



WorleyParsons

resources & energy

EcoNomics™

EcoNomics™

Delivering Profitable Sustainability

Capability and Experience





WorleyParsons

resources & energy



“There is no task so important or so urgent in our business, or our customers’ businesses, that it overrides the need to work safely...”

John Grill, WorleyParsons CEO

Zero Harm is our corporate vision for health, safety & the environment (HSE).

We are committed to our vision; it applies to all of our operations, at all times, in all locations, and at all levels of responsibility.

We will actively work to align our expectations and behaviors with those required to achieve our vision through a dedication to continuous improvement.

The launch of our HSE framework, OneWay™, enables us to further align and consolidate our global systems and procedures and continue to work with our personnel to reinforce a culture that underpins our drive to achieve our corporate differentiator of industry leadership in the HSE performance.

OneWay™
to zero harm

Corporate Overview

WorleyParsons is a leading global provider of professional services to the resources & 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.

- Power
- Minerals & Metals
- Hydrocarbons
- Infrastructure & Environment

38
countries

118
offices

32,200
personnel

EcoNomics™ Delivering profitable sustainability

EcoNomics™ is our range of services and technologies that profitably embed environmental, social and financial sustainability into project delivery, across the asset lifecycle. It is a seamless extension of our established project delivery capability in the key areas of Assessment, Efficiency and Treatment & Mitigation. We are committed to working with our customers to turn their sustainability objectives into good business practice.

EcoNomics™

EcoNomics™ assists our customers to adopt a broader view of the impacts of their operations and incorporates financial, social and environmental risk into their project decisions to deliver optimised and profitable solutions.

This initiative delivers projects that are future-proofed with improved risk management for our customers. EcoNomics™ compliments and strengthens our existing business and is based on WorleyParsons strong technical and business acumen.

EcoNomics™ converts customers' sustainability goals into tangible business solutions – reducing energy use, improving efficiency, eliminating waste, reducing emissions, and ensuring profitability. This makes it easier for our customers to assess and mitigate the challenges of changing commercial and ecological drivers that are altering operating environments worldwide and therefore changing customers project objectives. It also helps them to plan for and address the risks of unprecedented growth and volatility in energy and resource costs, rising stakeholder concern about sustainability and climate change as well as increased regulation and changing standards for environmental compliance, whilst remaining profitable.

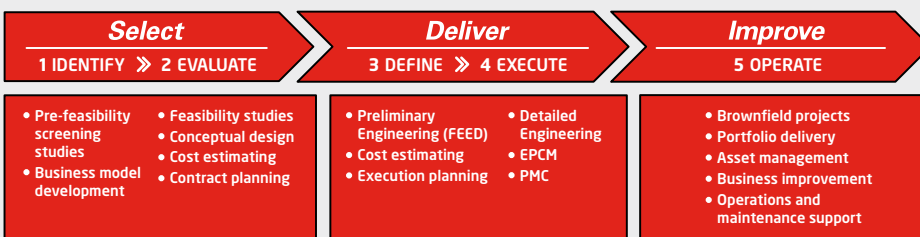
Our EcoNomics™ Assessment process and proprietary EcoNomics™ DELTA toolset provide us with a unique ability to monetize the value of all internal (project), and external (environmental and social) risk factors allowing project options to be compared on a like for like dollar value basis over a range of possible future conditions. This allows decision makers to identify optimal solutions for profit and sustainability. The assessment adds value at every level of consideration: high-level strategy, concept select and technology comparisons.

Following project selection we embed sustainability-related expertise and capability within an EcoNomics™-trained project team to design for business, environmental and social sustainability from the outset. These teams are supported by WorleyParsons' formally embedded systems and procedures, proprietary software, sustainability training, and a global network of leading engineering and technology capabilities.

EcoNomics™ projects completed in

20+
countries

130+
specialist EcoNomics™ capabilities



WorleyParsons' experience covers all five phases of the asset lifecycle. In each one of these phases we understand the critical issues and apply our specialist business lines, *Select*, *Deliver* and *Improve* to enable our customers to achieve their business objectives.

Our phased approach enables consistent project delivery worldwide and WorleyParsons' project systems are fully aligned to this process.



EcoNomics™ Benefits

The steps required to make a project or business sustainable have changed dramatically in recent times, and the change is ongoing. This change creates opportunities for new, improved and profitable ways to minimise risk and deliver projects for our customers.

In every industry we work in from offshore facilities to rolling rail stock we see opportunities to increase efficiency, reduce demands on resources, engage with communities, and at the same time increase profitability. EcoNomics™ enables our customers to enhance the profitability of their operations whilst addressing their sustainability objectives.

WorleyParsons provides customised solutions in the following areas of sustainability development:

- Improving energy efficiency, resulting in reduced fuel costs increasing the future profitability of operations
- Reducing dependency on fossil fuels, bringing increased energy security and reduced carbon costs in the future
- Reducing waste or converting waste into a valuable commodity
- Engaging communities, regulators and governments in sensible environmental and social debate where costs, benefits, and trade-offs are openly discussed and optimised improving stakeholder relations and accelerating approvals
- Developing new and improved processes and technologies, providing a competitive advantage and enhanced profitability
- Optimising resource usage, reducing input and waste disposal costs
- Improving and implementing regional and cross industry synergies

In these cases sustainability is acting as a catalyst for change that benefits business, rather than imposing a cost. EcoNomics™ services and technologies can be applied to all aspects of the project life-cycle in all industries we work in. Our philosophy is scalable making it suitable for any project size. The earlier in the project process our services are used, the greater the value delivered to our customers.

1.8+

petajoules of energy saved per annum

375k

tonnes per year SO₂ reduction

164m

tonnes per year of CO₂ saved for last five customers



Capability Overview

EcoNomics™ Global Experience

WorleyParsons has delivered EcoNomics™ projects across all of our customer sector groups in all regions. Some of the locations include:

Australia	Russia & FSU
Canada	Saudi Arabia
Europe	United Arab Emirates
Indonesia	United States of America
Qatar	



EcoNomics™ Assessment

It is important at the beginning of any project to involve all key stakeholders to define how sustainability fits into the scope, agree on the sustainability objectives for the project, identify project options and determine the economic, social and environmental variables to be considered in the design. Using our EcoNomics™ Assessment process and proprietary EcoNomics™ DELTA toolset we analyse all project options against the variables considered important to the customer. The analysis results are provided as a single metric allowing the customer to easily identify the optimum solution.



Embedded Delivery

Interfaces in engineering projects are often where opportunities are missed and problems occur, causing delays and sub-optimal project delivery. Engaging project delivery companies to focus on the financial, environmental and social performance of a project in isolation creates similar interfaces. We are committed to embedding EcoNomics™ specialists into the project team from the beginning and choosing lead project personnel trained in EcoNomics™ principles. This results in the whole project team identifying and executing ways to maximise opportunities to achieve or exceed the sustainability objectives for the project.



Specialist Capabilities

Sustainability is a broad topic covering many aspects. We have identified many specialist capabilities where we add value to our customers' operations. These capabilities are grouped under three main areas:

- Assessing Opportunities
- Increasing Efficiency
- Mitigation and Treatment

Our dedicated specialists have the technical skills to ensure customers using EcoNomics™ capture the maximum financial, environmental and social performance for their project.





WorleyParsons

resources & energy

EcoNomics™ Assessment

WorleyParsons provides customers with valuable strategic decision-making support by quantifying project sustainability in monetary terms.

We work closely with our customers through our EcoNomics™ framing workshops to agree on the key project objective, identify project options, and determine the financial and external assets to be assessed and the risks to be evaluated. This early alignment with the widest possible range of stakeholders provides a clear focus for the assessment.

All identified opportunities are evaluated by our EcoNomics™ experts using WorleyParsons proprietary EcoNomics™ DELTA software which has the ability to consider any combination of financial, environmental and social issues in the project analysis on a range of possible future conditions. The analysis provides results using the universal metric of money.

Quantifying these elements is made possible by using the latest available economic studies, literature and research, and current market costs to value externalities. All external values are taken from reputable organisations such as the UN, World Bank, and other government and industry bodies worldwide.

We use likely ranges of values for external assets and reference the benchmarks to determine how those values affect project economics. This allows uncertainties to be harnessed providing better decision making, risk mitigation and a more robust project outcome. Evaluating project options in this way allows our customers to optimise their environmental and social spending to avoid unnecessary expenditure driven by outside parties.

Having worked on many large multi-disciplinary projects across the world in a number of industries, our customers can rely on WorleyParsons resources and experience to analyse and quantify their most complex sustainability challenges, supporting improved decision making and more sustainable outcomes.

1

common metric for comparing all solutions - money

30+

external and internal variables considered

EcoNomics™ assessments completed on

100+

projects worldwide



Project: Leismer Expansion Project**Customer: Statoil Hydro****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Canada

EcoNomics™ Assessment assisted Statoil Hydro to select the most sustainable power and steam generation options for their SAGD plant both for now and in the future.

WorleyParsons completed an EcoNomics™ Assessment to determine the most sustainable combination of power generation, steam generation and carbon capture and storage to support the operation of a steam assisted gravity drainage (SAGD) plant with an associated 45,000 bbl/day of bitumen production. An EcoNomics™ framing workshop, risk analysis study and the EcoNomics™ DELTA tool provided insight on the overall economics and sustainability of the power and steam generation decision, taking into account the likely changes in policy and regulation in Alberta over the life of the project and likely changes in the values placed on key external resources, notably carbon and water.

**Project: Treated Wastewater Disposal Project Options Assessment****Customer: Water Corporation of Western Australia****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

The Water Corporation approached WorleyParsons to assist in assessing project options for the disposal of treated wastewater from regional plants. The Corporation was facing increasing pressure to pursue disposal methods with high financial cost. WorleyParsons provided EcoNomics™ Assessments of the full environmental, social, and financial costs and benefits of a number of technical options at five exemplar sites. The analysis allowed the Water Corporation to not only select the most sustainable project option at each site, but to better evaluate the dynamics and parameters affecting the balance of social and environmental outcomes as a basis for informed policy decision making.

**Project: Offshore LNG Development****Customer: Confidential****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

WorleyParsons provided a strategic analysis of the costs and benefits (private and societal) of engineering design options for a major offshore LNG development. The analysis identified the most sustainable designs and development approaches. The project included a fully integrated environmental and social impact analysis at each stage of the engineering design process along with detailed traditional financial analyses to identify the most economic engineering design approaches for each stage of the project.





WorleyParsons

resources & energy

Embedded Delivery

Realising sustainability opportunities requires a unique approach to every project which is achieved by embedding EcoNomics™ trained personnel and specialists within WorleyParsons project teams.

Embedding EcoNomics™ people in the project team minimises delays and avoids the need to revisit design reviews on sustainability and risk grounds to ensure that sustainability opportunities and benefits are realised and maximise the delivery of profitable sustainability.

Our people capitalise on the best-practice range of tools, systems and experiences from EcoNomics™ projects around the world. This provides our customers with the highest quality options for their project. The use of monetized data then enables like for like comparisons to ensure the most appropriate solution for the project is chosen.

EcoNomics™ is implemented from the top level of projects by using Project Managers and Project Leads trained in EcoNomics™ principles. These principles are then filtered down through the whole team emphasising the importance of sustainability to the project.

EcoNomics™ is also embedded in WorleyParsons project management processes (WPMP and EMS) to ensure procedures, prompts and checklists associated with EcoNomics™ are included at the most advantageous stages of a project.

By combining these facets EcoNomics™ provides a seamless extension of our established project delivery model.

300+

EcoNomics™
trained project leads

Integrated

within the
project team



Project: Strategic Carbon Management Plan**Customer: Confidential****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

United States

Through EcoNomics™ global resources and alliance partners, WorleyParsons provided the customer with the best options for managing their CO2 emissions.

WorleyParsons was retained to develop a carbon management plan for a new coal power plant and three existing facilities in the Midwest. The integrated project team brought together skilled personnel from our power engineering, environmental, and EcoNomics™ capabilities to determine the best options for managing CO2 emissions. Options considered included CO2-EOR, underground sequestration in saline formations, and trading CO2 in commercial markets. WorleyParsons also provided analysis of geological and hydrogeological settings of possible sites for CO2 sequestration. As part of the evaluation, WorleyParsons worked with Baker & McKenzie to provide our customer with guidance on pending US legislation regarding carbon trading.

**Project: Pilbara Iron Ore and Infrastructure Project****Customer: Fortescue Metals Group****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

This fast track project was undertaken in the culturally and environmentally sensitive Pilbara region of North West Australia. It was identified at project kick off that including EcoNomics™ specialists in the project team at the beginning of the project was the best way to minimise delays and maximise sustainability opportunities. The specialists were responsible for regulatory conformance and environmental project management construction, complying with the Public Environmental Review (PER) and Environmental Management Plans (EMPs) for the 45Mtpa iron ore development. This included environmental monitoring and management of multidisciplines for construction dust noise control, flora and fauna conservation (including invasive weed control), and marine dredging procedures for the protection and reclamation of coastal mangroves. They also ensured mine, rail, and marine components conformed to statutory regulations for vegetation clearing, acid sulphate soils and drainage, and water efficient dust control mechanisms. By embedding EcoNomics™ specialists in the project team, sustainability tasks were factored into the schedule and discussed openly, ensuring that there were no unexpected delays. This allowed the rest of the project team to focus on supplying the other project deliverables.

**Project: Reftinskaya GRES – Ash Handling System Rehabilitation Project****Customer: OAO Wholesale Generating Company No. 5****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Russia

At 3,800 MW, Reftinskaya is the largest coal-fired power plant in Russia; however, operations are limited by a shortage of land to extend the ash pond area, and water for ash transport, with disposal accommodated. Together with our Russian partner ROS Postavka, WorleyParsons Select is providing the front-end process design and management services for the design and reconstruction of the ash handling system. Through the specialist capabilities of our power and gas cleaning divisions and their in-depth knowledge of the new semi-dry technology, the ash handling system proposed will reduce water consumption by 50% reduce the secondary air pollution from the future ash pond and make a significant contribution towards the long term, environmentally sustainable operation of the plant.





WorleyParsons

resources & energy

Specialist Capabilities

WorleyParsons has a wide range of capabilities providing our customers with many opportunities for improving the sustainability of their projects. Our globally connected range of specialist engineers and innovators make it happen.

WorleyParsons' personnel work every day to improve the financial, social and environmental performance of projects by assessing opportunities, improving efficiency, and mitigating and treating negative impacts. WorleyParsons' globally integrates these resources, in order to provide best-practice and world-class service across the world.

EcoNomics™ projects include an elevated mandate from our customers to improve the financial, social and environmental performance of their project using these capabilities. Using our knowledge of the customer's project objectives and our specialist offerings we review each capability and select only those most beneficial capabilities to incorporate in each EcoNomics™ project. The selected specialists then become part of the traditional project team working towards the common project objective.

Delivering projects to scope is just as important to us as it is to our customers. The inclusion of sustainability in the scope provides our specialist engineers and innovators with additional opportunities to ensure the project is a success.

WorleyParsons has a wide range of specialist capabilities that support the delivery of EcoNomics™ projects. They are broadly categorised under assessing opportunities, increasing efficiency and mitigation and treatment. We have and will continue to actively partner with other world-leading organisations in areas that extend our range of EcoNomics™ services.

50+

assessment capabilities

30+

efficiency capabilities

50+

mitigation & treatment capabilities



Assessing Opportunities

Measurement/Data Collection

- Water monitoring/sampling
- Air monitoring/sampling
- Water quality
- Materials testing
- Noise monitoring/sampling
- Geomatics/Database (GIS)
- Terrestrial ecosystem monitoring/sampling
- Aquatic ecosystem monitoring/sampling
- Web based data collection

Simulation & Modelling

- Boiler/turbine simulation
- Groundwater modelling
- Coastal processes
- Advanced analysis
- Air modelling/simulation
- Dispersion/plume modelling
- Life Cycle Assessment
- FEA/CFD/SACS numerical modelling
- Surface water modelling/management

Evaluation & Reporting

- Social management services
- Air evaluation/reporting
- Noise evaluation/reporting
- Climate change prediction/adaptation
- Water evaluation/reporting
- Environmental Impact Assessment
- Terrestrial ecosystem evaluation/reporting
- Aquatic ecosystem evaluation/reporting
- Regulator approval/permitting/compliance

Assessing Opportunities

Energy Efficiency

- Pinch analysis
- Power transmission efficiency
- Co-generation
- Heat and energy optimisation
- Coal-fired generation efficiency
- Trigenation
- Power generation efficiency
- Gas-fired generation efficiency
- Energy auditing/modelling

Process Efficiency

- Pyrometallurgy
- Process optimisation
- Hydrometallurgy
- Process Control

Construction Efficiency

- Sustainable procurement
- Dynamic simulation of supply chains
- Modular construction
- Logistics modelling
- Sustainable building design
- Remediation, restoration and redevelopment

Mitigation and Treatment

Renewables & Alternative Fuels

- Solar power (photovoltaic and thermal)
- Biomass
- Hydro-electric generation
- Geothermal
- Wind
- Nuclear power generation

Improved Fossil Fuels

- Clean coal
- Carbon sequestration
- Coal seam methane
- Carbon trading and markets
- Carbon capture
- Gasification

Waste

- Site assessment and remediation
- Flue gas treatment
- Greenhouse gas monitoring and auditing
- Gas cleaning
- Hazardous waste
- Greenhouse gas reduction
- Sulfur removal
- Radioactive nuclear waste
- Landfill design and construction

Water

- Wastewater (sewerage) treatment
- Tailings management
- Water sensitive urban design
- Drinking (potable) water treatment
- Desalination
- Groundwater
- Industrial water or wastewater treatment
- Water reticulation and transport
- Process water reuse



Assessing Opportunities

WorleyParsons provides customers with specialist services for gathering, analysing and using information relating to the sustainability of their project or operation.

Our expertise in all forms of engineering assessment provides customers with the right information to frame their sustainability goals, measure their operation's performance and make strategic project decisions.

WorleyParsons' assessment services include:

- Measurement and Data Collection – Our specialists understand the importance of accurate measurement when collecting physical data relating to our customers operations. This data is used to establish baseline technical, environmental, social and financial performance to measure improvements and assess compliance
- Simulation and Modelling – Our global multi-discipline experience across many industries provides customers with access to a wide range of simulation and modelling applications. We are able to expertly model specific aspects of our customers operations and determine the environmental, social and financial effects of those operations
- Evaluation and Reporting – We provide a full range of evaluation and reporting capabilities to assist in all financial, environmental and social compliance and regulation aspects of operations. Our areas of expertise include: risk assessment and management; regulatory issues; stakeholder engagement and environmental auditing and reporting

The right information and analysis is essential for making informed financial, social and environmental sustainability decisions that comply with regulations and minimise project delays. When working with WorleyParsons our customers can rely on our specialist capabilities in assessing opportunities for support in tackling their complex operational challenges.

14,000
field hours
per annum

30+
years of
environmental
permitting



Project: Groundwater and Surface Water Monitoring**Customer: Suncor****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Canada

WorleyParsons is actively involved in helping Suncor manage its groundwater and surface water monitoring programs at its oil sands mine sites.

Water is critical to Suncor's operations in the Canadian oil sands region. Consequently, careful stewardship of its water management programs helps Suncor to maintain its license to operate and meet its sustainability objectives. WorleyParsons innovative use of forensic investigative techniques to clarify site conditions and determine the potential effects of mining activities and tailings ponds on local groundwater has enabled Suncor to implement highly targeted groundwater and surface water monitoring programs for adjacent wetlands, lakes and, ultimately, the Athabasca River.

**Project: Industrial Estate Cooling Water Circuit****Customer: Ma'aden Power and Infrastructure****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Saudi Arabia

During the design phase of the Ma'aden industrial estate it was calculated that the cooling water system required 1.2 million m³/hr of water. This large volume of water presented significant challenges in view of environmental and design constraints. WorleyParsons conducted innovative modelling to assess and minimize impacts to adjacent marine national parks. The results of this modelling were used to develop an effective and efficient master plan for the cooling water system which considered the site conditions and significant ecological values associated with the adjacent coastal ecosystems.

**Project: Copperbelt Environmental Project****Customer: Zambian Ministry of Finance and National Planning****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Zambia

WorleyParsons role in the Copperbelt Environmental Project was to assist the Zambian Government and World Bank with the ongoing privatization of the Zambian mining industry, while also maximizing the social and environmental benefits to communities impacted by past mining operations. We were able to achieve this by developing an integrated decision support matrix - a tool to screen pre and post closure land use options against economic, environmental and social criteria. This tool enabled WorleyParsons to engage all key stakeholders, including the affected communities, to participate in a rational planning process that balanced economic, social and environmental welfare in a transparent and informed manner, bringing the greatest possible benefit with a limited budget.





WorleyParsons

resources & energy

Increasing Efficiency

One aspect of sustainability is using available resources efficiently – using less and producing less waste. WorleyParsons helps customers maximise efficiency and deliver financial, social and environmental benefits.

As the value of raw materials, water and energy increases, customers will benefit greatly by looking for innovative ways to operate more efficiently. Our capabilities in energy, process, and construction and materials efficiency provide a diverse range of ways for customers to meet their efficiency objectives.

Our customers have been astounded with the energy efficiency savings achieved, on both existing and new plants. Using techniques such as pinch analysis, we can optimize plant-wide energy use and heat recovery. We have demonstrated on numerous projects that innovative solutions bring substantial energy gains, saving our customers money and improving the sustainability of their operation. Our specialists in efficient generation of energy, both in the traditional energy generation industries and using more novel techniques to generate power such as the recovery of potential and kinetic energy within processes, have strong industry specific knowledge and a track record of success.

For efficient use of raw materials we have developed innovative solutions to improve process efficiency by taking a whole-system approach to analysis, solutions are developed that reduce the use of raw materials, minimise waste production or even introduce recycle processes to add value to what would otherwise have been a waste stream.

Where sustainability during construction is an objective, WorleyParsons has experience in sustainable procurement, modular construction and plant layout optimisation. We also offer advice on sustainable building design

500+

gigawatt hours of energy saved per annum

Saving our customers

20m+

dollars per annum

(assuming 40 cents per KW/hr)



Project: Whareroa Energy Efficiency Project**Customer: Fonterra****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

New Zealand

WorleyParsons' energy efficiency specialist group in New Zealand, Demand Response, assisted Fonterra to achieve a 15% reduction in annual energy use over five years.

Fonterra is one of the largest dairy companies internationally. In 2002 WorleyParsons was engaged to assist in improving their energy efficiency. This project is one of the most ambitious and strategically important industrial energy efficiency projects to be undertaken in New Zealand by WorleyParsons. A site-wide process description was prepared, providing the basis for the pinch analysis. The key was to rethink the project boundaries and integrating the water, heat and energy systems. The concept developed used a 500 m³ stratified tank supplied by a number of low-grade heat sources to heat water from 20°C to 40°C and in turn supply heat to a number of processes. The energy savings generated a payback period of less than two years on the 3.5 million invested. Demand Response continues to assist Fonterra with their objective of ongoing energy efficiency improvements of 2.5% per annum.

**Project: Renewable Energy Generation Project****Customer: Sydney Water Corporation****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Australia

In 2007, Sydney Water approved the Renewable Energy Generation Program – a suite of renewable energy power plants to use existing energy sources within its water and wastewater systems. Gas produced in the wastewater treatment process will be used as a fuel for cogeneration. Potential energy in gravity fed water and wastewater flow will be harnessed for hydroelectric generation using mini-turbines. With a combined capacity of over 8 MW the facilities will achieve significant cost savings and an estimated CO₂ abatement of over 50,000 tonnes per annum. This represents a 15% reduction in Sydney Water's reliance on fossil fuel generated electricity and significant contribution to its commitment to become carbon neutral by 2020.

**Project: Double Digestion/Energy Efficiency Study****Customer: Alumina Partners of Jamaica (Alpart)****Phases:** IDENTIFY >> EVALUATE >> DEFINE >> EXECUTE >> OPERATE

Jamaica

WorleyParsons undertook an optimization study to reduce digestion energy consumption at the facility by at least 1 GJ/t. Options considered included combinations of double digestion (both counter-current and parallel), single stream slurry heating and pressure decantation. A systematic approach was used to generate 64 potential technology combinations and to screen these to a short-list of six realistic contenders. Alpart and WorleyParsons worked together to arrive at an option which made maximum use of existing equipment while still achieving the targeted energy savings. This led to a 65% reduction in capital cost relative to the customer's initially proposed concept.





WorleyParsons

resources & energy

Mitigation and Treatment

Resources and by-products from facilities aren't always aligned with customers sustainability objectives. WorleyParsons will explore and implement existing, new and emerging processes and technologies to mitigate where possible or otherwise treat the negative impacts on the environment and society.

Whether it is taking a new approach to a Greenfield project, offering customers an alternate solution or assisting in decommissioning and site remediation, we have the capability to achieve the desired outcome.

Our experience in alternative fuels and renewable energy generation provides a variety of options in project delivery. We support customers with energy generation using methods such as solar photovoltaic, solar thermal, wind, biomass, geothermal, nuclear and hydro-electric power.

Solutions also exist for the improved use of fossil fuels. WorleyParsons capabilities cover clean coal, coal seam methane technologies and gasification. Through our established strategic relationships, we can assist with carbon capture and sequestration and provide full access to the world's carbon markets.

WorleyParsons has a dedicated in-house water and waste water group. As the value of water increases, customers can take advantage of the opportunities that exist for advanced water treatment and water recycling technologies, and desalination as well as for innovative methods of reducing water consumption.

Where waste is unavoidable, we assist customers with waste treatment technologies and appropriate disposal methods. Our customers often engage us for sulphur removal from gas streams and tailings management.

3,000
megawatts of
renewable energy
in design

10+
years of CCS
research and
development

10,000
contaminated sites
investigated



Project: Clean Coal Power Project**Customer: ZeroGen Pty Ltd****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Australia

ZeroGen combines the technologies of Integrated Gasification Combined Cycle and Carbon Capture and Storage to produce low emission base load electricity.

For the clean coal power project WorleyParsons has been contracted to provide evaluate and define phase services in the development of process design and infrastructure and conformation of the optimization studies. Through benefits such as accelerating the deployment of large-scale low emission coal power plants in Australia and around the world, and providing a secure source of base load electricity supply with low CO2 emissions, the ZeroGen Project is helping to preserve coal exports and the sustainability of the Australian coal industry and reduce the impact of climate change.

**Project: Clean Smokestacks Program****Customer: Progress Energy****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

USA

This project consisted of the retrofit of individual, wet-type flue gas desulfurization systems to achieve 97% removal of sulphur dioxide from the flue gas leaving the boilers and produce marketable gypsum as a by-product. The project also included the retrofit of a Selective Catalytic Reduction (SCR) system to three units. The SCR systems were designed for >90% removal of nitrogen oxides from the boiler flue gas. WorleyParsons is providing engineering, design, material management, site support and start-up services to Progress Energy in the North Carolina Clean Smokestacks Program. This includes the Phase 1 technology evaluation as well as the Phase 2 detailed engineering, design, procurement, site support and start-up implementation phase.

**Project: Chlorophenol Contamination Remediation****Customer: Confidential****Phases:** IDENTIFY > EVALUATE > DEFINE > EXECUTE > OPERATE

Canada

WorleyParsons implemented a plan to remediate chlorophenol contamination in the soil and groundwater at a former sawmill wood preserving site. The plan used an innovative combination of invasive remediation and monitored natural attenuation. The contamination was remediated for a fraction of the cost of traditional “dig and dump” methods by source removal and use of monitored natural attenuation. A Remediation Confirmation report was prepared and submitted to the provincial Ministry of Environment information. Based on this report a Certificate of Compliance was obtained for the foreshore area.





WorleyParsons

resources & energy

Strategic Relationships

WorleyParsons has established strategic relationships with complimentary service providers to deliver added value to our customers. We actively partner with world leading organisations in the areas of sustainability that are important to our customers.

We have a proven record of creating and maintaining successful alliances and longterm relationships to deliver maximum value to our customers. We have applied a similar philosophy in establishing strategic EcoNomics™ relationships. Our relationships are chosen and structured to bring real added value to our customers through our integrated services. Like all good alliances this means the benefits customers receive from our strategic relationships are greater than either partner could provide individually.

Some of our strategic relationships and longstanding collaborations include:

- Carbon capture and sequestration - Schlumberger
- Carbon trading, current and emerging climate change policies, legislation and regulations – Baker & McKenzie
- Sustainability management – Synergy
- Climate change risk assessment – Acclimatise
- Climate change research – Imperial College, London

The challenges before us are unlike anything we have previously experienced. A new approach is required, and this is exactly what WorleyParsons' strategic relationships deliver.

10+

strategic relationships

Providing

complimentary services



Schlumberger

Schlumberger provides comprehensive geological storage solutions for carbon dioxide consistent with care for health, safety, and the environment. This service leverages over 80 years of proven subsurface evaluation experience in the oil gas industry. The global relationship combines the geological storage expertise and technologies of Schlumberger with WorleyParsons' capability in above ground gas treatment and removal, compression, piping and injection technology to provide a complete service in Carbon Capture and Sequestration (CCS).



Baker & McKenzie

Baker & McKenzie has the world's largest and most geographically extensive carbon legal practice. They have over 10 years experience in carbon markets with advisors to all sectors in the carbon field including multilaterals, sovereign states, banks, regulators, and carbon funds. Our longstanding collaboration with Baker & McKenzie allows us to offer customers access to a full range of services in global carbon markets and ensures customers are able to extract maximum value from sustainability initiatives and projects.



Synergy

Synergy works with companies, governments and non government organisations to improve performance and create positive social change by focussing on the social issues surrounding projects in emerging markets. Synergy's capabilities include social assessment, organisation development, stakeholder engagement, review and audit. These capabilities complement WorleyParsons project delivery capabilities to provide customers with completely sustainable projects.



Acclimatise

Acclimatise is the market leader in guiding businesses on the impacts of inevitable climate change. They provide cutting-edge climate change risk assessment and risk management services informed by the latest climate change science. This data assists customers manage the risks and realise the business opportunities from a changing climate and increasing climatic variability. This strategic relationship enables WorleyParsons to offer customers access to a unique, integrated portfolio of services on profitable sustainability and climate change so that they 'future-proof' their projects against the effects of climate change.





EcoNomics™ Initiatives

Engineers have long responded to governments and industry trends and regulations. Now we are helping to lead the way in shaping a more sustainable future.

Through EcoNomics™ the WorleyParsons business is actively identifying and commercialising opportunities for improvement in design, technologies, projects and markets related to sustainability. Our role is to conceptualize the solution and research the scope. We then work with our customers and partners to realize the commercial outcome.

Our customers benefit by having access to new technologies and solutions, improving the sustainability of their operations. WorleyParsons network of over 118 offices worldwide also allows us to engage a wider range of stakeholders around the world giving the technology critical mass and reducing the associated costs for everyone.

5

offerings for sustainable business solutions

Initiative: Advanced Solar Thermal (AST) Power Stations

Purpose: Utility-scale renewable power for Australia

Australia

Our vision is to deliver 40% of Australia's renewable energy needs by 2020.

Our vision is based on the urgent need to reduce carbon emissions and the role that renewable power generation can play in a world of rising energy prices and fossil-fuel restrictions. Australia is facing the challenges of reducing their reliance on fossil fuels while trying to provide 20% of its power from renewable energy sources by 2020 and reduce CO2 emissions by 60% by 2050. Australia has some of the highest intensity solar resources in the world and large areas of land that are unused due to their arid nature or high salinity.

Based on our extensive solar-thermal experience in California, we identified that AST could take advantage of these Australian characteristics resulting in high quality power generation with low environmental and social impact compared to other renewable energy sources. By working with industry partners and the government we are working towards commercialising the AST technology.

AST power stations use trough shaped parabolic mirrors to concentrate sunlight onto collector tubes along the mirrors' focal point. Heated oil from the collector tubes heats water in a boiler to produce steam. The steam drives a steam turbine to generate power. AST is a proven technology that has been continually improved for over 20 years in the deserts of California.

AST represents a step change in thinking for WorleyParsons by providing a solution to industry rather than responding to our customers' problems. It involved us identifying the challenge, assessing the unique/valuable attributes of the location, reviewing our global capabilities and adapting them to meet the requirements of the local scenario and creating a clear vision to meet the challenges. Through AST we have proven that we can act as a catalyst for an essential change that needs to take place in our society. Our goal is to play a leading role in helping companies and nations achieve the right outcomes for future generations.



Industry EcoNomics™

Industry offers many of the best opportunities to profitably enhance global sustainability. Opportunities exist to reduce energy demand, improve process efficiency, recover waste heat, use alternate fuels, and to turn waste streams into sellable by-products. We are currently working with a major steel mill operator in the USA to identify the types of technologies that could be used to recover the massive amounts of waste heat generated by electric arc furnaces.



Water EcoNomics™

Water, both its availability and discharge, is becoming an increasingly major issue in project developments and existing project operations. Our EcoNomics™ team is working with both government authorities and industrial companies to develop more sustainable water solutions. We have instigated a regional synergies study in a major mining area to demonstrate how a centralised approach to water management offers economic benefits to all parties in the region.



Energy EcoNomics™

Some of the greatest transformations to a more sustainable future will occur on the areas of energy production and power generation. We are helping power generators understand how to apply carbon capture to their existing power plants, while at the same time demonstrating the opportunities that exist in renewables such as solar, wind, and biomass. We are also at the forefront of gasification technologies that could provide the next generation of clean fossil fuel based power.



Transport EcoNomics™

The transport sector is probably the most affected by the dual challenges of escalating energy prices and increased emissions restrictions. Opportunities exist to introduce new and cleaner modes of transport while at the same time reducing dependence on oil. Using our experience in train operation, power generation and storage techniques we are helping to develop unique solutions for heavy haulage operations in the mining sector.



Community EcoNomics™

Communities are demanding, and increasingly placing value on, more sustainable developments. Industry is also increasingly recognising the importance of engaging the community in its development plans. WorleyParsons is investigating ways to apply our capabilities in life cycle assessment, energy efficiency, water and waste management, transport systems, and environmental management to create opportunities for improved urban designs





Setting a new standard

Our vision is that EcoNomics™ will be a key differentiator for WorleyParsons in delivering sustainable long term business outcomes for our customers.

To achieve this we have embedded EcoNomics™ into our project management process and quality systems which underpin all of the project phases and have been developed to ensure quality, efficiency and consistency in our approach to project delivery. They provide a common framework for project execution and apply to all project activities throughout the WorleyParsons Group. EcoNomics™ prompts are included in our quality documents providing a seamless extension to the project delivery process which is applied to all projects.

In addition to embedding these services in our project management process and quality systems, EcoNomics™ principles are applied across all our services.

Select brings real world experience into the front-end value adding phases to maximise investment return and underlying confidence. EcoNomics™ provides concepts designed for sustainability over the lifecycle of the project rather than just considering the upfront costs.

Deliver converts the highest potential value options identified by the Select group, into fully defined and successfully executed projects. Embedding EcoNomics™ specialists in the project team during these phases ensures sustainability issues and opportunities are identified and acted upon early in the project.

Improve supports and enhances customers' assets throughout the operating lifecycle. For these types of contracts, EcoNomics™ specialists identify areas in existing operations to improve efficiency, reuse potential energy and minimise waste, reducing the customers operating expenses and dependency on resources.

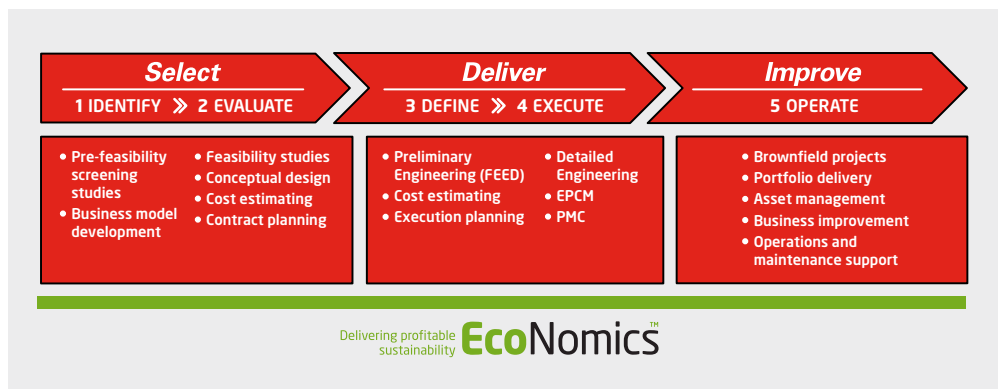
We deliver EcoNomics™ services for those customers interested in creating a more financially, socially and environmentally robust project. More of our customers are choosing to take up this service delivery option to minimise risk and maximise sustainable benefits for their projects. In the future, we believe that all of our customer's will see the benefits of delivering projects using EcoNomics™ thinking and processes.

Visionary

solutions delivering sustainability

Creating

better long term business outcomes





WorleyParsons

resources & energy

Our Vision

WorleyParsons will be the preferred global provider of technical, project and operational support services to our customers, using the distinctive WorleyParsons culture to create value for them and prosperity for our people.

Leadership

- Committed, empowered and rewarded people
- EcoNomics™ - Delivering profitable sustainability
- Integrity in all aspects of business
- Energy and excitement
- Minimum bureaucracy

Agility

- Smallest assignment to world scale developments
- Local capability with global leverage
- Responsive to customer preferences
- Optimum solutions customized to needs

Relationships

- Rapport with all stakeholders
- Open and respectful
- Collaborative approach to business

Performance

- Zero harm
- Results for our customers and other stakeholders
- World-class resources, capability and experience



WorleyParsons

resources & energy

For further information about
our global capability email:
economics@worleyparsons.com

www.worleyparsons.com

