Benefits of electrotechnologies
- Incentive eligibility and application process
- Sales collateral
- Customer support and FAQs

Ongoing Program Operations

Targeted Outreach

- Provide sales, account management, and field/technical services
- Coordinate with Large Account Managers to maximize outreach
- Identify opportunities for conversion to electric-powered technologies

Technical Support

- Work with end-users and dealers to explain the benefits of electrification
- Facilitate the process of conversion

Incentive Processing and Tracking

- Assist with application processing
- Perform inspections of completed projects

Technology Appendix

Ameren Missouri Beneficial Electrification

Forklifts

Common Industries

- Manufacturing
- Wholesale Trade
- Retail Trade
- Transportation and Warehousing

Technology Maturity: HIGH

Average Load Growth Impacts

kW	10 – 20
Annual kWh	15,000 – 30,000
Lifetime	10 – 12 Years

Forklift Classes

Class	Description
1	Electric Motor Rider Trucks: counterbalanced rider, stand up, 3-wheel or 4-wheel sit down, cushion or pneumatic tires
2	Electric Motor Narrow Aisle Trucks: order picker, high lift straddle, side loaders, turret trucks, high- or low-lift pallet
3	Electric Motor Hand Trucks: low-lift walkie pallet, tractors, high lift counterbalanced, single face pallet lift
4	Internal Combustion Engine Trucks: counterbalanced, solid/cushion tires
5	Internal Combustion Engine Trucks: counterbalanced, pneumatic tires

Charging Methods

Conventional Charge	Rapid Charge
Battery runs for 8 hrs, charges 8 hrs, cools 8 hrs	Battery charges for 1-2 hrs throughout the day to remain 20-80% charged, 8 hr equalization charge once a week
Ideal for 1-shift operation	Ideal for 2-shift operation
Typically 70% of electric forklifts are conventional	Typically 30% of electric forklifts are rapid

Truck Refrigeration Units (TRUs)

Common Industries

- Food Manufacturing
- Transportation and Warehousing (Cold Storage)
- Food Distribution and Services

Technology Maturity: MEDIUM

Average Load Growth Impacts

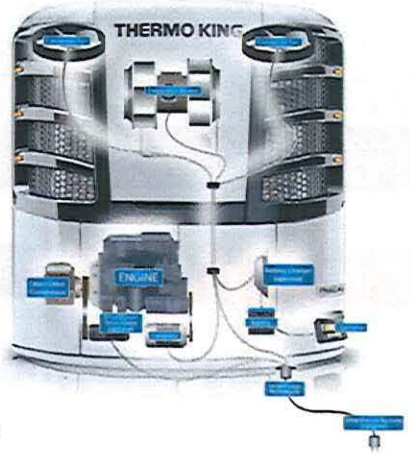
kW	8 – 15
Annual kWh	15,000 – 25,000
Lifetime	10 – 12 Years

TRU Types

Type	Description
Diesel	TRU powered by an auxiliary diesel engine at all times to cool truck trailer
Electric Standby	TRU powered by a diesel engine when mobile, but can plug into grid at warehouses/truck stops to cool trailer instead of idling

Primary Barriers

- Many customers are unfamiliar with technology
- Lack of electric infrastructure for plug outlets at warehouses and distribution centers



Primary Manufactures

Carrier TRANSICOLD

THERMO KING

Airport Ground Support Equipment

Common Technologies and Impacts

Technology Maturity: MEDIUM

Technology	KW	Annual KWH	Lifetime (years)	Usage
Aircraft Tractors/ Pushbacks	10 – 20	12,000 – 25,000	10	Pushing/towing aircraft
Baggage/Tow Tractors	10 – 20	20,000 – 35,000	10	Pulling trains of baggage carts to/from from aircraft to bag room or connecting flight
Belt Loaders	5 – 10	3,000 – 5,000	10	Unloading/loading baggage and cargo on moving belts on ramps
Ground Power Units	40 - 80	100,000 – 250,000	10	Suppling aircraft electricity while parked at facility

Truck Stop Electrification (TSE)

Common Industries

- Truck stops/Travel centers
- Distribution warehouses
- Shipping depots
- Intermodal shipping operations

Technology Maturity: MEDIUM

Average Load Growth Impacts

kW	1 - 2
Annual kWh	3,500 – 6,500
Lifetime	15 – 20 Years

Fuel Types

Type	Description
Diesel	Drivers idle engine overnight/while parked to power necessary services (HVAC/appliances)
Electric Standby	Drivers plug into grid overnight/while parked to power necessary services (HVAC/appliances)

Primary Barriers

- Lack of electric infrastructure at truck stops/travel centers

Missouri Area TSE locations: 3

Location	Bays
St. Louis, IL	30
Steele, MO	24
Booneville, MO	15

Port (Container) Cranes

Common Industries

- Ports
- Intermodal shipping facilities
- Railyards

Usage

- Dockside gantry cranes used for unloading/loading intermodal containers from container ships

Types

- High Profile: boom hinged at waterside and lifted in air to clear ships for navigation
- Low Profile: Boom shuttled toward and over ship to allow trolley to load/discharge containers

Technology Maturity: LOW

Average Load Growth Impacts

kW	350 – 450
Annual kWh	600,000 – 900,000
Lifetime	20 – 30 years

Rubber-Tired Gantry (RTG) Cranes

Common Industries

- Ports
- Intermodal shipping facilities
- Railyards

Usage

- Grounding or stacking containers in intermodal facilities

Fuel Types

- Diesel
- Biodiesel
- Electric

Technology Maturity: LOW

Average Load Growth Impacts

kW	300 – 400
Annual kWh	400,000 – 600,000
Lifetime	15 – 20 Years

Drayage Trucks

Common Industries

- Ports
- Intermodal shipping facilities
- Railyards

Usage

- Transportation of goods over a short distance, example: moving goods from ship to warehouse

Fuel Types

- Diesel
- LNG
- Electric
- Hybrid Electric

Technology Maturity: LOW

Average Load Growth Impacts

kW	8 – 15
Annual kWh	50,000 – 90,000
Lifetime	10 – 12 Years

ELECTROTECHNOLOGIES OVERVIEW

Mining Equipment

Common Technologies and Impacts

Technology	KW	Annual KWH	Lifetime (years)	Usage
Conveyors	250 – 150,000	1,000,000 – 800,000,000	10 – 20	Transporting mining materials
Draglines	7,000 – 14,000	20,000,000 – 30,000,000	20 – 30	Digging at surface mining sites
Hydraulic Shovels	420 – 2,300	900,000 – 16,000,000	8 – 10	Digging and moving large amounts of material at once at surface mining sites
People Movers	30 – 40	100,000 – 150,000	8 – 10	Transporting personnel throughout a mine
Ram Cars and Scoops	130 – 230	300,000 – 400,000	8 – 10	Moving heavy mining loads underground over short distances
Underground Shuttle Car	90 – 170	100,000 – 400,000	8 – 10	Moving people, equipment, and materials in underground mines
Blasthole Drills	150 – 2,000	1,000,000 – 6,000,000	5 – 10	Drilling shot-holes for explosive charges that loosens the material for extraction
Continuous Miner	400 – 600	100,000 – 1,000,000	5 – 10	Extracting material by shearing into walls of the mine with a rotating drum
Roof Bolters	90 – 150	100,000 – 300,000	8 – 10	Installing roof support bolts in underground mines