USING “BIG DATA” TO BETTER DESIGN AN ELECTRIFIED VEHICLE
以“大数据”改进电气化车型设计

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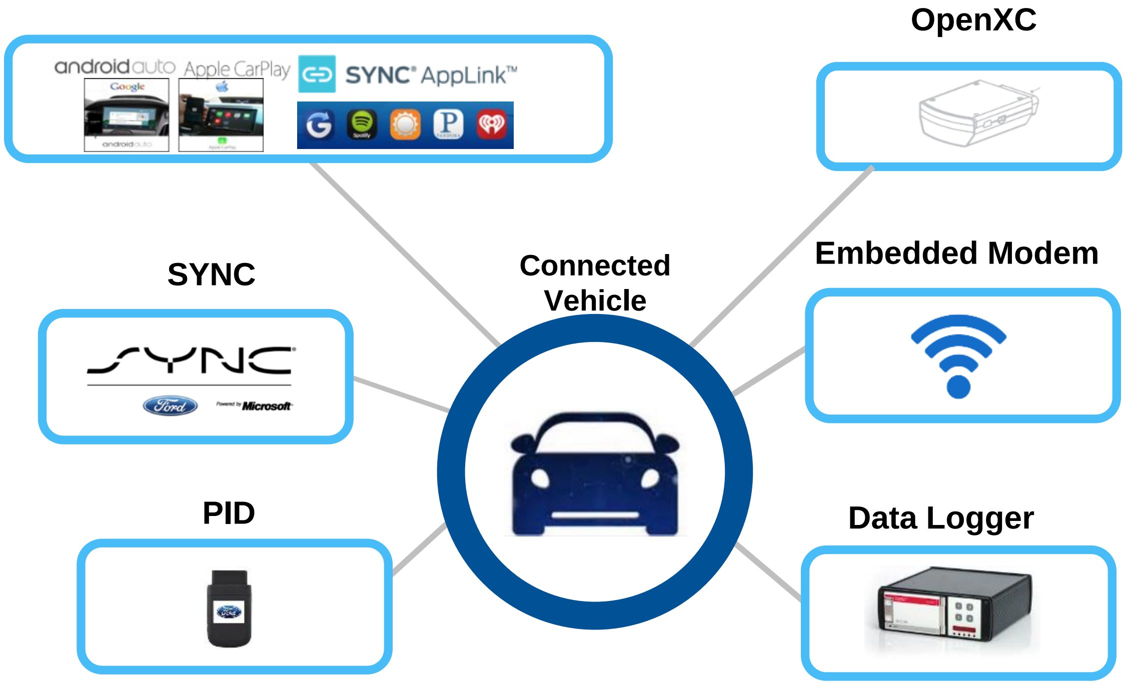
INTERNATIONAL

Go Further

CUSTOMERS AND THEIR BIG DATA 客户端的大数据

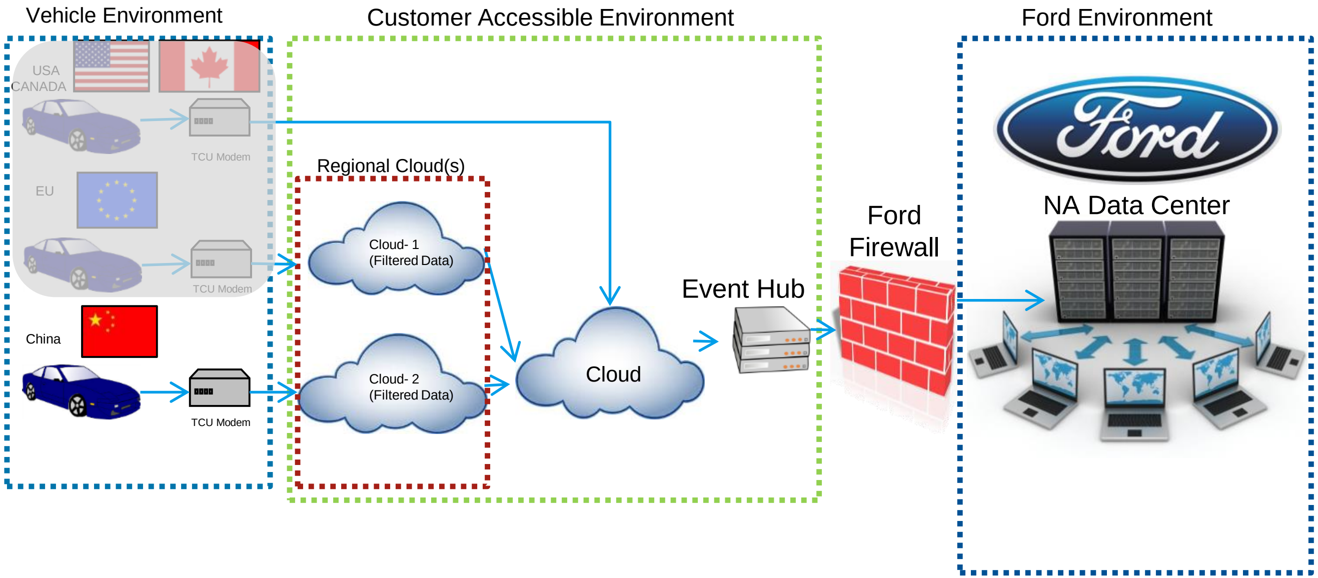
Connected Vehicle Technologies



Ford is a leader in the connected vehicle space
Number of technologies and methods are currently used to obtain data from vehicles

MYFORD® MOBILE AND FORDPASS®
MYFORD® 及 FORDPASS® 福特派

- Embedded Modem technology
- Event based data collected



Data is anonymized and stored in secure servers internally at Ford
Restricted access to any personally identifiable information such as VINs, GPS coordinates etc.

A NOTE ON DATA PRIVACY

Globally, Ford subscribes to the Alliance of Automobile Manufacturers Consumer Privacy Protection Principles.

- Agreement governing the collection, use, and sharing of certain vehicle data.

There are specific considerations for the data collected in the China market specifically focused on –

GPS/Mapping

- Foreign entities are completely forbidden from mapping activities, which includes any measuring, collecting, and presentation of shape / size / spatial position or properties of natural geographic elements.

Cyber Security Law

- Focused on protecting customer data and having explicit customer consent for any use of this data, including overseas data storage, marketing, and analytics.

Banking / Financial Data

This report only contains analysis done on non-China data only on an aggregate basis.

BIG DATA ANALYTICS: TOOLS & WORKFLOW
大数据分析:工具及协同

Data Storage

Exploratory Data Analysis

Distributed Computing

Statistical Data Analysis

Data Visualization

Provide Insights On Customer Usage

It takes more than a hammer to build a house

Why use Big Data? 为何使用大数据？

Gaining understanding of how customers will use electrified vehicle is invaluable in **designing**.

- How many Wide Open Pedal operations per 100 mi exist? Is it different for a performance product?

New technologies with very little **quality** history drive need for data to develop effective KLTs.

- How often and how much power is derived from the high voltage battery?

Electrified components are generally expensive and right-sizing them can provide best **value** to the customer as well as the OEM.

- Right size the battery for electric drive.

Big Data can be used to benefit designing products, adding value, and improving quality.

Examples of Big Data Projects 大数据项目举例

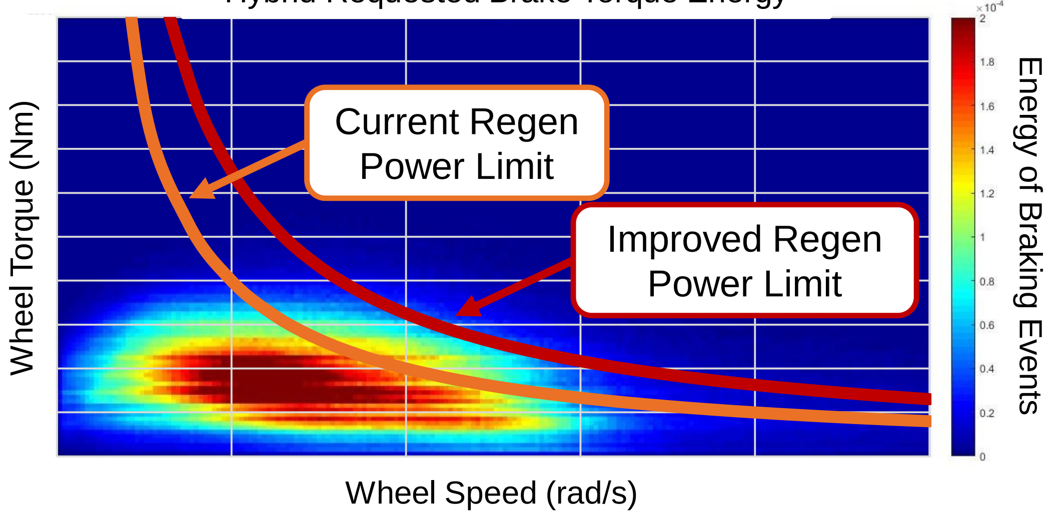
1. **Battery Charge Power Limit**
2. **Charger Sizing**
3. **WOP Occurrence**
4. **Powertrain Efficiency**

Example 1: Battery Charge Power Limit
例一：电池充电功率限值

Design:

- Set battery charge power limit to collect not only most of the regen from regulatory cycles, but also real world customer drives
  - Opportunity to increase regen power limit comes with e-AWD systems

20,987 trips	10 Hz frequency	1.02 million miles	765 million rows of data



放宽了再生制动充电功率的上限之后，回收的能量最大可提升到原来的27%

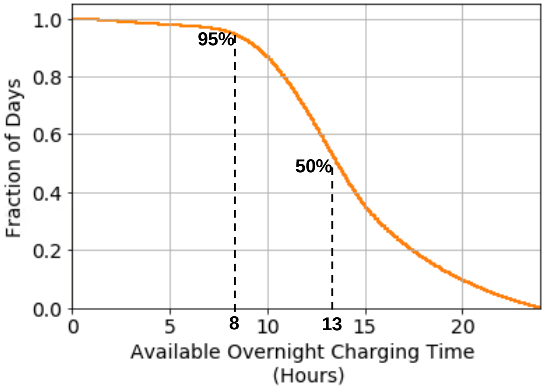
Up to 27% increase in available energy capture with increased regen braking power limit.

Example 2: Charger Sizing
例二 : 车载充电器功率

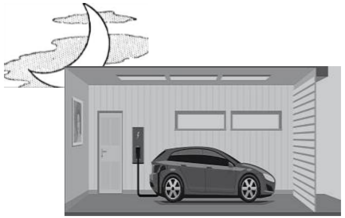
Design:

➢ Determine on-board AC charger size for a 300 mi electric vehicle

Traditional Method: Size charger to fully charge battery regardless of next day's driving distance



Overnight Charging



95% of the nights have at least 8 hours of available charging time.

Remaining range at start of charge: 0 miles

Miles to be added: 300 miles

Charge time required: 13 hrs (assumes a 7kW charger)

To charge in 8 hours, a ~11kW charger would be needed

仅有~50%的情况下，隔夜能有13个小时用于充电。因此很可能要选用更大功率的车载充电器。

Only ~50% of the nights have 13 hours or more available for charging. This will likely result in opting for a bigger charger.

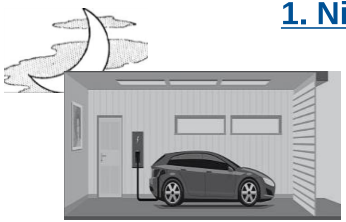
Example 2: Charger Sizing
例二：车载充电器功率

Design:

- Determine on-board AC charger size for electric vehicles such that next day's distance is fully charged overnight

Data Driven Method: Size charger so as to cover the next day's distance

1. Night



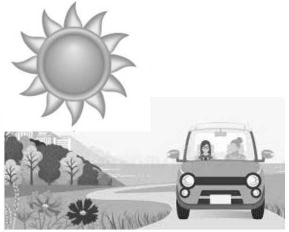
Start of Charge: 33 miles

Charge Duration: 8* hrs

Miles added: 184 miles (with 7kW charger)

* 95% of nights have at least 8 hours available for charging

2. Day



Start of Drive: 217 miles

A Long Drive: 200* miles

* 95th Percentile US Customer drives < 200 miles

3. Night

End of Trip: 17 miles

Charge Duration: 8 hrs

Miles added: 184 miles (with 7kW charger)

End of Charge: 201 miles

充电器的功率选择可以达到较高的成本效益，满足95%的用车需求。其它对里程需求更长的场景，可以通过直流快充来满足。

Charger can be cost-effectively sized to cover the 95th percentile of the scenarios. Remaining scenarios can be enabled through DC Fast Charging.

Example 3: WOP Occurrence
例三：全油门的使用

Design:

➢ Determine WOP occurrence rate and duration for BEV battery and thermal requirements

油门踏板开度90%以上即为全油门。

性能车型每100英里会出现 2.77次全油门的使用。

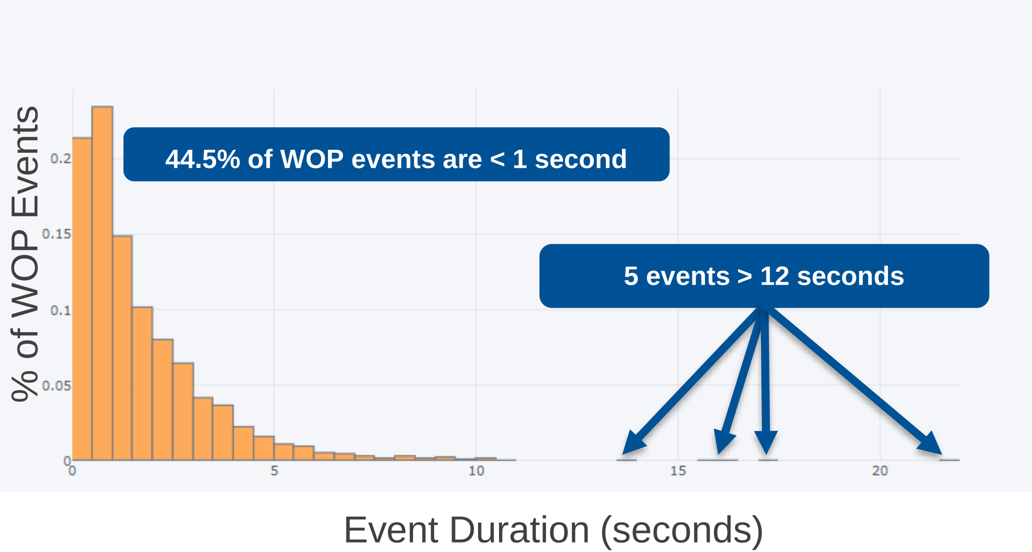
WOP event is one where the pedal position goes to greater than 90%.

Performance vehicles experience 2.77 WOP events per 100 miles

Example 3: WOP Occurrence
例三：全油门的使用

Design:

- ➢ Duration of WOP events have direct implications on thermal requirements



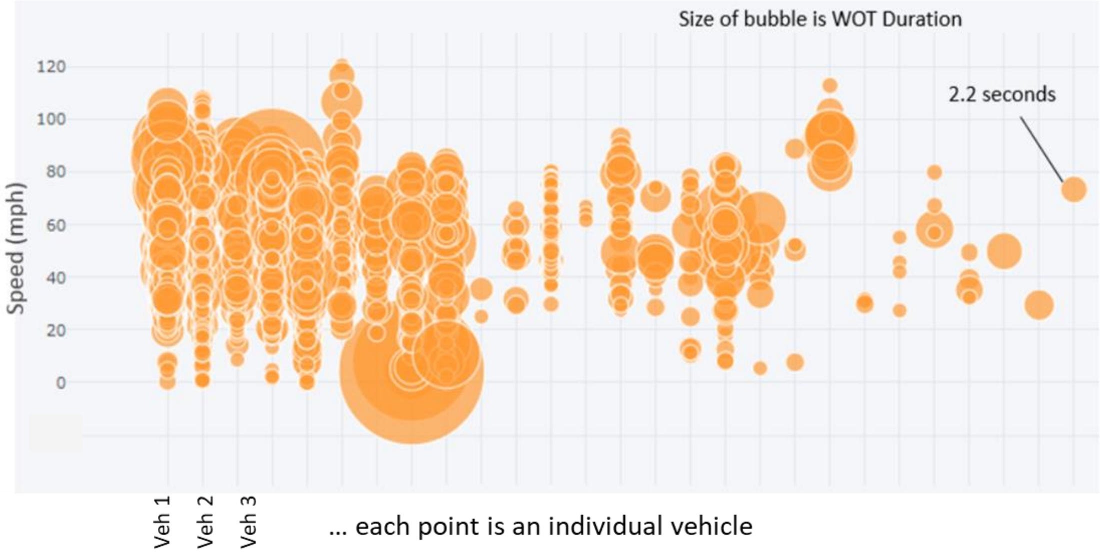
通过车联网数据分析发现，典型全油门的使用通常会小于 5 秒。

From connected vehicle data analysis, the typical duration of WOT events is generally less than 5 seconds.

Example 3: WOP Occurrence
例三：全油门的使用

Design:

- For power consideration, the duration and speed of a WOP events is considered.



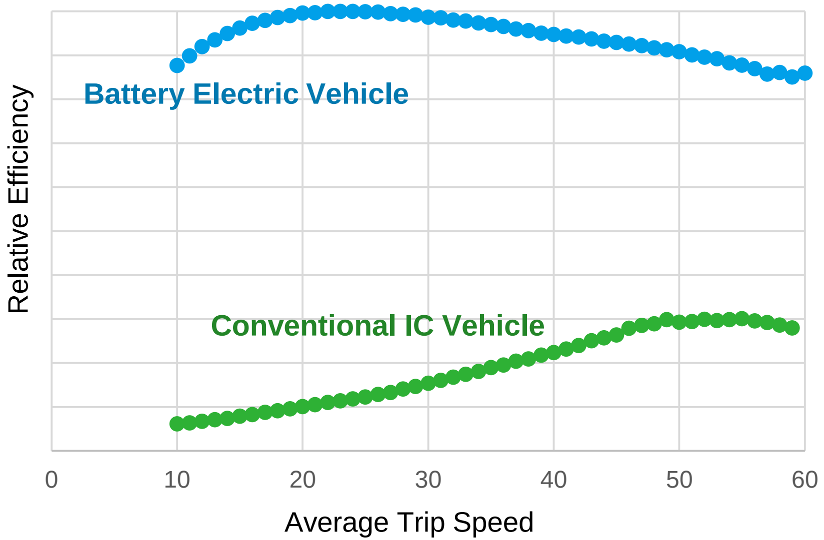
全油门发生时的车速也是一个设计考虑的因素 — 同样来源于大数据分析。

Speed at which WOT event occurs is another design factor – also enabled through big data.

Example 4: Powertrain Efficiency
例四:动力系统的效率

Value:

➢ Study of the relative efficiencies of a electrified powertrain vs. a conventional powertrain for different average trip velocity.



纯电动的动力系统相比传统动力系统，峰值效率发生在低速段。平均车速较低的国家，如中国，使用纯电动汽车会更有益。

BEV powertrains have peak efficiencies at low speeds compared to conventional powertrains. Low speed markets, like China, can benefit more from BEVs.

Example 4: Powertrain Efficiency
例四：动力系统的效率

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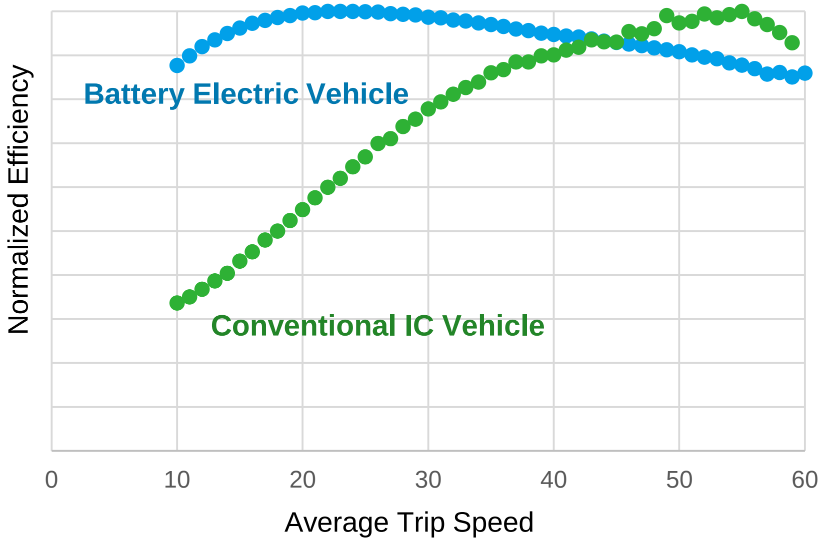


此外，纯电动动力总成受平均车速的影响，
相比传统动力总成来说更小。

Moreover, BEV powertrains are less sensitive to average trip speed compared to conventional powertrains.

USING BIG DATA
大数据的使用

Appropriately sizing the powertrain for a PHEV or BEV is a delicate balance between regulation, cost, and customer wants.

- Data collected from vehicles can help OEMs set the right balance for designing the vehicle.

There is a growing need in the automotive industry to standardize the analysis of this data.

- SAE can take the initiative for this globally by setting up data analysis standards and procedures.

SAE PAPER REFERENCE
SAE文献参考

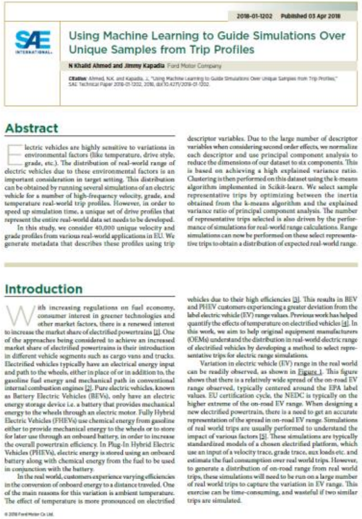
2017-01-0247 - Big Data Analytics: How Big Data is Shaping Our Understanding of Electrified Vehicle Customers

2017-01-1146 - Seasonality Effect on Electric Vehicle Miles Traveled in Electrified Vehicles

2017-01-0235 - Customer Data Driven PHEV Refuel Distance Modeling and Estimation

2018-01-1202 - Using Machine Learning to Guide Simulations Over Unique Samples from Trip Profiles

2018-01-0427 - Charger Sizing for Long Range Battery Electric Vehicles


2018-01-1202 Published 03 Apr 2018

Using Machine Learning to Guide Simulations Over Unique Samples from Trip Profiles

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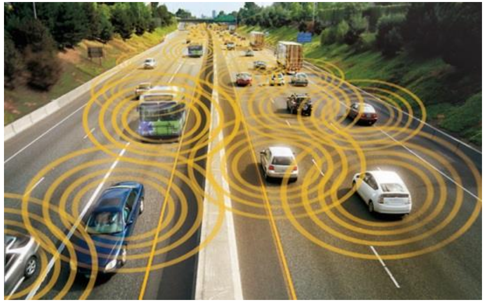
Abstract

Introduction

CONCLUSIONS
结论



Insights learnt from data collected from connected vehicles can be used to –

- Appropriately **design** the next EV
- Develop effective test methodologies for robust **quality**
- Right sizing components for best **value** to customer

Common, agreed-upon methodologies to analyze the data will become necessary.

- SAE can play a vital role in developing data analysis standards.

我们都应该仔细聆听汽车大数据的声音！

We should all listen carefully to what the vehicles are telling us!