

RENEWABLE ENERGY

A comprehensive approach for a
sustainable future

Multiconsult

MULTICONSULT

Multiconsult is one of the leading firms of consulting engineers and designers in Norway and Scandinavia, with expertise spanning a wide range of disciplines. This enables us to take charge of complex projects within fields such as oil and gas, buildings and properties, industry, transportation, energy and environmental protection. Multiconsult has played key roles in major national and international projects for more than a century.



Multiconsult has been helping to develop Norwegian and international energy resources for more than 100 years. Our unique and highly sought-after expertise covers the entire range of services from environmental impact assessments to commissioning, as well as the renovation and expansion of existing installations.

- **Designing and planning with a focus on project management and control**
- **Multidisciplinary, close-knit team with high capacity**
- **Nationwide network of offices with renewable energy consultants**

At Multiconsult we look at the big picture in renewable energy projects, including generation, distribution and consumption. Working at the interface between experience, research and development enables us to create efficient, sustainable energy solutions for the future.

- World leading renewable energy team with more than 270 employees.
- The industry leader in wind power in terms of expertise, capacity and breadth of experience.
- Norway's largest team of specialists in geotechnology and underground installations, with particular expertise in hydropower.
- Engineers, hydrologists, landscape architects and biologists collaborate closely to ensure an integrated, sustainable approach.
- Multiconsult pushes the boundaries in its use of new technology for designing and planning.

Multiconsult has expertise in hydropower, wind power, solar energy and bioenergy, and has participated in many large development projects in Norway and overseas. These include doing the detailed design for the Sarvossen Dam, Norway's largest dam project since 1985, acting as Owner's Engineer for the Alto Maipo HPP in Chile and the design and execution of Raggovidda wind power plant in Norway.



A CHANGING ENERGY MARKET

In the modern world, access to energy is a key factor for improving quality of life and economic performance. Transparent, predictable and reliable energy markets are needed to boost economic growth, support job creation and enable sustainable development.

Global political drivers and subsidies for new renewable energy production mean that there is growing investment in renewable energy projects. Sustainability and renewable energy will therefore be top priorities at Multiconsult in the coming years. With our knowledge and experience, we will help to develop renewable energy resources around the world.

New renewable energy projects face challenges including grid capacity, lower energy prices and bottlenecks in obtaining licences. Large-scale hydropower plants generally have low life cycle costs, but opportunities for new projects are limited. The main focus is therefore on upgrading and increasing the efficiency of existing plants, and expanding capacity to accommodate new operating patterns. There will also be a need to audit hydropower licences in the coming years, weighing up potential environmental measures against energy production. By taking a comprehensive and interdisciplinary approach, it will be possible to coordinate these audits with upgrades and expansions, providing additional benefits.

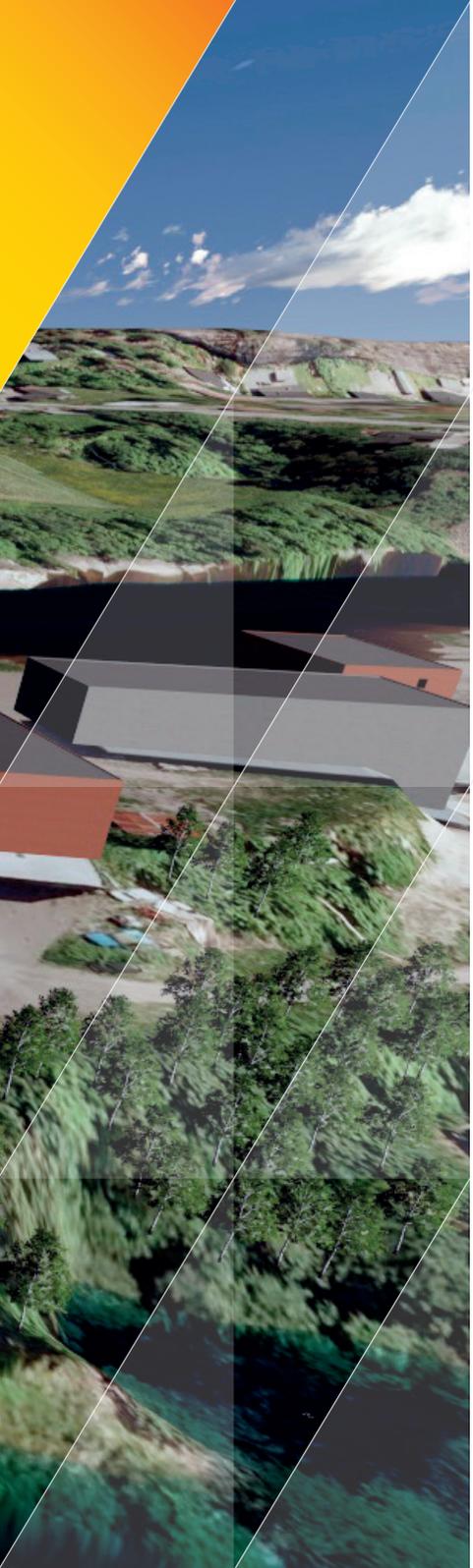
Hundreds of power plants will be built worldwide over the next decade, and Multiconsult has both the capacity and the expertise required to play an important part in this. Renovating power plants and dams is important from a safety perspective, and results in greater output and profitability. Our mechanical engineers are among the world's leading specialists in penstocks, sliding lock-gates and turbines. This expertise, combined with advanced models and tools, is vital for developing robust, long-term solutions.







RENEWABLE
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NEW REQUIREMENTS + NEW TOOLS = NEW METHODS

Stricter requirements for communication between the parties involved in building projects and with the authorities and third parties are creating challenges for everyone. Multiconsult is meeting these challenges by adopting new tools and methods.

Landscape and environmental considerations are key factors in the planning and development of renewable energy. There are stringent requirements relating to environmental impact assessments and landscape mitigation measures. Involving environmental specialists at an early stage results in sustainable, cost-effective solutions. Good visualisation models are an important element of communication with the authorities and third parties. Multiconsult has therefore adopted market-leading tools for 3D modelling, visualisation and photo manipulation.

Increasingly demanding construction projects, involving more people, with greater time constraints, and requiring greater efficiency, mean that 3D modelling is now used in most of Multiconsult's projects. Using 3D modelling in projects provides a good idea of the planned end product at an earlier stage, and makes it possible to continuously reassess numerous aspects of the design. This helps streamline the production process and contributes to greater planning accuracy and predictability.

Multiconsult has developed a model for executing large and small hydropower projects, which defines the level of detail needed in the flow of communication and information between the various disciplines and between the client, contractor, suppliers and designer.



**KINDARUMA
HYDROPOWER PLANT**

YEAR: 2009-2013
CLIENT: KenGen, Kenya



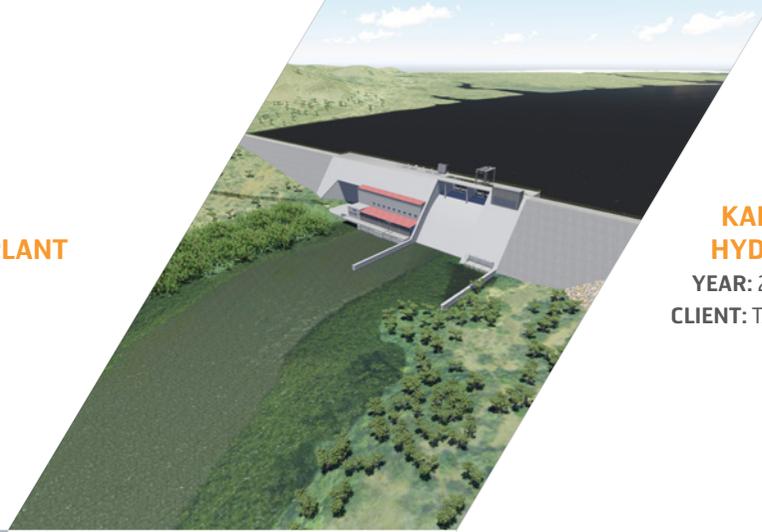
**AUNFOSS
HYDROPOWER PLANT**

YEAR: 2011-
CLIENT: NTE Energi AS, Norway



**MT COFFEE
HYDROPOWER PLANT**

YEAR: 2013-
CLIENT: LEC, LIBERIA



**KAKONO
HYDROPOWER PLAN**

YEAR: 2013-2014
CLIENT: TANESCO, TANZANIA



**RAGGOVIDDA
WIND POWER PLANT**

YEAR: 2013 -
CLIENT: Varanger Kraft, Norway



**YTRE VIKNA
WIND POWER PLANT**

YEAR: 2010-2012
CLIENT: Sarepta Energi, Norway



**VOROTAN CASCADE
HYDROPOWER PLANT**

YEAR: 2012-
CLIENT: ContourGlobal, Armenia



**SKARG
HYDROPOWER PLANT**

YEAR: 2012-
CLIENT: Otra Kraft DA, Norway



**NEELUM JHELUM
HYDROPOWER PLANT**

YEAR: 2007 -
CLIENT: WAPDA, Pakistan



**UPPER PADAS
HYDROPOWER PLANT**

YEAR: 2013-
CLIENT: Sabah Electricity Supply
Board, Malaysia



SMALL-SCALE POWER EXPERIENCE

Multiconsult possesses cutting edge expertise in planning, designing and supervising the construction of small-scale power plants, as well as performing the necessary environmental impact assessments. Over the last ten years, we have helped to plan more than 150 small-scale power plants.

Planning and consulting for small-scale power plants requires experience and expertise in order to identify good, efficient solutions. Engineers, hydrologists, biologists and landscape architects work closely together to provide cost-effective, sustainable designs. We have become experts in finding optimal solutions, even in the most demanding conditions.



HYDROPOWER LICENCE AUDITS

The main purpose of an audit is to improve the environmental conditions in regulated watercourses. Multiconsult has a great deal of experience in planning processes and audits, with reference projects from many of the relevant watercourses.

Hydrologists, biologists, landscape architects, engineers and economists work closely together, helping the client to ensure that audit projects are cost-effective and sustainable. Audits can be efficiently coordinated with upgrading and expanding existing plants, as well as with the implementation of any existing administrative plans and environmental measures.



UNDERGROUND INSTALLATIONS

Our services include:

- Time and cost estimates
- Geological surveys
- Planning, execution and follow-up of ground surveys
- Hydrogeology and environmental analyses
- Geotechnical planning
- Advanced stability analyses
- Assessments of boring methods
- Design and monitoring of rock stabilisation
- Injection and groundwater control

Multiconsult possesses all of the necessary expertise in the relevant disciplines, and can provide independent consulting engineers and/or interdisciplinary teams that follow a project through all of its phases.



SOLAR ENERGY

Multiconsult can deliver solar energy installations of any size, and can take projects through from concept to completion. We evaluate relevant technologies and design the installation, and based on this come up with a production estimate. We can also optimise an installation's design based on costs, area utilisation or kWh price. Naturally, we can also help with project management and construction management.



DISTRICT HEATING AND COOLING

Multiconsult has a great deal of experience in thermal energy, and offers services for both small and large-scale projects, and for all phases of a project.

District heating makes it easy to take advantage of renewable energy from biofuel, waste products, solar energy, ambient heat in the air, sea and ground, and waste heat from industry.

We possess broad expertise within all project phases, from pre-project consulting to detail design and construction management. Thanks to our extensive experience in all the relevant disciplines, we can offer standalone heating and cooling solutions, small-scale local heating networks and large district heating and cooling installations.



WIND POWER

Since 2002, Multiconsult has been systematically building up its wind power expertise. This was a natural progression given our background and experience from related industries, and today we possess significant expertise and references in this field.

The services we offer include:

- Pre-project consulting, feasibility studies
- Market studies and strategies
- Environmental impact assessments
- Due diligence
- Detailed planning and design
- Contracting
- Construction management

Our team comprises experts in marketing, business development and economics, with a strong understanding of the technical aspects of wind power. Environmental considerations are a key factor, and we make active use of our environmental expertise when designing and executing projects.



DAM SAFETY

Multiconsult has an interdisciplinary team with extensive knowledge of the regulations, relevant practices, calculation methods and tools. This means we can assist our clients with effective and appropriate solutions that satisfy the safety requirements for watercourse installations.

Our expertise covers the technical design of new projects, upgrading and maintaining dams and associated structures, and the following related fields and activities:

- Reassessments of dams
- Condition and maintenance surveys
- Monitoring and warning systems
- Procedures for supervising and monitoring dam installations
- Emergency plans and drills, action plans, evacuation plans and drills, institutional advice
- Flood calculations, preparation of flood mitigation procedures and strategies
- Dam break wave calculations, inundation maps and assistance with classifying watercourse installations
- Chartered dam engineer (VTA function)



HYDROMETRIC SYSTEMS

In many projects, establishing good systems for data capture and resource monitoring at an early stage is vital for providing a good basis on which to make decisions. This applies equally to feasibility studies, environmental impact assessments, licence applications and plans for hydropower projects.

Multiconsult possesses cutting edge expertise within hydrometry. We can deliver all types of stream gauging, establish on-site metering systems, inspect and maintain field installations, and capture and quality assure hydrological data. We can also assist with designing and establishing systems for the controlled discharge of minimum flows, preparing tenders and project management.



DETAIL DESIGN OF WATER PATHS

Dimensioning water conveyance systems is an important safety factor when planning a power plant. If a water conveyance system is breached, it can have a serious impact on nearby buildings, infrastructure and surrounding areas.

Water conveyance systems present challenges because their dynamic interaction with turbines and the power grid require special dimensioning criteria. Many projects channel water long distances in order to utilise as much of the head as possible, and the conveyance system thus represents a significant cost. We therefore focus on achieving the most cost-effective technical solution for the specific requirements.

Multiconsult has highly experienced professionals who plan and design water conveyance systems based on local conditions and dynamic forces, including pipes, gates and all of the other elements that make up a complete water conveyance system.



DUE DILIGENCE AND INVESTOR ADVISORY

Multiconsult has been accumulating expertise in technical and commercial analysis of renewable energy resources since 1908. We have good tools for analysing the current and future status of assets, modelling current and future investment needs, and estimating a project's approximate future cash flows with the aid of technical risk analyses.

Our expertise and experience cover technical and commercial due diligence investigations of large and small hydro, solar and wind power plants, distribution and transmission systems, and district heating and cooling systems. We can deliver market analyses for investors interested in the Norwegian energy market, due diligence reports for buyers and sellers, as well as technical and commercial risk assessments. Multiconsult can also provide an impartial appraisal of an installation's value.



ELECTRIC POWER SYSTEMS

Multiconsult has extensive experience of supplying high voltage systems, including associated control systems, auxiliary systems and earthing systems. We have experience of all aspects of the construction of power stations. We also deliver network analyses, licence applications, environmental impact assessments, environmental and transport plans, and interdisciplinary design projects for installations including:

- Power plants
- Substations
- HVDC and compensation systems
- Underground and subsea cable installations
- Power line installations
- Continental shelf electrification

We assist Norwegian and international clients with financial and technical analyses for all voltage levels, from distribution and transmission networks up to 420 kV national grid solutions.

Our assignments cover all phases of a project, and we also often perform jobs that involve rebuilding during ongoing operations. We also deliver integrated, smart solutions for optimised energy production and energy conservation.



OWNERS ENGINEER

Multiconsult can play an active role in all phases of a project and in all areas ranging from project management to the relevant technical disciplines. We always maintain a close dialogue with the client, and use our professional knowledge to define and achieve the optimum goals for the project.

Our consultants monitor projects right from the awarding of the contract through to handover, including the trial operation period.

Multiconsult has broad experience in this area, both as client representative and client's engineer for projects abroad.



RENEWABLE
ENERGY

- **Facilitator**
- **Reference projects in Norway and worldwide**
- **Recognized specialists**
- **More than 30 offices in Norway**
- **Subsidiaries in Norway, Singapore, Poland and the UK**
- **Ownership interests in Norplan Tanzania (49%), Newplan Uganda (40%) and SAM Chile (25%)**

ABOUT MULTICONSULT

Multiconsult is one of the leading firms of consulting engineers and designers in Norway and Scandinavia. Multiconsult offers multidisciplinary consulting, design, planning, management, verification and inspection services.

We use the experience that we have built up over more than a century to make history together with our clients. It is important to us that our 1,550 employees possess the right mix of skills, experience, and expertise to manage projects effectively. We encourage both our employees and our clients to see opportunities where others see obstacles, and to push through boundaries where others are tempted to go around them.

Multiconsult has more than 30 branch offices in Norway and abroad. Its head office is in Oslo, but Multiconsult's combined expertise is available through all of our branches. Multiconsult's services cover all phases of a project.

Our clients and partners can be found all over Norway and in many parts of the world. Multiconsult analyses, plans and designs projects throughout Norway and in Africa, Asia, South America and other parts of Europe.

Multiconsult's business areas

- Buildings and Properties
- Industry
- Oil and Gas
- Transportation and Infrastructure
- Energy
- Environment and Natural Resources

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