

# Technology Road-map to Ocean Going Vessel-IMO-tier 3 Emission Regulation Compliant Technologies

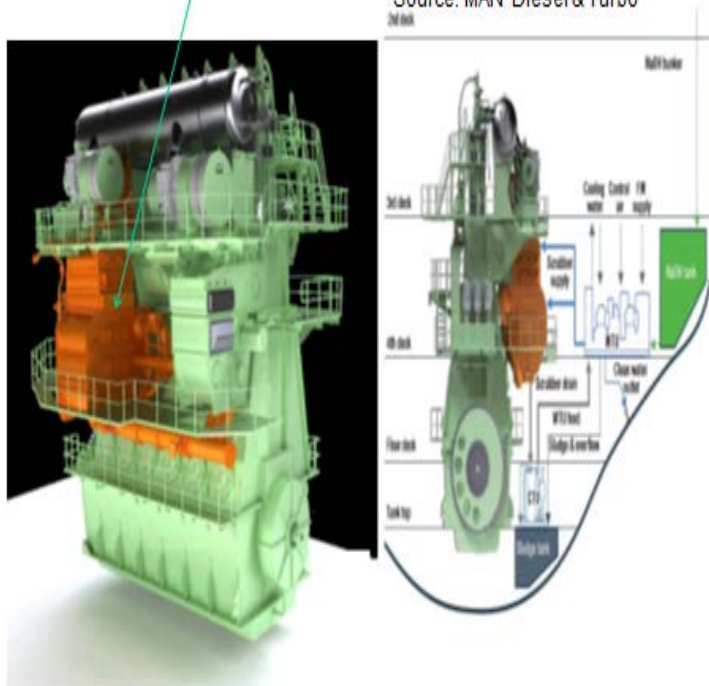
## 1) EGR (wet-scrubber)

## 2) Urea -SCR

## & 3) GreenPower DPF-HEGR

OGV: MAN's EGR Process(High-Pressure Loop, Wet-Scrubber Cleaning)

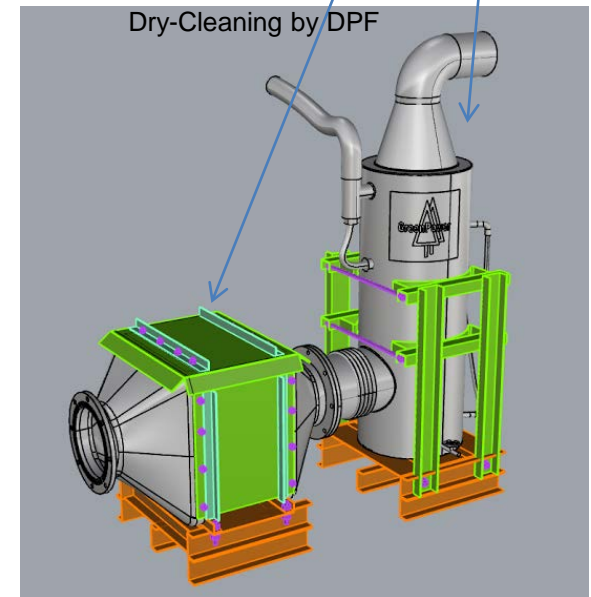
Source: MAN Diesel & Turbo



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[www.autogreenpower.com](http://www.autogreenpower.com)

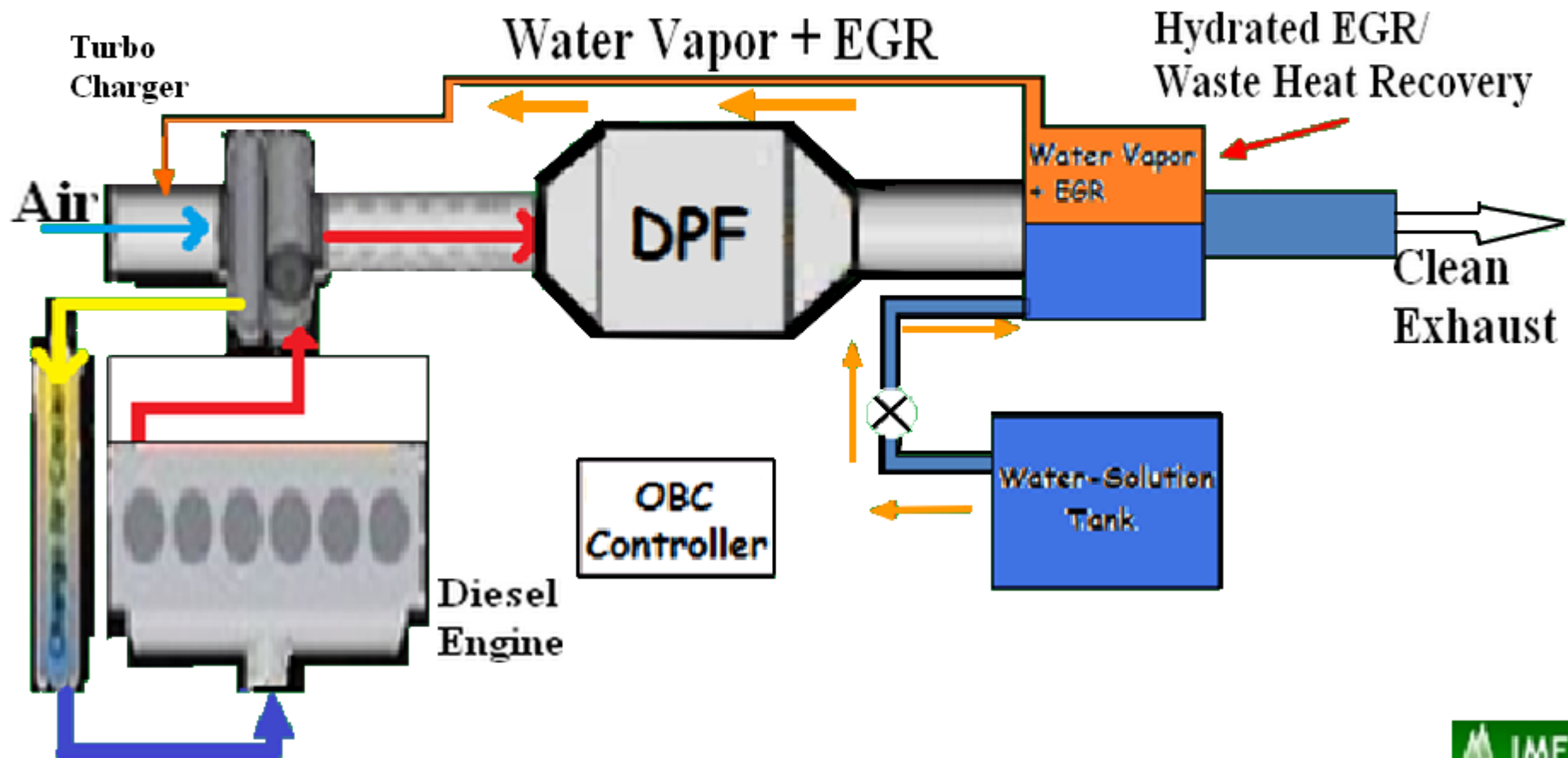
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- Dry-cleaning by DPF
- Waste Heat Recovery
- Hydrated-EGR

# GreenPower™ DPF-Hydrated EGR System

Award-Winning Technology for Marine Diesel Engine



<http://autogreenpower.com> US Patent #7530349, 6892531, Int'l Patents Pending

## IMET- POLA-HAL Award Winning OGV Demonstration Program:

The **Greenpower Fuel-Saver DPF-Hydrated EGR** uses waste heat recovered from the muffler to generate steam which is added via the air supply to the combustion process. It is an "emulsion" concept but water (i.e., steam) is added directly to the combustion chamber, not via fuel emulsion. The system also uses **FBC & OBC**.

-Statement by the Technical Community of the Ports of Los Angeles and Long Beach

# Grant Award

*By the Port of Los Angeles  
For Ocean-Going Vessel's  
Emission Control  
Technology.*



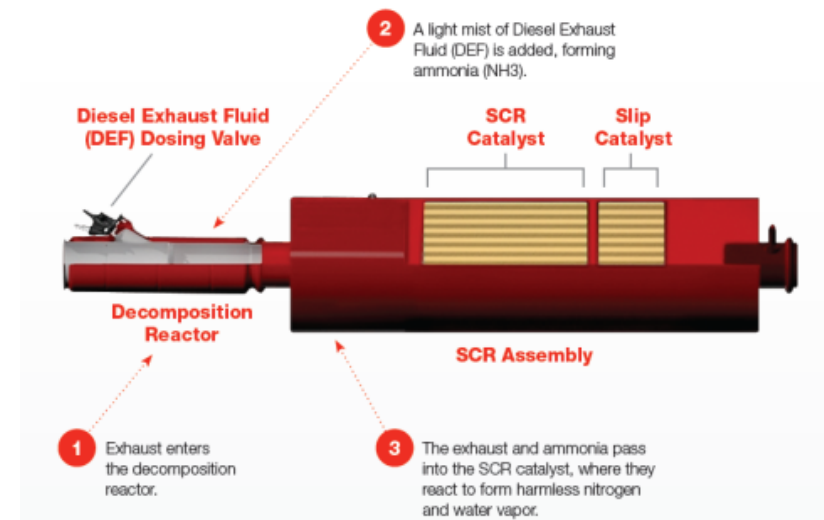
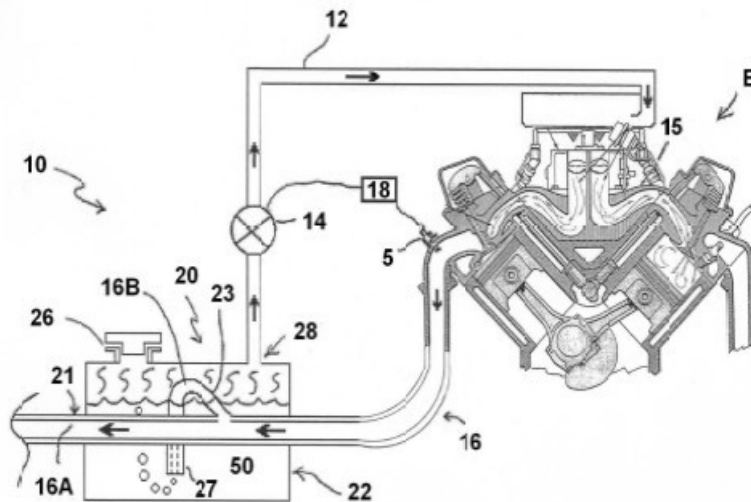
# NOx Reducing technologies

## GreenPower “H-EGR”

(Low Temp. Combustion by H-EGR)

## Conventional “Urea-SCR”

FIG-1



# DPF is regenerated by FBC in Europe, but in the USA by GreenPower-OBC. Do not use Pt/Pd-DPF & Urea-SCR.

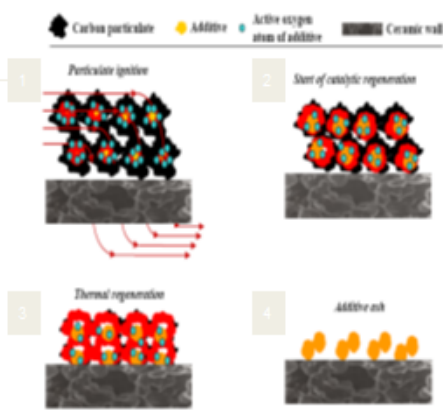


## Mechanism of FBC-DPF

FBC provides catalytic contact in 3 dimensions, while Pt/Pd-coated in 2 dimensions (Commercialized in Europe. IMET developed OBC-DPF in the USA).



Soot/PM oxidization description



- The FBC (additive) allows for easier ignition at lower temperatures
- The FBC is a metallic oxide that contains oxygen atoms help combust carbon faster
- The carbon is burned leaving CO<sub>2</sub> and H<sub>2</sub>O vapor to escape through the exhaust
- Ash remains

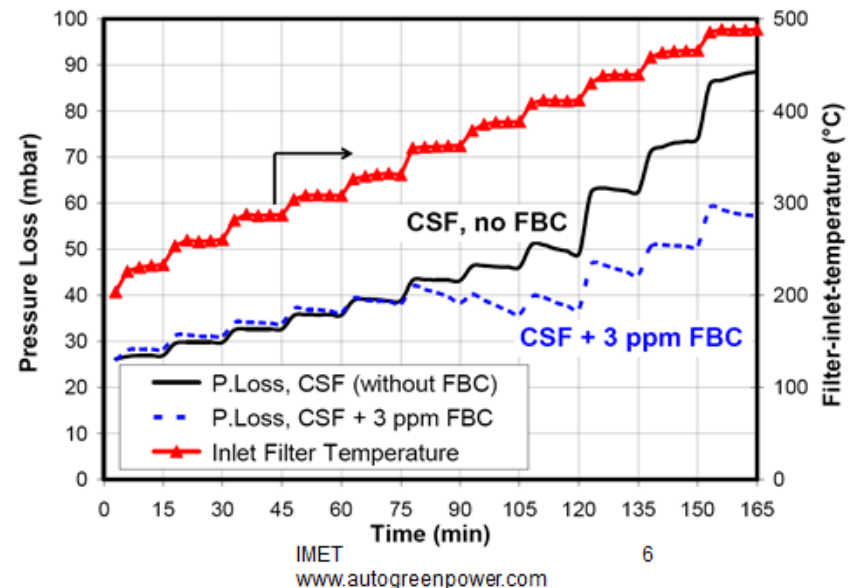
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## FBC >> Pt/Pd-coated DPF

Figure: Pressure Loss and temperature during step-test using CSF with or without Fe FBC (SAE Paper# 2011-01-0297, Published 04/12/2011)





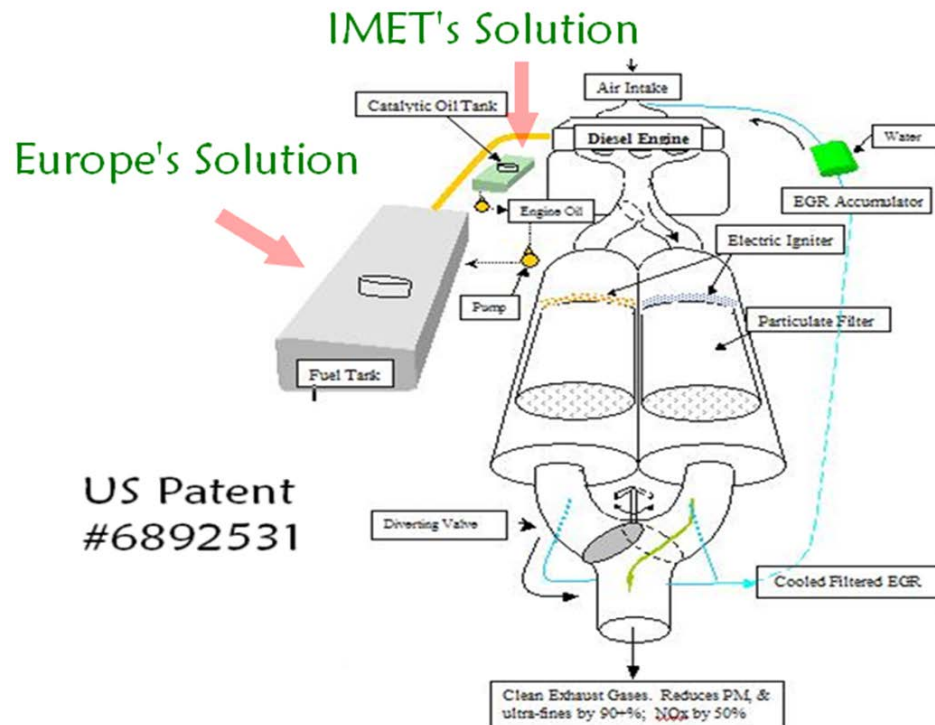
# GreenPower OBC-DPF in USA



EPA registered; CARB Approval (conditional) for OGV

## Oil Borne Catalyst(OBC)-DPF

## GreenPower OBC



# **IMET GreenPower™ Engine Retrofit System**

## **Process High-Lights:**

- **IMET-retrofit system reduces PM & NOx Cost-effectively**
- **Improves engine-performance & durability by OBC.**
- **Increases Fuel Economy**

## **IMET-Missions**

1. **Marines(OGV): Meet IMO-tier 3 NOx regulation**
2. **Trucks & Equipment: Meet the EPA -2007 PM-NOx emission regulation by retrofit.**