



AURORA  
BOREALIS

EUROPEAN  
RESEARCH  
ICEBREAKER

ICEBREAKER,  
DRILLING PLATFORM  
AND MULTI PURPOSE  
RESEARCH VESSEL

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Federal Ministry  
of Education  
and Research

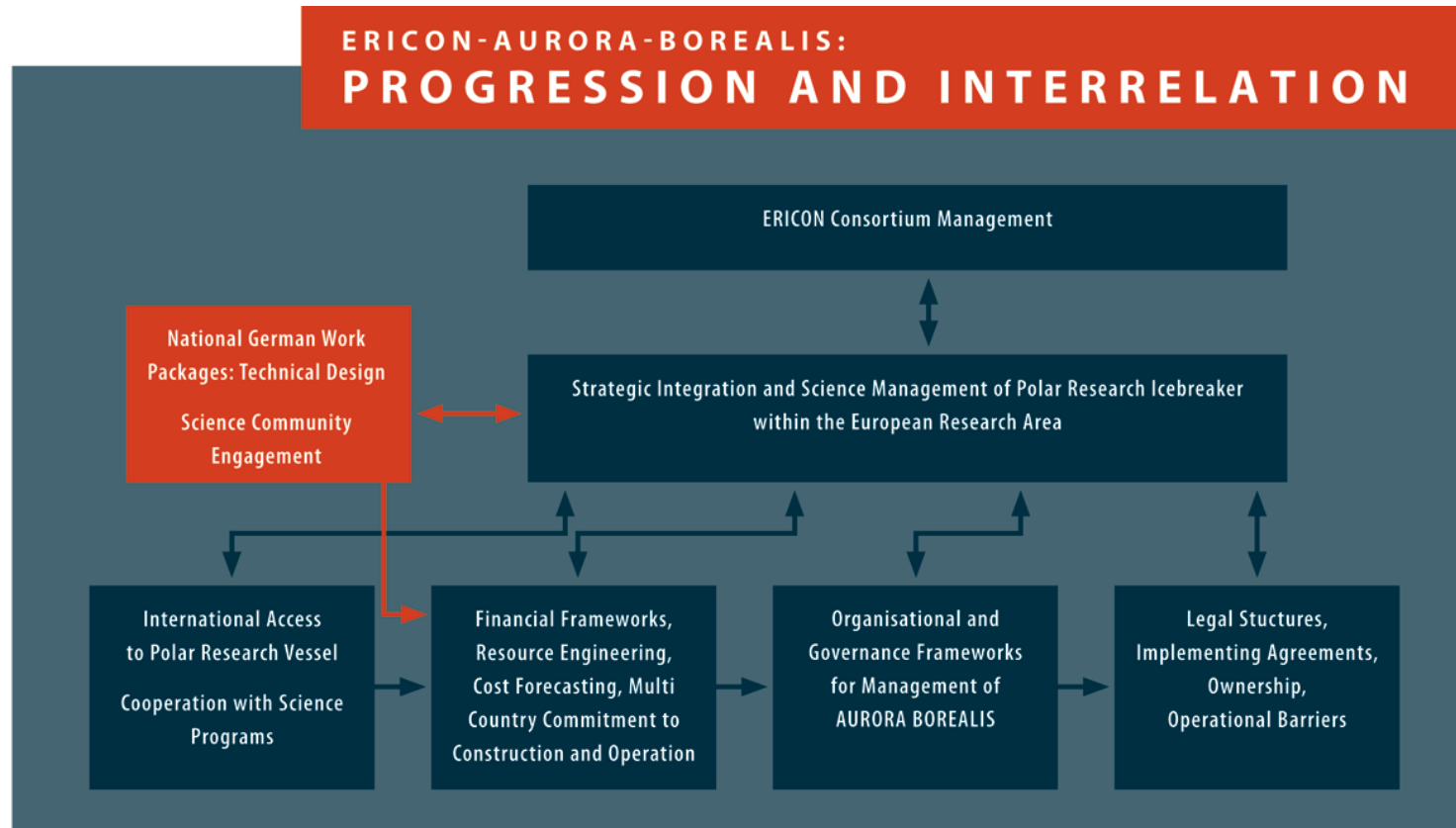


SEVENTH FRAMEWORK  
PROGRAMME





# European Research Icebreaker Consortium – ERICON -AURORA BOREALIS



48 Months duration

Budget: 4.5 Million Euro

Project started March 1, 2008 and runs till February 2012

# ERICON-AURORA BOREALIS

will generate the strategic, legal, financial and organisational frameworks for European ministries and funding agencies to decide about the construction and operation of AURORA BOREALIS.

## THE PARTNERS

ESF Fondation Européenne de la Science

AWI Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz Gemeinschaft, Germany

CNR Consiglio Nazionale delle Ricerche, Italy

PNRA Programma Nazionale di Ricerche in Antartide, Italy

CNRS-INSU Centre National de la Recherche Scientifique - Institut National des sciences L'Univers, France

AARI Arctic and Antarctic Research Institute, Russia

IPEV Institut Polaire Français Paul Emile Victor, France

MTL Merentutkimuslaitos (Finnish Institute Marine Research), Finland

NWO Netherlands Organisation for Scientific Research, Netherlands

UIB University of Bergen, Norway

BMBF Bundesministerium für Bildung und Forschung, Germany

FNRS Fonds National de la Recherche Scientifique, Belgium

BAI Bulgarian Antarctic Institute, Bulgaria

FAR Fundatia Antarctica Romana, Romania

AARC Aker Arctic Technology Inc., Finland



Aker Arctic



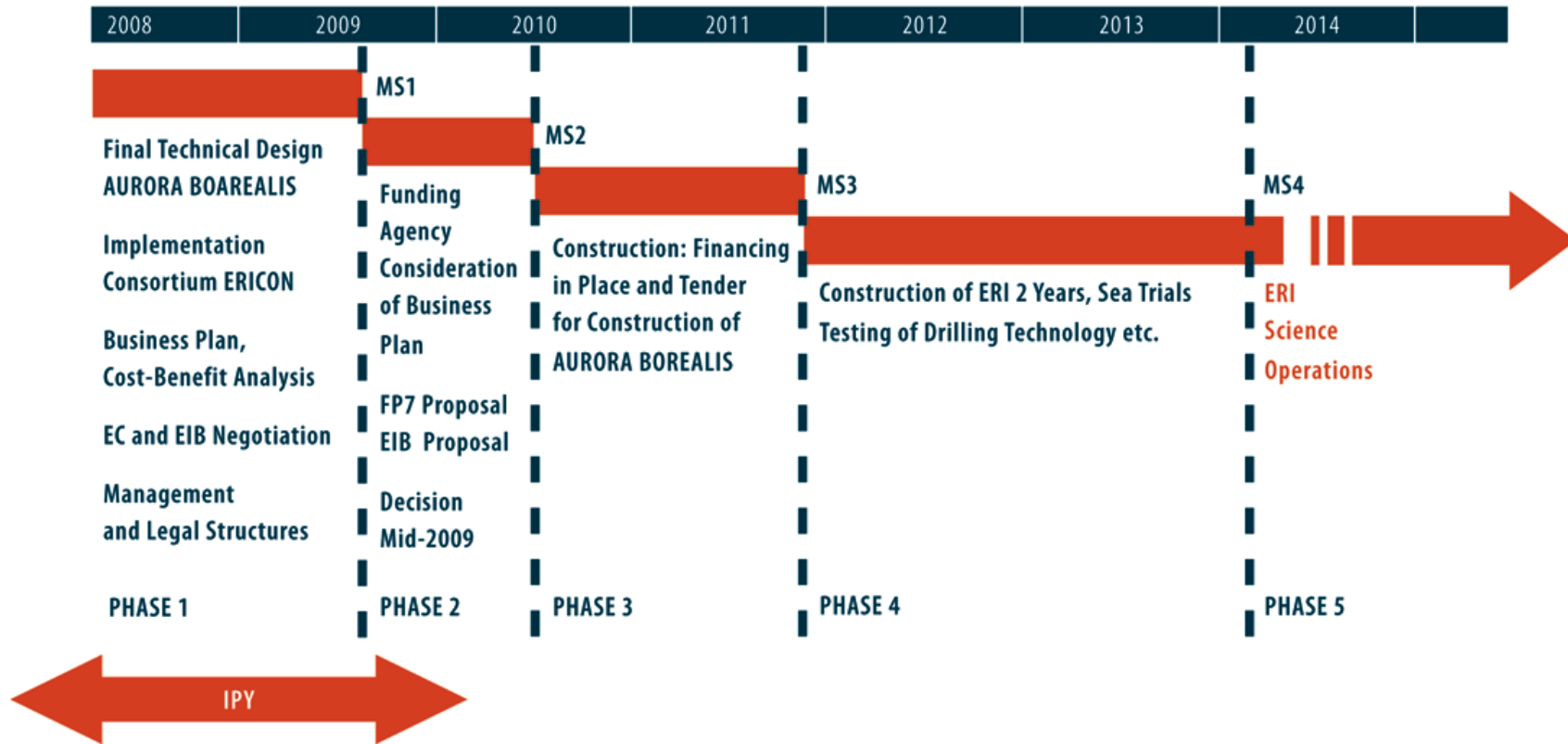
ECORD  
European Consortium for  
Ocean Research Drilling



FNRS

# ERICON-AURORA BOREALIS

## ROAD-MAP AND DEVELOPMENTAL STAGES FOR IMPLEMENTATION OF ERI-AURORA BOREALIS LARGE-SCALE FACILITY 2008-2014





An aerial photograph of the Aurora Borealis icebreaker ship, a large white and blue vessel with a prominent white superstructure. The ship is navigating through a field of sea ice. The hull is dark blue with the name 'AURORA BOREALIS' written on it. The superstructure features the European Union flag and the ship's name. Several orange cranes are visible on the deck. A yellow helicopter is on the deck. The ship is surrounded by a large area of broken ice floes.

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THANK YOU FOR  
YOUR ATTENTION

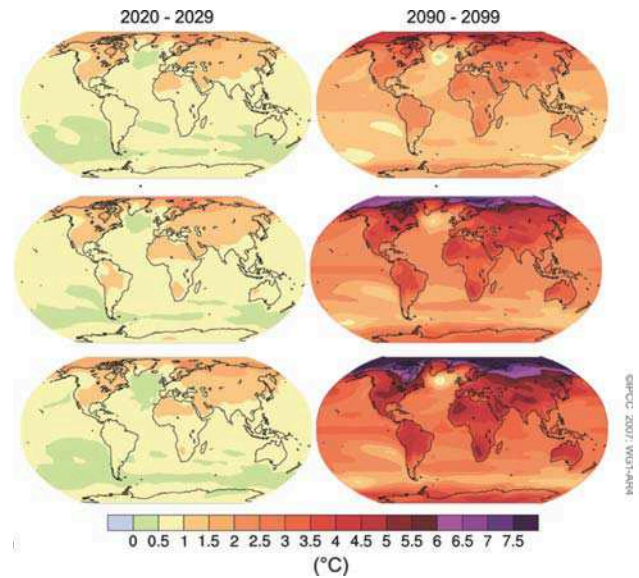
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Polar Oceans play a critical role in the earth system. They are characterized by large areas that are permanently or seasonally covered by sea ice, very low temperatures, pronounced seasonal changes, and bordering prominent continental ice sheets. These areas control global climate evolution on a broad range of time scales and directly influence global ocean circulation, sea level change, atmospheric forcing and teleconnections. Complex interactions between ecosystems, ocean, atmosphere and sea ice determine the nature of these unique regions. Long repeated time series observations will be critical for understanding the functioning of the Arctic and Antarctic climate system.

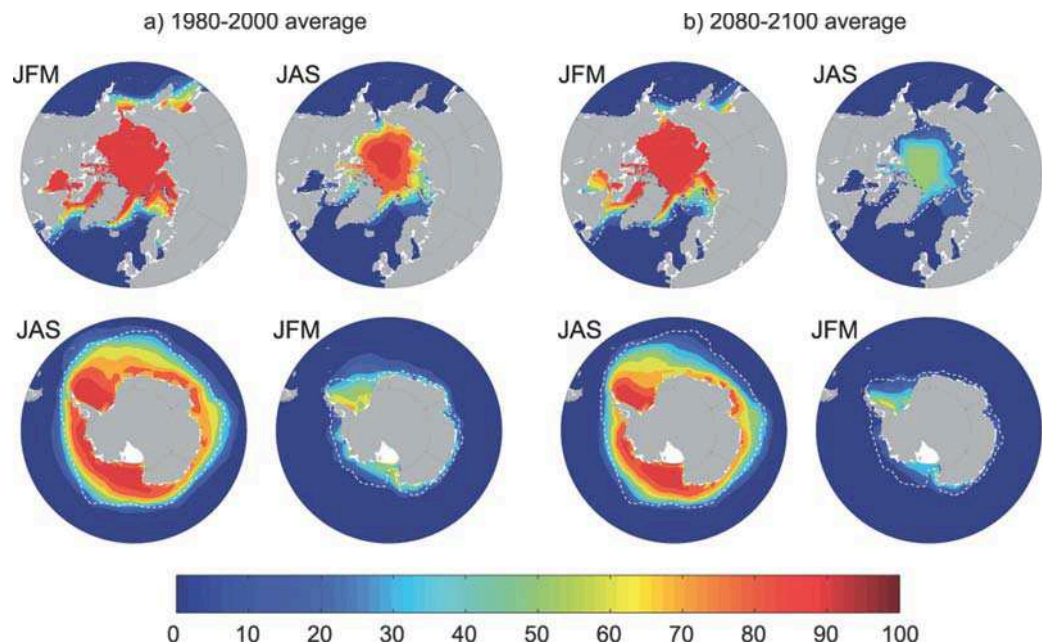
The Polar Oceans are potentially most vulnerable to present and future global environmental changes on our planet, where small shifts may cross thresholds, trigger unknown feedbacks and cause irreversible consequences. Research in the Polar Regions play a decisive role in developing and applying mitigation and adaptation measures for changing high latitude environments. Today, even the most sophisticated modelling forecasts, e.g. the IPCC 4<sup>th</sup> Assessment Report, are limited by insufficient data coverage in high latitudes. But Polar Regions will certainly face some of the most dramatic changes such as unprecedented rise in temperatures (Fig. 1), surpassing in magnitude other regions on Earth.

Fig. 1) Temperature rise



Understanding polar natural variability demands an extensive and profound knowledge of involved processes. To gain this insight, natural paleoenvironmental archives such as sediment cores from the deep seafloor must be retrieved and analysed. Despite the significance, polar realms are not well understood and substantially lack temporal and areal coverage in discrete sampling and observations. There is a lack of information about natural physical or biological variability of the oceans or long-term shifts in the cryosphere or ecosystems due to the extreme technical and logistical efforts involved to operate in these extreme environments. Even with widely differing forecasts about changing climates in the high latitudes, both Polar Regions will remain a challenge to operate in, due to severe ice and weather conditions (IPCC AR 4: Arctic and Antarctic Summer/Winter Sea ice concentration analysis/forecast see Fig. 2) for the foreseeable future.

Fig. 2) Sea ice concentration



## PRIORITY TARGETS FOR POLAR RESEARCH: AURORA BOREALIS SCIENCE PORTFOLIO

The unique year-round operational capacity will allow crucial new process-oriented studies of Polar Regions. Expeditions can be staged outside the optimal weather windows of opportunity, independent of the vagaries of drifting pack ice or limitations by severe weather and endurance, even in completely ice-covered waters. These scientific research comprise topics like:

- **Climate Variability:** scales and indicators of polar climate change to forecast future threats and possibilities.
- **State and stability of the cryosphere:** changing biodiversity and ecosystems in polar environments: Integrated real-time ice–ocean–atmosphere–hydrosphere observations and forecasting for users and inhabitants of Polar Regions.

The advanced scientific drilling capability turns AURORA BOREALIS into an extremely useful and necessary platform for scientific deep-sea drilling in regions inaccessible by other, conventional drilling platforms with a focus on:

- **Reconstruction of past climatic variability including extreme events.**  
Unravel the tectonic and geodynamic history of the Arctic and Antarctic ocean basins. Reconstruct the long-term history of Antarctic ice sheets and the transition from a distant “greenhouse” into the current “icehouse” world.
- **Assess nature and stability of the submarine permafrost environment, evaluate the potential de-stabilisation of continental margins and releases of gas hydrates into the hydro- and atmosphere.**
- **Long-term geophysical monitoring of boreholes and the surrounding environment with observatories and instruments.**
- **Access the deep biosphere below seafloor and study life in extreme environments below permanently ice-covered ocean basins.**



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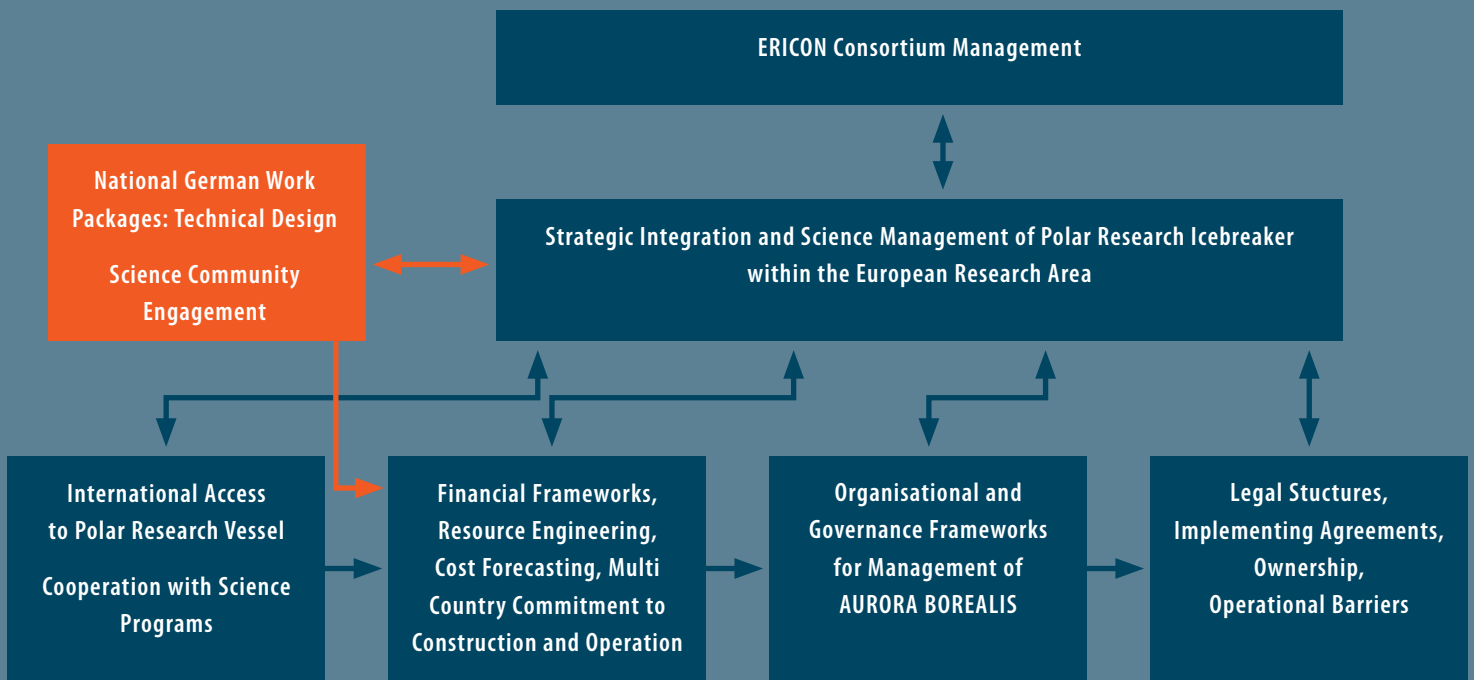
# THE CONSORTIUM



The European Research Icebreaker Consortium (ERICON) managed by the European Science Foundation and Alfred Wegener Institute comprises fifteen partners from ten European nations and associated countries that currently receive funding by the EC's 7<sup>th</sup> Framework Program (ESFRI Preparatory Phase). The overall aims of ERICON are to establish strategic, legal, financial and organizational frameworks for this multi-country research facility. The vessel AURORA BOREALIS will be operated as a large-scale research infrastructure by European nations and other partner nations. Consortium Partners will develop the frameworks for joint ownership and operation of the AURORA BOREALIS. A legal structure will be set up and connections with other existing research assets such as polar stations, air support and satellites. The final aim is to reach an agreement with nations committing to the construction and operation of the vessel. Scientific management frameworks will be established to handle large-scale, multi-year, mission-specific research programs and science and technology co-operations with EU strategic partner countries like Russia are anticipated.

The construction of AURORA BOREALIS as a joint European/international research icebreaker would result in a considerable commitment of the participating nations to co-ordinate and expand their polar research programs in order to operate this ship continuously and with the necessary efficiency. AURORA BOREALIS will contribute as a Polar Environmental Observing Platform for integrated Earth system science and to meet the Arctic and Antarctic drilling challenge within the context of international program such as IODP. The capacity for deep-sea drilling in ice covered oceans makes AURORA BOREALIS a powerful European research platform that complements the platforms provided by Japan (CHIKYU) and the USA (JOIDES RESOLUTION).

## ERICON-AURORA-BOREALIS: PROGRESSION AND INTERRELATION



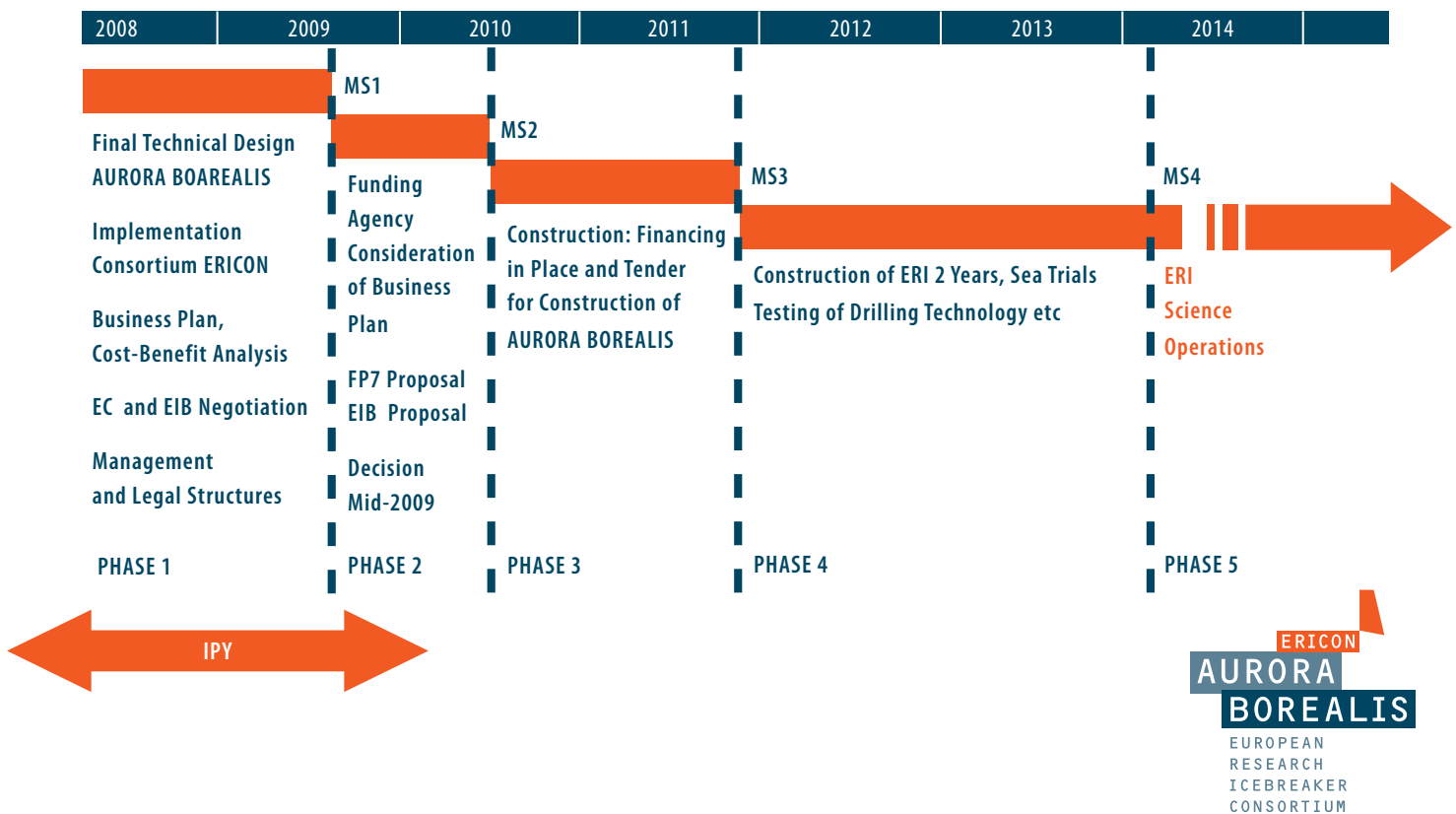
# ACTIVITIES

**The ERICON-AURORA BOREALIS Preparatory Phase comprises six activities:**

1. Adoption of a final technical design of the vessel by stakeholders, created by an external work package funded by the Federal Ministry of Education and Research, Germany.
2. Strategic integration of the vessel into the European Research Area, provision of research services and long term deployment planning.
3. Ensure international access for vessel to the Exclusive Economic Zone (EEZ) in the Arctic, draft possibilities for non-stakeholder nations and third countries to use ship.
4. Initial business perspective including budget plans for construction and operation costs. Acquire models for financial participation.
5. Agreement on organizational structures, decision making processes and the form of the managing agency.
6. Draft models on legal implementation structures, generation of an intergovernmental agreement between participating nations.

All of these combined actions shall enable a framework of facilitation to enable the implementation phase of the infrastructure.

## ROAD-MAP AND DEVELOPMENTAL STAGES FOR IMPLEMENTATION OF ERI-AURORA BOREALIS LARGE-SCALE FACILITY 2008-2014



The ERICON project is supported by the European Commission under Framework Program 7 (Grant Agreement No.: 211796).



# TECHNICAL DETAILS

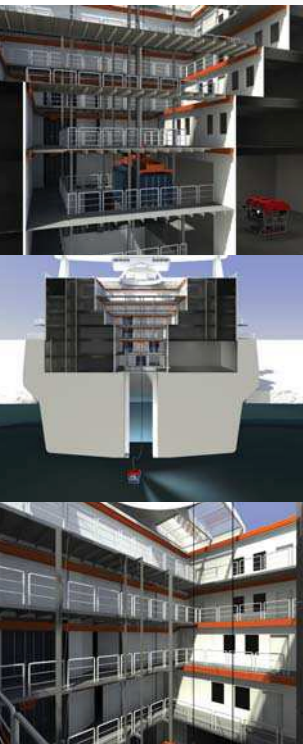
AURORA  
BOREALIS

The Research Icebreaker AURORA BOREALIS will be the most advanced Polar Research Vessel in the world with a multi-functional role of deep-sea drilling and supporting climate/environmental research and decision support for stakeholder governments for the next 35-40 years. The new technological features will include dynamic positioning in closed sea-ice cover, advanced ice-forecasting and management with autonomous, multiple helicopter support and the deployment and operation of Remotely Operated Vehicles (ROV) and Autonomous Underwater Vehicles (AUV) from the twin moon-pools.



The most unique feature of the vessel is the deep drilling rig, which will enable sampling of the ocean floor and sub-sea up to 5000 m water and 1000 m penetration at the most inhospitable places on earth. The drilling capability will on the long run be deployed in both Polar Regions and AURORA BOREALIS will be the only vessel worldwide that could undertake this type of scientific investigation. The possibility to flexibly equip the ship with laboratory and supply containers, and the variable arrangement of other modular infrastructure (in particular, winches, cranes, etc.), free deck-space and separate protected deck areas, will allow the planned research vessel to cover the needs of most disciplines in marine research. The ship can be deployed as a research icebreaker in polar seas because it will meet the specifications of the highest ice-class for polar icebreakers.

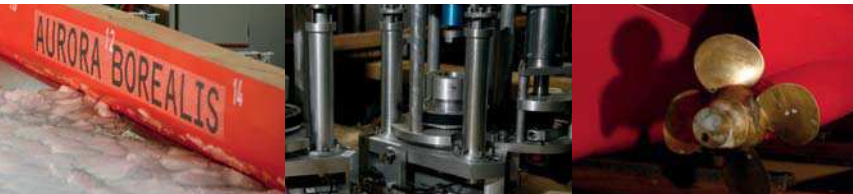
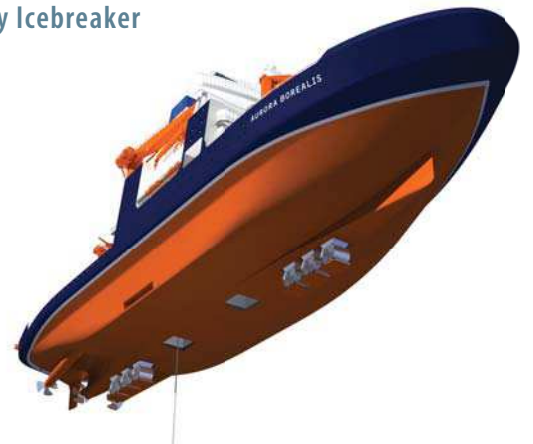
The vessel will be a powerful research icebreaker with approx. 65,000 tons displacement, a length of 199 m and with 81 Megawatt diesel-electric propulsion power. It will have high ice performance to penetrate autonomously (single ship operation) into the central Arctic Ocean with 2.5 meters of ice cover, during all seasons of the year. The construction of AURORA BOREALIS requires several new technical solutions and will provide an extended technical potential and knowledge for marine technologies and the ship building industry.





# TECHNICAL DETAILS COMPACT

Vessel type: Multi-Purpose Research Vessel, Deep-Sea Drilling Vessel, Heavy Icebreaker  
with highest AICS Ice Class: Polar Class 1



- Length over all: 199.85 m
- Length between perpendiculars: 174.27 m
- Moulded breadth: 49.00 m
- Breadth at 13 m draught: 45.00 m
- Maximum draught: 13 m
- Displacement: approx. 65,000 tons
- Max. cruise speed in open water: 15.5 kn
- Cruising speed in open water: 12 kn
- Max. operational endurance: 90 days
- Propulsion: diesel-electric
- Maximum generator output: ca. 94 MW (electric)
- Number of generator units: eight plus onshore and emergency generators, waste heat recovery and exhaust gas cleaning systems
- Main propulsion: 81 MW (3 x 27 MW)
- Main propeller: 3 x 6.5 m diameter, fixed pitch, ice strengthened
- Transverse thrusters: 2 x 3 units, fixed, fully retractable, one unit forward and aft also usable in retracted position for manoeuvring
- Operational temperature limit: full functional capability to  $-50^{\circ}\text{C}$ , working capacity  $+45^{\circ}\text{C}$  to  $-30^{\circ}\text{C}$
- Berthing capacity: 120 (science and crew)
- Accommodation: 80 single and 20 double cabins
- Dynamic positioning: in drifting ice of up to 2.5 m thickness and in open water
- Icebreaking capacity: more than 2.5 m multi-year ice with 2 – 3 kn
- Scientific disciplines: Geology, Geophysics, Biology, Physical and Chemical Oceanography, Glaciology, Meteorology, Atmospheric Physics and Chemistry, Bathymetry
- Moon pools: 1 for scientific drilling, 1 for other science equipment deployment, 7x7 m size each
- Drilling rig: Riserless drilling, 85 m height above keel. Max. static hook load: 680 mT, heave compensated
- Max drilling depth: 5000 m water depth, >1000 m below mudline
- Scientific echosounders: Multibeam with  $1^{\circ}\times 1^{\circ}$  resolution and sediment echosounder, additional echosounding systems depending on configuration
- Helicopter hangar and landing deck capacity for 3 helicopters

Start of construction: 2012 (planned)  
Commissioning: 2014 (planned)  
Operational lifetime: 35 – 40 years  
Estimated construction costs: 650 Mill. €  
Estimated operational costs: 36 Mill. € p.a.

December 2008

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# TECHNICAL CHARACTERISTICS

AURORA BOREALIS is technically unique. It is designed as a combination of a heavy icebreaker, a deep-sea drilling ship and a multi-purpose research vessel. The operational portfolio comprises the Polar Regions during all seasons of the year as well as the open oceans. To date, no comparable vessel for year-round polar expeditions is available worldwide, neither in commercial shipping and the offshore industry, nor for scientific operations. The naval architects and engineers thus succeeded in developing the world's most advanced icebreaker with the ability to perform scientific deep-sea drilling even within closed sea-ice cover.

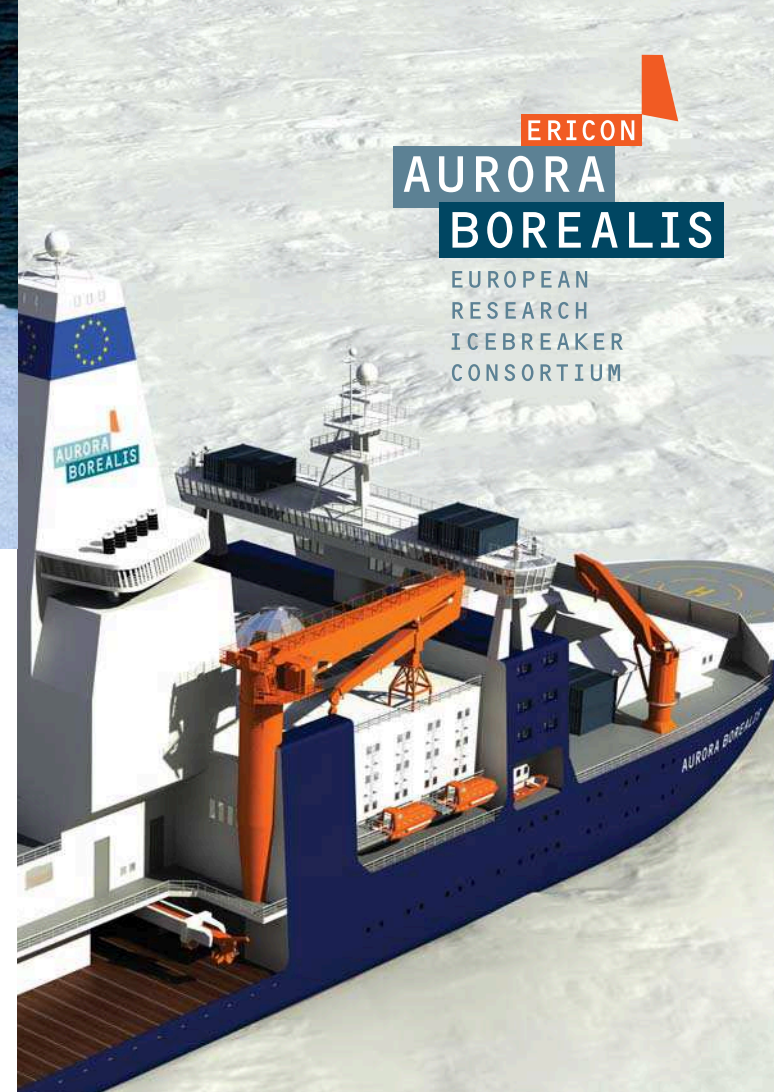


# TECHNICAL DETAILS COMPACT

- Diesel-electric icebreaker with 81 MW propulsion power
- Highest attainable shipping classification for icebreakers
- Complete twin hull design and full redundancy in ship's safety systems
- Two moon pools 7 x 7 m each, one for deep-sea drilling, one for deploying other scientific equipment (ROV, AUV, observatories, etc.)
- Dynamic Positioning System within closed sea-ice cover and open water
- Advanced ice-forecasting and management with autonomous, multiple helicopter support
- Deep-sea drilling in closed sea-ice cover with more than 2 m thickness
- Rig specification: drilling in more than 5,000 m water depth with 1,000 m penetration
- Riserless drilling technology
- Modularized mobile laboratory systems - mission specific laboratories

Length over all: 199.85 m  
 Moulded breadth: 49.00 m  
 Maximum draught: 13 m  
 Max. speed in open water: 15.5 kn  
 Cruising speed in open water: 12 kn

Personnel (crew, scientists and helicopter crew): 120  
 Max. operational endurance: 90 days



# ICEBREAKER, DRILLING PLATFORM AND MULTI-PURPOSE RESEARCH VESSEL



The AURORA BOREALIS project is supported by:



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KLEMM BRENDENJE





## THE PROJECT

The AURORA BOREALIS project focuses on two scientific communities that in part overlap and in part have divergent interests:

**The first** one is the general polar science community, which requires a research vessel for conducting field and marine work throughout **all seasons of the year**.

Polar sciences today lack the critical ability to carry out **year-round** research, observations and experiments in the central Arctic Ocean. Weather and ice conditions prevent the autonomous penetration of research vessels into this pack ice-covered realm during bad seasons when the most critical climatic, biological and oceanographic processes occur. AURORA BOREALIS with its maximum ice-breaking capability, dynamic positioning in closed sea-ice cover, advanced ice-forecasting and management with autonomous, multiple helicopter support, the deployment and operation of Remotely Operated Vehicles (ROV) and Autonomous Underwater Vehicles (AUVs) for sub-ice surveys from the twin moon-pools and the modularized mission-specific laboratory systems will be the premiere platform to accomplish such programs and yield new scientific results.

**The second** is the deep-sea drilling science community, which would use the ship mainly during **summer months** with optimal ice condition to study the structure and properties of oceanic crust and the history of the oceanic depositional environments.



In spite of the critical role of the Arctic Ocean in climate evolution, it is the only basin of the world's oceans that has essentially not been sampled by the drill ships of the Deep-Sea Drilling Project (DSDP) or the Ocean Drilling Program (ODP) and its long-term environmental history and tectonic structure is therefore poorly known. This lack of data represents one of the largest gaps of information in modern Earth Science. Therefore, the new research icebreaker AURORA BOREALIS shall be equipped with drilling facilities to drill in deep, permanently ice-covered ocean basins.



In a long-term perspective the AURORA BOREALIS will also be used to address research targets around Antarctica, both in its mode as a regular multi-purpose research vessel as well as a polar drill ship.

### Timeline

Preparatory phase: 2008-2011  
Construction phase: 2012-2014  
Operation: 2014 onwards

## SCIENTIFIC RELEVANCE

### Climate Change, European Polar Research, Research Icebreaker

Polar research and in particular the properties of northern and southern high latitude oceans are currently a subject of intense scientific debate and investigations, because they are (in real time) and have been (over historic and geologic time scales) subject to rapid and dramatic climatic variations. Polar regions react more rapidly and intensively to global change than other regions of the earth. News about shrinking of the Arctic sea-ice cover, potentially leading to an opening of sea passages to the north of North America and Eurasia, on the long to a "blue" Arctic Ocean, as well as about the calving of giant table icebergs from the ice shelves of Antarctica are examples for these modern changes.

Europe has a particular interest in understanding the Arctic environment and its potential for change because many of its highly industrialized nations reach into high northern latitudes and because Europe is under the steady influence of, and in exchange with, the Arctic environment. In addition, considerable living and non-living resources are found in the Arctic Ocean.

Research in the polar regions can only be carried out by sophisticated research vessels. Modern research vessels that are capable of penetrating into the central Arctic are rare. A new state of the art research icebreaker is therefore urgently required to fulfill the needs of European polar research.

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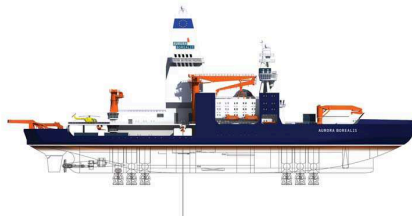
## THE PROJECT



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European nations have a mutual substantial interest in studying polar environments, their potential, processes and changes. This involvement stems from Europe being under constant influence of – and interaction with – the Arctic environment. Some countries' territories widely extend into the high northern latitudes, which provide considerable living and non-living resources, but modern research vessels capable of penetrating into the central Arctic are few.

The new European Research Icebreaker AURORA BOREALIS offers the unique possibility for European polar and marine scientists to attain a leading position and to consolidate scientific efforts for the coming decades. The vessel will facilitate extended expeditions into one of the most remote regions on our planet, and thus enable scientists to reveal new discoveries about the past and present polar realm, climate change or the present environmental conditions that affect polar oceans. In addition, the vessel will be the first platform technically able to generate continuous datasets of climate variability from these most sensitive regions, an indispensable prerequisite for projections of future anthropogenic changes in the Polar Regions.



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ICEBREAKER,  
DRILLING PLATFORM  
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RESEARCH VESSEL



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The Polar Oceans are the least known areas on the globe, although they hold the key to many of our climate's secrets. How does the sea ice cover and the sea water properties change? How do plants and animals survive under the most extreme conditions on earth? Which information of past climate change can be read from the sediments at the sea floor and how can the future climate change be predicted? In order to answer these questions the AURORA BOREALIS is planned as the technologically most advanced research vessel, able to drill deep into the sea floor, and to withstand not only the chilly summers but also the freezing winters of the Polar Oceans.

Year-round scientific observations are essential for understanding the dynamic systems in the Polar Regions and the possible climate modifications induced by humans. The European Research Icebreaker AURORA BOREALIS will enable Europe to launch international research expeditions into the Arctic Ocean and the Antarctic continental shelf seas during all seasons of the year. It will act as a mobile floating ocean observatory, seamlessly integrating with other stationary observation systems and platforms on land, in space, and in the ocean. For the first time, the planned vessel will enable polar scientists to study some of the most pressing scientific questions of the next decades.

AURORA BOREALIS will be a major asset for a European operational capability in all Polar Regions helping to realise the "European Research Area" and complementing future Framework Programs, long-term research strategies, and the Integrated Ocean Drilling Program (IODP).

THE PARTNERS

- ESF Fondation Européenne de la Science
- AWI Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz Gemeinschaft, Germany
- CNR Consiglio Nazionale delle Ricerche, Italy
- PNRA Programma Nazionale di Ricerche in Antartide, Italy
- CNRS-INSU Centre National de la Recherche Scientifique - Institut National des sciences L'Univers, France
- AARI Arctic and Antarctic Research Institute, Russia
- IPEV Institut Polaire Français Paul Emile Victor, France
- MTL Merentutkimuslaitos (Finnish Institute Marine Research), Finland
- NWO Netherlands Organisation for Scientific Research, Netherlands
- UIB University of Bergen, Norway
- BMBF Bundesministerium für Bildung und Forschung, Germany
- FNRS Fonds National de la Recherche Scientifique, Belgium
- BAI Bulgarian Antarctic Institute, Bulgaria
- FAR Fundatia Antarctica Romana, Romania
- AARC Aker Arctic Technology Inc., Finland



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THE CONSORTIUM

AURORA BOREALIS is one of the proposed pan-European new Research Infrastructures listed in the Environmental Sciences Section on the "European Strategy Forum on Research Infrastructures" (ESFRI) roadmap of the European Commission.

Since March 2008 the "European Research Icebreaker Consortium (ERICON) – AURORA BOREALIS" comprises fifteen partners from ten European nations and associated countries, that currently receive funding by the European Commission's 7th Framework Programme to establish strategic, legal, financial and organizational frameworks for national governments and the EC to commit financial resources to the construction and operation of AURORA BOREALIS.

The vessel will be jointly owned and operated as a large-scale research initiative by European nations and other interested partners. Consortium Partners will develop the frameworks for joint ownership and operation of this multi-country research facility. A legal structure for AURORA BOREALIS will be set up and connections with other existing research assets such as polar stations, air support and satellites will be sought.

The final aim is to reach an agreement with nations committing to the construction. Scientific management frameworks will be established to handle large-scale, multi-year, mission-specific research programs and science and technology co-operations with EU strategic partner countries like Russia are anticipated.

