Alewijnse Marine Systems

Marine Propulsion & Power Generation

Finding the best solution to meet your needs
Marine Propulsion & Power Generation

The design and installation of marine propulsion systems is a key discipline in marine engineering. The range of options available to ship owners is greater than ever before. The goal for today's owners is to select a propulsion and power generation system that suits their particular operational profile while at the same time being fuel efficient, clean, compact and cost effective.

There are many factors that need to be taken into account when deciding which propulsion technology is best for a specific vessel. This brochure is designed to introduce you to the basic attributes and advantages of the various power modes that are available. It also shows you some examples to illustrate how these options work out on real ships.

The principles underlying power generation:
To understand the process that underlies the search for ways to generate power that are both efficient and environmentally-friendly, it is useful to review some key concepts:

### ALL PROPULSION SYSTEMS USE SOME SOURCE OF ENERGY TO GENERATE PROPULSION POWER

**ENERGY SOURCES** are the point from which the energy actually comes. Hydrocarbons, solar radiation and wind are all energy sources. These are then converted into electricity or gases that act as the energy carriers to yield their energy. A number of energy sources such as solar or wind cannot be stored in their original form and must be converted to electricity or hydrogen gas to store them. Some energy sources can have negative impacts on the environment due to the release of by-products as the energy is used.

We speak of renewable energy when the source that is used is available continuously and endlessly in nature, such as wind and solar energy.

### ENERGY SOURCES

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Direct Use</th>
<th>Indirect Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil (diesel)</td>
<td>Diesel engine</td>
<td>Diesel generator (gen set)</td>
</tr>
<tr>
<td>Natural gas</td>
<td>NG engine</td>
<td>NG powered genset</td>
</tr>
<tr>
<td>Wind</td>
<td>Sailing</td>
<td>Wind turbine generator</td>
</tr>
<tr>
<td>Sun</td>
<td>Solar panel</td>
<td>Solar power</td>
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**ENERGY CARRIERS** are the forms in which energy is stored, rather than the energy itself. This is generally in chemical form (e.g. batteries, hydrogen), mechanical (e.g. flywheel) or in the form of electricity. In recent years a range of economic and environmental factors have led to engineers focusing on renewable energy carriers, chiefly electricity, as a source of cheap, clean power for propulsion systems.

For our engineers, the challenge is this:

**WE SEEK TO DEVELOP AND REFINE POWER GENERATION SYSTEMS THAT SUIT YOUR NEEDS IN THE BEST POSSIBLE WAY.**

Depending on your requirements, we will consider conventional systems as well as more innovative solutions. These are specifically of interest when reduction of the environmental footprint is required. The systems that we design and build must be cost-effective, versatile in their installation, low maintenance and efficient to monitor and operate. Furthermore, our goal is to develop safe, clean and compact systems, with optimal use of renewable energy and minimal impact on the environment.

**Types of propulsion and power generation:**

Generating thrust to drive a vessel through the water can be achieved in a large number of ways. These vary from conventional diesel direct propulsion to more recent innovations including diesel electric, fuel-cell-powered solutions and hybrid variants. However despite all these options there still remain just two fundamental ways to drive a propeller:

1. **With a combustion engine (mechanical propulsion)**
2. **Using an electric motor (electric propulsion).**

These can also be combined and the system is then referred to as hybrid propulsion.

### MECHANICAL PROPULSION

This tried and tested method uses an internal combustion engine to turn a shaft along with its propeller.

**Mechanical variants:**
- Diesel direct
- NG direct

### ELECTRICAL PROPULSION

Electricity can be used to power a variable speed electric motor that turns the shaft and propeller. Electricity can be supplied by a battery, a generator powered by an internal combustion engine or a fuel cell.

**Electrical Variants**
- Diesel Electric
- Battery Electric
- Natural Gas (NG) Electric
- Fuel Cells Electric

### HYBRID PROPULSION

Both internal combustion engines and electric motors are available and can be used individually or together to drive the shaft and the propeller, depending on the circumstances.

**Hybrid Variants:**
- Diesel Hybrid
- Natural Gas Hybrid
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Criteria and considerations

Your requirements can vary widely when it comes to selecting a new propulsion and power generation system for your ship. **Fuel efficiency** and **low emissions** may be most important for you, while **maximum power** or **flexible installation** may be a priority for others. **Cost** is always important. Every choice will have impacts both positive and negative on the environment, price, technical requirements, operational capabilities and interior layout of the vessel.

We can work together with you and guide you through the choices that must be made and ultimately design and deliver a system that provides the performance that you require with the minimum of compromise.

**ALEWIJNSE MARINE SYSTEMS HAS A LONGSTANDING EXPERIENCE WITH ELECTRICAL AND HYBRID PROPULSION SYSTEMS FOR**
- **INLAND SHIPS**
- **TUGS & WORKBOATS**
- **YACHTS**
- **SHORT SEA VESSELS**

The following examples show some of the solutions that Alewijnse has created for clients with specific and specialised requirements.

**This MPV operates between mid-range destinations and frequently manoeuvres within ports and inland waters. Its diesel electric propulsion system can respond quickly to variations in demand for propulsion power. It uses six diesel generators which together provide sufficient power for transit cruising speed. When travelling at lower speeds in inland waters less power is required and some of the generators are shut down. The remaining active generators operate under optimal conditions, resulting in reduced fuel consumption and lower emissions. Since the diesel generators can be placed anywhere in the ship, the diesel electric concept is not bound to a central engine room and offers freedom in the design of the ship layout. The redundancy provided by multiple generators also results in high operational availability.**

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### Propulsion type Pros Cons Suitable for Unsuitable for

| Diesel direct | • Low CAPEX**
• Low complexity | • Dirty, noisy
• Inflexible in the ship layout | • Ocean transits
• Medium-High power
• Small-Medium-Large ships | • Zero emission areas |

| Diesel electric | • Flexible layout
• Maneuvrability | • Less efficient than diesel direct at cruising speed | • Ocean transits
• High power
• Medium-Large ships | • Zero emission areas |

| Diesel hybrids* | • Low emission
• Low OPEX***
• Very adaptive to circumstances | • Complexity | • Ocean transits
• High power
• Large ships
• Variable circumstances | - |

| NG dual fuel | • Low emissions | • Large installation
• Limited power | • Regional operations
• Medium ships | • Global transits
• Zero emission areas |

| NG electric | • Low emissions
• Maneuvrability | • Large installation
• Limited power | • Regional operations
• Medium ships | • Global transits
• Zero emission areas |

| NG hybrids* | • Low emissions
• Low OPEX*** | • Large installation
• Limited power | • Regional operations
• Medium ships | • Global transits |

| Fuel cell electric | • Zero emissions
• Silent
• More autonomy than battery power | • High CAPEX**
• High OPEX***
• Complexity
• Limited power | • Local, inland shipping
• Zero emission areas
• Small ships | • Long distances
• Open sea
• Big ships |

| Battery electric | • Zero emissions
• Silent
• Low OPEX*** | • Low autonomy
• Limited power
• High CAPEX** | • Local, inland shipping
• Zero emission areas
• Small ships | • Long distances
• Open sea
• Big ships |

*Results for hybrids are very dependent on the choice of technologies that are combined.

**Capital Expense. ***Operational Expense.
Nemo H₂ is a boat used for tourist cruises in the Amsterdam canals and harbour area. Amsterdam is committed to improving environmental quality in the city. Diesel-powered boats cannot fulfill the future requirements for low emission. Nemo has a battery-powered electrical propulsion system that operates with low noise and zero emissions. The batteries are recharged overnight, but the range on battery power is limited. Therefore Nemo is also equipped with a hydrogen fuel cell system that generates electricity with zero emissions. The batteries are recharged overnight, but the range on battery power is limited. Therefore Nemo is also equipped with a hydrogen fuel cell system that generates electricity with zero emissions. The fuel cell system overcomes the limited capacity of the batteries, enabling the boat to cover longer distances while cruising in the Amsterdam harbour area. This propulsion system combines zero emission operation with the level of autonomy required by the owners.
How Alewijnse Marine Systems can support you to choose the proper propulsion system for your ship:

We developed a suite of methods that compare the merits of the different technologies against each other and match them to the operational requirements of the vessel itself.

Our engineers welcome your enquiries and are always ready to discuss individual projects and specialised requirements.

Working in partnership with you we set out to explore your requirements and specific wishes. We will than evaluate all the possible solutions, and discuss with you the advantages and disadvantages. This will give a clear overview of the alternatives for your situation as well as insights into the consequences. This will enable you to choose the best propulsion system for your situation.

Please contact us to find out more.