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WNTE: A regulatory tool for the EU?

GRPE Meeting of the Off-Cycle Emissions Working Group

Geneva, June 2006

On-going European regulatory developments

- Heavy-duty EURO V stage
- In-use conformity checking introduced
- Elements in 2005/55/EC
- On-board measurement with PEMS is seen as the main 'route'
- IUC 'Pass/Fail' options: Oriented towards 'WNTE type' methods (i.e a pass-fail method based on a control area), but other methods are being evaluated.
- *Definition of the test protocol and evaluation work conducted by the EU-PEMS group.*

Future European regulatory developments

- Heavy-duty EURO VI stage
- Off-cycle provisions introduced ?
- In-use conformity checking kept
- An issue is to keep a consistency and to prepare a transition between EURO V/IUC and EURO VI/OCE/IUC

- WNTE (<> US-NTE) is being considered as the main option but its applicability and their efficiency in the European context are being studied

Approaches studied ….

Approaches are sorted in 3 categories:

1. "Control area" (WNTE, US-NTE)

2. Work-based window

3. Compliance Factor (or BSFC based method, not discussed here as not applicable for IUC)

1. Control Area Approaches

Principle of the Control Area Approaches

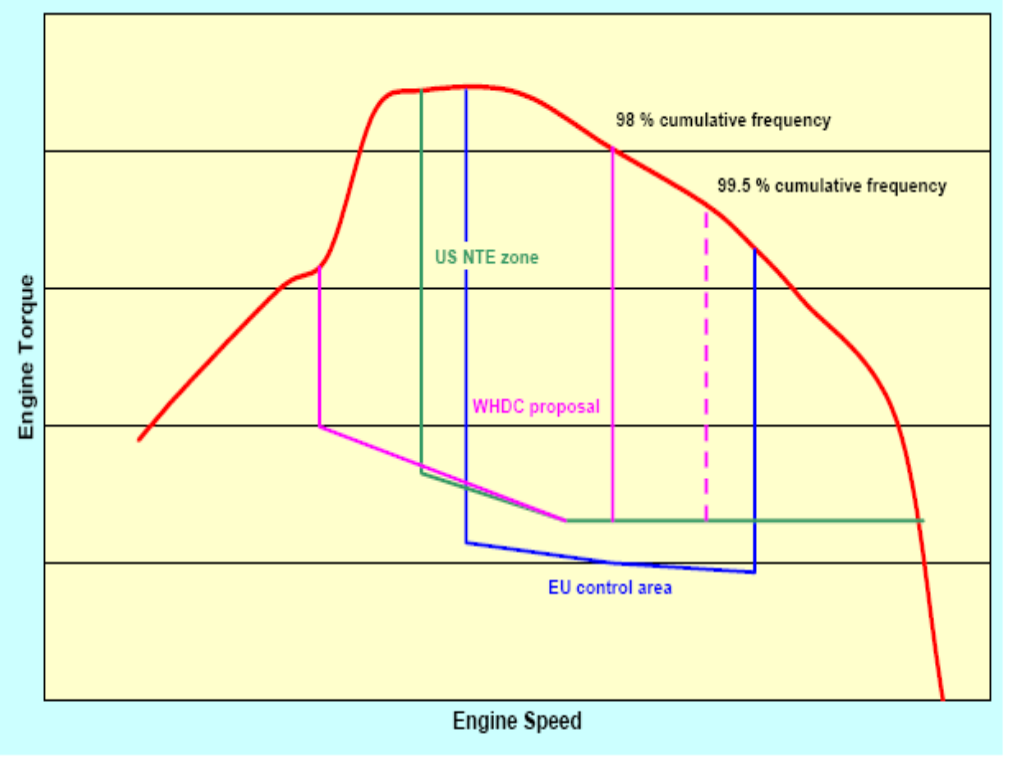
Not based on entire engine operation but rather on a "control area" that can match – to a certain extent – the control area from homologation cycles.

1. US-NTE

2. WNTE

3. "Simplified" to eliminate the operating points that should not be considered (cold start, idling)

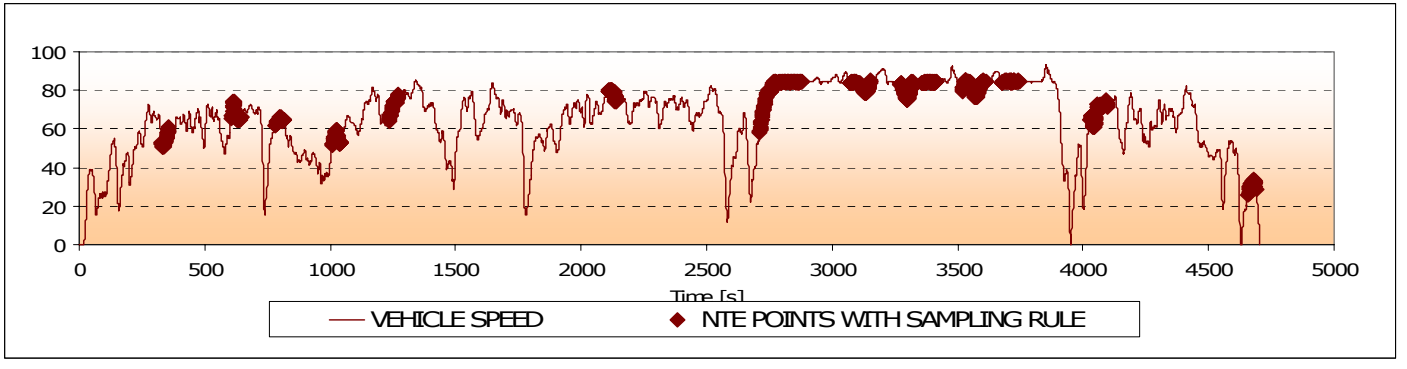
Existing control areas (OICA May 2005)

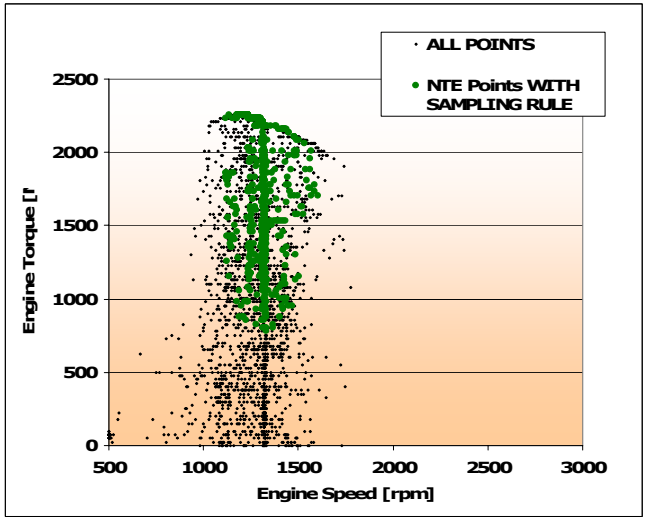


Do "Control Area" methods fulfill the needs?

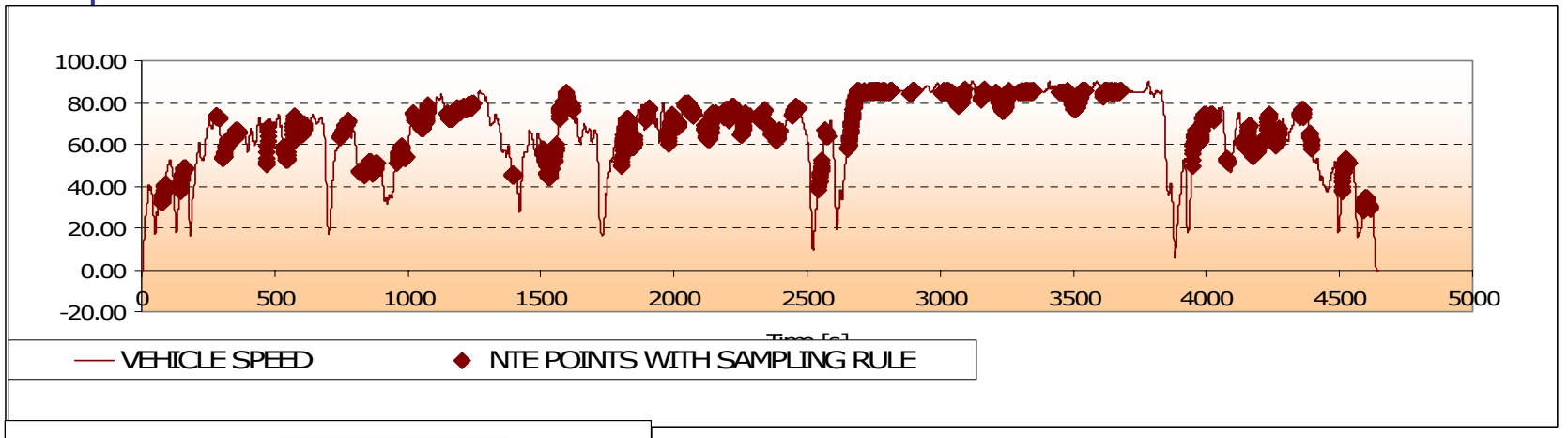
- Questions raised:
  - Are the 'control area approaches' (in particular the WNTE) suitable for any kind of engine/vehicle operation?
  - If not, how far can it be adapted? Shall we modify the control area? The minimum sampling rule?
  - What are the rationale behind the definition of the US-NTE and WNTE (Size of the control area and minimum sampling rule in particular)?
- Studies based on real-world data collected on different heavy-duty vehicles from various categories (currently 8, run with full or partial load - EU-PEMS project)

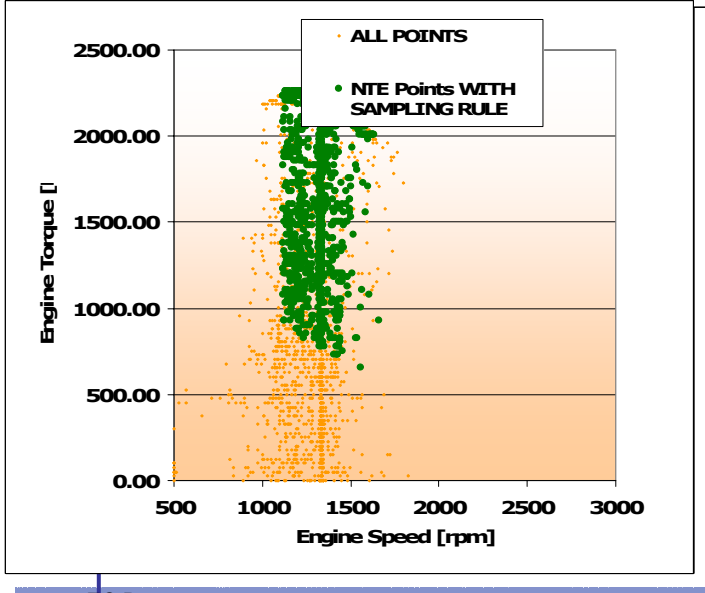
Case 1: Long-haul vehicle, fully loaded (40 tons)





- Control Area: US NTE
- Minimum Sampling rule: 30s
- % Points in the control area: **47%**
- % Points considered for the calculation: (Application of the sampling rule): **18% of all data**

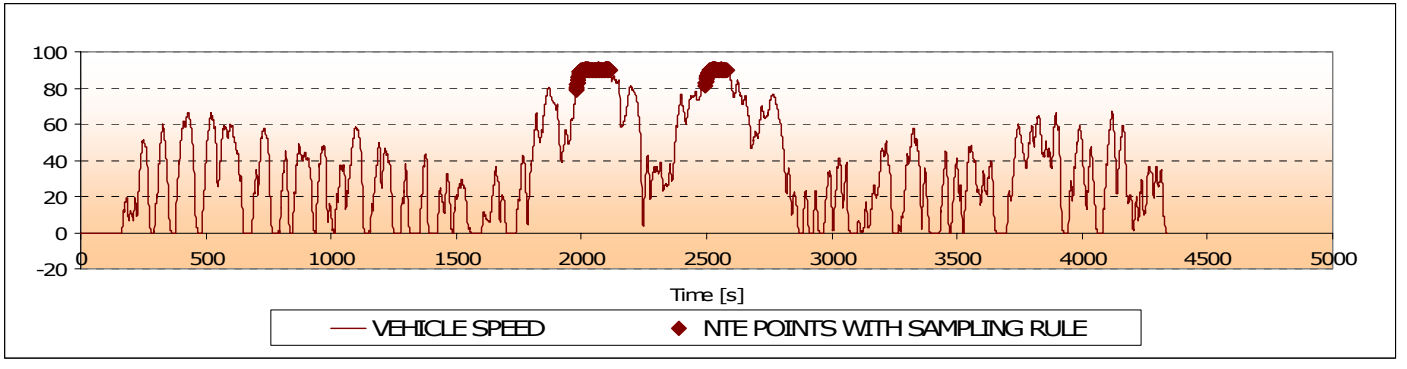


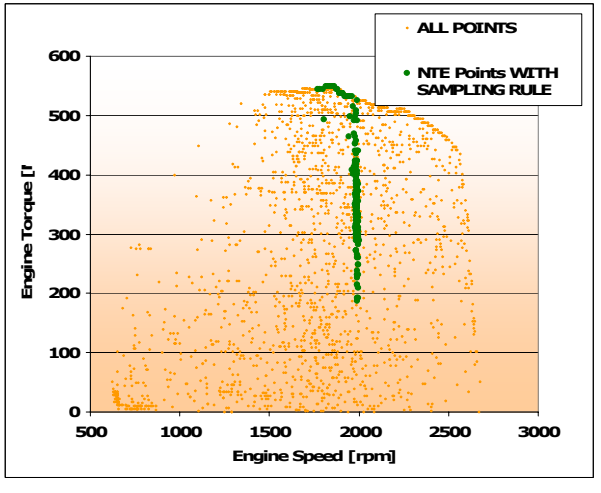


10s

- **The time sampling rule removes a lot of the transient operation…**

▪ Case 2: Local delivery truck, highly loaded (12 tons)





- Control Area: US NTE
- Minimum Sampling rule: 30s
- % Points in the control area: 36%
- % Points considered for the calculation: (Application of the sampling rule): 5% of all data
- Without motorway high velocity operation: 0%

Control Area Approaches: Preliminary conclusions

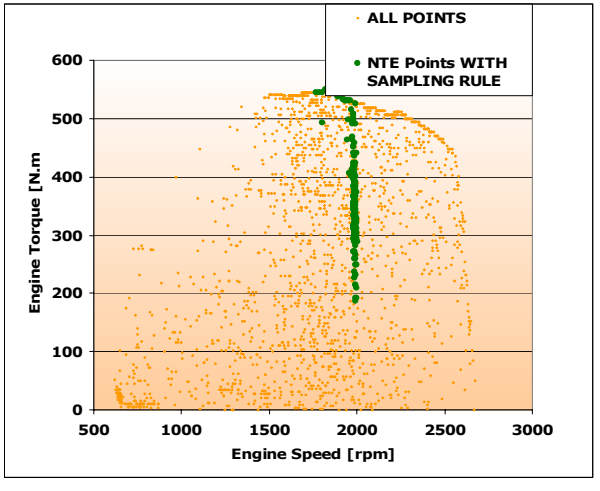
- The "Control Area" approaches are a very efficient tool to capture random operation of the engines in a definite control area
- With the current area definitions (US-NTE or WNTE) and a minimum sampling rule based on time (30s), it provides a very good tool to capture the operation of "long-haul" HD vehicles operated on motorways at high speeds and loads

But, because of the time (30s) sampling rule…..

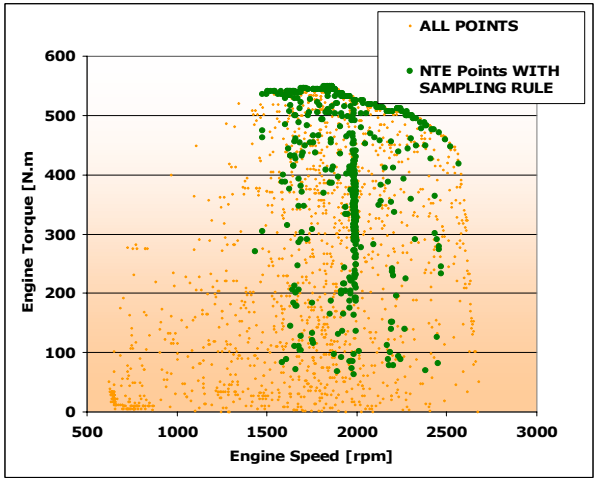
- Other kinds of engine/vehicle operation cannot be captured
- Delivery trucks? City buses?
- **Is there a way to solve the problem?**

- **How far can we modify the current "Control Area" tool to capture more data? Example of the delivery truck**

Current settings: 30%
MaxEngPower, 30 sec



Other settings: 10%
MaxEngPower, 15 sec



- **% Points in the control area:**
  36% **45%**
- **% Points considered for the calculation: (Application of the sampling rule):**
  5% **10%**

2. Work-based Approach

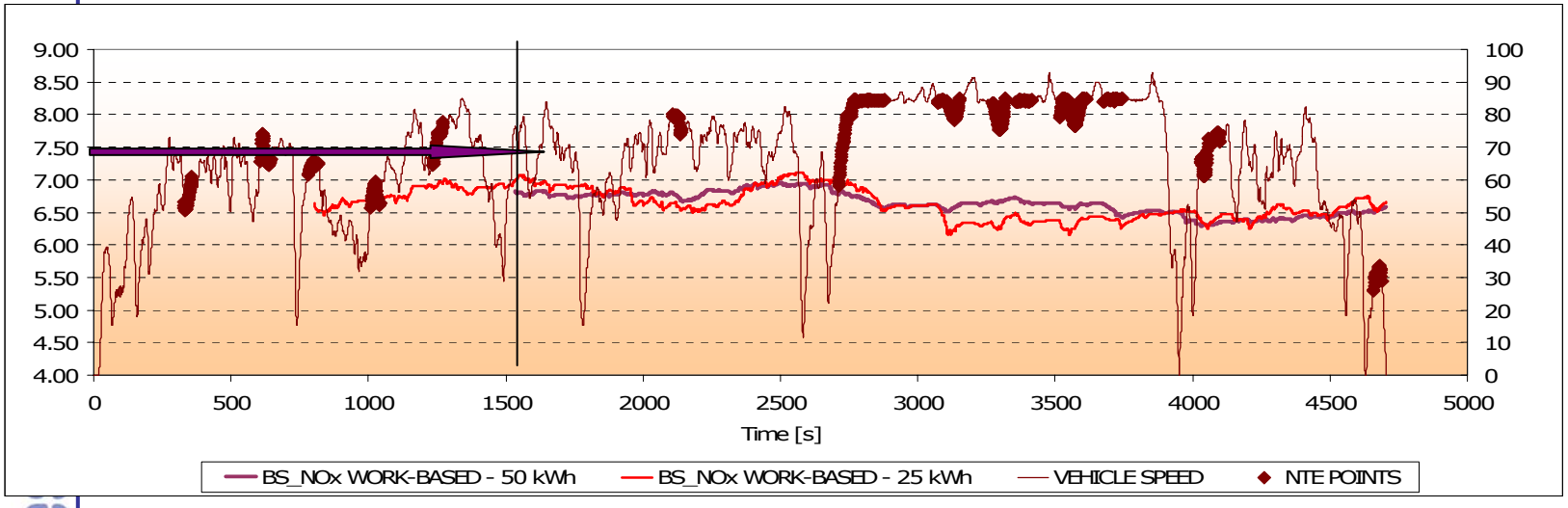
Work (or fuel based) Approach

Starting from the work W_{lab} [fuel consumption FC_{lab}] expressed in kW.h [liters] during a laboratory (homologation) test, one calculates for the "random" data (collected under real world conditions for instance) the brake specific emissions at every data point for the corresponding amount of work W_{road} or fuel FC_{road}

Algorithm:

At each time t1 of the road PEMS data, one searches for t2 such as $W_{road}=W_{lab}$ (or fuel $FC_{road}=FC_{lab}$)

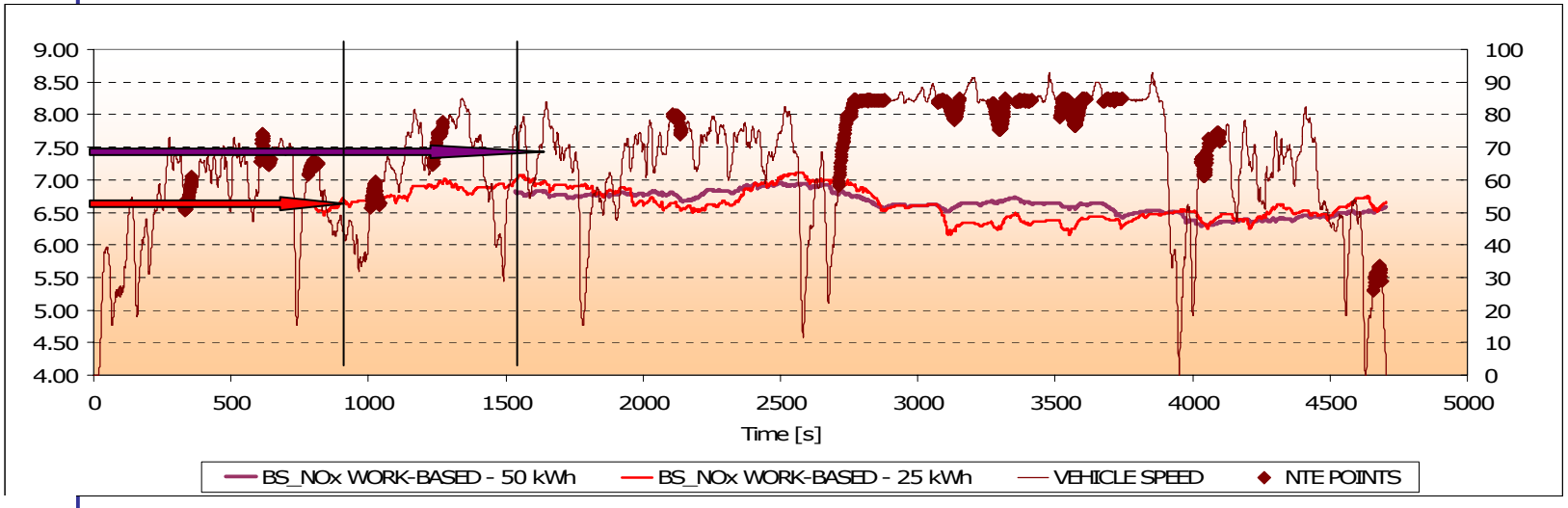
Calculating Brake-Specific emissions for a work window



Time needed to reach 50 kW.h from t=0

Calculation principle: Fixed work value (Matching the engine work on the homologation cycle for instance), the time required to obtain the chosen work varies = VARIABLE TIME WINDOW

Calculating Brake-Specific emissions for a work window



Time needed to reach 25 kW.h from t=0

Time needed to reach 50 kW.h from t=0

Effect of work window size: Lower work value increases the scatter

Preliminary conclusions / On-going analysis

- The "Control Area" (WNTE) methods are less suitable to capture certain types of vehicle operation: they wipe out the dynamics of vehicle operation because of the time sampling rule
- The "Work Window" method could be either an alternative solution or a complement to the existing WNTE
- The "Work Window" seems to offer a way to introduce on-vehicle PM filter mass based measurements (set of filters, each of them collecting PM quantity corresponding to the reference work value).

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- Analysis, based on on-road emissions data, is conducted for different kind of vehicles and operations to study the sensitivity of the different methods to the calculation parameters
- Final conclusions and technical proposal to be ready for Fall 2006