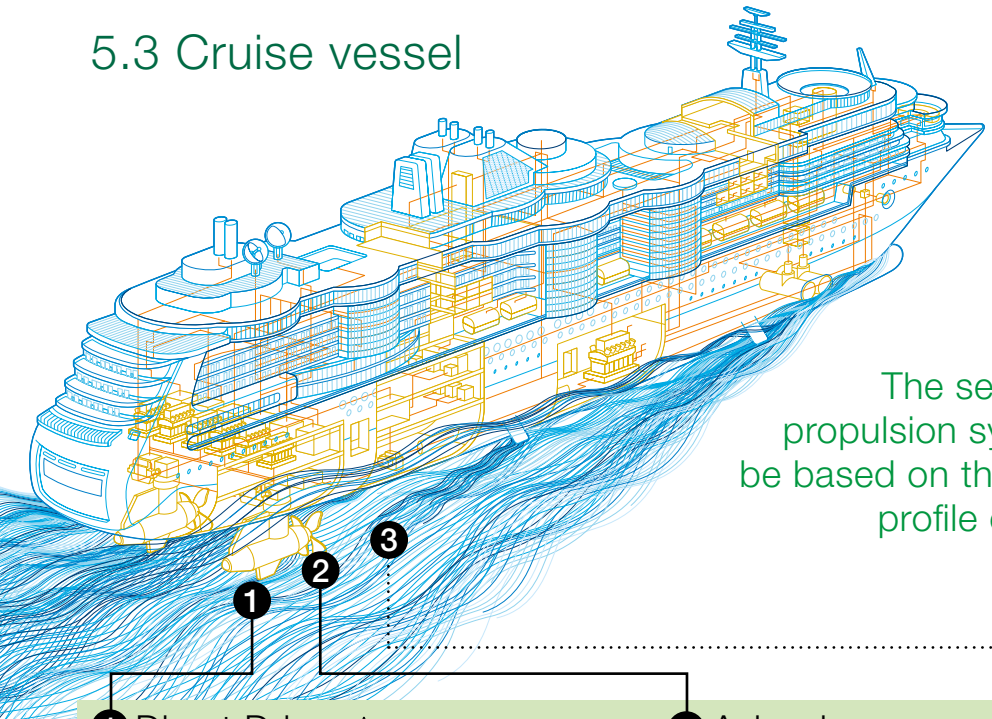
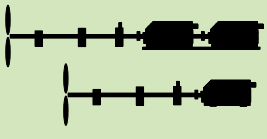
5.3 Cruise vessel



The selection of the propulsion system should be based on the operational profile of the vessel.

1 Direct Drive



LEISURE

DESTINATIONS

Energy rating: ★ ★ ★ ★

Pros:

+ Ready-made configuration: easy to specify, easy to build accordingly
+ Reliable technology
+ Propeller design with FPP or CPP and options based on efficiency
+ Less installed power needed. The main engine sea margin does not consume energy.
+ Flexible spatial arrangement of the propulsion components. Lower shaft heigh solutions are available.
+ Transformerless low voltage 690 V system design available for 2–4 propulsion motors, 1–18 MW total propulsion power.
+ Open to all energy sources and forms of energy storage

Cons:

- Hydrodymanical benefits created by the pulling propeller are not available
- A separate steering system is needed

2 Azipod

DESTINATIONS

Energy rating: ★ ★ ★ ★ ★

Pros:

+ Comfort through low vibration level
+ Low noise levels
+ Safety through excellent vessel performance in adverse weather and sea conditions
+ Excellent fuel economy
+ Environmentally friendly
+ Automated systems ensure the optimized operation and efficiency of all components

Cons:

- Needs close cooperation with the shipyard to reach its full potential

We have divided the operational profiles of cruise vessels into two simplified categories

LEISURE

Cruise vessel operational profile with more focus on passenger comfort than on the covered distance and destinations. The vessels sail more in the low speed range than at high speeds. Onboard activities have a key role.

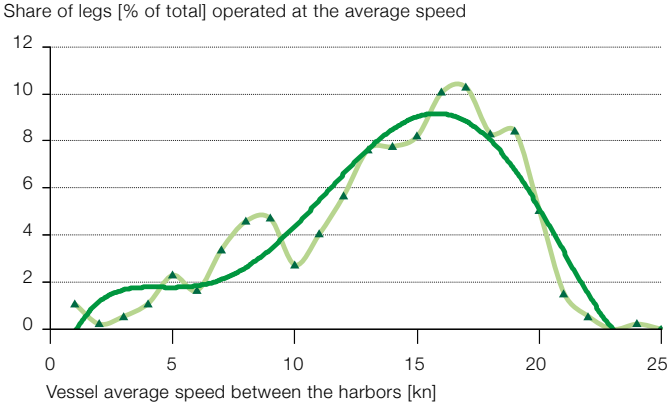
DESTINATIONS

It is more important to see new places and locations. Onshore activities have a key role.

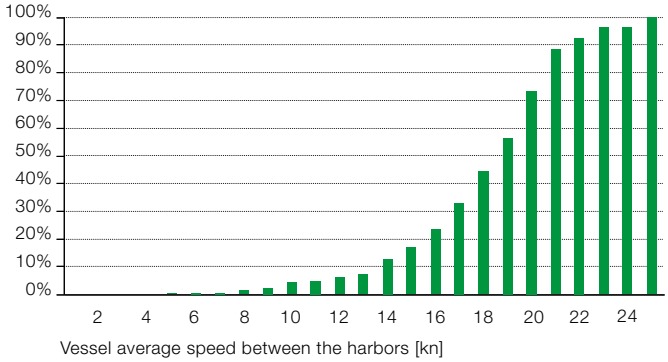
3 Azipod C

YARD TIP:

In some projects when the vessel speed is below 21 kn, it may be reasonable to consider a fully low voltage solution with three Azipod C units. This solution is suitable for high comfort classes when the total propulsion power is within the product range. See the mega yacht section for details.



Cruise vessels operate according to the itinerary requirements, which are based on the season and area of operation. To determine a standard and comparable itinerary, cruises in the season 2009–2010 were analyzed. Based on approximatelly 1,000 legs from 150 cruises, ABB Marine established a cruise ship standard.



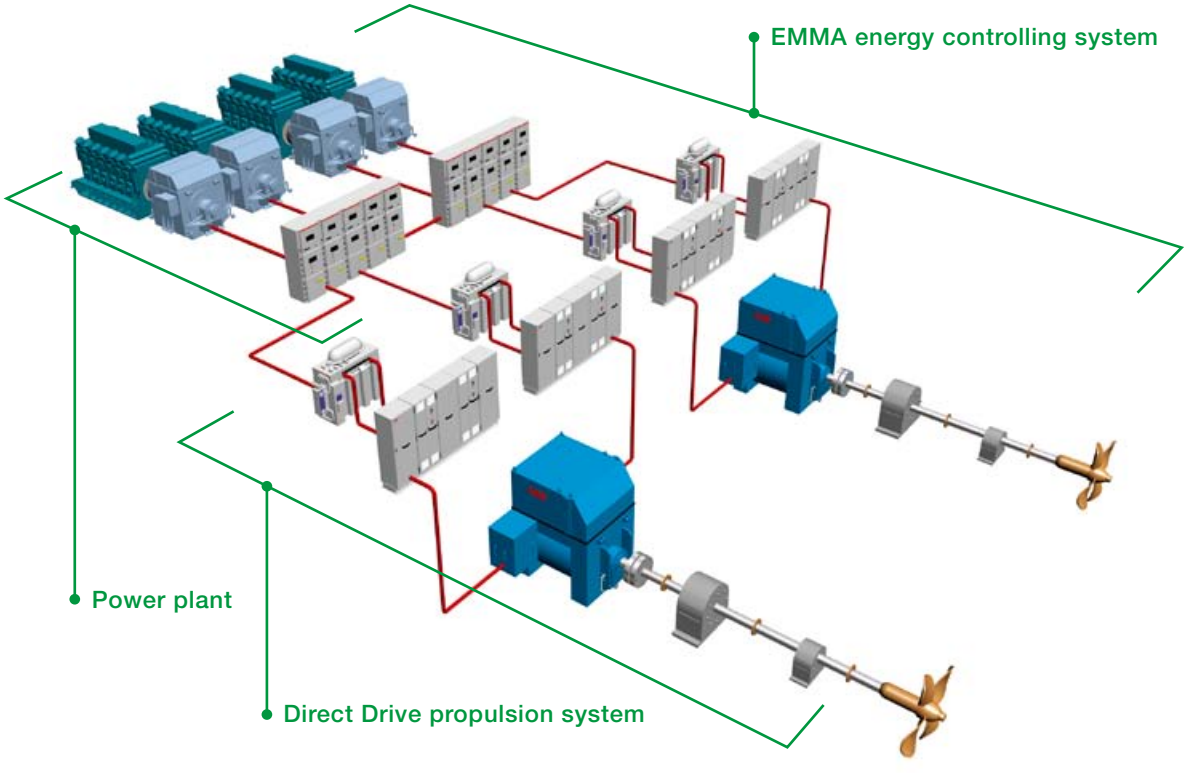
Share of cumulative energy consumption (% of the total consumption) of the 'Cruise vessel standard'. Calculations made for shaftline vessels in the customer project evaluation phase.

5.3 Cruise vessel

5.3.1 Direct Drive – system delivery

LEISURE **DESTINATIONS**

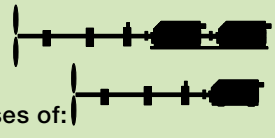
❶ Direct Drive is the optimal solution for conventional propulsion. A wide selection range, proven products and simple design satisfy the needs of even the most demanding customers. Redundancy levels provide an extensive selection for operational and passenger safety.



❶ Direct Drive

SIZE 0,5 – 20 MW / UNIT

LEISURE **DESTINATIONS**



Shaftline propulsion system comprises of:

Propulsion motor
Propulsion frequency converter
Propulsion control
Propulsion transformer (if applicable)

Available solutions	Benefits
Direct Drive propulsion system Sort according to performance, efficiency footprint, weight or redundancy – whichever you value the most – and find your solution. The combination of a propulsion motor, frequency converter and control system will guarantee a succesful voyage.	▶ **Effect on energy efficiency** Minimize the consumption by selecting the maximum performance.
+	
Power plant Optimize your power plant according to the consumers. Set the number of generators.	▶ **Effect on energy efficiency** Boosts your efficiency with different main engine ratings.
+	
EMMA energy controlling system Specify and design the energy production and consumption so that they can be easily monitored and managed.	▶ **Effect on energy efficiency** Savings produced by energy management are possible and unnecessary consumption is avoided.
=	

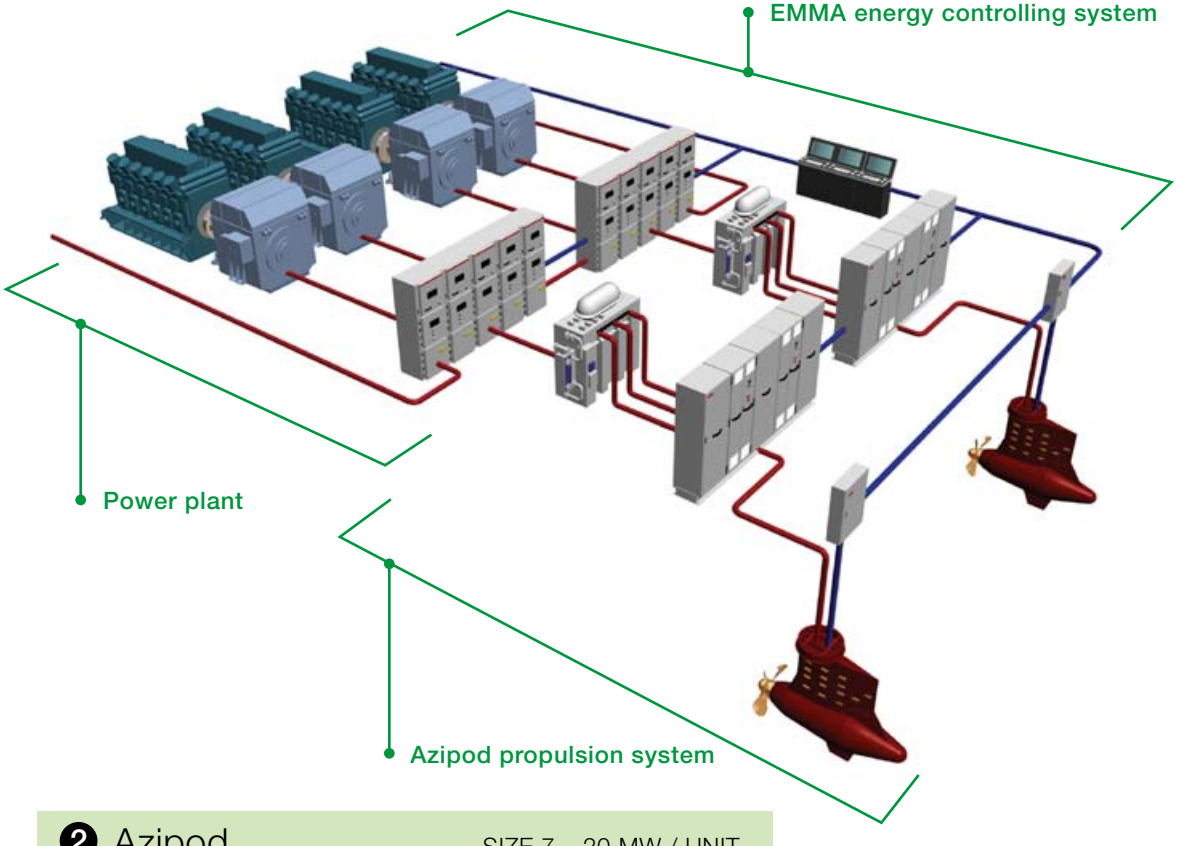
Combined advantages

Energy design and efficient total design, including the selected equipment, have a major impact on the operational costs. Often the most efficient solution also lowers the investment costs. The results of the energy efficiency design are in use immediatelly, not after a period of wasted energy.

5.3 Cruise vessel
5.3.2 Azipod – system delivery

DESTINATIONS

❷ ABB Azipod propulsion system is widely used in varius passenger ships. Because of its high performance capability, high comfort class rating and small amount of components inside the hull, it is a perfect solution for passenger vessels on the power level of 10–20 MW per unit.



❷ Azipod

SIZE 7 – 20 MW / UNIT

DESTINATIONS

Azipod propulsion system comprises of:
Azipod propulsor and steering unit + aux. equipment
Propulsion frequency converter
Propulsion transformer (if applicable)
Propulsion control

Available solutions	Benefits
Azipod propulsion system The Azipod propulsion system allows the propeller to be located optimally according to the hull lines. Efficient performance throughout the power range combined with hydrodynamical benefits provide high class performance with comfort.	▶ **Effect on energy efficiency** Gains from the pulling propeller and excellent partial load performance of the permanent magnet synchronous motor.
+	
Power plant Optimize your power plant configuration to be efficient at all operational points of the propulsion power.	▶ **Effect on energy efficiency** The main engine load is always in the optimal area.
+	
EMMA energy controlling system Specify and design the energy consumption in a manner which allows the monitoring and management of the energy production and the use of all energy forms.	▶ **Effect on energy efficiency** Savings produced by energy management are possible and unnecessary consumption is avoided.
=	

Combined advantages of total

The propulsion system may be driven as the main consumer of the power plant, loading the main engines optimally and controlling the consumption and propulsion simultaneously to reach the destination with minimum fuel consumption.

5.3 Cruise vessel
5.3.3 Direct Drive – system components

LEISURE **DESTINATIONS**

Direct Drive is a new concept in which the best shaftline solutions are used for maximum reliability and performance.

ABB portfolio for the low voltage system:

For smaller vessel and for the onboard processes, ABB offers the smartest drive with internal redundancy and propulsion motors with efficiency options.

From top to bottom: LV main generator, main switchboard MNS, propulsion drive ACS800 and propulsion motor. Ready-made Direct Drive solutions are available at the motor shaft heights from 560 mm to 1000 mm.

DESIGNER TIP:

Use ready-made ABB Direct Drive designs (see chapters 13–15)

ABB portfolio for the medium voltage system:

For large cruise vessels ABB offers the best and most reliable products in the market.

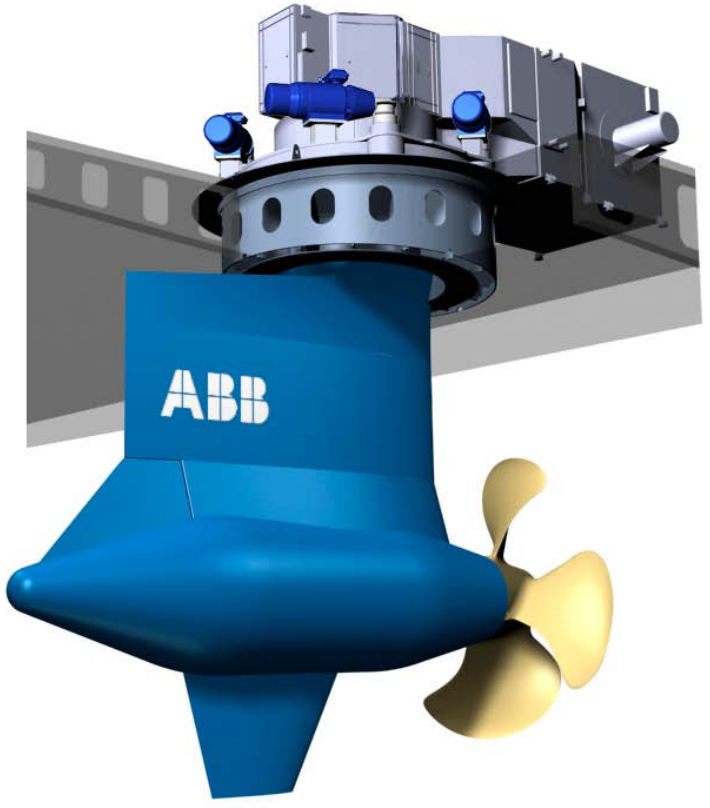
From top to bottom: MV main generator, main switchboard Unigear, transformer, propulsion drive ACS6000 and propulsion motor. Ready-made Direct Drive solutions are available at the motor shaft heights from 1120 mm to 2000 mm.

DESIGNER TIP:

Use ready-made ABB Direct Drive designs (see chapters 13–15)

5.3 Cruise vessel
5.3.4 Azipod – system components

DESTINATIONS



The Azipod® delivery is very simple. Instead of the alignment work involved long shaftlines, the Azipod® unit is modular and combined from pre-tested units.

Below ABB basic components for power production: medium voltage marine generator and marine main switchboard ABB Unigear.

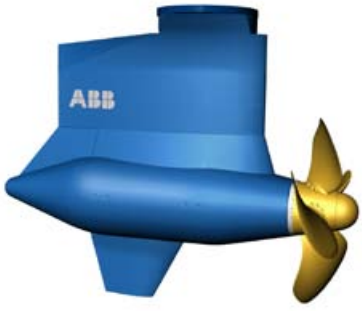
ABB Azipod® propulsion system is the proven and ever-improving cruise vessel standard that is the best solution when the vessel size, passenger comfort and manoeuvrability requirements are important.

With the Azipod propulsion, the delivery normally uses the medium voltage level in the network. This means that the propulsion frequency converter is a voltage source inverter, ABB ACS6000, designed for high-efficiency synchronous motors.

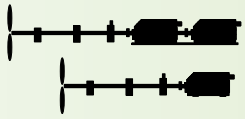
ABB ACS6000 propulsion drive offers additional design benefits which make the overall system design very favourable for energy efficiency optimization as well. This can bring down the operational costs while at the same time providing the highest level of comfort onboard.

The power generated by the medium voltage generators is distributed via an ABB main switchboard, which can be designed with low short circuit current ratings (design towards the lower values is a safety issue which reduces forces in case of a short circuit). The main reasons for this design are the high and constant power factor of a modern frequency converter as well as the low disturbances in the network voltage, which allows design without oversizing the generators.

Below propulsion chain components: propulsion transformer, modern ACS6000 drive and Azipod propulsion unit.



5.3 Cruise vessel
5.3.5 Summary of power savings potential

	Propeller selection	Hull design (current preferences)	Power plant	Harbor access ability
Direct Drive  LEISURE	CPP -15…0% FPP 0%	0…3%	-5…3%	-1…0%
Azipod®  LEISURE DESTINATIONS	FPP 0%	8…10%	-5…3%	0…1%
	Azipod has always FPP	Electric propulsion gives new possibilities for hull design which in turn enables power savings.	The selected power plant has a significant effect on energy consumption	Poor harbor access ability increases harbor time and in some cases the time must be won back with a higher cruise speed.

We have divided the operational profiles of cruise vessels into two simplified categories

LEISURE

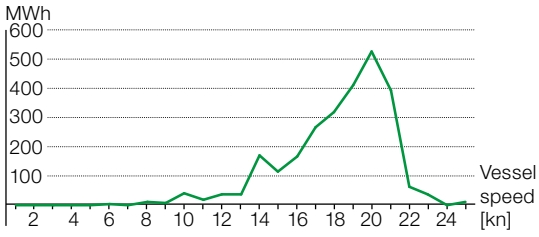
Cruise vessel operational profile with more focus on passenger comfort than on the covered distance and destinations. The vessels sail more in the low speed range than at high speeds. Onboard activities have a key role.

DESTINATIONS

It is more important to see new places and locations. Onshore activities have a key role.

Propulsion drive (ref. 98%)	Propulsion motor (ref. 97%)	ABB EMMA	Shore connection	TOTAL ENERGY SAVING POTENTIAL
-1…1%	-1…1%	3…8%	0…1%	**-5…12%**
0…1%	-1…1%	3…8%	0…1%	**5…20%**

Savings within the 10,000 running hours when the voltage source inverter is selected instead of the traditional LCI-type (cruise ship standard as presented on page 65).



Savings within the 10,000 running hours when a synchronous motor is selected instead of an asynchronous motor. (cruise ship standard as presented on page 65).