



The power to create renewable carbon-neutral ethanol

Eco Global Fuels (EGF) provides solutions to two key energy problems:

- waste CO₂ greenhouse gas emissions
- the need for renewable carbon-neutral transport fuels.

About Eco Global Fuels

A pioneer in clean renewable energy

Eco Global Fuels (EGF) is an innovative company at the leading edge in making and producing renewable carbon-neutral fuels.

With decades of research behind us, Eco Global Fuels has harnessed cheap hydrogen and waste carbon dioxide (CO₂) to create renewable ethanol and other transport energy fuels.

How do we do it? The hydrogen is manufactured using our unique intellectual property technology, making it the cheapest available hydrogen in the world according to an independently validated report. The CO₂ comes from waste emissions from gas and coal industries. We combine these gases using our unique catalysts and energy looped system, and deliver to the market place using existing infrastructure.

Our unique method reduces both CO₂ emissions and dependence on oil imports, and can reduce the use of fossil fuels. We do not use food in the production of our renewable fuels.

We also have iron oxide as a by-product of our hydroxy generators, which is the necessary ingredient in the most efficient, proven and cost effective method of CO₂ sequestering, known as OCEAN FERTILIZATION

EGF's mission is to supplement the transport fuel market with our carbon-neutral renewable fuels, including ethanol. This helps with increasing shortages and rising prices in the fossil fuel market, at the same time as reducing CO₂ emissions. The new EGF technology has the potential to enable all governments to meet their renewable energy quotas and agreements in place for Kyoto CO₂ reductions.

To accomplish these goals, Eco Global Fuels will produce ethanol and other fuels, with the brand name **SOLANOL fuels**. We are committed to educating the world on the environmental and economic advantages of our unique, renewable and carbon-neutral energy fuel.

Business problem and opportunity

Unlike other carbon-neutral initiatives, Eco Global Fuels is set up to work in partnership with oil, gas and coal electric power industries. We convert their emissions into a renewable source of energy. In addition to helping reduce greenhouse gases, EGF has the capability to save these industries billions of dollars in regulatory fines by reducing their carbon footprint.

A win-win for all.

EGF is in the business of renewable energy

Our renewable energy technology absorbs available vented CO₂ from many industries, including gas fields, and delivers competitive carbon-neutral fuels, without using biomass (plants or food). In the process, we save industries from generating emissions and the associated carbon taxes.

Our bottom line is we produce **SOLANOL** fuels and we are completely sustainable. We supply renewable transport fuels at competitive prices when compared to the rising costs and limitations of oil, and our fuels are easily integrated into existing infrastructure.

We reduce dependence on imported oil; we also reduce greenhouse gas emissions. Ours is the only process that can economically and cost-efficiently convert the sun's energy (or other renewable energy DC inputs) into liquid transport fuels.

In the manufacturing process, for every 1kg Enviro-Hydrogen we make, we also produce 8kg Enviro-Oxygen. This is to be used as a 'pure Enviro-Oxygen input' into 'oxygen coal fired' power stations (including natural gas oxy fired gas turbines), creating a pure concentrated CO₂ flue output gas stream. This makes sequestration efficient and economic.

The worlds number one sequestering method

A by-product of our system is iron oxide, which is used in CO₂ sequestering referred to as OCEAN FERTILIZATION, where algae is grown in the ocean, absorbing CO₂ and releasing O₂. Algae is 80% of the food chain, improves fish stocks and marine life. We have an excess of iron oxide which is utilized in this process. Ocean Fertilization is the most cost effective method of CO₂ sequestering

We also have the possibility of converting our CO₂ stream into pure carbon black. This form of carbon is used for manufacturing various products and keeps the CO₂ on the ground, rather than in the air. These features combine into seriously helping to 'clean up' industries and are good for the environment. A win-win for all industries.

EGF can also deliver Enviro-Hydrogen to the mining industry for ore separations in place of using acid leaching.

Comparisons

Current method of producing hydrogen

The current process is referred to as 'steam reforming' or 'steam methane reforming'. Natural gas (CH₄) is passed through a catalyst reaction with an external heat source. This converts steam and lighter hydrocarbons, such as methane, into hydrogen and carbon monoxide (CO), referred to as 'syngas'. This process also produces CO₂. More separation is required to obtain pure hydrogen (H₂).

Steam reforming wholesale: using US\$4.50 per GJ is US\$6 per kg H₂ and producing emissions of 56kg CO₂

Conventional electrolysis

Conventional diaphragm electrolysis technology is expensive to scale up, is unreliable, often 'clogs up', does not last long and has high maintenance levels.

Conventional electrolysis wholesale: due to increased maintenance costs, and manufacture costs of up to \$100 per kg, making H₂ by this method is uneconomical.

Conventional hydrogen production

- Costs are continually rising.
- Causes major CO₂ emissions.
- Many countries have a new carbon tax, set at approximately US\$23 per tonne.
- Carbon tax will be increasing in years to come.
- Production depends on fossil fuels.
- Fossil fuel costs are increasing and all are non-renewable.

Eco Global Fuels makes hydrogen more cheaply than either conventional electrolysis and steam reforming, and ...

- Produces no CO₂.
- Gains carbon credits.
- Produces O₂ as by-product that can be used for oxy-firing of coal powered stations and sold to industry.
- Uses CO₂ in ethanol production.
- Basic costs are stable: water and steel.
- Currently ethanol wholesales at US\$0.90 per litre ... and EGF can produce it at US\$0.40 cents litre.

EGF's technology does not compete directly with Biofuels, as the market is under-supplied and governments cannot obtain sufficient renewable fuels; however we are 70% more cost effective, without subsidies.

Technical overview

- EGF's Intellectual property (IP) hydroxy generators: Proof of concept from Macquarie University, independent validation of unique IP, ultra reliable, built from low-cost materials using no expensive noble metals (as used in competition), cost-efficient making it economically achievable to scale up to refinery, proven to be durable and safe, very low maintenance, validated flow rate 162 litres kWh H₂ with 81 litres O₂ (can be easily increased).
- DC input comes from waste electricity, gas turbines, unique CO₂ looped pure oxy-fired coal (non-polluting), solar panels; geothermal, wind and tidal energy.
- Known industrial process of cryogenics external density separation, (separating H₂ from O₂), makes the process cost effective and achievable. The environmental cost-effective economics of the technology makes many industrial processes viable..
- IP unique catalyst energy efficient looped system.

The features above determine the successful future of Eco Global Fuels and renewable fuels for the planet.



EGF and off-peak waste electricity

Our current electricity system is based primarily on coal-fired and natural gas-fired power stations which cannot be turned on and off at short notice.

Using off-peak electricity

Generating power during times of peak demand (day-time) entails also generating power during off-peak times (night-time), even if there is no demand for that power at a price that covers average costs. Here we have a base load supply, which easily exceeds the demand for off-peak power at average cost, and sometimes even at fossil fuel cost. The result is that off-peak power must be heavily discounted, and even so, demand is barely enough to keep the turbines turning.

Major consideration must be given to utilising the off-peak power period for the production of **SOLANOL**.

Using waste electricity

All waste electricity in industry can now be converted at any time of the day or night for the production of carbon-neutral **SOLANOL**. This process utilises electrical power generated and normally lost via the burning of coal or natural gas, particularly where these power stations cannot easily be varied in electricity power output for the necessary base load power at different times of the day.

Energy from coal

Coal is primarily used as a solid fuel to produce electricity and heat through combustion. The energy density of coal can be expressed in kilowatt-hours, the units that electricity is most commonly sold in, per units of mass to estimate how much coal is required to power electrical appliances. One kilowatt-hour is 3.6MJ, and the energy density of coal is 6.67 kWh/kg. The typical thermodynamic efficiency of coal power plants is about 30%, so of the 6.67 kWh of energy per kilogram of coal, 30% of that – 2.0 kWh/kg – can successfully be turned into electricity; the rest is waste heat. *So coal power plants obtain approximately 2.0kWh per kilogram of burned coal.*

Improving efficiency

Over and above the off-peak generating losses in coal-fired power stations operating at 30% and natural gas fired power stations of 20% efficiency. This efficiency can be improved dramatically by utilising the by-product of the hydroxy electrolysis process, Enviro-Oxygen.

It is estimated that the thermal efficiency of oxygen-enriched coal-fired power stations and natural gas power stations can be improved up to 60%, with only 40% losses. This increase in thermal efficiency can be utilised for the production of additional **SOLANOL** increasing the return on investment.

EGF uses a unique closed looped system for natural gas turbines

Turbine input efficiency enhancer

The combustion of natural gas produces 50% less CO₂ emissions when these are utilised in the generation of electrical power.

The utilization of natural gas as an electrical power source for the production of **SOLANOL** is completely practical due to the necessity of cheap electricity and access to the exhausted flue gases from the natural gas turbine generators.

The introduction of the Enviro-Oxygen (O₂) as a by-product of Eco Global Fuel's hydroxy electrolysis process, in closed loop combustion of natural gas, produces all the necessary CO₂ output from the natural gas combustion turbine generating system. In other words, we have *developed an energy loop system – it feeds back energy into our system making it more efficient*. This facilitates the necessary CO₂ to be catalytically converted into carbon monoxide (CO) for the total input requirements of the ethanol catalyst for the production of Solanol.

Therefore, the CO₂ flue gas emissions are totally converted by the catalyst to produce SOLANOL.

A **SOLANOL** carbon-neutral refinery has a benign non-polluting nature that will initially use normally vented CO₂, as the feedstock to create a carbon-neutral fuel matrix. The normally vented CO₂ from the Natural Gas turbine generating system is utilised to produce **SOLANOL** fuel in a closed looped system. When combusted via the emissions, the same absorbed CO₂ is released into the atmosphere and does not increase the CO₂ levels, and hence does not attract any 'carbon tax'.

This will greatly increase the energy produced in the form of electricity from a gas turbine generating system. It works at high efficiency due to the **higher temperatures** with minimal changes to the turbine configuration when burning **with O₂ input only**, for the total combustion of natural gas, which should increase the overall efficiency from 20% to 60%.

Additionally, natural gas cost per GJ has only doubled in the last 10 years which is marginal when compared to petroleum products. Cost of Natural Gas increases by approx US\$0.2 per annum = US\$2 in 10 years to US\$4.50 per GJ currently.

Calculations using this system have produced our highest return on investment (ROI):

50 MW within 5 years – ROI 30–50%

EGF's unique solution to the pollution

We use pure oxy-fired coal/NG power producing transport fuels at the same time as also producing massive sequestering (via by-product pure oxygen and iron oxide)

Currently, national (international) coal and gas-fired power stations have an inherent environmental impediment – that 300 million tonnes of CO₂ is emitted into the atmosphere annually. The cost of removing this CO₂ component vented from the flue gases is a major technical-cost-deficit problem.

This will be overcome by introducing Eco Global Fuel's **Enviro-Oxygen (O₂)**, which is a surplus by-product of the **SOLANOL** fuel process, to combust with coal or gas fired power stations instead of with air.

EGF produces pure O₂ as a by-product of our hydrogen production. We inject pure O₂ into the coal turbines in contrast to the current process of using air, which contains impurities and high amounts of nitrogen. This produces polluting emissions and prevents them from sequestering.

We retro fit coal combustion for pure oxy-fired burn, which then makes a pure carbon black product which converts into stable carbon products:

- olefins – plastics
- formaldehyde, paints etc.
- carbon black – e.g. car and truck tyres
- carbon fertilizers
- carbon graphite.

This keeps the carbon or CO₂ on the ground and not in the atmosphere. And it means *massive sequestering* for the fossil fuel industries. Initial calculations and a study on utilizing coal off peak electrical power have concluded a healthy return on investment for this process. At the same time, the process cleans up the coal power industry and produces a renewable transport fuel: **SOLANOL**.

What is ocean fertilization?

This is the process of distributing iron oxide into the ocean, which encourages the growth of algae, which sequesters CO₂ from the atmosphere. The good news is we have free iron oxide from our hydroxyl electrolysis process, for example: equivalent to the level necessary to sequester all the CO₂ produced by a 60 MW turbine. We produce the necessary iron oxide as a by-product of the hydroxy electrolysis process, required for iron fertilization of the ocean, to sequester all carbon dioxide emissions.

Photovoltaic renewable DC energy input

- Excellent government subsidies
- Return on investment from 13–17% as risk management
- Use of cheap arid land anywhere in the world
- Dramatically improved performance and efficiency
- Long lasting (25+ years)
- Hugely reduced cost of manufacture

It is NOW feasible to convert the SUN's energy into a liquid matrix transportation fuel – **SOLANOL**.

Solar power is experiencing a global explosion in use. Concerns over climate change and rising energy prices have driven billions of dollars into developing the efficiency and variety of technologies that capture energy from the sun. From new developments in photovoltaic panels to advances in materials, manufacturing processes and solar tracking, the entire production chain is being reconfigured.

Eco Global Fuels has access to the most inexpensive silicone-based solar panels on the market. Global photovoltaic manufacturing principals guarantee an operational life span of 25 years. Although photovoltaic-generated electricity is only available for approximately 11 hours per day, Eco Global Fuel overcomes this time constraint by storing the sun's energy in a carbon-neutral alcohol fuel matrix to be used as fuel at night and or any other time.

The current cost of buying photovoltaic cells is US\$4 per Watt, but according to our projections these costs will be reduced to US\$1 per Watt by 2015. Although the construction costs for a photovoltaic farm and a coal-based power station are not identical, the running costs of the former come out to be much less: \$0.006 per kWh compared to US\$0.03 per kWh. Why? Because the coal-based power station requires continual coal as fuel to run, when compared with photovoltaic farms which run on sunlight – a free and renewable fuel source.



EGF mining and mineral ore separation

EGF offers a novel way to extract nickel, copper and chromium from refractory ore which is currently not amenable to acid leaching processes.

EGF proposes a safe, environmentally sound, economical process for extracting the following metal ores (based on 2011 commodity prices):

- Copper (Cu₂O) – refractory copper ore US\$9000 per tonne
- Nickel (NiO) – refractory nickel ore US\$4000 per tonne
- Chromium (CrO) – refractory chromium ore US\$6400 per tonne.

Different grades of mineral ores will consume between one to 10 tonnes of hydrogen per tonne of mineral ores. . It is estimated to produce a return on investment depending on ore type and energy input for the extraction of mineral ores by the use of EGF Hydrogen.

EGF ammonia production

Ammonia is normally produced by the catalytic reaction of nitrogen, and the cracking efficiency is about 75% with a profit of US\$0.20 per kg.

N₂ + H₂ ammonia catalyst reaction plus Enviro-Oxygen

Efficiency @ 75% of 823g N₂ + 177g H₂ ammonia catalytic reactions:

Elements	% _{th}	MJ	kWh	H ₂ gr
Hydrogen	13	33.75	9.375	177
Nitrogen	62			823
Heat losses	25	11.25	3.125	
Total	100	45	12.5	1000

In the catalytic reaction, the 823 grams of nitrogen plus 177 grams of hydrogen will produce 750 grams of ammonia per hour. Additionally, the hydroxy electrolysis system after membrane separation will produce 1416 grams of Enviro-Oxygen as a by-product. This by-product can easily be utilised, looped and combusted with the methane powered turbine to produce the necessary electrical power for the production of hydroxy gas. This will greatly improve the energy produced in the form of electricity from a gas turbine generating system at high efficiency due to the **higher temperatures** obtained when burning with O₂ input only for the total combustion of natural gas, which should increase the overall efficiency from 20% to 70%.

Market place applications

SOLANOL REFINERIES

10MW applications

50MW applications

100MW applications

5000MW applications

Bigger and better return on investment

DC INPUTS

Off-peak electricity

Renewable photoV (solar / wind / geothermal / tidal)

Natural gas turbines

Unique oxy-fired CO₂ looped coal power (non emissions)

PRODUCING

SOLANOL – ethanol and other fuel components

H₂, O₂

Cheap hydrogen forming the basis of manufacturing fertilizers / ammonia

Mining application for ore separations: non-polluting production of nickel, copper, chromium

Pure carbon black products

Market place value

Current 2011

- **SOLANOL** wholesale US\$0.85 litre
- Production cost US\$0.40 litre
- Margin US\$0.45 litre
- Plus 2kg O₂ per litre **SOLANOL** @ US\$0.30 per kg

Total wholesale

- **SOLANOL** + O₂ = 0.85 + 0.60 = US\$1.45 turnover
- Minus production cost US\$0.40 = US\$1.05 profit per litre of **SOLANOL** ethanol components and O₂ (without government subsidies)

Hydrogen + Oxygen production H₂ + O₂ per kg of hydrogen

- H₂ = 1kg
- O₂ = 8kg
- We require 9kg water (H₂O)
- We need 70kWh to produce 1kg of pure hydrogen
- We also produce 8kg of pure O₂
- Enviro-Hydrogen value is US\$6 per kg
- Enviro-Oxygen value is US\$0.30 per kg

Revenue summary:

- Sale of renewable carbon-neutral **SOLANOL** / ethanol
- Sale of environmental O₂ and H₂
- Production of electricity
- Joint ventures with coal/gas industries retro fitting to pure oxy burn, and eliminating CO₂ emissions
- Licensing fees
- Carbon black products
- Massive carbon footprint credits
- Mining and mineral ore separations
- Turning the sun's energy into base load and transport fuels

ROI have been calculated for:

10–50MW using photoV, natural gas, off-peak waste electricity

Calculations and projections are based on 162 litres H₂ plus 81 litres O₂ flow rate per kWh (independent validation trials). In-house trials have produced 195 litres H₂ plus 97.5 litres O₂ flow rate per kWh. This means all calculations and projections can be modestly increased by $195/162 = 1.2 = 20\%$ increase on ROI.

Calculations do not include any performance increases from our IP unique **SOLANOL** catalytic reactions

Key features

Eco Global Fuels

A pioneer in clean renewable energy

- A unique independently validated technology to produce the cheapest hydrogen. It is efficient and cost effective, uses cheap readily available materials and is economically feasible to scale up to any size
 - A method of extracting CO₂ from CO₂ emitting industries, combining it with hydrogen to produce Ethanol, which at the same time reduces CO₂ emissions and increasing ROI.
 - A by-product 'O₂', can be looped directly back into a coal burning power station. Rather than using AIR, which contains NITROGEN (N₂), we feed the flue system with 100% PURE O₂ to produce CLEAN CO₂ emissions that can be directly converted to carbon black products, (without toxic residuals), such as tires and other products.
 - A method of utilizing our by product iron oxide into the most efficient sequestering method known referred to as 'ocean fertilization'
 - A method of producing a variety of energy efficient fuels such as ethanol, butanol and aviation fuels.
 - **SOLANOL** fuels provides identical mileage to gasoline and aviation fuel and has a higher octane level than many other biofuels such as methanol
 - Eco Global Fuel plants can be located near existing coal or oil powered plants stations, and/or on very cheap land
 - Produces fuel at market-competitive prices with excellent ROI
 - Reduces dependency on oil and coal
 - We are a 24 hour base load industry
 - **SOLANOL** is distributed using existing delivery Infrastructure
 - All financial returns are above average ROI
 - Unique IP
 - Ultra reliable
 - Low cost to manufacture
 - Cheapest hydrogen in the world
 - Durable, robust, safe
 - 25 year life span!
 - External separation (competition has unreliable internal separation)
 - No exotic expensive materials (as with competition)
 - Low maintenance – no obstruction (as with competition)
 - Scalable, economically achievable (unlike competition)
 - FLOW RATE PROVEN and independently tested
 - 162 litres/kW hour H₂ production
- The Eco Global Fuels model for energy fuel production is more cost-effective than our competitors, yielding a higher ROI without subsidies and without having any effect on food prices. Also for every 1kg/lb of H₂ produced, 8kg/lb of O₂ is also produced
- Anywhere, where CO₂ is emitted, we can build a facility which converts greenhouse emissions into ethanol, a win-win for all.



Eco Global Fuels

The Power to Create Renewable Carbon Neutral Carbon-neutral
Transport Fuels

***Sustainable SOLANOL
ethanol***

www.EcoGlobalFuels.com

In the future, the production of transportation fuels will be sustainable, affordable and ecologically sound. Thanks to Eco Global Fuels, the future is now.

SOLANOL is our registered Trade Name for any transport fuel produced with our unique technology

including ethanol, methanol, DME, butanol-aviation fuels

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