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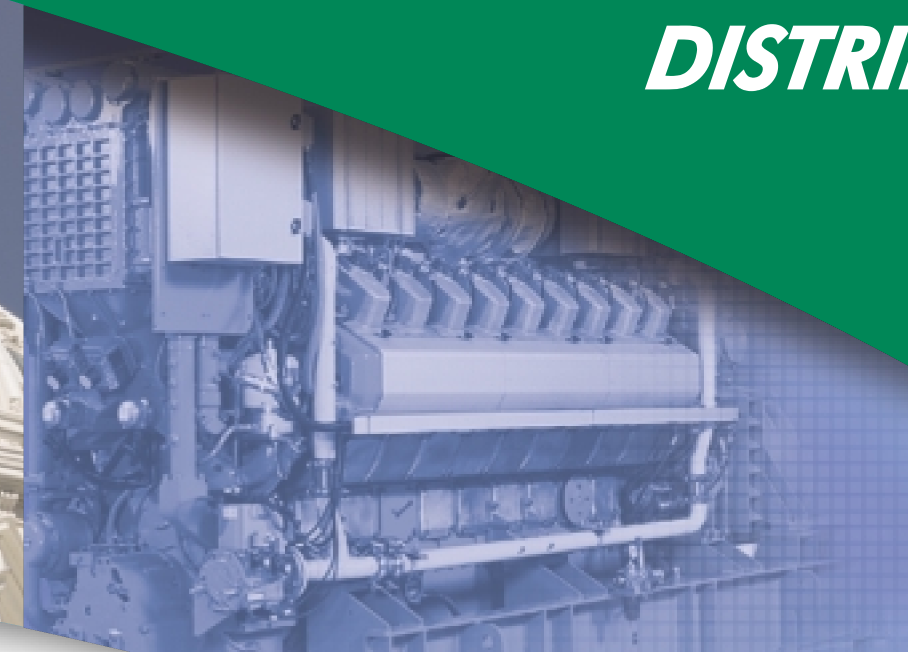
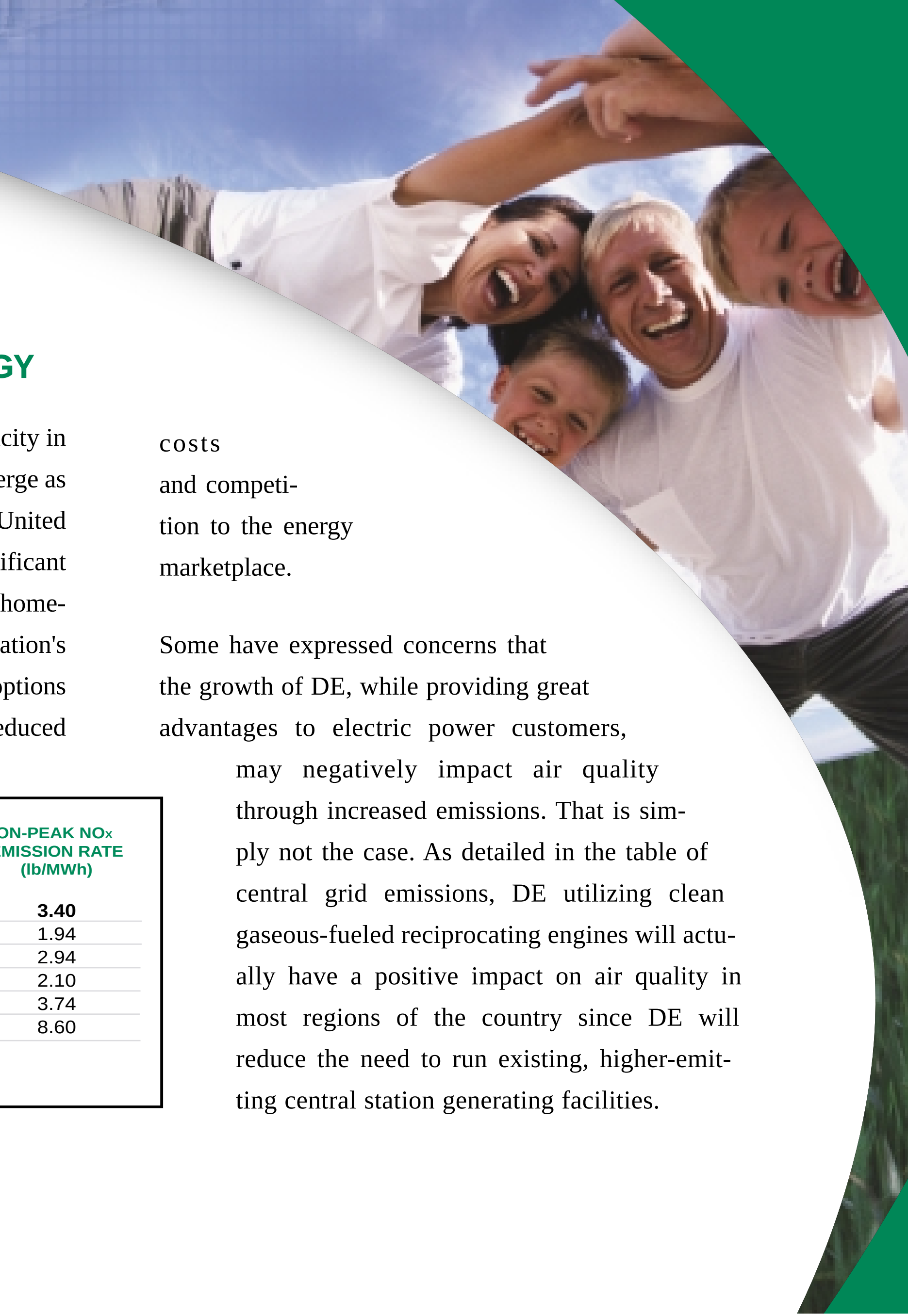
THE TIME IS NOW!

DISTRIBUTED ENERGY & ENGINES

Environmental Quality





ACTIONS THAT ENCOURAGE DE WILL BENEFIT THE CONSUMER, THE NATION, AND THE ENVIRONMENT

In addition to its other advantages, the use and expansion of DE can provide an environmental benefit by reducing the need to operate older, less efficient and more polluting central power plants. In this way, the deployment of DE can actually improve air quality.

Clean gaseous-fueled engines are efficient and cost-effective sources of power for DE applications. Engine emissions are either inherently low or have been reduced by improved engine technology and appropriate aftertreatment devices, and generally have much lower emissions and greater efficiencies than existing central grid peaking power units.

In light of these facts, policymakers and regulators should encourage the deployment of DE through the following regulatory actions:

- **Set reasonable emission standards for DE that are strict enough to ensure that DE emission rates do not exceed the region's average on-peak grid emissions**
- **Incorporate a leadtime period of at least 4 years for any new emission standard to ensure adequate time for product development**
- **Adopt standards consistent with the long-term research or "stretch goals" established for DE technologies**
- **Consider the implementation of less stringent emissions standards in attainment areas**
- **Provide flexibility in final permitting decisions**
- **Consider increased energy efficiency, availability of CHP applications, avoidance of transmission line losses, alleviation of "on-peak" power demands, and utilization of waste fuels when developing regulations applicable to DE**
- **Establish a streamlined certification or permitting system for DE applications less than 7.5MW**
- **Provide incentives to encourage the development and installation of advanced DE systems, including those that utilize CHP**

DE & ENGINES, THE ENVIRONMENTAL QUALITY CHOICE!

FOR MORE INFORMATION CONTACT EMA

GASEOUS-FUELED ENGINES — THE FIRST CHOICE FOR DISTRIBUTED ENERGY

Distributed Energy (DE), the production of electricity in close proximity to its point of use, is poised to emerge as a significant source of electric power in the United States. The emergence of DE can provide significant advantages, including energy savings, energy and homeland security through diversification of the nation's power supply, improved reliability, and viable options for electricity consumers. This brings choice, reduced costs and competition to the energy marketplace.

Some have expressed concerns that the growth of DE, while providing great advantages to electric power customers, may negatively impact air quality through increased emissions. That is simply not the case. As detailed in the table of central grid emissions, DE utilizing clean gaseous-fueled reciprocating engines will actually have a positive impact on air quality in most regions of the country since DE will reduce the need to run existing, higher-emitting central station generating facilities.

EMISSION RATES	BASELOAD NO_x EMISSION RATE (lb/MWh)	ON-PEAK NO_x EMISSION RATE (lb/MWh)
UNITED STATES AVERAGE	**3.50**	**3.40**
CONNECTICUT	2.67	1.94
TEXAS	2.61	2.94
NEW YORK	1.34	2.10
MASSACHUSETTS	1.91	3.74
ILLINOIS	3.20	8.60
GASEOUS-FUELED ENGINE WITH AFTERTREATMENT	0.3 - 0.6	

Source: Gas Technology Institute

DE POLICIES SHOULD CONSIDER THE ENTIRE ENVIRONMENTAL EQUATION

When considering the development of DE in the context of air quality issues, it is important to look at the entire environmental equation. For DE, this includes comparing overall energy efficiency, conservation of natural resources, land-use impacts, and air emissions, including relative greenhouse gas emissions. Looking at a single component, such as the emissions rate of one particular pollutant, while ignoring the other environmental and energy advantages of DE technologies will provide an incomplete and often misleading perspective. Environmental policymakers and regulators should expand their field of view when considering DE to ensure that an integrated environmental decision is made taking into consideration:

- **FUEL EFFICIENCY AND ENERGY SAVINGS BENEFITS FROM DE**
- **ACTUAL EMISSION RATES OF DE**
- **RELATIVE EMISSION RATES OF DISPLACED CENTRAL GRID POWER**
- **REDUCTIONS IN GREENHOUSE GAS EMISSIONS FROM DE**
- **NATURAL RESOURCE CONSERVATION BENEFITS OF DE**
- **AVOIDED TRANSMISSION LINE LOSSES**
- **NET AIR QUALITY IMPROVEMENTS FROM DE**
- **REDUCED IMPACTS ON LAND USE**

FACTS ABOUT DE EMISSIONS

EXPANDED USE OF DE CAN IMPROVE REGIONAL AIR QUALITY

Energy created through the combustion of all fuels creates emissions, and it is appropriate to assess the impacts of DE and other sources of electricity on air quality. In doing so, however, it is important to consider several facts impacting emissions, including greenhouse gas emissions, relative emissions from central grid facilities, relative energy efficiencies, and other factors, and to do so using valid comparative measures. When this is done, the facts show that using today's engines in DE applications can actually help clean the air.

Because of their many advantages, gaseous-fueled engines are the first choice in DE under 7.5 megawatts (MW). Gaseous-fueled engines are naturally low emitters of several criteria pollutants including particulate matter (PM), sulfur oxides (SO_x), volatile organic compounds (VOC, including air toxics), and carbon monoxide (CO). Given their greater levels of efficiency, natural gas engines are also lower emitters of carbon dioxide (CO_2), a key greenhouse gas. Thus, gaseous-fueled engines are a very sound environmental choice.

The primary pollutant from DE that has received attention is nitrogen oxides (NO_x), a precursor to ozone formation. Tremendous improvements have been made over the last 15 years with respect to NO_x emissions from reciprocating engines. Manufacturers have reduced engine-out emission rates by approximately 95% from 44 pounds per megawatt hour (lb/MWh), to current emission rates of 2-6 lb/MWh for lean-burn natural gas engines. In addition, aftertreatment technologies can be used to reduce emissions even further. Some examples of those technologies include three-way catalysts, selective catalytic reduction systems, oxidation catalysts and lean-NO_x catalysts. Such aftertreatment technologies, while adding to the costs of DE, can reduce NO_x emissions by another 95% to 0.3-0.6 lb/MWh when needed to meet the stringent air quality standards that may be necessary in nonattainment areas.

COMPARATIVE EFFICIENCIES/NOx EMISSIONS

POWER GENERATION TECHNOLOGY	EFFICIENCY (%)	NOx EMISSIONS (lb/MWh)
COAL PLANT	33	5.6
SIMPLE CYCLE GAS PLANT	33	0.6
MICROTURBINES	22	0.4
SMALL TURBINE	25	1.1
LEAN-BURN GAS ENGINE (WITH AFTERTREATMENT)	**36**	**0.3 - 0.6**

Source: GTI; EMA Data

EMISSIONS BY GENERATION TYPE (lb/MWh)

GENERATOR TYPE	NO_X	CO_2	SO_X
NATURAL GAS COMBINED CYCLE GAS TURBINE	.09-3.8	770	~ 0
OIL (2.2% SULFUR) FUELED STEAM ELECTRIC PLANT	3.0-3.7	1,770	25.4
OIL (0.3% SULFUR) FUELED COMBUSTION TURBINE	3.7-6.8	2,200	4.4
COAL-STEAM ELECTRIC	6.1-9.4	2,300	46.6
LEAN-BURN GAS ENGINE (WITHOUT AFTERTREATMENT)	**2.0 - 6.0**	**970**	**0.01**

Source: Pace Law School Energy Project 2000

Even further improvements in engine performance and emission reductions are on the horizon. The Advanced Reciprocating Engine Systems (ARES) program funded by the US Department of Energy and supported by engine manufacturers is conducting research to improve engine efficiency and further reduce emissions. The "stretch" goals of the ARES program are to increase energy efficiency to 50% while cost-effectively reducing NO_x emissions by 2010. A similar program is underway in California known as the Advanced Reciprocating Internal Combustion Engine (ARICE) program. While these additional improvements in efficiency and emission characteristics will be difficult to achieve, they are within the reach of emerging engine technologies.

Just as important, emission rates from today's improved gaseous-fueled engine technologies compare very favorably with other technologies, particularly existing central station generating plants powered by coal and oil (see tables). Although certain larger-scale technologies may have somewhat lower NO_x emissions compared to engines, one must also consider other factors -- including greenhouse gases, energy efficiency, transmission line losses, and adaptability for specialized applications -- that comprise the overall benefits of DE technology.

THE EMISSIONS BENCHMARK — SETTING THE STANDARD FOR BETTER AIR QUALITY

Current power generation systems can vary significantly in their emissions levels, from zero emission technologies such as solar and wind, to older fossil-fueled power plants. They also vary in other attributes such as energy efficiency, availability, and cost. Therefore, when considering options for implementing emission control regulations, a fundamental issue is to determine the proper benchmark for DE.

A key fact in this regard is that DE will improve air quality as long as the emission rate from the installed DE equipment is lower than the emission rate from the current central power system used to generate the power that will be displaced by DE. The emission rates of the displaced power, also known as the central power grid emissions, can be obtained from US EPA information. Those data reveal that central grid emissions vary across the country depending on the mix of nuclear, coal, oil and gas central station power plants operating in a particular region. The data for on-peak NO_x emissions, the emissions that DE would normally displace, vary from 0.7 lb/MWh in the Far West to 7.3 lb/MWh in the Midwest. The average on-peak emissions for the entire US is 3.4 lb/MWh.

THE BOTTOM LINE

As long as DE emission rates are lower than the relevant on-peak central grid averages, the installation and deployment of DE will have a positive impact on air quality. And, since the emission rates from gaseous-fueled engines used in DE equipment fall below the on-peak grid average in most regions of the country, any increased use of DE will generally improve air quality rather than contribute to increased emission levels. This improvement is even greater when the DE equipment includes combined heat and power (CHP), a process that harnesses otherwise wasted heat for productive use and enhanced overall efficiencies. Rather than be a cause for concern, therefore, gaseous-fueled engines used in DE represent a clean-air solution due to their inherently low emissions characteristics and their continuing improvement in emissions performance and efficiency.