We assist our customers in identifying, assessing and managing their most critical risks. We enhance their business performance by assessing and advising on safety, quality, technology, business and sustainability aspects. We certify or verify compliance and drive new standards, best practices and digital ecosystems within five business areas: Maritime, Oil & Gas, Energy, Business Assurance, and Digital Solutions.
For the shipping industry, 2017 began with little promise, with most people expecting another year of weak growth and tight markets. As the year progressed, however, both the world economy and shipping demand picked up. Since customers were looking for new opportunities, DNV GL offered them a raft of new options and services designed to maximize their business.
The future of classification

In 2017, we implemented many modern classification solutions that will enhance our class services and improve communication with customers. From electronic certificates, machine learning tools and drone surveys to the launch of the Veracity open platform, we presented a range of innovative services and products that can help customers to improve their operations and performance, reduce maintenance and operational costs and enhance safety. However, digitalization is not an end in itself, but another means to fulfil our main purpose of ensuring safe operations at sea and protecting life, property and the environment.

The end of the paper chase

In 2017, we were the first classification society to roll out IMO-compliant electronic class and statutory certificates across the entire DNV GL-classed fleet. Certificates are published on our customer portal as soon as an onboard survey is completed, so that all relevant parties can access the latest certificates from anywhere in the world.

The electronic certificates are secured with a digital signature and unique tracking number, which can be checked online, assuring their validity and authenticity. Customers can choose to share access to their certificates with stakeholders (charterers, ports, flag administrations, insurers) by providing temporary access codes. With the temporary code, the stakeholder can directly access the customer’s secure certificate folder, reducing the ship owner’s administrative burden to the absolute minimum.

By the end of 2017, more than 52 flag state administrations had authorized DNV GL to issue electronic statutory certificates on their behalf and over 40,000 certificates for more than 2,000 vessels had been issued – and these numbers are continuing to grow fast.

Smart survey booking

We also introduced the new Smart Survey Booking tool. This uses smart algorithms and machine learning to help customers find the best time and place to book a survey. The algorithms identify when the maximum number of survey items can be combined by assessing the initiation and expiration dates for class surveys, audits and conditions. An estimate of the required time that the ship needs to be available for the survey/audit, along with the associated travel and costs, is also generated. The tool will even recommend a port of call based on all these factors. Finally, after a customer makes the booking, the Smart Survey Booking tool provides a set of survey preparation documents for the vessel’s crew, enabling them to prepare more effectively.
Knut Ørbeck-Nilssen – new IACS chairman

DNV GL Maritime’s CEO Knut Ørbeck-Nilssen was appointed chairman of the International Association of Classification Societies (IACS) in 2017 and announced an agenda focussed on improving IACS quality systems and the assessment of IACS members against those standards. He also pushed for modernizing class in anticipation of the developments created by digitalization, and for deepening IACS’ ongoing commitment to transparency.

A vessel for a new ‘green corridor’

In January 2017, we entered into a joint industry project in Singapore with BHP Billiton, Mitsui O.S.K. Lines, Rio Tinto, SDARI and Woodside to build and assess the business case for LNG as fuel for Capesize bulkers trading between Australia and China and develop an efficient LNG-fuelled Capesize concept design. The ‘Green Corridor’ joint industry project resulted in an innovative LNG-fuelled Newcastlemax design. The project showed that bringing together partners from across the industry can result in unique solutions that fulfil owners’ and operators’ requirements, as well as being in full compliance with international rules and regulations.

Maritime forecast to 2050

The ‘Maritime Forecast to 2050’ was launched as a supplement to DNV GL’s Energy Transition Outlook. It provides a new long-term forecast for the shipping industry through to 2050, including factors such as population and GDP growth, energy use, trade forecasts, geographical differences and the impact of policy and technology. The forecast contains several notable projections, including an overall increase in the demand for seaborne traffic of 60% by 2050. And that shifting fuel use, as well as incremental gains in efficiency, mean that despite the growth of the global fleet and trade, the shipping industry will reduce its overall carbon emissions by 20%.

4,408 certificates issued related to the EU Monitoring, Reporting and Verification regulation for ships’ CO₂ emissions.

60% increase in demand for seaborne transport is projected by our Maritime Forecast to 2050.
Veracity pilots show potential

DNV GL’s new open data platform Veracity was launched in 2017 to improve data quality and manage the ownership, security, sharing and use of data. By creating frictionless connections between data owners and users, Veracity will open up new opportunities for improving ship performance and safety, while at the same time reducing operational costs.

In one of the first data-sharing pilot projects on the new open platform, Wilhelmsen is testing a system to share ship compliance and condition data with a port state authority to reduce paperwork and physical inspections when entering ports. Wilhelmsen has created a secure data container on Veracity, where it can collect compliance, condition and other relevant data on its vessels. Through the platform, the company is then able to grant the port state authority access to this data, reducing paperwork and speeding up port entry.

NYK and DNV GL together with engine manufacturer MAN Diesel & Turbo presented the first results of an ongoing pilot project. Operational data from NYK vessels is collected on Veracity for use in the evaluation of vessel performance. By dashboards and further drilling down into the data, the users can continuously monitor that all sensors on board the vessel are working properly and can easily identify non-performing sensors which may lead to low data quality or missing data during a voyage.

First offshore drone survey

DNV GL surveyors carried out their first offshore drone survey on the semisubmersible vessel Safe Scandinavia in the North Sea. This 25,383 GT tender support vessel (TSV) is owned and operated by Prosafe, supporting Statoil’s drilling operations off the coast of Norway. We have built a network of trained drone pilots based in Gdynia, Piraeus, Singapore, Houston and Shanghai. At the same time, we are developing guidelines and updates to our rule set to reflect the use of remote inspection techniques.

Cyber security – an increasing threat

The cyber security of maritime assets is a topic that is growing in importance as digitalization spreads through the industry. Alongside our recommended practice on cyber security, we worked with customers on several projects to enhance security and awareness. In a pilot project with Greek owner Consolidated Marine Management, we undertook a series of tests on a vessel’s communication and control systems in order to strengthen the systems’ overall robustness and resilience. And, working with Kongsberg, we developed a new type approval programme and issued the first cyber security assessment certificates for control system components, verifying both the technical reliability and cyber security of control systems.

200,000

customer requests to our technical experts were processed by a new machine learning tool.
Innovative methods and schemes will eventually change the way classification surveys are conducted. Self-verifying systems, automation, remote testing and other technologies will reduce scheduling issues and the need for a physical presence.
To help maritime customers enhance the sustainability of their businesses, DNV GL supports the development, implementation, certification and enablement of new technologies, systems and practices that let them improve their safety level, environmental performance and efficiency.

Sustainable solution highlights include:

**OFFSHORE VESSEL – ONSHORE POWER:** KL Sandefjord, owned by K Line Offshore AS, is the first offshore vessel with the DNV GL class notation Shore Power. The Shore Power notation verifies the design and installation of a vessel’s on-board electrical shore connection. When in port, the vessel can shut down its engines and rely on a shore-based electrical supply for its needs at berth – so called “cold ironing”.

**ECO SOLUTIONS:** designed to improve efficiency, reduce emissions and improve our customers’ vessels and operational competitiveness.

**ENVIRONMENTAL AND CLIMATE SERVICES:** ensures safe implementation and compliance with regulations like the Ballast Water Management Convention and EU Monitoring, Reporting and Verification (MRV) Regulation.
Early signs of stability and cautious optimism returned to the oil and gas industry in 2017. In this improving climate, DNV GL assisted customers to become more cost-effective while enhancing the safety and sustainability of their operations.
Some stability returned to DNV GL’s Oil & Gas business area in 2017 as resizing and restructuring efforts that started in 2016 began to bear fruit. Our external revenue was ahead of forecast across all quarters. Chargeability was at its highest since 2014.

We focused our efforts on increasing efficiency while maintaining technical expertise, and did not need any further significant resizing or restructuring in 2017.

We reinforced our business strategy by growing our position in midstream and downstream sectors and continuing to support customers upstream.

Seventy per cent of our employees reported that their units were using digitalization to improve ways of working with customers, demonstrating progress as we increase our strategic focus on this area.

85% of senior oil and gas professionals saw cost containment as a top priority in 2017.

According to DNV GL research, cost containment remained a top or high priority for 85% of senior oil and gas industry professionals in 2017.

While Brent spot prices were USD 26-55/b in 2016, they were in a narrower, though still broad, band of USD 44-67/b in 2017. Gas spot price averages for NBP and Henry Hub were respectively 24.1% and 18.4% higher last year than in 2016.

Despite this increased stability compared to previous years, there was no rebound in capital expenditure within the market, and operating expenditure remained constrained as market conditions continued to be volatile.

Encouragingly though, signs of longer-term thinking emerged as the industry began adjusting to ensure cost efficiency and grow margins in an environment – the ‘new normal’ – where oil prices will likely remain lower for much longer. Our research indicated an increasing appetite for industry collaboration, standardization and digitalization: three areas core to DNV GL’s strategy and value proposition.

Some stability was supported by DNV GL’s first-ever Energy Transition Outlook, our independent model of world energy supply and demand. It forecasts that oil and gas will continue to play a crucial role in meeting world energy demand through to the middle of the century; that gas will become the largest energy source towards 2050; and that significant investment in new oil and gas production capacity will be needed.

During the year, our customers started to rebalance their business portfolios to ensure long-term growth. Around a quarter of senior oil and gas professionals expected their business to invest or increase investments in energy from less carbon-intensive sources in 2017. More than three-quarters believed gas will become increasingly important in the global energy mix over the next decade, as the transition to a less carbon-intensive mix gathers pace.

This sentiment was supported by DNV GL’s first-ever Energy Transition Outlook, our independent model of world energy supply and demand. It forecasts that oil and gas will continue to play a crucial role in meeting world energy demand through to the middle of the century; that gas will become the largest energy source towards 2050; and that significant investment in new oil and gas production capacity will be needed.

Increasing stability

According to DNV GL research, cost containment remained a top or high priority for 85% of senior oil and gas industry professionals in 2017.

While Brent spot prices were USD 26-55/b in 2016, they were in a narrower, though still broad, band of USD 44-67/b in 2017. Gas spot price averages for NBP and Henry Hub were respectively 24.1% and 18.4% higher last year than in 2016.

Despite this increased stability compared to previous years, there was no rebound in capital expenditure within the market, and operating expenditure remained constrained as market conditions continued to be volatile.

Encouragingly though, signs of longer-term thinking emerged as the industry began adjusting to ensure cost efficiency and grow margins in an environment – the ‘new normal’ – where oil prices will likely remain lower for much longer. Our research indicated an increasing appetite for industry collaboration, standardization and digitalization: three areas core to DNV GL’s strategy and value proposition.

85% of senior oil and gas professionals saw cost containment as a top priority in 2017.

Some stability was supported by DNV GL’s first-ever Energy Transition Outlook, our independent model of world energy supply and demand. It forecasts that oil and gas will continue to play a crucial role in meeting world energy demand through to the middle of the century; that gas will become the largest energy source towards 2050; and that significant investment in new oil and gas production capacity will be needed.

During the year, our customers started to rebalance their business portfolios to ensure long-term growth. Around a quarter of senior oil and gas professionals expected their business to invest or increase investments in energy from less carbon-intensive sources in 2017. More than three-quarters believed gas will become increasingly important in the global energy mix over the next decade, as the transition to a less carbon-intensive mix gathers pace.

This sentiment was supported by DNV GL’s first-ever Energy Transition Outlook, our independent model of world energy supply and demand. It forecasts that oil and gas will continue to play a crucial role in meeting world energy demand through to the middle of the century; that gas will become the largest energy source towards 2050; and that significant investment in new oil and gas production capacity will be needed.

Increasing stability

According to DNV GL research, cost containment remained a top or high priority for 85% of senior oil and gas industry professionals in 2017.

While Brent spot prices were USD 26-55/b in 2016, they were in a narrower, though still broad, band of USD 44-67/b in 2017. Gas spot price averages for NBP and Henry Hub were respectively 24.1% and 18.4% higher last year than in 2016.

Despite this increased stability compared to previous years, there was no rebound in capital expenditure within the market, and operating expenditure remained constrained as market conditions continued to be volatile.

Encouragingly though, signs of longer-term thinking emerged as the industry began adjusting to ensure cost efficiency and grow margins in an environment – the ‘new normal’ – where oil prices will likely remain lower for much longer. Our research indicated an increasing appetite for industry collaboration, standardization and digitalization: three areas core to DNV GL’s strategy and value proposition.

85% of senior oil and gas professionals saw cost containment as a top priority in 2017.

Some stability was supported by DNV GL’s first-ever Energy Transition Outlook, our independent model of world energy supply and demand. It forecasts that oil and gas will continue to play a crucial role in meeting world energy demand through to the middle of the century; that gas will become the largest energy source towards 2050; and that significant investment in new oil and gas production capacity will be needed.

During the year, our customers started to rebalance their business portfolios to ensure long-term growth. Around a quarter of senior oil and gas professionals expected their business to invest or increase investments in energy from less carbon-intensive sources in 2017. More than three-quarters believed gas will become increasingly important in the global energy mix over the next decade, as the transition to a less carbon-intensive mix gathers pace.

This sentiment was supported by DNV GL’s first-ever Energy Transition Outlook, our independent model of world energy supply and demand. It forecasts that oil and gas will continue to play a crucial role in meeting world energy demand through to the middle of the century; that gas will become the largest energy source towards 2050; and that significant investment in new oil and gas production capacity will be needed.

Increasing stability

According to DNV GL research, cost containment remained a top or high priority for 85% of senior oil and gas industry professionals in 2017.

While Brent spot prices were USD 26-55/b in 2016, they were in a narrower, though still broad, band of USD 44-67/b in 2017. Gas spot price averages for NBP and Henry Hub were respectively 24.1% and 18.4% higher last year than in 2016.

Despite this increased stability compared to previous years, there was no rebound in capital expenditure within the market, and operating expenditure remained constrained as market conditions continued to be volatile.

Encouragingly though, signs of longer-term thinking emerged as the industry began adjusting to ensure cost efficiency and grow margins in an environment – the ‘new normal’ – where oil prices will likely remain lower for much longer. Our research indicated an increasing appetite for industry collaboration, standardization and digitalization: three areas core to DNV GL’s strategy and value proposition.

85% of senior oil and gas professionals saw cost containment as a top priority in 2017.
To enhance our digital services, we have chosen the widely used Siemens’ Teamcenter® portfolio of product lifecycle management (PLM) software to help our customers manage the performance and safety of all information over an asset’s lifecycle.

This collaboration combines DNV GL’s deep technical domain knowledge from oil and gas projects and operations with Siemens’ PLM technology to create a powerful digital asset model.

In another example of how we use digital technologies to enhance our services, we started conducting verification surveys applying remote witnessing to help reduce compliance-related costs. This involves equipping a technician onsite with a camera or smartphone and dedicated software to enable remote, real-time support from a DNV GL surveyor to execute an independent verification survey.

In addition, our Inspection Services Division conducted its first offshore drone survey in 2017 – on a semi-submersible vessel offshore Norway. The survey proved the ability of drones to check the condition of remote external components in challenging conditions. We continue to work on developing guidelines and updating our rule set to reflect remote inspection techniques.

We further developed our quantitative risk assessment (QRA) visualization tool MyQRA to allow users to conduct near-instantaneous online sensitivity simulations for assets, based on scenarios. Results can now be visualized in minutes. In September, the Chinese Chemical Safety Authority (CCSA) recognized DNV GL and its MyQRA services with an Excellent Achievement Award for safety in the industry. The CCSA commented: “MyQRA upgrades traditional QRA services to digital services, which can make QRA more efficient and convenient, and improve the understanding of risk.”

The global demand for our technical expertise in the oil and gas and other industries was highlighted by DNV GL signing a Memorandum of Understanding with parties in Singapore to collaborate on developing disruptive applications in additive manufacturing (3D printing), drone, and digital twin technologies. The focus is on technology that could revolutionize solutions for that country’s offshore and marine sector and boost its global competitiveness.

The safety of information has moved up the global agenda. As the result of a DNV GL-led joint industry project (JIP), we launched Recommended Practice (RP) DNVGL-RP-G108 Cyber security in the oil and gas industry based on IEC 62443 to outline a tailored approach for the industry on how to build cyber security. Crucially, it emphasizes a combination of operational technology and IT.

To enhance our digital services, we have chosen the widely used Siemens’ Teamcenter® portfolio of product lifecycle management (PLM) software to help our customers manage the performance and safety of all information over an asset’s lifecycle.

This collaboration combines DNV GL’s deep technical domain knowledge from oil and gas projects and operations with Siemens’ PLM technology to create a powerful digital asset model.

In another example of how we use digital technologies to enhance our services, we started conducting verification surveys applying remote witnessing to help reduce compliance-related costs. This involves equipping a technician onsite with a camera or smartphone and dedicated software to enable remote, real-time support from a DNV GL surveyor to execute an independent verification survey.

In addition, our Inspection Services Division conducted its first offshore drone survey in 2017 – on a semi-submersible vessel offshore Norway. The survey proved the ability of drones to check the condition of remote external components in challenging conditions. We continue to work on developing guidelines and updating our rule set to reflect remote inspection techniques.

39% of senior industry professionals expected their organization’s spending on digitalization to increase in 2017.

69% of senior oil and gas professionals expected the sector to increase global standardization activities in 2017.
Increased midstream and downstream focus

We continued to widen our involvement with the oil and gas transmission, refining, petrochemical and gas-distribution sectors in line with our strategy to enhance our footprint in markets with the strongest growth opportunities.

Key projects included a study showing huge potential for liquefied natural gas as a marine fuel in the Iberian Peninsula. UK regulator OFGEM awarded National Grid and DNV GL a major innovation contract to enable consumer use of lower-carbon gas and improve gas-bill calculations.

The international HYREADY JIP led by DNV GL was launched to help the gas industry explore the introduction of new, lower-carbon gas compositions in the energy transition. HYREADY will develop practical processes and procedures for introducing hydrogen to grids. Our decarbonization work was recognized by French natural gas transmission system operator GRTgaz, which awarded our low-carbon emission solution for pipeline purging operations first place in its annual innovation competition.

Significant innovation and business impact have been achieved in our midstream business in North America. For example, experts based at our specialist pipelines laboratory in Ohio, US, are conducting a preparatory study drawing upon our previous pipeline failure investigations for operators in order to support safer, more reliable pipeline projects and operations. This study validates that using DNV GL as an independent custodian of multiple operators’ data on historical pipeline failures can enable the reliable analysis of causes and trends to help optimize line pipe manufacture and the design, construction and operation of pipelines.

Our continued drive to develop and publish best practices in the offshore pipeline sector included launching a new RP, DNVGL-RP-F114 Pipe-soil interaction for submarine pipelines. We updated the most used and recognized offshore pipeline standard in the world – now called DNVGL-ST-F101 – and the widely-used DNVGL-RP-F105 for solving issues related to free spans in offshore pipeline design and operation.

In China’s refining and petrochemical sector, we assisted companies such as Wanhua Chemical Group to benchmark health, safety, environmental and quality (HSEQ) performance against international standards using our International Safety Rating System (ISRS). Identifying gaps in HSEQ management allows companies to plan how to enhance their safety management, safety culture and risk assessment.

Supporting efficiency and safety upstream

We continued to support new and existing operators to achieve their goals of safe, efficient, cost-effective upstream operations.

Among new contracts, OneSubsea awarded our Offshore Technology and Approval Center in Houston, US a project for the independent third-party verification of 20,000-psi subsea equipment for the Gulf of Mexico. In Europe, we secured a combined engineering services agreement with Chrysaor Holdings, a leading independent exploration and production company in the UK.

Our support for operational efficiency and sustainability in the North Sea also included working with Lundin Norway to develop the first step in a solution for predicting unplanned shutdowns of the operator’s Edvard Grieg production platform offshore Norway. In our continuing work with new operators in Norway, DEA Norge, the first operator to implement DNVGL-RP-O101 Technical documentation for subsea projects, publicly validated the recommended practice’s value in reducing the cost of – and time spent on - such documentation.
In an example of collaboration across DNV GL’s activities, the Oil & Gas and Maritime business areas together provided BP with a broad range of technical skills for the challenging conditions in which the Glen Lyon FPSO vessel will operate west of Shetland. This vessel is classed by DNV GL.

Collaboration and innovation to produce and update best practice guidelines and standards that enable cost-efficient and sustainable operations were also evident. Thousands of professionals in the marine and offshore sector engaged with DNV GL’s updated standards DNVGL-ST-N001: Warranty approval of marine operations and DNVGL-ST-N002 Site specific assessment of mobile offshore units in 2017.

The updated standards are the first to be available from our online Noble Denton marine services’ Standards Wizard. This allows users to input details about asset types, operations and structural codes to receive simple, clear documents detailing elements of the standards most pertinent to their projects and operations.

Top five areas for technology investment in 2017

- **22%** Digitalization
- **14%** Subsea technologies
- **11%** Floating liquid natural gas (FLNG)
- **22%** Cybersecurity attack prevention, detection and response
- **11%** Enhanced oil recovery

Source: Short-Term Agility, Long-Term Resilience: The outlook for the oil and gas industry in 2017: dnvgl.com/industryoutlook2017
SUSTAINABLE SOLUTIONS

To help oil and gas customers enhance the sustainability of their businesses, DNV GL, in collaboration with partners, supports the development of industry best practices and technology innovations that enable customers to meet regulatory requirements, maintain a social licence to operate and forge a pathway in the transition to a lower carbon energy mix.

Sustainable solution highlights include:

**ENABLING LARGE-SCALE DECARBONISATION OF THE UK GAS NETWORK:** DNV GL is working with gas transmission and distribution system operators on innovation projects to introduce lower-carbon gas mixes into the British gas network and improve consumers’ gas bill calculations.

[Read more >](#)

**SUPPORTING CHINA’S PETROCHEMICAL AND REFINING INDUSTRY TO RAISE HSEQ STANDARDS:** our International Safety Rating System is helping China’s downstream sector benchmark its safety, environmental and quality performance against international standards.

[Read more >](#)

**DEVELOPING BEST PRACTICE IN CARBON CAPTURE AND STORAGE:** we developed a framework for certifying the geological storage of carbon dioxide (CO₂) and a recommended practice for the design and operation of CO₂ pipelines. The certification framework serves to improve stakeholder dialogue and investor predictability, and the recommended practice provides a recipe for the safe transportation of CO₂.

[Read more >](#)
While an era of abundant renewable energy lies ahead of us, multiple actions are needed to move towards a cleaner, more electrified world. Larger flows of renewable energy, digitalization and the electrification of transport, industry and households make power networks more complex. To ensure a reliable electricity supply, we are helping the energy industry and large energy users manage the complexity of this fast-changing environment.

**ENERGY**

**MAKING RENEWABLES SMARTER**

REVENUE

Energy’s share of total (19,475)

3,677 NOK MILLION

EMPLOYEES

Energy’s share of total (12,715)

2,348 EMPLOYEES
New players

Renewable energy sources are no longer expensive alternatives to fossil fuel power generation. Renewables are becoming more competitive as a result of the decreasing cost of generating electricity from them. At the same time, there is increasing political and business pressure to transfer to cleaner energy sources.

Although the cost of investing in renewable assets is decreasing, the extent of the growth in their usage needed to meet climate policy goals means that financing requirements will continue to increase. Financiers, however, are relatively new players in a renewable energy market based on complex technologies and variable generation capacity.

We help our customers to understand the technical aspects and implications of renewable power plant investments, whether they concern a new project, a stock swap, or the acquisition of assets by performing due diligences to mitigate a project’s financial risks. In parallel, we review and test new technologies relating to generation, storage and transmission & distribution.

In 2017, we updated our global GRIDSTOR recommended practice for energy storage and further developed our solar irradiance database Sunspot. We also launched the 2017 edition of our solar module reliability scorecard and created Navigator for geothermal projects.

A bright future for renewables

In its 2017 Energy Transition Outlook report, DNV GL predicts that solar photovoltaic (PV), onshore wind, hydropower, and offshore wind, in that order, will account for 85% of global electricity production in 2050. The installed wind power capacity will reach 9000 GW in 2050, and the offshore wind capacity in China and the US will outstrip that of Europe in the 2020s.

Cost competitiveness is driving intense efforts across the industry to reduce the levelized cost of energy for wind and introduce new technologies. One of the findings in the subsequent report ‘Certification for the wind energy of tomorrow’ suggested that certification by DNV GL could add more value if it continued to deepen the technical insight into the design, in-service or lifetime-extension phase. DNV GL is taking these valuable messages from the industry seriously by developing and adapting the certification schemes, including shop approval certification at the manufacturer’s facilities.
Digitalization of the energy system

As the renewables industry matures, there is constant pressure to reduce costs and increase revenue. There is little room for downtime and under-performance is no longer tolerated. Our wind energy customers’ challenges are to actively manage turbine performance and reduce downtime whilst simultaneously decreasing maintenance costs and extending the life of assets beyond their original design life.

We developed WindGEMINI as a digital twin which models different aspects of an operating wind turbine. It uses a range of innovative algorithms and physics-based simulation models to analyse the vast amounts of Supervisory Control And Data Acquisition (SCADA) data and provide prognostic analytics and remaining-life estimates.

Our services add value in the field of monitoring and managing solar PV and wind assets producing 14 gigawatts of installed power at 2,300 facilities in 51 countries. In addition, we offer integrated tools for financial, operational and maintenance management.

We also launched an upgraded Smart Cable Guard 2.0, which is a data-driven online monitoring solution that locates weak spots and faults in power cables within minutes, avoiding costly repairs and downtime in power supply.

A lifetime in high-voltage testing

In 2017, we officially opened our upgraded ‘Queen Máxima High-Power Laboratory’ in Arnhem, the Netherlands. This newly extended KEMA test laboratory is the world’s first and only facility capable of testing power transformers up to 800 kV and switchgear up to 1200 kV.

The new laboratory will help the power industry successfully transition to so-called ‘super grids’ to meet the rapidly growing demand for sustainable electricity and the transportation of power over long distances.

In the field of high-voltage direct current (HVDC), we have conducted the first type test of a 320 kV cable system at our laboratories. No technical standards for HVDC switchgear currently exist.

We chair the EU R&D programme PROMOTioN, we are committed to demonstrating the testing of HVDC circuit breakers using our existing AC short-circuit generators. The project outcomes will pave the way for the standardization of DC switchgear testing, with an eye on the development of HVDC offshore grids.

14 GW

of solar PV and wind power from 2,300 assets in 51 countries worldwide is monitored by DNV GL.

65 million smart meters in Europe are certified by DNV GL.
Cyber security of critical energy infrastructure

The electricity grid is a critical infrastructure providing essential services for the smooth functioning of modern society and serves as the backbone for economic activities. A smarter energy system can perform generation, grid-management and market-related tasks with better precision and faster response times than a human-dependent system, but is more vulnerable to cyber attacks.

New technologies introduce intelligent components that communicate in more advanced ways. Utilities, independent power producers and system operators need to be able to proactively address cyber-security related concerns to ensure their systems are immune from attack.

Our risk-based advisory and testing services bridge the gap between information technology and operational technology to enable operators of critical infrastructures to be prepared for and protected against cyber threats. We support our customers with SCADA implementation and upgrade projects, development of smart grids and smart meter testing, cyber vulnerability assessments and NERC compliance.

150,000+

people listen to the ‘DNV GL Talks Energy’ podcast series featuring top managers in the energy industry.

Energy management and energy efficiency

A sustainable energy economy requires major commitments to both energy efficiency and the use of renewable energy sources. Implementing energy efficiency and energy conservation measures is highly cost effective. Besides investing in renewables, these topics are the core of policy debates over climate change and greenhouse gas emissions.

Our B-READY building resilience assessment tool translates climate-related risks into building-specific resilience strategies. Global enterprises wish to be 100% renewable, like Google which has powered its data centres and the offices for its 60,000 staff entirely by renewable energy since 2017.

In the US, we run several energy efficiency programmes, like the one for ComEd in Illinois. We also received the ‘Supplier of the Year Award’ from the Arizona Public Service Company after achieving energy efficiency savings and customer satisfaction goals.

In Europe, our energy management services are mainly focused on changing the energy culture and performing energy audits. We help customers to reduce their organization’s energy consumption through a change in their operational excellence culture.

13,000 MVA

installed short-circuit power in our high-power laboratories.
To help power and renewables customers enhance the sustainability of their businesses, DNV GL supports the decarbonization of the energy markets. Renewables are attracting investors, creating jobs and connecting people to electricity globally. We help customers to develop, operate and maintain renewable energy projects, adapt and keep the grids operational and manage the use of energy by inspecting, testing and certifying products and running climate-action and energy-saving programmes.

Sustainable solution highlights include:

**WIND ENERGY:** we launched the digital twin tool WindGEMINI and the upgraded WindFarmer: Analyst.

Read more >

**SOLAR ENERGY:** we published the PV module scorecard 2017 and increased the power monitored by DNV GL owned Green Power Monitor from 6 to 14 GW, meanwhile integrating the solar and wind monitoring tools.

Read more >

**ENERGY MANAGEMENT:** to achieve sustainable buildings and communities, we have developed the B-READY building resilience assessment tool.

Read more >
The adoption of digital technologies combined with digital connectivity is impacting societies, enterprises and consumers, while making it more complex for companies to address multi-dimensional compliance. Companies are increasingly expected to demonstrate and communicate their commitment to and credibility regarding both performance and compliance, creating a growing need for assurance services.

**REVENUE**  
Business Assurance’s share of total (19,475)  
3,278 NOK MILLION

**EMPLOYEES**  
Business Assurance’s of total (12,715)  
1,976 EMPLOYEES
Management system certification standards evolving

Management system certification constitutes the major share of our Business Assurance portfolio. DNV GL continues to hold a leading market share and the growth of this service portfolio persisted in 2017, mainly related to ISO standard certification. New editions of the major ISO standards, i.e. ISO 9001 (quality) and ISO 14001 (environment), and sector-specific standards such as AS/EN 9100 (aviation, space and defence) and IATF 16949 (automotive) have been launched and companies certified to these standards must transition to the new versions by 15 September 2018. While the transition progressed slowly in 2016, we saw a significant increase in 2017, which also led to more demand for our transition training services.

The new ISO 45001 (occupational health & safety) will replace OHSAS 18001 in 2018. We actively participated in the ISO Working Group and consultation rounds. As a co-founder of OHSAS 18001, we fully support its replacement. ISO standards provide for a more transparent development process and broader stakeholder involvement. Converting to an ISO standard allows for efficient integration with companies’ other management systems, e.g. quality and environmental, and helps create safer and healthier workplaces.

Lumina benchmarking tool

We continued our work to advance the value of assurance by developing concepts, services and roles in the digital space. With the launch of Lumina™ in 2017, customers gained access to a suite of benchmarking tools based on advanced analytics and data gathered from DNV GL’s thousands of company audits. It provides unique market-based insights and support to identify and prioritize improvement areas in management systems and business performance.

Whether addressing environmental, quality or safety aspects or targeting energy, information security or food safety, Lumina allows companies to identify weak spots and creates valuable insight to discover improvement areas and understand where to invest time and resources. By the end of 2017, Lumina contained two million audit findings. A self-service tool (Lumina app) was made available via DNV GL’s Veracity platform and the benchmarking tool will be further developed and expanded throughout 2018.

90,000 customer certificates (the majority related to ISO standards) were stored to a secure, private blockchain for better transparency and validity check.

Watch a video on Lumina, the performance benchmarking tool
**Digital drives new assurance opportunities**

Together with customers and partners, we are exploring how our Veracity industry data platform and ecosystem of services, as well as blockchain technology, can be used for advanced analytics to ensure better decision-making and address traceability and increased transparency and trust in our customers’ supply chains. A growing interest in services related to food safety culture and food fraud poses new challenges and digital solutions offer interesting opportunities for effective improvements. We see the digital transformation as a major challenge and opportunity for all industries in the years to come.

---

**Industry 1st: using blockchain technology for certificates**

In September, we announced that all management system, product and supply chain certificates issued to our customers are stored in a secure, private blockchain. This was the first blockchain application in production in the assurance industry, as well as outside the finance industry. Every certificate is digitally tagged, traceable and stored in the blockchain. The technology blocks counterfeit certificates, allowing companies to communicate their certification in a transparent and secure way. A unique QR code allows anyone to instantly confirm that a certificate is valid. Building digital trust into every certificate is the first step towards building digital assurance concepts in supply chains and other areas.

---

**Increasing impact in food and beverage sector**

Food and beverage sales continued to grow strongly, by 15% in 2017. We expanded our aquaculture portfolio to include system and product certification and aquaculture inspection services in addition to technical assurance services. Technical assurance, such as risk management, project development and classification of floating structures, has been applied to new, innovative aquaculture structures and concepts. By combining our aquaculture-, industry- and assurance competence with our expertise in the maritime and oil & gas industries, we developed into a significant partner for the aquaculture industry in Northern Europe.

---

**Watch a video on certificates in the blockchain**

---

40,000

users have access to Lumina, our new performance benchmarking tool, which contains information from more than 2 million audit findings raised by DNV GL in companies across all industry sectors.
Companies focus on sustainable supply chains

Sales of supply chain services grew by 29% in 2017. The demand for sustainable supply chains is continuing to put pressure on companies, from both a risk and business opportunity perspective. Companies with a high degree of supply chain maturity tend to be more in control of their operational risks, responding to increasing legislative and stakeholder requirements and demands and deriving benefits from more sustainable operations throughout their value chain.

Helping companies sustainably manage their supply chains continues to be a focus area for us in 2018, combining our core assurance and industry expertise with digital solutions to create new digital assurance arenas.

Sales of healthcare accreditation and certification services grew by 14% in 2017 and we continued to make headway within precision medicine. In 2016, DNV GL became a partner in BIGMED, a key Norwegian innovation project exploring the IT bottlenecks that inhibit the implementation of precision medicine. In 2017, we used our Veracity data platform technology to build a prototype for sharing anonymous information on genetic variants between hospitals in Norway and Sweden. Leveraging Veracity’s ability to securely share data between hospitals, the solution can be used for genetic analysis in laboratories and lead to a safer and more efficient service for patients.

Product assurance grows in automotive

Our product assurance portfolio sales grew by 7% in 2017, driven by the assurance of medical devices, hazardous area services and functional safety services. The latter particularly continues to grow in the field of autonomous vehicles and vehicular systems, especially in Japan and Korea. We successfully expanded into the emerging Chinese market in 2017.

80,000

companies, including many of the largest and most famous brands in the world, are relying on DNV GL to certify their management system, products or supply chains.
Is your supply chain fit for the future?

DNV GL's ViewPoint survey among 1,408 professionals worldwide about their supply chain sustainability maturity and how they approach and manage sustainability in their value chains.

### Main benefits from implemented actions

1 in 2 improved their ability to meet customers’ needs

- **49%** Improved ability to meet customer needs
- **41%** Improved relationship with stakeholders
- **38%** Reduced social or environmental risks
- **33%** Gained brand reputation

### Cost/benefit ratio for actions undertaken

For **76%** benefits are greater than or equal to costs

- **83%** For companies that invested in external audits and in training for suppliers
- **85%** For companies that extended their actions across the full supply chain

See all key findings
To help customers across all industries enhance the sustainability of their businesses, DNV GL assures the performance of management systems, products, personnel and supply chains through our diverse portfolio of certification, verification, assessment and training services. Beyond integrating sustainability into everything we do, specific solutions were developed in 2017.

Sustainable solution highlights include:

**FOOD SAFETY AND SUPPLY CHAIN AUDITS:** that address hunger, clean water and climate by assuring compliance to high standards. Our aquaculture assurance services also help customers contribute to life below water and in 2017 we released our project on advanced analytics in the aquaculture sector to help fish farmers improve feed efficiency and fish health and reduce mortality levels.

**PRODUCT CERTIFICATION:** that enables trust in the safety and quality of products. In 2017, DNV GL together with UNIDO launched a water calculation tool for the textile industry to help companies evaluate the water footprint of their manufacturing process.

**MANAGEMENT SYSTEM CERTIFICATION:** that assures compliance with best-practice standards and requirements, ranging from quality, safety and environmental to social, ethical and climate change. In 2017, we launched Lumina™, a suite of benchmarking tools to help customers identify and prioritize improvement areas in management systems and business performance.
Digital Solutions was formed as a new business area in 2017, and includes our software house. However, it only became operational from January 2018, so this annual review focuses exclusively on our 2017 software business.
2017 REVIEW

Strong growth in a challenging market

For DNV GL’s software house, 2017 was a year of accelerating our software’s transition to integrated digital asset ecosystem solutions. The digitalization of the shipping industry gathered further speed in 2017. Although the shipping market was generally weak due to overcapacity in tonnage and a record low number of new vessels under construction, investments in software solutions for fleet management and operations increased. The strong growth in sales of maritime software solutions in 2016 continued in 2017. Our maritime software solutions were deployed to almost one thousand additional vessels in 2017, taking the total number of vessels using DNV GL software to 6,200.

A prototype for a new cloud-based solution called Navigator Shore was developed and deployed on Microsoft Azure for testing by customers, who provided valuable feedback before the release in 2018.

Integration and collaboration

The offshore newbuilding market is experiencing a downturn, but we are beginning to see more upcoming projects, within structure design and engineering. We retained the number of structure ecosystem customers in 2017 and registered increased interest in our software products for offshore wind turbines.

Strengthening analytical capabilities

The software market in the downstream oil and gas segment performed well, driven by customers looking to reduce costs through optimization and digitalization. Increased regulation also contributed to greater demand for asset performance management solutions. Sales of plant ecosystem software increased, with China standing out as the area with most growth for the year.

In 2017, we acquired ComputIT, a Norwegian company that owns KFX software for computational fluid dynamics (CFD). This particularly strengthened our position in the Asian market, where customers increasingly request 3D modelling capabilities. The acquisition also added leading CFD analysis capabilities to our digital asset ecosystems, specifically for plants, pipelines and structures.
The energy value chain is in the midst of a significant transformation with new energy resources and increasing digitalization. This takes place in the context of ageing infrastructure and continuously tight operational budgets. DNV GL continued to expand its electric grid software market and the target in the main market, North America, was surpassed.

In addition to a new high in licence sales and 40% growth in revenue in 2017, the year was a major milestone in the development of the electric grid digital asset ecosystem offering. More than 55% of customers engaged actively through user-group meetings, helping to shape the development. The technology stack is becoming more cloud-based, open and modular. The release of Synergi Electric 6.0 brought a new mobile inspection solution, a business intelligence product and a forward-looking health and risk management application.

Upcoming regulation is driving changes in the pipeline market. In the United States, the Transmission Integrity Management Program (TIMP) is expected to implement new regulations in 2019 related to pipeline risk management.

We sustained our market share for software in the pipeline ecosystem in 2017. Acceptance of cloud technology is becoming more prevalent across the industry. Customers are also looking to benefit from a shift towards probabilistic risk models, allowing a more targeted approach to risk management. In 2017, Synergi Pipeline development included both cloud-based technology and a new probabilistic risk model.

Several new pipeline products were launched in 2017, including Synergi Pipeline — Ticket Risk Assessment (TRA) which was then licensed to the largest distribution company in the US. With Enterprise Leak Detection, we grew our market share in leak detection and anticipate continued growth in that area.

QHSE investments in SaaS technologies

In a highly competitive market with broad investment in new technologies, DNV GL’s QHSE software solutions saw double-digit growth in 2017. Synergi Life was the first of our products to come with a fully cloud-enabled solution and is the front runner in the transformation of our business from the traditional on-premise software model to the cloud, mobile and software-as-a-service (SaaS) model.

We expect the change towards the SaaS subscription offering to be critical in the market in the coming years and in 2017 we professionalized and optimized our SaaS business.

A new design for improved user experience was also developed in 2017 and the number of new customers more than doubled in 2017 compared to 2016.

The energy value chain is in the midst of a significant transformation with new energy resources and increasing digitalization. This takes place in the context of ageing infrastructure and continuously tight operational budgets. DNV GL continued to expand its electric grid software market and the target in the main market, North America, was surpassed.

70% of new customers of our Synergy Life software in Europe chose SaaS solutions.
To help customers across industries enhance the sustainability of their businesses, DNV GL develops software and data management solutions which are used by thousands of customers to manage risk and improve safety and asset performance.

Sustainable solution highlights include:

**SYNERGI LIFE**: QHSE software, which provides a platform for recording, tracking and responding to incidents and enables the reduction of operational risk related to human safety and environmental impact.

Read more >

**NAVIGATOR INSIGHT**: software facilitating the reporting of ships’ voyage data from departure to arrival. It includes options for fully integrated bunkering and Remaining on Board management.

Read more >

**SMART CITIES**: digital solutions help city leaders to reap the social and environmental benefits of a distributed energy model while also meeting their climate action objectives and becoming more resilient.

Read more >