

# PROPANE

## Engine Fuel Roadmap

September 2005

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## Acknowledgements

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# EXECUTIVE SUMMARY

Americans use more than 700 million gallons of propane for engine fuel applications each year and is largely attributed to propane's advantages as a clean and efficient alternative to gasoline and diesel fuel.<sup>1</sup> Although propane is clearly the fuel of choice in several key segments in the engine fuel market, abundant opportunities exist for propane companies to recapture, retain, and expand propane's significant share of the engine fuel market.

The unique characteristics of propane can help fleet managers, farmers, commercial mowers, and other engine equipment users contain costs and meet increasingly stringent environmental regulations. By understanding the environmental and economic drivers of engine fuel choices, the propane industry can position itself for success in the engine fuel market.

## Market Drivers:

- Costs
- Environmental Pressures
- Incentives

The propane industry recognizes the importance of the engine fuel market, which accounts for about five percent of the total non-chemical propane used in the United States.<sup>1</sup> On October 7, 2004, the Propane Education & Research Council (PERC) approved a plan that created the Engine Fuel Coordinating Committee (EFCC), which is now responsible for PERC's engine fuel efforts. The EFCC undertakes a comprehensive approach to the market through projects that encourage the development, commercialization, and marketing of propane-related engine technologies. The EFCC seeks programs that increase off-season demand.

In order to ensure industry resources are streamlined and investments are focused on engine fuel programs, EFCC has developed this Engine Fuel Roadmap. The Roadmap represents an exciting vision for propane in the engine fuel market, strategic elements to achieve that vision and market needs. The propane industry envisions expanding propane's leading alternative fuel position and sales volume through the retention, optimization and penetration of existing and new market segments. The industry has developed strategic goals and priorities that align with the vision. Page *iii* presents an overview of the Roadmap and illustrates the engine fuel market strategy.

***Vision:*** *Expand propane's leading alternative fuel position and sales volume through the retention, optimization and penetration of existing and new market segments.*

## Strategic Elements

PERC has established five strategic elements that guide their engine fuel activities:

STRATEGIC ELEMENTS	
Research & Development	Maximize investment by developing platforms, engines, vehicles and certified fuel systems
Consumer Education & Marketing	Improve propane's market share in the engine fuel market by creating internal and external marketing and communication mechanisms
Safety & Training	Increase knowledge by developing model maintenance and training programs
Stakeholder Alliances/Partnerships	Develop programs that are easily replicated across the country in multiple markets
Market Synergies	Develop cooperative interaction among market sectors

## Engine Fuel Market Challenges

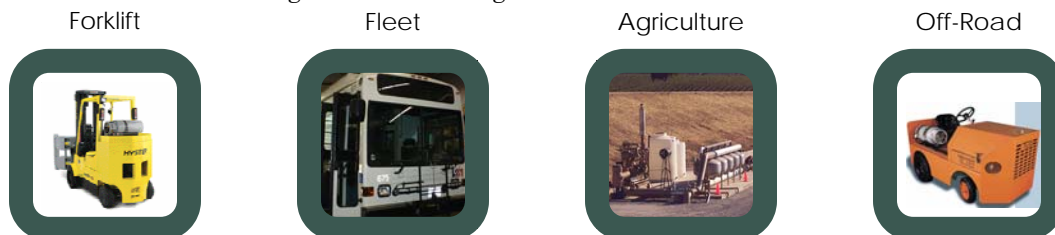
In order to expand propane's use in the engine fuel market, the following challenges must be addressed in each market segment.

Engine Fuel Market Challenges
1. Limited outreach and partnerships with original equipment manufacturers (OEMs), government, and industry organizations
2. Lack of economically competitive propane engines
3. Lack of information and education <ol style="list-style-type: none"><li>Lack of understanding emissions regulation and enforcement</li><li>Lack of awareness of external funding opportunities</li><li>Need for maintenance and training programs for each market segment</li><li>Need to improve methodology of engine fuel market statistics</li></ol>
4. Limited off-road refueling equipment

## Engine Fuel Market Strategy

The propane industry will adopt strategic activities to strengthen propane's position as the fuel of choice for engine applications. This strategy is depicted on page *iii*; the icons show the key market segments the industry will target for development, while the wheel displays the strategic elements that will drive development of the engine fuel market.

The priorities listed at the bottom of page *iii* illustrate a range of activities designed to position propane for success in four segments of the engine fuel market:



All of these priorities have the potential to significantly impact one or more of the strategic elements. The economic and environmental climate is ready for market development. By implementing the strategy and priorities of this Roadmap, the propane industry will continue to expand propane's role as an advantageous engine fuel in nearly all market sectors.

# VISION OF THE PROPANE ENGINE FUEL MARKET

Expand propane's leading alternative fuel position and sales volume through the retention, optimization and penetration of existing and new market segments

## STRATEGIC ELEMENTS

### RESEARCH & DEVELOPMENT

- Maximize investment by developing platforms, engines, vehicles and certified fuel systems

### SAFETY & TRAINING

- Increase knowledge by developing model maintenance and training programs

### CONSUMER EDUCATION & MARKETING

- Improve propane's market share in the engine fuel market by creating internal and external marketing and communication mechanisms

### STAKEHOLDER ALLIANCES/PARTNERSHIPS

- Develop programs that are easily replicated across the country in multiple markets

### MARKET SYNERGIES

- Develop cooperative interaction among market sectors

## CHALLENGES

- Limited outreach and partnerships with OEMs, government, and industry organizations
- Lack of economically competitive propane engines
- Limited off-road refueling equipment
- Lack of information and education
  - Emissions understanding
  - Funding awareness
  - Maintenance and training
  - Market statistics methods

## ENGINE FUEL MARKET STRATEGY

### STRATEGIC ELEMENTS

Drive development of the propane engine fuel market



## TOP PRIORITIES

### FORKLIFT

- Reduce cost of maintenance and training
- Build stakeholder relationships
- Develop external marketing programs
- Develop engine data and qualification

### FLEET

- Heavy duty vehicles
  - Increase OEM outreach
  - Increase new product availability
- Develop sole resource to initiate contact with fleets
- Develop service and training programs

### AGRICULTURE

- Develop irrigation pumping
- Improve propane-fueled engine durability
- Develop mobile and nonmobile farm equipment
- Stimulate broad propane industry support

### OFF-ROAD

- Develop applications in
  - commercial mowing
  - airports
  - ports
- Develop auxiliary power units
- Identify and develop construction equipment needs

# I. OVERVIEW OF ENGINE FUEL MARKET

## *History*

Since the 1920s, engine fuel has played an important role in increasing the market mix for propane demand. In fact, several propane retail operations operate solely to serve the engine fuel market. The engine fuel market presents year round opportunities for propane sales, use of tanks and trucks and helps build summertime pipeline allocations. In the last several decades, propane has become an integral part of the “clean air” agenda of legislators and regulators. Summer markets traditionally enjoy lower fuel costs that offer real savings to customers. However, allegiance by some propane marketers has waned recently due to escalations in conversion costs and wide variations in propane prices. Additionally, the increasing sophistication of servicing underhood equipment has grown beyond the capability of most technicians; therefore many OEMs have discontinued offering propane powered vehicles.

Over the last 50 years, the market has swayed in many directions and changed significantly. However, one consistent factor has been customer interest and loyalty. Air quality issues, legislative mandates and incentives, OEM support and propane vehicle development are the challenges facing the propane industry today. While cost was a major market driver for propane, the ability to operate an engine while meeting emission standards has become increasingly more important. Recent clean air legislation which offers new incentives to purchase clean burning engines, will enable propane to recapture some of its lost glory and market share.

## *Market Drivers*

New and upcoming engine exhaust and fuel system emissions regulations, market movements such as high fuel costs for gasoline and diesel, competitive pressures to reduce costs, organic farming, social desires to clear the air we breathe, and non-financial benefits promoting fuel efficient vehicles will impact growth in all market segments. Propane dealers and distributors need marketing materials and programs that encourage participation in additional engine fuel markets. Equipment dealers need continuing outreach on product availability and continuing education and training. Industry organizations need to understand the benefits of propane as an engine fuel along with other industrial and consumer applications. State and local air quality regulatory agencies also need to understand the benefits of propane in a variety of engine applications. Streamlining industry resources to effectively manage these issues across propane engine fuel market segments will maximize industry investment and foster propane industry growth.

The propane industry looks to expand the use of propane as an engine fuel by capitalizing on exciting opportunities with the U.S. engine equipment and vehicle industries. The introduction of new propane products could revolutionize the way heat and power is created for industry and homes, solve major environmental issues, and stimulate economic growth. The economic and environmental climate is ready for market development. The time is right for the engine fuel segment of propane to transform itself to secure its position as the leading alternative fuel for years to come.

## *Vision*

*Expand propane’s leading alternative fuel position and sales volumes through the retention, optimization and penetration of existing and new market segments*

The customer will view propane as an exceptional source of energy for a wide range of applications in forklifts, fleets, agriculture equipment, and off-road equipment. As such, propane will need to solve some of the most daunting operational and competitive challenges safely, cleanly, reliably, and economically.

### *Strategic Elements*

The propane industry is committed to its vision of engine fuel markets. To help guide its efforts to realize this vision, the industry has established strategic priorities that, if achieved, will position the industry for success in engine fuel markets. The following are five strategic elements for the engine fuel market:

<b>STRATEGIC ELEMENTS</b>	
<b>Research &amp; Development</b>	Maximize investment by developing platforms, engines, vehicles and certified fuel systems
<b>Consumer Education &amp; Marketing</b>	Improve propane's market share in the engine fuel market by creating internal and external marketing and communication mechanisms
<b>Safety &amp; Training</b>	Increase knowledge by developing model maintenance and training programs
<b>Stakeholder Alliances/Partnerships</b>	Develop programs that are easily replicated across the country in multiple markets
<b>Market Synergies</b>	Develop cooperative interaction among market sectors

## Challenges to Achieving Strategic Elements

Several critical challenges need to be addressed in each market segment in order to expand propane's use in the engine fuel market:

### ✦ **Limited outreach and partnerships with Original Equipment Manufacturers (OEM), government, industry organizations**

- **Need to Develop Original Equipment Manufacturers (OEM) Relationships** – market development is dependent on industry working with OEMs, especially in the off-road segment
- **Need to Increase Government Outreach and Develop Partnerships** – industry needs to increasingly promote the advantages of propane to federal, state, and local governments, particularly on how propane will improve environmental compliance with transportation improvement plans and state implementation plans
- **Need to Develop Propane Industry Organization Outreach** – working with industry organizations to build relationships and partnerships to actively promote the advantages of propane and encourage increased use

### ✦ **Lack of economically competitive propane engines** - new product offerings are essential for the development of the propane engine market

### ✦ **Limited off-road refueling equipment** - the lack of remote propane storage and refueling equipment is perceived as a significant impediment to more widespread adoption of propane-fueled mobile off-road technologies in the agricultural sector

### ✦ **Lack of Information and Education**





- **Lack of Understanding Emissions Regulation and Enforcement** – an important role in market development is to improve the propane industry's understanding of current and future emissions regulation, particularly regarding compliance, environmental stewardship, reduction issues, and propane's ability to help government achieve its environmental goals
- **Lack of awareness of external funding opportunities** - although funding exists at the federal and state levels of government, industry needs to take advantage of current programs and apply for funding; in addition, industry must identify, expand, and create new opportunities for engine fuel external funding
- **Need for maintenance and training programs for each market segment** - one of the most important elements to the development of the engine fuel market is the ability to maintain the products once placed in the market; model programs that achieve success in one area should also be applied to the other market segments

### ✦ **Need to improve methodology of engine fuel market statistics** - in order to measure program results and effectiveness, a statistical baseline needs to be developed as well as a mechanism to continuously measure gallons in the future

## II. PROPANE ENGINE FUEL MARKET STRATEGY



### *Market Segments*

The propane industry will adopt a comprehensive strategy to strengthen propane's position as the fuel of choice for engine applications. As such, the propane engine fuel market is divided into the following four segments:

























Forklift	 <p>Forklifts represent the largest segment of the propane internal combustion engine market. Since forklifts (except rough-duty models) are operated (mostly) indoors, propane engines have been utilized on a great majority of internal combustion engine-powered forklifts.</p>
Fleet	 <p>The fleet vehicle market includes all vehicles that operate on the national, state, and local highways and airports, including buses, cars, light- and heavy-duty trucks.</p>
Agriculture	 <p>Engines are used all over farms to power irrigation pumps and other motors. Their ubiquitous nature illustrates the important role of engines in agriculture and the large potential market in agriculture for propane as an engine fuel.</p>
Off-Road	 <p>Propane engines are used in a wide variety of off-road equipment, including commercial mowers, airport ground support equipment, mobile sweepers, commercial compressors, pumps and generator sets, industrial saws, and construction loaders and tractors.</p>



## Engine Fuel Market Relationships

The engine marketplace is a series of interconnected market segments that cover a range of horsepower and a broad scope of applications. To that end, each of the research and development programs previously undertaken by PERC and the Propane Vehicle Council (PVC) has served as building blocks to support the development of a comprehensive program that can enable significant propane penetration into the various engine market segments.

The following table illustrates the impact of challenges in each market segment. A  indicates a large number of priorities are needed to address the market barrier. A  indicates priorities are needed to address the market barrier, while a blank space indicates the area does not require priority research at this time.

**Recommended Focus Areas in Engine Fuel Market Segments**

	Forklift	Agriculture	Fleet	Off-Road
OEM Relationships				
Emissions Regulation and Enforcement				
External Funding				
Government Outreach and Partnerships				
Industry Organization Outreach				
Equipment Availability				
Maintenance and Training				
Refueling Infrastructure				
Market Statistics				

-  High activity needed
-  Medium activity needed

### III. MARKET SPECIFIC ACTIVITIES

PERC's Engine Fuel Coordinating Committee will use the Roadmap to ensure PERC investments address the most strategically important needs of each market segment as it seeks to improve its position as a preferred engine fuel. The Engine Fuel Coordinating Committee will work closely with PERC's four other advisory committees (Research & Development, Consumer Education, Safety & Training, and Agriculture Advisory Committee) on projects that overlap several mission areas. Collaborating with propane marketers, equipment suppliers, universities, and government agencies will allow PERC to leverage its investments with additional financial and technical resources, stimulating even greater innovation and progress towards the vision.

This chapter identifies the important challenges and needs facing the propane industry today in increasing the use of propane as an engine fuel. The following information is provided for each market segment listed in the following pages:

- History and description of the market
- Factors that drive the market
- Challenges to be addressed
- Description of market needs



## Forklift Market

### 1. Forklift Market

#### *History*

Forklifts are used to engage, lift and transfer palletized loads in warehousing, manufacturing, materials handling, and construction applications and are rated into one of six classes. Class 1-3 forklifts are electric motor driven and Class 4-6 are driven by internal combustion engines.

For many years, propane has been the consistent fuel of choice by Class 4-6 forklift operators. Based on shipment statistics reported by the Industrial Truck Association (ITA), the propane share of the internal combustion engine forklift market has been steadily increasing since 2001. In 2004, over 69,000 propane-fueled forklifts were shipped compared to almost 41,000 electric rider trucks.<sup>5</sup> While more than 670,000 propane-fueled forklifts currently operate in the United States, representing approximately 13.5 percent of total propane consumption, electric forklifts continue to threaten propane's share of this market segment.<sup>5</sup>

#### *Market Drivers*

Propane's preference as a forklift fuel is built upon the benefits propane offers to industrial forklift operators, including durable engine fuel systems for widely varying engine speed applications, lower carbon monoxide emissions, lower engine maintenance costs and ease of refueling. Refueling liquid propane does not involve open fuel transfer. Future trends in sales of propane forklifts will continue to be affected by non-road engine regulations and certification requirements. Emission advantages and costs are important considerations for maintaining propane's prevalent position in the market. Additionally, competitive pressures from new generation gasoline engines that reach near-zero emission levels with exhaust after treatment are being addressed with propane closed loop and exhaust treatment systems.

#### *Market Challenges*

Below are important challenges in the propane-fueled forklift market:

FORKLIFT MARKET CHALLENGES	
◆	Maintaining a competitive edge over gasoline, electric and natural gas to protect propane's current market share
◆	Limited capability to ensure fuel quality is compatible with and meets the needs of new fuel systems
◆	Lack of a mechanism that ensures proper service and maintenance of forklifts
◆	Lack of refueling methods that do not require lifting cylinders onto the rear of forklifts



## Forklift Market

### Market Needs

To address these challenges and ensure the propane forklift industry's continued success as the dominant forklift fuel, a comprehensive, multi-year approach is needed. The program consists of a multi-tiered approach targeted at all relevant stakeholders (current and future) in the forklift industry, including the following priorities:

FORKLIFT MARKET NEEDS	
<b>Maintenance and Training</b>	❖ <b>Reduce cost of maintenance and training</b> – in order to demonstrate the industry's commitment to the market, proactive industry programs, such as the "best practices" propane education program for forklift technicians and end users in proper fuel system maintenance should be continued and emphasized throughout the forklift market
<b>Stakeholder Relationships</b>	❖ <b>Build relationships with relevant stakeholders (OEMs and Industry Trade Associations)</b> – the propane industry has enjoyed strong corporate relationships with forklift stakeholders over the years and should be maintained for continued success in the forklift market
<b>Marketing Programs</b>	❖ <b>Develop external marketing programs</b> – marketing pieces that highlight and summarize the performance, economic, and environmental benefits of using propane are needed to further enhance propane's image in the industry
<b>Engine Data and Certification</b>	❖ <b>Develop emissions data research &amp; increase engine certification</b> – the marketplace needs a better understanding of relative emissions of various fuels to clarify propane's position as a clean and economical fuel
<b>Technology Assessment</b>	◆ <b>Increase technology assessment</b> – an improved understanding about changes in the material handling industry is needed to deal with customer preferences and to develop research and development projects that will support future forklift certification and emissions standards, retrofit and operational requirements
<b>Regulation Support</b>	◆ <b>Increase legislative &amp; regulatory activities</b> – new measures in state and federal regulations can have significant impacts on propane use in the forklift market; significant resources and continued diligence on behalf of the propane industry is needed to maintain propane's presence in the rulemaking process, particularly with the California Air Resources Board (CARB) and their State Implementation Plan (SIP)

#### ❖ Top priority market needs



## Fleet Market

## 2. Fleet Market

### *History*

Propane is the leading alternative fuel in the United States and worldwide. The first truck converted to propane took place in 1928. Yet, the U.S. is one of the few countries where the propane vehicle population is declining. In the early 1980s, there were more than 450,000 propane-fueled vehicles in the U.S. However, the U.S. Department of Energy states that there are only about 270,000 in use today.<sup>10</sup> Consistently, a large number of these have been fleets that include light- to heavy-duty trucks, buses, taxicabs, police cars, and pickup and delivery vehicles.

### *Market Drivers*

Despite propane's ability to offer fleet operators distinct economic advantages over gasoline and diesel, propane vehicle use is decreasing. A case can be made that propane is the most cost effective alternative to conventional transportation fuels when capital costs (vehicle and infrastructure) and operation and maintenance costs are all taken into consideration. Of all available alternative fuels, propane offers the best mix of vehicle driving range, durability and performance. Remarkably, these advantages have not presented a consistent competitive edge over gasoline and diesel or earned customer trust. Therefore, OEMs have shifted their focus from alternative fuels to hybrids. Without OEM support, the propane industry must drive development of propane-fueled vehicles and engines.

### *Market Challenges*

The traditional attributes of propane including lower fuel and maintenance costs, high octane, easy to install refueling facilities and theft proof fuel systems are still valid reasons to influence fleet operators to prefer propane again. First, the following challenges must be addressed:

FLEET MARKET CHALLENGES
◆ Limited number of vehicle offerings
◆ Limited OEM, government, and industry support
◆ Limited availability of trained maintenance professionals
◆ Lack of a cohesive marketing approach
◆ Limited understanding of the role of retrofits and PERC's role in supporting retrofit certification costs
◆ Lack of clarifying information regarding durability of existing engines and components
◆ Lack of technician training to keep retrofits on the road



## Fleet Market

### Market Needs

To address these challenges, the following fleet needs are required:

FLEET MARKET NEEDS	
<b>Heavy Duty Vehicles</b>	<ul style="list-style-type: none"> <li>❖ Increase OEM outreach</li> <li>❖ Increase new product availability</li> </ul>
<b>Resource Management</b>	<ul style="list-style-type: none"> <li>❖ Develop a sole resource to initiate contact with fleets and drive market growth</li> <li>◆ Develop an action plan for specific fleet applications</li> </ul>
<b>Education and Marketing</b>	<ul style="list-style-type: none"> <li>❖ Develop service and training programs</li> <li>◆ Encourage the development and sale of OEM products through effective sales and marketing of high quality, environmentally friendly propane vehicles</li> <li>◆ Increase customer confidence with respect to maintenance</li> <li>◆ Increase the image and awareness of propane as the number one alternative fuel in the US and worldwide by organizing propane industry merchandising support for retail refueling outlet development</li> </ul>
<b>Collaborative Opportunities</b>	<ul style="list-style-type: none"> <li>◆ Institutionalize propane into government agencies by establishing a high-level industry-wide and governmental task force with the objective of identifying and prioritizing projects regarding propane vehicles, engines and infrastructure</li> <li>◆ Create a proactive public environment through fiscal and non-fiscal initiatives</li> </ul>

❖ Top priority market needs



## Agriculture Market

### 3. Agriculture Market

#### *History*

Although the propane tractor market and other farm engine applications were popular from 1950-1970, the development of diesel engines for non-military uses after World War II displaced propane engines throughout the agriculture market. Diesel engines were larger, offered higher horsepower and low fuel costs. Meanwhile, propane focused on developing niche farm use applications, including grain drying, poultry and pig brooders, irrigation engines, flame cultivation and weed control. Today, more than 1.5 billion gallons of propane are used on more than 660,000 farms every year.<sup>2</sup> Propane is many farmers' first fuel choice because it is reliable, safe, clean and efficient, and can be used in hundreds of different agricultural applications. Residential farm houses rely on propane for heating, cooking, water heating and clothes drying. Once a propane tank is installed on the farm, multiple uses are possible.

#### *Market Drivers*

Now farms are larger, more efficient and technologically advanced than ever before. Producers are increasingly forced to grow in capacity to gain economies of scale, many times buying up land across counties or even states. As a result of these trends in agriculture, larger equipment is operating many miles from a centralized base of operations and the need to refuel agricultural equipment in the field has grown more complex.

Although engines used on farms are predominantly powered by diesel today, exhaust emissions from farm equipment are now subject to regulation. Diesel emission control is complicated and expensive, thus creating opportunities for propane to recapture the agricultural engine market. Additionally, increasing peak demand electric rates and expensive power line installation costs in rural areas offer propane new opportunities to displace diesel and electric in the irrigation engine market. Advances in propane technology are critical to meeting the many demands farmers place on their engines and are essential to promoting propane fuel use in the agriculture market.

#### *Market Challenges*

The limited selection of propane remote refueling equipment is perceived as a significant impediment to more widespread adoption of propane-fueled mobile off-road technologies in the agricultural sector. The recently completed *Market Study for a Propane Utility Tractor* found that while propane enjoys a well established network of dealers and distributors many tractor users lack the storage and refueling equipment they need to integrate propane tractors into their operations. These challenges in the marketplace present obstacles for propane that must be overcome in order to develop and promote propane as a convenient fuel source.



## Agriculture Market

### *Market Challenges (continued)*

Below are the most important challenges to increased propane-fueled engine use in the agricultural market:

AGRICULTURE MARKET CHALLENGES
◆ Lack of farm tractor engines of sufficient horsepower to replace diesel as well as engines to power swathers, combines, corn and grain harvesters. Although some engines are available, they are not designed to be integrated into these farm applications.
◆ Limited propane refueling infrastructure; increased storage and refueling equipment is needed for integrating remote propane-fueled tractors and equipment into the farming operation
◆ Lack of accurate total fuel use data across geographic areas
◆ Lack of understanding interrelated, gross agricultural market opportunities; including high-value-added agricultural operations (i.e., certified organic farms need a broad range of propane-fueled engine-driven equipment such as tractors, harvesters, trucks, generators, and pumps)
◆ Limited leveraging of regional and local agricultural industry partnerships; collaboration is needed with state air quality and agriculture agencies and distributors of small equipment, especially in rural areas where agriculture is the only market



## Agriculture Market

### Market Needs

To address these challenges and support the industry goal of displacing diesel and other fuels with propane in agricultural use, the following priorities are needed:

AGRICULTURE MARKET NEEDS	
<b>Irrigation Pumping</b>	❖ <b>Develop heavy duty propane-fueled engines for irrigation pumping</b>
<b>Mobile and Non-mobile Farm Equipment</b>	❖ <b>Develop mobile and non-mobile farm equipment that utilizes propane-fueled engines</b>
<b>Engine Durability</b>	❖ <b>Increase propane-fueled engine durability by developing engine technologies that compete with diesel</b>
<b>Broad Industry and Stakeholder Support</b>	❖ <b>Stimulate broad propane industry support from both large and small distributors, including urban, suburban, and rural participants</b> ♦ Engage stakeholders in both the overall and some selected secondary goal-setting processes ♦ Work with stakeholders to develop methods to accumulate and distribute agricultural energy use data that is appropriate, accurate, and timely and enables the following: <ul style="list-style-type: none"> <li>- Creation of an engine development plan that will rapidly lead to a significant number of propane-powered engines that meet or exceed EPA Tier 3 / Stage IIIA emissions reduction targets by the time those regulations come into effect.</li> <li>- Engine manufacturer and academic researcher cooperation towards reaching the emissions reduction goals of the EPA's proposed "Interim" and "Final" Tier 4 / Stage IIIB and Stage IV benchmarks out to 2015</li> </ul>

❖ **Top priority market needs**



## Off-Road Market

### 4. Off-Road Market

#### *History*

Off-road engines are used in equipment that perform a wide range of important jobs in our economy, including airport ground service, construction, commercial lawn care, and other industrial applications. Historically, propane has been well represented in off-road markets due to its unique characteristics, particularly for its infinite shelf life, theft deterrence and prolonged engine life. For example, off-road equipment frequently sits unused for long periods of time in which diesel fuel tends to stratify and propane does not. The propane fuel system is closed to the atmosphere and under pressure, which does not lend itself to easy theft. Also, small engine off-road equipment that operates under varying speeds tends to decrease engine oil and spark plug service life due to the additives in gasoline. Propane's gaseous qualities prolong engine life and reduce maintenance when engines are properly maintained.

#### *Market Drivers*

Off-road engines contribute greatly to air pollution in urban as well as rural areas. The marketplace is increasingly concerned about cost, safety, availability, and ease of use of the refueling equipment. Although propane-fueled engines offer significant reductions in operating costs, noise, and emissions compared to diesel and gasoline engines, propane product developments in commercial mowing, airport and port applications are needed that focus on both off-road engine equipment and the supporting refueling infrastructure.

Alternative fuel vehicles are increasingly more visible in shuttle fleets and ground support equipment. Propane's clean-burning properties and excellent operational characteristics make them potentially good candidates for the Federal Aviation Administration (FAA) 2003 Voluntary Airport Low Emission Vehicle Program (VALE). The program promotes alternative-fuel vehicle usage at airports in non-attainment or attainment/maintenance areas.

#### *Market Challenges*

Below are the challenges to increased propane use in the off-road market:

OFF-ROAD MARKET CHALLENGES
◆ Lack of engines and OEM equipment for many off-road markets
◆ Lack of OEM retrofit equipment
◆ Lack of certification and testing protocols by industry and OEMs
◆ Diesel's prevalence in the market; diesel is widely preferred for its high fuel efficiency and high torque output, except in lawn mower applications
◆ Limited remote refueling capabilities
◆ Low consumer perceptions; education is needed to show consumers that propane storage and refueling methods are affordable both short term and long term



## Off-Road Market

### *Market Needs*

To address these challenges, the EFCC is building a comprehensive strategy in developing the off-road market. The program consists of the following priorities:

OFF-ROAD MARKET NEEDS	
<b>Program Development</b>	<ul style="list-style-type: none"> <li>❖ <b>Develop program applications in</b> <ul style="list-style-type: none"> <li>– commercial mowing</li> <li>– airports</li> <li>– ports</li> </ul> </li> </ul>
<b>Auxiliary Power</b>	❖ <b>Develop auxiliary power units</b>
<b>Construction Equipment</b>	❖ <b>Identify and develop construction equipment needs</b>
<b>Collaborative Relationships</b>	<ul style="list-style-type: none"> <li>◆ Develop close working relationships and partnerships with OEMs</li> <li>◆ Forge collaborative working relationships with equipment dealers and propane distributors</li> </ul>
<b>Remote Refueling</b>	◆ Develop safe and economical solutions for remote refueling of propane fuel
<b>Marketing</b>	◆ Develop a nationwide marketing effort that targets market niche opportunities that value reduced noise and emissions

### ❖ Top priority market needs

# ACKNOWLEDGEMENTS

We thank PERC's Engine Fuel Coordinating Committee for the direction and support in the development of this Roadmap. The content of this Roadmap reflects a diverse set of perspectives to illuminate promising directions for propane in the engine fuel market. The thoughtful comments received from the reviewers of this report were instrumental in sharpening and improving the final Propane Engine Fuel Roadmap.

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