

# Research on Retrofits for Off-road Diesels in Beijing

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## Outline

- ◆ Current status of diesels for off-road mobile machinery in Beijing
- ◆ On-going work
- ◆ Plans for the future

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## Current status of off-road diesels in Beijing

- ◆ Construction machines:
  - ◆ Population : 45,000 units
  - ◆ Volume of sales per year: 5,000 units

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## Current status of off-road diesels in Beijing

- ◆ Emission Standards used
  - ◆ 2003.1.1, Released the Stage 1 of National Emission Standard, equivalent to Euro stage I(>37kw)
  - ◆ 2005.1.1 , Released the Stage 2 of National Emission Standard, equivalent to Euro stage II (>18kw), or US Tier 1(<18kw)

## Current status of off-road diesels in Beijing

- ◆ Limits of exhaust pollutants from off-road diesels, Stage 1

| $P_{\max}$ (kW)              | CO (g/kWh) | HC (g/kWh) | NO <sub>x</sub> (g/kWh) | HC+ NO <sub>x</sub> (g/kWh) | PM (g/kWh) |
|------------------------------|------------|------------|-------------------------|-----------------------------|------------|
| $130 \leq P_{\max} \leq 560$ | 5.0        | 1.3        | 9.2                     | —                           | 0.54       |
| $75 \leq P_{\max} < 130$     | 5.0        | 1.3        | 9.2                     | —                           | 0.7        |
| $37 \leq P_{\max} < 75$      | 6.5        | 1.3        | 9.2                     | —                           | 0.85       |
| $18 \leq P_{\max} < 37$      | 8.4        | 2.1        | 10.8                    | —                           | 1.0        |
| $8 \leq P_{\max} < 18$       | 8.4        | —          | —                       | 12.9                        | —          |
| $0 < P_{\max} < 8$           | 12.3       | —          | —                       | 18.4                        | —          |

## Current status of off-road diesels in Beijing

- ◆ Limits of exhaust pollutants from off-road diesels, Stage 2

| $P_{\max}$ (kW)              | CO (g/kWh) | HC (g/kWh) | NO <sub>x</sub> (g/kWh) | HC+ NO <sub>x</sub> (g/kWh) | PM (g/kWh) |
|------------------------------|------------|------------|-------------------------|-----------------------------|------------|
| $130 \leq P_{\max} \leq 560$ | 3.5        | 1.0        | 6.0                     | —                           | 0.2        |
| $75 \leq P_{\max} < 130$     | 5.0        | 1.0        | 6.0                     | —                           | 0.3        |
| $37 \leq P_{\max} < 75$      | 5.0        | 1.3        | 7.0                     | —                           | 0.4        |
| $18 \leq P_{\max} < 37$      | 5.5        | 1.5        | 8.0                     | —                           | 0.8        |
| $8 \leq P_{\max} < 18$       | 6.6        | —          | —                       | 9.5                         | 0.8        |
| $0 < P_{\max} < 8$           | 8.0        | —          | —                       | 10.5                        | 1.0        |

## Current status of off-road diesels in Beijing

- ◆ The dates of the emission standards for off-road diesels and Heavy-duty Diesel Vehicles

| Stage<br>Model                | 1          | 2          | 3          | 4<br>(municipal<br>vehicles) | 4 (all<br>vehicles) |
|-------------------------------|------------|------------|------------|------------------------------|---------------------|
| Heavy-duty Diesel<br>Vehicles | 1. 1. 2000 | 8. 1. 2002 | 1. 1. 2007 | 3. 1. 2008                   | 1. 1. 2010          |
| Off-road Diesels              | 1. 1. 2003 | 1. 1. 2005 |            |                              |                     |

## Current status of off-road diesels in Beijing

- ◆ Comparison of pollutant limits of off-road diesels and Heavy-duty Diesel Vehicles

| Stage | CO<br>g/kWh | HC<br>g/kWh | No <sub>x</sub><br>g/kWh | PM<br>g/kWh |
|-------|-------------|-------------|--------------------------|-------------|
| I     | 4.5         | 1.1         | 8                        | 0.36        |
| II    | 4.0         | 1.1         | 7                        | 0.15        |
| III   | 2.1         | 0.66        | 5.0                      | 0.10        |
| IV    | 1.5         | 0.46        | 3.5                      | 0.02        |

| Stage | CO<br>g/kWh | HC<br>g/kWh | No <sub>x</sub><br>g/kWh | PM<br>g/kWh |
|-------|-------------|-------------|--------------------------|-------------|
| I     | 5.0         | 1.2         | 9.2                      | 0.54        |
| II    | 3.5         | 1.0         | 6                        | 0.2         |

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## Current status of off-road diesels in Beijing

- ◆ The emission limit levels for off-road diesels are far behind those of heavy duty diesel vehicles:
  - ◆ CO limits: 2.4 ~ 3.1 times (off-road: on road)
  - ◆ HC limits: 2.0 ~ 3.2 times
  - ◆ NO<sub>x</sub> limits: 1.8 ~ 2.2 times
  - ◆ PM limits: 18.4 ~ 21.6 times
- ◆ The general emission level of off-road diesels is 8~10 years behind heavy duty vehicles.

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## Current status of off-road diesels in Beijing

- ◆ Technology Situation:
  - ◆ Heavy duty diesel engines:
    - ◆ Electronically fuel injection + common rail + turbo charge + intercooler + aftertreatment
  - ◆ Off-road diesels
    - ◆ Mechanical fuel injection + natural aspiration

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## Current status of off-road diesels in Beijing

- ◆ Current situation of emission control :
  - ◆ There are no licenses, no annual emission tests and no daily emission supervision for diesels used in off-road mobile machine in Beijing. The exhaust pollutants are freely emitted to the atmosphere.
  - ◆ Most off-road diesel's emission level is less than stage 1.
- ◆ **The pollutants from off-road diesels are an important source of air pollution in Beijing.**


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## On-going Work

- ◆ Drift the Third Stage pollutant emission standard, it will be referenced to Euro stage 3 regulation and US tier 2
- ◆ Survey the exactly current status of off-road machines, Investigate the exact population and the contribution of models, emission levels and technology levels
- ◆ Research the management policy. Harmonize the administration policies and strategies of different governmental departments
- ◆ Research the technical proposal and feasibility of retrofitting

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## Plans for the Future

- ◆ Control new machinery to meet the emission standards, to encourage off-road diesels to use the same emission control technologies as the new heavy-duty vehicles
  - ◆ Establish the phase-out policy for the old or high pollutants emitting off-road diesels
  - ◆ To retrofit the off-road diesels voluntarily that are in good technical condition
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**Thank you for your  
attention!**

