Renewable Energy
Global Capability & Experience

AGL Energy’s Hallett 5 Wind Farm, South Australia
Renewable energy is one part of an increasingly diverse energy mix, but one whose time in the sun has come.

Assisting our customers into a world with more renewables, WorleyParsons offers a suite of services across this diverse and quickly evolving sector, at the core of which is:

- A culture driven by safety and integrity
- Local focus, with global reach
- Strong innovation leadership
- Practical, project skilled staff
- Extensive energy experience
- Risk based management and processes
- Being technology neutral
- Asset lifecycle aware engineering
- Contracting flexibility
- Broad capability outside of energy
- A sustainability focus through EcoNomics™

Our customers are diverse, including utilities, governments, developers, contractors, equipment suppliers, and companies interested in sourcing or investing in renewable assets.

**Our renewables service lines cover project inception, deployment, and operation to provide full asset lifecycle support.**

With a strong operational focus, WorleyParsons stays relevant to our customers’ needs as assets age. This increases the value of our design and front-end services as new projects, technologies, and concepts can be tested against the successes and failures of those already operating to deliver low-risk, low-cost solutions.

WorleyParsons also benefits customers with our broad expertise base. We provide access to specialists across disciplines as diverse as advanced computational modelling, offshore structures, and plant decommissioning, to provide optimum solutions customised to our customers’ needs.

WorleyParsons sees a bright future for the renewables energy sector. Our services are aimed at ensuring that the full potential of renewable energy is met while exceeding the expectations of our customers, so that renewables’ time in the sun is indeed a long one.

**Results for our customers**

WorleyParsons aligns with our customers’ needs and drivers so that we continually add value, not just complete an assignment. We also focus and respond to our customers locally, but with the flexibility to reach out globally to our extensive experience and resource base. This local/global strength brings real results to our customers.
There are many drivers for change in the power sector. One indication of this is the growth of renewable energy.

Renewable technologies are diverse, but all have the fundamental ability to provide virtually inexhaustible, emissions-free energy. Sources include the sun, wind, the ocean through currents and waves, flowing water, geothermal heat, and a wide range of biological materials as diverse as waste saw-mill residue and sewage gas.

Renewable energy is not just the production of electricity. It can include the provision of heat for industrial processes, various forms of liquid bio-fuels, and a range of hybrid technologies that work alongside the more traditional technologies using oil, coal, gas, or nuclear fuels.

Renewables bring different characteristics to more traditional energy sources. For example, while you cannot always control renewable energy output – the sun does not shine at night – renewables are not subject to fuel price volatility, with output costs virtually fixed.

These differences mean that our energy systems will need to transition as renewable energy input increases. The future of energy points to a growing portfolio of renewables working alongside the traditional sources. Enablers, such as energy storage and smart energy, will play an important role in this transition.

WorleyParsons has critical expertise in renewable energy, from concept decision making to hands-on operations.

These global services utilise a broad experience base and cover diverse roles, such as:

- Design of North Sea offshore wind farm structures
- Operations of sewage-gas plant in Australia
- Study of solar/gas hybrid plant in Kuwait
- Permitting of solar and wind plant in Chile
- Planning of energy storage systems in the United States
- Assessment of transmission options in New Zealand

WorleyParsons’ ability to combine a deep understanding of traditional energy technologies and systems, renewables, and their enablers is particularly valued by our customers. We marry the experience and maturity of the past with future needs, allowing renewables to meet and exceed expectations of both energy markets and asset owners.

WorleyParsons utilises our experts and experience to provide innovative, low-risk solutions for our customers:

- WorleyParsons is a company with great depth, working in a very broad range of industries associated with energy
- We understand the full complexity of issues that affect investment choices
- We use this knowledge to identify and treat project risks across all value-chain elements, not just narrow isolated components
Experience Around the Globe

Solar Tower Permitting

**CUSTOMER:** SOLARRESERVE  
**TIMEFRAME:** 2011 - ONGOING  
**LOCATION:** NORTHERN CAPE, S. AFRICA  
**OFFICE:** PRETORIA, RSA

WorleyParsons has supported SolarReserve on multiple solar tower projects around the world, including conceptual engineering for site projects, preliminary reference plant engineering, plant layouts and general arrangements, evaluating site selection, and full support for permit documents. In South Africa, WorleyParsons was appointed by SolarReserve to undertake Environmental Impact Assessments, associated environmental licensing, and permitting applications for a number of planned projects. Our work is helping SolarReserve overcome one of the critical barriers to progressing these solar tower projects in South Africa.

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**Starfish Hill Wind Farm O&M**

**CUSTOMER:** RATCH  
**TIMEFRAME:** 2007 - ONGOING  
**LOCATION:** SOUTH AUSTRALIA  
**OFFICE:** BRISBANE, AUSTRALIA

As part of our joint venture, Transfield Worley Power Services (TwPS), we operate and maintain the 35 MW Starfish Hill wind farm. Our services include:

- Complete site and facility management
- All maintenance
- Fault response and rectification
- Emergency response

Through improved maintenance practices, TwPS has increased the availability of this plant by over 20%.

Our services also significantly lowered costs and increased effectiveness of ongoing maintenance.

The Starfish Hill O&M work received an Asset Management Award in 2010 from the Australian Institution of Engineers.

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**OPG Biomass Conversion Program**

**CUSTOMER:** OPG  
**TIMEFRAME:** 2009 - 2014  
**LOCATION:** ONTARIO, CANADA  
**OFFICE:** ONTARIO, CANADA

WorleyParsons is providing Owner’s Engineer services to support the Ontario Power Generation (OPG) system-wide Biomass Conversion Program. The goal of the program is to convert several of OPG’s existing coal-fired power generating units to 100% biomass by 2014.

Our scope includes assessment of technical option, identification and management of project risks, development of conceptual designs, capital cost estimates, feasibility studies, EPC bid package development, and procurement support.

WorleyParsons assessments will help to optimise value throughout the program’s systems, including material receipt, handling, storage, transport, and all associated biomass-related safety issues.

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**APS AZ Sun Program**

**CUSTOMER:** ARIZONA PUBLIC SERVICE  
**TIMEFRAME:** 2009 - ONGOING  
**LOCATION:** ARIZONA, USA  
**OFFICE:** PHOENIX & SACRAMENTO, USA

Arizona Public Service Co. (APS) and WorleyParsons have entered into an agreement for the APS AZ Sun Program.

Under this program, APS, Arizona’s largest and longest-serving electricity utility, is investing in the development of 200 MW of solar photovoltaic power stations across Arizona.

WorleyParsons provides project management and owner’s engineering oversight for the projects, including concept engineering, the writing and issuing of specifications, procurement oversight, and delivery management.

This role is continuing into plant operations through the provision of ongoing engineering support.

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**Solar Generation Framework**

**CUSTOMER:** PAEW  
**TIMEFRAME:** 2011 - 2012  
**LOCATION:** MUSCAT, OMAN & MADRID, SPAIN  
**OFFICE:** DELFT, NETHERLANDS

WorleyParsons led a team, including Macquarie Bank and Chadbourne & Parke, to evaluate a solar framework for the Public Authority for Electricity and Water (PAEW) of Oman. This produced a technical and financial program including ownership structures, risk allocations, solar energy support mechanisms, capital grants, tax incentives, loan guarantees, and renewable targets.

WorleyParsons subsidiary INTECSEA performed an in-depth, fit-for-purpose study for the grated connection for the wind turbine foundations, including:

- Review of analytical design approaches for the grated connection
- Verification of the as-built condition to the design condition and calibration of the design formulation

This work also includes extensive operational field measurements.

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**OWeZ Offshore Wind Farm Grouted Connection Study**

**CUSTOMER:** NOORDZEE WIND  
**TIMEFRAME:** 2008 - ONGOING  
**LOCATION:** NORTH SEA, EUROPE  
**OFFICE:** DELFT, NETHERLANDS

The Offshore Windpark Egmont-aan-Zee is located off the coast of the Netherlands. It is installed in 18-20 m (60-65 ft) of water and consists of 36 turbines. The turbine generators used are Vestas V90 3 MW machines and in operation since 2007.

WorleyParsons subsidiary INTECSEA performed an in-depth, fit-for-purpose study for the grated connection for the wind turbine foundations, including:

- Review of analytical design approaches for the grated connection
- Verification of the as-built condition to the design condition and calibration of the design formulation

This work also includes extensive operational field measurements.

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The provision of ongoing plant operations through the Starfish Hill O&M work received an Asset Management Award in 2010 from the Australian Institution of Engineers.
Solar Power

Solar Power uses energy directly from the sun and is a rapidly advancing energy resource of key interest to many of our customers.

While passive uses include domestic heating and hot water production, industrial use involves two basic technologies: photovoltaic (PV) and concentrated solar thermal power (CSP, sometimes also called CST).

PV produces electricity directly with a technology that is rugged, simple, modular, and continuing to decrease in price as production capacity around the world increases. Technologies include flat-plate silicon modules, thin film modules, and concentrating PV (CPV), with other types in development.

CSP varies from PV in that it captures and concentrates direct solar insolation, extracting the energy as heat that can be stored and released as required. Heat can be combined with fossil fuels in hybrids, used in industrial processes such as gas reformation, or used to raise steam to drive a turbine to produce electricity. Technologies include solar towers, parabolic troughs, dish/engines, and linear Fresnel.

WorleyParsons works across all of these solar technologies through services such as site selection, conceptual and detailed designs, output estimating, project delivery management, and operational support.

WorleyParsons has particular expertise in solar hybrids, such as solar boosting on large coal-fired power stations or integration with combined cycle gas turbines to increase plant efficiency and reduce carbon footprint.

Supporting our customer’s solar goals

- **CUSTOMER**: MASEN
- **PROJECT**: OUARZAZATE SOLAR POWER PLANT
- **LOCATION**: MOROCCO, NORTH AFRICA
- **PHASE**: Contract consulting, including for power purchase agreements, was also provided.

WorleyParsons has assisted the Moroccan Agency for Solar Energy (MASEN) with the development of the first plant of the 500 MW Ouarzazate Solar Complex. This complex is the first part of an ambitious program to install 2000 MW of solar generation in Morocco by 2020.

Along with program assessment and analysis, WorleyParsons developed the Infrastructure Plan of Development for the entire complex utilising the common infrastructure, such as water, roads, substations, communications, and security.

PV, at first glance, appears a very simple technology. But at scale this is deceiving, as siting, designing, and integrating large-scale PV power systems with all the performance expectations of utility-grade generation, while keeping costs manageable, can be challenging. WorleyParsons has worked on some of the largest utility-scale PV power stations and continues to support these in operation. We will transfer our experience to your project to ensure successful completion and operation.

Maximising rooftops with 250 MW of PV

- **CUSTOMER**: SOUTHERN CALIFORNIA EDISON (SCE)
- **PROJECT**: UTILITY-SCALE 250 MW ROOFTOP PV
- **LOCATION**: CALIFORNIA, USA
- **PHASE**: WorleyParsons is providing a wide range of engineering services to SCE, which has undertaken the United States’ largest rooftop distributed PV program.

WorleyParsons is providing site assessment, civil and structural engineering review, electrical interconnect review, PV panel and balance of system review and assessment.
Wind Power

Wind Power is considered a mature, relatively lower cost technology, with hundreds of thousands of wind turbines now operational throughout the world.

Almost all of these produce electricity, with only a small fraction used for grinding, pumping, or the production of heat.

Wind turbines can be large, with commercial machines available with rotors of more than 150m (450 ft) across and hub heights of around 150-200m (450-600 ft). These turbines are deployed collectively in wind farms that have been mostly on land, but to take advantage of better winds and to avoid siting issues, machines are increasingly being placed offshore. Offshore wind farms bring a new level of complexity and operational risk.

Wind Power has its own unique challenges. While winds are predictable, follow seasonal patterns, and wind farm output can be forecast with good accuracy, finding sites acceptable to stakeholders and dealing technically with output variations can bring challenges that require experience.

Because of the relatively low cost, Wind Power is often the first renewable energy source considered, and WorleyParsons’ role often begins early. Such work includes location siting, system studies to gain network access, as well as identify and plan any related transmission requirements. WorleyParsons also delivers and operates wind farm projects for customers through project and site management, commissioning, and into operation, including complete facility management and wind turbine servicing.

Successful wind farm management

- **CUSTOMER**: AGL ENERGY LTD
- **PROJECT**: THE BLUFF 52.5 MW WIND FARM
- **LOCATION**: SOUTH AUSTRALIA
- **PHASE**: Design, construction, and testing.

For this 52.5 MW wind farm, WorleyParsons provided project and construction management for AGL - Australia’s leading renewable energy company. WorleyParsons’ role also included cost control, risk management, project scheduling, and construction management. The project was completed on schedule and was driven with a strong emphasis on safety and the environment.

Geothermal energy

There is an enormous amount of heat within the earth, either generated through radioactive decay or as a legacy of the earth’s formation. Tapping this is an engineering challenge, despite geothermal power stations being relatively common. WorleyParsons brings exceptional global thermal generation experience into the geothermal world and has undertaken successful roles in New Zealand, United States, and Chile.

Increasing geothermal potential

- **CUSTOMER**: CALENERGY OPERATING
- **PROJECT**: BLACK ROCK 1-6 GEOTHERMAL POWER
- **LOCATION**: CALIFORNIA, USA

WorleyParsons enhanced the economic value and lessened the environmental impacts of the geothermal plants.
Biomass presents a diverse and complex set of applications utilising a range of fuel resources and technologies.

Biomass resources are sourced from plant and animal derived materials and represent an enormous source of energy. While much of this is used for heating and cooking, biomass may be used as a fuel for direct use in a range of energy industries. For example, biomass can be utilised as a feedstock for the production of syngas for power generation, or as a precursor for the processing of liquid fuels and chemicals.

Biomass can come from a variety of sources including grain crops, woody plantations, animal manure, human sewage, waste streams, and can even be derived from algae. The technologies required to use these fuels vary from direct boilers, to fluidised bed reactors, to standard reciprocating engines and very complex chemical plants.

Biomass projects can be complex, which fits well with WorleyParsons’ chemical, industrial, and thermal generation expertise. Our experienced Biomass specialists have a broad and up-to-date knowledge of current project development and bio-energy issues. We have worked on small, kW-sized projects up to the very largest Biomass facilities across the full range of resource inputs and plant types.

Utilising on-site renewable resources

CUSTOMER SYDNEY WATER
PROJECT SYDNEY WATER ENERGY PARTNERSHIPS
LOCATION NEW SOUTH WALES, AUSTRALIA
PHASE

Under an Alliance arrangement with Sydney Water, WorleyParsons and Energetics have targeted commercial renewable projects within Sydney Water’s existing plant operations. Aimed at utilising on-site renewable resources, WorleyParsons has undertaken the design, procurement, installation, and operation and maintenance of the resulting facilities. These currently include the use of biogas from wastewater treatment works and small-scale hydro facilities extracting energy from flows within Sydney Water’s water and wastewater systems.

Delivering small-scale hydro developments

CUSTOMER ALTERRA POWER CORPORATION
PROJECT TOBA MONTROSE HYDROELECTRIC PROJECT
LOCATION BRITISH COLUMBIA, CANADA
PHASE

WorleyParsons was retained as Owner’s Engineer and to provide Project Management services for the 196 MW Toba Montrose “Run-of-River” hydroelectric project for the Toba Montrose Partnership (between Alterra Power Corporation and GE Energy Financial Services). Services include project delivery for the execution phase of the project, including ongoing technical review, quality, contract administration, safety, program, and project management.
Enablers are growing in importance in relation to renewable energy. These are processes, technologies, and market mechanisms that essentially remove roadblocks to higher renewable penetration in energy systems. Many of these enablers are still emerging, but include:

- **Energy storage** – the ability to move output to better match loads (called arbitrage), or to smooth output from renewable plants so that any impacts are minimised
- **Smart energy** – the design, use, integration with and control of various devices including loads, energy storage and network assets such that renewable input value is maximised
- **Integration** – achieving renewable energy input into an energy system within technical, commercial and regulatory constraints. This includes effects on other system assets, issues of compliance as well as acceptable operational methodologies

Enablers improve the ability of renewable energy to compete and grow as part of broader energy systems. However, such systems by nature are complex, and detailed knowledge across all of their elements is essential in understanding, promoting, and deploying enablers.

WorleyParsons has an extensive history with energy systems, with broad, practical knowledge across their components and interdependencies. This knowledge allows us to view the whole energy picture, which has resulted in many roles in which enablers have been progressed.

Also emerging are a range of new renewable technologies, including tidal and wave power systems, and some of the emerging solar and biomass technologies. Within these, WorleyParsons’ roles have included design, engineering review, due diligence for investors, project inception assistance, and advisory roles for Governments providing development grants.

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**Compressed air energy storage (CAES)**

- **CUSTOMER**: NYSEG and PGE
- **PROJECTS**: SENECA & CENTRAL VALLEY CAES
- **LOCATION**: MULTIPLE LOCATIONS, USA
- **PHASE**: We work with emerging technologies to provide the latest enablers to our customers.

The key objectives of these projects are improved grid reliability through centralised energy storage for wind arbitrage and ancillary services.

The US Department of Energy has sponsored both projects which involve the planning, conceptual design, and cost/benefit assessment of Compressed Air Energy Storage using various reservoir types. The plants range in size from 150 to 300 MW intended for daily operation in the 10-16 hours range.

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**Renewable & fossil hybrids**

Hybrids of renewables with fossil fuelled processes will be an important component of the renewable energy sector. These can include such things as wind input into islanded loads, the use of solar thermal technology in chemical processes, solar boosting on large thermal power stations, and the combination of renewables with gas turbines. WorleyParsons has recent experience across all of these, leveraging our significant fossil capability to ensure such integration is successful in the long term.

**Solar combined cycle in cold climates**

- **CUSTOMER**: CITY OF MEDICINE HAT
- **PROJECT**: DEMONSTRATION ISCC
- **LOCATION**: ALBERTA, CANADA
- **PHASE**: We work with emerging technologies to provide the latest enablers to our customers.

Medicine Hat has started installation of a 1 MW Integrated Solar Combined Cycle (ISCC) project at their existing generation facility with a goal of demonstrating solar thermal in Canada. WorleyParsons supports all three project phases; feasibility and optimisation, detailed design, and operating asset monitoring.
The success of renewable energy projects can be particularly sensitive to siting, planning, and approvals. These raise a number of issues, including:

- The renewable resource – variations, suitability, and plant production
- Land suitability – logistics, constraints, and regulatory hurdles
- Transmission/network access - the ability to move the energy to where it is needed
- Stakeholders – gaining the social license to operate
- Approvals – gaining the regulatory license to operate
- Technology selection – choosing the right technology

In assisting with these, WorleyParsons draws on its broader capability, which includes environmental, planning, and stakeholder specialists, staff skilled in the interface issues with energy networks, and our renewables specialists who know technology capabilities and costs. They work as a team to assist customers to make the right early-stage project choices.

WorleyParsons uses world-class Geographic Information Systems (GIS) to assess and combine constraints to development. By combining layers of GIS information, it is possible to study vast areas, with prospective sites ranked mathematically using an Analytical Hierarchy Process. This multi-criteria assessment tool simplifies the selection process, which can often involve conflicting constraints.

Our work has included large-scale renewable planning for Governments seeking to understand nation-building infrastructure policy, the full planning and approvals for wind farms and solar power stations, and such peripheral work as line route studies for the interconnection of renewable assets to transmission networks.

Obtaining PV environmental approvals

CUSTOMER SOLARPACK
PROJECT PV SOLAR PLANT POZO ALMONTE
LOCATION CHILE, SOUTH AMERICA
PHASE

WorleyParsons Ambar in Chile undertook the Environmental Impact Studies (Declaration of Environmental Impact) for the utility-scale PV project Pozo Almonte 1, 2 and 3, totaling 32.5 MW with the installation of 480,480 photovoltaic modules. This plant will inject energy into the Northern Chile Electrical Grid (SING).

Assisting our customers to meet environmental requirements.

Operating renewable assets

The benefits of renewable energy from a business and environmental perspective can only be realised through a long, successful operational life. WorleyParsons undertakes a range of operational roles from the provision of engineering support, to full facility management, including asset planning and the scheduled and unscheduled maintenance of equipment.

Assisting the asset manager

CUSTOMER COLLGAR WIND FARM PTY LTD
PROJECT COLLGAR WIND FARM OPERATIONS OE
LOCATION WESTERN AUSTRALIA
PHASE

The 206 MW Collgar Wind Farm was commissioned in late 2011. WorleyParsons are providing long term owner’s engineer and general facility assistance during its operational phase.

Work includes representing the owner in engineering issues, performance scrutiny of the plant and contractors, and assistance with environmental and safety compliance.

Bringing our broad expertise in the running of renewable assets.
Our Differentiators

Differentiator 1
Combined empowerment and technically capable people

Differentiator 2
Industry leadership in health, safety, and environmental performance

Differentiator 3
Economics™ - delivering profitable sustainability

Differentiator 4
Outstanding operational and corporate performance

Differentiator 5
Focus on long-term contracts and asset-based services

Differentiator 6
Success in project delivery - large and small

Differentiator 7
Comprehensive geographic presence

Corporate Overview

WorleyParsons is a leading global provider of professional services to the resources and energy sectors, and the complex process industries.

We cover the full asset spectrum, both in size and lifecycle, from the creation of new assets, to services that sustain and improve operating assets.

Our business has been built by working closely with our customers through long-term relationships, anticipating their needs, and delivering inventive solutions through streamlined, proprietary project delivery systems. Strong growth continues to characterize our performance, both through organic development and through strategic acquisition, as we strive to provide tailored services wherever our customers need us.

HYDROCARBONS

POWER

MINERALS, METALS & CHEMICALS

INFRASTRUCTURE & ENVIRONMENT

EcoNomics

EcoNomics™ provides our customers with the systems, technologies, and expertise to optimise and balance financial, social, and environmental outcomes, improving sustainability performance while enhancing profit and long-term viability.

WorleyParsons’ vision is to be a leader in sustainability by helping our customers capture new markets and business opportunities created by the new energy economy.
Renewable Energy
Capability & Experience

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