Analyzing the Uncertainty in the Fuel Economy Prediction for the EPA MOVES Binning Methodology

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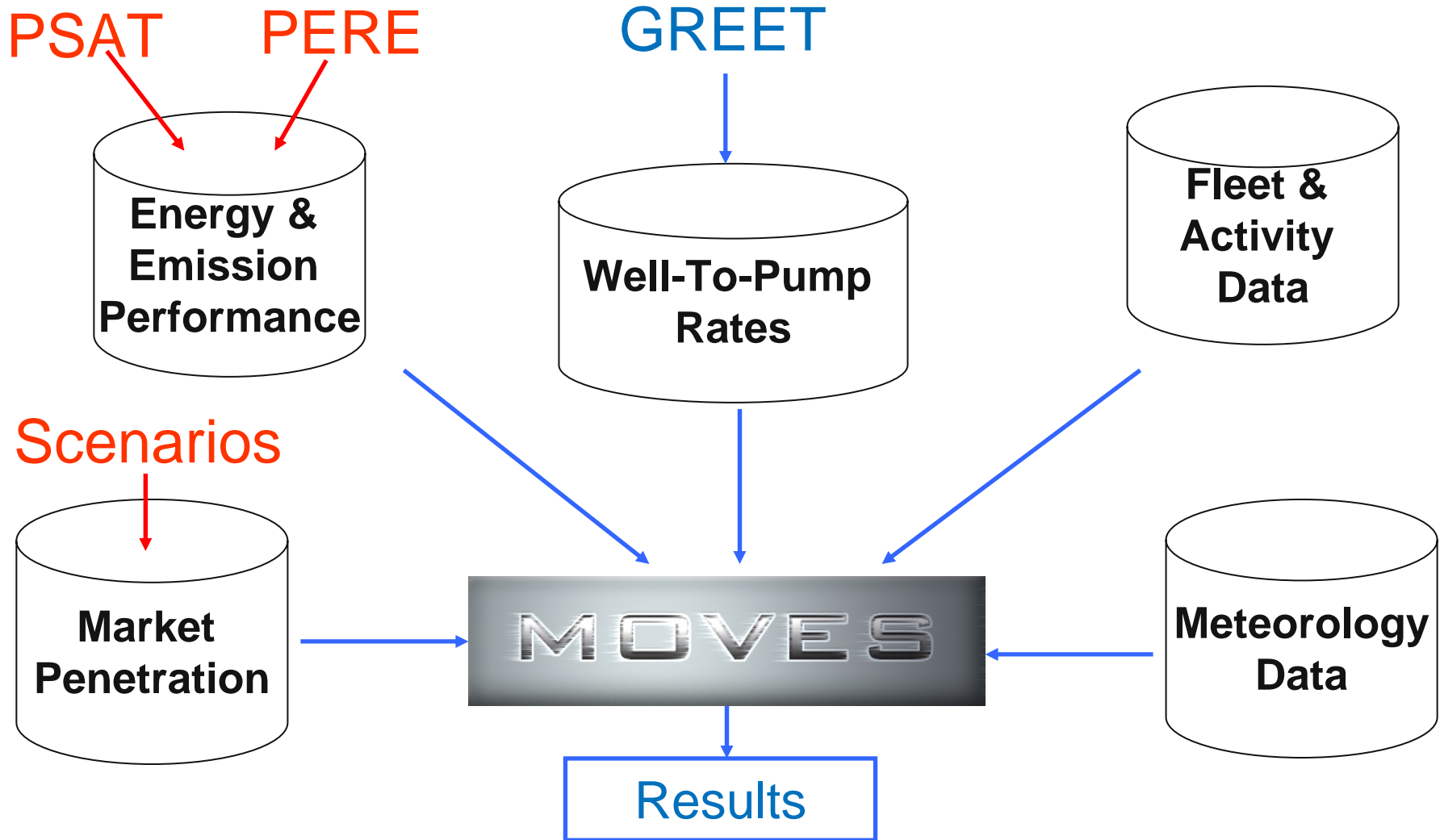
Phil Sharer

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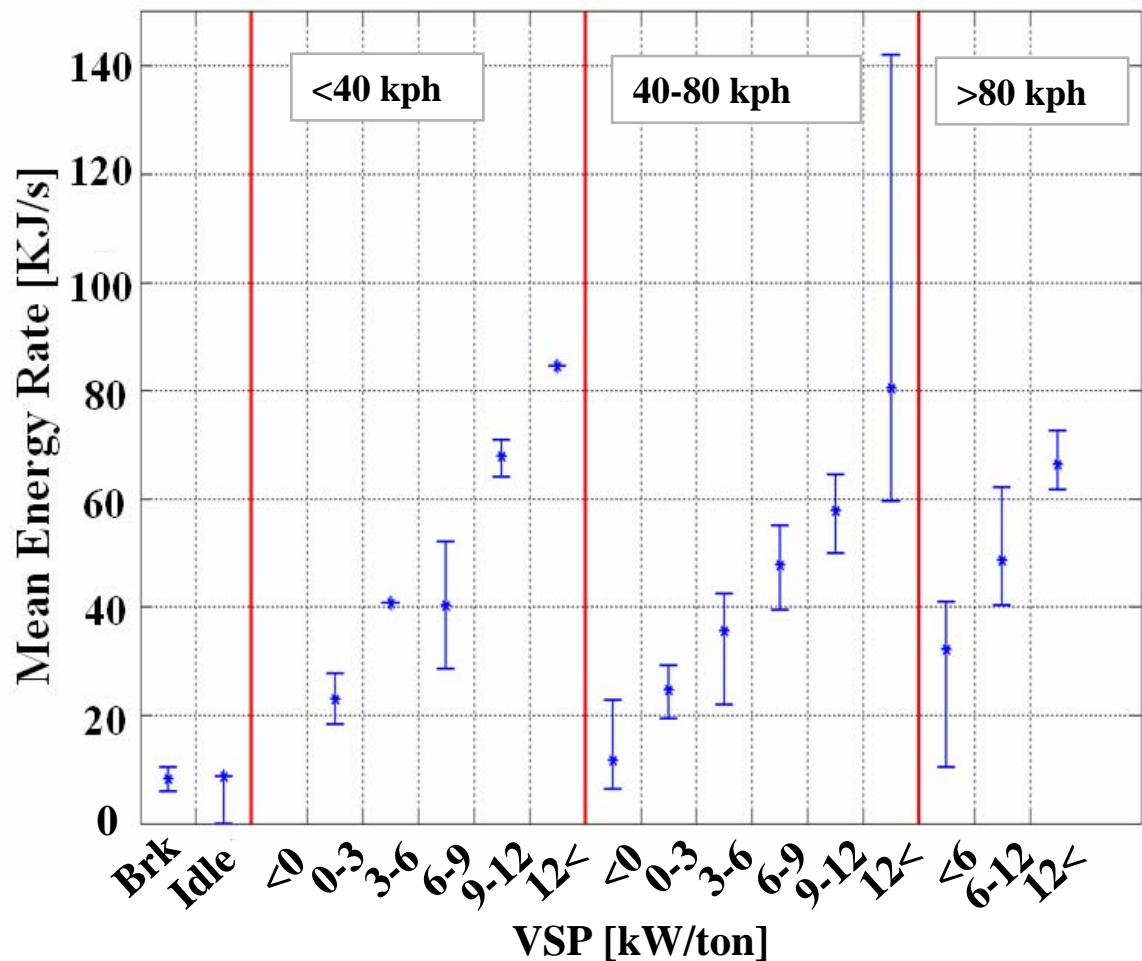
FreedomCAR & Vehicle Technologies Program

MOVES Dedicated to Estimate Emissions for On-road and Nonroad Sources

- **MO**tor **V**ehicle **E**mission **S**imulator
- Replacement for MOBILE6
- Covers multiple analysis, from fine scale to national inventory
- Estimate:
  - Energy consumption
  - Criteria pollutants
  - Basic emission processes (starts, idle, brake wear…)
  - Toxics

# PSAT Used to Populate MOVES for Advanced Powertrain Energy Consumption

PSAT   PERE   GREET

Energy & Emission Performance

Well-To-Pump Rates

Fleet & Activity Data

Scenarios

Market Penetration

MOVES

Meteorology Data

Results

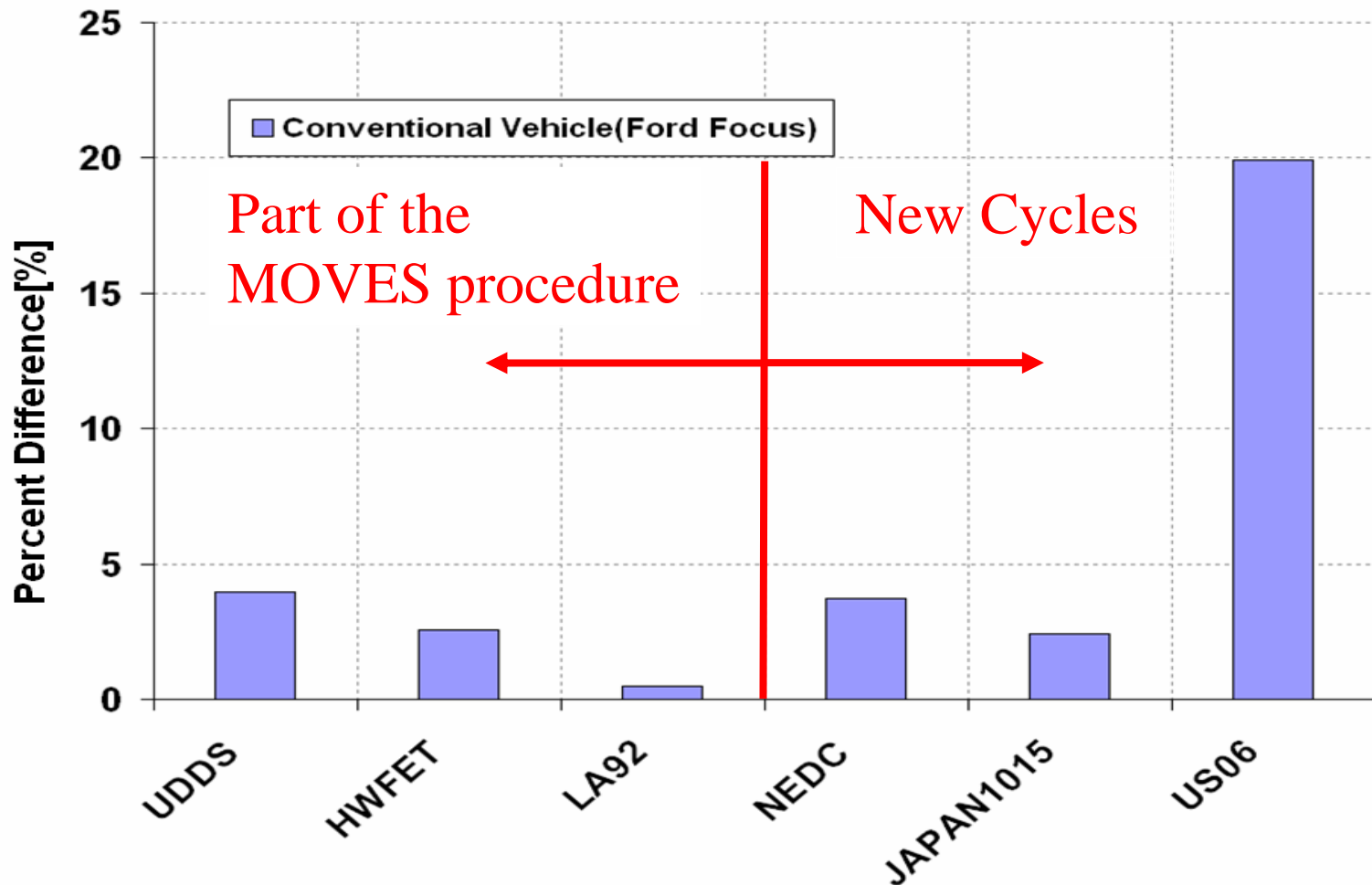# MOVES Fuel Economy Based on Vehicle Specific Power (VSP) Binning Approach

Based on three driving cycles (UDDS, HWFET, LA92)

Limitation:
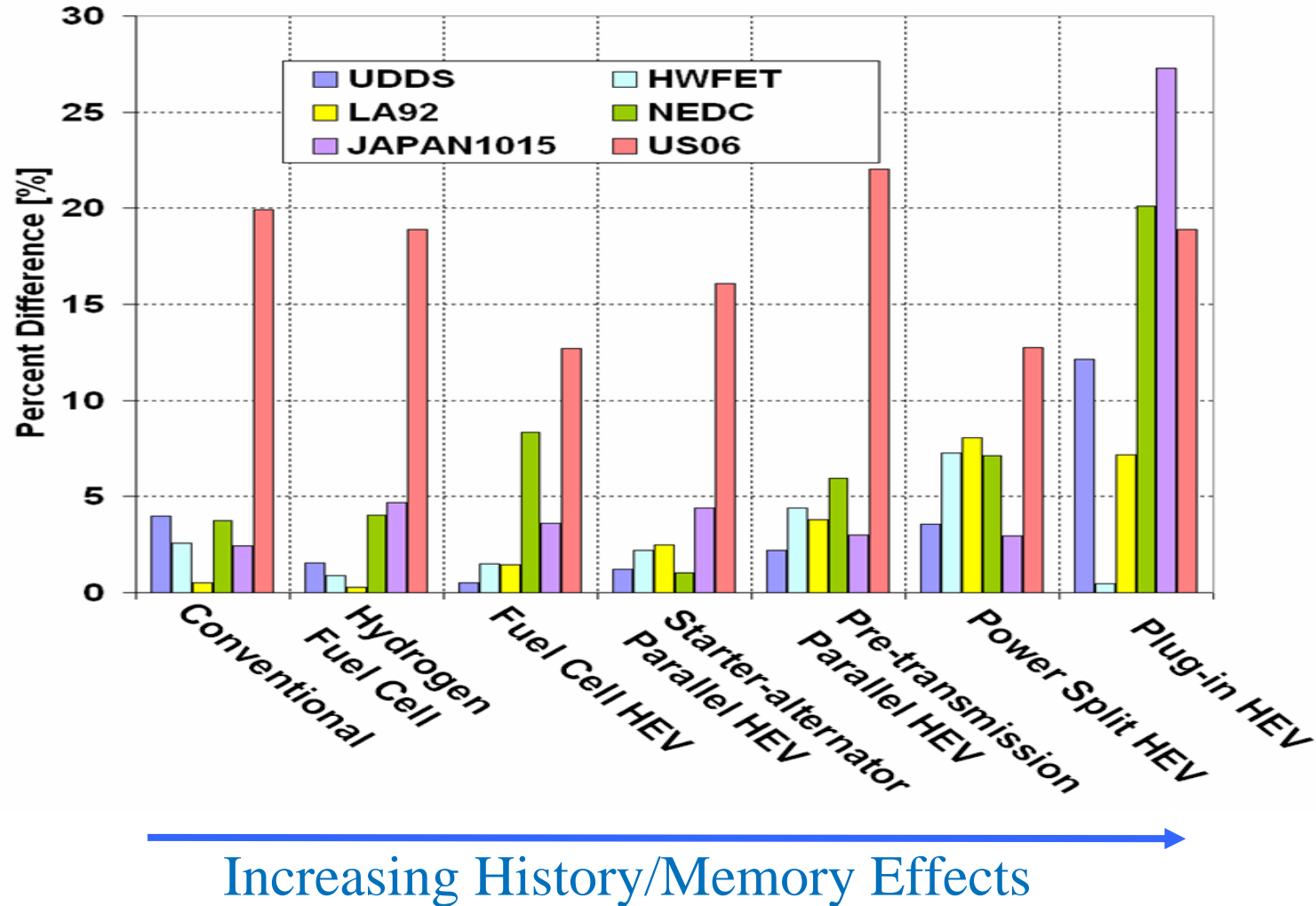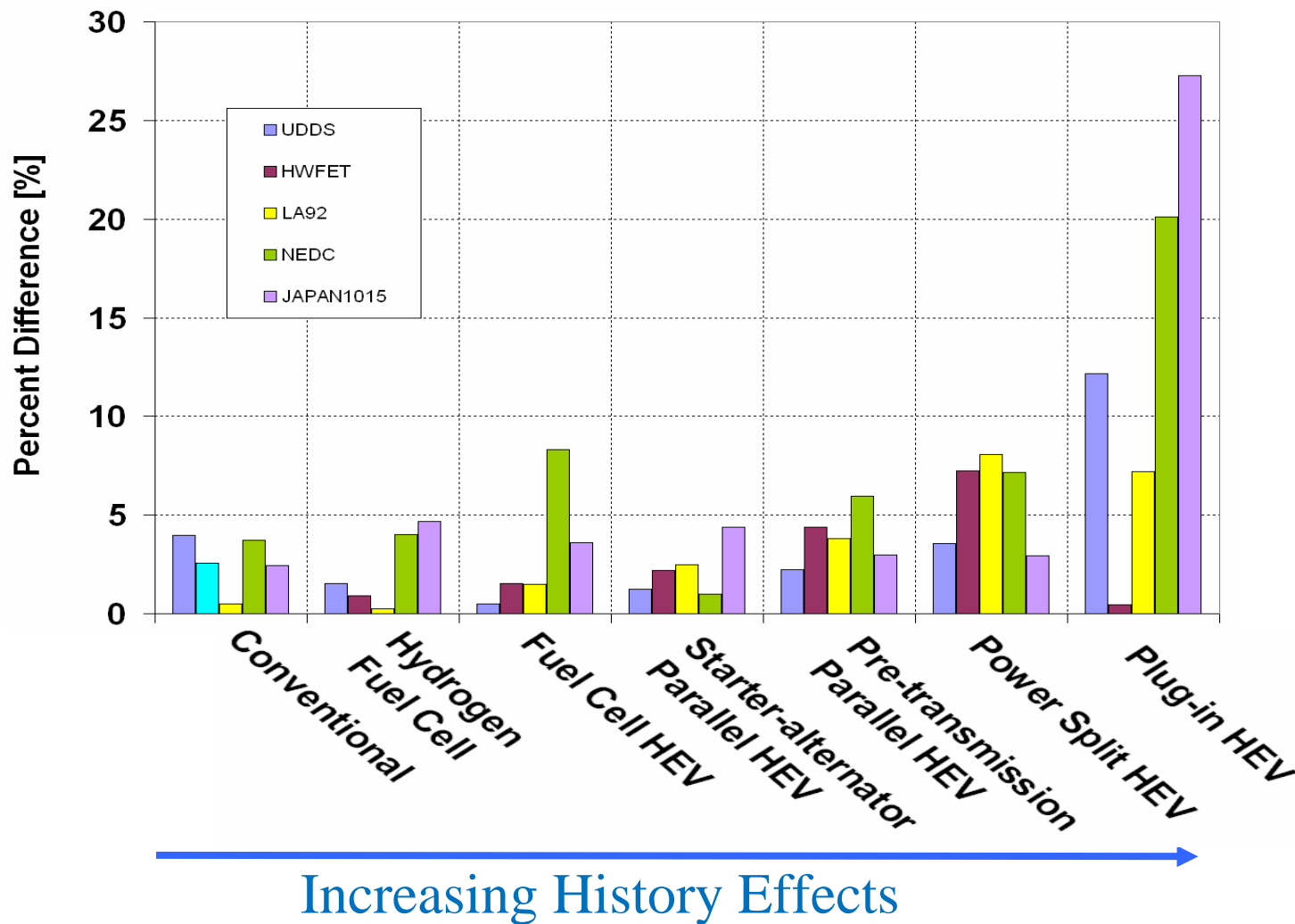**Does not take history effects into account**

Uncertainty Evaluation Process
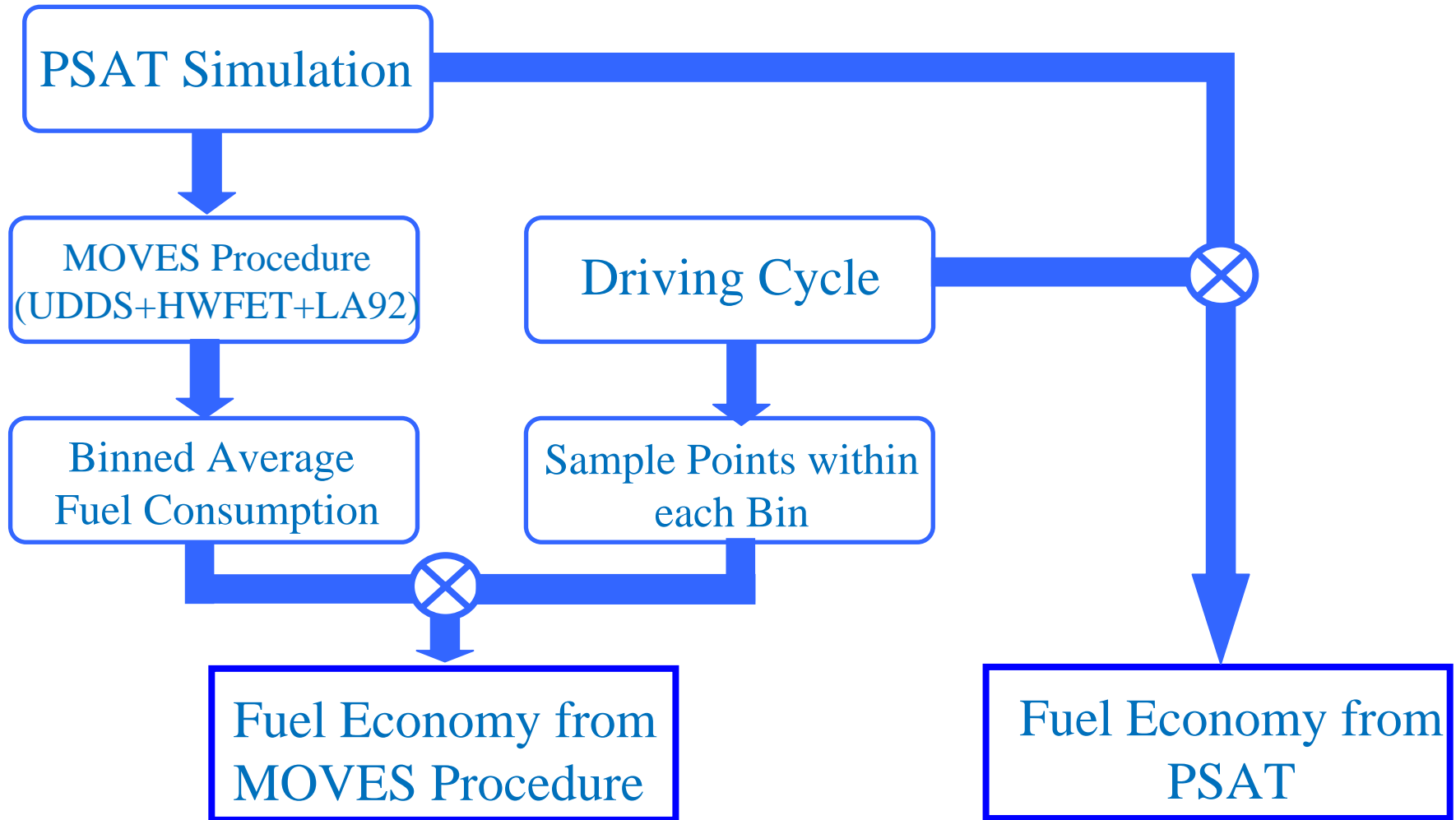
PSAT Code Verified for Conventional Vehicles Outside US06

Powertrains with Low History Effects Show Very Good Correlation
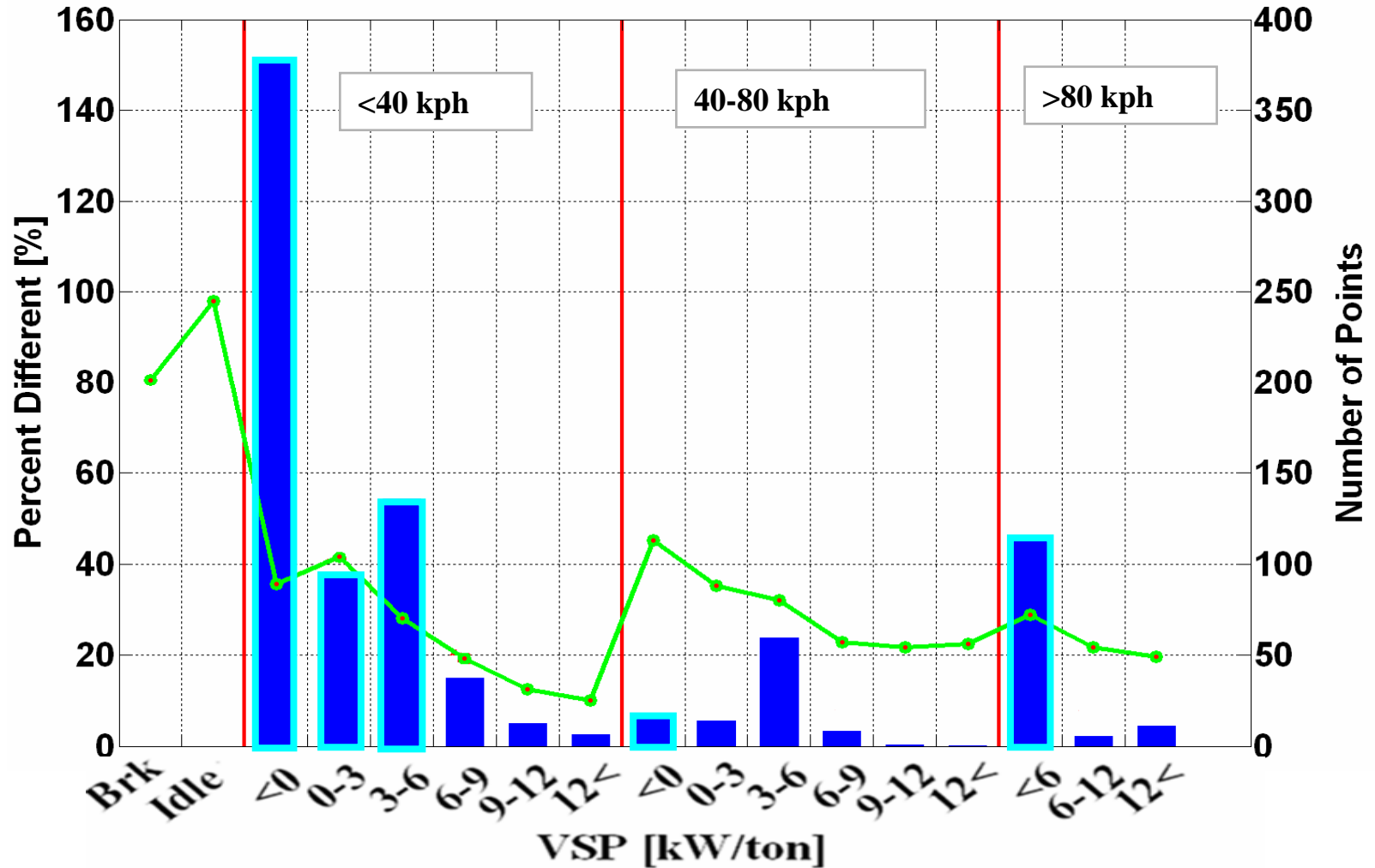

Increasing History/Memory Effects

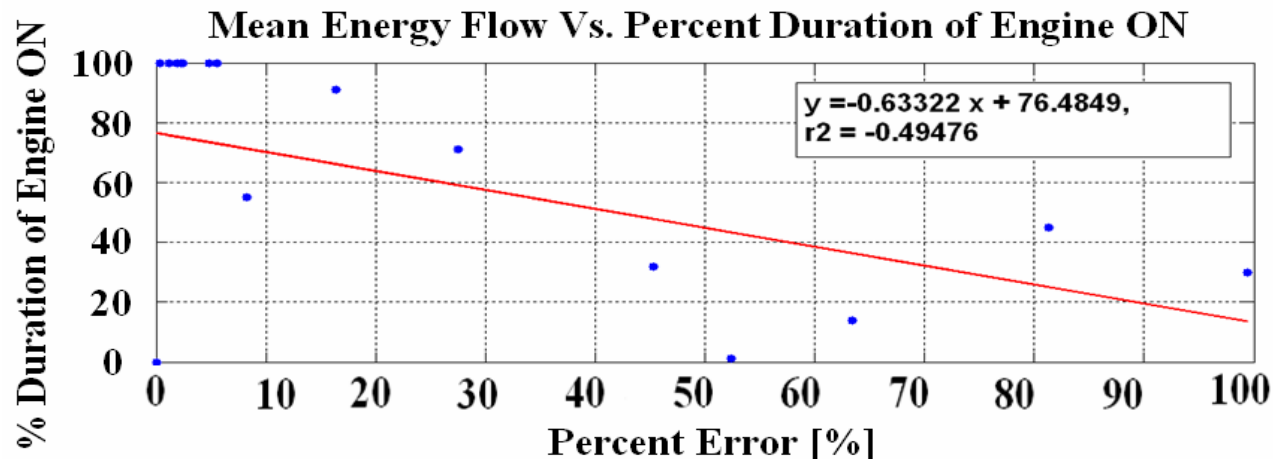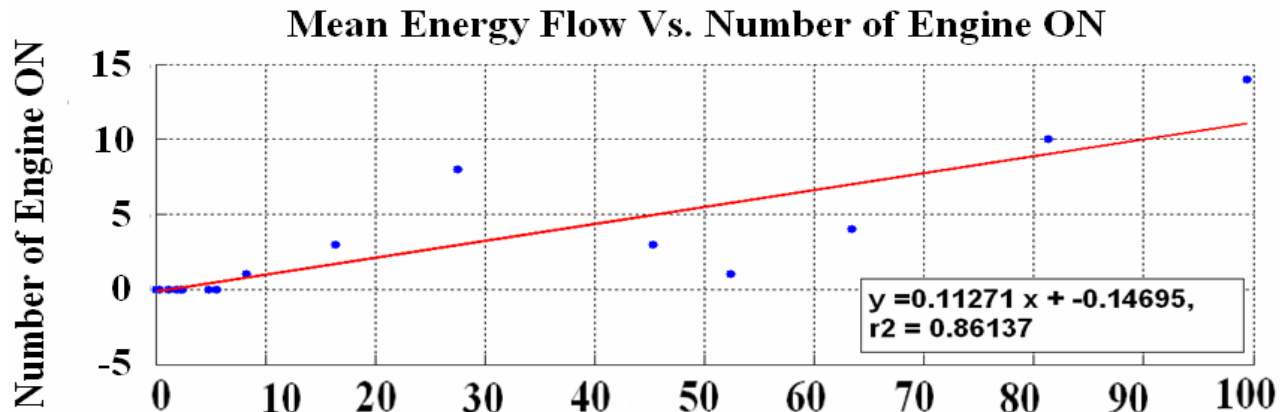# *Powertrains with Low History Effects Show Very Good Correlation*

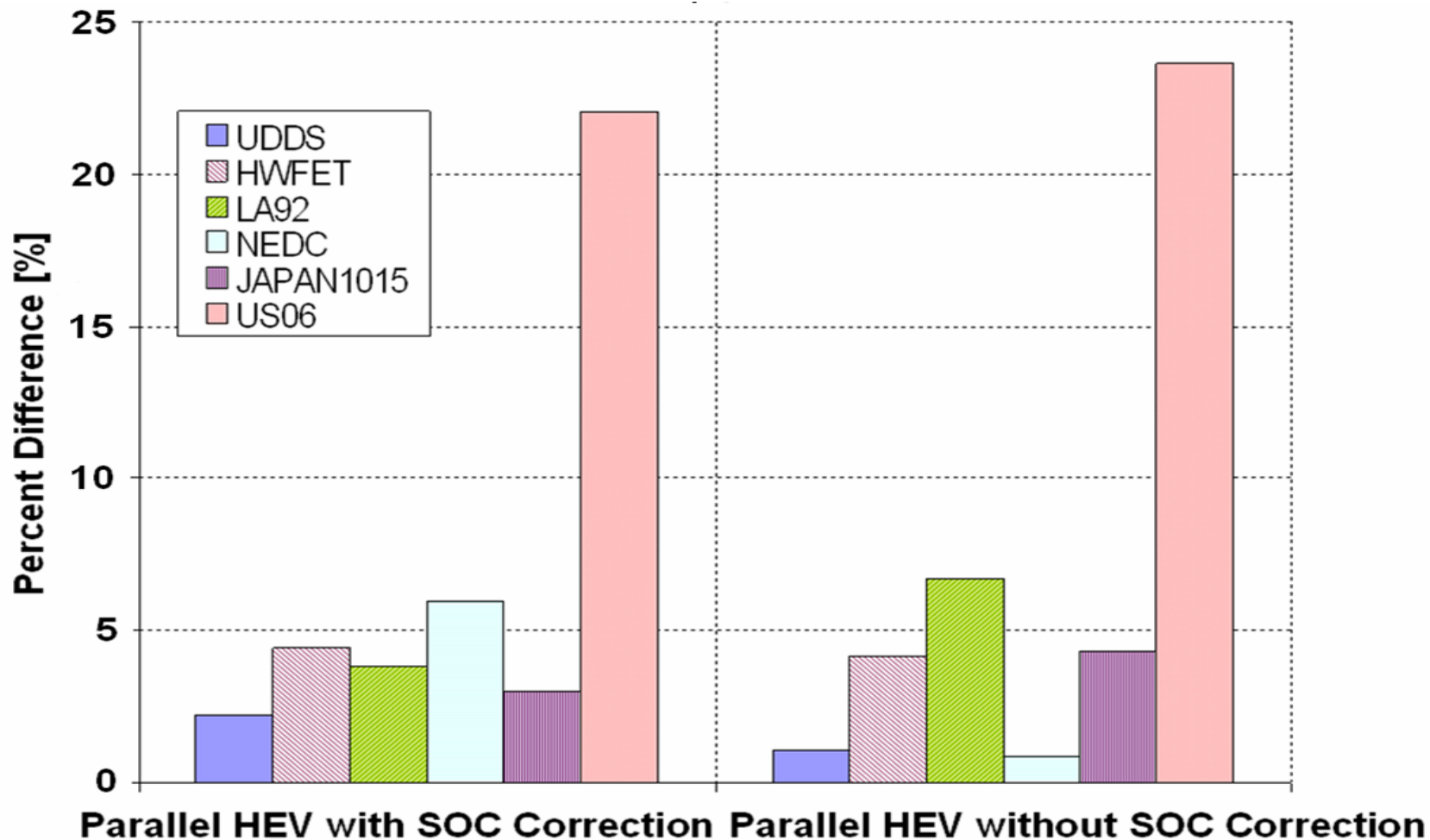# Uncertainty Greater at Low Power Demands, Linked with Engine ON Starts

Power Split HEV on LA92 Cycle

Uncertainty Greater at Low Power Demands, Linked with Engine ON Starts
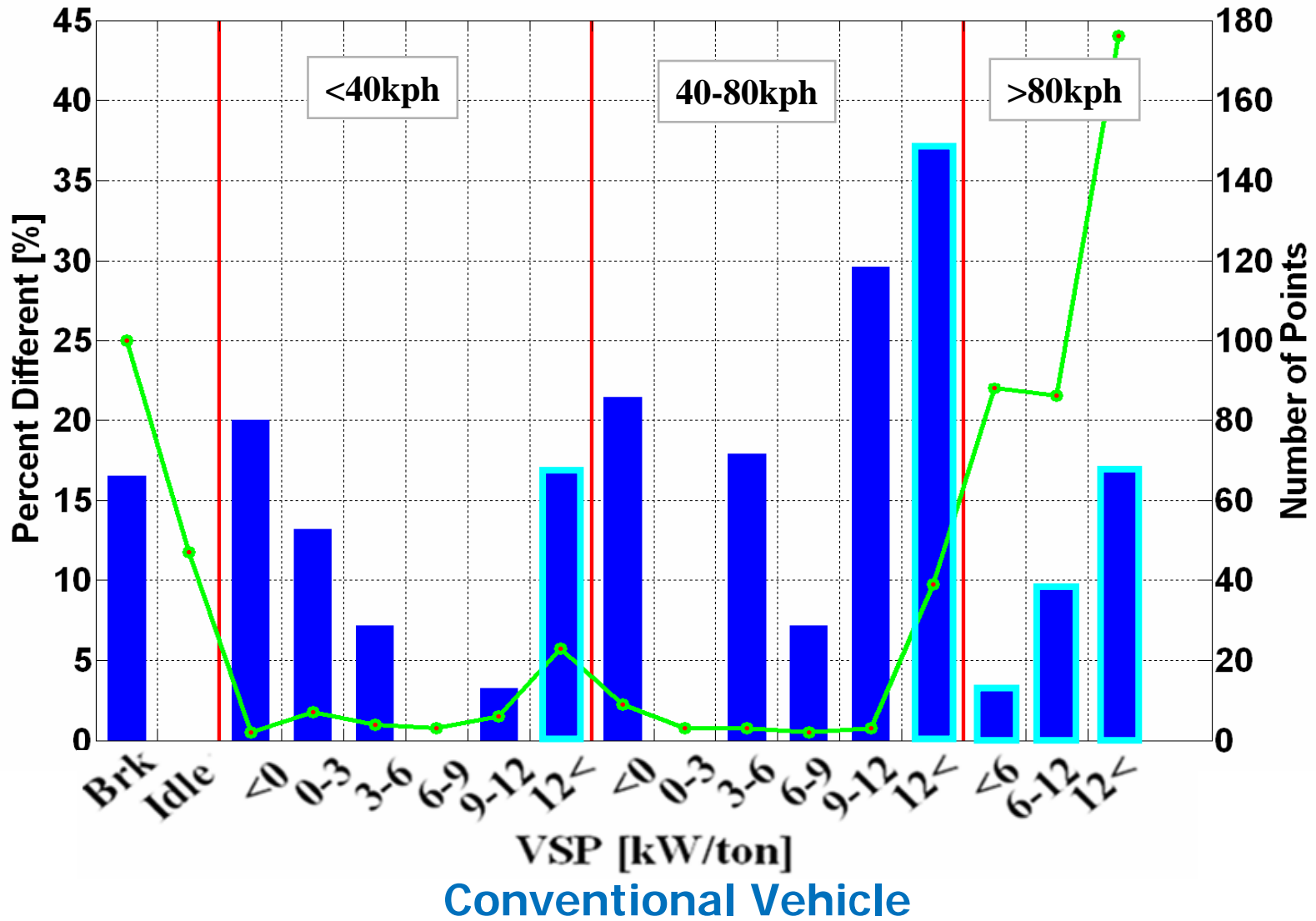

Power Split HEV on LA92 Cycle

SOC Correction Has Little Impact on Uncertainty

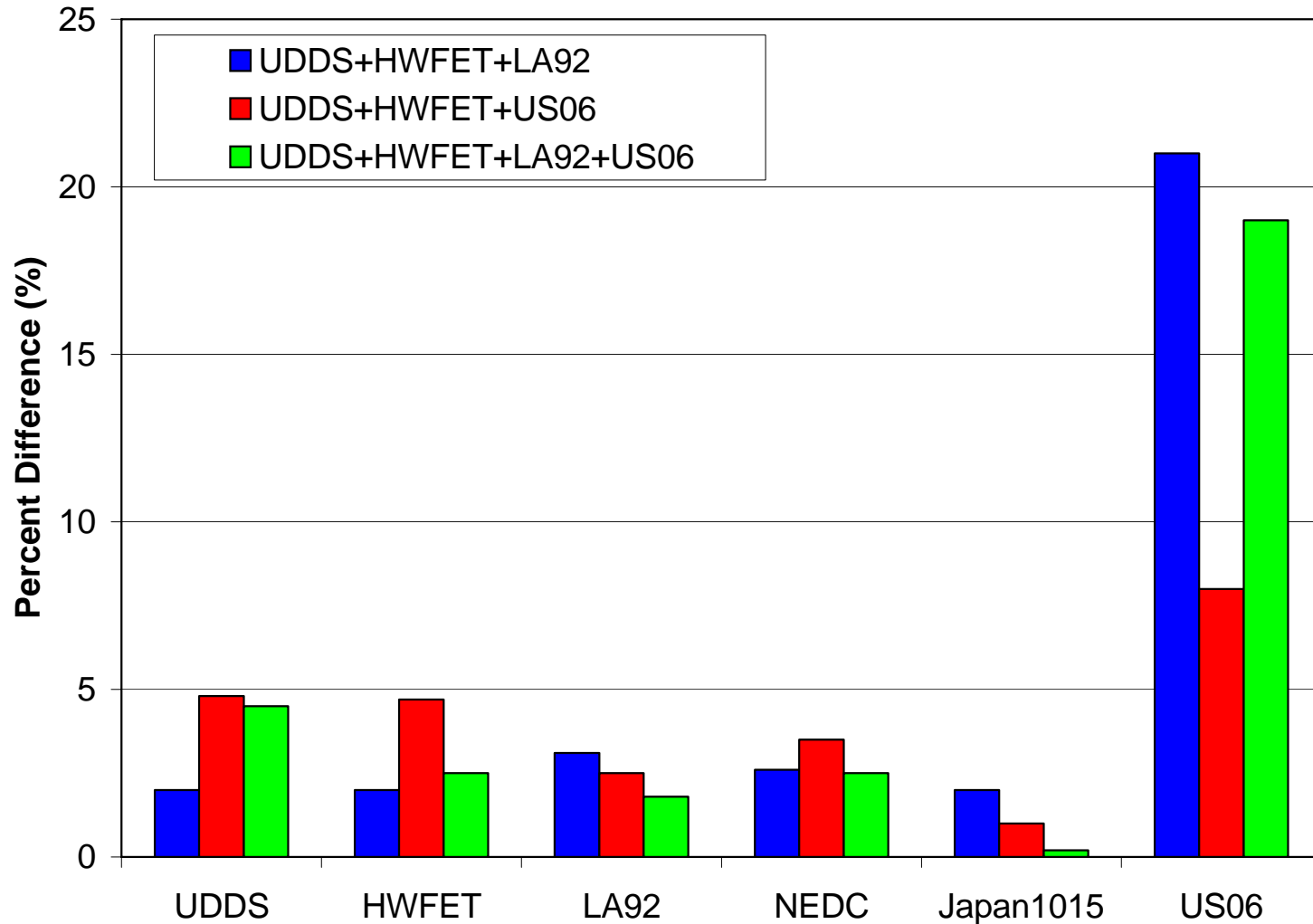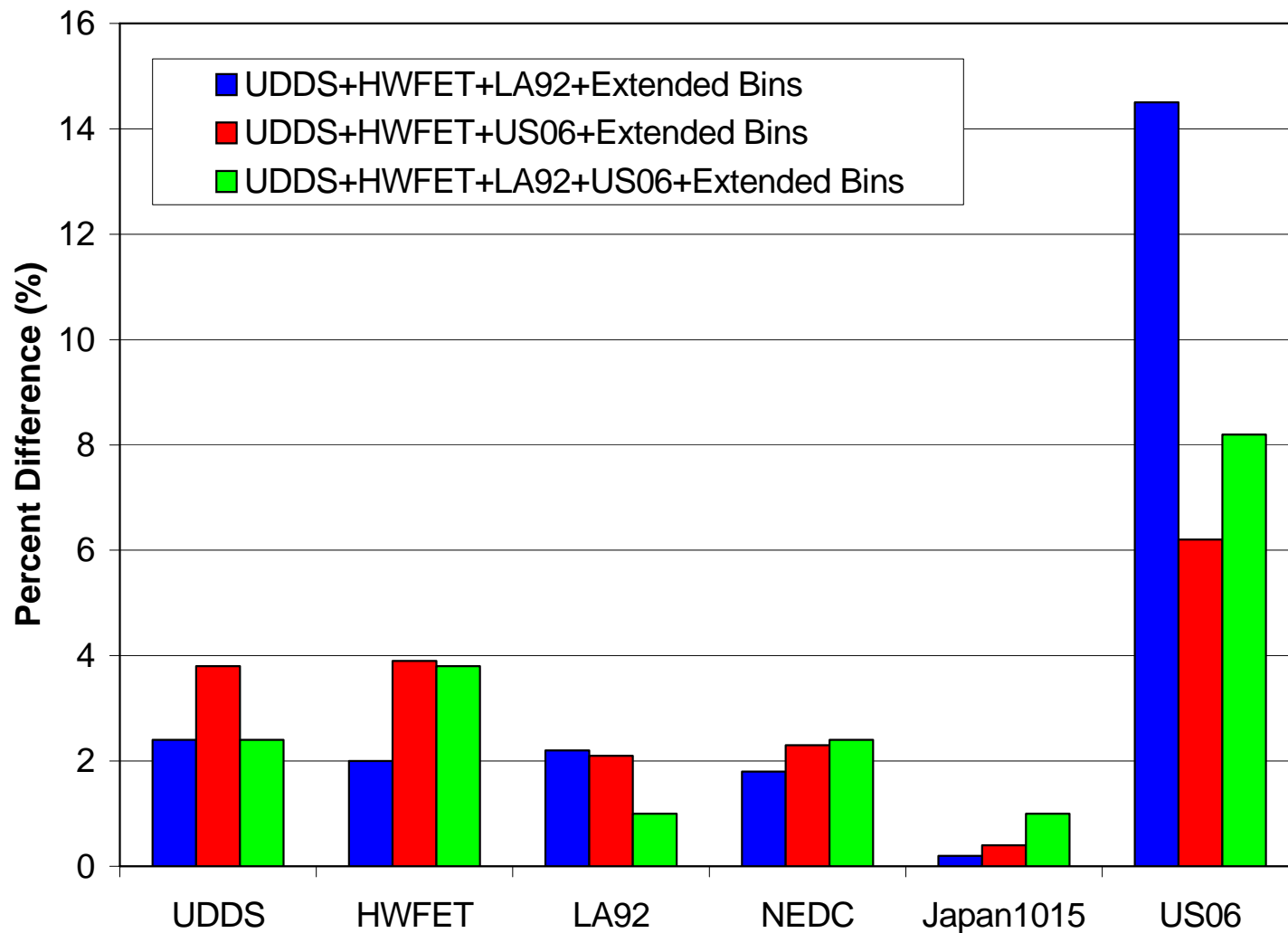# US06 Shows the Greatest Uncertainty…

Conventional Vehicle

As the US06 Vehicle Speed is not Properly Characterized
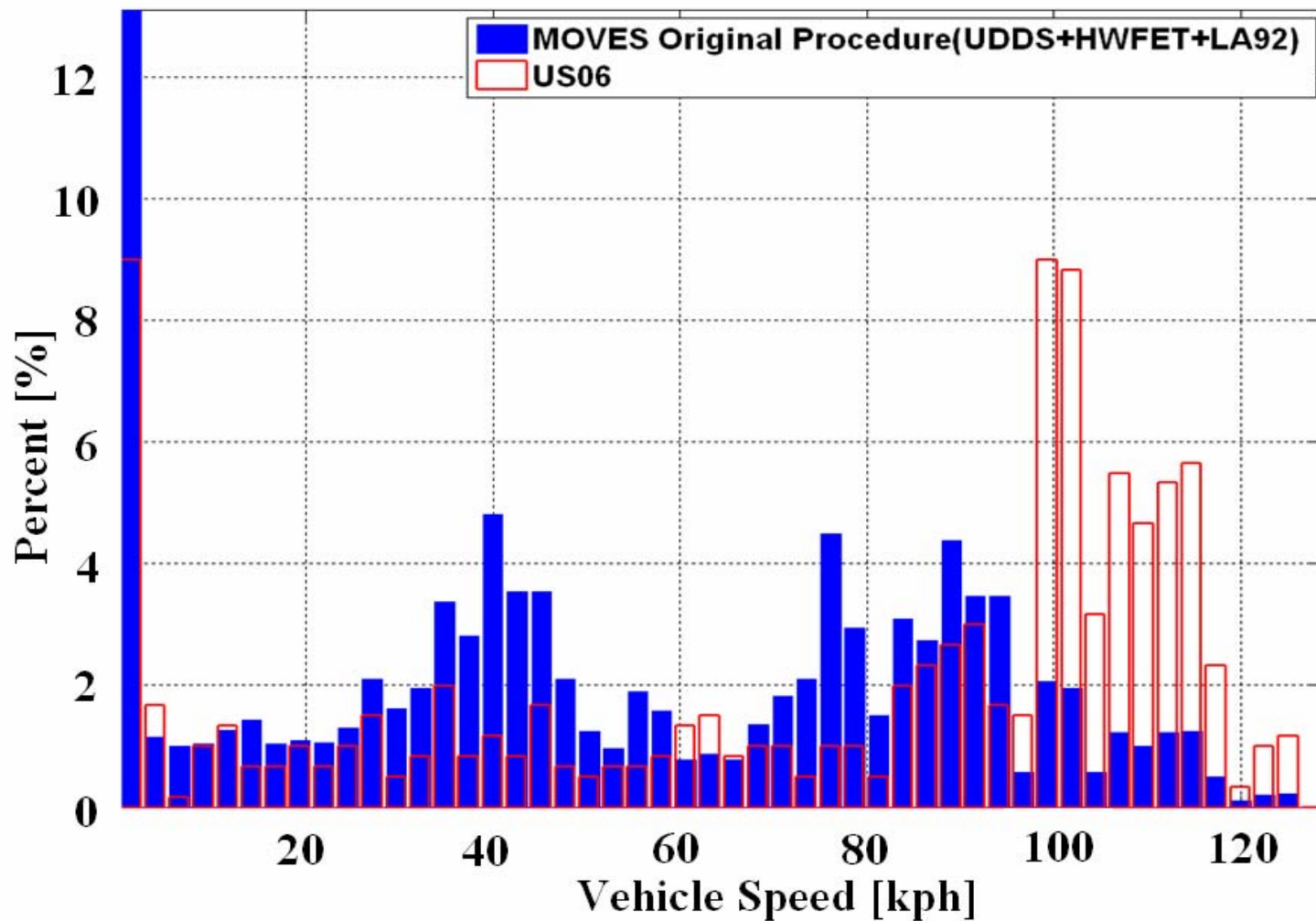
Option #1: Addition of the US06 Drive Cycle as Part of the Procedure

Option #2: Additional Extra Bins at High Power Demands

VSP Binning Procedure Well Adapted for MOVES

- MOVES procedure predicts the fuel economy very well for single-power-source vehicles, such as conventional and fuel cell vehicles with an uncertainty lower than 5%.

- The uncertainty increases with the hybridization of HEVs. The maximum uncertainty can be viewed for PHEVs (20% on NEDC).

- The discrepancies in fuel economy on HEVs are mostly due to non-repeatable engine ON/OFF behavior.

- The combination of the UDDS, HWFET, LA92, and US06 cycles with two extra bins for the MOVES procedure can be used to minimize the "out-of-range" problem in the US06 cycle.

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VSP Binning Procedure Well Adapted for MOVES

- Using a detailed approach such as PSAT is feasible for specific vehicles, but would not be applicable for MOVES because of the very large range of vehicles and timeframes considered.

- This study demonstrated that the uncertainties introduced by the current procedure were generally acceptable to fulfill the purpose of MOVES possibly to the exceptions of PHEVs.

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