



A blue articulated bus is driving on a road next to a waterfront. In the background, there is a city skyline with a prominent church spire. The bus is moving towards the right side of the frame.

# **Ethanol buses**

**– experiences and prospects for sustainable urban transport**

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Senior Vice President  
Powertrain Development  
Scania

# 115 years of industrial history

|       |                                     |      |                                  |
|-------|-------------------------------------|------|----------------------------------|
| 1891  | Company founded                     | 1964 | Factory in the Netherlands       |
| 1897  | First car                           | 1969 | Saab and Scania-Vabis merge      |
| 1902  | First truck<br>First marine engine  | 1976 | Factory in Argentina             |
| 1905  | First industrial engine             | 1992 | Factory in France                |
| 1911  | Scania and Vabis merge<br>First bus | 1993 | Factory in Poland                |
| 1921  | Bankruptcy                          | 1995 | Factory in Mexico                |
| 1930s | Buses main product                  | 1995 | Independent company              |
| 1934  | Last <b>red</b> figures             | 1996 | Scania a public company          |
| 1940s | New strategy                        | 1999 | Ownership uncertainty            |
| 1950s | Exports started                     | 2000 | Factory in St Petersburg, Russia |
| 1957  | Factory in Brazil                   | 2004 | New truck range                  |
|       |                                     | 2005 | New bus and coach range          |





Long-haulage



Construction



Distribution



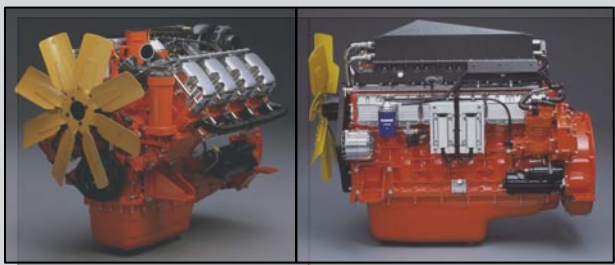
City



City and intercity



Intercity and coach



Industrial and marine engines

# Product ranges

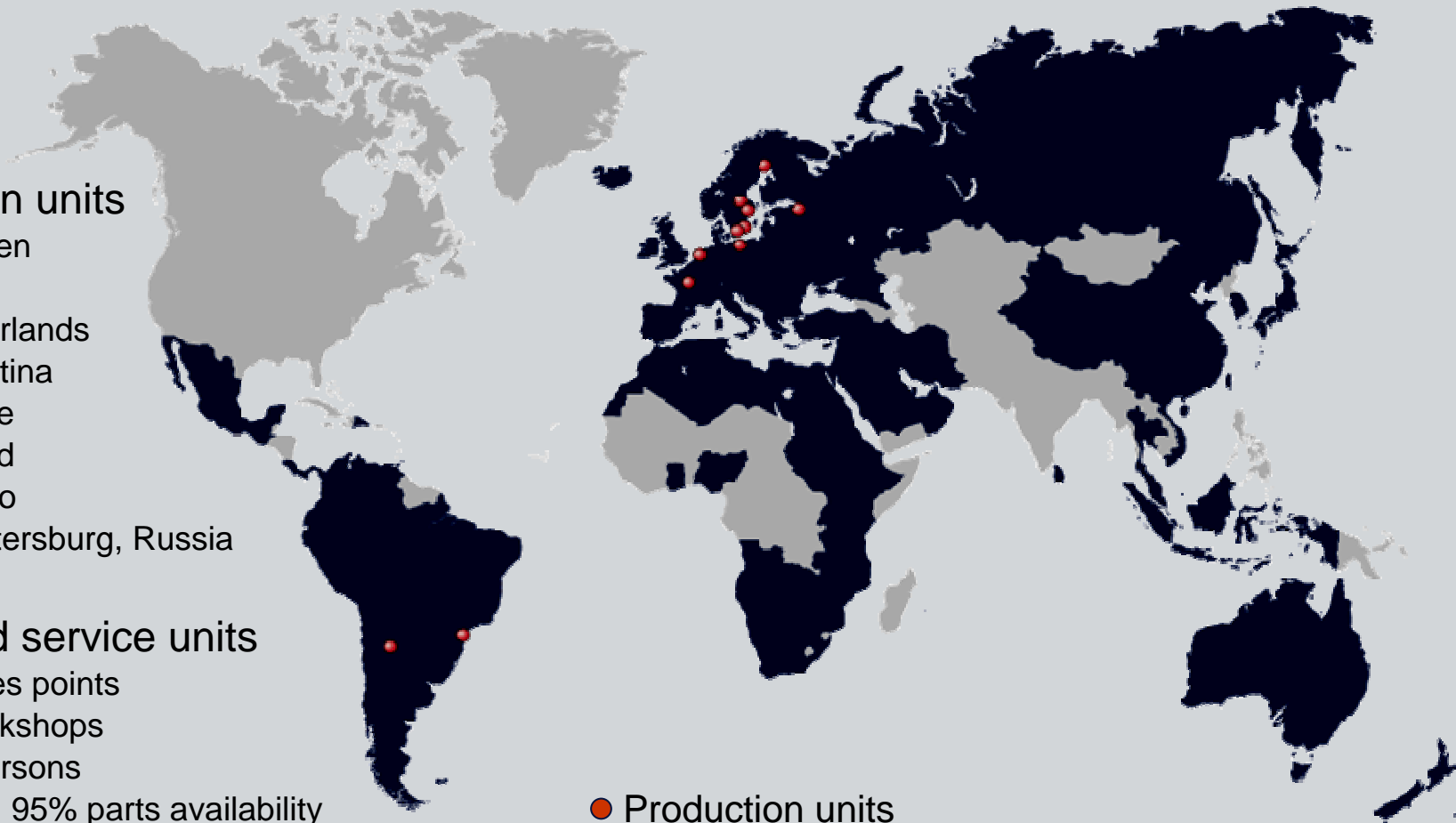
# The world of Scania

## Production units

- 1891 Sweden
- 1957 Brazil
- 1964 Netherlands
- 1976 Argentina
- 1992 France
- 1993 Poland
- 1995 Mexico
- 2000 St Petersburg, Russia

## Sales and service units

- 1,000 sales points
- 1,500 workshops
- 30,700 persons
- More than 95% parts availability
- Round-the-clock assistance



- Production units
- Sales and service network

# Historical growth

Vehicles produced

70,000

60,000

50,000

40,000

30,000

20,000

10,000

0

1946

1955

1965

1975

1985

1995

2005

Trucks

Buses



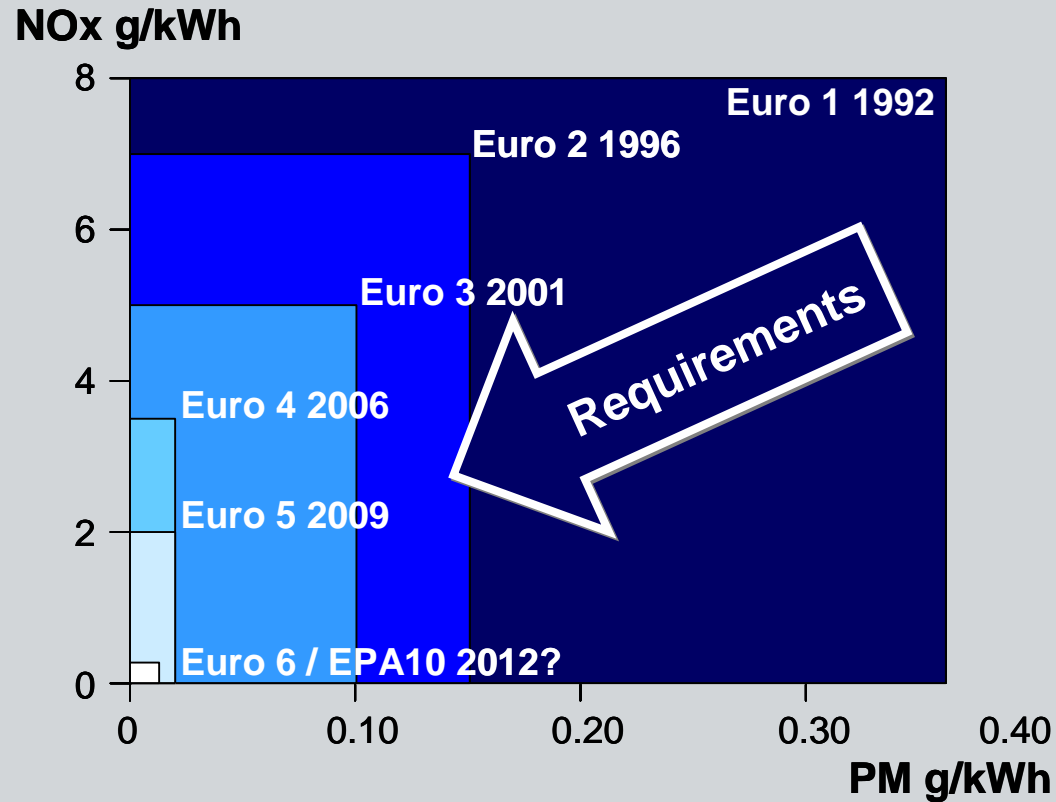
# Challenges and drivers

- Customers demand minimised fuel cost
- Insecure long-term oil supply
- Global warming – cut CO<sub>2</sub> emissions
- Legal requirements
- Environmental ambitions



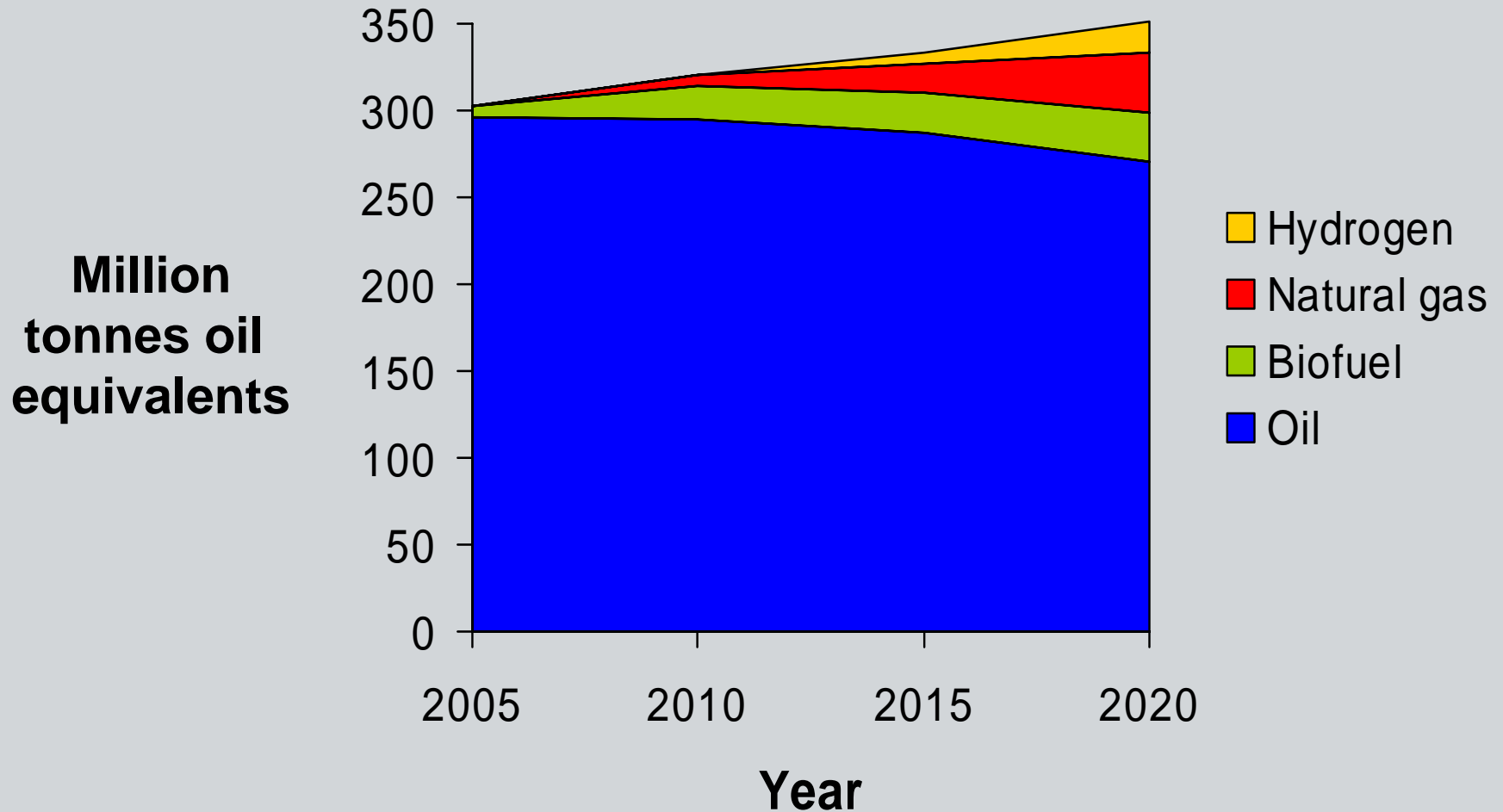
**Efficient energy converters**  
**Alternative fuels**

# European emission standards





# European fuel demand – EU targets



Dir. 2003/30/EG and European Energy and Transport: Trends to 2030

# Viabile alternatives

- **Ethanol – liquid renewable fuel**
  - With 5% ignition improver
- **RME (FAME) – liquid renewable fuel**
  - 100% or mixed 5% in diesel
- **Synthetic diesel – fossil or renewable**
  - 100% or mixed with diesel
- **Gas (methane) – fossil or renewable**

# Liquid fuels preferable for vehicles

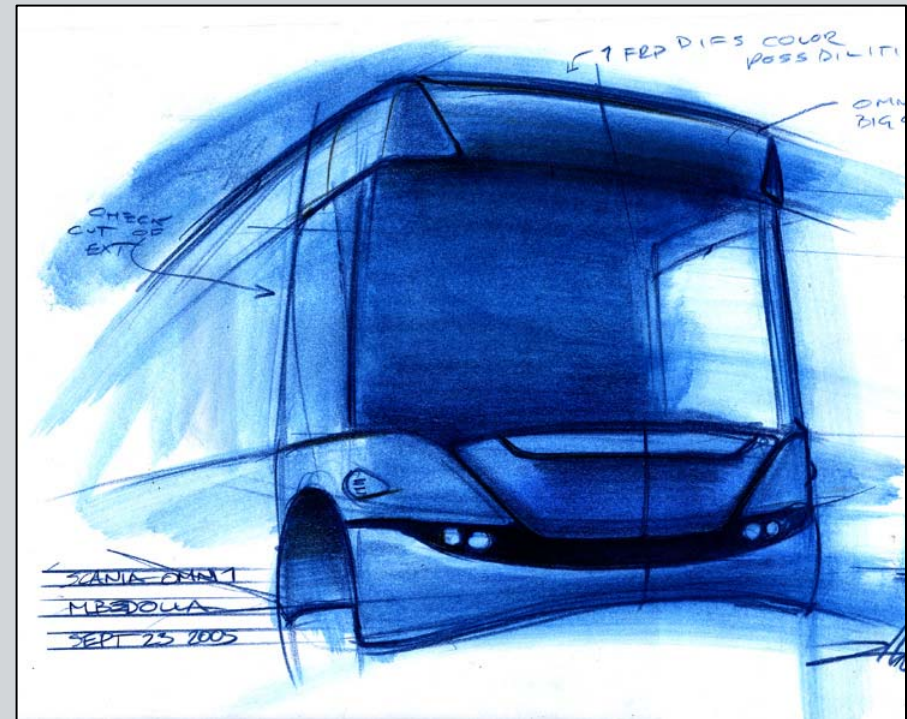
- Gas ideal for stationary plants
- Gas propulsion possible for urban use
- Gas gives weight and bulk penalty onboard
- Liquid fuel convenient to distribute and handle
- Liquid fuel easy to carry onboard a vehicle



Source: BEST kickoff

# Robust hybrid technology – fuel flexibility

- Existing robust engine technology
- Fuel saving at least 25 percent
- Robust energy storage with ultracapacitors
- Ethanol, RME, diesel or gas
- Excellent emission and noise reduction potential



# Ethanol – liquid renewable fuel

- Pure ethanol plus 5% ignition improver
- Diesel engine technology, high efficiency
- Liquid renewable fuel, easy to handle
- Potential for high global volumes
- Excellent emission levels



# Scania ethanol history



1916 First ethanol engine

1979 First vehicle tests

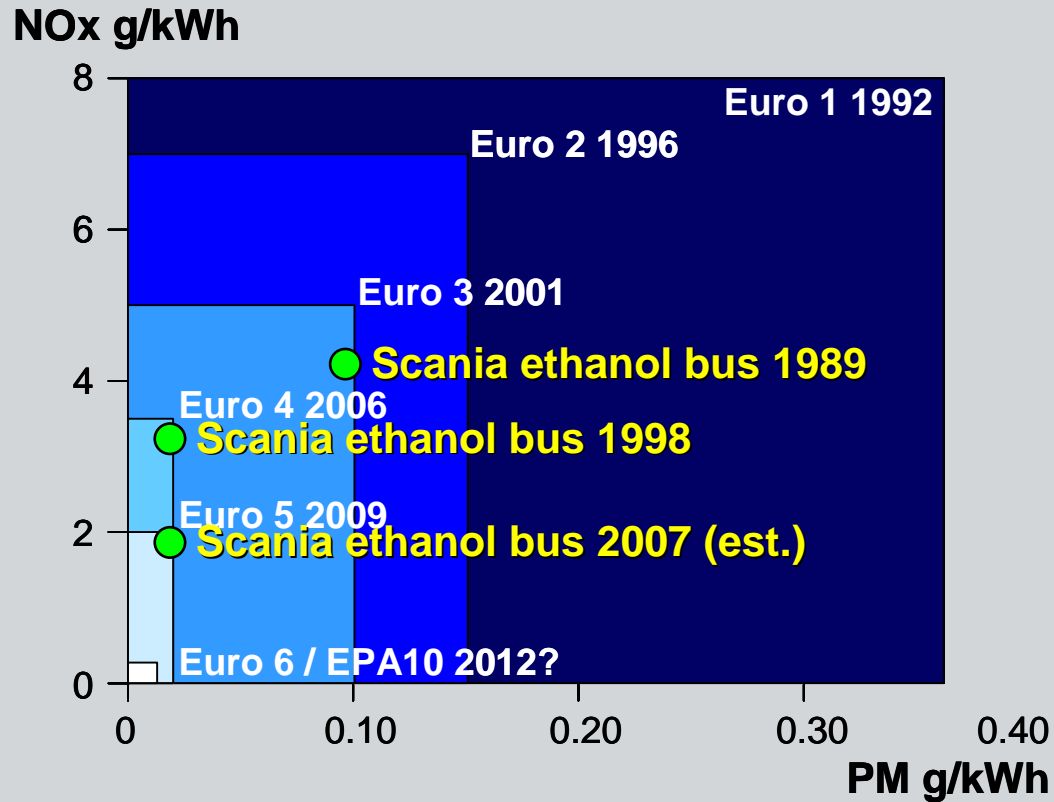
1985 First buses tested in Sweden

# Scania ethanol history



1990- 600 buses supplied  
mainly to Sweden

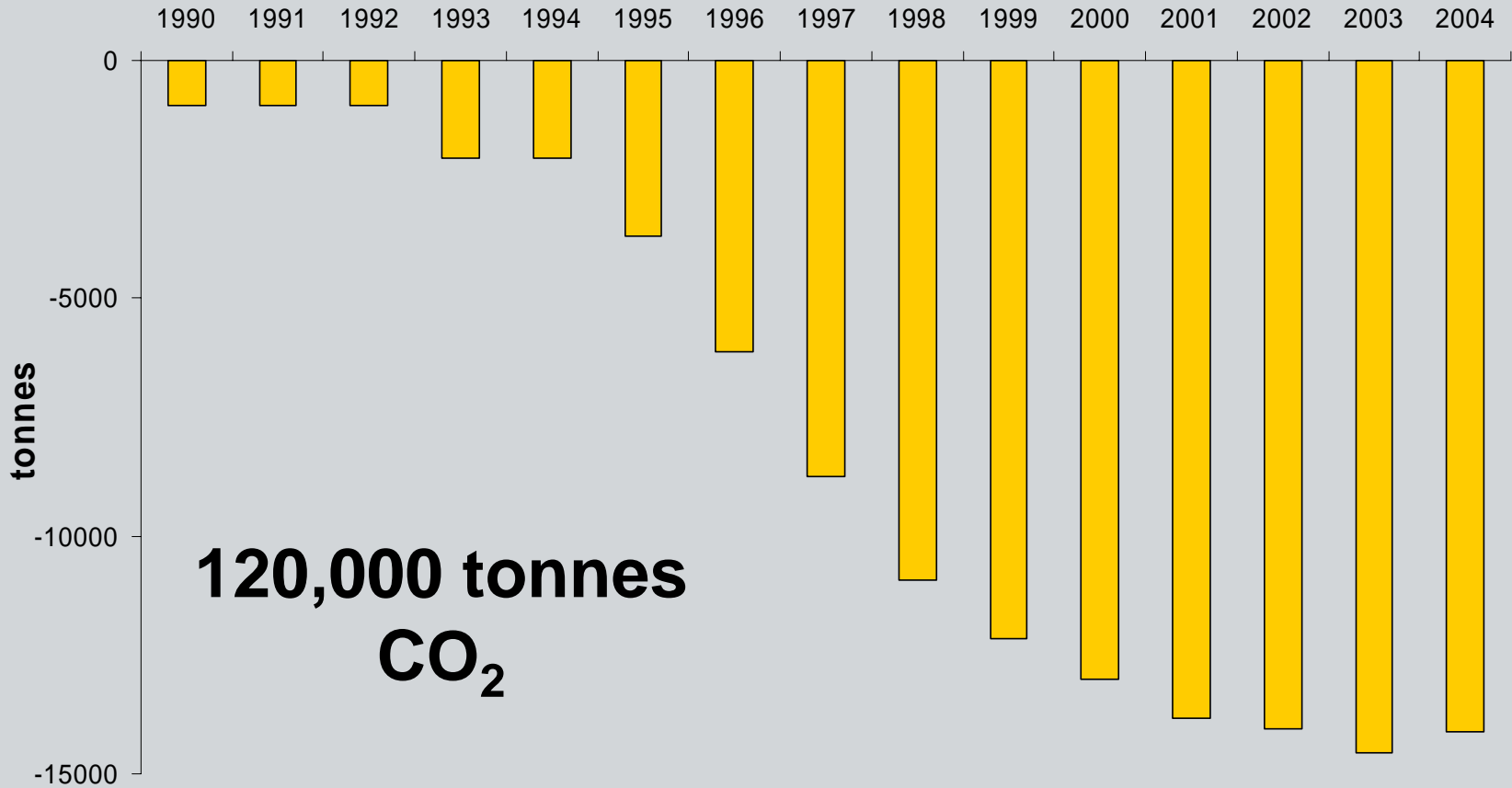
# European emission standards





# Net gain in CO<sub>2</sub> with ethanol

## Stockholm, diesel vs. ethanol

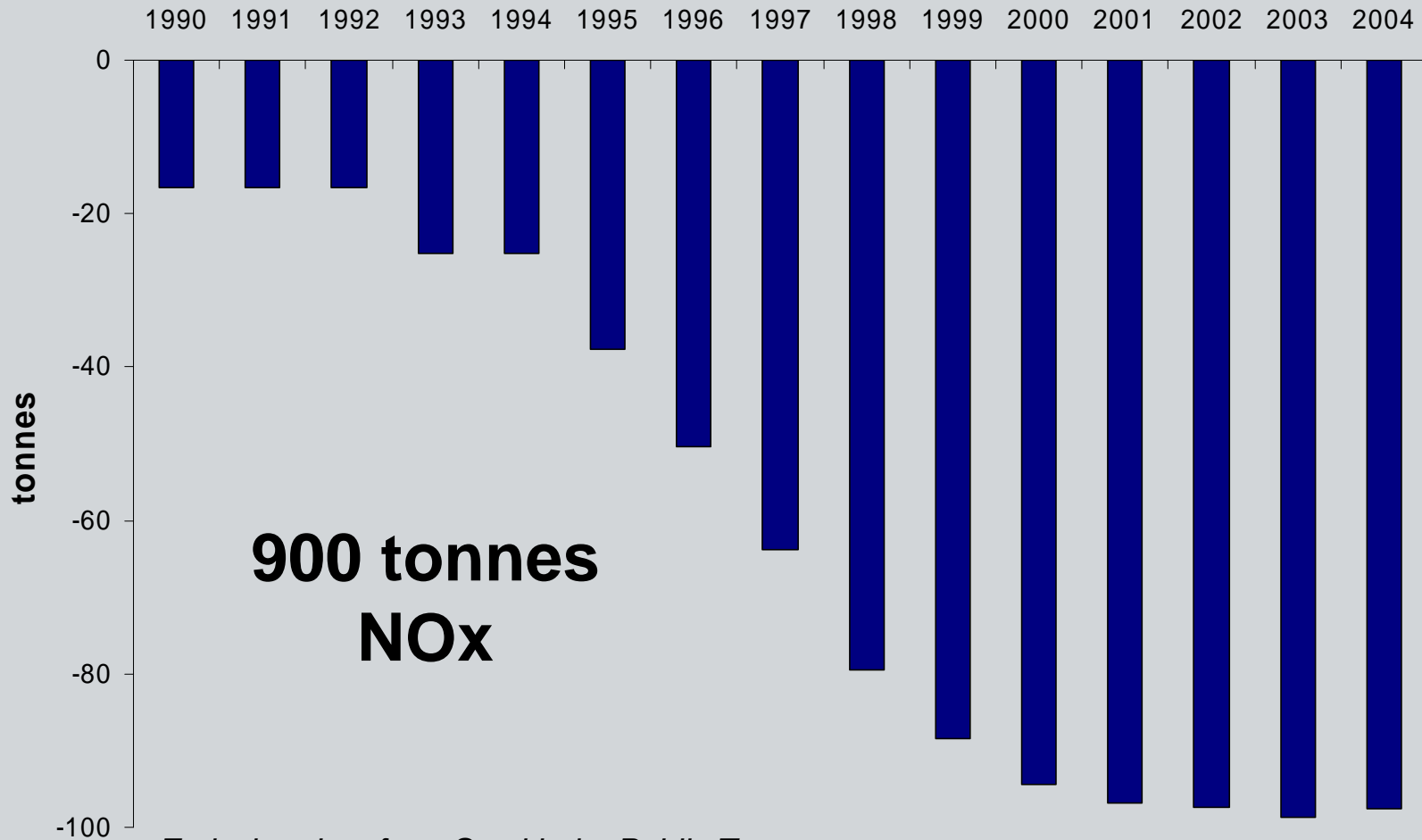


*Emission data from Stockholm Public Transport:*

**Emissions of fossil CO<sub>2</sub> reduced by 120,000 tonnes since 1990**

# Net gain in NOx with ethanol

## Stockholm, diesel vs. ethanol

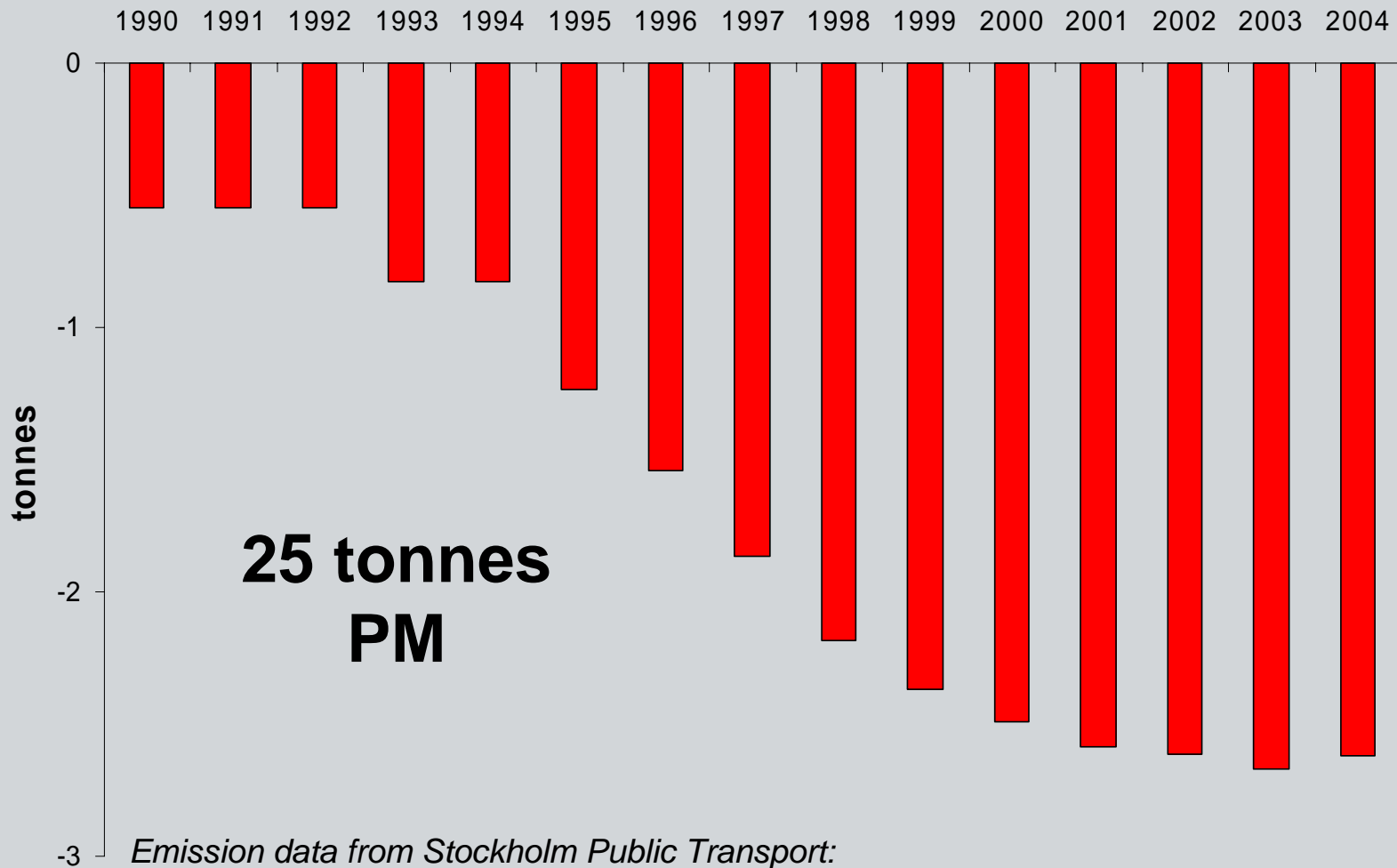


*Emission data from Stockholm Public Transport:*

**Emissions of fossil NOx reduced by 900 tonnes since 1990**

# Net gain in PM with ethanol

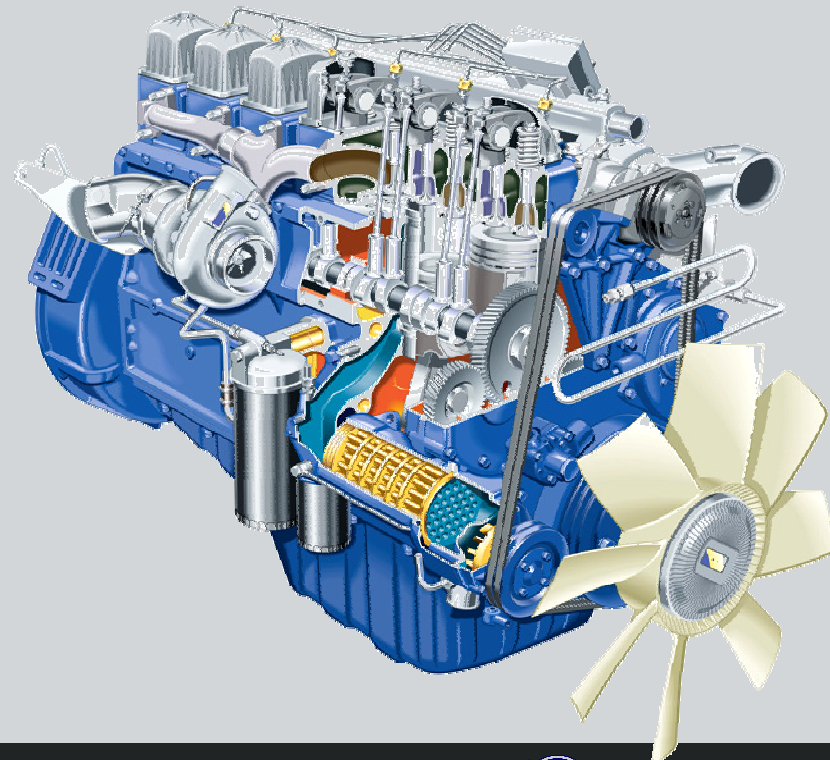
## Stockholm, diesel vs. ethanol



# Ethanol as diesel fuel

## Technical changes

- Compression ratio raised from 18:1 to 28:1
- Larger fuel injection nozzles
- Injection timing altered
- Gaskets and filters changed
- Larger fuel tanks needed

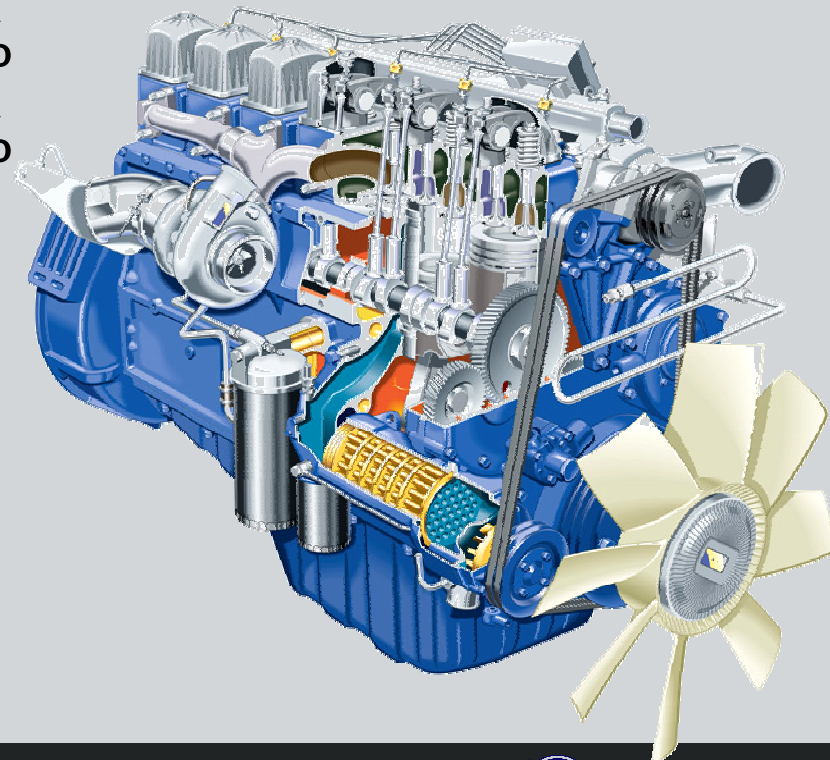


# Ethanol engine efficiency \*

| Engine load | <i>min.</i> | <i>max.</i> |
|-------------|-------------|-------------|
| 25%         | 32.4%       | 36.3%       |
| 50%         | 36.6%       | 38.0%       |
| 75%         | 37.4%       | 40.0%       |
| 100%        | 37.4%       | 40.6%       |

## Fuel economy

65-70% more ethanol  
than diesel



\* Single-cylinder test

# Ethanol as diesel fuel



## Operational aspects

- Fuel handling
- Sprinkler system standard
- Shorter oil-change intervals (halved)
- More scheduled maintenance required

# Ethanol buses – a proven alternative since 15 years

- Easy fuel handling and storage
- Diesel engine
- Proven and reliable technology
- Standard Scania city bus with standard Scania components



Source: BEST kickoff



**SCANIA**



2000

XLK 425