Growing Selection of NGVs from OEMs, SVMs

OEMs

- American Honda
- General Motors
- Chrysler Ram Trucks
- Thomas Built Bus
- Blue Bird Bus
- Optima/NABI
- El Dorado
- New Flyer
- MCI -Motor Coach Ind.
- Gillig
- DesignLine
- Elgin
- Johnston
- Schwarze
- Tymco

OEMs

- Freightliner Truck
- Volvo
- International/Navistar
- Kenworth
- Peterbilt
- Mack
- ALF Condor
- Crane Carrier
- Autocar Truck
- Capacity
- Freightliner Custom Chassis*
- Isuzu Truck North America*

HD OEM/Repower Engines

- Cummins Westport
- Westport Innovations

SVMs (LDV/MDV/HDV)

- Altech-Eco
- Landi Renzo USA / Baytech
- IMPCO Technologies
- Westport/BAF Technologies
- NGV Motori USA
- NatGasCar
- Auto Gas America
- Go Natural CNG
- Greenkraft
- PowerFuel Conversions
- EcoDual
- American Power Group
- Peake Energy Solutions
- Clean Air Power

Retrofits of GM, Ford, Dodge, VW, Mitsubishi, Mazda, Workhorse, Isuzu, JAC, UtiliMaster, FCCC; Cummins, Daimler/MB, Cat.,

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EPA Certification Requirements of NGVs

- 1994: EPA sets certification requirements for CNG.
  - OEMs use of ECMs; concern about conversion emissions;
  - OEMs began complying to new standard; SVMs given alternative (Memo 1A Option 3).
  - Dozens of “kit manufacturers” leave market (“good”; quality/reliability was a mess)
- April 2002: Option 3 phased out
  - SVMs must certify; very costly, technically difficult , requires expertise and $$$ equipment; further differentiated the quality engineered retrofit systems from “kits”
- March 2011: EPA revised aftermarket certification rules
  - Relaxed rules apply primarily to vehicles “outside useful life” although less burdensome data submittals are available for vehicles that are “intermediate age” (IUL) defined as current year minus 2; e.g. 2011MY vehicles or older may now apply for IUL listing. Both OUL and IUL still require EPA review of data/technical documentation

Tools: Available Vehicles, Manufacturers & Engines

- NGVAmerica's EPA/CARB Certified list
- AFDC Clean Cities Tools
  - Heavy-Duty Vehicle Search
  - Light-Duty Vehicle Search

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American Honda Civic Natural Gas Sedan

- Dedicated NGV; 1.8L 4-cylinder engine; 8 GGE tank: 225-250 mile range
- American-made – (OEM mfd: Greensburg, IN - 70% US-sourced parts)
- Fleet applications: sales reps, project supervisors, document and medical lab couriers, transit route supervisors, social service workers, code officials, parking enforcement, non-pursuit police/security.
- Originally offered only through Honda fleet sales dealer network, now available via growing number of “retail” Honda dealers to consumers
- Consumer adoption is increasing in areas with public access infrastructure.

General Motors

- Dedicated CNG 2500/3500 Express/ Savana cargo vans introduced 02/11
- LC8 6.0L V8 Vortec engine features hardened exhaust valves and hardened intake and exhaust valve seats
- Two tank configurations available
  - 4 -- 23GGEs; 3 – 16GGEs
- 5 year/100K mile warranty

- Bi-Fuel 2500HD Silverado/ Sierra extended cab pick-up introduced 03/12
- Proven LC8 6.0L V8 Vortec engine
- 2x/4x, Short and Long bed options
- Single Type III tank 17.2GGE CNG fuel package complements 36 gallon gasoline system
- 5 year/100K mile warranty

Chrysler Group

- Bi-Fuel Ram 2500 CNG crew cab 4x4 w 8’ bed pick-up truck premiered 03/12
- 5.7L HEMI engine with factory engineered and installed CNG systems.
- 2 Type I cylinder fuel storage system provides 18.2GGEs (~255miles), supplementing 8 gasoline gallons (~112miles) for total range of 367 miles ; option available for standard 34 gallon gas tank.
- Production began July 2012

OEM HD Natural Gas Powertrains

CWI 8.9L ISL-G	CWI 11.9L ISX-G	Westport HD 15.L	(2014) Volvo 13L D13	(2015) CWI 6.7L ISB-G	(2016) CWI 15L ISX-G
			?	?	?
• Spark Ignition	• Spark Ignition	• Dual Fuel (LNG+Diesel)	• Dual Fuel (LNG+Diesel)	• Spark Ignition	• Spark Ignition
• CNG or LNG	• CNG or LNG	• LNG Only	• LNG Only	• CNG or LNG	• CNG or LNG
• Peak Rating:	• Peak Rating:	• Peak Rating:	• Peak Rating:	• Peak Rating:	• Peak Rating:
– 320 hp / 1,000 ft-lbs	– 400 hp / 1,450 ft-lbs	– 450 hp / 1,750 ft-lbs	– hp /torque TBD	– ~260 hp / ~660 ft-lbs	– hp /torque TBD

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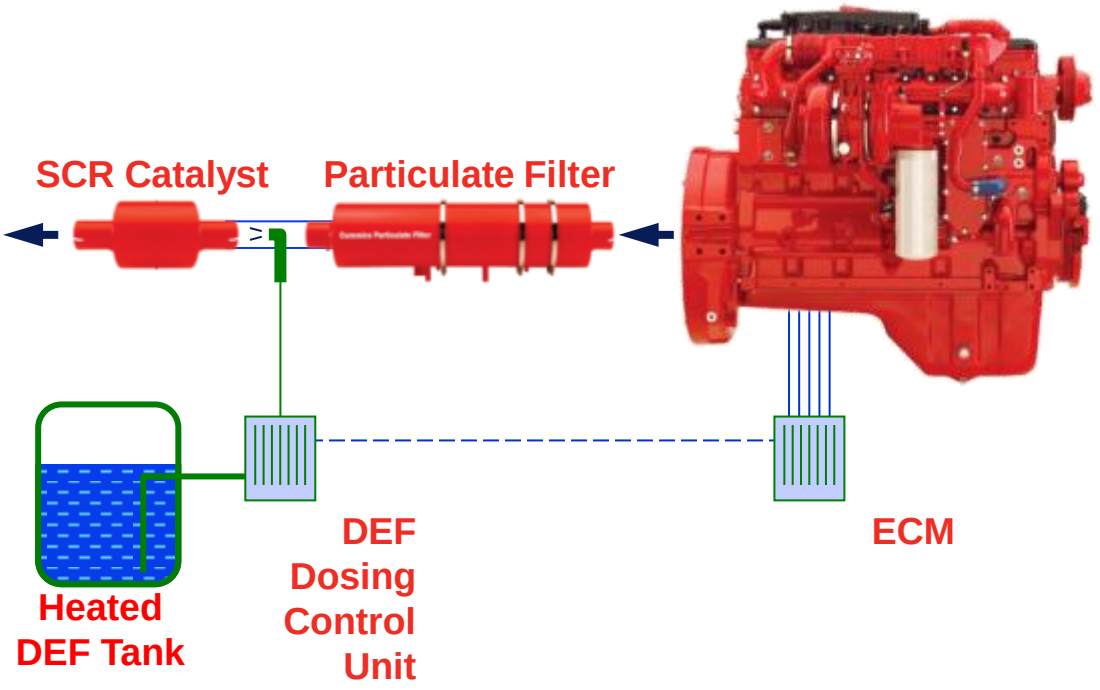
Aftertreatment Comparison

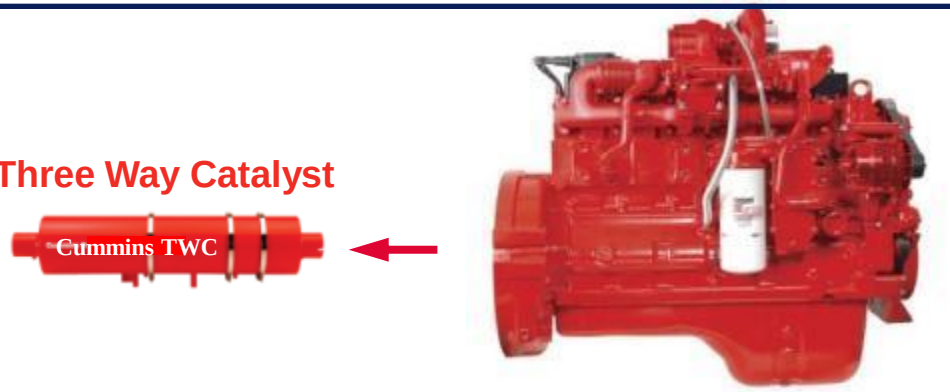
ISL9

(diesel)



ISL G

(natural gas)



Transit and School Bus Platforms

Vocational/Specialty/Work Truck

Local-Regional Haul/Line Haul

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North America

OEM	Model	Segment	ISL G	ISX12 G	Comments
Freightliner Truck	Business Class M2 112 (Class 7/8)	MD/HD Truck	X		**Applications: 6X4 Tractor (LNG, CNG), CNG - 4X2 Tractor, 6X2, 4X2 Truck, Vocational**
	Cascadia	HD Truck		X	**ISX12 G - Mid 2013**
Kenworth	W900S	MD/HD Truck	X	X	**Vocational/Mixer**
	T440 / T470	MD/HD Truck	X		**Local & regional haul, vocational.**
	T660	HD Truck		X	**ISX12 G - Mid 2013**
Peterbilt	Model 384	MD/HD Truck	X	X	**Model 384 - Tractor**
	Model 365	MD/HD Truck	X	X	**ISX12 G - Mid 2013**
Volvo	VNM	MD/HD Truck	X		
	VNL	HD Truck		X	**ISX12 G - Mid 2013**
Mack	Pinnacle	HD Truck		X	**ISX12 G - Mid 2013**
	Granite	HD Truck		X	**ISX12 G - Mid 2013**
International	TranStar	MD/HD Truck	X		**New 2012**
American LaFrance	Condor	Refuse	X		
AutoCar	ACX	Refuse	X	X	**ISX12 G - Mid 2013**
Crane Carrier	LCF	Refuse	X		
Peterbilt	320	Refuse	X	X	**ISX12 G - Mid 2013**
Mack	TerraPro Low Entry	Refuse	X		
Mack	TerraPro Cab Over	Refuse	X		
NABI	35 LFW/40 LFW/60 BRT	Urban Bus	X		
New Flyer	30 LF/35 LF/40 LF	Urban Bus	X		
Orion	Orion V HF/Orion VII LF	Urban Bus	X		
Foton	City - L40 CNG	Urban Bus	X		
Gillig	LF	Urban Bus	X		**New 2011**
MCI	Commuter Coach 40/45	Motor Coach	X		**New 2011**
DesignLine	Commuter Coach 40/45	Motor Coach	X		**New 2012**
El Dorado National	Axess/E-Z Rider II/Transmark RE/XHF	Shuttle	X		
Blue Bird	All American	School Bus	X		
Thomas Bus	Saf-T Liner	School Bus	X		
Capacity	TJ9000 , TJ5000	Yard Spotter	X		
AutoCar	Xspotter	Yard Spotter	X		

Dual Fuel Technologies: Re-emerging Opportunity

- Dual fuel technology is making a comeback, primarily being marketed to “Intermediate Use (IUL)” and “Out of Useful Life (OUL)” HD engine applications; one company has “new” COC. Could see this option in trucks offered by OEMs
  - Varying amounts of diesel is displaced by natural gas during duty cycle

- 3/11 - EPA established a lower cost “appro process that reduced cost and data burden thus making this dual fuel retrofit system option economically attractive to legacy flee
- “Approval” process requires technical paper, supporting documentation, field data
- Took 6-8 months to see first “EPA listing.” Presently, ~100 engine families have been approved but more are added each month

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