

# Helping growers reduce emissions and increase production



*“The economic and environmental benefits of the ECO2-Pro system are unprecedented. Now you can minimise emissions AND increase production.*

*The ECO2-Pro system fits to your Combined Heat and Power station, purifying gas emissions and enriching the atmosphere with carbon dioxide that stimulates plant growth in greenhouses.*

*Ask us how you can increase plant production by up to 40%, reduce your environmental impact, and increase utilisation levels to 95%.”*

Dean Marchiandi, Managing Director,  
Exhaust Control Industries Australia.



**The energy gained in the use of engine CHP stations in greenhouses can be used in various ways to operate farms**

## POWER

### Electrical Energy

Artificial lighting with excess electricity fed back into the power grid.

## HEAT

### Thermal Energy

Heat serves the purpose of efficiently supplying heat to the greenhouse.

## GROW

### CO<sup>2</sup> Fertilisation

CO<sup>2</sup> from the purified engine exhaust gas is used effectively to stimulate plant growth.

Economic Carbon Dioxide Production (ECO2-Pro) System has an enormously high utilisation level (95%) ensuring that growers can run operations effectively and minimise their environmental footprint.

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## Economic Carbon Dioxide Production (ECO2-Pro) Systems

ECO2-Pro Systems provide a low-cost way to increase plant production whilst regulating the environment in greenhouses.

The ECO2-Pro System fits to your Combined Heat and Power (CHP) station, purifying exhaust gases and releasing the remaining carbon dioxide into the greenhouse atmosphere.

ECO2-Pro System reduces nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO) and ethylene pollutants from engines and promotes growth in plant crops with continual carbon dioxide (CO<sub>2</sub>) production.

## Carbon Dioxide (CO<sub>2</sub>) Enrichment

The ECO2-Pro System provides carbon dioxide (CO<sub>2</sub>) enrichment in greenhouses by purifying exhaust gas from your generator and enriching the atmosphere with the CO<sub>2</sub> to a level that stimulates plant growth.

Accelerating the chemical process of photosynthesis with chlorophyll as a catalytic converter, plants turn CO<sub>2</sub> into carbon and gain part of their source of growth from this process.

Approx. 350 ppm CO<sub>2</sub> is generally contained in the natural ambient air, however plants prefer an optimum ratio of 1,000 to 1,200 ppm. By enriching the atmosphere with CO<sub>2</sub> to this level, plant growth can be increased by up to 40%.

The ECO2Pro System continually monitors the emissions of nitrogen oxide (NO), nitrogen dioxide (NO<sub>2</sub>) and CO<sub>2</sub> and ethylene from engines, it then reduces the total NO<sub>x</sub>, CO and ethylene content, cleaning the exhaust gases to a point where only CO<sub>2</sub> remains. These purified gases can then be used for supporting plant growth. This is known as **carbon dioxide (CO<sub>2</sub>) enrichment**.

## The ECO2-Pro System

Generators are installed in greenhouse systems to produce electricity and heat, and now their emissions can be used to enhance plant growth.

Greenhouse Combined Heat and Power Stations (CHP) are made up of generators running on combustible gas fuels that produce electrical and thermal energy, achieving an excellent overall effectiveness level of up to 90%.

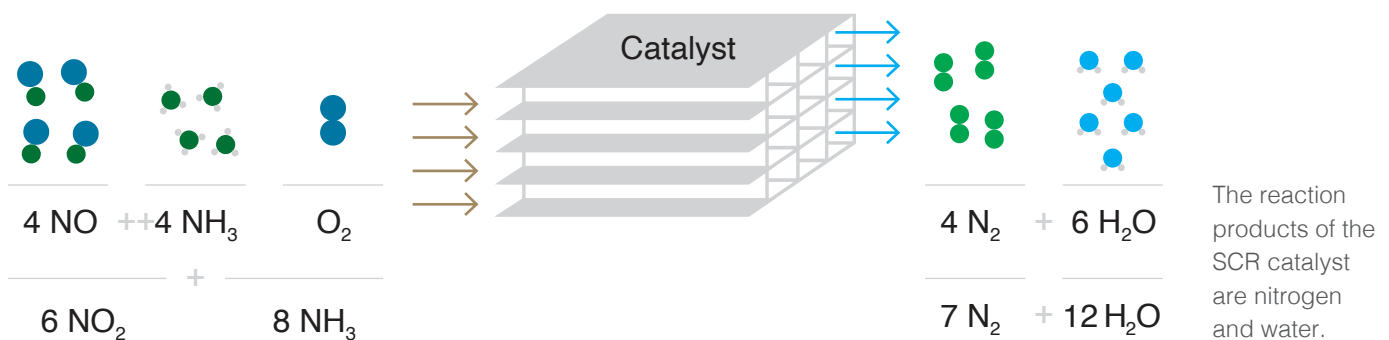
The exhaust gas from generator engines is made up of NO<sub>2</sub> and nitrogen oxide (NO), CO, non-methane hydrocarbons (NMH), CO<sub>2</sub>, oxygen (O), and water vapour (H<sub>2</sub>O); depending on the mode of operation (gas/air ratio).

This results in a CO<sub>2</sub> concentration of approximately 5-6 Vol.% in natural gas operation. This carbon dioxide can now be used for CO<sub>2</sub> fertilisation in greenhouses.

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## Reaction formula for the SCR catalytic converter



## The ECO2-Pro Process

The basis of this procedure is the selective catalytic reduction of nitrogen oxides by introducing a reductive agent into the SCR modules at temperatures of 320 to 480°C. The exhaust gases produced during the engine combustion process travel via the exhaust duct into the subsequent SCR module, where the nitrogen oxides are converted into water and nitrogen.

After passing through the catalyst, the exhaust gases released from the nitrogen oxides arrive in the subsequent units and move from there into the atmosphere via the chimney or stack.

During the first step, the nitrogen oxides contained in the exhaust air are removed from the exhaust air flow, because they are absorbed by the reducing agent. Due to the drop in concentration levels, these substances diffuse into the catalyst surface.

Due to the chemical reactions occurring inside the surface, the activation energy for the reaction of nitrogen oxides to nitrogen and water via the reducing agent is reduced so that reactions can already take place at temperatures of 320 to 480°C. After this, the reaction products, nitrogen and water are driven out of the pores and conducted out with the exhaust gases.

The rate of the reducing agent in the exhaust duct before the catalytic converter is controlled depending on the NO output concentration after the catalytic converter and depending on the engine load.

The amount of reducing agent present in the exhaust duct before the catalyst is regulated dependent on the engine load and released via a signal Engine "On"-"Off" as well as via an additional temperature control to ensure that no reducing agent is injected into the catalyst below a temperature of 320°C.



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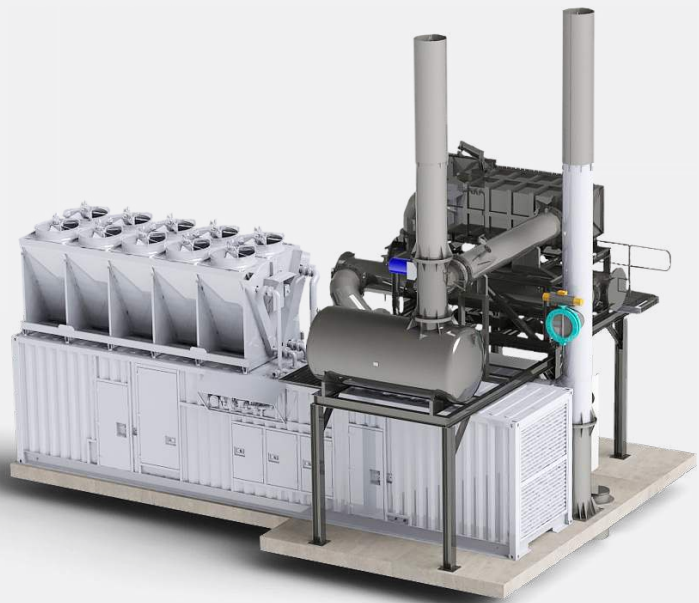
**The engine exhaust gases are purified by a catalytic converter system in two stages**

## Stage 1

Nitrogen oxides are reduced by 95% by adding a 40% urea solution to the exhaust gas flow in connection with a SCR catalytic converter.

## Stage 2

In the oxidation stage, ethene is reduced up to 99% and carbon monoxide (CO) is at the detection limit of < 1 ppm emissions.



## How the greenhouse computer monitors the CO<sup>2</sup> content in the greenhouse

### 01

If it drops too low, the computer sends a CO<sup>2</sup> request to the ECO2-Pro system. The ECO2-Pro system injects a reducing agent (UREA) before the catalytic converter and this then reduces the exhaust gas levels.

### 02

If the emissions from the ECO2-Pro System are within the required range, the control sends a release signal to the greenhouse computer. The CO<sup>2</sup> ventilation is started and the CO<sup>2</sup> valve is actuated, allowing CO<sup>2</sup> to be distributed throughout the greenhouse.

### 03

The ECO2-Pro System continually monitors the emissions of NO, CO, NO<sup>2</sup> and ethylene. The CO<sup>2</sup> release is withdrawn if a limit value is exceeded - the CO<sup>2</sup> ventilation is immediately switched off and the CO<sup>2</sup> valve is actuated to close.

### 04

The CO<sup>2</sup> valve is monitored with end position switches. In the event of any fault in the CO<sup>2</sup> valve, the engine is switched off and untreated exhaust gases are prevented from entering the greenhouse.

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## ECO2-Pro Features and Benefits

- ✓ The system can be retrofitted to an existing CHP system
- ✓ Includes special safety and monitoring that guarantees the protection of sensitive crops.
- ✓ Continually monitors emissions.
- ✓ Prevents impurified gases from entering the greenhouse.
- ✓ The new modular system allows you to easily extend your capacity, growing with your facility.
- ✓ Touch panel display provides information at a glance; measurement values, temperatures and switch phase diagrams.
- ✓ High catalytic effectiveness level at relatively low temperatures
- ✓ Large exhaust temperature range of 350-500°C
- ✓ Maximum system reliability
- ✓ Catalyst material warranties can be extended
- ✓ Small, compact, horizontal or vertical construction of the catalytic converter housing
- ✓ Modular system for the urea dosing and control and analysis station
- ✓ The catalyst material's rigid honeycomb structure produces a high resistance to vibrations, mechanical, temperature impacts, pulses and engine misfiring
- ✓ Very high sound-insulating capacity over the catalytic converter bed
- ✓ Complete catalytic material recycling after the end of the service life
- ✓ Effective safety systems to protect the ECO2-Pro System, the gas engine and greenhouse crops
- ✓ Quick adaptation of the software to any operator requests
- ✓ System check-out, commissioning and operator training (system assembly optional)
- ✓ Documentation according to the EC machinery directive 2006/42/EC
- ✓ CE declaration of conformity
- ✓ Minimum maintenance work
- ✓ Reliable service and remote system maintenance via the internet, keeping staff and travel costs low
- ✓ Retrieval of data can be scheduled for a regular day and time and historical data is accessible.
- ✓ Long-term service and maintenance contracts available



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*Your generator's utilisation level of 95% ensures your operations run more efficiently*



## **The Economic and Environmental Benefits of the ECO2-Pro.**

CHP engine systems in greenhouses produce electricity and heat, and now the ECO2-Pro can purify their gas emissions to increase crop production.

This high utilisation level of 95% ensures your operations run effectively.

The ECO2-Pro System continually monitors the emissions of NO, CO, NO<sup>2</sup> and ethylene, safeguarding your sensitive crops and minimises your environmental impact.

ECO2-Pro Systems enhance plant growth and minimise emissions, enhancing your production levels and improving your environmental footprint.



# New Technology is Leading The Way

*Meeting the high demands of nursery operators,  
ECO2Pro systems are operating around the world*



Australia  
Belgium  
Denmark  
Estonia  
France

Germany  
Greece  
Ireland  
Russia  
Spain

Ukraine  
Turkey  
United Kingdom  
The Netherlands

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