WHITE PAPER

# Non-Road Electrotechnology Programs: Increasing Utility Load Growth and Revenue While Decreasing Air Pollution

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## Executive Summary

*Non-Road Electrotechnology programs, which promote the displacement of fossil-fueled customer equipment with electric-powered equipment, can help electric utilities increase net margin, improve load factor, and reduce net service-territory emissions. This paper summarizes ICF International's approach to evaluating the feasibility and economics of such programs, provides indicative economics for several programs, and presents case studies of real-world applications.*

*By promoting electrotechnologies such as non-road transportation, material handling equipment, agricultural water-pumping, port and airport equipment, and other technologies, ICF finds that a typical utility can increase energy sales by approximately 0.3 percent a year with an investment of only 0.15 percent of annual revenues and an expected ROI of 160 percent (over the lifetime of the equipment and depending on regulatory treatment of incremental margins). At the same time, net site emissions from the affected equipment can be expected to decline 95 percent. Even small scale programs focused on a single technology (such as forklifts or agricultural pumping) can increase energy sales by as much as 0.10 percent with an ROI in the range of 80 percent to 120 percent. And unlike on-road electric vehicle programs which can be complicated and depend, in part, upon factors outside a utility's control, non-road programs are less risky and comparatively simple to design, operate, and control.*

*ICF has a proven approach to forecasting the impacts of electrotechnology programs, including potential models and technology databases that can be quickly calibrated to any utility's service territory. These tools have already been used by 8 electric utilities. In addition, ICF implements many customer equipment choice programs across North America, and provides load building services to 12 utilities. This "real world" experience ensures that ICF's program designs are practical, and that estimates of program participation and costs are reliable.*

*Founded in 1969 with headquarters in Fairfax, Virginia and 54 offices across the United States, ICF has more than 5,000 employees and 2014 revenues exceeding $1B. ICF supports electric utilities through market research, analytics, and implementation services that can help increase the adoption of demand-side electrotechnologies. ICF is currently implementing more than 150 diverse demand-side management programs for 50 utilities in 26 states and 3 Canadian provinces.*

## Electrotechnology: A Significant Need, a Compelling Opportunity

Electrotechnology programs (sometimes called "decarbonization" or "beneficial electrification" programs) address the growth needs of electric utilities while also providing compelling benefits for businesses, consumers, and the environment. Utilities can promote the use of non-road, electrically-powered equipment, such as forklifts, airport ground support equipment, agricultural equipment, and cranes, across a variety of applications. These technologies typically have a much longer life (and utility revenue stream) than their internal combustion counterparts, and can increasingly be promoted in ways that limit the impact on peak demand and focus on increasing off-peak and shoulder period usage.

Electrotechnologies typically use approximately 90 percent fewer moving parts and have no engine fluids or hoses. They can often reduce fuel costs by 50 percent-70 percent and decrease exposure to volatile commodity prices. Businesses that use electrotechnologies may experience a safer and more efficient work environment with less noise congestion due to the quiet operation of electric-powered equipment.

And with air quality being a major concern for many cities in the U.S. (more than 322 nationwide counties violate the 2008 75 PPB Ozone Standard set by the EPA) utilities serving such counties can promote zero-site-emission technologies, offer real benefits to the environment (potentially qualifying for state and local environmental incentive payments), and help position themselves as environmental leaders.

## Potential Revenue Growth by the Numbers

ICF has evaluated more than 60 individual electrotechnologies for inclusion in utility load growth programs, including: material handling equipment, marine/port equipment, airport ground support equipment, locomotives, mining equipment, agricultural equipment, and other applications. These assessments typically include evaluation of first and life-cycle costs, facility charging infrastructure requirements, annual energy requirements, peak coincidence factors, dealer/distributor infrastructure, market pricing of the electrotechnology, pros/cons of the electric and internal combustion technologies, quality of the service provided, and other factors. In many cases, this has included an evaluation of utility line extension policies, customer contributions in aid of construction (CIAC), tariffs and billing demand/ratchet impacts, fossil fuel and electricity price projections, estimation of O&M differentials and in some cases estimation of the geospatial (down to the feeder) level of adoption and assessment of potential distribution system reliability impacts and infrastructure upgrades.

While the importance of these and other factors is unique to each technology and utility service territory, the potential incremental load, revenue, and emissions impact can be significant, as illustrated in Table 1 below for a small sample of technology categories.

**Table 1 - Illustrative Non-Road Electrotechnology Load Impacts**

| Technology/ Equipment Type | Charging Type | Load Impact (kW) per unit | Lifetime Net Revenue ($) per unit* | Lifetime $CO^2$ Reduced (tons) per unit** |
|---|---|---|---|---|
| **Material Handling Equipment** | | | | |
| Forklifts (Rapid Charge) | Rapid | 16.58 | $32,123 | 186 |
| Forklifts (Conventional Charge) | Conventional | 11.43 | $29,725 | 385 |
| Electric-standby Truck Refrigeration Units (REEFERs) | Direct Plug-in | 11.46 | $19,935 | 107 |
| Refrigerated Rail Cars | Direct Plug-in | 49.82 | $214,574 | 1,678 |
| **Marine/Port Equipment** | | | | |
| Ship-to-Shore Electrification-Cold Ironing (per visit) | Direct Plug-in | 3,000 | $7,396,044 | 22,263 |

Table continued on next page

| Technology/ Equipment Type | Charging Type | Load Impact (kW) per unit | Lifetime Net Revenue ($) per unit* | Lifetime $CO^2$ Reduced (tons) per unit** |
|---|---|---|---|---|
| Shore-side Port Cranes (Wharf Cranes) | Direct Plug-in | 204.4 | $837,044 | 2,645 |
| Rubber-tired Gantry Cranes (RTGs) | Direct Plug-in | 337.94 | $1,083,375 | 4,373 |
| Rail-mounted Gantry Cranes (RMGs) | Direct Plug-in | 337.94 | $1,083,375 | 4,373 |
| Wide-Span Cranes | Direct Plug-in | 21,625 | $132,835,658 | 902,692 |
| Yard Hostlers/Drayage Trucks | Conventional | 50.33 | $124,000 | 616 |
| Dredgers | Direct Plug-in | 66.43 | $293,810 | 1,802 |
| Harborcraft | Rapid | 130 | $348,169 | 1,871 |
| **Airport Ground Support Equipment** | | | | |
| Pushbacks | Rapid | 76 | $109,564 | 383 |
| Belt Loaders | Rapid | 16.79 | $23,427 | 73 |
| Tugs and Tow Tractors | Rapid | 32 | $44,641 | 151 |
| Ground Power Units (GPUs) | Direct Plug-in | 28.8 | $115,849 | 349 |
| Pre-conditioned Air Units (PCAs) | Direct Plug-in | 167.85 | $163,117 | 20 |
| **Locomotives** | | | | |
| High-Speed Passenger Trains | Direct Power Connection | 15,471.39 | $124,538,074 | 984,322 |
| Shore Power plug-in unit for locomotives | Direct Plug-in | 83.04 | $353,807 | 2,117 |
| Battery-electric Switch Locomotives | Conventional or Rapid | 18,684 | $150,398,211 | 1,188,715 |
| **Mining Equipment** | | | | |
| Underground Mining Shuttle Cars / Haul Trucks | Direct Plug-in | 160.39 | $178,845 | 560 |
| Continuous Miners | Direct Plug-in | 410 | $528,326 | 2,148 |
| Hydraulic Shovels | Direct Plug-in | 1,993 | $3,259,819 | 4,079 |
| Blasthole Drills | Direct Plug-in | 1,993 | $3,259,819 | 17,403 |

| Technology/ Equipment Type | Charging Type | Load Impact (kW) per unit | Lifetime Net Revenue ($) per unit* | Lifetime $CO^2$ Reduced (tons) per unit** |
|---|---|---|---|---|
| **Agricultural Equipment** | | | | |
| Agricultural Pumps (Vertical, Mixed-Flow, Propeller) | Direct Plug-in | 71.77 | $96,223 | 344 |
| Battery Powered Sprayers | | 1.1 | $1,189 | 3 |
| **Other Equipment** | | | | |
| Truck Stop Electrification (TSE) | Direct Plug-in | 7.1 | $36,096 | 152 |
| Auxiliary Power Units (APUs) | Direct Plug-in | 47.75 | $66,225 | 205 |
| Turf Trucks | Conventional | 10.52 | $11,614 | 36 |
| Golf Carts | Conventional | 4.21 | $5,843 | 14 |
| Ride-on Sweepers | Conventional | 6.52 | $6,750 | 18 |
| Walk-Behind Scrubbers | Conventional | 6.52 | $6,750 | 18 |
| Walk-Behind Burnishers | Conventional | 6.52 | $6,750 | 18 |
| Personnel/Burden Carriers | Conventional | 10.52 | $11,614 | 36 |
| Ride-On Scrubbers | Conventional | 6.52 | $6,750 | 18 |
| Walk-Behind Sweepers | Conventional | 6.52 | $6,750 | 18 |

*Estimated net revenue based on $8/kW demand charge, $0.0875/kWh energy charge, and $0.0279/kWh cost of generation

**Estimated net carbon dioxide emissions = site emission reductions – source emission increases based on NERC SERC regional grid mix

Technologies of interest can be promoted individually (such as in a "Forklift" or "Agricultural Pumping" program) or as part of broader based sectoral program (such as "Materials Handling"). Case studies for three current approaches are discussed below.

## Case Study 1: Materials Handling Program

This program promotes a set of technologies found in many utility service territories, including: Forklifts, Truck Stop Electrification, Electric-standby Truck Refrigeration Units, Golf Carts, and basic

Airport Ground Support Equipment (Pushbacks, Belt Loaders, Tow Tractors, and GPUs). The program provides incentives for customers to adopt covered electrotechnologies, as outlined in Table 2. The utility has approximately 400,000 customers and annual sales of approaching 12,000 GWh.

**Table 2 – Case Study 1 Sample Incentive Structure**

| Sample Incentive Structure | |
|---|---|
| **Technology** | **Incentives** |
| Forklifts | $500 |
| Aircraft Tractors / Pushbacks | $600 |
| Baggage / Tow Tractors | $400 |
| Belt Loaders | $400 |
| Ground Powered Units | $600 |
| Truck Refrigeration Units | $200 |
| Truck Stop Electrification | $200 |
| Golf Carts | $50 |

ICF's support of this program includes full delivery of the program providing customer targeting, trade ally recruitment, technical support, account management, marketing, and IT/tracking. The annual implementation budget for the program is approximately $1M, including approximately $330,000 for customer incentives. Over three years, this program is expected to increase annual revenue by approximately $8M or 0.5 percent, with an ROI of 315 percent, and to reduce annual site carbon emissions by 76,000 tons. Similar Materials Handling programs can be developed to meet the needs of most medium and large utilities, and can be customized to address other technologies that might be present in the service territory.

## Case Study 2: Agricultural Pumping Program

Utilities that serve a territory with a significant agricultural sector can benefit from an Irrigation Pumping Program which encourages farm operators to power their irrigation systems with electricity, rather than diesel. While net savings to the farmer will vary based on rates, regulations, and fuel prices, common payback times for the farmer range between 6 months and 2 years. Additional advantages for farmers include: avoided exposure to volatile diesel prices and significantly reduced maintenance costs, along with air-quality compliance benefits in certain regions. Typically, the utility will want to target pumps in reasonable proximity to an existing 3-phase line (or even a single-phase line if adjustable speed drives/phase converters are used).

ICF's support of one such program includes:

- Geospatial mapping of well locations relative to the distribution system
- Gathering of well statistics (e.g., owner, horsepower, lift, usage, etc.)
- On the ground sales staff located in areas of high concentrations of potential wells

- Inbound and outbound telemarketing with utility call center integration
- Marketing campaign development
- Trade ally engagement strategy and activities
- Feasibility and financial analysis/sales tools
- Program management and IT tracking
- Facilitation of the line extension and CIAC process

For a utility serving approximately 9,000 agricultural accounts, this program costs approximately $3.5M per year and will, over the lifetime of the pumps, have an ROI of approximately 92 percent. Note that this program does not provide any incentives directly to the farmers since the payback is already very attractive, and the primary barriers are not financial, but are rather the lack of: education and awareness, time to navigate the line extension process, and trade ally engagement.

## Case Study 3: Forklift Program

Perhaps the easiest entry point into electrotechnology programs is a forklift program. With the increasing availability of electric forklifts in larger sizes and the improving suitability of electric lifts for outdoor use, there exists significant opportunity to encourage the displacement of diesel and LPG forklifts with electric lifts. And, with the increasing acceptance of rapid-charge technologies (which recharge a forklift in as little as 30 minutes), the ability to keep load impacts off-peak is significantly enhanced.

ICF's administration of one such program includes:

- Coordination with the utility's economic development group to identify high-value customers building new facilities and who may be purchasing or leasing fleets of forklifts
- Training of forklift dealers regarding the benefits of electric lifts, and training on how to address customer push-back and other barriers
- Participation in sales calls with forklift dealers
- Support of the incentive application process
- Establishment of trade ally support networks, including battery manufacturers
- Development of collateral and website material
- Conduct of submetering studies to establish load profiles for both rapid and conventional charge lifts

As a result of the program, almost 2,700 electric forklifts have been placed in the service territory and the market share of electric lifts has grown by 46 percent. The program has added 33MW of load, and has reduced emissions by the equivalent of 22,627 passenger cars.

## How ICF Can Help Utilities Capitalize on Electrotechnology Programs

ICF has over eight years' experience in the development of market assessments and potential studies for non-road electrotechnologies and effective implementation of electrotechnology incentive programs for utilities. ICF's proven approach for developing electrotechnology programs for utilities includes:

Technology Assessment – including development of a list of potential technologies, screening and prioritization of the technologies, and analysis of market availability and suitability for particular utility service territory.

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## About ICF International

ICF International (NASDAQ:ICFI) provides professional services and technology solutions that deliver beneficial impact in areas critical to the world's future. ICF is fluent in the language of change, whether driven by markets, technology, or policy. Since 1969, we have combined a passion for our work with deep industry expertise to tackle our clients' most important challenges. We partner with clients around the globe—advising, executing, innovating—to help them define and achieve success. Our more than 5,000 employees serve government and commercial clients from more than 70 offices worldwide. ICF's website is www.icfi.com.

**Market Assessment –** including determination of the technical potential of each technology, researching of past studies and reports, federal, state and local records, industry group and trade associations databases, development of electrotechnology penetration scenarios, estimation of related infrastructure needs, and evaluation of potential grid impacts and mitigation strategies.

**Cost Benefit Analysis –** including determination of the realistic potential of each technology, including estimation of incentive levels, costs, revenue, margin, load impact, incremental supply costs, geographic distribution system impacts, and emissions impacts and value.

**Program Design –** including development of the business case, staffing model, marketing plan, IT requirements, schedule, entry strategy, alliance opportunities, and an operating model.

**Program Implementation –** including (for utilities who choose not to implement the program internally) field sales and outreach, marketing plan execution, IT/Database Design, call center/sales desk operations, and incentive processing.

For questions or program inquiries, please contact:

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