

AUTOMOTIVE
SUMMIT 2014



Green Mobility Changing the World

19 - 20 June 2014

Bitec Bangna, Bangkok

AUTOMOTIVE SUMMIT 2014



**Step Forward to Green DDF Mobility with
PTT-DIESEL-CNG**

Dr. Krisada Wannatong
PTT Public Company Limited

AUTOMOTIVE SUMMIT 2014

19-20
June²⁰¹⁴

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Thailand

- ❑ Introduction
- ❑ Simple Diesel Dual Fuel (DDF) Technology
- ❑ DF-PCCI New Diesel Dual Fuel Combustion Concept
- ❑ PTT-DIESEL-CNG New DDF Conversion Kit
 - ❑ Development
 - ❑ Evaluation
 - ❑ Commercialization
- ❑ Summary

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Natural Gas Application in Thailand Transportation



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Why Natural Gas



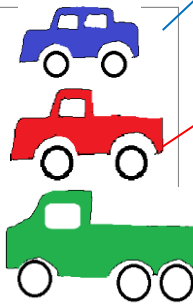
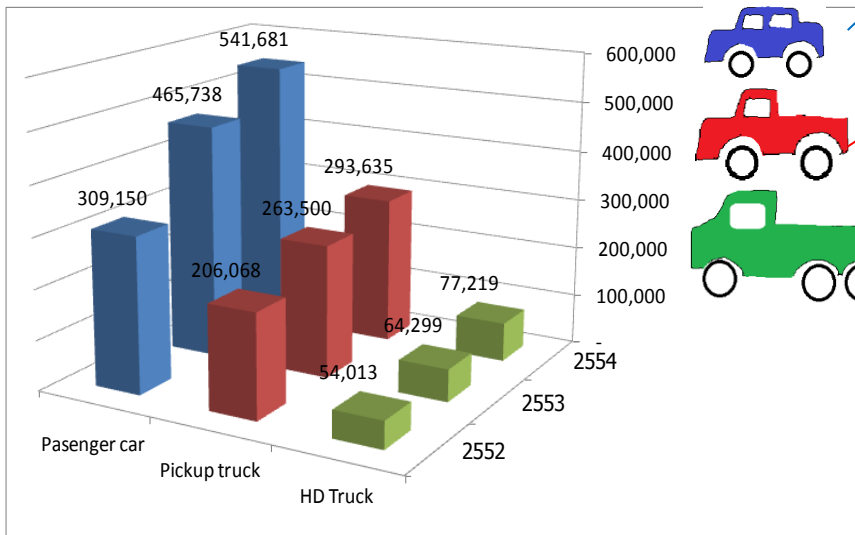
BlueInnovation	
12 JUN 2012 21:50	
	Baht/Litre
BlueGasoline 91	40.75
BlueGasohol 91	35.08
BlueGasohol 95	36.83
BlueGasohol E20	33.68
BlueGasohol E85	21.38
BlueDiesel	29.53
	Baht/Kg.
NGV	10.50
Price History	
Oil Provincial Price	



Bi-fuel

???

Dedicated Gas Engine



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No Existing Good NGV Solution for Diesel Pick-Up Truck



Light Duty Truck
(Diesel Engine)



Dedicated Gas Engine

Disadvantage

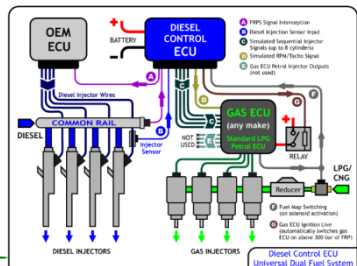
- Short Distance
- Lack of NGV Station



Spark Ignition Conversion

Disadvantage

- Conversion Cost
- Durability Issues



Simple Diesel Dual Fuel (DDF)

Disadvantage

- Bad Fuel Economy
- High Emission
- Engine Damaged Risk

NEW DDF Technology

- High Energy Replacement
- Long NGV Distance
- No Engine Conversion
- Good Fuel Economy
- Lower Emission
- No Damaged Risk

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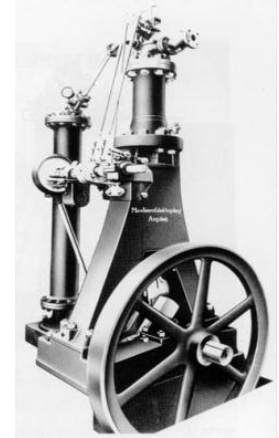
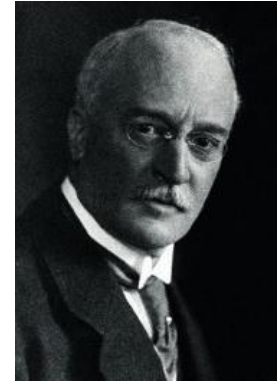


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Diesel Dual Fuel Since 1901

- **1892:** February 23, Rudolf Diesel obtained a patent (RP 67207) titled "Arbeitsverfahren und Ausführungsart für Verbrennungsmaschinen".
- **1901:** the U.S. Patent Office issued to Rudolf Diesel patents that covered all the essential features of the dual fuel and gas diesel engines



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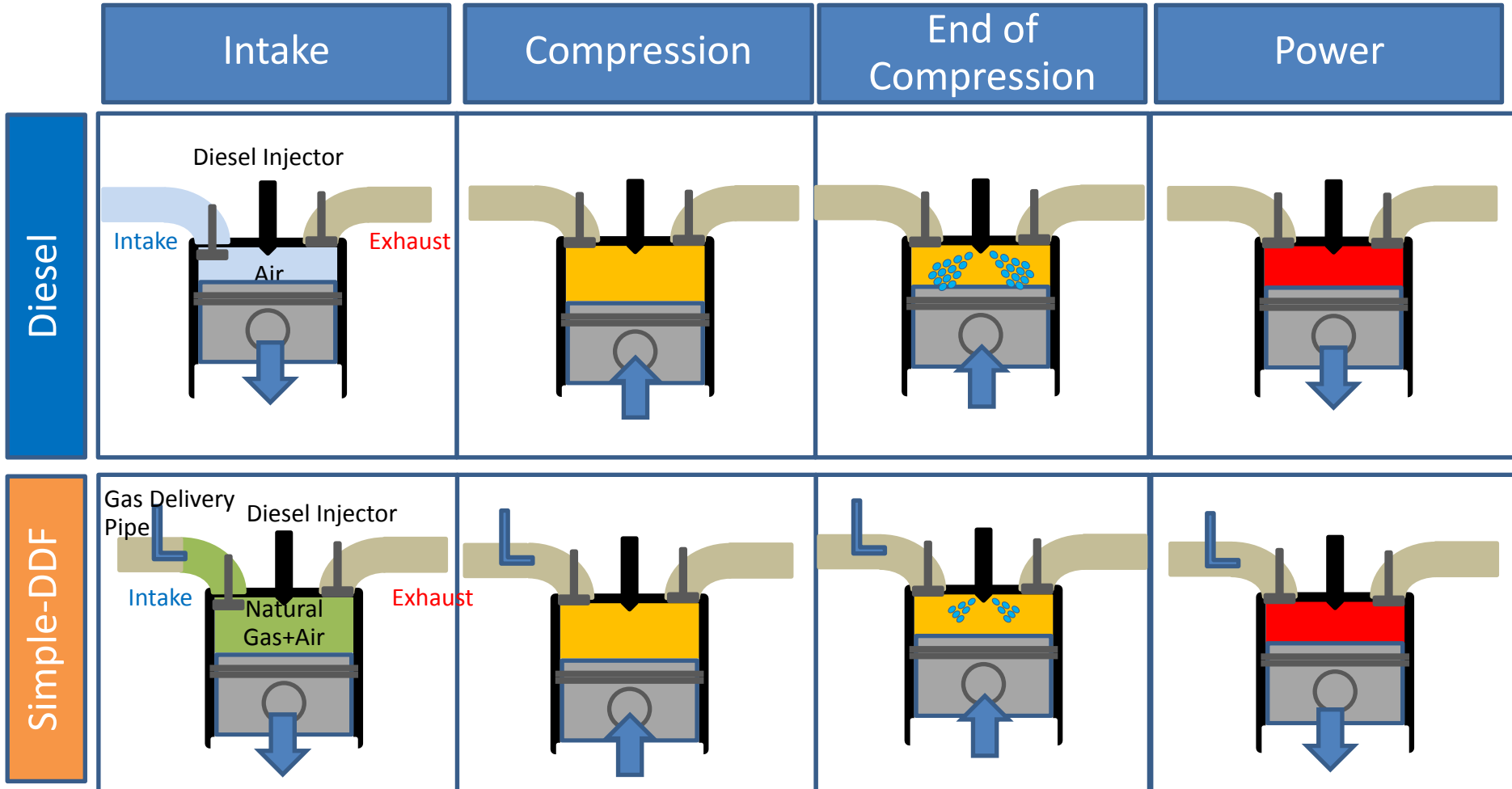
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Diesel & Simple Diesel Dual Fuel



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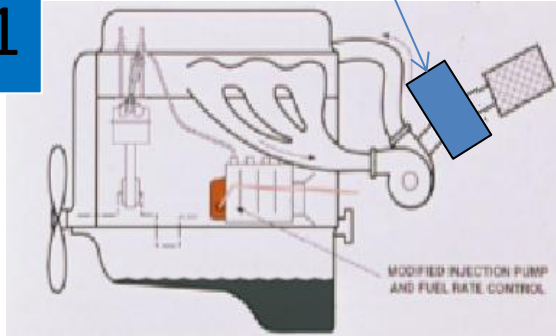
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Simple Diesel Dual Fuel

1

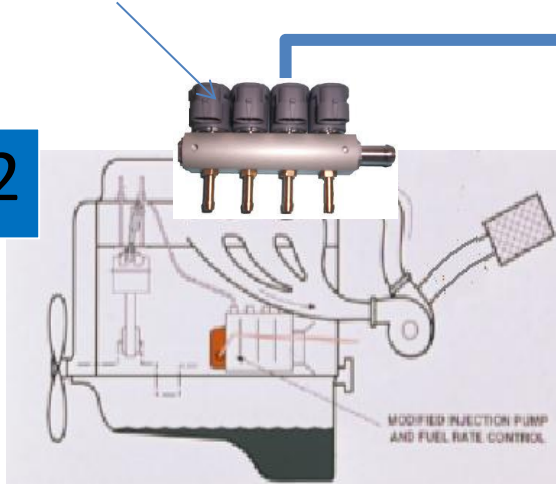
Gas Mixer



- Gas control
 - Gas is introduced to engine by mixer
- Diesel control
 - Without any diesel control

Gas injectors

2



Controlled by ECU

- Gas control
 - Gas is introduced to engine by gas injector
- Diesel control 2 options
 1. Without any diesel control
 2. Shorter diesel injection duration

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Simple Diesel Dual Fuel Evaluation

- Low energy replacement
- Bad fuel economy
- High exhaust emissions
- Durability
 - Engine damaged from knock
 - Injector tip melted from high combustion temp and low cooling effect from diesel fuel
 - Exhaust valve damaged from high exhaust temperature



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- ❑ 60% energy replacement (NEDC)
 - ❑ Better emissions
 - ❑ Equivalent to Diesel Engine on
 - ❑ Performance
 - ❑ Efficiency
 - ❑ Durability

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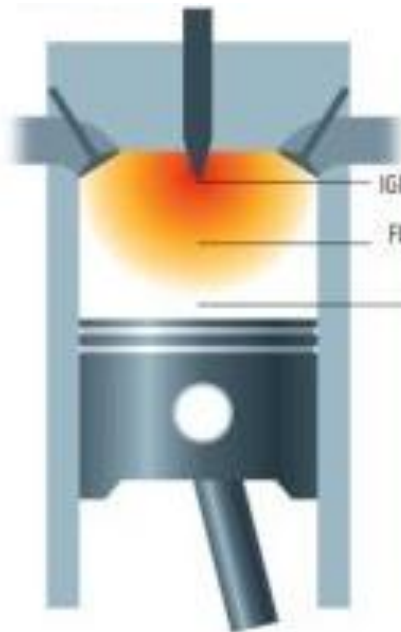


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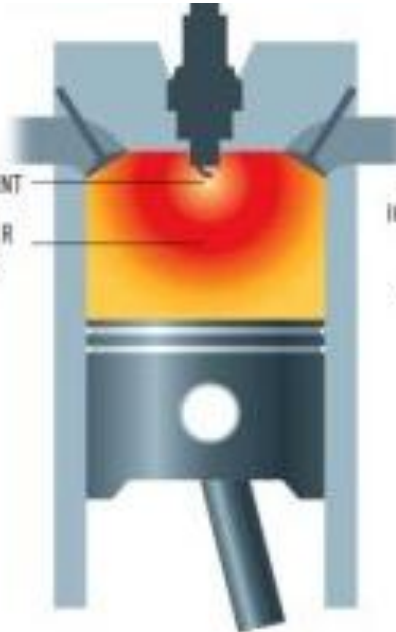


Advanced Combustion: Concept of DF-PCCI

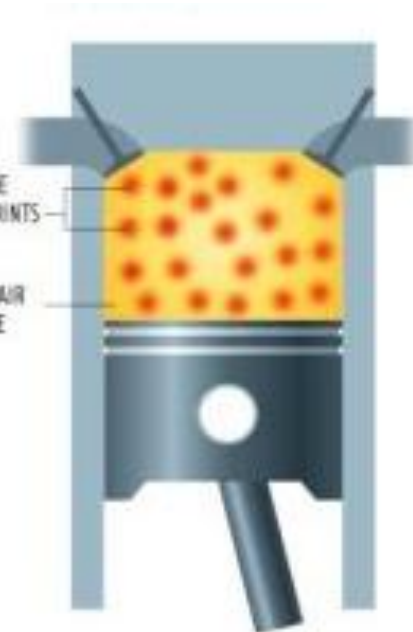
Diesel Fuel
(Compression Ignition)



Natural Gas
(Spark Ignition)



Advanced Combustion
(Control Auto ignition)



HCCI/PCCI/DF-PCCI

- High fuel efficiency
- Low exhaust emissions

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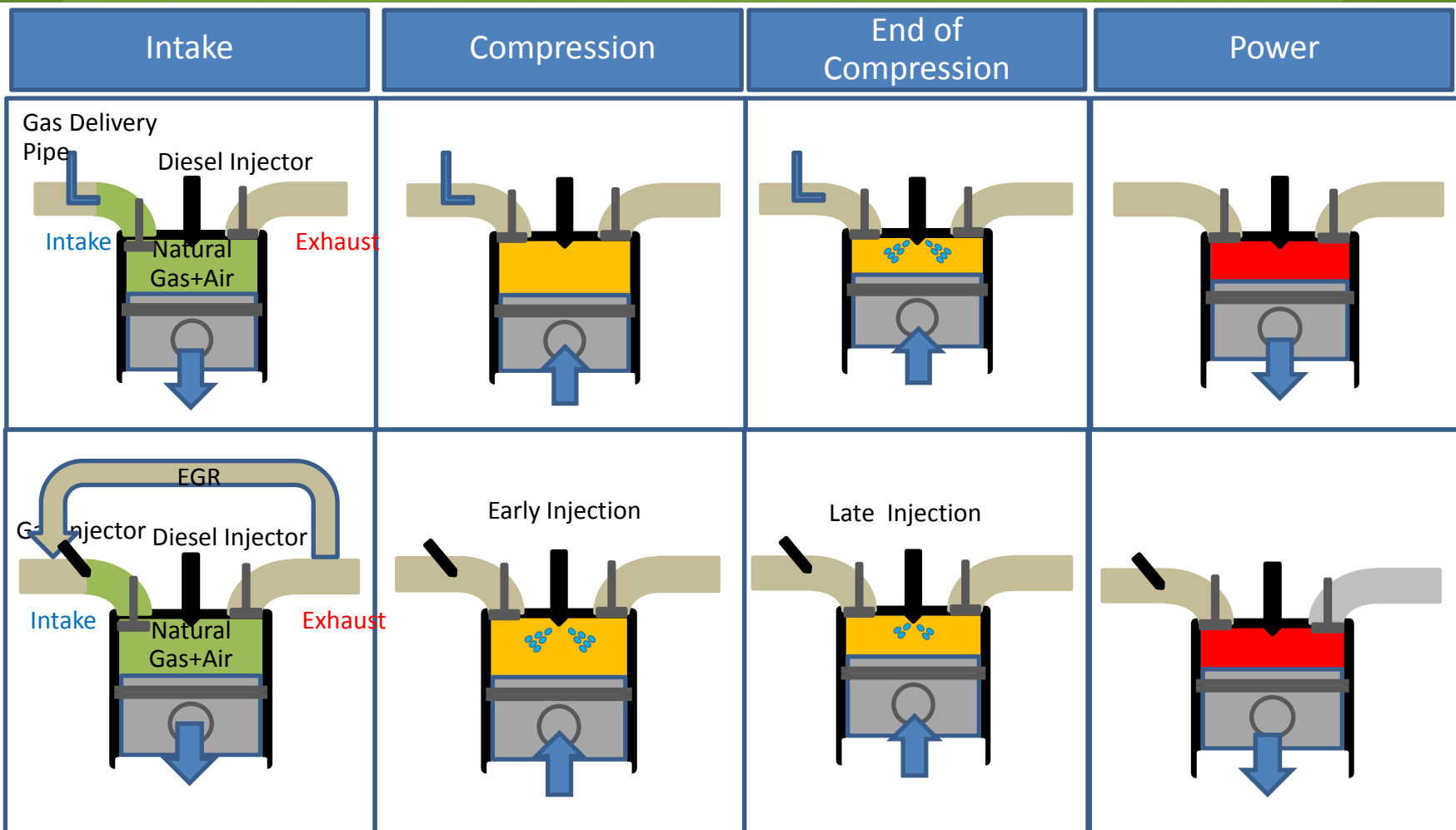
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DF-PCCI: Dual Fuel Premixed Charge Compression Ignition

Simple DDF

DF-PCCI



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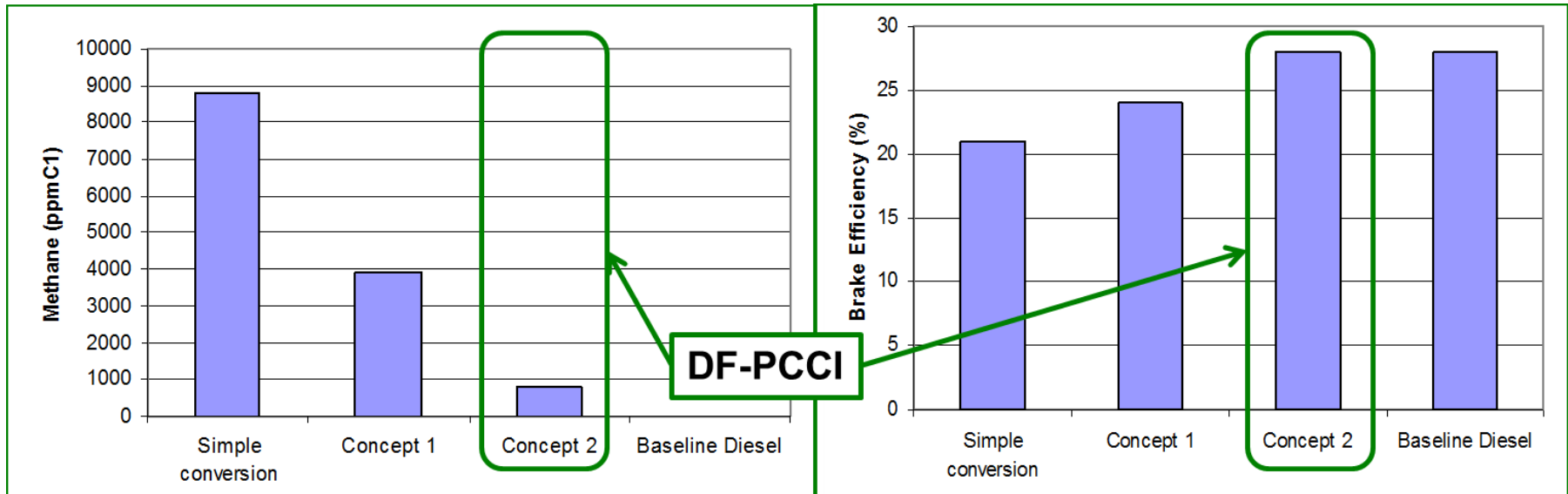
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DF-PCCI: Dual Fuel Premixed Charge Compression Ignition



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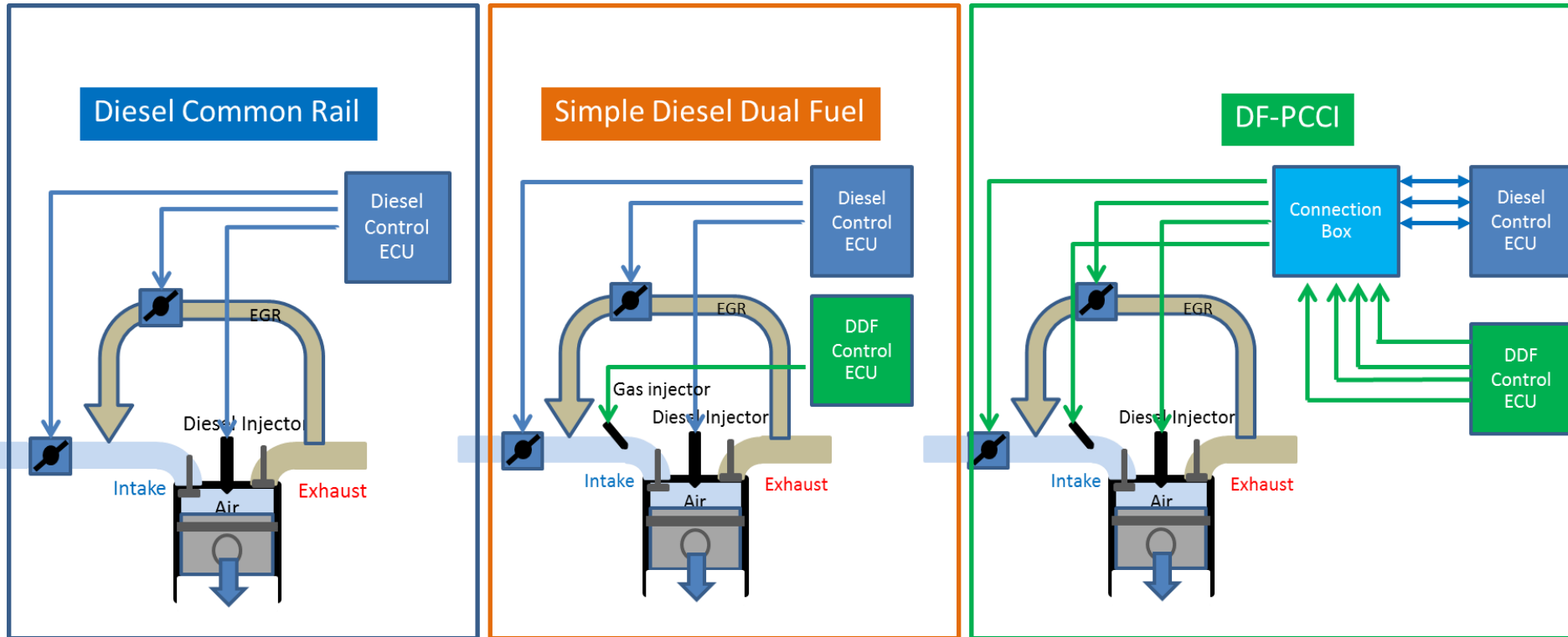
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DF-PCCI: All Actuators Need to be Controlled



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 - ❑ Development
 - ❑ **Evaluation**
 - ❑ Performance Test
 - ❑ Driveability Test
 - ❑ Engine Durability Test
 - ❑ Field Test
 - ❑ Commercialization
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Commercialization: Licensed to SGP



- Contract was signed in July 2013 with Sammitr Green Power Co., Ltd. (SGP)

- SGP debut pick-up truck using PTT DIESEL CNG called “Erawan Diesel CNG” marked at Motor Expo in Nov. 2013



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Summary

- Introduction
- Simple DDF
- DF-PCCI
- PTT-DIESEL-CNG

Natural gas is alternative fuel for transportation sector but has no good gas technology for diesel engine, the most popular engine for Thailand transportation

There are many poor characteristics of Simple DDF

- Poor efficiency
- Low energy replacement
- High emissions (especially HC)
- Engine damaged

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Summary

Introduction

Simple DDF

DF-PCCI

PTT-DIESEL-CNG

DF-PCCI: Dual Fuel Premixed Charge Compression Ignition

- New DDF technology developed by PTT
- High efficiency equivalent to diesel engine
- High replacement
- Better emissions (especially HC, NOX, Soot)

PTT-DIESEL-CNG

- New DDF conversion kit using DF-PCCI technology
- Powerful / Durable / Save
- Licensed to SGP
- Introduce to Thai market in name **“ERAWAN”**

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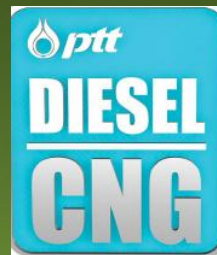
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