

**Stakeholder Dialogue on  
Improving Environmentally Sustainable Transport in Sri Lanka  
Organized by  
Ministry of Environment & Renewable Energy  
Air Resource Management Center  
Clean Air Sri Lanka  
Centre for Science and Environment**

# **CLEANER FUELS AND VEHICLES**

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**Hotel Taj Samudra, Colombo 03  
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# **OVERVIEW**

- **The Context**
- **Fuel Economy**
- **Cleaner Vehicles**
- **Cleaner Fuels**

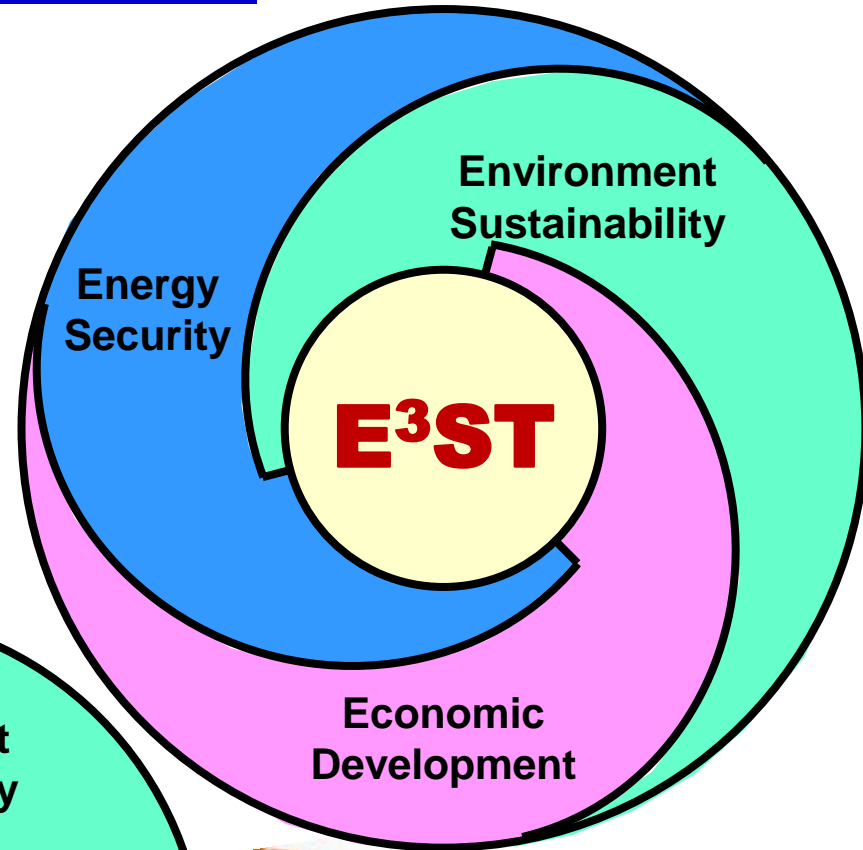
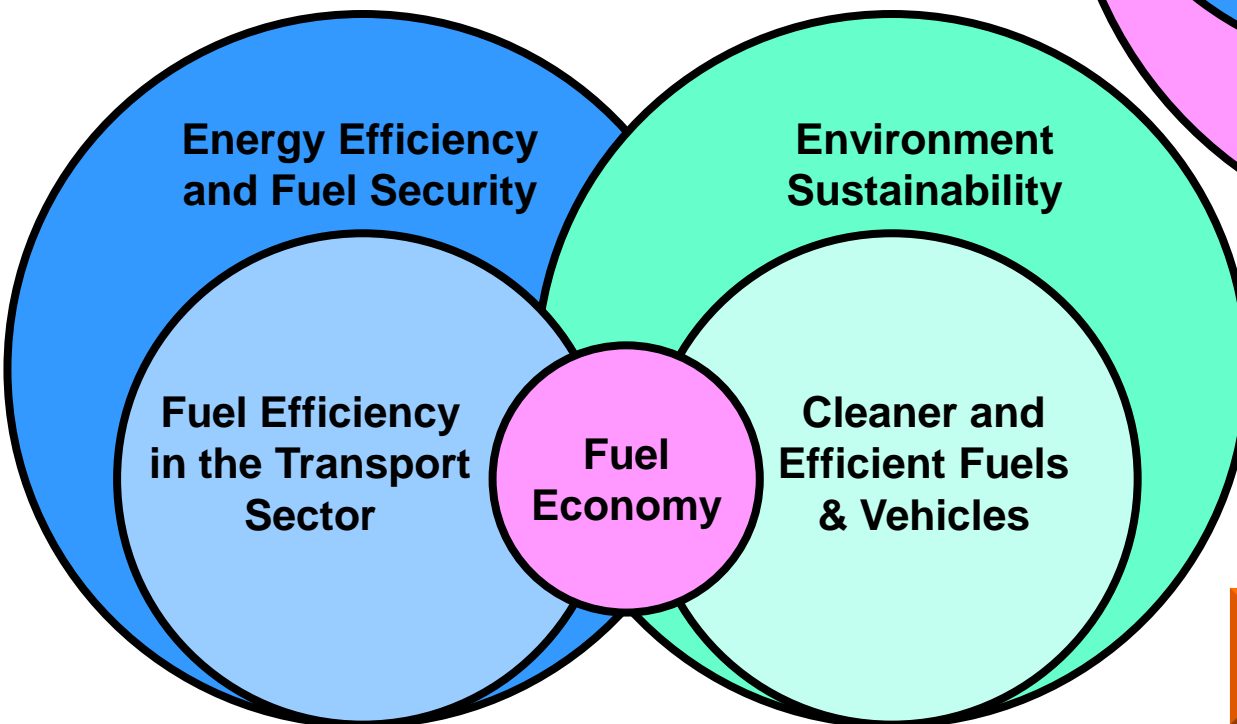
# THE CONTEXT

## ■ Growing Concerns

- ✓ Energy Security
- ✓ Environment Sustainability
- ✓ Economic Development

## ■ Interventions in Transport

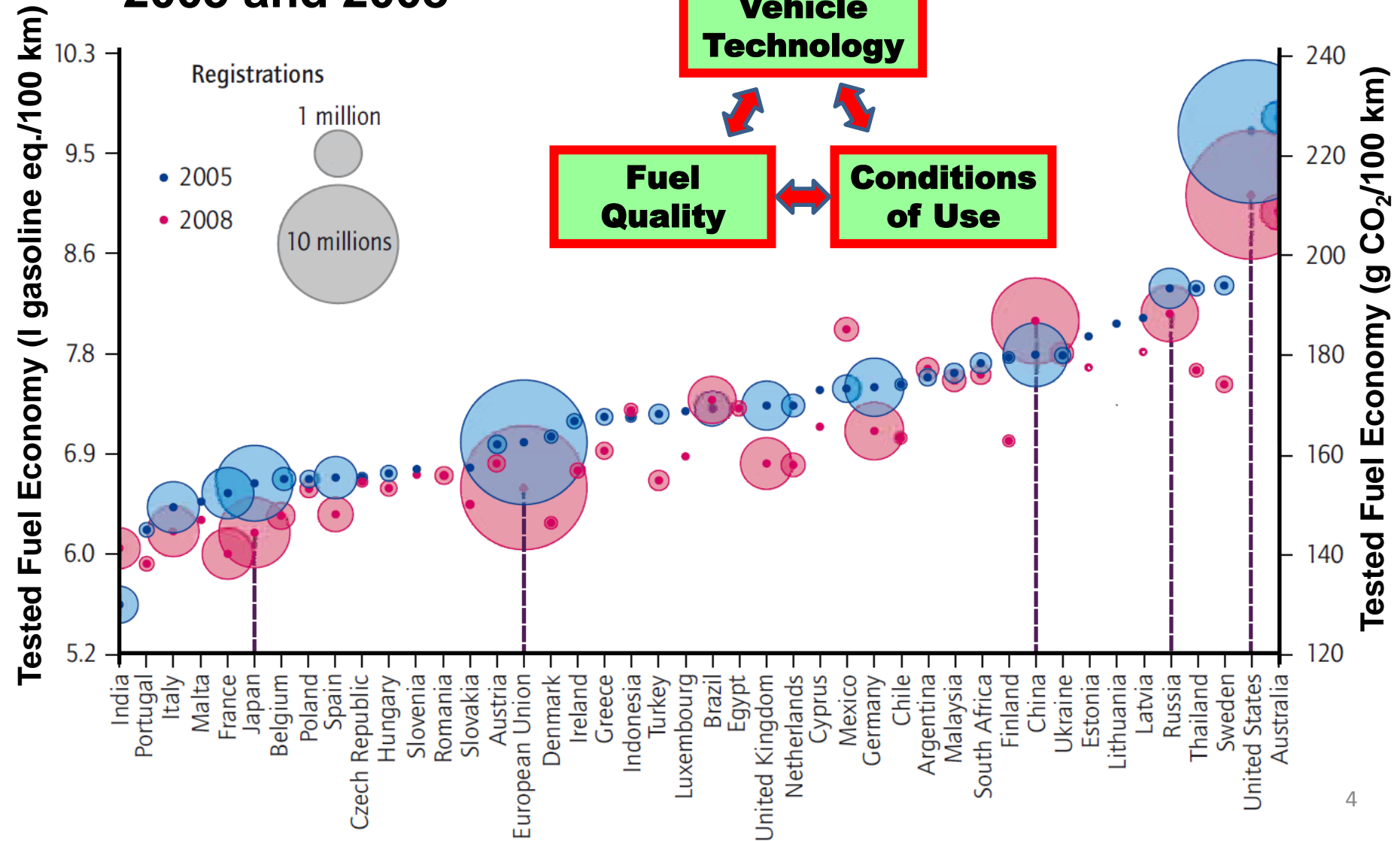
- ✓ Energy Efficient & Environmentally Sustainable Transport System (E<sup>3</sup>ST)



**Managing Energy Intensity in the Economy**

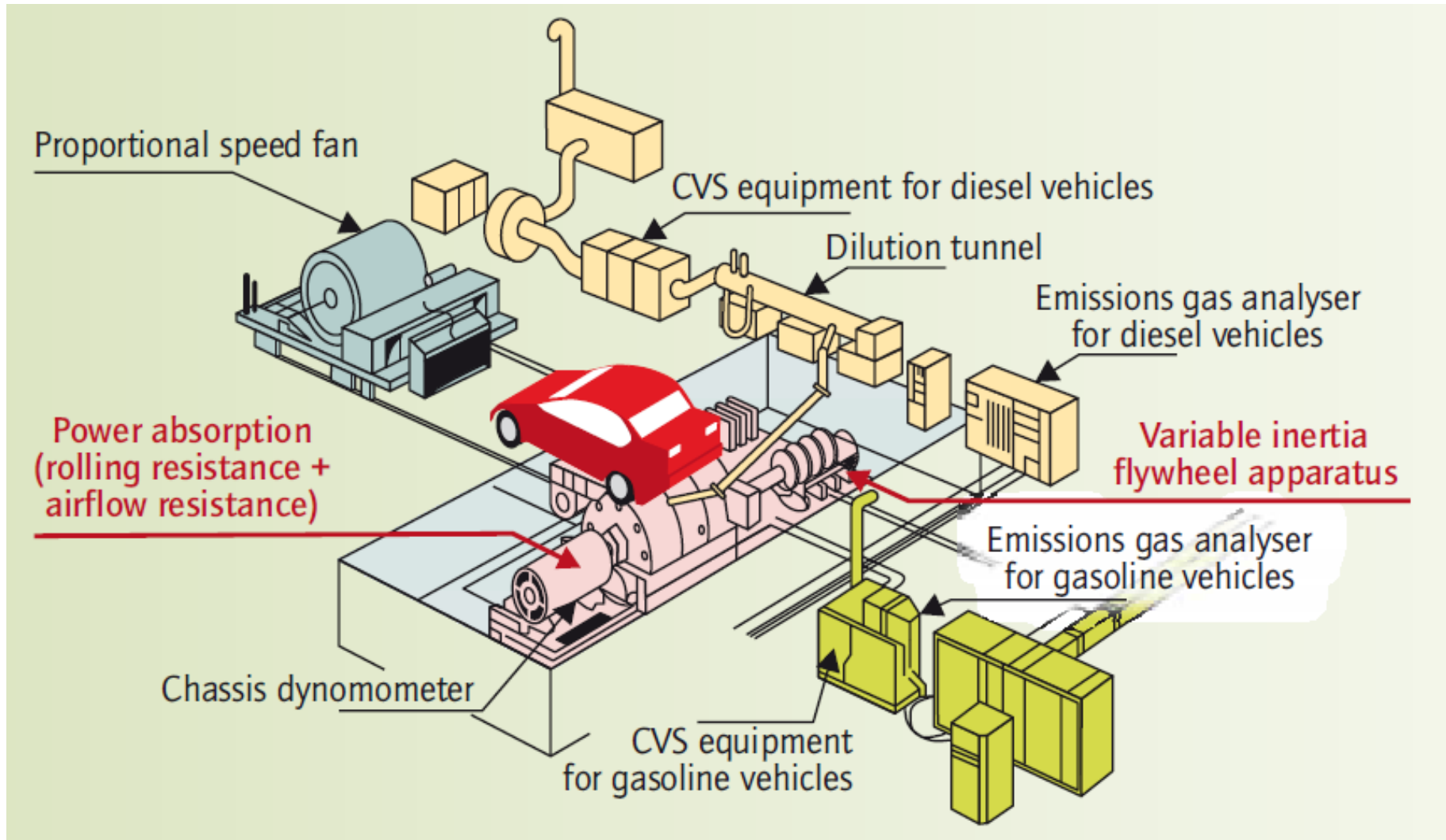
# FUEL ECONOMY

- Average fuel economy and new vehicles registrations, 2005 and 2008



# FUEL ECONOMY

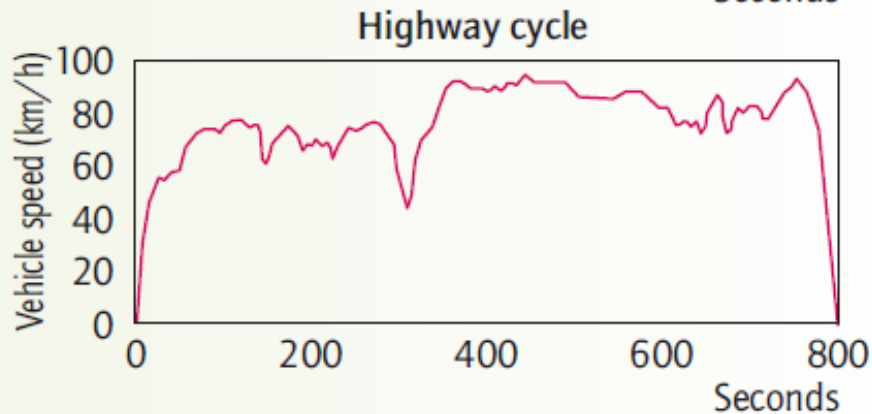
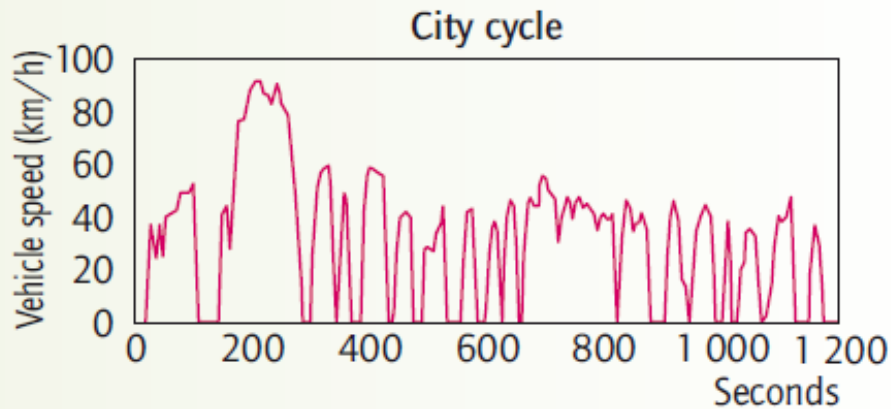
## ■ Fuel Economy Testing in a Chassis Dynamometer



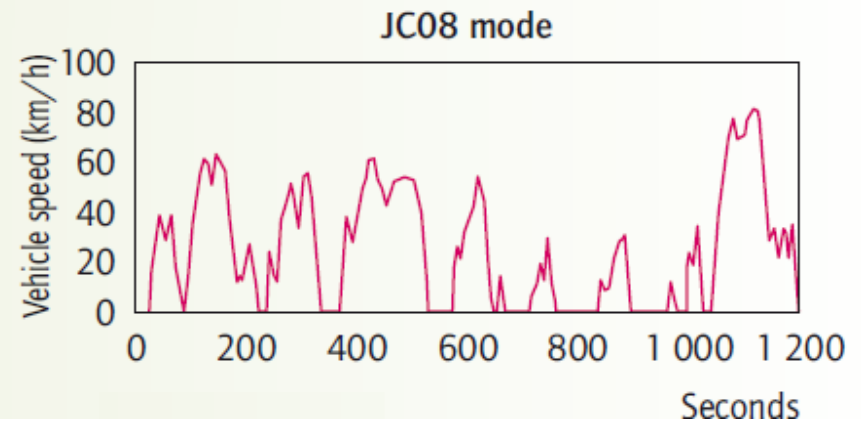
# FUEL ECONOMY

## ■ Fuel Economy Testing in a Chassis Dynamometer

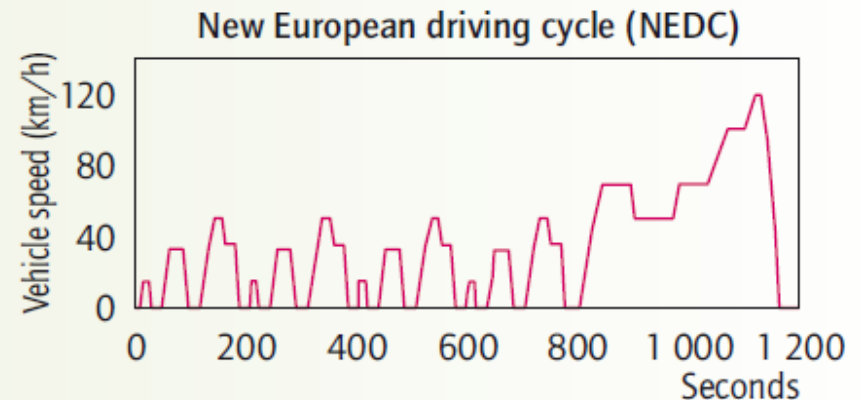
### United States



### Japan

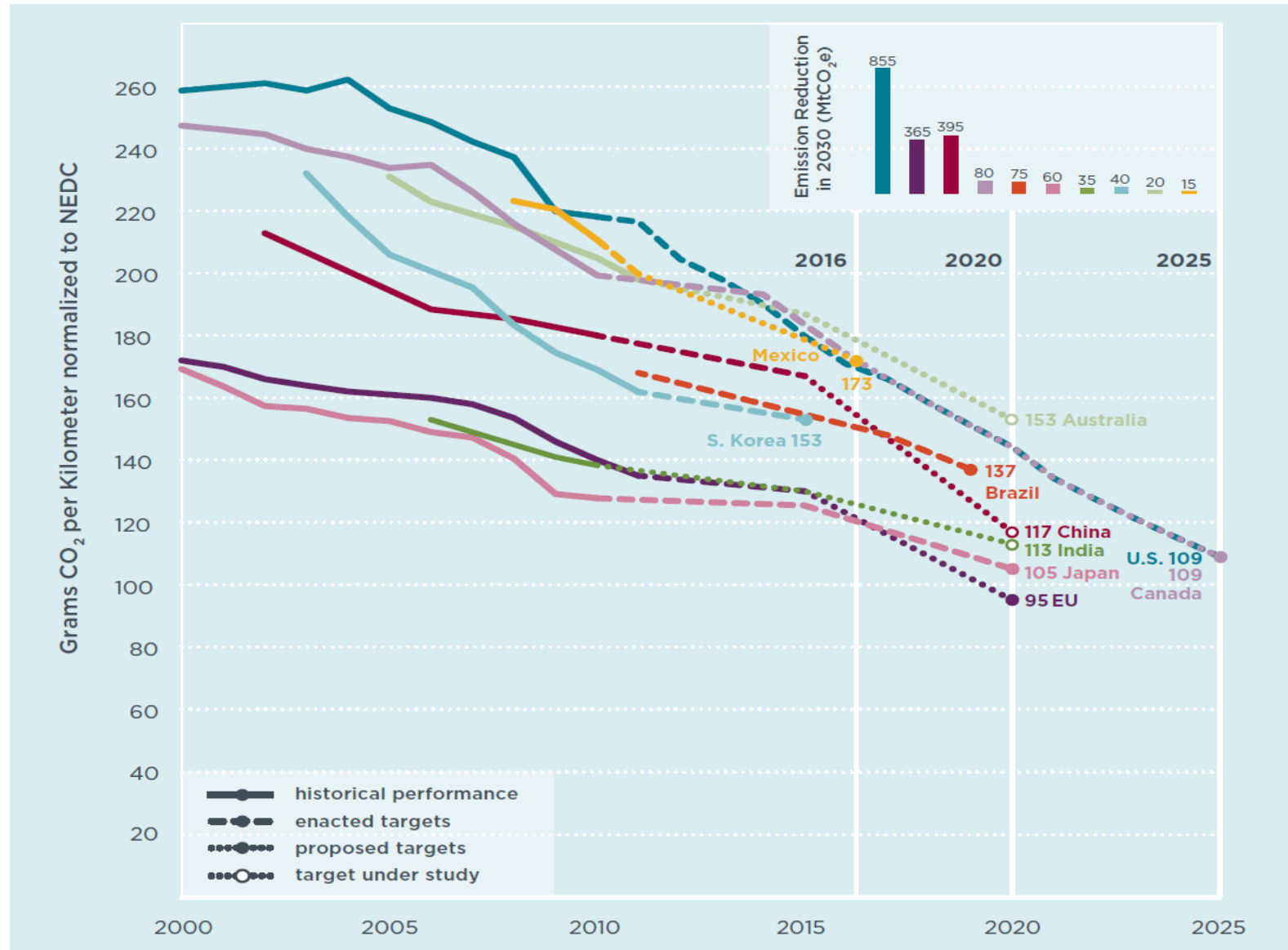


### Europe



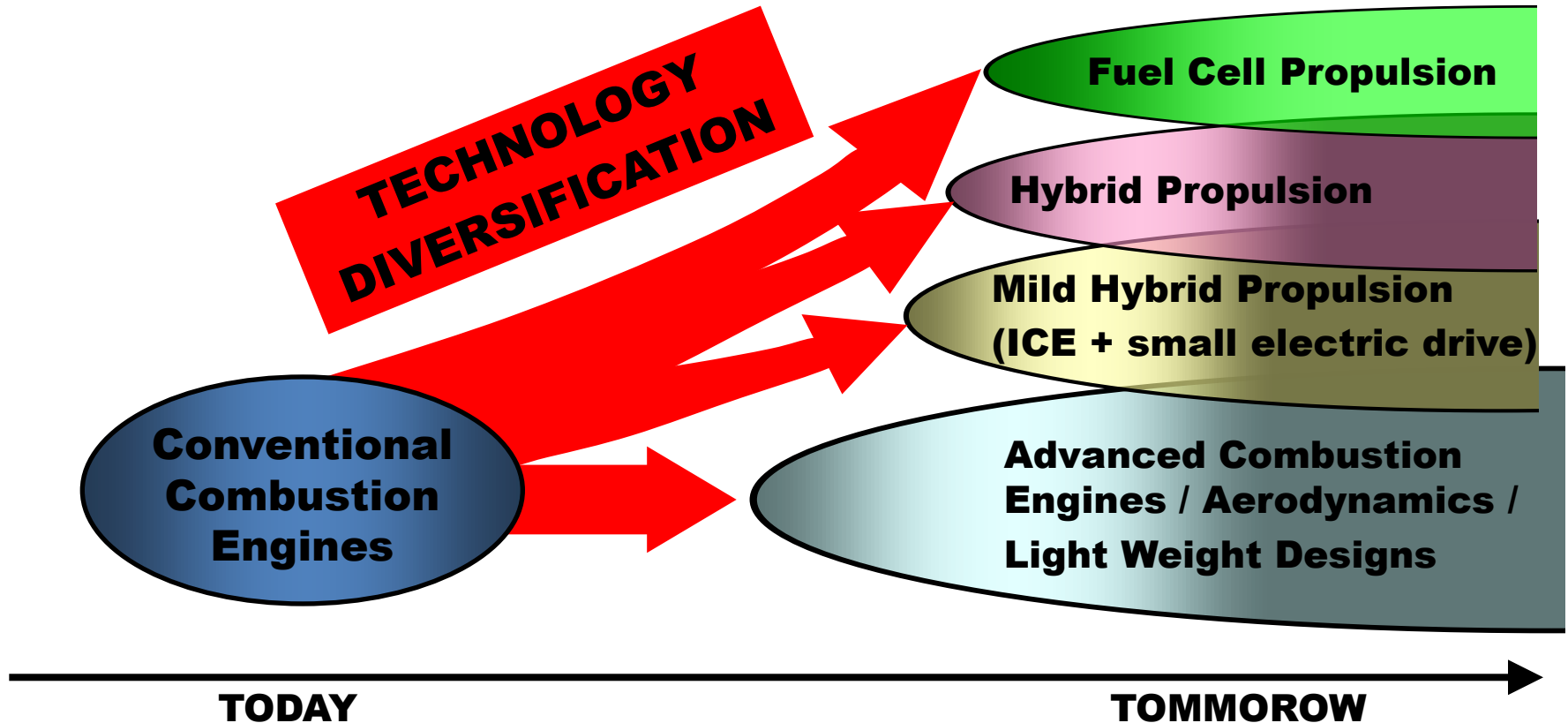
# FUEL ECONOMY

## ■ Comparison of LDV CO<sub>2</sub> Emission Rates



# CLEANER VEHICLES

- Roadmap of Advanced Power-train Technologies





# **CLEANER VEHICLES**

## ■ **Advanced / Emerging Technologies for New Vehicles: Propulsion System Improvements**

- ✓ Direct Fuel Injection
- ✓ Secondary Air Injection
- ✓ Pre-chamber / Swirl Chamber
- ✓ Cylinder Deactivation
- ✓ Variable Valve Timing
- ✓ Controlled Auto-ignition
- ✓ Advanced turbochargers
- ✓ Friction Reduction
- ✓ Smart Cooling
- ✓ Variable Compression Ratio
- ✓ High Pressure Fuel Injection
- ✓ Camless Valve Trains

### **Medium Term (5 – 10 yrs)**

**Up to 10 % Improvements  
in Fuel Economy**

### **Long Term (10 – 30 yrs)**

**Up to 35 % Improvements  
in Fuel Economy**

# CLEANER VEHICLES

## ■ Advanced / Emerging Technologies for New Vehicles: Non-propulsion System Improvements

- ✓ Vehicle Aerodynamics
- ✓ Tire Rolling Resistance
- ✓ Vehicle Weight Reduction

3 – 8 % Improvements  
in Fuel Economy

## ■ Alternative Fuels / Technologies

- ✓ Electric
- ✓ Hybrid
- ✓ Bio-fuels (Ethanol, Biodiesel, Biogas)
- ✓ Hydrogen IC / Hydrogen Fuel Cell

### Electric

- ✓ EV: 5 km / kWh ( $\eta = 60\%$ )
- ✓ Limited range per full charge

### Fuel Economy Benefits of Hybrid

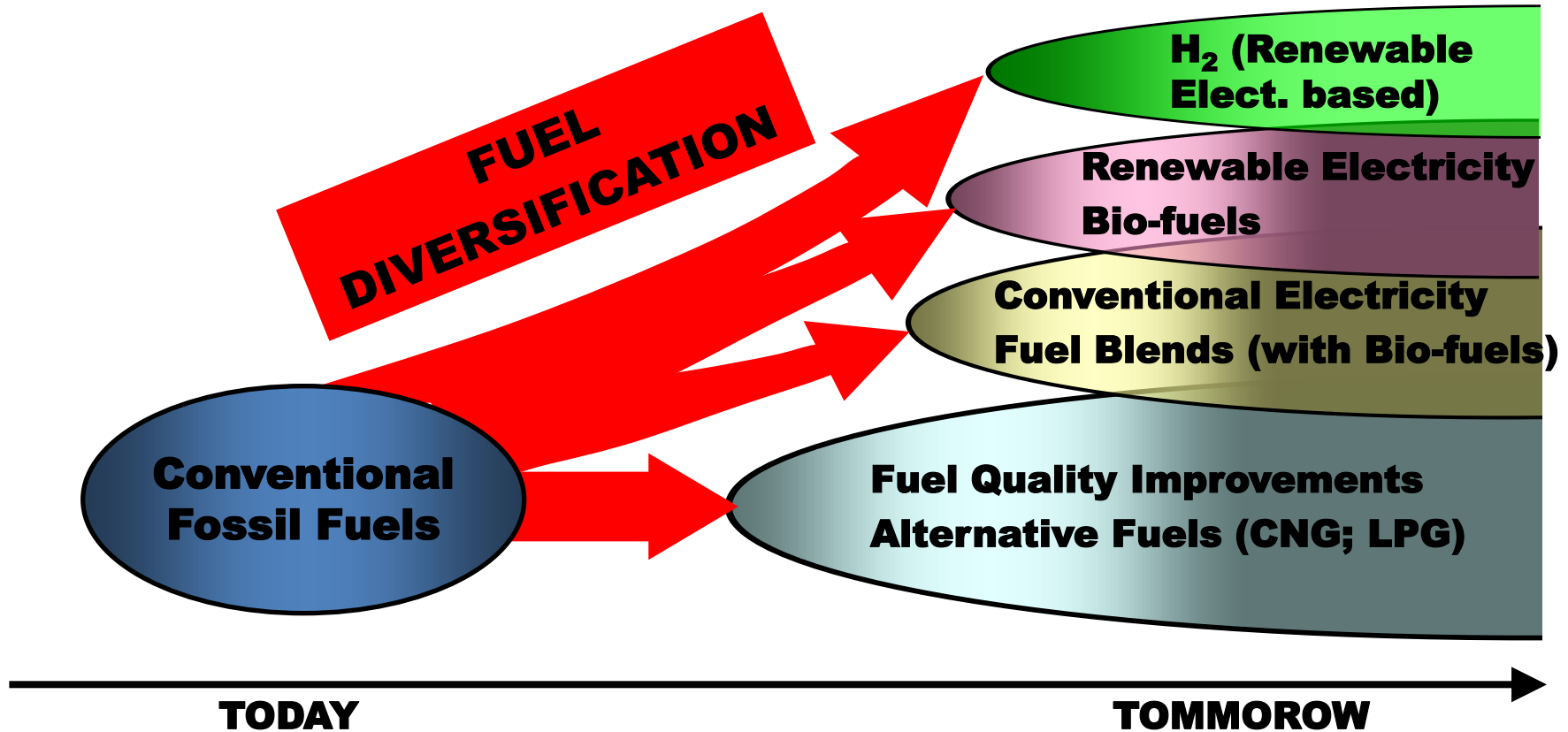
- ✓ Weak Hybrid: Up to 20%
- ✓ Mild Hybrid: Up to 50%
- ✓ Full Hybrid: Up to 80%

### Hydrogen

- ✓ Production of 1 kg of H<sub>2</sub> needs 55 kWh of electricity ( $\eta=70\%$ )
- ✓ IC Engine: 25 km / kg H<sub>2</sub> ( $\eta=6\%$ )
- ✓ Fuel Cell : 80 km / kg H<sub>2</sub> ( $\eta=20\%$ )

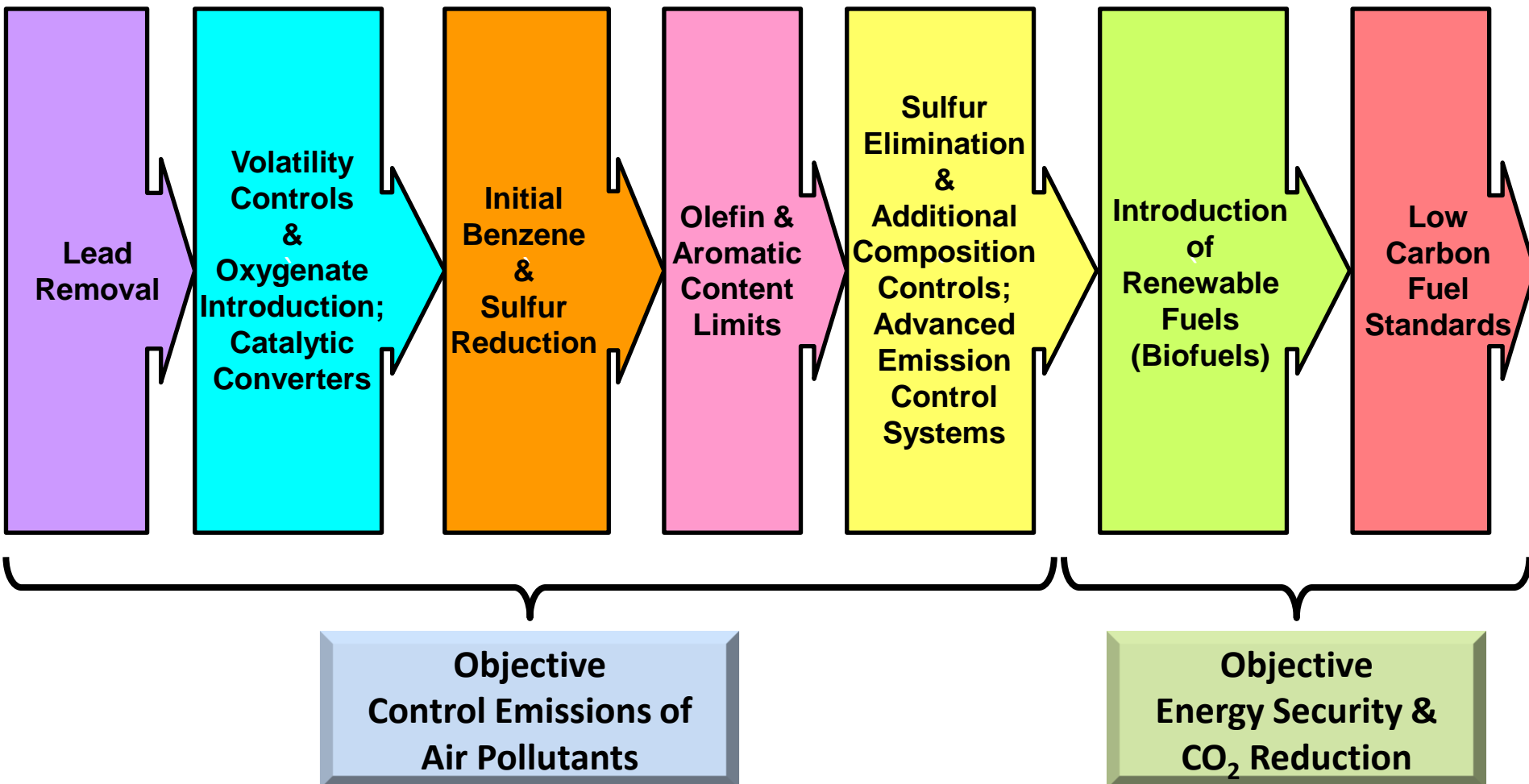
# CLEANER FUELS

- Road Map for Cleaner Fuels:



# CLEANER FUELS

## ■ Global Fuel Quality Developments:



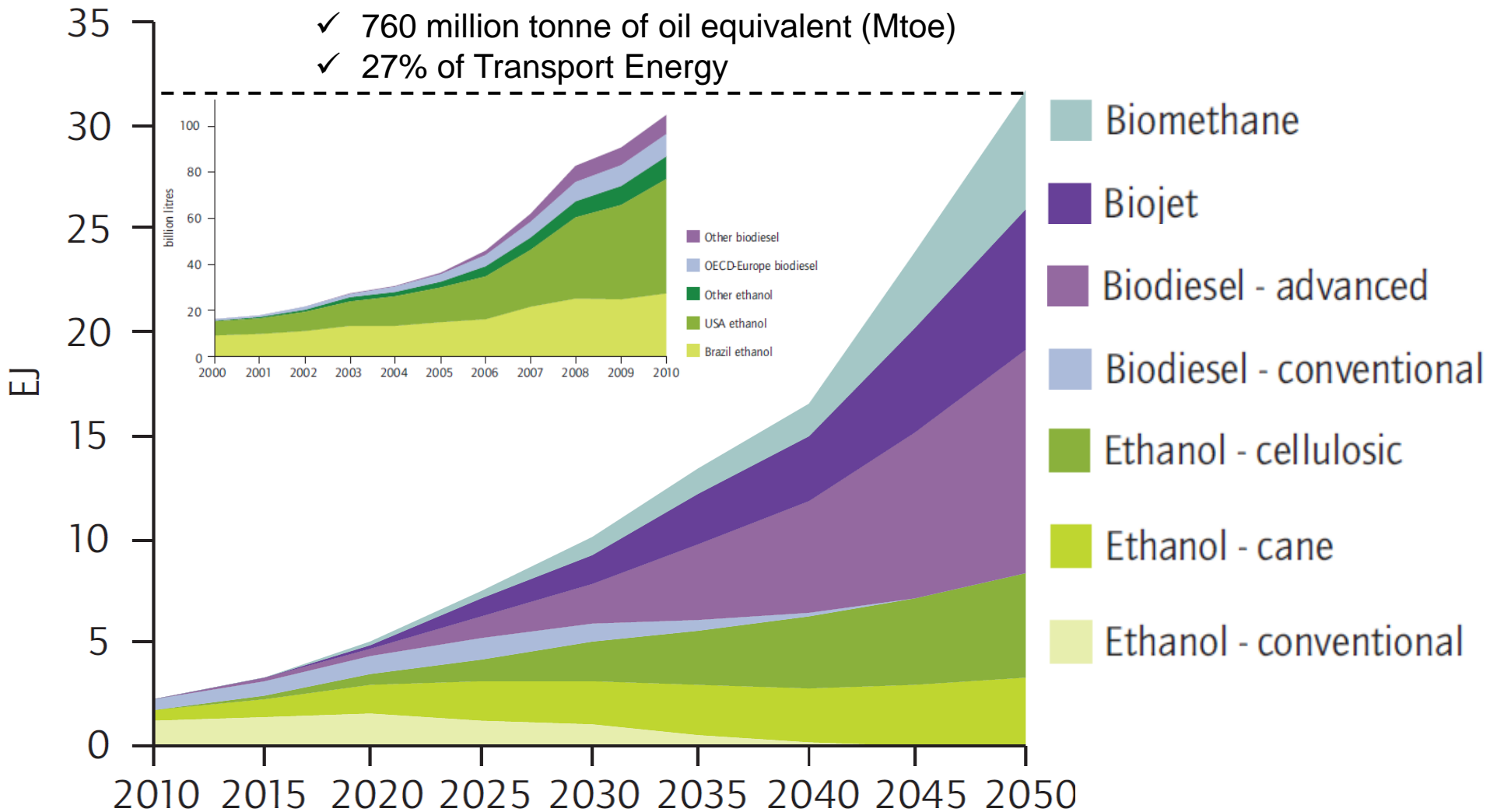
# CLEANER FUELS

## ■ Conventional and advanced biofuel conversion technologies

|                         |                                           | Advanced Biofuels                                  |                             | Conventional Biofuels               |
|-------------------------|-------------------------------------------|----------------------------------------------------|-----------------------------|-------------------------------------|
|                         | Basic and Applied R&D                     | Demonstration                                      | Early Commercial            | Commercial                          |
| Bioethanol              |                                           | Cellulosic Ethanol                                 |                             | Ethanol from sugar and starch crops |
| Diesel-type biofuels    | Microalgae – Biodiesel<br>Sugar-based HCs | Biomass to Biodiesel (from gasification)           | Hydro-treated vegetable oil | Biodiesel (by transesterification)  |
| Other fuels & additives | Novel Fuels (e.g. furanics)               | Biobutanol, Dimethylether<br>Pyrolysis-based fuels | Methanol                    |                                     |
| Biomethane              |                                           | Bio-synthetic gas                                  |                             | Biogas (AD)                         |
| Hydrogen                | All other Novel routes                    | Gasification with reforming                        | Biogas reforming            |                                     |

# CLEANER FUELS

## ■ Demand for Biofuels – IEA BLUE Map Scenario



***Thank You***