




**SIEMENS**  
*Ingenuity for life*

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Discover a solution that  
electrifies your business  
with rapid success.

Replace your mechanical equipment by electric  
drive trains – for low OPEX, increased availability,  
and high efficiency.

[siemens.com/turbine-replacement](https://www.siemens.com/turbine-replacement)



# Are you ready to tackle the status quo?

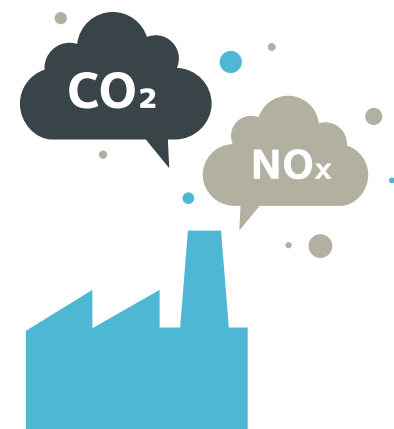
**It's time to think about alternative ways to modernize old or conventional turbine trains. Constant growth, higher revenue, economic success – anyone who wants to stay one step ahead must plan in advance. Even when it comes to replacing turbine drives. Time-honored solutions quickly reach their limits when attempting to fully meet challenges like stricter emission regulations, the demand for higher process availability, and the need for reduced OPEX.**



**Do you think there's no way to cut carbon emissions?**

## Rethink!

The need to meet emission regulations. Relief from climate-related taxes and levies. Support for industry-specific climate protection agreements like the Oil and Gas Climate Initiative (OGCI). Do you want or need to further reduce your company's emissions? As a solution partner for the oil and gas industry with many years of experience, we offer a solution that helps you permanently eliminate your current CO<sub>2</sub> and NO<sub>x</sub> emissions caused by turbines. You get everything you need from us, all from a single source – from consulting, planning, supply and installation to training and service.



**Do you calculate with consistent OPEX?**

## Recalculate!

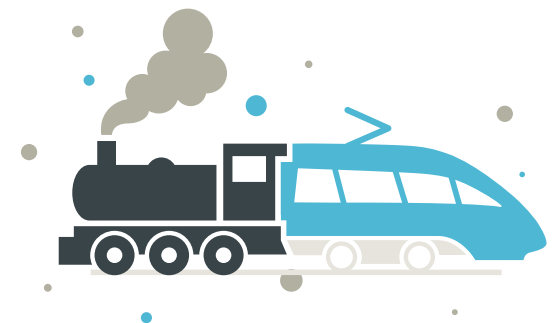
Cushion the blow of low oil and gas prices – and support your company's economic success with targeted savings in operating costs. Even if you've already taken many steps in this direction, your options for effectively cutting costs are far from being exhausted. Take one more step forward: Our economical turbine replacement solution helps you significantly lower the OPEX for your rotating equipment.



**Do you consider turbines to be the only choice?**

## Reconsider!

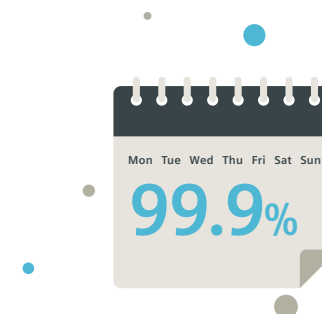
Your processing machines need a powerful and reliable drive. In the past, you've used gas or steam turbines with great success. But the times and technologies are changing. Today a turbine is not necessarily the best drive solution anymore. We offer a highly efficient and highly dependable zero-emission alternative to your aging turbines. One that is based on years of experience and successfully used in many industries – including the oil and gas industry.



**Have you analyzed your cost factors?**

## Reanalyze!

There are many costs you are facing: from the investment and reserves for purchasing to maintenance and operational expenses to CO<sub>2</sub> taxes. Plus, a conventional turbine has a long startup and restart phase meaning the downtime is driving costs as well. With our turbine replacement solution you can now benefit from significant savings: it lowers CAPEX and OPEX, minimizes malfunctions during operating processes, and offers a potential availability of up to 99.9 percent.



Boost your oil and gas business ...

... by seizing new opportunities.

# Rethink!

## "E" is coming.



To meet all these challenges, we've developed our "E" solution for driving your processing machines. Simply by replacing your gas or steam turbine with our electric drive train for the oil and gas industry, you can achieve more of your business goals.

**Emissions abolished. Efficiency increased. Turbine replaced.**

By replacing your gas turbine drive with our electric drive train, you cut your drive-related CO<sub>2</sub> and NO<sub>x</sub> emissions to zero, because the completely combustion-free electric-powered drive train generates no emissions whatsoever on-site.

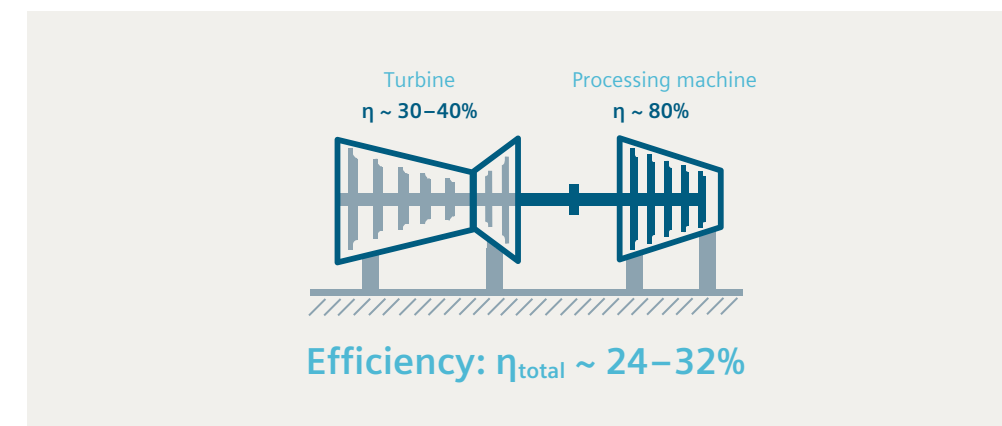
You'll also profit from significantly higher efficiency. The entire electric drive train has an efficiency rate of up to 96 percent and therefore consumes far less energy than a turbine. Unlike turbines changing ambient conditions like temperatures do not directly impact the efficiency. Optimized start and stop conditions also allow for fast stops and immediate restarts with run-up time of a few minutes. Using an electric variable frequency drive system enables compared to turbines an almost constant high efficiency while covering the required speed range.

**OPEX reduced. Uptime increased. Turbine replaced.**

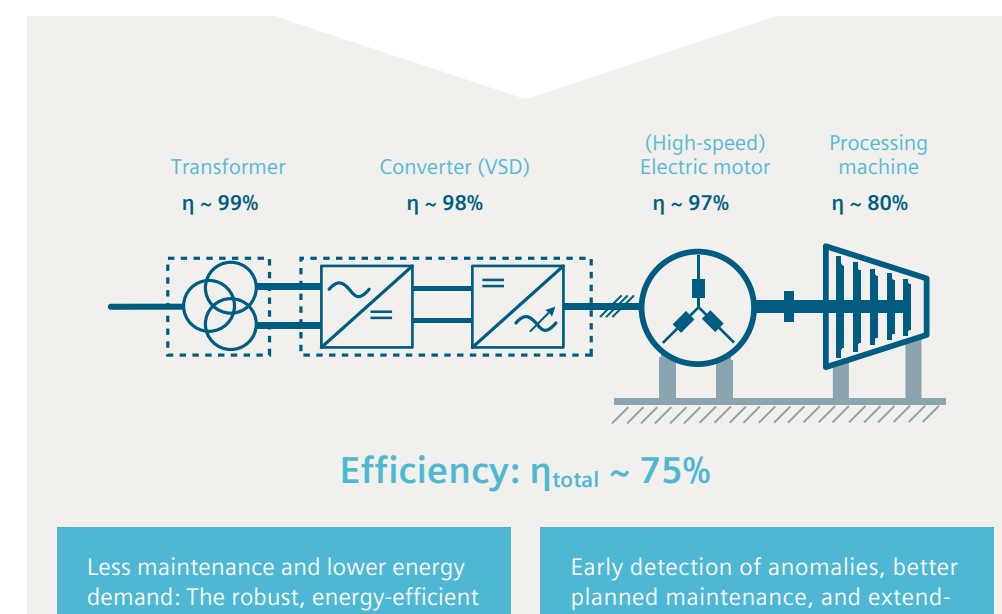
Our electric drive train also pays off financially in many different ways. Thanks to our emission-free technology, you'll avoid or reduce your CO<sub>2</sub> taxes, permits, or carbon offsets. Much higher efficiency, lower energy demand, and temperature fluctuation stability slash your energy costs. You'll also minimize your maintenance costs, because general overhauls are usually not necessary for 20 to 25 years. The inspection and service during this time period can be performed on-site and requires only a few days of shutdown during the drive train's lifetime.

You'll also increase your production uptime. Due to Drive Train Analytics (DTA) and visual inspections during operation, it's possible to operate for up to four or even five years with no shutdowns. And the electric drive train has an availability of up to 99.9 percent.

## Replace your mechanical equipment ...



## ... by electric drive trains



Less maintenance and lower energy demand: The robust, energy-efficient Active Magnetic Bearing technology from Siemens provides contactless, lubrication-free, and wear-free suspension of fast rotating rotors with speeds up to 18,000 rpm.

Early detection of anomalies, better planned maintenance, and extended operating time between shutdowns: With Drive Train Analytics, an analysis of the entire electric drive train can be performed.

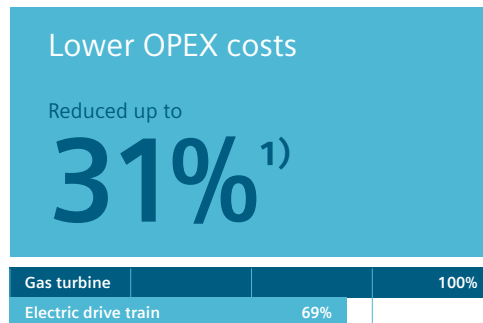
# Recalculate!

## Outstanding facts about "E".

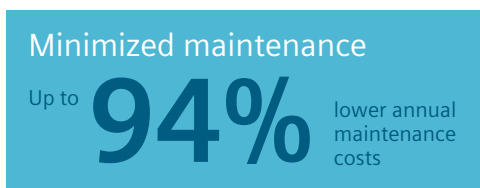


Nothing is more persuasive than figures. See for yourself. The electric drive train from Siemens for the oil and gas industry pays off in every respect – from emissions, energy consumption, and reliability to reduced costs and maintenance-related downtime.

Here are a number of sample figures and comparisons as a rough guideline. Parameters like ambient conditions, load, power, and operating hours vary from one project to the next and can influence the calculation. The configurations of the turbines to be replaced and the specific electric drive trains required also affect the calculation examples. We would be happy to take a look at your specific drive situation and prepare an individual calculation for you.



<sup>1)</sup> Based on required power of 10 MW, 8,000 operating hours per year, turbine emissions of 0.5 kg CO<sub>2</sub>/kWh and values from German industry in 2016 according to Statista



	Gas turbine	Electric drive train
Regular maintenance (planned)	2–10 days (annual)	0–2 days (annual)
General/major overhaul	Exchange of turbine (overhaul at factory/repair shop) after 6–9 years	No major overhaul for 20–25 years

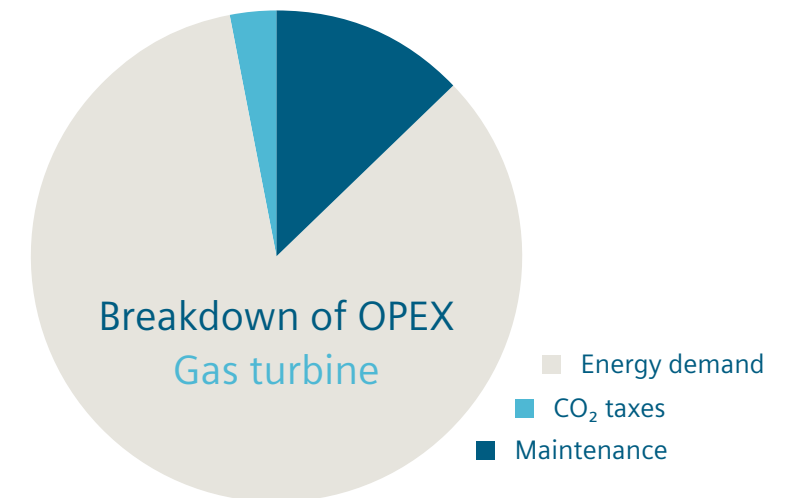
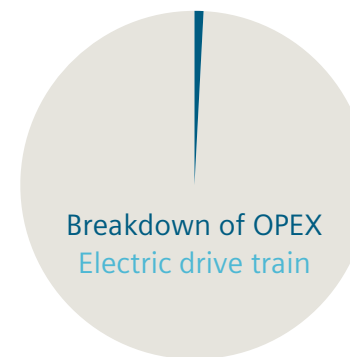
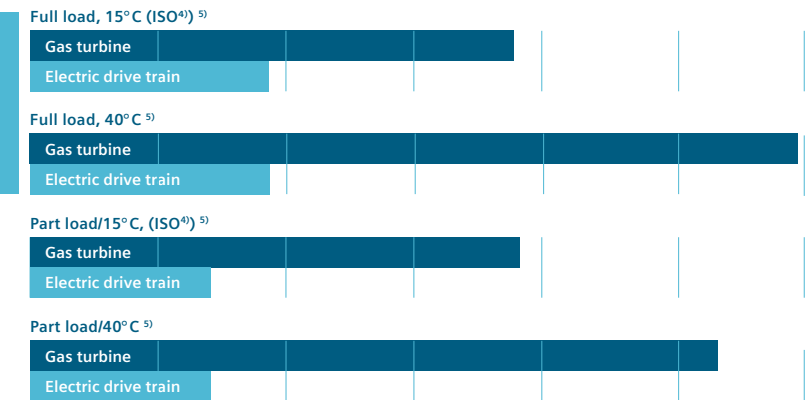


	Gas turbine	Electric drive train
CO <sub>2</sub> emissions	40,000 t CO <sub>2</sub> /year <sup>2)</sup>	0 t CO <sub>2</sub> /year <sup>1)</sup>

<sup>2)</sup> Assumption: Required power of 10 MW; 8,000 operating hours per year; turbine emissions of 0.5 kg CO<sub>2</sub>/kWh  
<sup>3)</sup> Combustion of gas is also a major source of nitrous oxides (NO<sub>x</sub>), carbon dioxide (CO<sub>2</sub>), and carbon monoxide (CO).  
<sup>4)</sup> When buying electric power, the purchasing price includes the emission tax for power generation and no further tax is due.

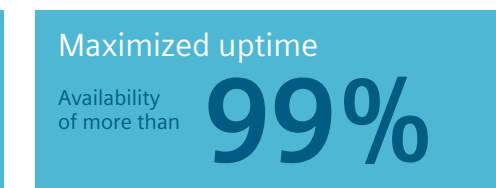


<sup>4)</sup> ISO: 15° C, sea level, 60% relative humidity <sup>5)</sup> 8,000 h/year, 10 MW



Heavy-duty turbine <sup>5)</sup>	26%
Aero-derivative turbine <sup>5)</sup>	32%
Electric drive train <sup>5) 6)</sup>	75%

<sup>5)</sup> Including a typical compressor efficiency value for the design point (same value for all three calculations)  
<sup>6)</sup> Transformer, VSD, high-speed motor



	Gas turbine	Electric drive train
Availability	~ 96%	> 99%
Reliability	~ 97%	> 99%

# Replan!

## How to go electric ...



Would you like to replace your turbine with an electric drive train? You can rely on Siemens. We'll provide everything from a single source – from an initial ROI calculation to the feasibility study to project execution; and from providing all components to installation, assembly, and commissioning, including documentation and service by our electric engineering experts. We'll also be happy to train your personnel.

### ROI calculation

Could it be worthwhile to replace your turbine with an electric drive train? We'd be happy to help you determine this by preparing a nonbinding ROI calculation, including a technical comparison, for you. Free of charge, of course – regardless of how the result turns out. This gives you a budget estimate for implementing the project and forms the basis for subsequent steps.

### Data capturing

In the first step, we collect all relevant information on your existing turbine drive as the basis for a holistic analysis and subsequent design of the electric drive train and the replacement project. We also check, for example, the existing interfaces and ambient conditions on-site.

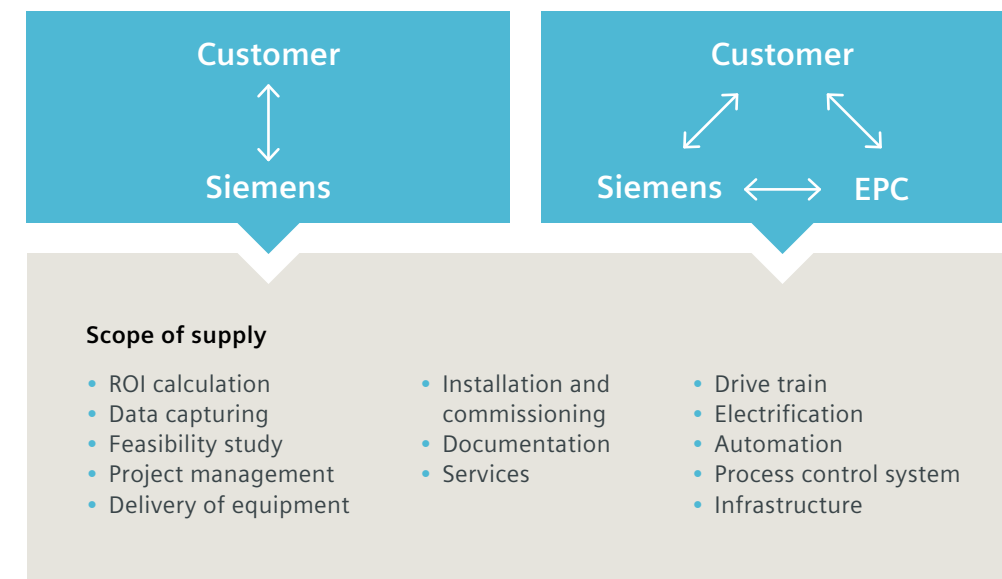
### Feasibility study

Next, we draw up an offer for you, including costs and a detailed description of the feasibility study scope and contents. The study we then prepare for your plant gives you reliable information on feasibility, scope of supply and services, equipment specifications, project workflow and schedule, and defined areas of responsibility as well as the budget, costs, ROI, and savings.

### Project execution

Based on the feasibility study, we prepare an offer for replacing your turbine, and we also handle the implementation – from dismantling the old equipment, delivering the equipment, installation and commissioning, and adjustments to documentation and services like the service contract and spare parts.

... with a trusted partner.



### Everything from a single source

Bundled responsibility with no interface losses: With Siemens, you benefit from a single point of contact throughout all phases of the project – and you also benefit from our many decades of experience in all aspects of the drive train. For example, 160 years of experience in building motors and 30 years of experience in developing and manufacturing variable-speed drives.

### Working with your EPC

If you would like your Engineering, Procurement and Construction (EPC) contractor to handle the planning, we'll be happy to work with you and the EPC to coordinate the individual work packages, interfaces, workflow, and timing and to define the areas of responsibility.

# Reconsider!

## Join the pioneers.



The future is now. The electrification of the oil and gas industry has begun. From refineries and compressor stations to chemical plants, electric drive trains from Siemens are already being used successfully in plants all over the world, resulting in many satisfied customers. You'll also get your equipment ready for the future and secure your competitiveness.



### Thailand

#### Compressor station gets modernized

Siemens provided a completely integrated solution for replacing four gas turbines with four electric motors with variable-speed drives (4.25 MW) in Rayong, Thailand. This included constructing a new substation building as well as four new skids to host the compressor, gearbox, coupling, and motor.

#### Benefits:

- High degree of plant availability and operational reliability
- Lower operation expenditures due to reduced maintenance, spare parts, and personnel
- No CO<sub>2</sub> and NO<sub>x</sub> emissions on-site
- Lower noise level
- Short and easy startups and shutdowns
- Sizing of turbocompressors becomes independent from standardized gas turbine models

### Russia

#### 38 gas turbines have had their day

A total of 38 gas turbines had been replaced in several compressor stations for a Russian natural gas producer. For this project, Siemens supplied and installed 22 3.8-MW high-speed motors, 16 6.6-MW high-speed motors, and VFD systems.

#### Benefits:

- Increased reliability and availability
- Greater efficiency
- Speed variation
- Fewer auxiliaries

### USA

#### Refinery pioneers of the electric future

To replace a steam turbine at a refinery with an electric drive train, Siemens supplied and installed a variable-speed drive with a high-speed motor at 3.4 MW and 5,300 rpm. The solution also covered foundation adaptation work and included additional operating points for the compressor.

#### Benefits:

- In practice, ROI twice as fast as expected
- Speed variation
- Increase in process efficiency
- Longer maintenance-free operation
- No complex starting sequence

### Netherlands

#### Europe's largest gas field steps into the future

Declining gas field pressure, an ecologically sensitive zone, the need for maximum drive train reliability, and a very short project execution time frame – Siemens offered the best possible solution for the challenges of Europe's largest gas field: drive trains with active magnetic bearings based on well-proven standard industrial electronic components and remote diagnostics via automatically captured status data. Two motor shaft ends allow one or two compressors to be operated depending on the compression power required.

#### Benefits:

- Flexible use of the gas field for decades
- Extremely high system availability of 99.97 percent
- Oil-free drive train complies with all environmental regulations
- Shorter time to profit, because the project was completed ten days ahead of schedule

### Canada

#### Compressor station optimizes performance

To enlarge its output and speed range, a Canadian compressor station was modernized with a completely integrated solution. Siemens manufactured and supplied all components for this station, including the interface engineering, installation and commissioning, and documentation and training.

#### Benefits:

- Broader output and speed range
- Short shut-off period due to detailed planning and full cooperation of Siemens Canada and experts

### UK

#### Chemical plant goes electric

Four 50-year-old steam turbines at a chemical plant in the UK needed to be upgraded. To replace them with an electric drive train, Siemens supplied four 1.7-MW high-speed motors, transformers, converter, and lubrication system.

#### Benefits:

- Increased reliability and availability
- Reduced noise level
- Less civil works thanks to containerized VFDs