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Verband der
Automobilindustrie

SCR for Passenger Car Applications -

AdBlue Is Becoming a Commodity for Smaller Cars

Strategy and Requirements of the
German Automotive Industry

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Structure

SCR for Passenger Car Applications

1. The Challenge of the Automotive Industry
2. The Need for an AdBlue Infrastructure
3. SCR Customers Expectations
4. SCR Warning Strategy according to EURO-5 /-6
5. Interim/Emergency Refill-Solution
6. Summary

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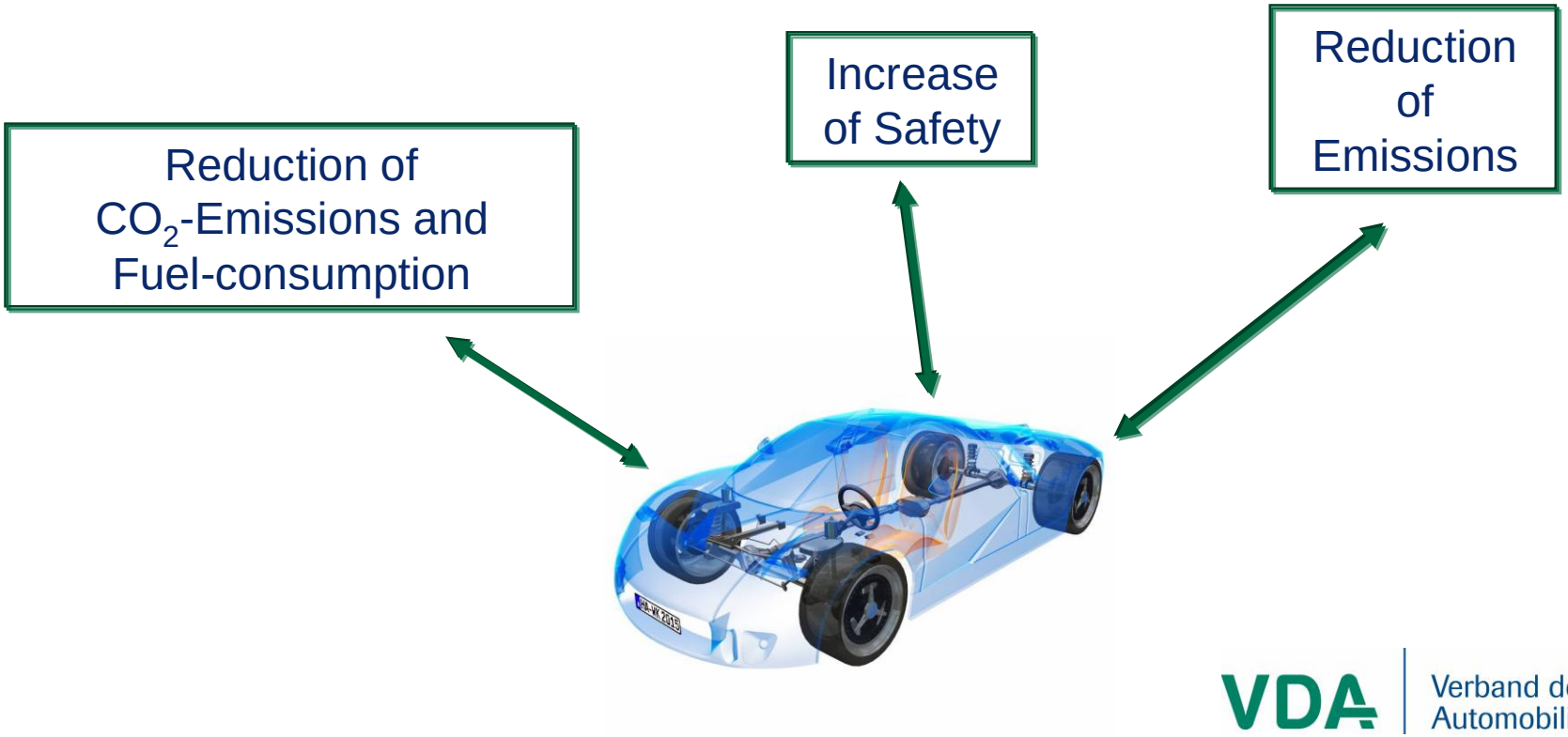
1. The Challenge of the Automotive Industry

Major technical challenges:
Clean - Safe – Efficient



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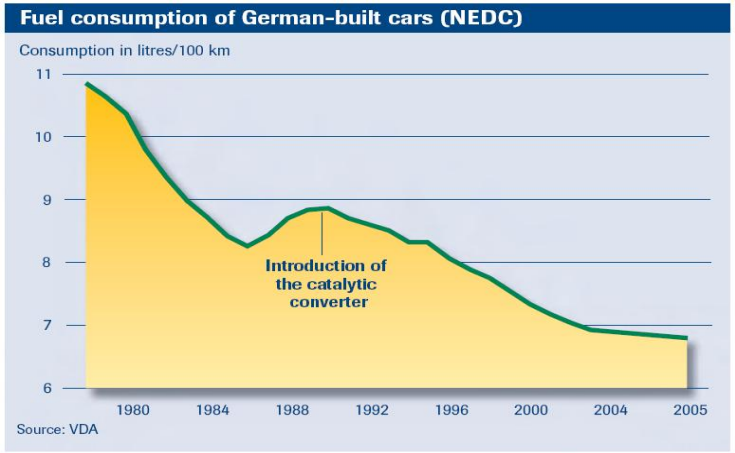
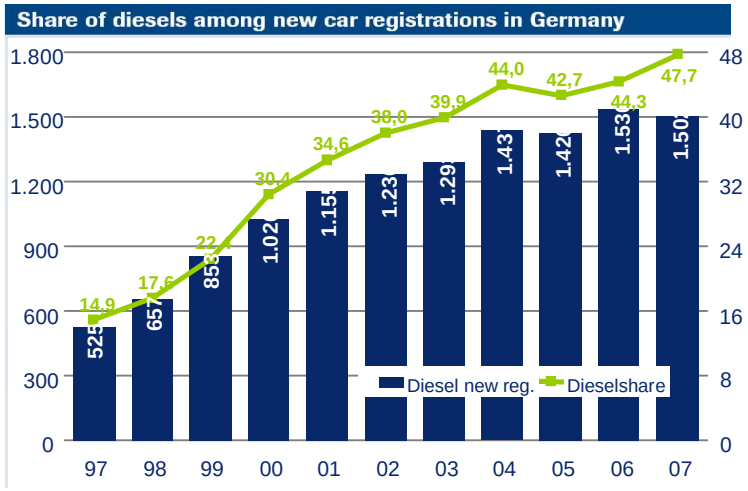
1. The Challenge of the Automotive Industry





- Reducing fuel consumption by 40% since the end of the nineteen seventies
- Reducing fuel consumption by 25% since 1990 of German new cars. This corresponds to a reduction of 2l/100km
- The environmental friendly German Clean Diesel is the key for efficiency

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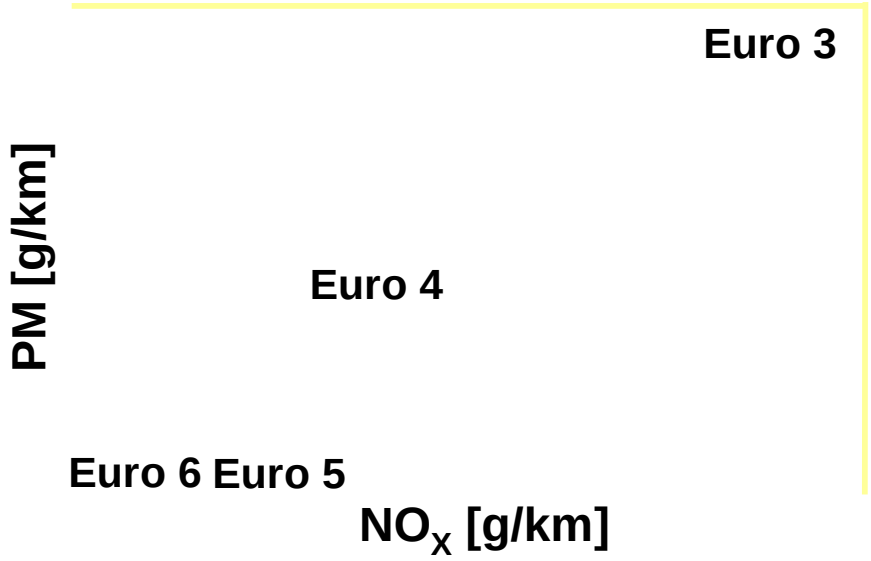
1. The Challenge of the Automotive Industry

Future emission limits and air quality standards require an efficient DeNOx exhaust aftertreatment system



- NO_2 directive
- European Legislation
- WLTP
- Future emission limits

SCR AdBlue system is a very efficient and mature DeNOx technology:

- SCR systems are designed for worldwide application
- OEM committed explicitly on AdBlue as reduction agent for PC and SUV and Light Duty Trucks

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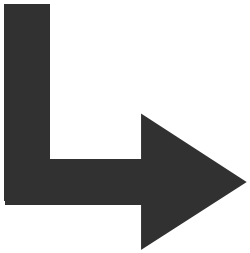
1. The Challenge of the Automotive Industry

Challenge: Reduction of CO_2 emissions:



- Fuel-efficient Diesel vehicles are an essential part of vehicle fleets
- Ambitious targets for vehicle weight reduction
  - Abandonment of non-essential weight proportions
  - Appropriate volume reduction of operating fluids

Common approach of the OEM:

- Implementation of small AdBlue tanks on-board
- Appropriate easy-to-handle AdBlue refill option for frequent customer use

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2. The Need for an AdBlue Infrastructure

The German Car Manufacturers commonly decided the introduction of small AdBlue tanks for all SCR diesel vehicles due to environmental needs.

- We expect, that future emission legislation (e.g. WLTP) will require SCR for all diesel model lines and will increase the AdBlue consumption, that even with current AdBlue tank volume AdBlue regular refilling (2 – 3 times) in between oil drain service interval would be needed.
- With future AdBlue tanks refuling of AdBlue will be necessary in average every 4th diesel-refueling
- Future CO_2 reduction needs make a lowering of AdBlue tank volumes indispensable due to the stringent space requirements for technical CO_2 measures and the SCR necessity for smaller size vehicles.
  - Large AdBlue tanks for a service refill strategy include disadvantages like: Tank volume limits the technical degree of freedom, increases vehicle weight (FE drawbacks), impossible for smaller cars, loss of spare wheel.

→ **A service based AdBlue refill concept cannot be maintained with the introduction of smaller AdBlue tank volumes.**

→ **A customer friendly AdBlue fuel station infrastructure is necessary for the future.**

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2. The Need for an AdBlue Infrastructure

SCR vehicles with reduced AdBlue tank volume will have a soon market launch (2011) with an overall roll out until 2015.

- SCR light duty and passenger cars are already in the European market.
- SCR customers will ask for AdBlue availability at fuel stations with increasing penetration of SCR vehicles with smaller tank systems, e.g. business drivers with company fuel credit cards.
- The installation of an infrastructure with AdBlue pumps has to be started in 2011.
- The first AdBlue pumps should cover local hotspots:

  Fuel stations with a large amount of Diesel sales e.g.: big cities, highways, car pools,…

→ **Until 2015 an area wide coverage with AdBlue pumps will be required in Germany and Europe.**

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3. SCR Customers Expectations

Passenger car customers are used to a high comfort for oil drain frequency and other refill requirements for operating fluids.

- Customers will not accept the need for additional visits to service repair shops only for AdBlue refill, therefore AdBlue refilling must be enabled at fuel stations.
- Refilling of AdBlue by means of canisters can be only a compromise for a short transition period.
- Customers will expect the possibility to fill up the AdBlue tank completely (difficult with fixed volume canisters), to reduce the frequency for AdBlue refilling and to increase the vehicles driving range.
- The AdBlue refilling timing should not exceed diesel refuelling and should not disturb the fuel filling station flow.
- Passenger car/light duty truck filling without spitback and smell. For this reason only a closed system is possible (recovery system) including a standardised adapter.

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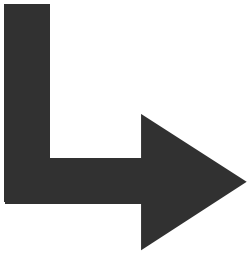
3. SCR Customers Expectations

Customers require a cheap, clean, easy and safe refueling of AdBlue

- The need of AdBlue refill inbetween the vehicle service intervall must be facilitated by a simple, suitable and reliable AdBlue refill infrastructure at fuel stations.
- Customers will need an adequate AdBlue infrastructure to avoid the case of engine shut down due to missing AdBlue availabilty. (see Chapter 4)



A dedicated AdBlue-Pump will be the most promising solution for the comfort of customers and gas station flow.

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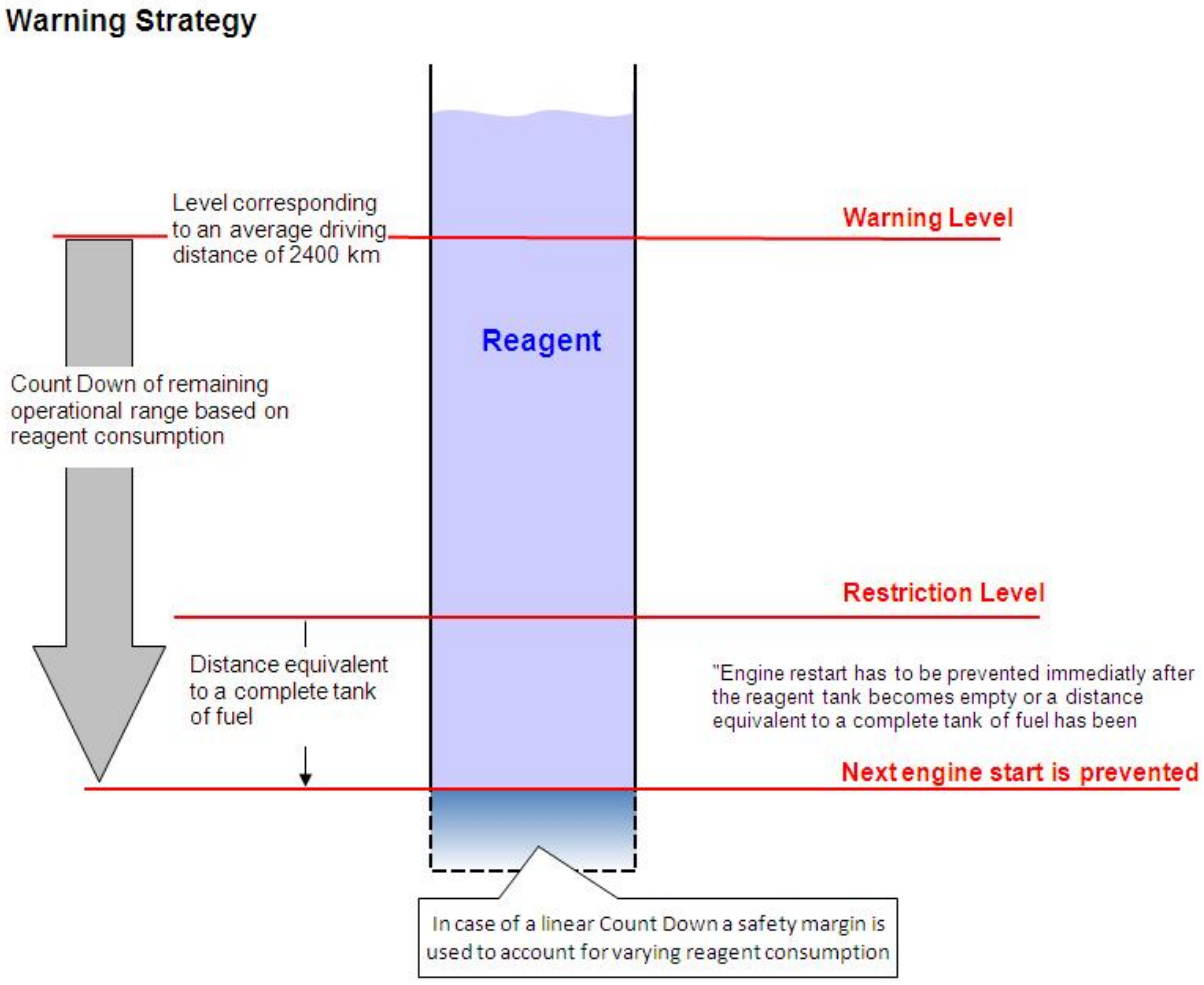
4. SCR Warning Strategy according to EURO-5 /-6

For SCR vehicles an AdBlue filling level warning strategy and an engine shut down in the case of AdBlue run-off is required by law.



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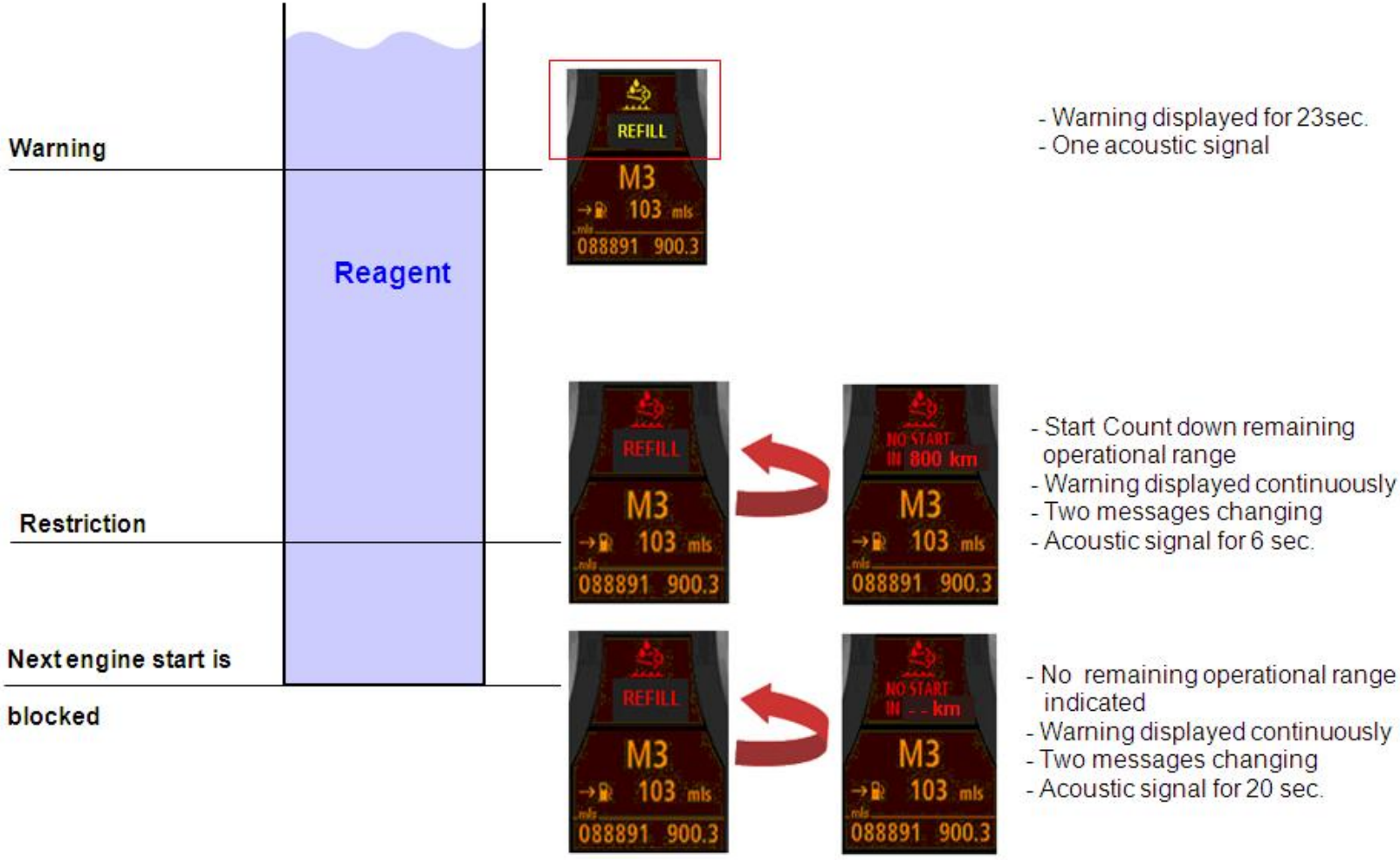
4. SCR Warning Strategy according to EURO-5 /-6



- Warning displayed for 23sec.
- One acoustic signal

- Start Count down remaining operational range
- Warning displayed continuously
- Two messages changing
- Acoustic signal for 6 sec.

- No remaining operational range indicated
- Warning displayed continuously
- Two messages changing
- Acoustic signal for 20 sec.

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5. Interim/Emergency Refill-Solution

- A large area diffusion of AdBlue-Pumps is not realistic at the beginning

→An interim/emergency solution is needed (e.g. bottle/canister)

A bottle/canister-solution is only an interim/emergency solution:

- Only small bottles feasible due to bottle/neck-weight restrictions
- For complete refill several bottles necessary (not feasable for customer)
- Negative environmental impact for recycling of bottles

1/2 gal
and 1 gal

2010 2011 2012 2013 2014 2015

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5. Interim/Emergency Refill-Solution

Acceptability

- Passenger car/light duty truck filling without spitback and smell. For this reason only a closed system is possible (recovery system) including a standard adapter.

Size:

- Passenger car /light duty truck filling can handle only the size from ½ gallon maximal 1 gallon is conceivable.

Options:

- Further options for the emergency fill aren't requested.

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5. Interim/Emergency Refill-Solution

- A dedicated AdBlue-Pump is the only feasible solution that offers an appropriate refilling and the needed customer acceptance, so that Diesel technology remains attractive.

- Lead time is necessary to implement a widespread infrastructure of dedicated AdBlue-Pumps.

- AdBlue canisters with ½ gal and 1 gal capacity are seen as an adequate interim/emergency solution.

- This solution can not replace a dedicated AdBlue-Pump because of dosage, handling and customer acceptance, but it can be rapidly realized.

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6. Summary

Possible measures to support the build up of an infrastructure

- Information:
  - Flyer
  - Internet
  - OEM-Information
  - Stickers

- Cooperation:
  - with Automobile Clubs and Consumer Organisations
  - Common Discussions
  - AdBlue-Forum
  - IAA-Symposium Sept. 2009

- Commonly Defined Solutions:
  - Cost Effective due to higher AdBlue-Volumes
  - Easy to Use: Attractive for PC-Customers

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6. Summary

- We expect, that future emission legislation will make SCR-Technology necessary for all diesel model lines.
- Due to technical restrictions and environmental needs the German Car Manufacturers commonly decided the introduction of small AdBlue tanks for all SCR diesel vehicles.
- Customers need a simple and clean AdBlue-Refill solution.
- Customers need an adequate AdBlue infrastructure for Passenger Cars.
- AdBlue canisters with ½ gal and 1 gal capacity are seen as an adequate interim/emergency solution.
- The installation of an infrastructure with AdBlue pumps has to be started in 2011.

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6. Summary

Thank You for your attention !

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