Efficient and safe

Environmentally sustainable oil production

Crude oil production
Mittelplate

DEA

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wintershall
Shaping the future.

Partner: Wintershall (50 %)

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Safe crude oil production from Germany's richest oil field

Leading-edge technology in the exploration and production of oil, expertise ranked with the best in the world, and the work of experienced, responsible specialists are the pre-requisites for environmentally compatible, safe production of crude oil from the Mittelplate reservoir located off the west coast of the German state of Schleswig-Holstein.

DEA Deutsche Erdoel AG as operator and its partner Wintershall – each with a 50 per cent stake – have already produced over 32 million tons of crude from the oil deposit. The reservoir holds a further 20 million tons of crude in technically and commercially recoverable reserves. There may be potential for additional resources to be developed in other parts of the oil field.

As the remaining oil reservoirs in Germany are now largely depleted, not only has the Mittelplate field meanwhile become Germany's most productive oil field with just under 55 per cent of domestic production; it is also one of the few deposits with a viable future.

Rapid developments in geophysical methods and in drilling and production technologies in recent years have opened up new horizons for efficient drilling and production methods, making it possible for oil production to be continually optimised. Crude oil production is carried out using a combination of offshore and onshore installations – that is, crude is extracted both offshore and from the mainland.

The western sections of the deposit have been developed from the Mittelplate Drilling and Production Island, located seven kilometres offshore, since production started in 1987. Land-based production from the eastern section of the field, under way since mid-2000, is carried out by means of high-tech, extreme extended-reach production wells, some of which extend over more than nine kilometres. All activities have been carried out without incident in the 28 years since production started. The drilling, production and transportation concept, which is constantly adapted to incorporate numerous innovations, has proven itself time and again. A major proportion of capital spending to date – some 1.5 billion euros – has gone towards implementing safety measures of an extremely high standard.

Top: View from the mainland, showing Mittelplate Drilling and Production Island, located seven kilometres off the coast of Friedrichskoog Spitze. In the foreground, the Dieksand Land Station with the crude oil treatment plant.

Right: The satellite image shows the production area as seen from a height of 850 kilometres.

Oil production in the National Park

Mittelplate Island is located in a protected area designated as the Nationalpark Wattenmeer, in the southern part of the Wadden Sea tidal flats in the German state of Schleswig-Holstein. The facility is inside the Protection Zone 2, where certain types of uses of the Wadden Sea tidelands are permitted. The extraction of oil is permitted under the National Park legislation. The legislation specifies the types of measures and uses that are allowed, and it also provides for exceptional permits and exemptions. These include the drilling for, and extraction of oil, but these measures are restricted to the approved Mittelplate Drilling and Production Island and must be coordinated with the National Park Authority.

Drilling and production at the highest level

Top: View from heliport landing deck, facing west, showing the portal crane and the drilling tower.

Bottom: The T-150, which cost about 50 million euros, is one of the most modern drilling rigs in Europe. An area of about 900 m² accommodates some 2,200 tons of steel construction and equipment. The height of the installation is approx. 70 metres.

Entrepreneurial courage and determination marked the beginning of the Mittelplate oil production project: in November 1979, the second oil shock hits consumers. Oil and gas companies raise their level of investment in the exploration and production of domestic energy supplies. The Mittelplate 1 exploration well strikes oil in August 1980. The oil deposits are located at a depth of 2,000 to 3,000 meters in Dogger sandstone layers. Additional wells soon confirm considerable oil potential off the west coast of the state of Schleswig-Holstein. Test production from the reservoir begins in October 1987 with six wells drilled from the artificially created Mittelplate Drilling and Production Island in the Wadden Sea.

The safety and protection of the tidelands are assured right from the start as the entire facility is completely sealed off from the surrounding tidal flats. The island covering an area of 70 x 95 metres is constructed on the sandy tidelands in the form of a compact, leak-proof steel-and-concrete basin and is surrounded by high sheet pile walls facing the open sea. Nothing can escape to the outside unchecked, and even rain and spray water is collected and treated on the island. A comprehensive closed waste disposal system guarantees that the North Sea and the Wadden Sea tidelands are not exposed to contamination. Sophisticated monitoring and control systems provide multiple levels of safeguards for all drilling and production operations.

The pilot phase is successfully concluded in 1991. Since then, DEA and Wintershall have continually upgraded and improved the drilling and production operation on Mittelplate Island by incorporating new technologies and innovative concepts.

Using a minimum of space, 28 wells have been drilled from the artificial island to date. The island has slots for a total of 44 wells. The wells lead deep into the underground, down to the oil-bearing sandstone strata.

With the offshore field development requiring ever more sophisticated technologies, a powerful, electrically operated high-tech drilling rig has been in operation here since the end of 2005. The rig features special equipment that allows it to operate in an environmentally compatible manner in the ecologically sensitive tidelands.

Striking oil the high-tech way

To allow access also to more distant sections of the deposit, the facilities on Mittelplate Island were upgraded to meet the new requirements during the period from 2003 to 2005. Once the new living quarters were in place, a portal crane and the new T 150 drilling rig were installed on the island, at a total cost of 90 million euros.

Intelligent solutions optimise oil production

Top: Experienced crews ensure safe drilling operations.

Bottom: The state-of-the-art T-150 drilling rig in operation: the electrically-powered rig is capable of drilling wells over a distance of up to 8,000 metres to reach the oil reservoir. This method allowed the Mittelplate oil field to be developed gradually from the island.

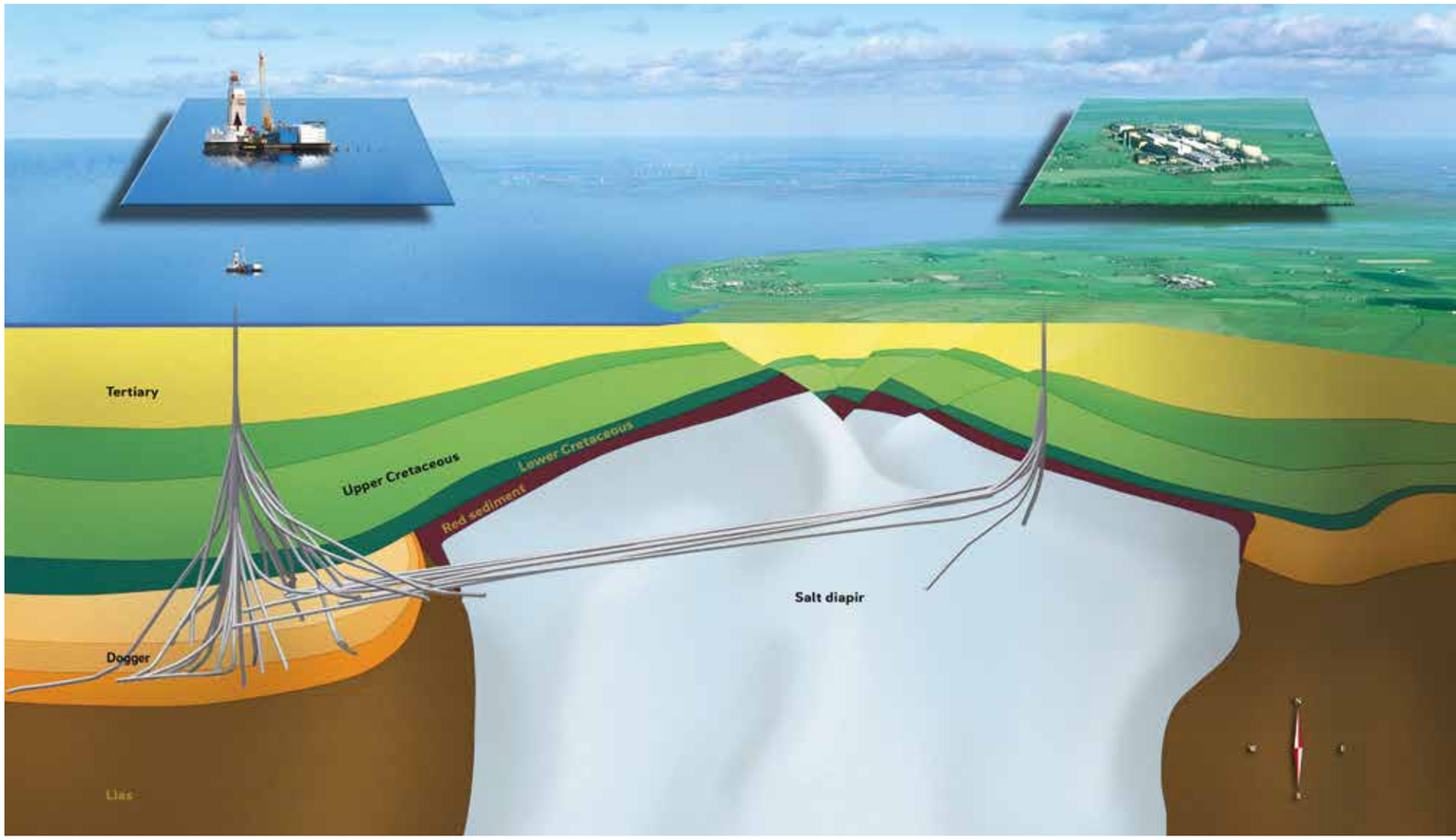
The Mittelplate oil production project enjoys an outstanding reputation in the global oil industry. The most demanding engineering standards developed to guarantee the safe exploration and production of oil in an ecologically sensitive environment are considered exemplary for similar projects worldwide. It is the technologies deployed in the realisation of this environmentally compatible oil field development in particular that have been setting new benchmarks across the globe.

The drilling and production concept is also a commercial success: through the production wells sunk from this unique facility worldwide to date, some 32 million tons of crude were extracted by the spring of 2016. The total volume of crude produced from the seven high-tech, extended-reach wells drilled from the mainland amounts to about 13 million tons.

The combined annual production from both offshore and onshore wells makes a substantial contribution to the domestic supply, and it more or less equals the imports from Saudi Arabia. The annual production from Mittelplate of 1.3 million tons yields around half a billion litres of heating oil – enough to heat about a quarter of a million single-family homes for a year. In addition, the annual production provides enough feedstock for around 350 million litres of petrol.

Using advanced extended-reach drilling technology (extremely deviated wells extending over vast horizontal distances), additional oil has also been produced from the eastern sections of the Mittelplate reservoir directly from the mainland since mid-2000.

7,727, 8,284, 8,367, 8,995, 9,275, 8,450 and 8,672 metres – these are the impressive lengths of the extended-reach wells drilled from the land-based drilling site at Dieksand.

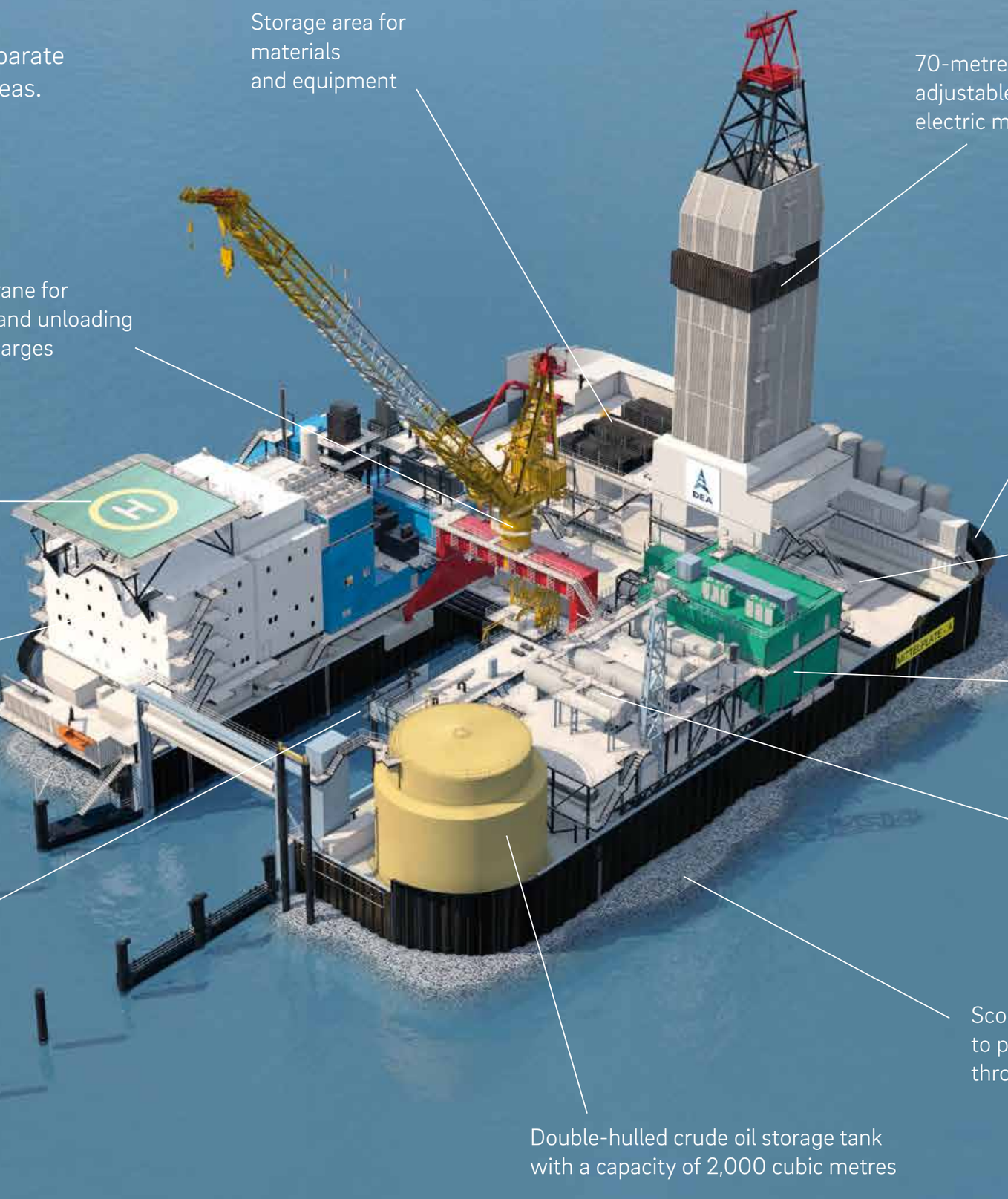


Extended-reach wells

The illustration shows the paths of the wells sunk to date. The drilling operations presented a major technical challenge to geologists and drilling engineers alike. The onshore wells needed to be deviated and then extended over distances ranging from 8,000 to more than 9,000 metres. The seven production wells sunk here set new standards and are among the most widely deviated extended-reach wells in the world.

Mittelplate Drilling and Production Island

A compact system featuring separate living, drilling and processing areas.



Storage area for materials and equipment

70-metre high, hydraulically adjustable drilling rig with electric motor

Portal crane for loading and unloading supply barges

Sheet pile wall with wave deflector

Helicopter landing pad for emergencies

Rig cellar made of concrete

Living quarters with beds for 106 persons

Floodwater treatment station

Crude oil treatment plant

Harbour basin with lock gate

Scour protection made of rocks to protect against scouring through tidal currents

Double-hulled crude oil storage tank with a capacity of 2,000 cubic metres

A model for responsible oil production acknowledged around the world

Top: Sheet pile wall with wave deflector. The sheet pile wall facing the open sea extends to a height of 11 meters. Nothing can enter from the outside, apart from rain and spray. And nothing can escape to the outside, not even rain water.

Right: Sophisticated, state-of-the-art technology, multiple safeguards in all work procedures and the use of experienced and responsible skilled staff result in an optimum safety package for drilling operations.

The facilities and equipment on Mittelplate meet a set of specially developed safety and environmental protection standards that are required for oil production in the Wadden Sea tidelands. The basic principle is to establish reliable protection against the forces of nature on the outside, and equally reliable insulation of the facility towards the outside so as to protect the environment.

The island perimeter is fortified by means of a scour protection belt made of rocks and water-resistant mortar. Due to constant, naturally occurring changes in the tidal flats, this scour protection requires regular maintenance to adapt it to the changing conditions.

Designed on the basis of detailed and comprehensive hydrographical, fluid dynamics and meteorological studies, this type of construction provides maximum stability. Neither storm tides, shifting tideways or floating ice have in any way affected the island since the start of production. The solid construction of the basin, which is designed to withstand extreme forces, offers yet another advantage: in the event of an accident, the impermeable surface of the island (which is sealed by means of a specially developed concrete compound and surrounded by the sheet pile walls) could contain far more crude than is stored on the island at any given time. Furthermore, the extensive systems of piping and cable ducts are of oil-tight construction, as are the rig cellars.

Mittelplate Island has its own comprehensive, closed waste disposal system: waste water from the residential quarters and the kitchen is purified in the island's own treatment plant, collected in tanks and then disposed of on the mainland in the same way as solid waste. Even spray and rain water is collected and disposed of on the mainland.

The materials brought to the surface during drilling, the rock cuttings, are separated and brought to the mainland in sealed containers for further treatment During this treatment, the drilling mud is recovered, recycled and re-used.

Specialist personnel monitor and control both drilling and production operations on the island round the clock by means of instrumentation and control systems.

Working responsibly in a sensitive environment

Over the years it has been shown that the responsible and proper consideration of all aspects of environmental protection will lead to the development of suitable measures, and of the technological means for implementing these measures. For example, in the event that any system parameters deviate in the production area, the crude oil pumps are automatically shut off. The production wells are fitted with quick-action stop valves at a depth of about 90 metres. If pressure drops, the valves shut automatically. Additional shut-off valves fitted at the wellhead provide an added layer of safety.

Left: The health and safety of the workers has top priority on Mittelplate. Work clothing conforms to internationally recognised safety standards.

Right: The double-walled oil storage tank for the intermediate storage of the extracted crude has a capacity of 2,000 cubic metres. In the event of damage to the inner wall, the outer hull would safely contain the entire volume of oil.

Bottom centre: View of the drilling rig's substructure, with the shut-off valves that guarantee safety at all times.

Bottom right: The island has an integrated harbour basin that can accommodate supply ships and transport barges. During loading and unloading operations, a lock gate is lowered to seal and secure the basin. Production and treatment of the crude is carried out in accordance with the highest technical standards.

Top: View of the island during construction.

Centre: Crew making adjustments to the wellhead of a production well.

Bottom: The process tanks for the treatment of the crude are linked in a closed system fitted with vapour recovery pipes, which effectively prevents emissions.

In 2005, much of the equipment and facilities on Mittelplate Island were upgraded, optimised or replaced. This also includes a new, high-performance portal crane with a slewing range that is adequate to meet all lifting requirements on the entire island.

Production and treatment of the crude is carried out in accordance with the highest technical standards.

The Dieksand Land Station

Processing plant for crude, petroleum gas and petroleum gas condensate.

Machinery halls

Helicopter landing pad for emergencies

Workshop and warehouse

Washdown area

Rain retention basin

Operations buildings

Horizontal separators

Machinery halls

Flat-bottomed tanks

Gas dehydration plant

Flare

Environmentally compatible crude oil treatment at the Dieksand Land Station

Top: The entire operation of the Land Station is constantly monitored by specialist personnel from the control station.

Centre: The petroleum gas separated out is sent to the customers in Friedrichskoog and Brunsbüttel via pipelines.

Bottom: The processing plant is the heart of the Land Station.

Production wells extract the Mittelplate crude from the oil-bearing sandstone formations located at depths of 2,000 to 3,000 metres 24 hours a day. The oil produced both on Mittelplate Island and through the horizontal extended-reach wells on the mainland reaches the processing plant at the Dieksand Land Station via pipelines. Here, the valuable commodity is processed to make it suitable for refining.

The facilities for processing the crude are needed to separate the mixture produced from the wells into pure oil, petroleum gas and condensate. Water extracted along with the oil is separated out and then pumped back into the oil-bearing rock formations in order to maintain pressure inside the reservoir. The crude is then treated further in four flat-bottomed tanks with a capacity of 2,500 m³ each. It then goes via pipeline to Brunsbüttel to the customers. The petroleum gas is fed into compressors and then undergoes a dehydration process, before entering a pipeline to Brunsbüttel. The condensate separated out from the crude is subjected to the same treatment.

The construction concept for the Dieksand Land Station, which covers an area of 55,000 m², is designed specifically to minimise the impact of the operation on the environment. All container vessels without double walls are placed inside impermeable collector basins made of concrete. To control noise emissions, compressors and pumps are housed inside process buildings.

The entire plant conforms to all the relevant statutory water protection regulations, preventing any contamination of groundwater. A process control system monitors onshore oil production as well as all the crude oil treatment processes and automatically shuts down the entire treatment plant in the event of any incident. The safety technology is designed with multiple levels of redundancy. The operations buildings also contain offices, sanitary facilities, a fire-fighting station and central heating unit as well as workshops, a laboratory and storage facilities.

Oil processing and transportation

The Land Station is the central control station for the crude oil processing and the entire transport network. From here, the pipeline carrying the crude produced on the island to the processing plant at the Land Station as well as the pipelines carrying the processed products oil, petroleum gas and condensate from the Land Station to Brunsbüttel are monitored and controlled.

With the construction of the pipeline linking the island to the mainland in 2005, a substantial expansion of the treatment plant was needed to provide the capacity to process the offshore production from the Mittelplate oil field at the Land Station as well. Around 42 million euros was invested in the modifications and expansion of the processing facilities.

Comprehensive information on the subject of Mittelplate

Top: The importance of the Mittelplate deposit and of crude oil as a commodity is conveyed via multimedia displays at the Info Point in Friedrichskoog.

Right: At the Info Point in Friedrichskoog, multimedia material is used to illustrate Mittelplate's significance as an oil deposit and the importance of crude oil as a commodity.

The Mittelplate Info Point in the Friedrichskooger Deichpassage pedestrian mall is a point of contact for anyone interested in finding out more about life and work on the drilling and production island. Here the overall theme of crude oil production is depicted in easy-to-understand displays for the benefit of visitors. Touchscreens, interactive games and partition screens displaying multimedia content allow the Mittelplate project to be experienced with great immediacy, and they are designed to appeal to younger target groups as well.

While a great deal of information is already provided at the Info Point, many visitors still ask many additional questions. For this reason, DEA offers a series of lectures at the Info Point. Entry is free. The presentations are intended for the local population as well as holiday-makers, adults, children and students. The lectures are presented by DEA employees and by external speakers.

The spectrum of topics is broad, ranging from lectures about Mittelplate Drilling and Production Island and the importance of crude oil as a source of energy all the way through to fundamental issues on the subject of energy. Other lectures in the series provide information about the long history of crude oil production in Schleswig-Holstein, or about the search for oil in Germany. Topics such as "Drilling technology – then and now" also appeal to audiences with an interest in engineering and technology.

Since the Info Point was launched, interest among visitors has been increasing steadily. The aim is to turn the subject of Mittelplate crude oil production into a vivid experience through the use of interactive elements, and to create an awareness of the importance of "Petroleum in our daily lives".

At the experimentation station, visitors can examine thin sections of oil-bearing sandstone under the microscope, revealing microfossils and plankton – the substances that eventually turned into crude oil.

Info Point

At the Info Point, visitors can obtain information about everything to do with Mittelplate from Easter right through to autumn. Special dates on which events such as lectures take place are advertised by posters, in the region's calendar of events, and on the website. These free events are suitable for audiences of up to 30 people. Enquiries can be made directly at the Info Point.

On request, lectures can also be arranged on an individual basis.

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Protecting the environment thanks to safe operation

The findings of the studies carried out so far and which will be continuing into the future indicate that, with the exception of the structure of the island itself, there have been no lasting deviations from the natural changes occurring in the tidal flats. No negative effects from the oil production on the environment, and especially on the tidal flats and its inhabitants, have been recorded to date.

The oil production activities associated with the Mittelplate oil field have repeatedly been met with scepticism, accusations and criticism. These concerns were taken into consideration throughout all planning activities and in the formulation of regulatory requirements and approvals for the Mittelplate project, both in the initial stages and for any subsequent developments.

The issue is whether valuable resources can be extracted without endangering, not to mention destroying, the natural environment. This is a fundamental issue – and the answer to the question is straightforward. Commercial activities without any impact on the environment whatsoever will always be an exception. Nevertheless, today and from here on, it must be an absolute requirement that the elimination of any such effects to the extent possible must be pursued with a high level of responsibility, and through the application of state-of-the-art technologies. Given the outstanding importance of environmental protection, the choice of technologies employed in the exploration and production of oil must be based on the principle of ensuring minimal intervention in ecological systems.

DEA as operator and its partner Wintershall are aware of their immense responsibility for the Wadden Sea tidal flats, a unique natural habitat. For this reason, the last 28 years of incident-free oil production on Mittelplate saw the implementation of extensive measures designed to protect the environment. Throughout the continual development of the oil field, independent research institutes and engineering consultants have conducted long-term studies to investigate and assess the effects of oil production on the sensitive environment. This included biological surveys focusing on microorganisms, fish and birdlife, as well as marine geomorphological and sedimentological studies in certain areas.

This information also serves as a vital basis for planning by the National Parks Administration.

Mittelplate demonstrates that the interests of the Wadden Sea tidal flats are compatible with production of crude oil, a vital commodity.

Protecting the unique natural environment of the Wadden Sea tidelands

The protection of the Wadden Sea tidelands and its inhabitants has top priority. This is why DEA welcomes the listing of the Wadden Sea region as a World Heritage Site. In consultation with the state governments of Schleswig–Holstein and Lower Saxony, the company made a commitment not to erect any additional structures for the production of oil or gas in the Wadden Sea Tidelands National Park. This means that in future, additional potential oil deposits will be exploited only using the existing facilities on Mittelplate Island or by means of extreme extended-reach wells drilled from outside the national park.

Leading-edge technology generates macroeconomic value added

Key figures about crude oil production on Mittelplate:

Investments since the start of the project: About 1.5 billion euros

Volume of crude produced without incident: More than 32,000,000 tons

Length of wells drilled successfully: Over 216,000 metres

Current reserve potential: 20 million tons of crude (not including additional potential resources)

Potential reserves in Germany: The Mittelplate deposit contains about half the entire German reserves of crude oil, and it is the biggest and most productive German oil field

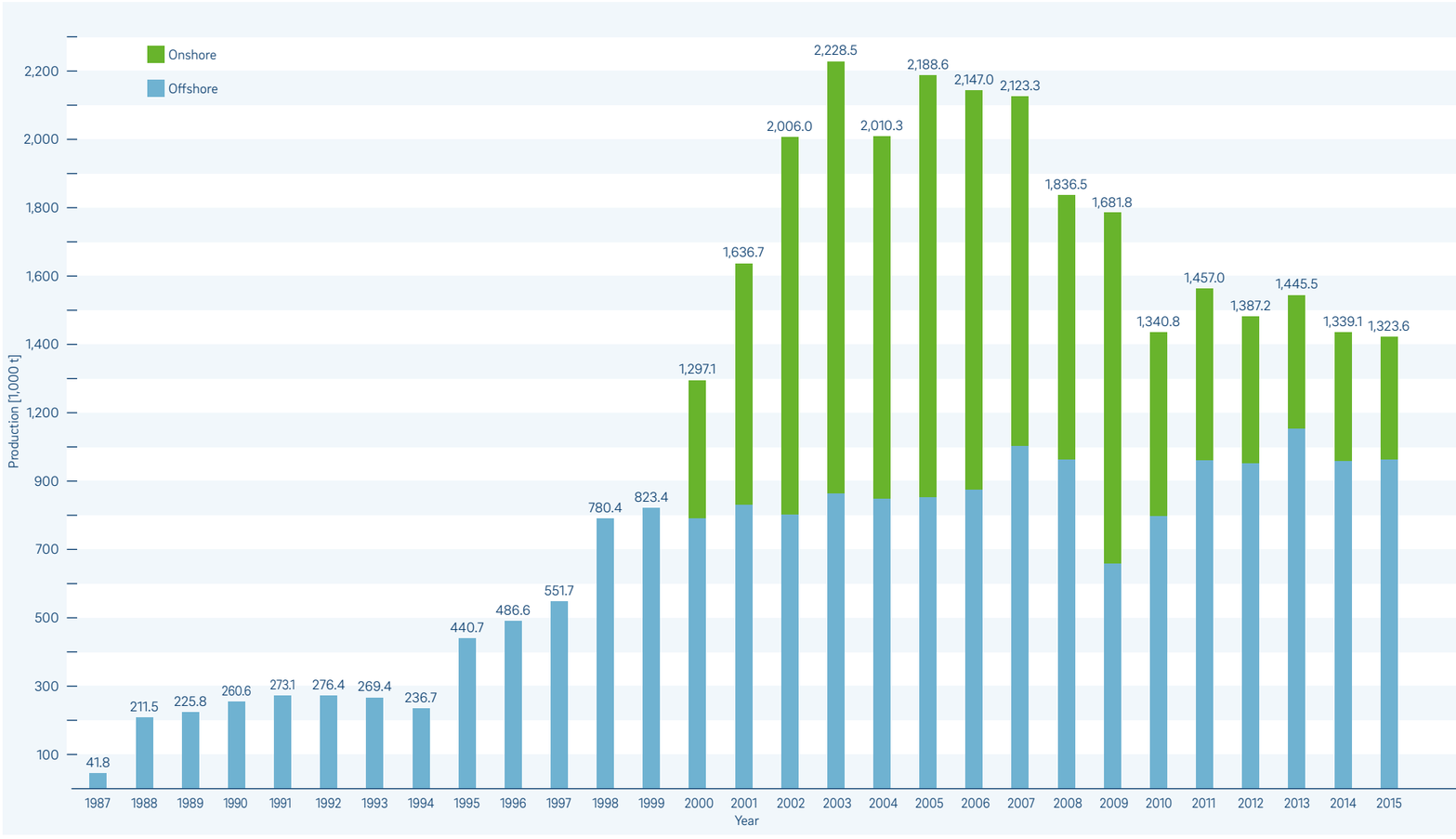
Benefit: Oil production from the Mittelplate field reduces the degree of dependency on oil imports from abroad; it benefits the national economy and contributes to the security of energy supplies

After years of safe drilling, production and transport operations, it is clear that oil production from the Mittelplate reservoir is technically feasible, commercially viable, and able to be carried out without compromising environmental protection in any way.

Thanks to the experience gained in this operation on the North Sea coast, DEA and Wintershall now have at their disposal the expertise and the state-of-the-art technologies needed for environmentally compatible oil production. This kind of expertise is gaining in importance worldwide, and it represents a distinct advantage in the competition for exploration and production licences.

The Mittelplate oil deposit is valued at several billion euros. Its significance for the economy and in terms of its contribution to domestic value added is high. Each ton of oil produced from domestic sources reduces Germany's dependence on imports. The flow-on effects for the economy are enormous: investments and ongoing operations have been, and will be, lending momentum for the local job market for years, for regional suppliers, thus contributing to a more broadly based economic revitalisation.

The short supply routes and good infrastructure in the state of Schleswig–Holstein can be used to good effect. At the ChemCoast Park Brunsbüttel, the crude is processed to manufacture a vast range of different products. Over 1,000 jobs depend directly on this domestic source of oil. At the Heide refinery alone, about 500 employees are involved in the processing of the Mittelplate crude. An additional benefit to the national economy is derived from tax revenues and royalties from the production operation. The royalties payable on oil produced here represent a reliable source of income for the federal state of Schleswig-Holstein.



Production from the Mittelplate field

Estimates of the reserve potential at Mittelplate have continually been adjusted upwards. In addition to the 32 million tons of crude already produced, current estimates are for some 20 million tons of commercially recoverable reserves. As a result of the continual optimisation of the drilling and production concept, it has also been possible to maintain the annual production rates at a high level. To maintain production at a high level for as long as possible, the oil field is gradually developed further by spudding additional production wells.