Innovation, Electric Vehicles and Future Mobility

创新驱动、电动汽车和未来出行

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世界电动车协会创始主席

EMSD Summit – Imaginovate HK
17 November 2016

Future Mobility

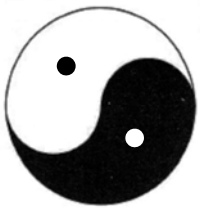
解放思想，
Open Minded,
破解难题，
Solve Problem,
创新驱动，
Innovation Driven,
实现中国梦！
Realize China Dream!

易经基本原理： 变化、周期、平衡、对立统一
Yi-jing basic principles:
Change, Periodic, Balance, Unity of Opposites

直接、一成不变的思维
Straight Forward Approach

说“Yes”就是“Yes”
说“No”也不会变成“Yes”
“Yes” is “Yes”
“No” is “No”

整体、辩证的思维
Holistic, Dialectic Approach

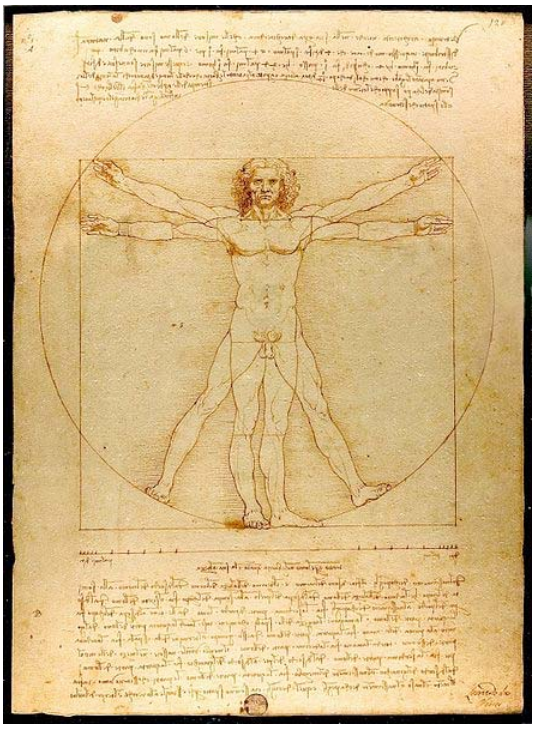


“Yes”可转变为“No”
“No”也可转变为“Yes”
“Yes” can be turned into “No”
“No” can also be turned into “Yes”

《易经》的思维法则

The beginning of the cultural movement of the Renaissance

David, by Michelangelo, an example of high renaissance art



Leonardo da Vinci`s Vitruvian Man, an example of the blend of art and science during the renaissance

Open Mind
解放思想

- A closed Mind Can Not Change!
  封闭的思想不能进步！
- Saw Beyond What Was, to See What is!
  观察到以前的，更要看到今天和明天的！

Characters of Renaissance Scientists & Engineers

文艺复兴式的科学家和工程师的特征

Think the World and not just the THINGS

思考全球而非局限于某些事物

- Global thinking instead of local thinking;
  纵览全球而非坐井观天；
- Harmony thinking between human and nature;
  天人合一思维；
- Circle thinking instead of linear thinking;
  环形思维取代线性思维；
- Closed loop thinking instead of open loop thinking;
  闭环思考取代开环思考；
- Life cycle thinking instead of partial life thinking;

生生不息、全生命周期考虑，而非涸泽而渔、短暂考虑；

- 3R thinking (Reduce, Re-use, Recycle).

思考 减少消耗，再利用，回收。

创新之源泉和氛围

Innovation Sources & Environment

- 理念是创新之魂。
  Conceive is the soul of innovation
- 创意是创新之源。
  Creativity is the source of innovation
- 人才是创新之本。
  Talent is the basis of innovation.
- 创新生态和氛围是成功的要素 Innovation ecology and environment is the key to success：

1. 自由、开放、合作、包容；
   Freedom, openness, cooperation, tolerance;
1. 公平的市场竞争； Fair market competition;
2. 完善的知识产权保护；IPR Protection;
3. 网路和大数据的支持。 Network and big data support.

Mobility is Freedom.

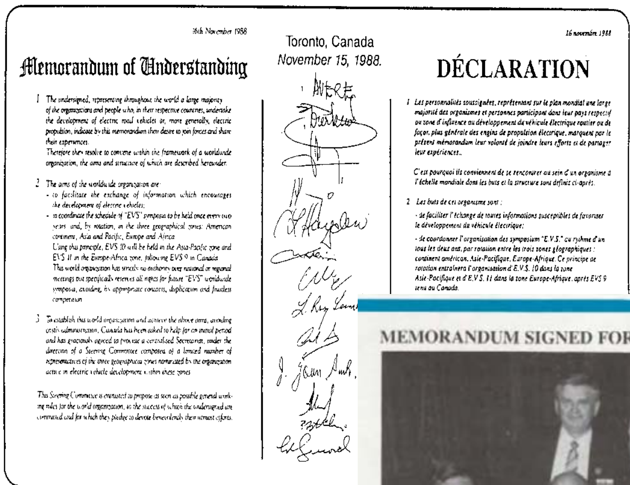
Mobility is the most apt expression for our quest for happiness.

移动意味着自由

移动最贴切地表达了我们对幸福的追求。

Historical Document Signed at EVS.9

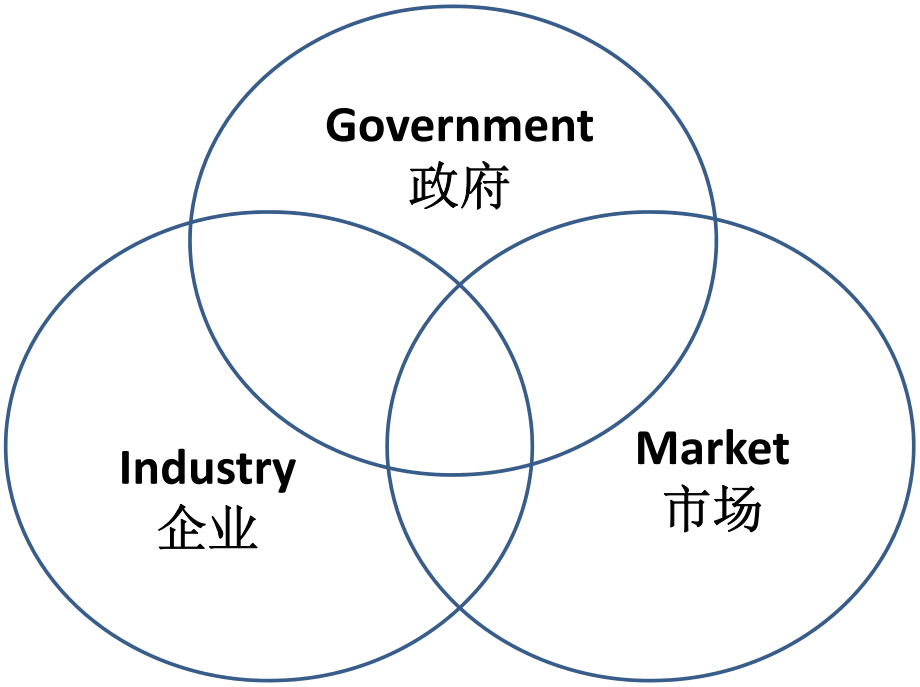
Committing Support to Formation of World Electric Vehicle Association



MEMORANDUM SIGNED FOR WORLD ELECTRIC VEHICLE ASSOCIATION

Participants from Top left: B. Fijalkowski (Poland), R. Atanassov (Bulgaria), H. Payot (France), C. Hayden (U.S.), Z. Feng (China), W.A. Adams (Canada), Bottom left: M. Chiogioji (US), R. Leembruggen (Australia), J. Lea (Korea), L. Secord (Canada), C.C. Chan (Hong Kong), F. Dierkens (A.V.E.R.E.), A. Ananthakrishna (India), T. Matsuo (Japan). The above gentlemen signed the memorandum of agreement for the formation of a World Electric Vehicle Association during EVS.9 last November. Cliff Hayden (US), Ferdinand Dierkens (Europe) and Dr. C. Chan (Asia) have been appointed a steering committee.

Government, Industry and Market
政府、企业和市场

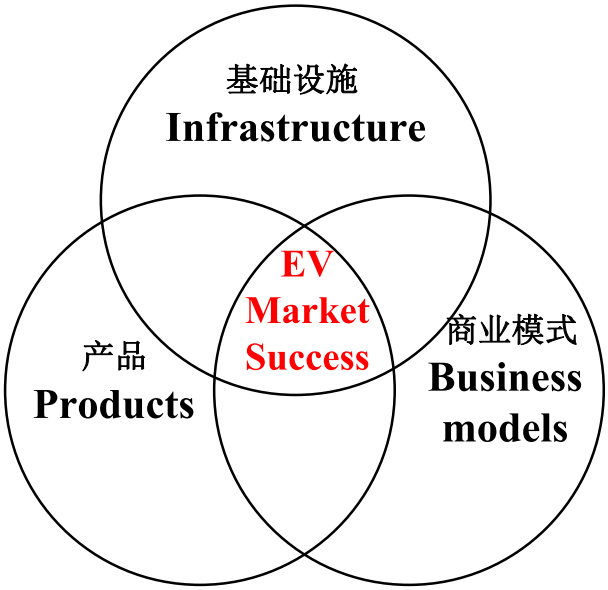


Key Issues 关键因素

三好：好的产品、好的基础设施、好的商业模式

Three Goodness Factor :

Good Products; Good Infrastructure; Good Business Model

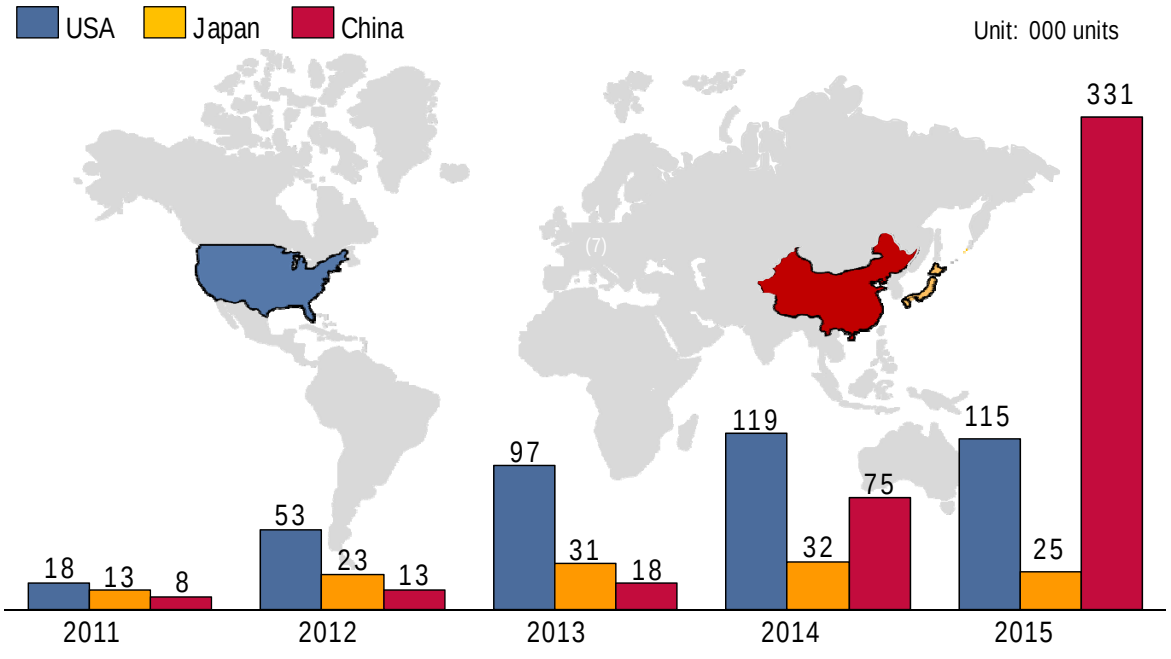


Electric Vehicle is Disruptive Industry
电动汽车产业是颠覆性产业

- **Electric vehicle is not only just a transportation means, but also an electric device with moving energy storage capability.** 电动汽车不仅是交通工具，而且是能源和信息载体，可以进行能源、信息的交互。
- **Thus the integration of electric vehicles and smart gird, of electric vehicles and information and communication technologies, is quite essential.**

  电动汽车和智能电网、智能信息的结合。
- **Such integration and collaboration should aim at gradually achieving the common goal of four zeros: zero emission, zero gasoline, zero traffic accident, and zero traffic jam** 电动汽车和智能交通、智慧城市的结合。逐步达到零排放、零汽油、零交通堵塞、零交通伤亡。

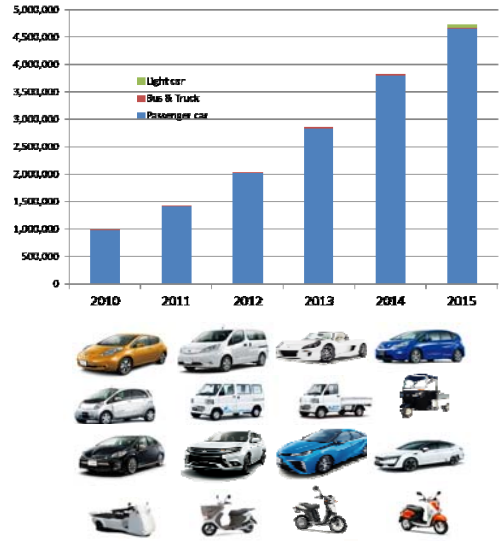
CHINA OVERTOOK THE US TO BECOME THE LEADING NEV MARKET IN 2015.



Source: CAAM

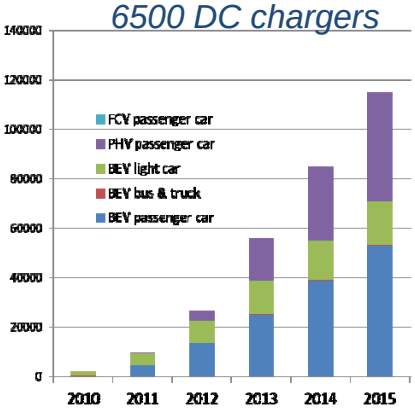
Remark: The volume here include both NEV PV and NEV CV

JAPAN, one of the most EV conscious countries



4.5 million HEV
& increasing BEV/PHV/FCV

12500 AC chargers &
6500 DC chargers



What is Electric Transportation?

- Car
- Truck
- Bus
- Marine
- Airport
- Forklift
- Marine

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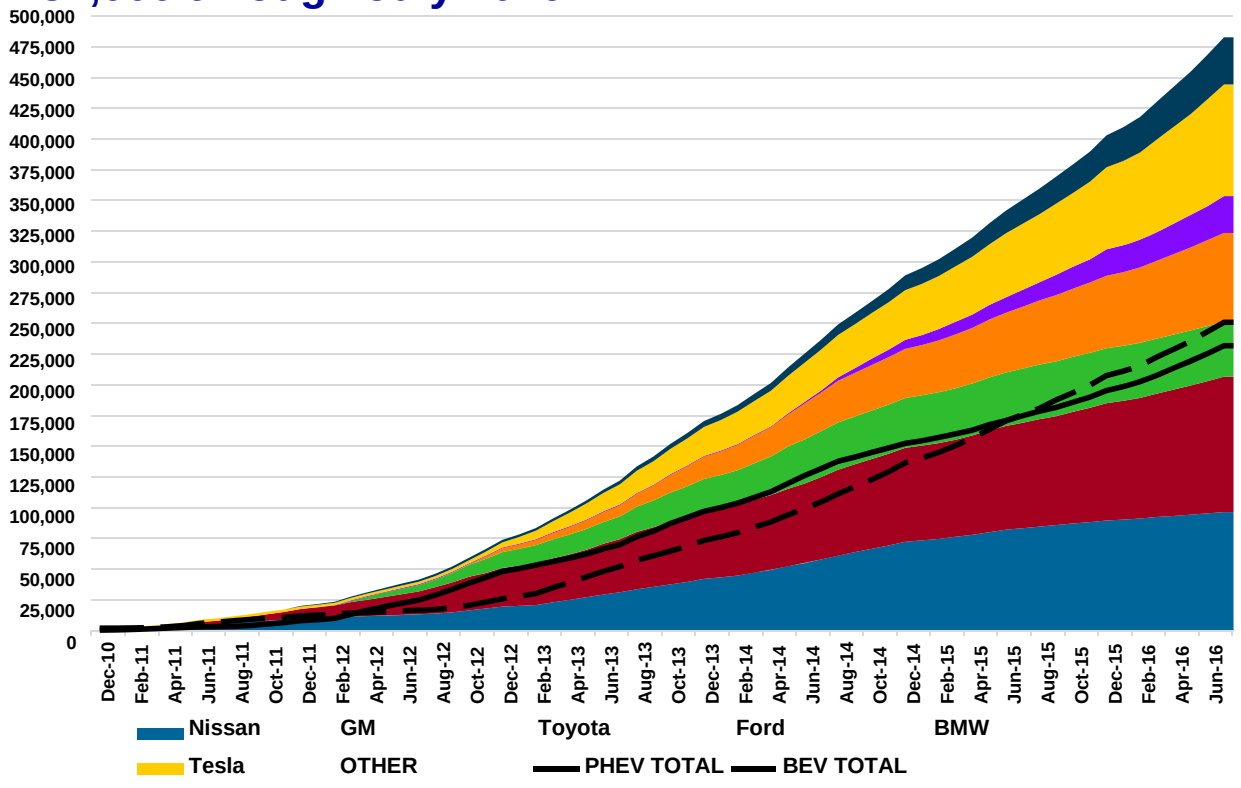
Cumulative US PEV Sales
482,000 through July 2016



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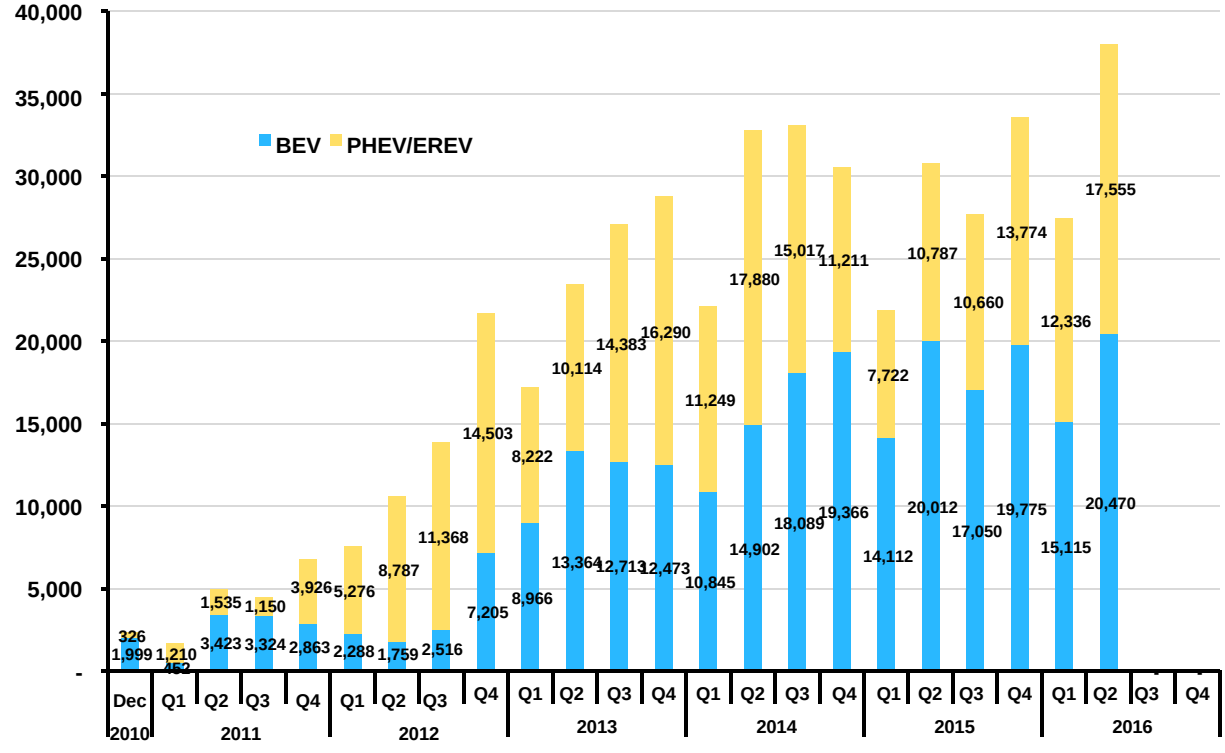
PEV sales by quarter – Q1 and Q2 2016
Up 23% over 2015



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Customer choice is increasing
~35 new PEVs coming in 2016-2019















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EPRI ELECTRIC POWER RESEARCH INSTITUTE

China EV Development Strategy

中国新能源汽车发展战略

Pressure on Energy & Environment

Oil Consumption & Energy Saving

Chinese Electric Mobility Achievement

中国需要开发不同类型的新能源汽车
China Needs Various Types of EVs

- 国民车：没有超跑性能、价廉、高效、安全、智能。
  Citizen EVs: Low Cost, Reliable, Light Weight, Intelligent, Without Race Car Performance.
- 高端车：高性能、高舒适、高安全、高智能。
  High Class EVs: High Performance and Luxury
- 特种车：**Special Purpose EVs**
  公交车、客车、 **Buses**
  出租车 **Taxis**
  物流车 **Logistic EVs**
  重载车 **Heavy Duties HEVs**
  特种用途车

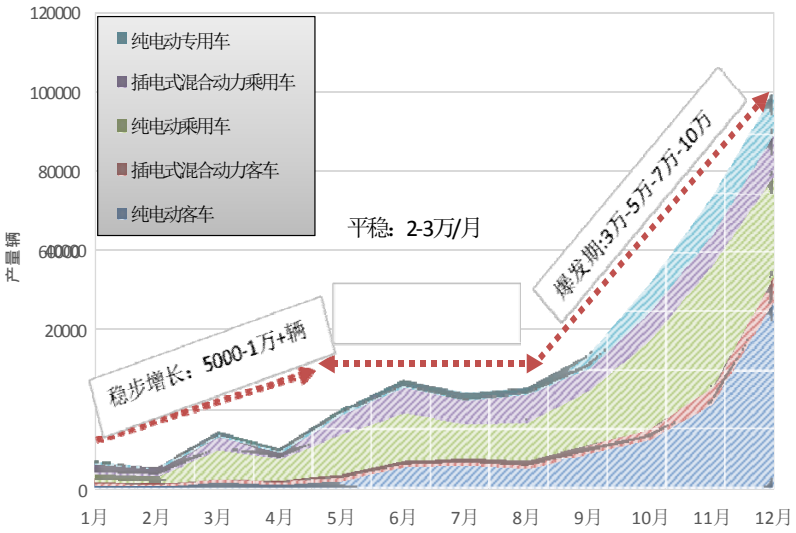
新能源汽车发展战略目标路线图 China Road Map of New Energy Vehicles

时间阶段	现在~2020年	2020年~2030年	2030年~2050年
发展驱动力 Driving Force	减排为驱动力 PM2.5为主 Mainly PM2.5 Reduction	节能为主驱动力， PM2.5缓解，CO2上升 Mainly Energy Conservation	减少CO2为重点 Mainly CO2 Reduction
标志性事件		自产气使用量超过石油	
发展战略 Strategy	公交车、出租车、物流运输车的推广，小型电动车推广运用 Bus, Taxi, Logistic, Small EV,	电动汽车大规模运用，氢燃料和燃料电池量上升 EVs in various applications	氢燃料和燃料电池量大规模推广，生物质燃料上升 Large scale hydrogen fuels and fuel cells; Increase in biofuels
新能源汽车（纯电动和插电式）所佔比率 Penetration %	2%	10% - 15%	50%

2020年减排为主，2030年节能为主。

2015年新能源汽车产业化发展 NEV Types

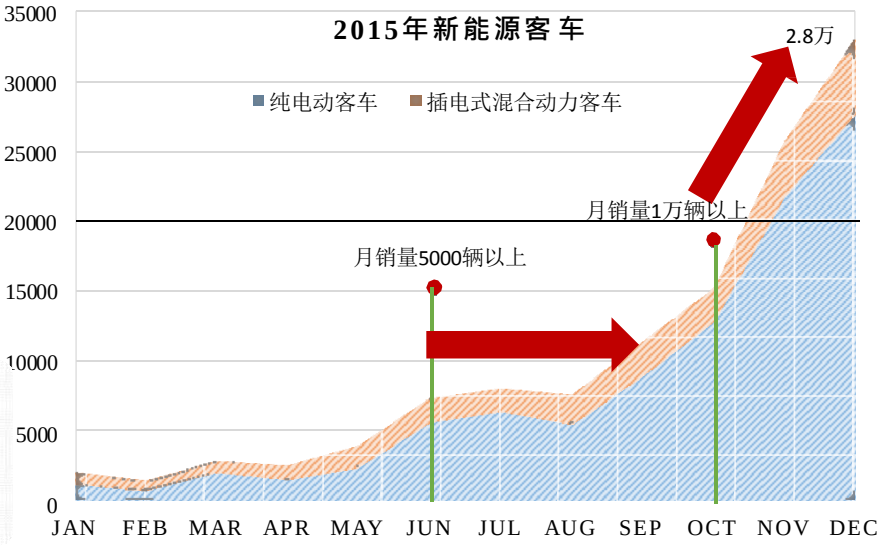
历经多年努力、集聚多种能量，中国新能源汽车呈现高速增长



2015年各类新能源汽车总产量为37.9万辆(工信部统计数据，汽车协会数据为34万辆），新能源汽车年销量在新增汽车销售量中的占比首次超过1%， 单月最高占比达2.9%。

新能源汽车发展分车型分析 Buses & Vans

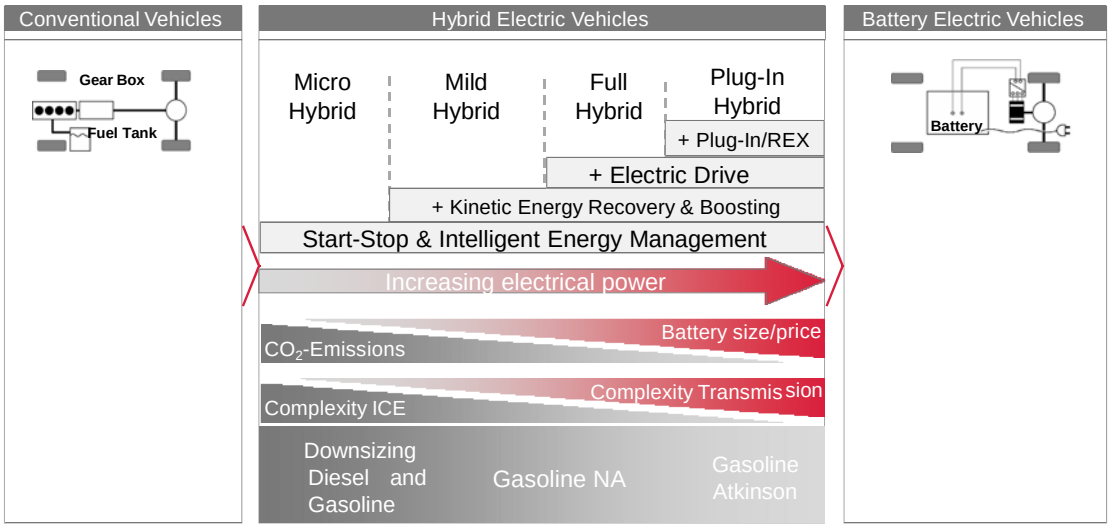
大中型新能源商用车超高速发展



2015年，各类新能源客车年累积产量超过11.2万辆。
高速发展也带来质量参次不齐、产业链不协调等问题。

HEV with varying degrees of electrification span the gap between conventional vehicles and battery electric vehicles

HEV ARCHITECTURE



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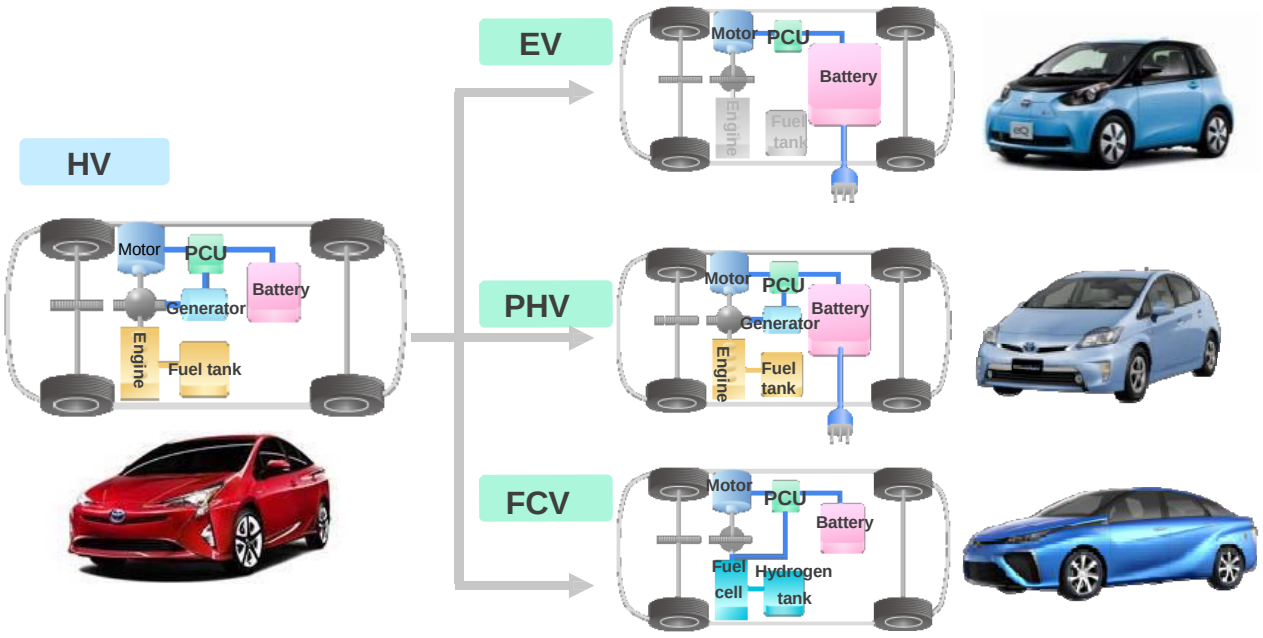
Development of hybrid technology



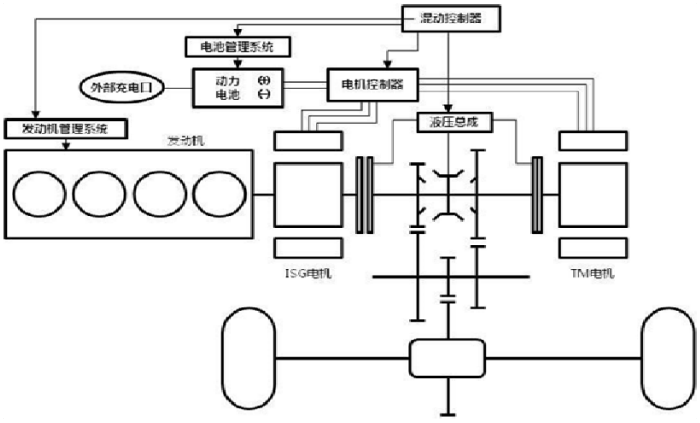
Hybrid technology is central to Toyota's development of PHVs, EVs and FCVs. Toyota has positioned it as a core technology.

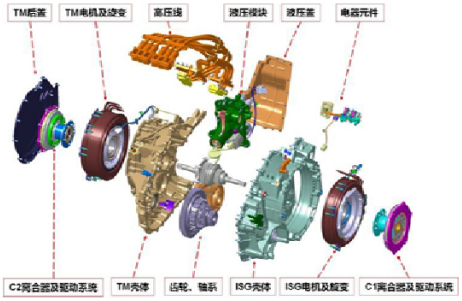
The plug-in hybrid passenger car/插电式混合动力乘用车

Breakthrough in Electromechanical Coupling Technology/
机电耦合技术取得突破

- Technical breakthrough : ***Double motor series parallel configuration***/
  机电耦合技术取得突破：双电机串并联构型

荣威e550 /
ROEWE 550

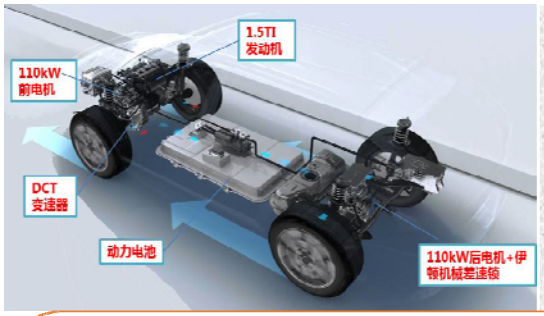


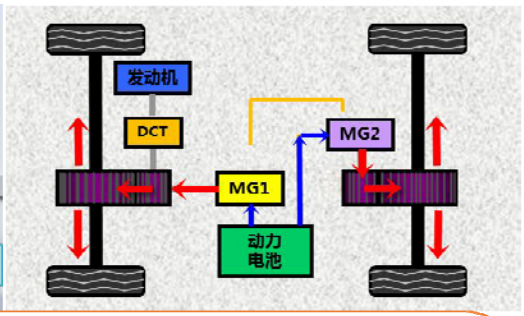


The plug-in hybrid passenger car/插电式混合动力乘用车

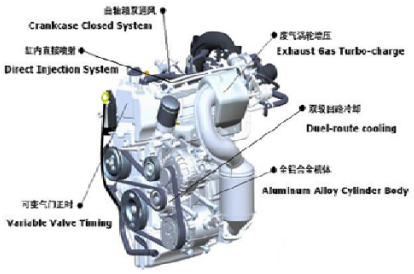
Breakthrough in Electromechanical Coupling Technology/
机电耦合技术取得突破

- Technical breakthrough : ***Four-wheel Drive Configuration SUV***/
  机电耦合技术取得突破：SUV四驱构型





4WD保证了强劲动力性。
百公里加速时间4.9s



Strong Hybrid (i-MMD) Advantages

强电混合动力的优点：高能源效率和低排放

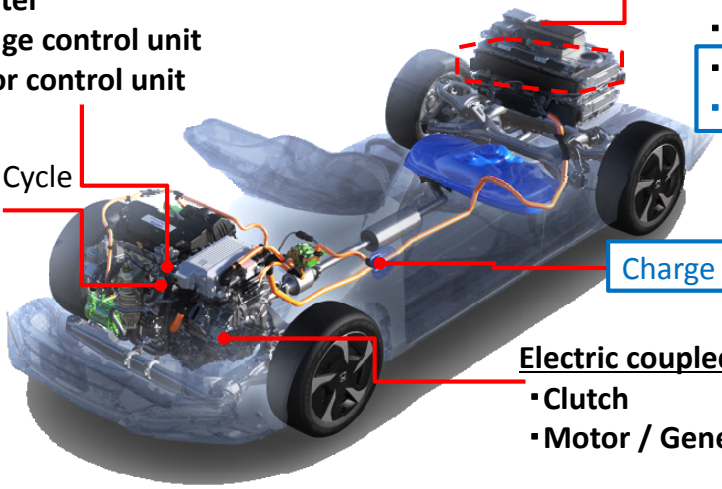
Significant overlap: FHEV & PHEV

US Label: 47 / 49 MPG
(Ref ICE: 32 / 33 MPG)

Power Control Unit
- Inverter
- Voltage control unit
- Motor control unit

Intelligent power unit
- DC/DC converter
- Battery control unit
- High-capacity Li-ion battery*
- Onboard charger*

Atkinson Cycle Engine



Charge lid*

Electric coupled CVT
- Clutch
- Motor / Generator

*PHEV exclusive

亚太股份

EV with Wheel Motors 轮毂电机驱动—彻底电动化、消除机械传动

Motors + Computer, No Mechanical Transmission

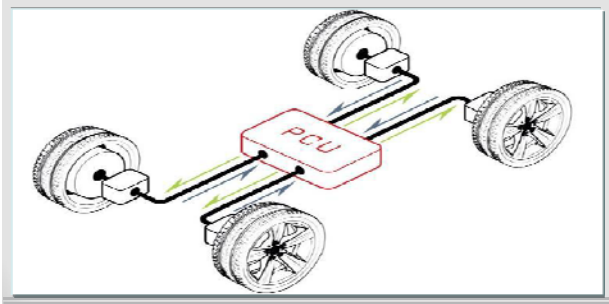
2. 中央执行器的优势——主动安全

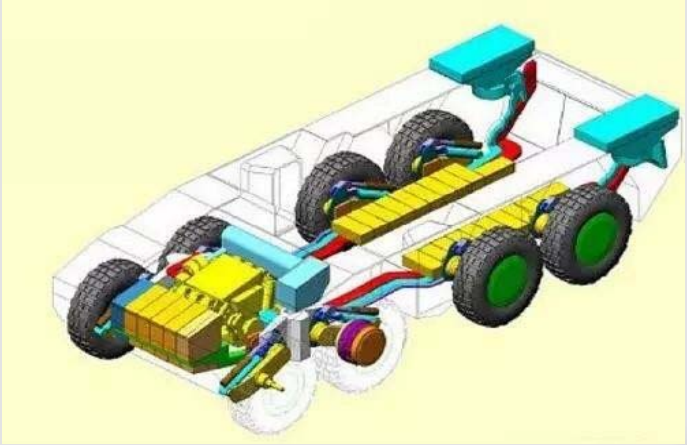
A,一个重量200克的单元，取代了差速锁、粘性联轴器、驱动轴、车轴、球笼等超过200个零件；

B,主动、独立控制每个车轮的牵引力和轮速，取代ESP/ESC系统；

C,无数种驾驶模式可供开发、客户定制化空间巨大；

D,具备随动转向系统开发空间、进一步取代转向助力系统；





未来城市智能交通解决方案——无所不至无惧拥堵

车轮90度旋转

轻松原地转圈

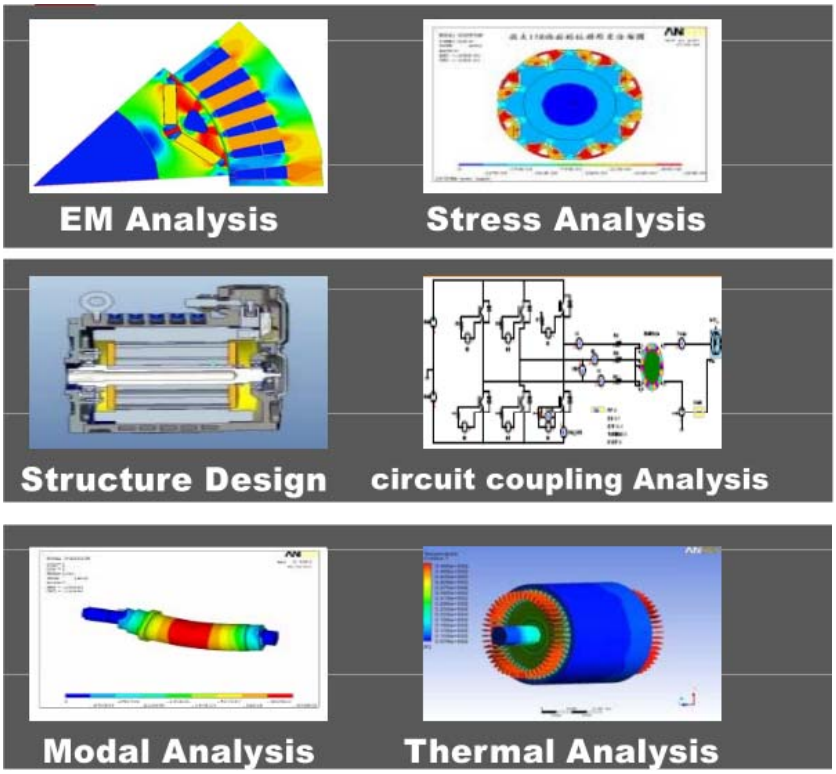
没有停不进去的车位

只有停不进去的车子

亚太股份

独特的底盘结构及四轮控制系统才能实现——真正的越野

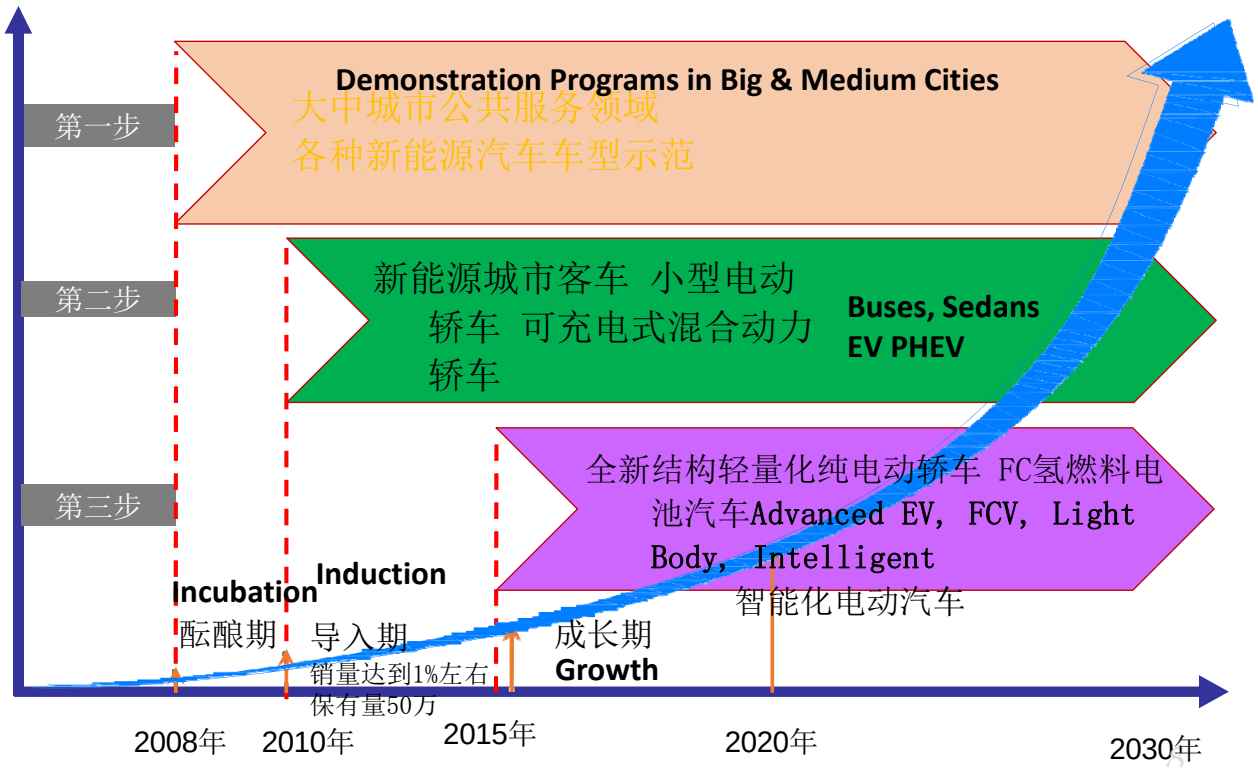
分别控制单个驱动轮的转速和扭矩，可以将传统汽车的ABS、ESP等功能完全整合到中央执行器（PCU）中，从而实现整车的制动、防侧滑、车身稳定性**全面主动精确控制**，同时也是智能驾驶、高级驾驶辅助系统（ADAS）、自动无人驾驶汽车最理想的整车平台。



www.wolong.com

新能源汽车“十二五”目标达成情况 NEV Road Map

“十二五”新能源汽车销量和保有量预定目标基本实现

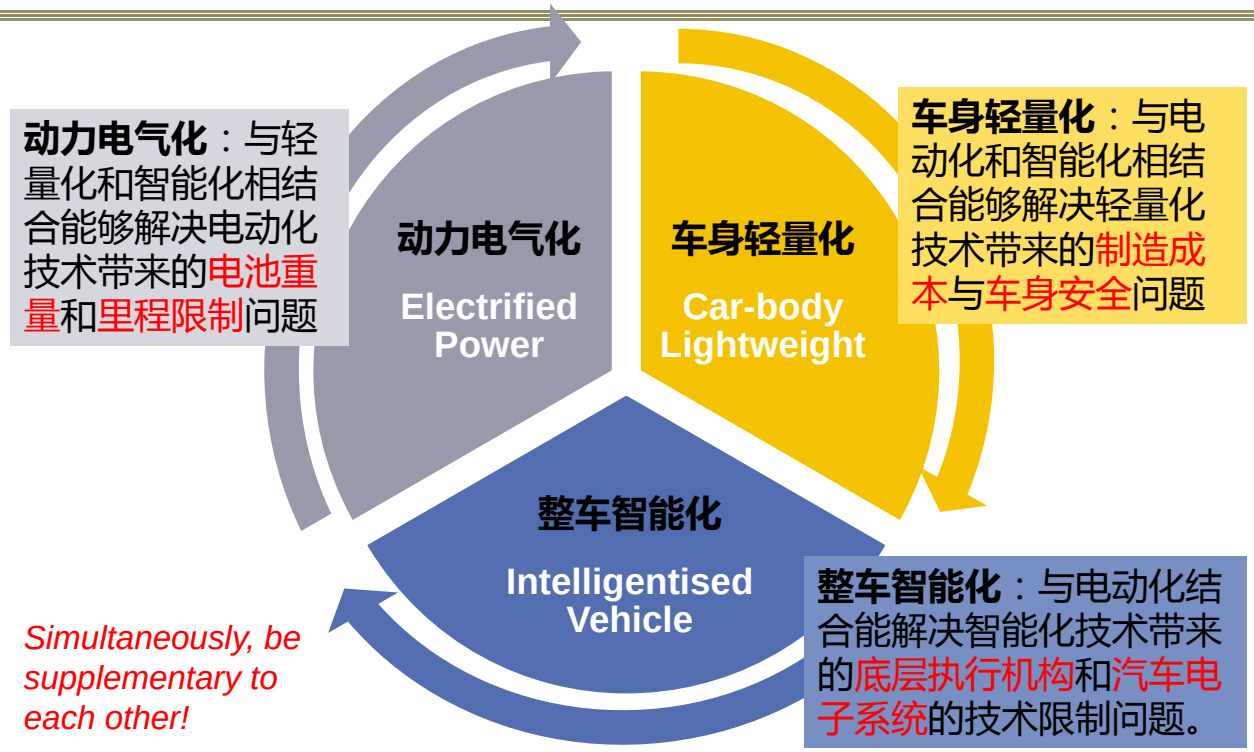


Spreading NEVs in China in the next phase needs to switch the driving forces to government policy plus market driven initiatives./下一步发展必须是“政策+市场”的双驱动

- As the first step, according to the Ministry of Finance, starting from 2016 until 2020, the subsidy will be gradually reduced by 10% to 20% annually.
- The new incentive policies need to balance the benefits among stakeholders, including key component suppliers, infrastructure providers and users.
- The NEVs should be able eventually to compete with conventional vehicles in the market without any government subsidies.

- **从总体上看，提高技术水平、降低生产成本，仍然是发展的主题，创新技术、降低成本、离不开政策的支持，但是，它更需要的是市场，需要市场的激励、倒逼和筛选。种种情况表明，电动汽车发展动力应该由政策驱动转向市场、政策双向驱动，促进产业进入成长期。**

Technologies towards Advancing the E-vehicle Development Strategy /电动汽车发展战略技术深入



动力电气化：与轻量化和智能化相结合能够解决电动化技术带来的电池重量和里程限制问题

车身轻量化：与电动化和智能化相结合能够解决轻量化技术带来的制造成本与车身安全问题

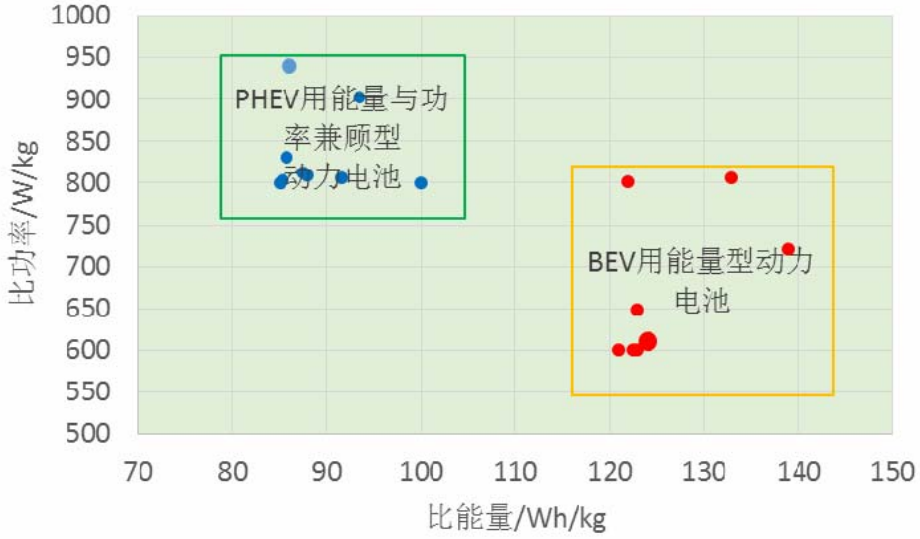
整车智能化：与电动化结合能解决智能化技术带来的底层执行机构和汽车电子系统的技术限制问题。

Simultaneously, be supplementary to each other!

Battery Technology

电池技术

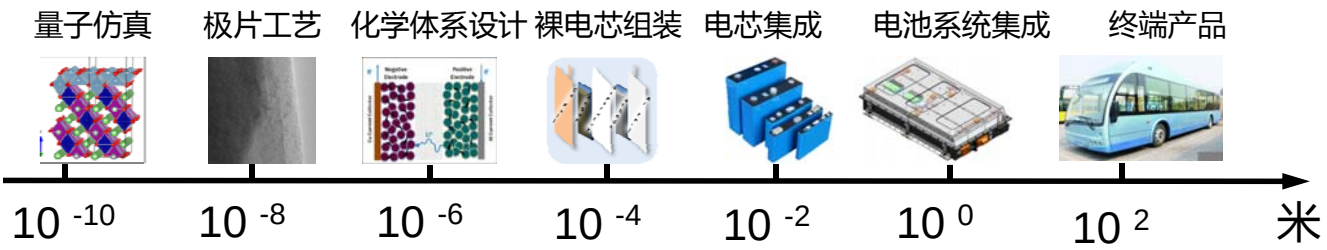
新能源汽车动力电池进展
Current Status of EV Batteries



- **三元正极材料的能量型动力电池模块比能量最高达到140Wh/kg, PHEV用兼顾型动力电池模块比能量最佳90Wh/kg,同时比功率可达900W/kg**（根据十二五《电动汽车》重点专项验收资料统计）；Blue: Power Batteries; Red: Energy Batteries.
- **国内电池标杆企业通过产学研合作，在动力电池热安全技术方面取得重要进展。**

电池系统的安全性管控

The Key Control Of Battery System Safety



- 过电流/外部短路保护
- 绝缘阻抗和抗电强度
- 直接接触和间接接触（等电位）
- 高压标识

- 过电压/欠电压保护
- 过温保护
- 过电流保护
- 碰撞过程中断开高压
- ASIL等级

- 密封（IPXX等级）
- 耐振动
- 耐冲击
- 碰撞防护
- 防爆

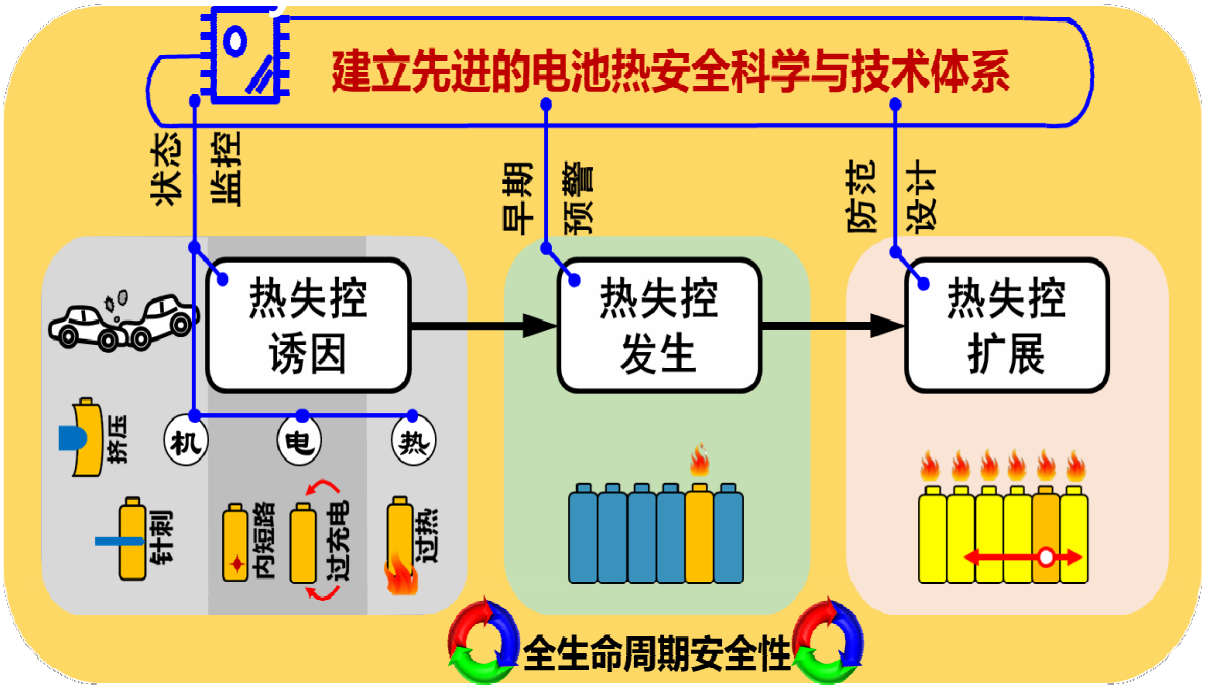
- 材料阻燃等级
- 电芯的安全要求
- 危险物品的标识

CATL

新能源汽车动力电池安全性研究进展

China EV100 中国电动汽车百人会

Battery thermal runaway analysis



EV Infrastructure

电动汽车基础实施

基础设施进展情况
Infrastructure Business Chain

新能源汽车充电产业链正在形成

据不完全统计，全国建成各类充电站3600个，公共充电桩4.9万个。社会力量积极参与，涌现了10余个具有核心竞争力的充电设施企业。

充电设备制造商

中恒、富电、追日
Chargers Equipment Manufactures…

充电设施建设商

华商三优、挚达、富电…
Chargers Construction Contractors

充电设施运营商

国网、普天、特锐德、富电、万帮
Charging Providers…

充电设施信息提供商

E充网、电桩、充电桩、聚电
Charging Information Providers

基础设施进展情况

充电技术创新活跃

特来电公司的智能充电系统
Smart Charging

中兴公司的无线充电系统
Wireless Charging

上海电巴公司的小型化换电站
Battery Swapping

比亚迪公司的充电停车塔
Charging Tower

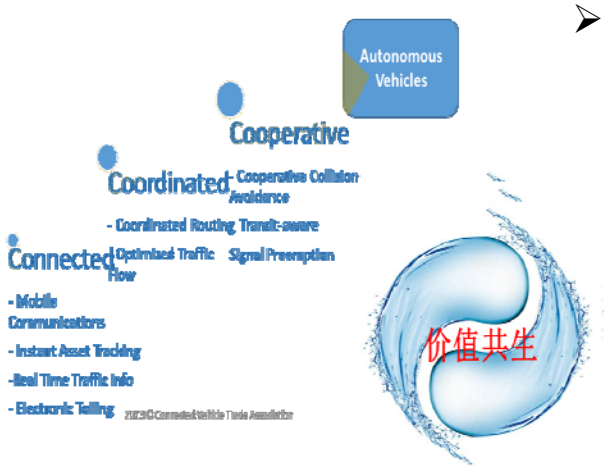
Intelligent Electric Vehicles

Integration of Traffic, Energy and Communication

智能电动汽车

智能交通网、能源网和信息网的融合

***NEVs are not just a means of transportation but also involve moving energy storage and a moving-terminal of the Internet./*NEV不仅仅是交通工具，更是一个移动的互联网终端！**



- We have to be able to analyze the global issues of the development of NEVs, including their political, economic, environmental and social benefits, as well as to have a better and detailed understanding of the complex relationship between a variety of both industrial and technical sectors and their values.

Information technology plays a very important role in promoting symbiotic values, particularly to integrate statistical physics and information theory which should lead to deeper understanding of the correlation between energy and information. Therefore the *3D-Time-dependent Schrödinger Equation* can be applied to analyze different factors in energy systems (Chan, C.C., 2014).

M

- MOBILE
- MAN TO MAM
- MAN TO MACHINE
- MACHINE TO MACHINE

What's next?
Now and in the future

- Autonomous driving
  - Tesla, Apple, Google

- High power charging
  - Current 50 kW; future 150 kW; goal 350 kW
- Long-distance (~200 mile) mass-market battery electric vehicles
  - Chevy Bolt
  - Tesla Model 3
  - Gen 2 Nissan LEAF
- Ownership Models / Transportation On-Demand
  - Car share /
  - Lyft / Uber

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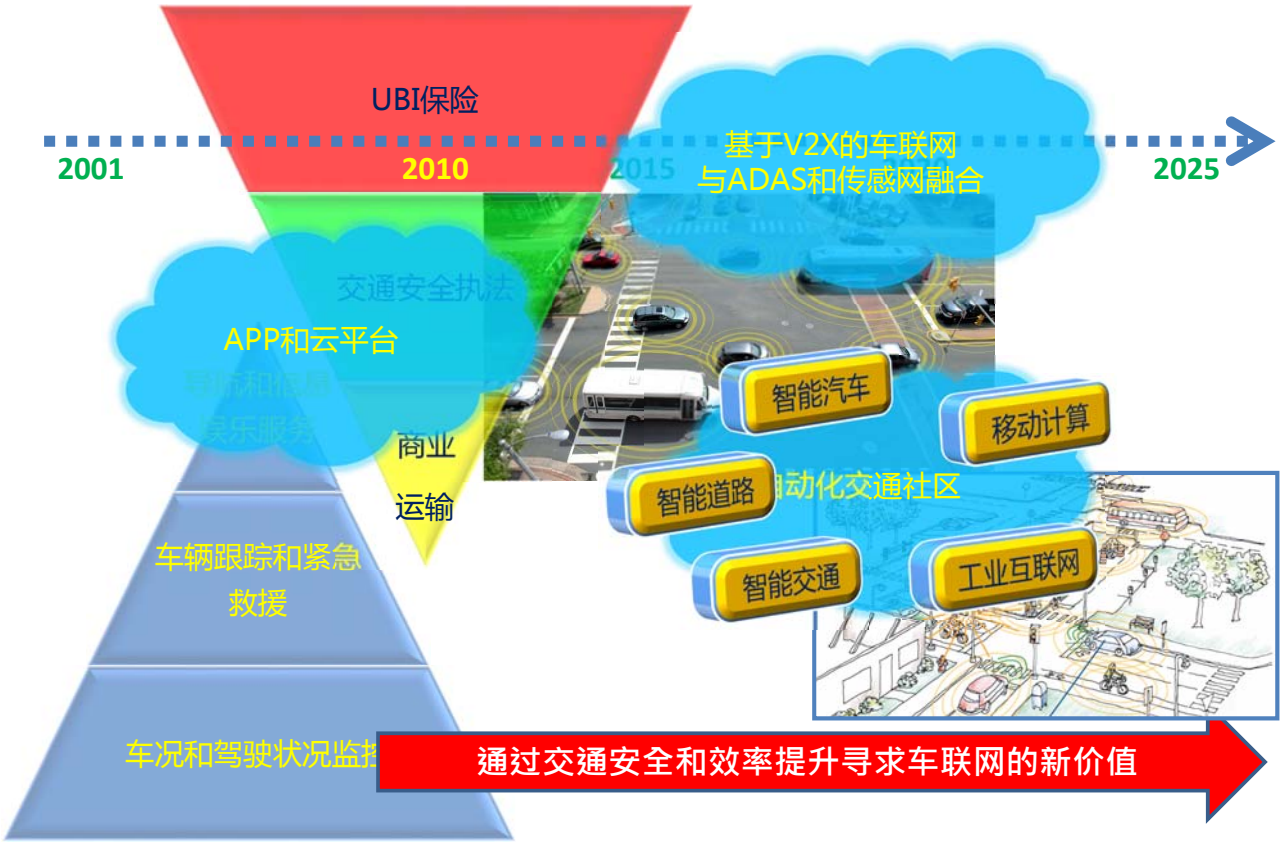
EPRI ELECTRIC POWER RESEARCH INSTITUTE

GOOGLE AUTONOMOUS CAR AT MOUNTAIN VIEW CITY

Network-coordinating by connecting Transport sector and Energy Sector/交通-能源网联化

- Integration of Smart Energy Grid and Internet of Vehicles/**电动汽车智能电网与车网融合：以电动汽车为储能终端的能源互联网、车联网、信息互联网相互交融。**

技术的进步推动车联网从信息服务到智能汽车和智能交通



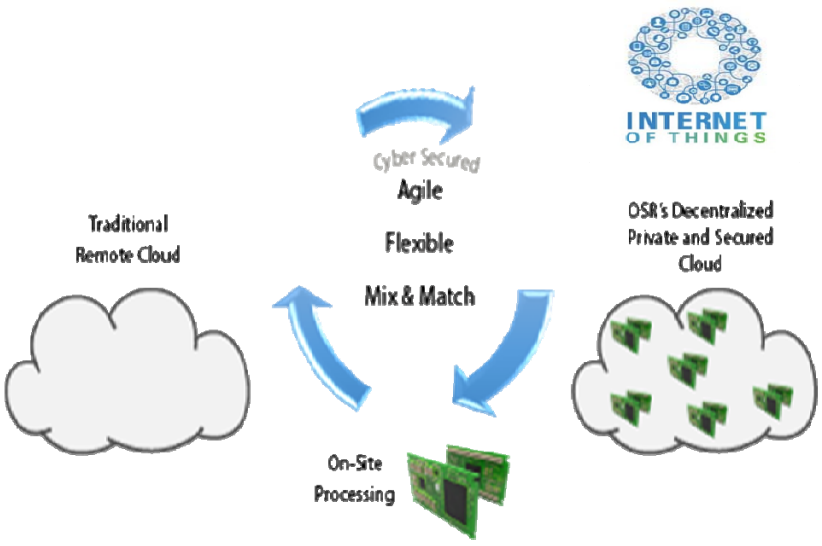
交通网、能源网、信息网、人文网的融合
Integration of Networks of Transportation, Energy, Information & Humanity

- 交通资源的全时空动态感知
  All times dynamic perception;
- 交通工具的全过程运行管控
  All processes controls;
- 无处不在互联 Ubiquitous Internet;
- 无处不在感知 Ubiquitous perception;
- 无处不在管控 Ubiquitous Controls;
- 无处不在服务 Ubiquitous Services.

Ultra-Genius IoT (Internet of Things) – Secure Cloud
超智能物联网 – 安全的云

A new methodology to detect and prevent next generation threats and malfunctions/检测和预防下一代威胁和故障.

- On site processing
- Close to the sensor
- Real time decision
- Secured communications on site and from site to cloud
- Cross sensor behavioral and validation algorithms
- Constant and dynamic validation of the eco-system

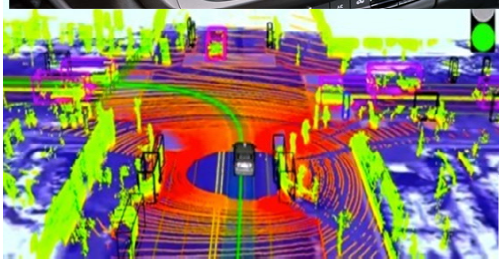


Future Vehicles/未来的交通工具

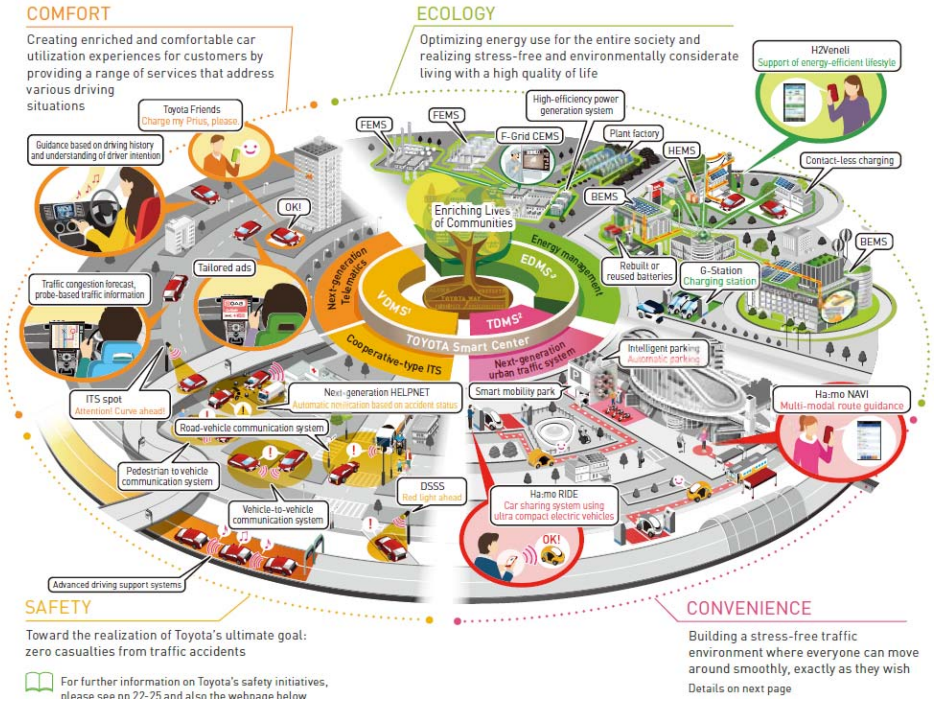
The Future Information and Entertainment- the Home Like Experience

电动汽车：未来的 信息、娱乐终端，并提供“家一般的体验”

- **Intelligent Vehicles technologies will eventually turn drivers into passenger；**
- **The need to create a “home like” experience for the passenger of the next generation Intelligent Vehicle.**



***The long-term success of NEVs in China will depend on the coordination among technology, market and the government policies*/新能源汽车的长期发展在于技术、市场和政策的协调。**



SUCCESS

$UCCESS

Inspiration 激情

Imagination 想像力

Innovation 創新

Integration 集成

Implementation 實現

Investment 投資

Thank you!