

# Biofuels in road transport and effects on air pollutants

Workshop 'Synergies and Trade-offs between Climate and Air Pollution Policies: Optimizing Opportunities and Preventing Risks'  
18 June 2010

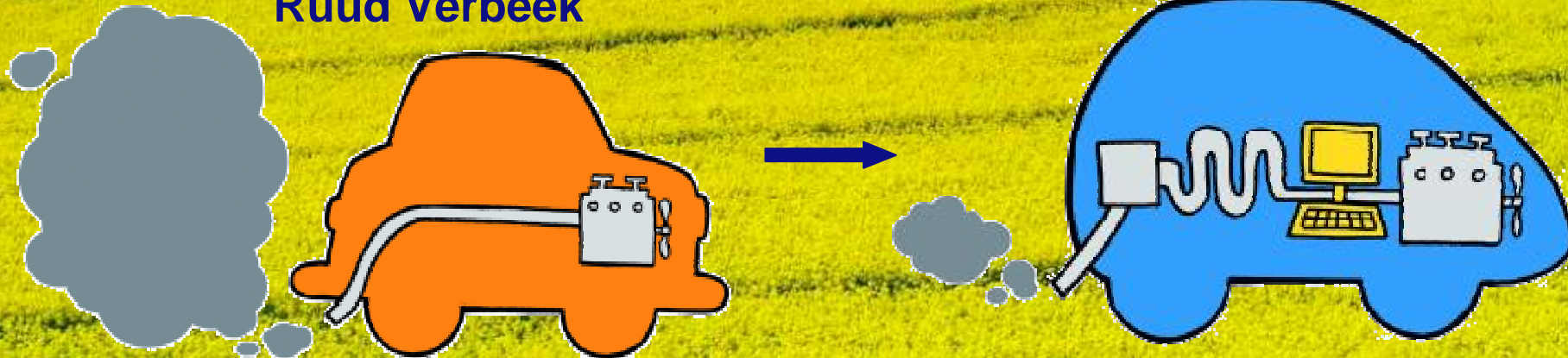
**TNO | Kennis voor zaken**



CE Delft



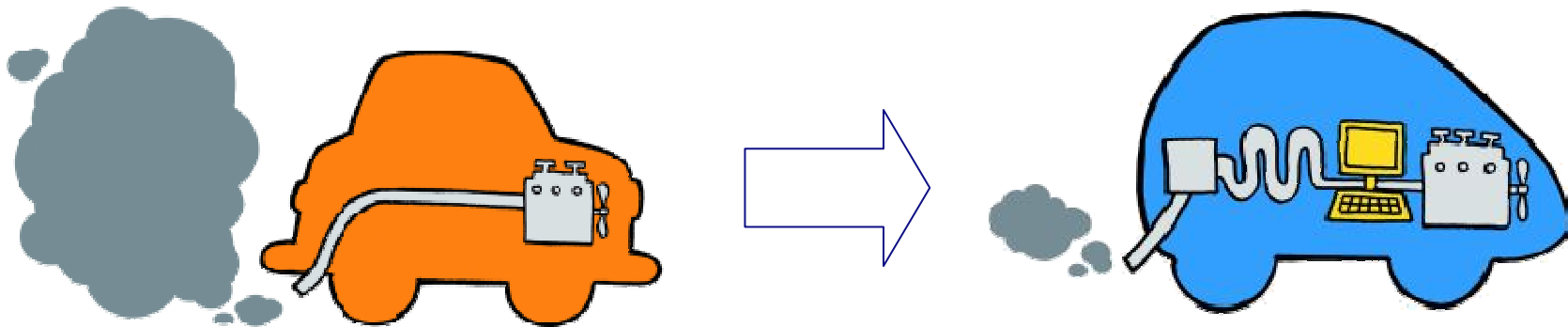
**TNO & CE Delft**  
**Ruud Verbeek**



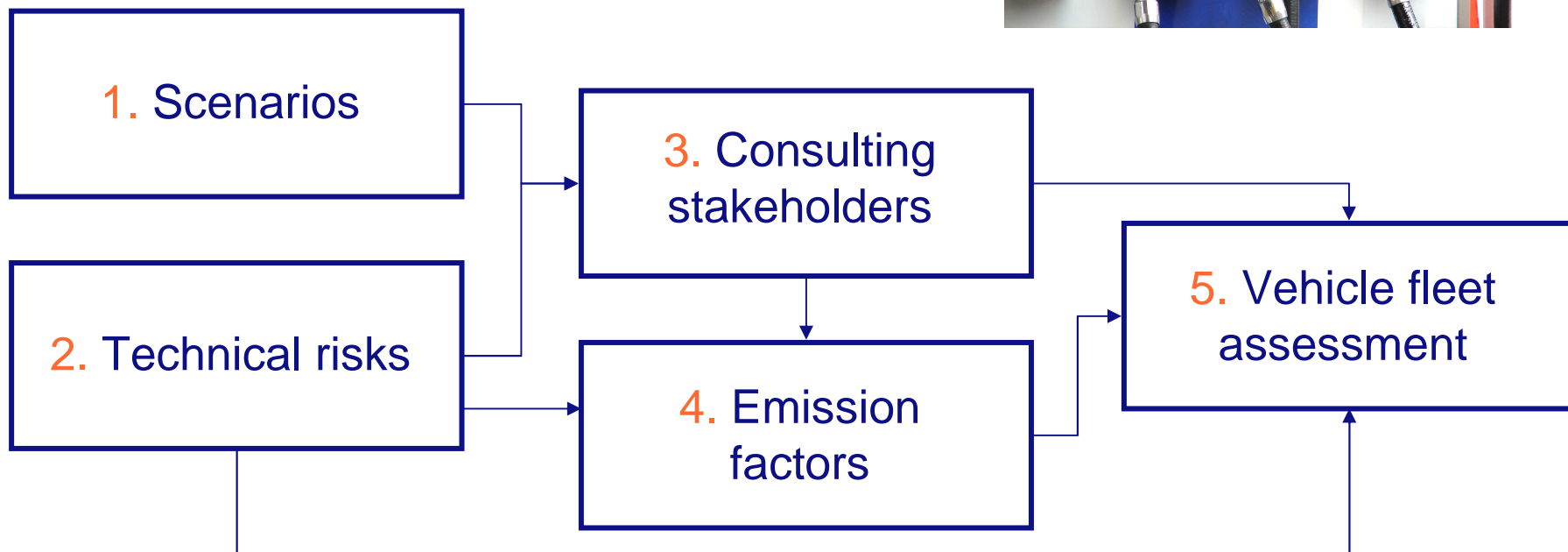
Utrecht, 18 June 2010

# Objective

- Evaluation of the effects of 3 biofuel scenarios on the national emissions of road transport in 2020
- Evaluation of measures to minimise risks of negative emission effects



# Structure project



# Contents

- Fuel mix scenario's
- Technical compatibility / stakeholders consultation
- Emission factors for biofuel blends
- Emissions on a national level
- Conclusions and recommendations



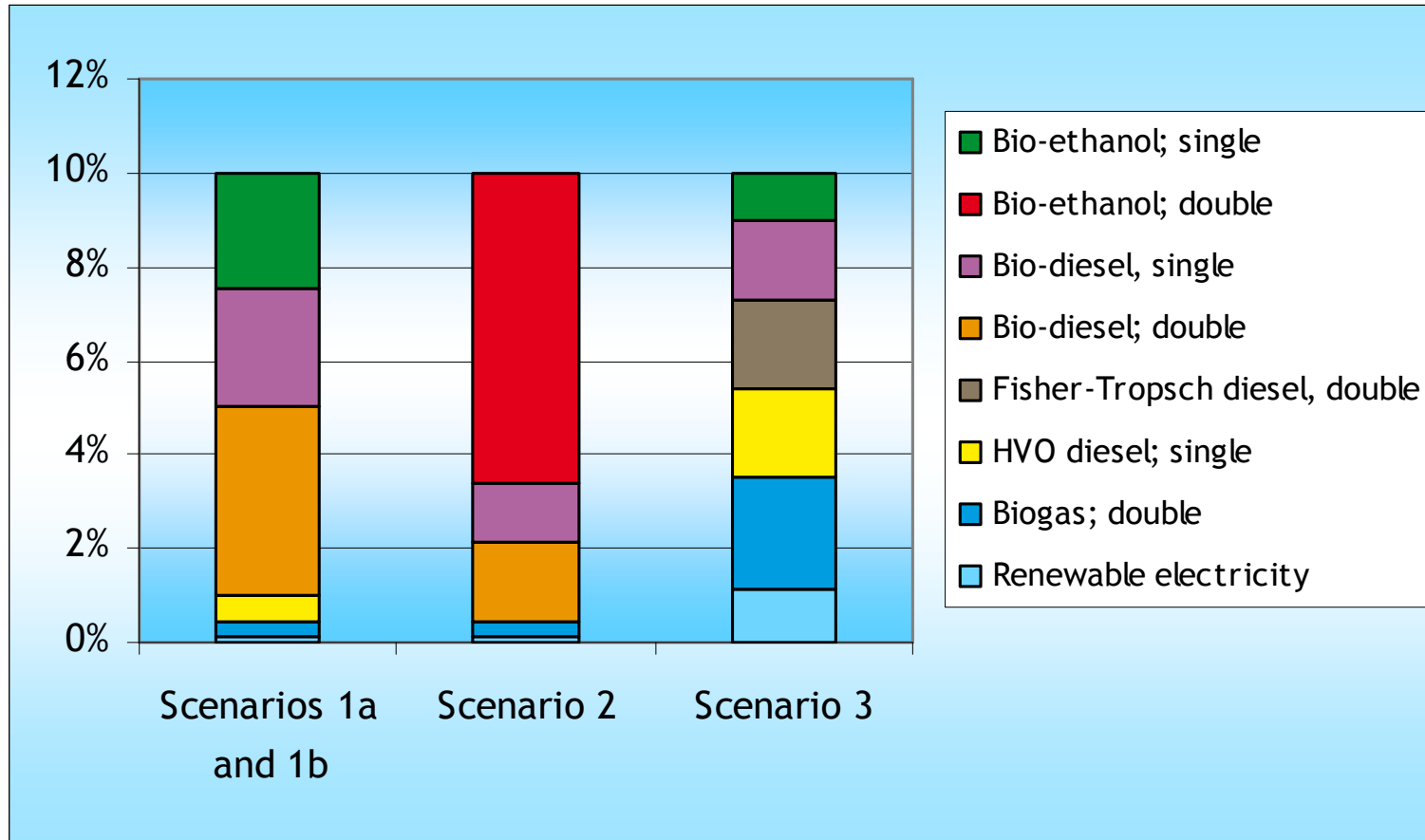
## Biofuel options

Popular biofuels (blends)	Within fuel specification	maximum
“gasoline replacement”: Ethanol: low blend in standard vehicles Ethanol: high blend in FFV Biogas (upgraded to NG quality)	0 -10% 0 - 85% 0 - 100%	15% 100%
“diesel replacement”: Biodiesel: methyl esters: FAME. FAEE HVO: Hydrotreatment Vegetable Oil BTL: Biomass to Liquid	0 - 7 % 0 - 30% 0 - 30%	100% 100% 100%

# Fuel mix scenario's for 2020

- 1. Focus on single (& double) counting biodiesel and ethanol.*  
Bulk fuels are B7 and E10  
High blend for heavy-duty vehicles:
  - B30 (scenario 1a): 10% market share
  - B100 (scenario 1b): 2.3% market share
- 2. Focus on double counting ethanol and biodiesel.*  
2% market share by energy of E85 for passenger cars and biodiesel only in low blend (<B5)
- 3. Focus on air quality.*  
5.6% market share by energy of natural gas / biogas for passenger cars  
bulk diesel with low blend biodiesel, HVO and BTL.  
Largest share of plug in hybrids and electric  
(4.2% by energy, 660.000 vehicles)

# Fuel mix scenario's for 2020



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## Ethanol and low blend biodiesel are well implemented in future emission legislation

- E10 and B7 will most likely be implemented as standard fuels for the emissions legislation Euro 6 / VI



- E85: implemented in legislation (Euro 5 phase B)
  - Same requirements as for petrol
  - No significant technical problems expected



- Technical issues with high blends biodiesel (FAME)
  - Emissions change (possible NOx increase)
  - Durability issues of emission control systems



## High blend (conventional) biodiesel (FAME) can seriously affect the performance and durability of emission control systems !

<b>Euro class</b>	<b>Emission control technology</b>	<b>Possible failure</b>
Euro III		Injector deposits
Euro III Euro IV Euro V	EGR	Injector deposits EGR valve sticking or EGR cooler fouling
Euro IV Euro V	SCR	Injector deposits SCR catalyst poisoning
Euro VI	EGR + SCR + DPF	Injector deposits DPF failure EGR valve sticking or EGR cooler fouling SCR catalyst poisoning

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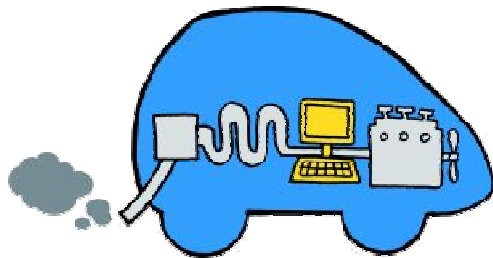
# Emission Factors for biofuels blends

$$\boxed{\begin{array}{l} \text{Emission} \\ \text{Factor}_{\text{biofuel}} \end{array}} = \boxed{\begin{array}{l} \text{Emission} \\ \text{Factor}_{\text{convention}} \end{array}} \times \boxed{\begin{array}{l} \text{Standard} \\ \text{Factor}_{\text{biofuel}} \end{array}} \times \boxed{\begin{array}{l} \text{Failure} \\ \text{Factor}_{\text{biofuel}} \end{array}}$$

CAR II

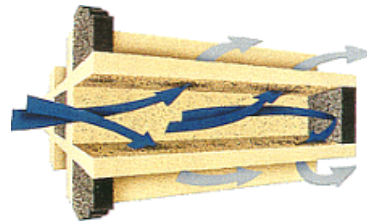
B10 – B100  
E85

B10 – B100



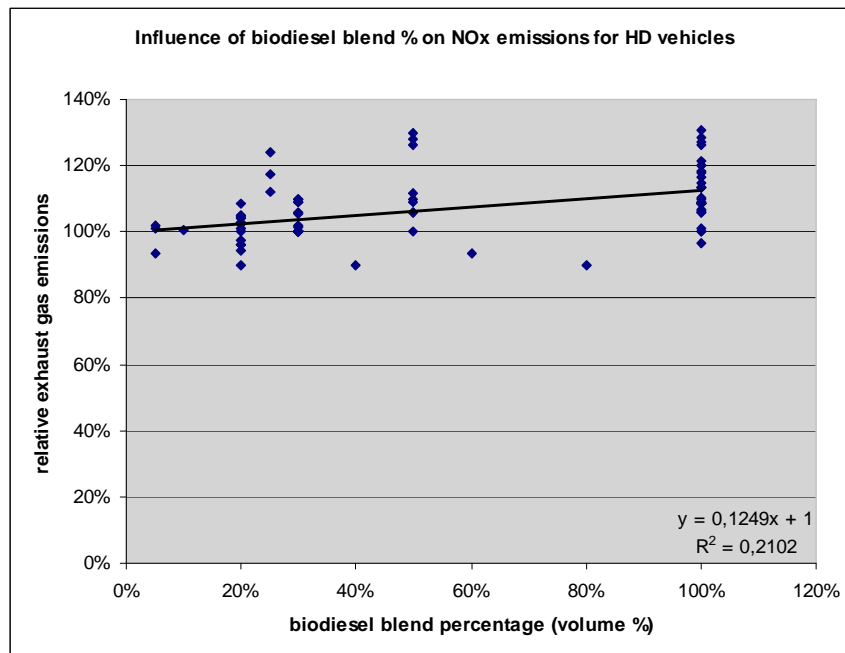
increase or  
decrease

increase  
1% - 5%  
failures

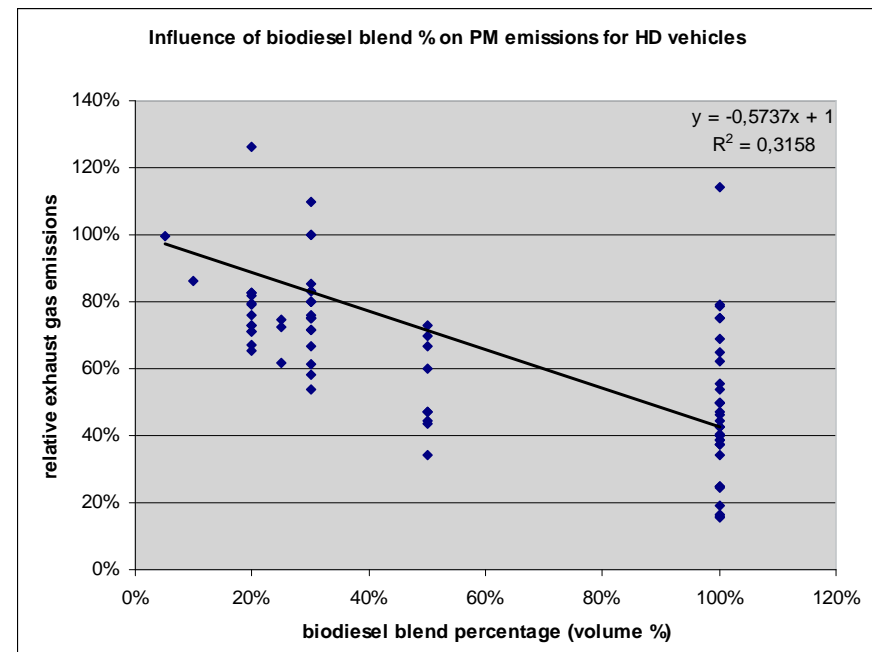


# Biodiesel (FAME) increases NOx and reduces PM emissions

## NOx



## PM



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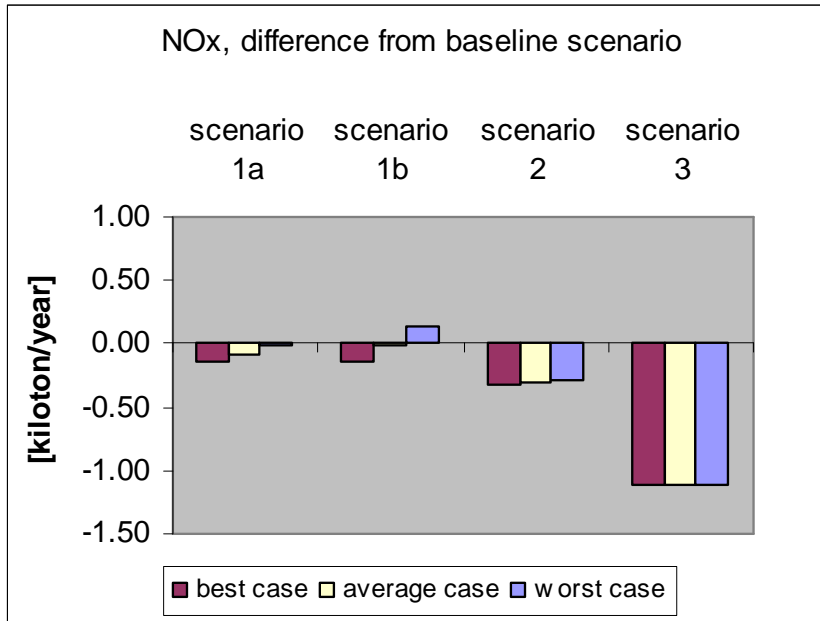
## Emissions on a national level

- Emission factors in g/km converted to g/GJ fuel energy (7 vehicle categories):

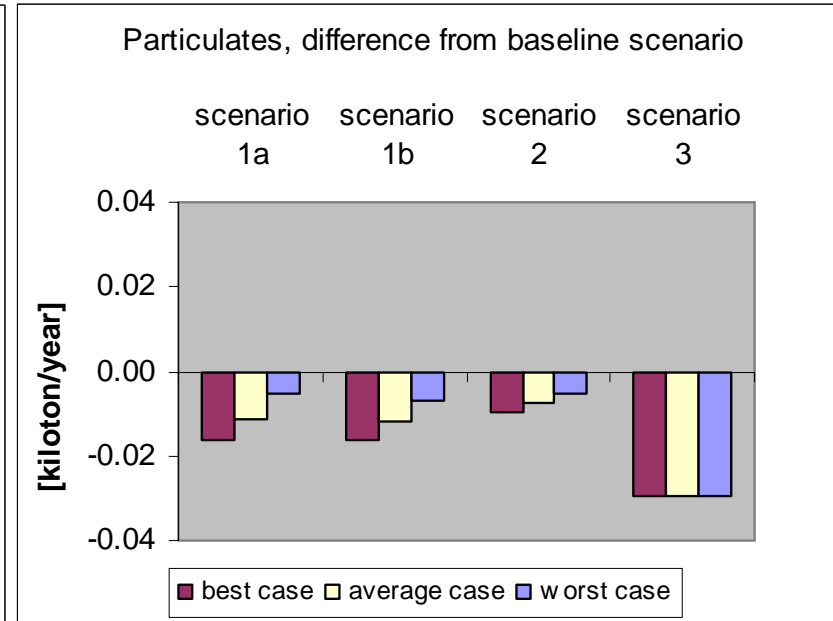
$$\begin{array}{|c|} \hline \text{Emission factor} \\ \hline \text{g/MJ} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Energy consumption} \\ \hline \text{MJ/year} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Total emissions} \\ \hline \text{g/year (kTon/year)} \\ \hline \end{array}$$

# Small effects on emissions on a national level

- Influence of biofuel scenarios on emissions [kiloton/year]



NOx  
up to 2% reduction



PM  
up to 2-5% reduction  
of tailpipe emissions

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## Conclusion / Key message

**Effects of 10% biofuel target on NOx and PM emissions for 2020 are very small, provided that the potential issues with high blends of FAME type biodiesel can be controlled or avoided.**



# Recommendations

- High blends of FAME type biodiesel are not recommended, also not for trucks
- Stimulate double counting biofuel because it reduces the need for high blends?
- Stimulate and monitor fleets with trucks on high blends of biodiesel and passenger cars on biogas/natural gas
- Provide technical guidelines and requirements for high blends biodiesel for trucks
- Monitor failure rates and quality of all fuels extensively.

# Thank you for your attention !

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