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***Presented by:***

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# **The ICOM Dynamic Dual Fuel Engine System CNG/RNG/LNG And Diesel**

**(Powered By Ecomotive)**

## **The Path Forward For Natural Gas Vehicles**

ICOM Dynamic CNG Systems with case studies

TECHNOLOGIES  
TO SUPPORT THE FUTURE





**ECOMOTIVE SOLUTIONS**  
**an Holdim Group Company**

# HOLDiM Group

Since 1991



Group Headquarter



Branch Companies



Group Headquarter - Serralunga di Crea (AL) - ITALY



## d-gid<sup>®</sup> Diesel Dual Fuel Basic Knowledge

Natural Gas



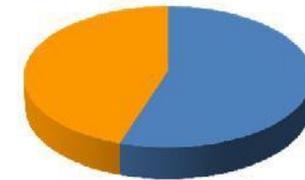
Diesel Dual Fuel (DDF)  
d-gid<sup>®</sup> ECU  
*(diesel-gas injection dynamic)*



Diesel Engine



Diesel / Natural Gas  
Average Substitution Rate



■ 50÷60% Natural Gas

■ 50÷40% Diesel

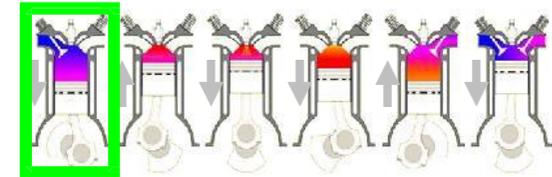


“Diesel Dual Fuel” refers to an engine working with Diesel and Natural Gas (CNG or LNG) simultaneously

d-gid system allowing to fuel diesel engines with a mixture of diesel oil and natural gas (CNG compressed natural gas, LNG liquefied natural gas, Biomethane, Syngas, etc.), d-gid Control Unit determines the amount of diesel fuel injected and air/gas mixture dosage dynamically, modifying it in real time according to the feedback provided by the engine to guarantee perfect operational conditions.

# Diesel Dual Fuel Cycle

## INTAKE

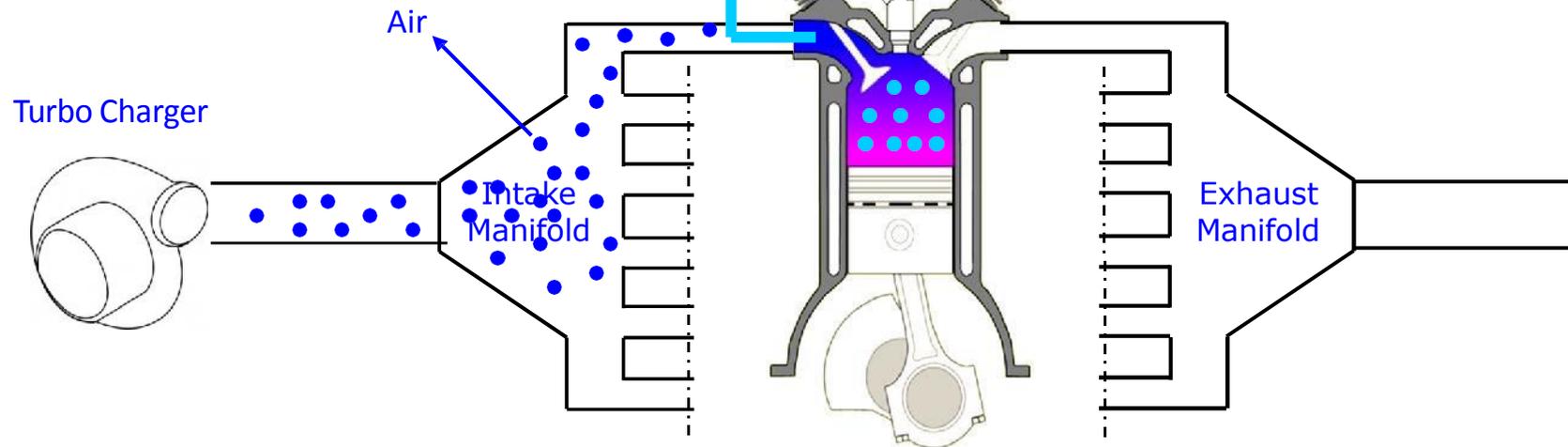


Four Stroke Diesel Cycle

Natural Gas  
low pressure feeding line

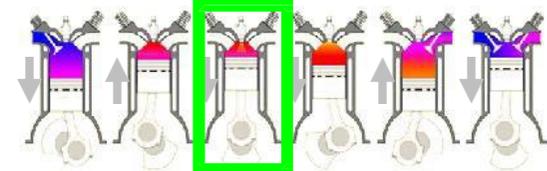
Natural Gas  
Injectors

Injected  
Natural Gas  
is controlled by  
d-gid DDF ECU



# Diesel Dual Fuel Cycle

## IGNITION

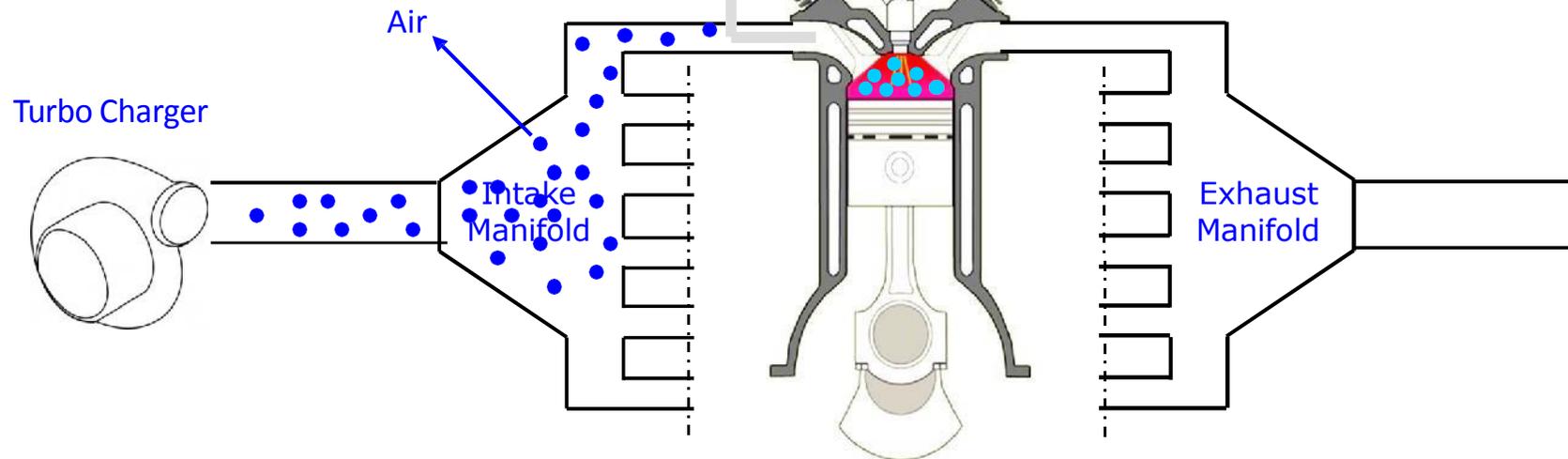


Four Stroke Diesel Cycle

Natural Gas  
low pressure feeding line

Natural Gas  
Injectors

*Injected Diesel  
is override and  
controlled by  
d-gid DDF ECU*





## Spark Ignition Otto Cycle Engines for Industrial and Genset applications



Conversion of Diesel engines to 100% Natural Gas spark ignited Otto cycle with phased ignition

Natural Gas / LPG / Syngas / Biogas

**NEW**

**Omnivorous Engine Program**



## Diesel Dual Fuel for Industrial and Genset applications

**d-gid® Genset**  
*conversion of a gensets with  
d-gid Dual Fuel technology*



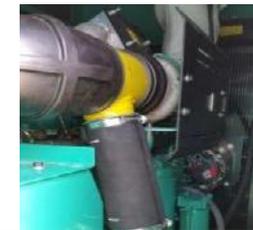
d-gid® Dual Fuel Controller  
Intallation



Cylinders Temperature  
Active Controlc



d-gid® Dual Fuel Natural  
Gas Mixer



## Diesel Dual Fuel for Industrial and Genset applications



**d-gid® Genset**  
*conversion of a gensets with  
d-gid Dual Fuel technology*

Natural Gas gastrain installation  
and complete system configuration

## Case Histories

### Our Experience Works



*Piacenza ITALY LNG station  
Dual Fuel ECOMOTIVE SOLUTIONS truck is refueling*

## Case Histories

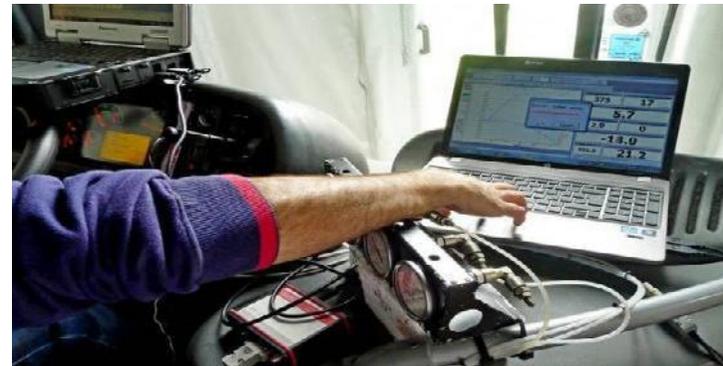
### Our Experience Works



*Santo Domingo DDF Fleet*

## Case Histories

### Our Experience Works



*Chile private and public transportation DDF*

## Case Histories

### Our Experience Works



*Brazil Su*



*Brazil DDF Long Distance Bus*

## Case Histories

### Our Experience Works



*Turkey long distance bus*



## Case Histories

### Our Experience Works



*Turkey some of our conversions*

## Case Histories

### Our Experience Works



*Turkey some of our conversions*



## Case Histories Our Experience Works

# Johannesburg Converts 30 Buses to Natural Gas

September 4, 2015 | South Africa, Johannesburg and Italy, Serralunga di Crea



Italy's Ecomotive Solutions, a Holdim Group company and engine calibration specialist, has supported the conversion of 30 buses from the Johannesburg (South Africa) Metrobus fleet into Dual Fuel CNG (compressed natural gas) through its South African partner, Vehicle Gas Solutions. The recent conversion to natural gas is a part of a "Going Green" approach aimed at promoting and incentivizing the use of methane by the urban public transport system in Johannesburg.



*Mayor Parks Tau, addressing people during the unveiling of the new Metro busses.*



*Delegates and commuters who were there to witness a new chapter in the Johannesburg Metro transport system.*



*The Mayor officially unveils the new busses.*

## Case Histories Our Experience Works

*Russia DDF on Iveco*



## Case Histories

### Our Experience Works



*Russia DDF on Uralaz*

## Case Histories Our Experience Works

### Dual Fuel LNG for Fishing Boats Project

First Italian Dual Fuel Fishing Boats Project  
2012 Porticello Palermo (Sicily) IT



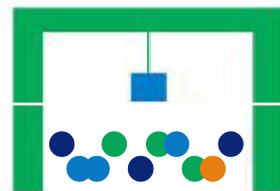
Case Histories  
Our Experience Works

# Green Cranes

GREENCRANES DEMONSTRATION DAY

Port of Livorno, January the 16th, 2014





SEAterminals



## Case Histories

### Our Experience Works



d-gid® Dual Fuel Controller  
Installation



**d-gid® Genset**  
*conversion of a gensets with  
d-gid Dual Fuel technology*



Cylinders Temperature  
Active Control



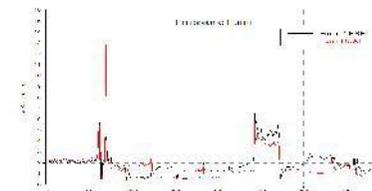
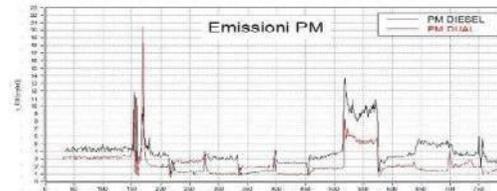
d-gid® Dual Fuel Natural  
Gas Mixer



## Emission Test in Real-World Driving with PEMS System



*Portable Emission Measurement System, lightweight laboratory which purpose is to test and assess emissions on mobile sources during on-the-road tests or in dynamometer sessions. This service can be offered also on site by our specialized technicians.*



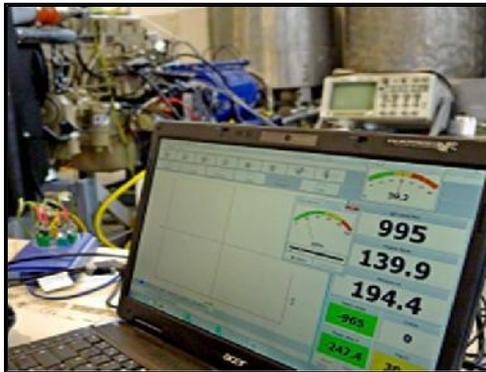
## Rolling Road Dynamometers Test and OEM Production



*Thanks to the technologies available at the Holdim group, our chassis dynamometers have been provided with a hydraulic link supporting realistic road simulations in all the engine working conditions while testing cars/light vehicles, heavy duty trucks and buses, tractors and motorbikes.*

*Not only we support tests specifically conceived for a wide range of purposes, but we also develop special tools and solutions based on our clients' needs.*

## Alternative Fuels Engine Development



*Our structure, together with a wide partners network, offers a comprehensive range of services focused on the development of the engine working with alternative fuels. Our power bench testers/chassis dynamometers and the engineering support provided by our companies assure the highest features in testing and for the development of reliable performances.*

## Special Developments & Partnership for EU Calls



*Development of special products and projects according to the EU call requirements in partnership with Universities, Public Entities and OEM or any company which needs to obtain validation and certification concerning the alternative fuels and new technologies application.*



## The Icom Dynamic **CNG/LNG/RNG** Diesel Dual Fuel System Advantages

***The Icom Dynamic Dual Fuel CNG/Diesel System has the following industry leading attributes:***

1. ICOM Electronic Control Unit (ECU) Powered by Ecomotive Solutions
2. ICOM Dynamic works direct on the OEM Can Bus Network (which is transparent)
3. ICOM Dynamic while in dual fuel mode ICOM ECU controls OEM diesel injection and our CNG injection for maximum diesel displacement and performance.



## The Icom Dynamic CNG/LNG/RNG Diesel Dual Fuel System Advantages

- **Icom Dynamic has numerous fail-safes in place to protect the engine:**
  1. **Monitors coolant temperature and if it exceeds temperature Icom System is shutoff and reverts to just diesel.**
  2. **Monitors Air Intake Temperature if normal operation is going to be exceeded Icom System is shutoff and reverts to just diesel.**
  3. **Monitors Oil Temperature and if normal temperature is going to be exceeded Icom system is shutoff reverts to just diesel.**
  4. **Monitors Exhaust Gas Temperature and if normal temperature is going to be exceeded Icom System is shutoff and reverts to just diesel.**



The Icom Dynamic **CNG/LNG/RNG** Diesel Dual Fuel System Advantages

- ➔ **Engine light safety:** If any derate engine code is on the Icom Dynamic System will shut off until the engine light is back off.
- ➔ **Leak monitor based on High pressure and low pressure sensors** and if any leak is detected on either side the Icom system will shut off until the leak is repaired.



## The Icom Dynamic **CNG/LNG/RNG** Diesel Dual Fuel System Advantages

**Icom Dynamic only injects CNG if all the above are met. If any are exceeded Icom Dynamic System will shutoff and revert to just diesel.**

Further the Icom dynamic System will not change-over to natural gas/diesel on initial start until all the above are in normal operating range.

All these fail-safes protect the engines and have contributed to global success.

***No driver input is necessary on any of the above.***



## The Icom Dynamic CNG/LNG/RNG Diesel Dual Fuel System Advantages

- If the truck is equipped with a Regen system, EGR system or such the Icom Dynamic System will turn-off on CNG while in the Regen type mode.
- Icom Dynamic ECU can see this thru the Can Bus Network. (This avoids many-many issues.)
- Icom Dynamic System is being utilized on the latest 2018 engines including Cummins, Paccar, Detroit Diesel, Mercedes and Volvo as well as engines back to the 1980's.
- Icom Dynamic system can do both automatic and manual transmissions.
- Under 100% load you will achieve the most displacement (all other CNG/Diesel Dual Fuel systems turn-off at 80% load or add a de-rate switch which relies on driver turning on and off manually).



## The Icom Dynamic CNG/LNG/RNG Diesel Dual Fuel System Advantages

### **The Icom Dynamic Systems Pneumatic Components:\**

The Icom Dynamic System utilizes cutting edge componentry from Icom and Blackstone

- The Regulator meets the latest standards and is best able to meet fuel demands.
- The Mixing Ring allows for a very precise air/fuel ratio.
- Sensors are state of the art.



## The Icom Dynamic **CNG/LNG/RNG** Diesel Dual Fuel

The Icom Dynamic System injects natural gas post turbo! allowing for a more precise timing of injection for the engine (most other systems inject pre-turbo which can-and often has-lead to them having timing issues which causes the engine to over-fuel and can lead to engine damage.

Additionally, fumigating pre turbo can cause turbo temperature to heat-up and possibly blow the intercooler and the turbo by applying too much pressure).

**The Icom Dynamic System avoids all these issues.**



## The Icom Dynamic CNG/LNG/RNG Diesel Dual Fuel

**Clearly the Icom Dynamic System allows for the:**

- Most displacement of diesel
- Best performance
- Reduced emissions

*We can successfully convert and achieve approval on most any diesel engine.*

- ***Over 5000 trucks and HD equipment -- Ports (UTR's, Cranes, Generators etc.) worldwide with zero engine issues.***

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# Thank You for your interest!

*With the proper use of alternative fuels, we can enjoy increased energy security, increased employment in an emerging sector, and decreased emissions.*



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