

# Propane Technology Review

2010



## About the Propane Education & Research Council

The Propane Education & Research Council (PERC) promotes the safe, efficient use of propane as a preferred energy source. With the passage of the Propane Education and Research Act (PERA) in 1996 by the U.S. Congress, the propane industry conducted a referendum among propane producers and marketers, who overwhelmingly approved the formation of PERC.

PERC is funded by an assessment or “check-off” on each gallon of odorized propane gas sold. Through PERC, the propane industry has undertaken a multidisciplinary effort to improve consumer and employee safety, fund research and development of new and more efficient propane equipment, and expand public awareness of propane and its many uses and advantages.

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Mark Leitman, *director of agriculture programs*

### Credits

This report was prepared by Energetics Inc. for the Propane Education & Research Council.

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# Welcome

Propane is a clean, safe, efficient fuel for an increasingly sophisticated energy era. As energy options change, new and innovative propane technology is essential to win new customers and better serve existing markets.

For more than a decade, the Propane Education & Research Council (PERC) has supported the development of propane technology to drive industry growth. Our three technology committees — the Research and Development Advisory Committee, the Engine Fuel Advisory Committee, and the Agriculture Advisory Committee — have guided research and development efforts to produce new concepts and products. More groundbreaking technology in our portfolio comes closer to market readiness every day.

To realize the potential of our R&D efforts, we have refined our technology development strategy to focus on bringing new products to market. This change supports the 2008–2012 *PERC Strategic Plan*. Commercialization is important because it helps move innovations out of the laboratory and into our lives. It not only drives industry growth but also provides more efficient ways for consumers to use propane in their homes and businesses and on their farms.

To support this approach, PERC published the [2009 Propane Research and Development Roadmap](#), which includes commercialization as a key focus area. PERC is implementing a new product development process under the leadership of its chief commercial officer.

The following pages review technology that recently came to market as a result of our committees' programs, projects, and partnerships. These technology efforts took the dedicated support of volunteers from all sectors of the propane industry.

In residential and commercial markets, we took steps toward commercializing the Generac premium generator set, which can be integrated with remote, off-grid solar or wind power generation installations to boost efficiency and reliability. We also demonstrated the Freewatt Plus, which offers cost-effective, reliable heat and power for homes and businesses.

In engine fuel markets, we brought new medium-duty engines and trucks to market for fleet and farm use. The exciting new Roush F-250 pickup — which we drove through America's heartland in a demonstration tour — came to market as the first in a line of medium-duty trucks and vans. And development of the General Motors Corp. 6.0-liter engine for light- and medium-duty trucks and vans continued.

In operational R&D, our equipment testing program provides objective comparative data on the performance of remote tank level monitoring systems, underground tank coatings, and other equipment for the safe handling of propane.

In agricultural markets, we studied the market for thermal weed control technology, and our findings are shaping our technology development efforts. We also achieved Environmental Protection Agency certification for the GM 5.7-liter and the Ford 4.0-liter stationary engines for agricultural irrigation. Certification will ensure that the engines can be sold nationwide.

PERC also took steps to determine the green benefits of propane technology. Our analysis showed that propane offers lower greenhouse gas emissions than other fuels in key applications, and we continued to develop and validate other emissions-reducing technology, such as next-generation fixed maximum liquid level gauges. This work will help the industry attract eco-savvy consumers to propane products.

PERC will continue to work with leading manufacturers to develop and commercialize products that bring safe, innovative uses of propane into our homes, farms, businesses, and vehicles.



Roy Willis, president and CEO  
Propane Education & Research Council



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## Innovation Drives Industry Growth

In 2008 and 2009, PERC researched, developed, and commercialized new technology in promising market areas for propane. These products — including combined heat and power systems, irrigation engines, and on-road vehicles — have the potential to reduce greenhouse gas emissions, improve operational and equipment efficiency, and contribute to increased propane sales.

### Micro-CHP

- [Freewatt Plus](#) — a micro-CHP (combined heat and power) system fueled by propane — converts 90 percent of fuel energy to electricity and heat, while grid-based generation converts only 35 percent of fuel energy to electricity.
- [Freewatt Plus](#) offers homeowners the ability to reduce carbon dioxide emissions by approximately 25 percent, compared to using only grid power.
- A single [Freewatt Plus](#) unit is estimated to consume 1,500 gallons of propane per year.

*For more information on residential and commercial technology, see pages 4–5.*

### Irrigation Engines

- The [GM 8.1-liter and the Ford 6.8-liter irrigation engines](#) produce 9.6 to 16 horsepower-hours of work per gallon of propane consumed, exceeding the current Nebraska Pumping Plant Criteria standard.
- On average, [propane irrigation engines](#) produce 24 percent fewer emissions than gasoline irrigation engines.
- Each new [Ford 4.0-liter irrigation engine](#) is estimated to consume more than 5,000 gallons of propane per year and each new [GM 5.7-liter irrigation engine](#) is estimated to consume more than 9,000 gallons of propane per year.

*For more information on agricultural technology, see pages 6–7.*

### On-Road Vehicles

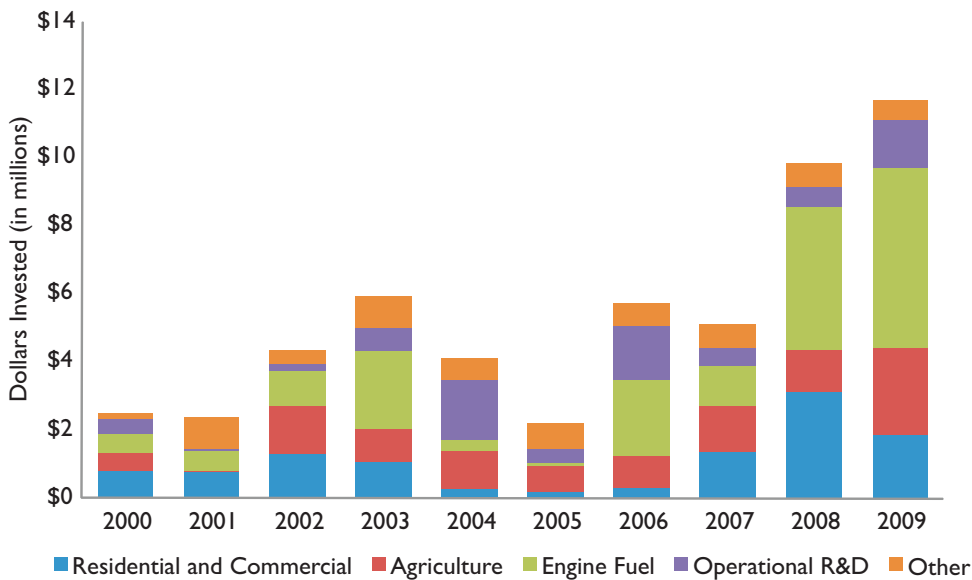
- New Roush liquid propane injection conversion kits are 30 percent more powerful than older kits that relied on vapor injection.
- Compared to the gasoline version, the new F-250 liquid propane injection conversion reduces greenhouse gas emissions by 10 percent.
- The number of on-road propane-fueled vehicles is expected to increase by almost 65 percent between 2010 and 2015 to a total of more than 88,000 vehicles.

*For more information on engine fuel technology, see pages 8–9.*

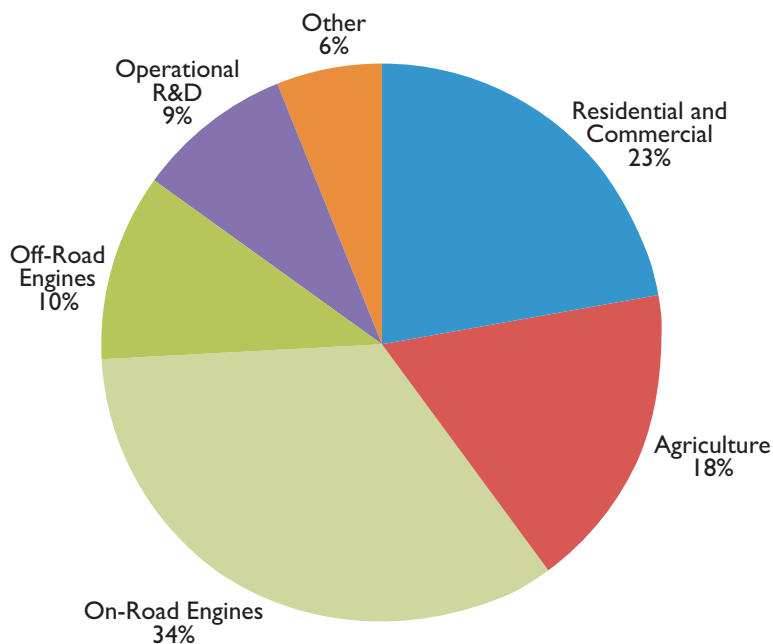
# Financial Summary

## R&D Investments, 2000–2009

PERC's R&D mission invests in research, development, and commercialization activities to expand propane markets, reduce costs, enhance safety, and improve environmental performance. In 2008 and 2009, PERC allocated considerable resources to develop and commercialize propane products in the residential and commercial, agricultural, and engine fuel markets. In 2010, PERC plans to invest more than any previous year to support R&D.

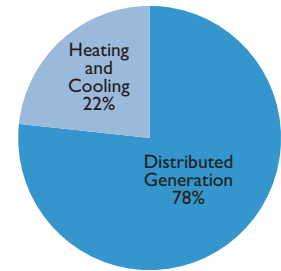


## 2008–2009 R&D Investments

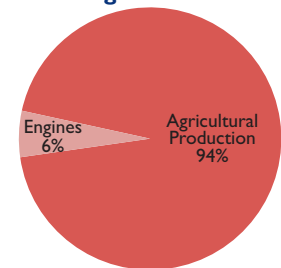


## R&D Investments by Category, 2008–2009

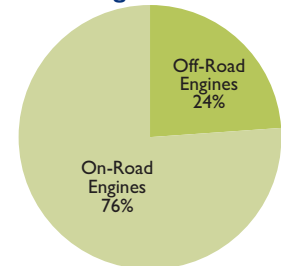
### Residential and Commercial



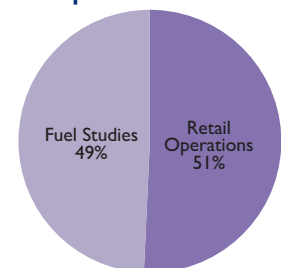
### Agriculture



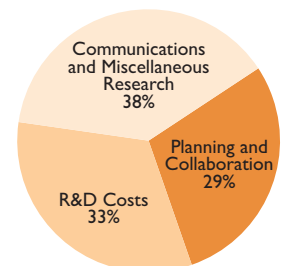
### Engine Fuel



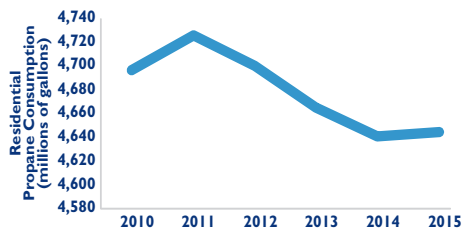
### Operational R&D



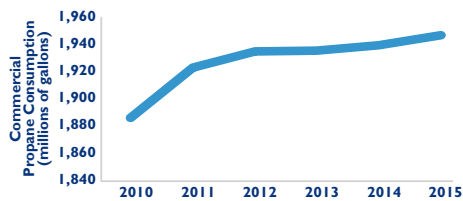
### Other



# Residential and Commercial



Annual residential housing starts are expected to double between 2010 and 2015.



Annual commercial propane sales are expected to increase by more than 60 million gallons between 2010 and 2015.

## Premium gensets enhance hybrid renewable energy installations

Integrating a premium propane generator set into a solar or wind energy system provides low-cost, efficient, and reliable on-site power generation. A survey of generator dealers showed that hybrid systems are a significant potential growth market — more than half of the dealers surveyed expect renewable energy to represent 11 percent to 50 percent of their sales by 2020. To capitalize on this opportunity, three efforts are focusing on developing premium propane gensets for hybrid renewable power generation systems:

- *Premium Genset Development and Commercialization (Docket 15490)* is developing a [6-kilowatt premium Generac genset](#) that is optimized for use in propane hybrid renewable systems.
- *Midsized Extended Run Generator (Docket 16413)* is developing an 11-kilowatt Generac genset for use in grid-tied green homes and for telecommunications and demand response applications.
- Under *Heavy Duty Residential and Commercial Hybrid Generator (Docket 16054)*, Kohler is developing a genset optimized for use in residential and commercial off-grid hybrid applications. The Kohler system is likely to include a variable-speed 6-kilowatt direct current output for use with renewable energy sources and a 14- to 18-kilowatt alternating current output for accommodating large loads.

Propane-fueled distributed generation in off-grid U.S. homes represents 53 million gallons of potential new propane sales per year.



## New gensets integrate propane tanks for more portable power

Portable propane gensets typically use an external fuel tank to provide reliable power generation almost anywhere, including construction sites, events, recreational sites, and emergency situations. To improve transportability of these units, two R&D efforts are developing generators with propane tanks integrated into the design:

- *Towable and Rental LPG Fuel Generator Sets (Docket 16053)* is developing a line of lower-emission propane-fueled towable/rental Kohler generators ranging from 25 to 100 kilowatts for the commercial market. The generators will be EPA-compliant, Department of Transportation-approved, cost-effective alternatives to EPA Tier 4-certified units fueled by diesel.
- *Propane Portable Generator Line (Docket 16414)* is designing, testing, and commercializing a [line of portable Generac generators](#) that incorporate DOT-approved propane cylinders in place of an exterior tank. The line includes a 1.6- to 2.0-kilowatt unit for recreational use, a multipurpose portable 3- to 4-kilowatt unit, and a 5-kilowatt unit for conventional storm response.

## Market assessment evaluates distributed generation potential

Recent advances have made propane-fueled distributed generation more competitive with conventional power generation systems. To determine the potential U.S. market for new propane distributed generation applications, *Develop a [Propane Distributed Generation Market Assessment](#) (Docket 15487)* completed a technology and market assessment for applications less than 1 megawatt in size. The study found that propane distributed generation could have the greatest impact in combined heat and power applications for industrial facilities and commercial complexes including office buildings and hotels. In addition, hybrid renewable power generation showed significant potential for increasing propane sales in off-grid residential applications — more than 50 million new gallons of propane per year.

## Demonstrations help bring Freewatt Plus to market

*Commercialization of Freewatt Plus Micro-CHP System (Docket 15625)* embarked on a comprehensive one-year demonstration and field test of the highly efficient [Freewatt Plus micro-CHP system](#) at 10 homes in the upper Midwest and the Northeast. Data collected from the demonstration units will help researchers fine-tune the Freewatt Plus for market entry. Coordinated marketing and outreach will help spur consumer adoption.



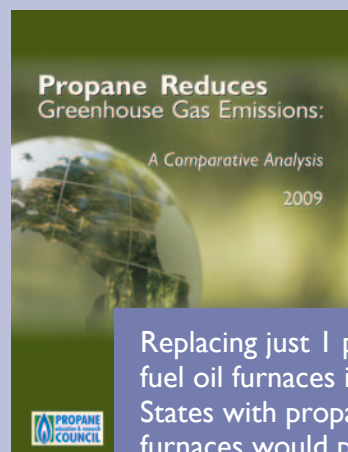
## Research explores propane's green benefits

In response to rising demand for efficient, low-emission technology, several projects explored propane's potential environmental benefits.

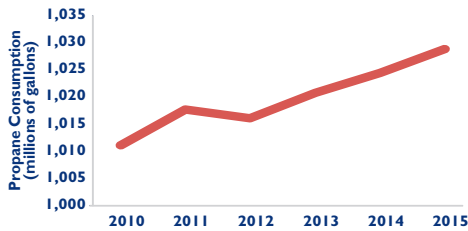
*Expert Analysis for the Concept of Synthetic and/or Biopropane (Docket 15866)* developed key R&D and business strategies for the commercial production of synthetic propane, biopropane (from biomass feedstocks), and clean-burning dimethyl ether.

*Greenhouse Gas Emissions for Propane Equipment Analysis II (Docket 15964)* compared the greenhouse gas emissions profile of propane to those of other fuels in 13 commercial and residential, engine fuel, and agricultural applications. The study confirms that propane offers lower greenhouse gas emissions than other fuels in all 13 applications analyzed, performing especially well in residential space heating, dehumidifiers, medium-duty trucks and truck engines, irrigation pumps, and commercial mowers.

*Expert Analysis of Propane's Ozone-Forming Potential (Docket 16303)* began compiling and measuring emissions from devices representing a range of propane combustion processes. The study will use the measurements to assess propane's potential to form ozone and greenhouse gases to ensure fair treatment by the EPA.



Replacing just 1 percent of all fuel oil furnaces in the United States with propane-fueled furnaces would prevent more than 2 million tons of greenhouse gas emissions over the lifetime of the systems — the same impact as removing 300,000 sport utility vehicles from the road for an entire year.



Each year, more than 1 billion gallons of propane — approximately 10 percent of annual U.S. odorized propane sales — are sold to the agricultural sector.



## Certifications and demonstrations introduce new engines to the market

Emissions certifications and field demonstrations are essential to assure consumers that new propane engines can perform efficiently and reliably in the real world. Five projects took these critical steps to help introduce new engines to the agricultural market:

- *U.S. EPA Certification of GM 5.7L Stationary LPG Engine (Docket 15667)* obtained EPA and California Air Resources Board emissions certification of the [GM 5.7-liter engine](#) used for irrigation.
- *EPA and CARB Certification of a Ford 4.0-Liter Industrial Engine (Docket 16081)* is working to achieve EPA and CARB certification of the [Ford 4.0-liter engine](#).
- Field evaluations and demonstrations of the [GM 8.1-liter and Ford 6.8-liter irrigation engines](#) conducted by *Economic Analysis and Demonstration of Propane Irrigation Engines – Phase 2 (Docket 12296)* gathered data that will help to update irrigation engine performance standards and promote more energy-efficient and cost-effective irrigation.
- *Emission, Economic, and Performance Analysis Propane-Fueled Mower (Docket 12409)* seeks to confirm that propane-fueled mowers are a cheaper and cleaner alternative to gasoline mowers for turfgrass management.
- *Propane Vehicle Statistical Data Research (Docket 15607)* is converting at least 10 Department of Agriculture vehicles to run on propane, collecting weekly or monthly vehicle data and providing vehicle viewing opportunities across the country.

## Research drives flame weeder toward commercialization

[Propane-fueled flame weeders](#) use a concentrated flame to control weeds, complying with organic crop farming standards. Several efforts to commercialize these units are helping the propane industry capture even more of the U.S. organic farming market, which totals close to 2 million certified acres of cropland.

*Determining Biologically Effective Propane Dose for Weed-Crop Flaming (Docket 12202)* established the propane dose for specific weed species and corresponding crop tolerance to these doses at various crop growth stages, while *Crop Yields as Influenced by the Propane Dose (Docket 12546)* determined the effects of various levels of crop injury to field corn, soybean, and sorghum crop yields.

The information gained from these studies helped to direct *Design and Optimization of a Propane-Fueled Weed-Crop Flamer (Docket 12343)*, which used computer models to design a more fuel-efficient and adjustable [flame weeder](#) for safer, more economical weed control. *Innovative Propane Flaming Technology for Crop Production (Docket 15920)* is using previous lessons learned to refine an advanced [four-row hooded flame weeder](#) for demonstrations in field corn and soybean crops.

## Steam system controls soil nematodes without chemicals

Propane-fueled steam systems are environmentally friendly alternatives to chemical treatments for the control of root-destroying soil nematodes. *Developing a Propane-Fueled Means to Control Soil Nematodes – Phases 1 and 2* (**Dockets 12203** and **12423**) designed, fabricated, and field-tested a prototype aerated steam system and developed a plan for commercialization.

These projects led to *Steam as a Methyl Bromide Alternative in Florida and California* (**Docket 12582**), which is evaluating the economic feasibility of this soil-disinfestation technology and a tandem soil and solarization system in high-value cut flower and strawberry crops. *Develop and Commercialize Steam Disinfestation Technologies* (**Docket 16408**), also resulting from previous steam system efforts, aims to commercialize up to three options for deploying steam for nematode control.



An average-size farm would use nearly 7,000 gallons of propane by treating crops with flame weed control twice a year.

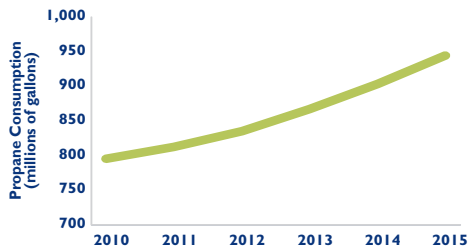
## Temp-Air process expands versatility of heat sanitation technology

The [Temp-Air thermal remediation process](#) uses a direct-fired propane heater to control pests in food- and feed-processing facilities and storage structures. Two projects are currently under way to refine this effective process and increase its use:

- *Temp-Air Thermal Remediation Program – Phase 2* (**Docket 16420**) is upgrading a [thermal remediation system](#) pioneered by *Thermal (Pest) Remediation in Grain and Other Ag Structures* (**Docket 11958**). The project is developing and field-testing a unit for use in smaller bins, silos, and storage facilities; identifying agricultural market segments that are likely to adopt propane-fueled pest and pathogen control products; and finalizing a business plan to upgrade and build equipment for these sectors.
- *Heat as Alternative to Fumigants in Grain Facilities* (**Docket 16024**) is optimizing the effectiveness of whole-structure heat treatment fueled by propane in grain-processing facilities and demonstrating the system at commercial facilities.



# Engine Fuel



The number of propane-fueled vehicles in operation (including on-road, off-road, and forklifts) is expected to increase by 14 percent between 2010 and 2015, to a total of nearly 885,000 vehicles.

## Fuel injection engines power vehicles efficiently

To improve the efficiency and performance of Kohler's medium-duty (19 to 41 horsepower) internal combustion engines, *Closed-Loop Electronic Fuel Injection (EFI) LPG Engines (Docket 16296)* is converting Kohler's entire twin-cylinder gasoline engine line to a closed-loop electronic propane fuel injection system. The EFI technology will be available in 26 models that are suitable for use in industrial, commercial turf, and welder applications.

*GM 6.0L LPG Engine Emissions Certification and Durability Development (Docket 12413)* is developing and testing a mono-fueled liquid propane injection system for the GM fourth-generation 6.0-liter engine. The versatile 6.0-liter engine can be fitted in light-duty, heavy light-duty, and medium-duty GM trucks and vans and will undergo both durability and emissions testing before commercialization. This effort marks the first time the new GM 6.0-liter engine will be offered in a dedicated propane application.

Annual sales of the GM 6.0-liter engine could exceed 4,000 vehicles, which would generate more than 8 million gallons of new propane demand each year.



## Innovative vehicles offer new choices for fleets

Propane-fueled vehicles can help fleet managers meet environmental standards without sacrificing performance. Two new projects are helping propane capture a larger share of the fleet vehicle market:

- *Type-A School Bus NHTSA Testing (Docket 16332)* is designing, developing, and commercializing the first Type A school bus that uses a liquid propane injection system. The Type A school bus, which transports smaller busloads of passengers than Type C buses, will add to propane's marketable lineup of school buses. Once testing and development are complete, technology demonstrations will begin in Texas, Oregon, Washington, New York, and California.
- *Roush Multi-year/Multi-model Propane Engine Fuel Program (Docket 15494)* is designing and commercializing four new propane-fueled Ford vehicles: the 2010 Ford F-250 and F-350 trucks, and the 2010 and 2011 Ford E-150 to E-450 vans. To increase their marketability, these vehicles will undergo environmental and performance certification. The propane F-250 and F-350 have already received CARB approval, and the propane E-250 van has qualified for a Super Ultra-Low Emission Vehicle emissions rating, making it eligible for an 80 percent conversion tax credit.

## Propane-fueled engines power lawn and turf equipment

The growing market for low-emission outdoor equipment has created a substantial opportunity for propane. *Development of Propane Outdoor Power Equipment (Docket 16312)* is expanding Lehr's lineup to include a commercial engine. These engines will enable the development of several new products, including commercial leaf blowers, Eco Trimmers, and consumer leaf blowers and reel mowers.

Kawasaki's line of propane lawnmower engines is also undergoing testing to confirm that the engines are cleaner burning than gasoline mower engines. *Propane Fuel Systems for New Kawasaki Engine Platforms (Docket 15961)* is measuring the emissions, carbon footprint, and performance of the mowers and aims to achieve EPA's Blue Sky emissions control standards.

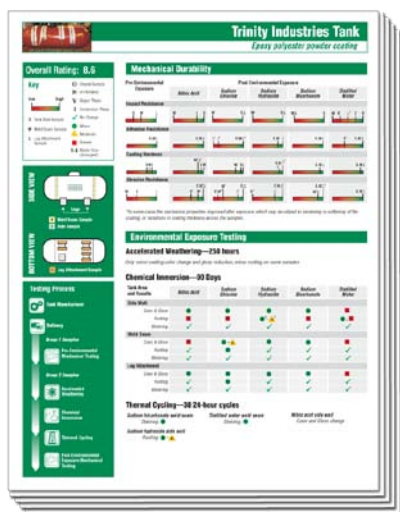


## Manufacturer partnerships drive on-road vehicle commercialization

Many of PERC's successful efforts to develop engines and vehicles have a strong manufacturing partnership at their core. PERC will continue to partner with manufacturers through the following projects:

- Building on the success of the F-150, F-250, and F-350, Roush is again partnering with Ford and PERC to design the new propane-fueled 2010 and 2011 Ford truck and van models under *Roush Multi-year/Multi-model Propane Engine Fuel Program (Docket 15494)*. This partnership has historically enabled Roush to develop vehicles using Ford's existing platforms and distribute them via Ford's network of large fleet dealers, expediting the commercialization process. With new vehicles under development and continued support from Ford and PERC, Roush expects to build annual sales to 5,000 units.
- Blue Bird, CleanFuel USA, and Power Train Integration have come together with PERC under the *Blue Bird Vision School Bus Engine Finance Program (Docket 16139)* to ensure the continued success of the propane-fueled Vision school bus. The partnership is financing the completion and sale of 750 discontinued GM 8.1-liter engines for use in Vision buses to help further expand the propane school bus market.
- *Type-A School Bus NHTSA Testing (Docket 16332)* relies on a strategic partnership between CleanFuel USA, Collins Bus, and PERC. CleanFuel USA's liquid propane injection system and base platform chassis will serve as the foundation for the bus that Collins Bus — a leading manufacturer of Type A school buses — will produce. In addition, Collins Bus has over 55 dealers in its existing distribution network to aid in commercialization.





The results of [Testing and Evaluation of Underground Propane Tank Coatings \(Docket 12469\)](#) are available in a [series of easily comparable fact sheets](#). To download this series, visit [www.propaneresearch.com](http://www.propaneresearch.com).



The growing number of new propane products entering the market underscores a need for strong infrastructure. Operational R&D supports technology commercialization by ensuring that the propane industry runs efficiently, safely, and at the high level of quality that customers expect.

## Comparison testing provides marketers with useful performance data

Equipment comparison tests measure the performance of equipment used by the propane industry. The resulting information helps marketers identify which product best meets their needs.

[Testing and Evaluation of Underground Propane Tank Coatings \(Docket 12469\)](#) compared the performance of seven propane tank coatings from five tank manufacturers. Stringent mechanical and environmental testing showed that, overall, powder coatings perform better than liquid coatings and that welded seam areas often do not perform as well as side or leg areas. [Performance Testing of Remote Tank Level Monitoring Systems for Bulk, Commercial, and Residential Propane Tanks \(Docket 16112\)](#) is also conducting performance tests to assess the effectiveness of remote propane tank-level monitoring systems.

## Fuel studies provide insight for improving fuel quality

Consistent, quality fuel is essential for the efficient operation of propane equipment and engines. These efforts are gaining a better understanding of fuel quality issues:

- [Fuel Sampling and Analysis Program \(Docket 15683\)](#), a testing program at Southwest Research Institute, is troubleshooting equipment and engine problems in the field to determine whether fuel composition is the cause. The program provides direct support to marketers to help them to continue providing the highest quality fuel to customers.
- To gain a better understanding of how varying fuel composition affects performance and how to remediate or prevent potential issues, the [Study of LPG Deposit Formation Mechanisms and Mitigation Methods \(Docket 12116\)](#) identified factors that influence the formation of deposits in propane vaporizers and possible ways to prevent deposits from forming.
- [LPG Additive and Filter Effectiveness Studies \(Docket 15938\)](#) is conducting the additional testing of filters and deposit-preventing additives recommended through [Docket 12116](#).

## Low-emission gauges safely reduce emissions

[Low-emission fixed maximum liquid level gauges](#) have reduced-diameter orifices for more environmentally friendly operation. Supporting the industry's focus on low-emission equipment, [Testing of Low-Emission Fixed Maximum Liquid Level Gauges \(Docket 15198\)](#) confirmed that [low-emission FMLLGs](#) with reduced-diameter orifices pose no greater risk of freezing or clogging compared to FMLLGs with standard orifice sizes.

# Research and Funding Partnerships

PERC continues to collaborate with manufacturers, researchers, and government partners to strengthen technical knowledge, leverage funding, and maximize investments. This cooperation helps move products from the laboratory to the marketplace to increase propane's market share.

## Off-road manufacturer partnerships bring new engines to irrigation

In addition to building partnerships with on-road vehicle manufacturers (see p. 9), PERC is also working with off-road engine distributors to benefit the agricultural sector. PERC partnered with Buck's Engines and Engine Distributors Inc. to commercialize new stationary engines for irrigation pumps. As a part of this effort, the partners will work together to commercialize the [GM 5.7-liter engine](#) and certify a [Ford 4.0-liter model](#).

## Partnerships diversify propane-fueled options for on-site power generation

As the demand for on-site power continues to grow, several partnerships are developing propane-fueled power generation systems:

- Generac took steps to commercialize a [6-kilowatt premium genset](#) that can be integrated with renewable energy installations featuring solar, wind, or hybrid energy sources. Generac is also developing a midsize extended run generator and a line of portable propane generators.
- Gas Technology Institute provided expert analysis, development, and testing for a wide range of propane applications, including regulators, distributed generation systems, combined heat and power systems, and agricultural technology.
- Kohler is developing a new closed-loop liquid propane engine, a complete line of towable and rental propane-fueled generator sets, and a genset optimized for use in residential and commercial off-grid hybrid applications.

## Demonstration partnerships highlight propane's versatility

Demonstration partnerships enable PERC to showcase propane's versatility in a real-world setting. These efforts provide valuable data to researchers and help market the product prior to commercial launch.

In *Molten Carbonate Propane Fueled Fuel Cell Demonstration – HI (Docket 15165)*, Logan Energy validated the design of the propane fuel supply system for a 200-kilowatt molten carbonate fuel cell at the U.S. Navy's Pacific Missile Range Facility in Kauai, Hawaii. Once the fuel cell is operational, Logan and partners will begin propane fuel sampling and reporting during a 33-month demonstration period.

The *PERC-NPS Propane Energy Optimization Working Group (Docket 16443)* is creating a structured partnership between the National Park Service and the propane industry to demonstrate new propane equipment for use in national parks.

## 2009 Partners

### Commercialization

Alliance Autogas  
Blue Bird  
Blue Shepherd  
Buck's Engines  
CleanFuel USA  
Collins Bus Corp.  
ECR International  
Generac  
The GSI Group  
Kohler  
Lehr  
Logan Energy Corp.  
Onyx Environmental Solutions Inc.  
Polar Power Inc.  
Quaker Oats (PepsiCo)  
Roush  
Temp Air Inc.  
Yankee Scientific  
Yanmar America Corp.

### Additional R&D

Battelle Memorial Institute  
California Clean Air Technologies LLC  
California State University, Fresno  
Central Texas Clean Cities  
Comprehensive Loss Management Inc.  
Connecticut Agricultural Experiment Station Research Foundation  
Diedrichs & Associates Inc.  
Dunlap Group  
Energetics Inc.  
Engine Distributors Inc.  
Environmental Protection Agency  
Gas Technology Institute  
Iowa State University  
JE Associates  
KTA Tator  
Ohio State University  
Propane Education Foundation of Alabama  
Resource Dynamics Corp.  
Southwest Research Institute  
University of California, Riverside  
University of Nebraska, Lincoln  
Welch Propane

# Looking Ahead

Develop New Technologies

Commercialize New Products

Improve Operation of the Industry

Conduct Communications and Outreach

Propane is the fuel of choice where clean, affordable, safe, and reliable energy is required.

[PERC R&D strategy through 2012](#)

The commercial success of products like the [GM 5.7-liter engine](#) and the propane-fueled F-150 and F-250 trucks has proven PERC's ability to bring innovative propane applications to market. Looking ahead, PERC plans to continue accelerating and formalizing technology commercialization efforts. Guided by the [2009 Propane Research and Development Roadmap](#) and a new, structured process for project and portfolio evaluation based on industry best practices, PERC will support full commercialization of market-ready technology to realize new propane applications and increase propane demand.

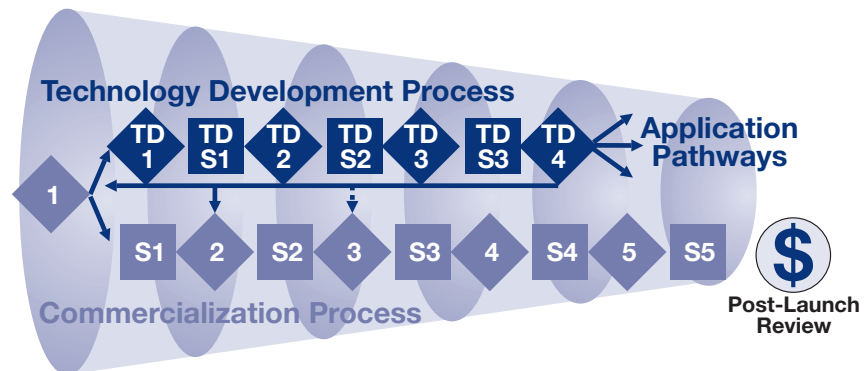
## Updated R&D strategy emphasizes commercialization

Aligning guidance from the [PERC Strategic Plan](#) with the challenges and opportunities driving the propane industry, the [2009 Propane Research and Development Roadmap](#) describes a new strategic framework that will guide research, development, and commercialization efforts through 2012. The roadmap centers on four strategic priorities that will enable PERC to maintain a balance between innovation and accelerated technology commercialization:

- **Develop new technologies:** research and develop innovative propane technology to increase propane use year-round and nationwide.
- **Commercialize new products:** allocate resources to support achieving market readiness and acceptance.
- **Improve operation of the industry:** increase the efficiency and safety of operations to maintain and grow the industry's customer base.
- **Conduct communications and outreach:** inform the industry, government, and the public about propane and propane technology.

## New procedure improves technology evaluation

PERC's new operating framework was implemented to raise both the quantity and the quality of propane projects and to improve overall management of its project portfolio. The framework increases PERC's leadership role in stimulating the development of propane-fueled equipment, appliances, and vehicles for residential, commercial, agricultural, and fleet markets. A new procedure called the Propane Equipment Launch (Propel) will bring more rigor and discipline to PERC's technology mission by clarifying which projects merit further developmental support and which should be deemed complete. This process also strives to better align product development with market needs and potential.



# Recent Grants

12464 PERC Blue Bird Propane Vision Demonstration Program \$120,000	15217 PERC Batchen Stinger Steam Weeder – Fabrication \$129,000	15667 Buck's Engines U.S. EPA Certification of GM 5.7L Stationary LPG Engine \$106,000	16139 PERC/Blue Bird/CleanFuel USA/ Powertrain Integration Blue Bird Vision School Bus Engine Finance Program \$1,397,703
12546 University of Nebraska, Lincoln Crop Yields as Influenced by the Propane Dose \$104,324	15236 California State University, Fresno Stinger Efficacy & Economics Survey \$131,933	15683 PERC/Southwest Research Institute Fuel Sampling and Analysis Program \$50,000	16142 CleanFuel USA 6.0-Liter W42 Custom Workhorse Chassis Liquid Propane Application \$245,975.96
12569 PERC Validation and Commercialization of NovelAire's Desiccant Dehumidifier (Comfort Dry 400) \$617,113	15286 Diedrichs & Associates Inc. Orchard Heater – Phase II \$35,000	15866 PERC/Gas Technology Institute Expert Analysis of the Concept of Synthetic and/or Biopropane \$99,261	16144 PERC Engineering Analysis of Aftermarket Tank Installation \$16,360
12570 PERC Distributed Generation Project Development and Implementation 2008 \$204,460	15384 JE Associates Disinfesting Food Processing Facilities with Heat \$137,500	15920 University of Nebraska, Lincoln Innovative Propane Flaming Technology for Crop Production \$274,000	16227 CleanFuel USA Heavy Duty OBD II 6.0-Liter L96 Engine Demonstration Testing \$192,759.50
12579 Diedrichs & Associates Inc. Electronic Ignition Control System for Propane Orchard Heaters \$32,000	15385 PERC Reducing Soil Erosion through Thermal Pest Control \$60,220	15938 PERC/Southwest Research Institute LPG Additive and Filter Effectiveness Studies \$449,300	16245 PERC/Gas Technology Institute/ Yanmar America Corp. Development, Testing, and Demonstration of Micro-CHP (Yanmar) \$795,000
12580 Connecticut Agricultural Experiment Station Research Foundation Reducing Blacklegged Tick Populations with Propane Torches in Controlling Invasive Barberry \$30,000	15451 JE Associates Optimization of Propane Steam Generator for Soil Sanitation \$29,100	15948 Ohio State University Propane Flaming of Sand to Reduce Bacteria Counts in Bedding \$116,176	16296 Kohler Closed-Loop Electronic Fuel Injection LPG Engines \$725,000
12581 Blue Shepherd Batchen Stinger Reliability and Water Trials \$16,500	15474 Welch Propane Flame Tiller for Sanitizing Litter in Poultry Houses \$62,955	15961 Onyx Environmental Solutions Inc. Propane Fuel Systems for New Kawasaki Engine Platforms \$100,000	16303 PERC/University of California, Riverside Expert Analysis of Propane's Ozone-Forming Potential \$300,000
12582 JE Associates Steam as a Methyl Bromide Alternative in Florida and California \$145,200	15487 PERC/Resource Dynamics Corp. Develop a Propane Distributed Generation Market Assessment \$165,000	15964 PERC/Energetics Inc. Greenhouse Gas Emissions for Propane Equipment Analysis II \$82,000	16306 Osborn & Barr Communications Agriculture Technology Demonstration and Validation Program \$586,000
15123 Diedrichs & Associates Inc. Farm Cart for Refueling Agricultural Equipment \$218,000	15489 PERC Testing Regulator Capacity at Different Operating Conditions \$83,009	16024 PERC/EPA/Quaker Oats (PepsiCo) Heat as Alternative to Fumigants in Grain Facilities \$73,900	16312 Lehr Development of Propane Outdoor Power Equipment \$915,600
15165 Logan Energy Corp. Molten Carbonate Propane Fueled Fuel Cell Demonstration – HI \$107,500	15490 PERC/Generac Premium Genset Development and Commercialization \$524,000	16053 PERC/Kohler Towable and Rental LPG Fuel Generator Sets \$420,000	16332 Collins Bus Corp. Type A School Bus NHTSA Self-Certification Testing \$503,546
15177 Polar Power Inc. Advanced Premium Genset \$215,000	15494 Roush Roush Multi-year/Multi-model Propane Engine Fuel Program \$3,975,725	16054 PERC/Kohler Heavy Duty Residential and Commercial Hybrid Generator \$667,500	16397 PERC 2010 RDAC Oversight and Advisory Committee Support \$230,000
15196 PERC Propane DG Demonstration Program – Phase II \$350,000	15532 Dunlap Group California Air Resources Board (CARB) Certification Road Map \$60,000	16081 Engine Distributors Inc. EPA and CARB Certification of a Ford 4.0-Liter Industrial Engine \$106,000	16408 Gas Technology Institute Develop and Commercialize Steam Disinfestation Technologies \$889,016
15198 PERC/Battelle Testing of Low Emission Fixed Maximum Liquid Level Gauges \$105,000	15607 Propane Education Foundation of Alabama Propane Vehicle Statistical Data Research \$65,000	16086 CleanFuel USA Cab Chassis Tank Application for 6.0-Liter Engine Certification \$184,631.38	16412 PERC/Generac Demonstration Units and Installations 6-Kilowatt Off-Grid Generator \$45,250
15203 PERC/Battelle Testing of Pressure Relief Valves for Customer Tanks \$446,700	15623 PERC 2009 RDAC Oversight and Advisory Committee Support \$208,000	16090 The GSI Group GSI/Purdue Dryer Energy Reduction Product Testing \$15,000	16413 PERC/Generac Midsize Extended Run Generator \$353,250
15207 Iowa State University Hot In Place Recycling of Asphalt Pavements – Market Analysis \$27,997	15624 PERC 2009 Technical Communications & Outreach \$190,000	16109 Connecticut Agricultural Experiment Station Research Foundation Controlling Barberry with Propane – Reducing Lyme Disease – Year 2 \$25,000	16414 PERC/Generac Propane Portable Generator Line \$423,750
15208 Iowa State University Propane Subbase Materials Drying Techniques and Technologies \$92,574	15625 PERC/Gas Technology Institute/ Yankee Scientific Commercialization of Freewatt Micro-CHP System \$840,000	16112 PERC/Battelle Performance Testing of Remote Tank Level Monitoring Systems for Bulk, Commercial, and Residential Propane Tanks \$375,000	16419 PERC/Energetics Inc. 2010 Technical Communications and Outreach \$195,000
15213 Gas Technology Institute Tankless Propane Air Handler Comparison Study \$95,000	15632 Energetics Inc. Update to the Research and Development Roadmap \$67,000		16420 Temp Air Inc. Temp-Air Thermal Remediation Program – Phase 2 \$496,704
	15649 California Clean Air Technologies LLC CARB Off-Road Verification of Propane Addition System \$280,000		

The PERC Grants Management System is available online at [www.percgms.com](http://www.percgms.com).



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