FIAT GROUP

INDUSTRIAL RANGE FOR CONSTRUCTION APPLICATIONS.

THE STRENGTH OF INNOVATION.

TIER 4 INTERIM/STAGE IIIB.

Clean Power for engines from 130kW (174 hp) and above.

FPT POWERTRAIN TECHNOLOGIES

POWERING THE FUTURE


FIAT
GROUP


FIAT
GROUP
FPT
POWERTRAIN TECHNOLOGIES
POWERING THE FUTURE

Clean Power.

During the combustion process inside an engine, the chemical energy is transformed into a mechanical one. Due to the impurity of fossil fuel during the combustion process, several toxic substances are produced. They are primarily NOx, CO, HC, PM.

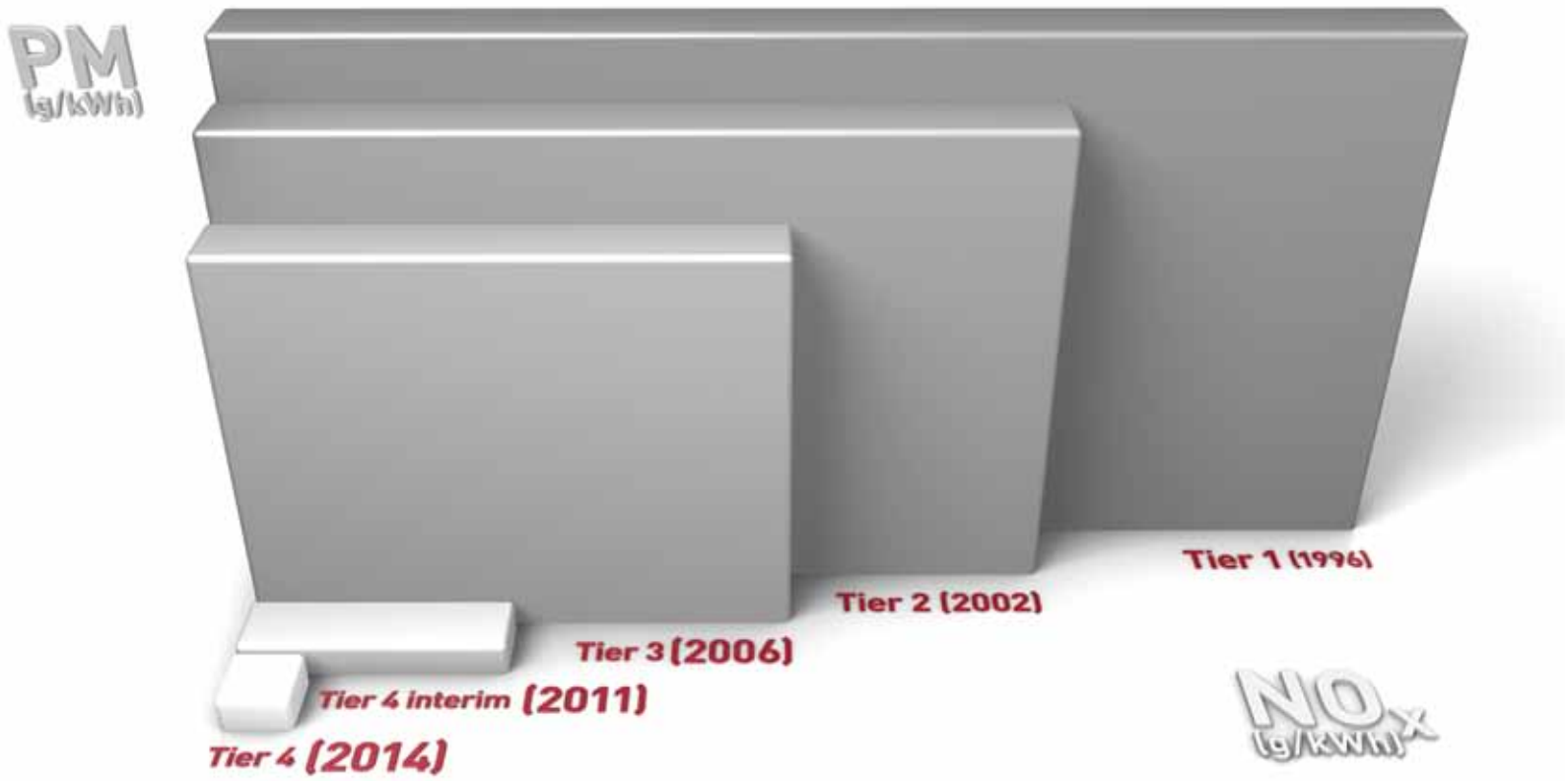
- **NOx:** Nitrogen Oxides are the main cause of acid rain and ozone layer reduction. At high combustion temperatures, usually above 1600°C, molecular nitrogen (N_2) and oxygen (O_2) disassociate into their atomic states and react producing NOx.

- **CO:** Carbon Monoxide is a poisonous gas, tasteless and odourless. It develops during combustion in presence of low oxygen concentration (rich blends) or when the oxygen is not uniformly distributed. CO emission for Diesel engines are low.

- **HC:** Hydrocarbons are composed by organic elements - contained both in the fuel and in the oil - and produced by incomplete combustion. The HC amount increases together with the fuel volume in the combustion chamber.

- **PM:** Particulate Matter is mainly composed by minute carbon particles and other toxic substances created during incomplete fuel burning process i.e. low combustion temperature. The effects of inhaling particulate matter have been widely studied in humans and animals and include asthma, lung cancer and cardiovascular issues.

Being the most critical pollutants, NOx and PM have been both reduced by approximately 60% since 1996.
In the next few years a further step of approximately 90% reduction of NOx and PM will be achieved.

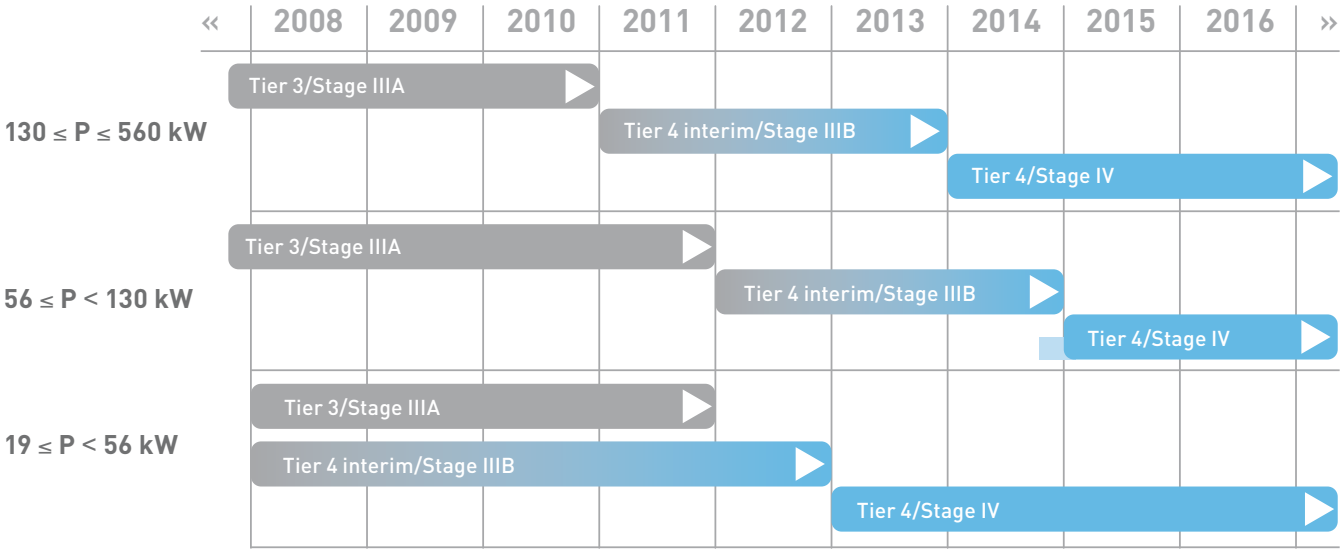


Making a cleaner environment.

Both in the US and Europe many efforts have been carried out to make Diesel engines as clean as possible.
Engines must be environmentally friendly during their entire life period and under a wide range of operating conditions.
Starting from 2011, Tier 4 interim/Stage IIIB regulations will firstly concern engines with power above 130kW to be then extended to other power ranges.
Tier 4 interim/Stage IIIB compliance implies a significant reduction of both NOx (-50%) and PM (-90%) over today's Tier 3/Stage III levels.

Emissions Standards.

Non-road engines for mobile, construction and forestry machineries (Europe and US).



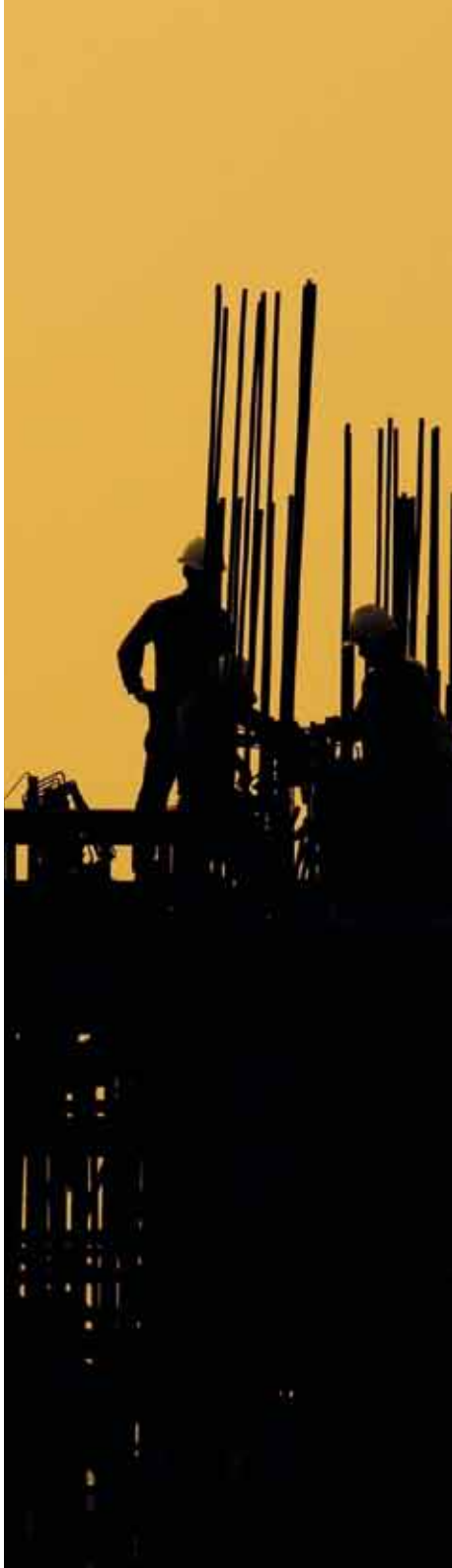
LEGEND

Stage IV introduction date is 1st September 2014, while Tier 4 is 1st January 2015.

Emission Limits	Stage IIIA/Tier 3(1)				Stage IIIB/Tier 4 interim				Stage IV/Tier 4			
(g/kWh)	NOx	HC(2)	CO	PM	NOx	HC(2)	CO	PM	NOx	HC(2)	CO	PM
130 ≤ P ≤ 560 kW	4.0		3.5	0.20	2.0	0.19	3.5	0.02(3)	0.4	0.19	3.5	0.02(3)
56 ≤ P < 130 kW	4.0		3.5	0.20	3.4(4)	0.19	5.0	0.02(3)	0.4	0.19	5.0	0.02(3)
P < 56 kW	4.7		5.0	0.40	4.7		5.0	0.30(5)	4.7		5.0	0.03(3)

LEGEND

(1) Only worst case (lower) limits reported (higher limits available for limited power bands in USA and for CO and PM in Europe)
(2) NMHC considered for US Tier Limits
(3) EU Stage IIIB and Stage IV PM limit is 0.025
(4) EU Stage IIIB NOx limit is 3.3
(5) EU Stage IIIB PM limit is 0.40



The environment request: simultaneous reduction of NOx and PM.

Due to the opposite reaction to combustion temperature, the reduction of either of the combustion products (NOx or PM) necessarily implies the increase of the other one.

In order to simultaneously reduce either NOx and PM, as required by Tier 4 interim/Stage IIIB, it is necessary to work on different combustion management and exhaust gas treatment systems.

SCR (Selective Catalyst Reduction) technology is an after-treatment system that transforms the NOx produced during the higher temperature combustion process into Nitrogen (N_2) and Water (H_2O), both of which are naturally occurring "chemicals" in the atmosphere.

Thus the use of the SCR system allows PM reduction, optimizing at the same time combustion process and engine performance, whereas NOx reduction occurs downstream of the engine.

FPT answer: SCR technology

FPT TECHNOLOGY

Starting from the Tier 3/Stage IIIA, SCR allows exhaust emissions to comply with Tier 4 interim/Stage IIIB emission level in two simple steps.

1

The high temperature combustion engine calibration produces NOx and a very limited amount of PM.

2

SCR after-treatment reduces NOx. Independently of the combustion process.

Tier 4 interim/Stage IIIB

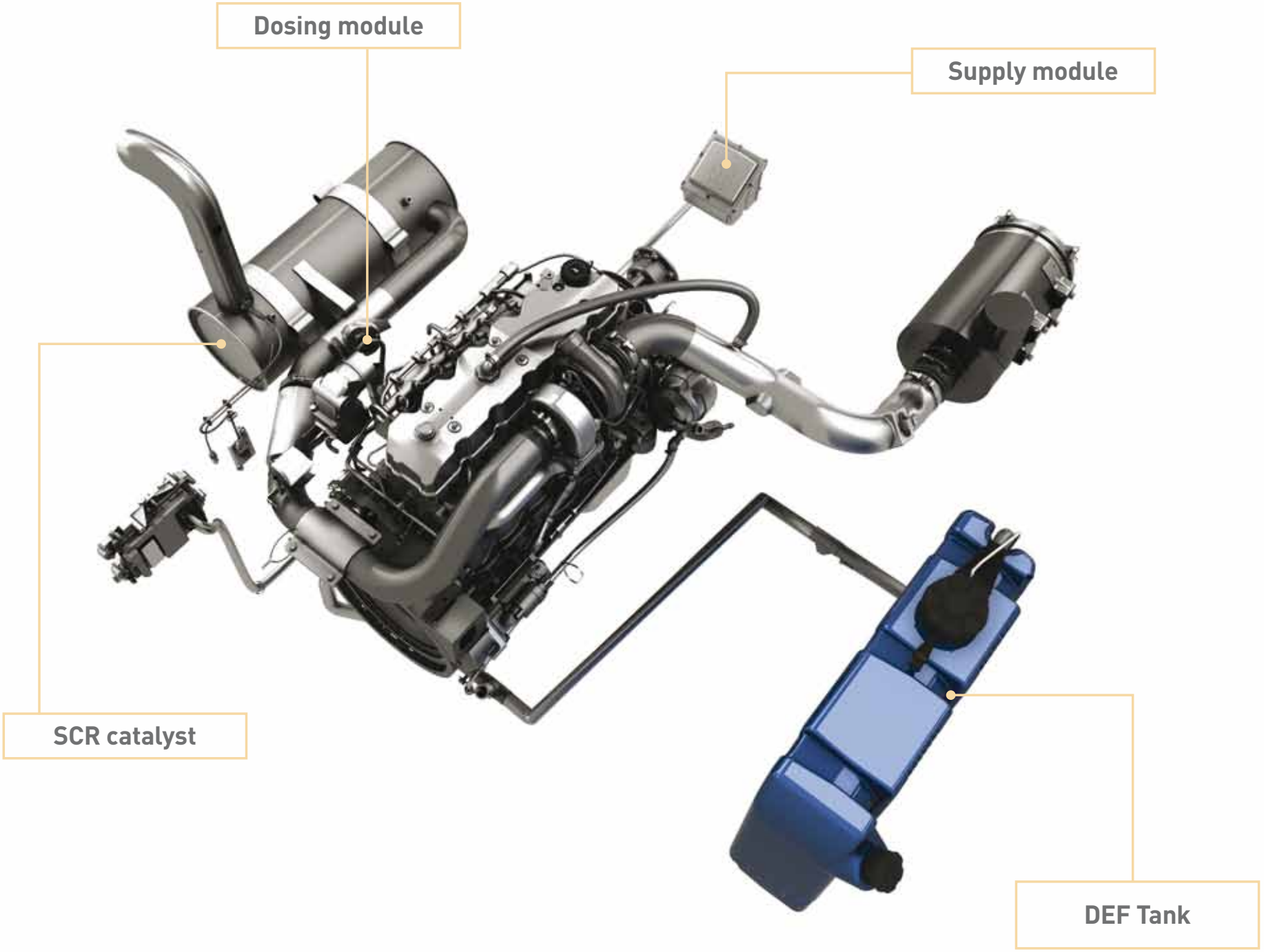
SCR system: how it works.

The SCR (Selective Catalyst Reduction) after-treatment system adopts a catalyst converting NOx into Nitrogen (N_2) and Water (H_2O) thanks to the chemical reaction with a Water-Urea solution (DEF: Diesel Exhaust/Emission Fluid).
The Water-Urea solution is a non toxic, colourless and odourless mixture of chemical urea and demineralised water.
The whole system is controlled and managed by the Dosing Control Unit (DCU) inside the Supply Module.

The main components of the SCR system are:

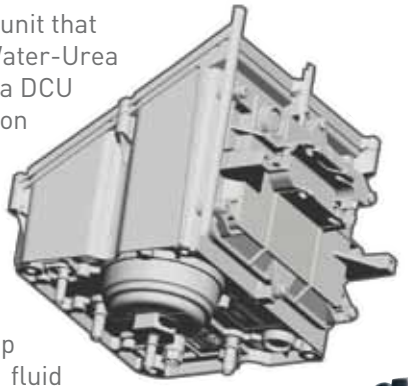
- **Supply Module**
- **DEF Tank**
- **Dosing Module**
- **SCR Catalyst**

During the engine start up, the DCU performs the after-treatment system check. In the next step the Water-Urea solution is introduced into the exhaust pipe by means of a specific injector (Dosing Module), producing steam and ammonia (NH_3) (hydrolysis).
In a second step, the SCR Catalyst reaction gives out nitrogen and water substances, innocuous for the environment.
When switching off the engine, the Water-Urea solution is completely purged into the tank.


Dosing module
Supply module
SCR catalyst
DEF Tank

SCR main components.

Supply module: is the unit that pressurizes and pumps Water-Urea solution. It is made up of a DCU and Water-Urea solution pump. The DCU controls and manages Water-Urea solution in quantity and pressure via temperature and pressure sensors. The Water-Urea solution pump conveys the pressurized fluid to the dedicated dosing Module.



DEF Tank: is the storage place of Water-Urea solution on the vehicle. It contains fluid temperature and level sensors.

Dosing module: is the unit responsible for the injection of Water-Urea solution inside the SCR Catalyst. It is managed by the supply module.

SCR Catalyst: is the part of the system where chemical reduction takes place.

FPT TECHNOLOGY

System Integration.

The SCR system is engineered to allow simple installation and flexible positioning giving the OEM the possibility to keep the same vehicle architecture as Tier 3/Stage IIIA.
The specific design of all the system components makes them easily accessible in terms of maintenance and refilling operations (see picture below).

10 reasons for choosing SCR.

1) **OUTSTANDING PERFORMANCE:** as SCR is an after-treatment system, the engine is designed to maximize torque and power with the shortest load response time.

2) **HIGH RELIABILITY:** the SCR system allows the engine to reduce heat rejection of many internal engine components which leads to better reliability.

3) **LOWER FUEL CONSUMPTION:** the efficiency of the combustion process optimizes fuel consumption reducing customer running costs.

4) **LONGER SERVICE INTERVAL:** the optimized combustion process preserves oil physical properties reducing maintenance activities and related downtime.

5) **COMPACT PACKAGING:** compared to Tier 3/Stage IIIA engine, the thermodynamic efficiency of SCR system allows to downsize displacement enhancing performance.

6) **WIDE FUEL COMPATIBILITY:** the SCR system works regardless fuel quality. In the FPT SCR technology the catalyst substrates are not influenced by the presence of traditional poisoning substances in the fuel, such as sulphur.

7) **UNBEATABLE DURABILITY:** the SCR system is engineered for life! The reduction of PM inside the engine grants total absence of clogging problems and excludes any regeneration intervention.

8) **USER FRIENDLY SOLUTION:** the SCR system is simple! The only thing to do is refilling DEF when the level indicator flashes in the vehicle instrument cluster.

9) **ADVANCED TECHNOLOGY:** the SCR is recognized by most of the engine manufacturers as the technology of the future to be compliant with Tier 4 final/Stage IV.

10) **ENVIRONMENTAL CARE:** utilising the SCR system, pollutants produced during the combustion process are converted into harmless N_2 and H_20, already present in the environment.

SCR BENEFITS

FPT Tier 4 interim/Stage IIIB engine line up for Power above 130kW.

Engine Model					
	N67 ENT	C87 ENT	C10 ENT	C13 ENT	V20 ENT
Rated Power kW	210	295	330	452	560
Rated Speed (rpm)	2200	2150	2100	2000	2100
Torque (Nm)	1143	1600	2000	2880	3200
Peak Torque Speed	1500	1100	1500	1400	1500
After-treatment	SCR	SCR	SCR	SCR	SCR

Questions & Answers.

What is the driver of FPT strategy to achieve Tier 4 interim/Stage IIIB emissions?

FPT has chosen to focus on customer's productivity and operating costs optimization, recognizing SCR as the best solution for medium & heavy duty engines. SCR allows to reduce the high operating costs by working on fuel consumption and maintenance intervals (oil change).

How does SCR achieve the emission target?

With the SCR technology gas reduction is completely managed by the after-treatment system outside the engine, which is thus capable of performing optimal combustion with lower fuel consumption.

Which advantages does the SCR technology offer?

There are at least 10 valuable reasons by which SCR is the most convenient choice:

- **Outstanding Performance**
- **High Reliability**
- **Lower Fuel consumption**
- **Longer Service interval**
- **Compact packaging**
- **Wide Fuel Compatibility**
- **Unbeatable Durability**
- **User friendly solution**
- **Advanced technology**
- **Environmental care**

Where will the SCR be commercialized?

SCR will be commercialized in all the countries where the emission regulations will require Tier 4 interim/Stage IIIB standards.

Will DEF (Diesel Emission Fluid) be distributed also in the USA?

Yes.

Is there any critical issue regarding SCR introduction in the USA?

No, because by 2011 the DEF distribution network will be developed in the USA (many American engine's manufacturers will adopt SCR for EPA10 on road compliances).

What does it happen if DEF Tank is empty?

A led on the vehicle's cluster will switch on and after a period of time the engine will be switched in limp home-mode to preserve the safety.

Is the SCR system affected by low temperatures?

No, FPT SCR system perfectly works at low temperature. Even in case of cold start with frozen urea solution (temperature below -11°C/12°F) the engine works properly without any derating.

Has SCR installation constraints?

OEM's have to respect FPT SCR installation guidelines, however the system is engineered in order to be easy to install, with flexibility in terms of length of pipes & height positioning, and FPT will provide full support to ensure the final installation complies with the emission legislation.

At your service everywhere.
Sales and Services.

FPT counts on a worldwide organization including over 1500 sale & service points able to assist Customers in their purchase and to provide them with engine maintenance and parts.

Thanks to frequent training courses, FPT network will be pleased to assist you wherever and whenever necessary, supplying only original parts of proven quality.

FIAT POWERTRAIN TECHNOLOGIES S.p.A.

Corso Settembrini 167, 10135 - Torino, Italy
Email: press@fptpowertrain.com - www.fptpowertrain.com

FIAT GROUP

POWERTRAIN TECHNOLOGIES

P2G01Z002E-04.10

POWERING THE FUTURE