Biweekly Report 002 Aug/15

EV Charging Industry Report

August 2016

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SMM
Shanghai Metals Market

Shanghai Metals Market

CAAM: State Departments Working to Push for Charging Infrastructure Construction

Jul. 11, 2016 Source: China Securities

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The development of charging station industry is lagging behind that of EV industry, so great efforts are needed to accelerate construction of charging infrastructure, Yao Jie, Deputy Secretary General at China Association of Automobile Manufacturers (CAAM), said on July 11. Meanwhile, several state departments, including Ministry of Industry & Information Technology (MIIT) and National Development & Reform Commission (NDRC), are also working to push for charging infrastructure construction.

Insufficient Charging Facilities Constrains the Development of EV Industry

Aug. 2, 2016 Source: people.cn

The *2016 New Energy Vehicle Blue Paper* was released on August 1. As of the end of 2015, the number of EV/ the number of chargers ratio was less than 10:1 in China, acting as a bottleneck for development of EV industry, Wu Zhixin, Deputy Director at China Automotive Technology & Research Center (CATARC) said. Data from the National Energy Administration (NEA) showed China's EV production and sales reached nearly 500,000 units as of the end of 2015, while just 3,600 public charging and swap stations and 49,000 chargers had been built. China still has a long way to go in achieving its goal of building 12,000 charging stations and 4.8 million distributed chargers before 2020.

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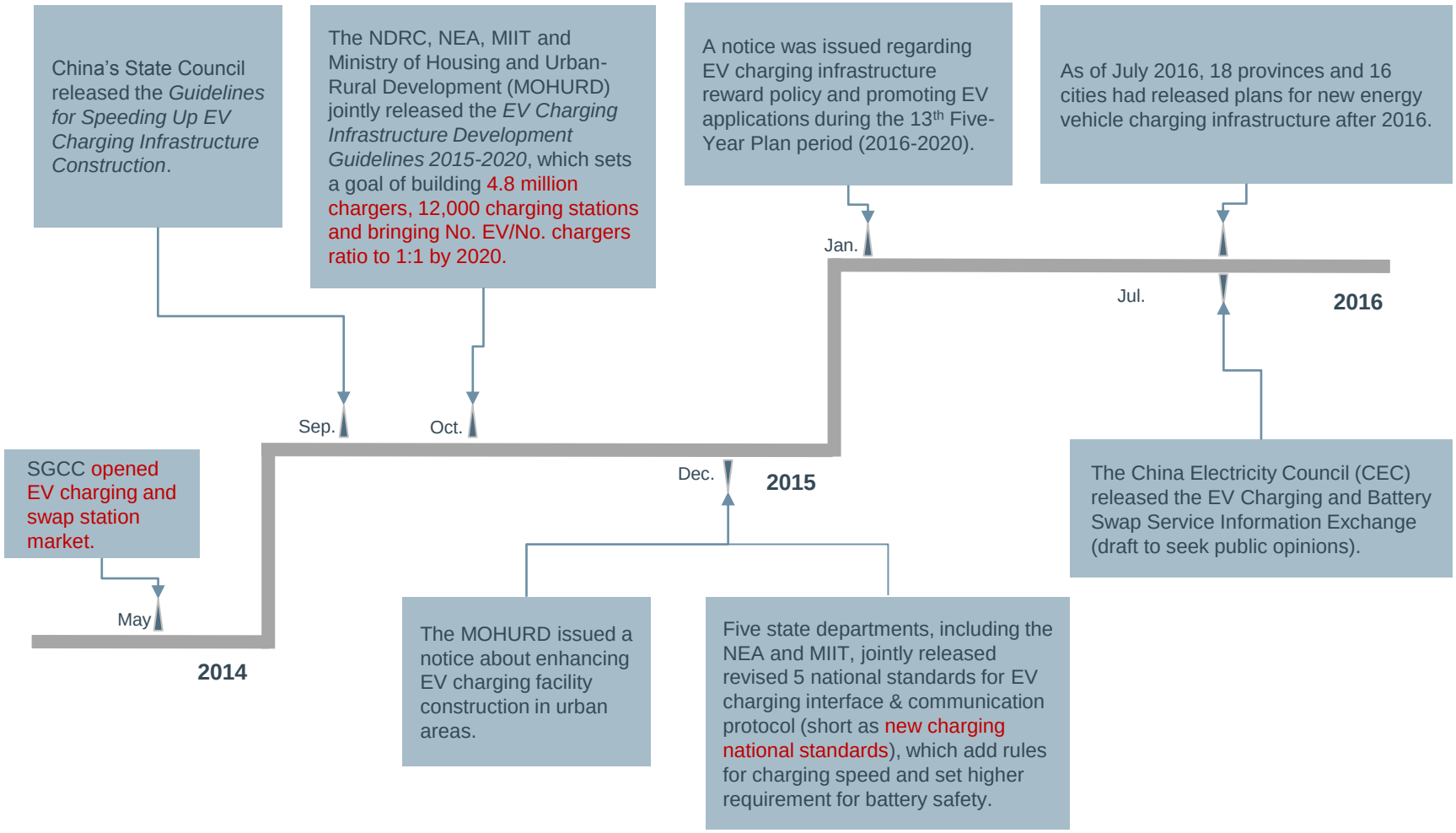
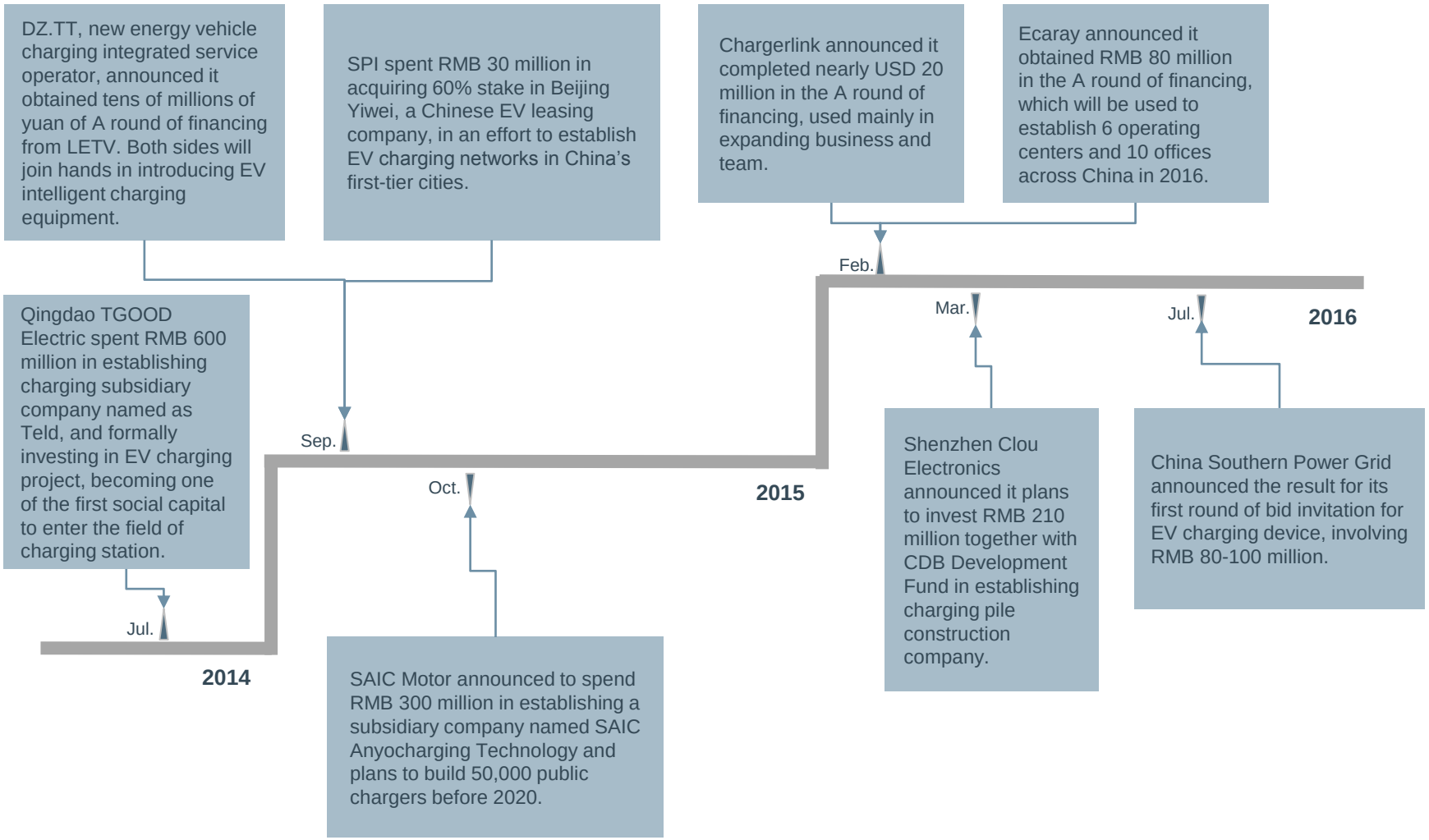
Important Policies

- China has frequently released guidelines for EV charging infrastructure construction since State Grid Corporation of China (SGCC) opened EV charging and swap station market in May 2014



Investment & Financing Events

- Capital has poured into EV charging pile industry since SGCC opened EV charging and swap station market in May 2014



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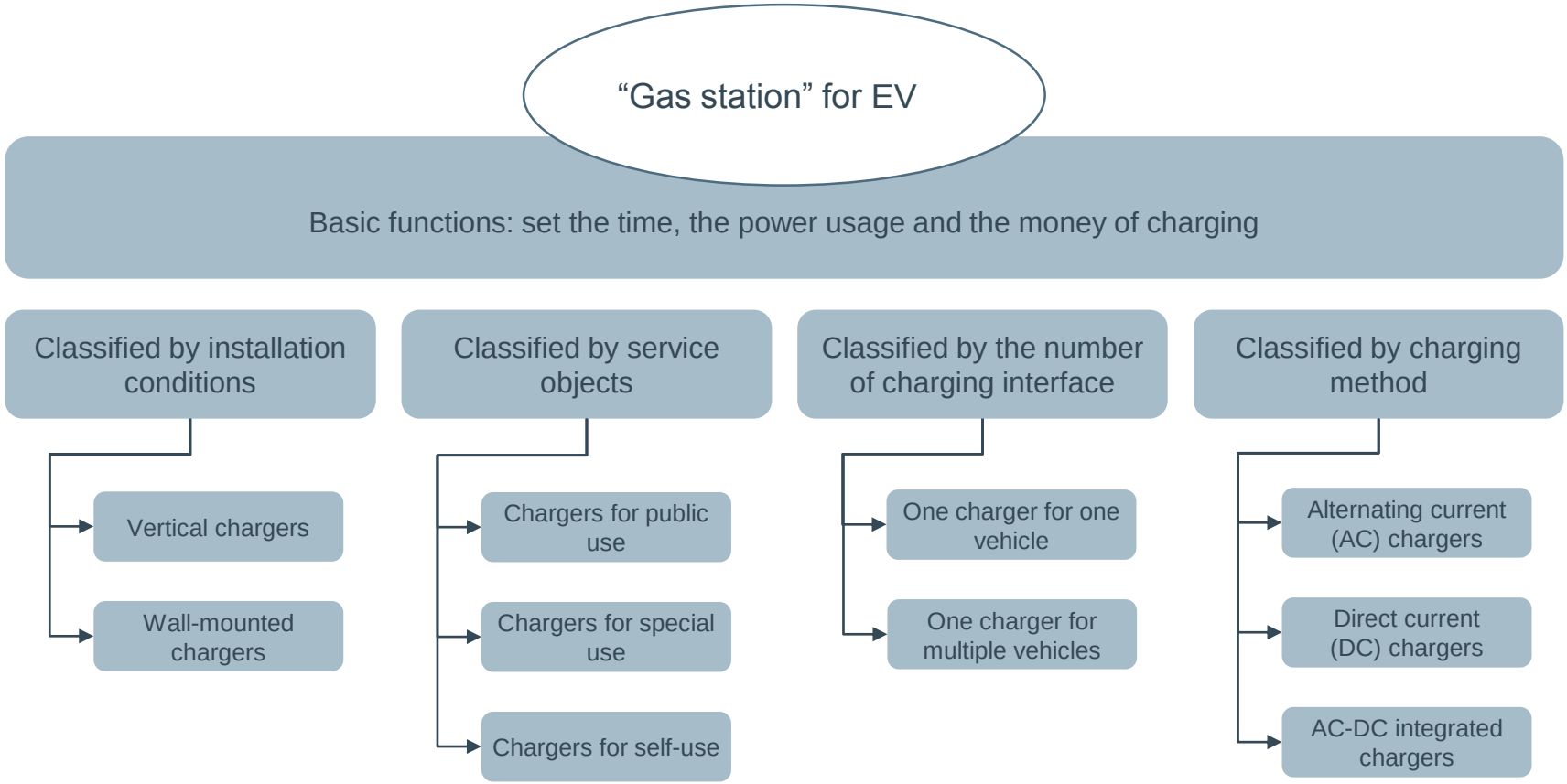
Definition of Charging Point & Classifications of Chargers



Current Market Supply & Demand

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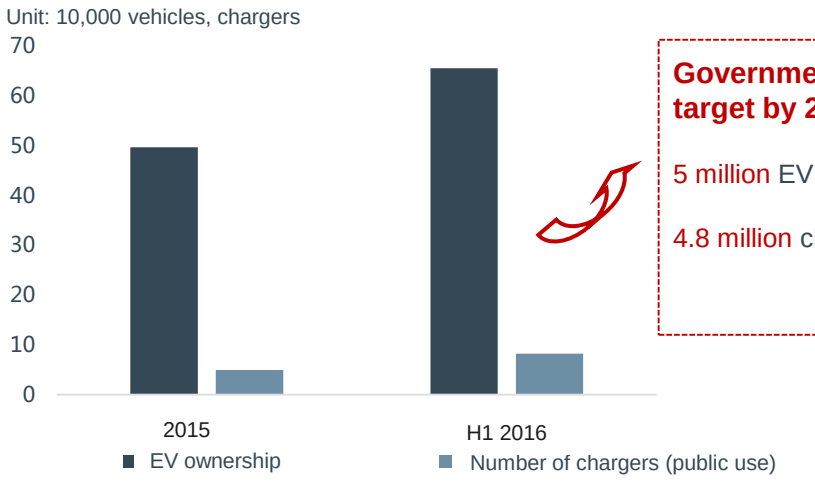
EV Ownership VS Number of Chargers



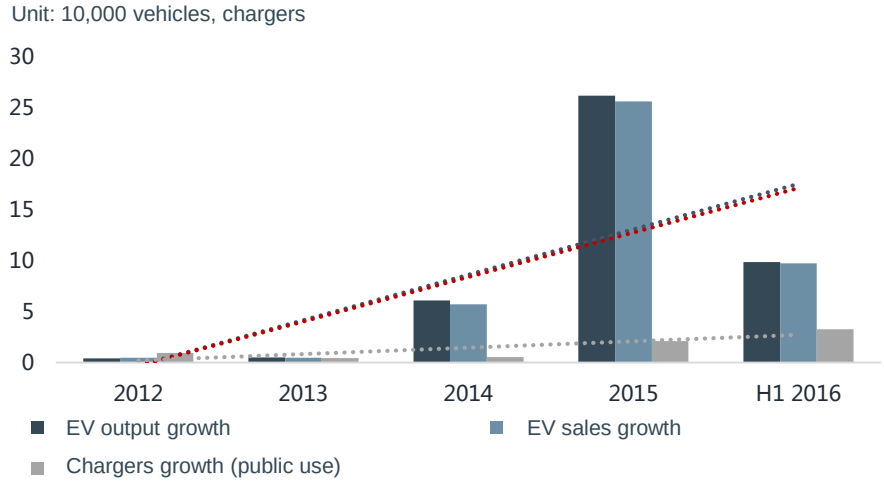
Government target by 2020

5 million EV

4.8 million chargers

Source: CAAM

EV Growth VS Chargers Growth



Sources: CATARC, abaogao.com

- **Far more EVs than Chargers**: Limited number of chargers is one of the constraints for EV popularization
- **Huge Gap:** There is a huge gap between current number of chargers and its target number, so explosive growth is expected in the foreseeable future

- EV production and sales maintain fast growth, reaching a peak in 2015
- EV production and sale growth, though down, remained high in H1 2016, boosting demand for supporting facilities
- **Supply & Demand Contradictory**: EV production and sales grow much faster than charger construction, leaving chargers in severe shortages

Main Problems

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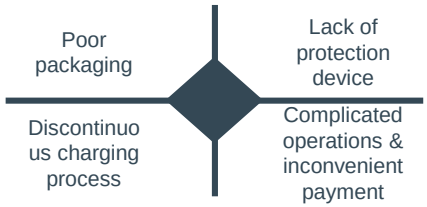
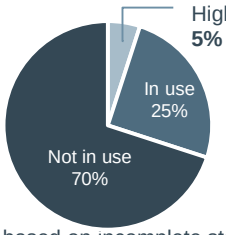
	Causes	Problems
Quality	• Quality varies from company to company • Acceptance & supervision standards need improving	**Quality and safety issues** 
Utilization Rate	• Public charging points are built in non-business districts and suburbs where **population density is low** and there is Information asymmetry • Parking lots for chargers are **occupied** by gasoline cars in downtown where parking lots are in shortages • In response to **high charging costs** at public charging points, car owners prefer to charge at home	**Low utilization rate for public chargers**  Note: based on incomplete statistics
Connection	• There is inconsistency between **charging interface and communication protocol** • Charging fees vary greatly due to **discrepancy in settlement standards** • Unsound **policies**	**Incompatibility between Chargers and Vehicles** 

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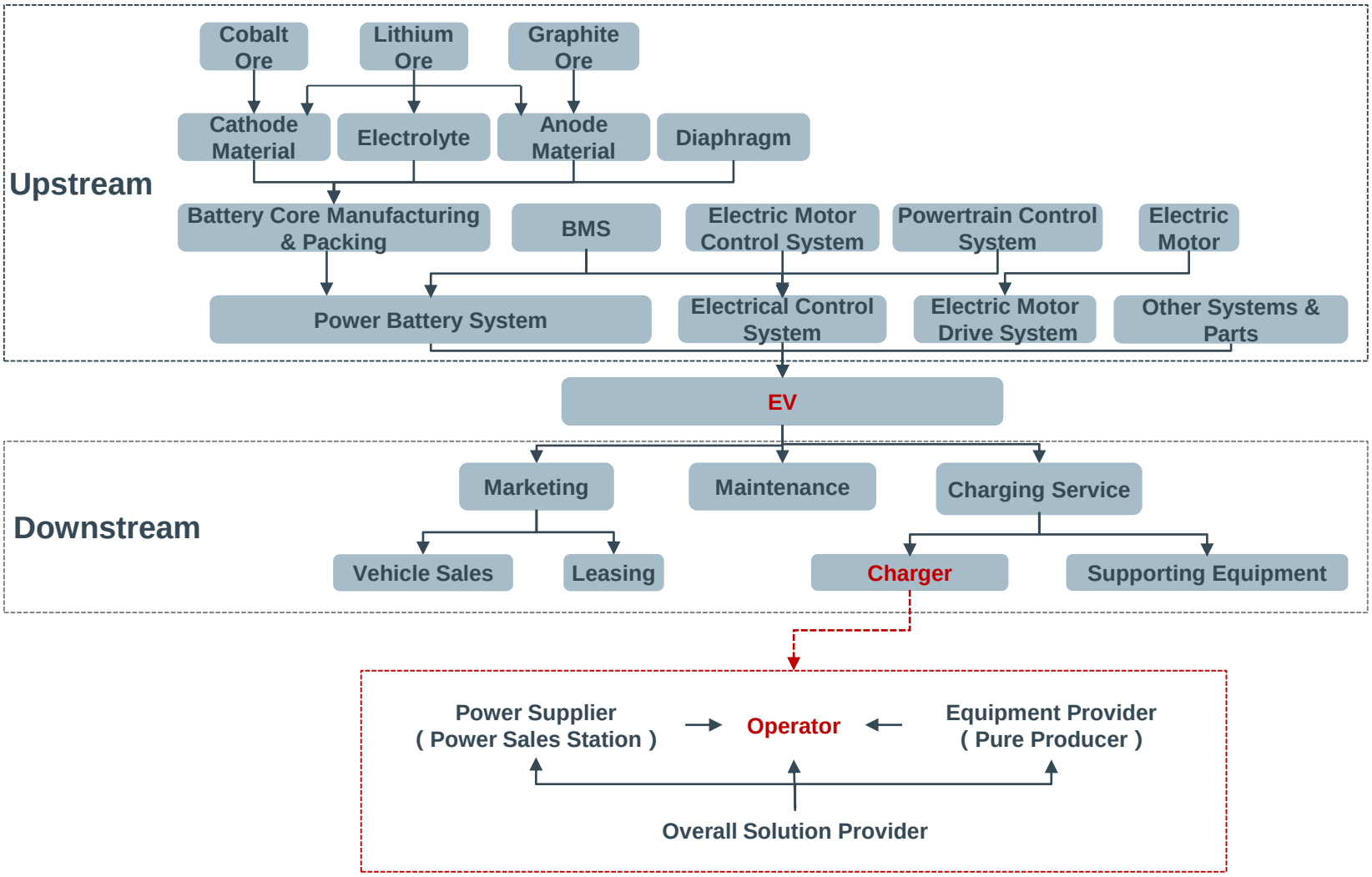
Industry Chain Structure



Note: operator refers to "Pure Operator" and "Operator + Equipment".

Business Model

Shanghai Metals Market

Traditional Business Model

1 Features

A stable mode dominated by compression operating costs and the key to which is reducing power purchasing costs and operating costs

2 Source of profit

Charging business (differential power tariffs + charging service fees)

3 Problems

Fees from charging business cannot cover equipment costs, given low utilization rate of chargers

Solution-Based Business Model

1 Features

Provide equipment or equipment integrated solutions for charging operators, equipment producers, automakers and commercial property developers

2 Source of profit

Consulting fees

3 Problems

A lack of unified industry standards

Integrated Business Model

1 Features

Form the industry closed-loop by integrating industry value chain (automakers, charging equipment producers, charging operators, users, etc.) and/or by introducing App that connects vehicles, chargers and car owners

2 Source of profit

Fees from charging business + Fees from other value-added services, such as charger-based advertisements, insurance, finance, car sales, vehicle leasing and big data service

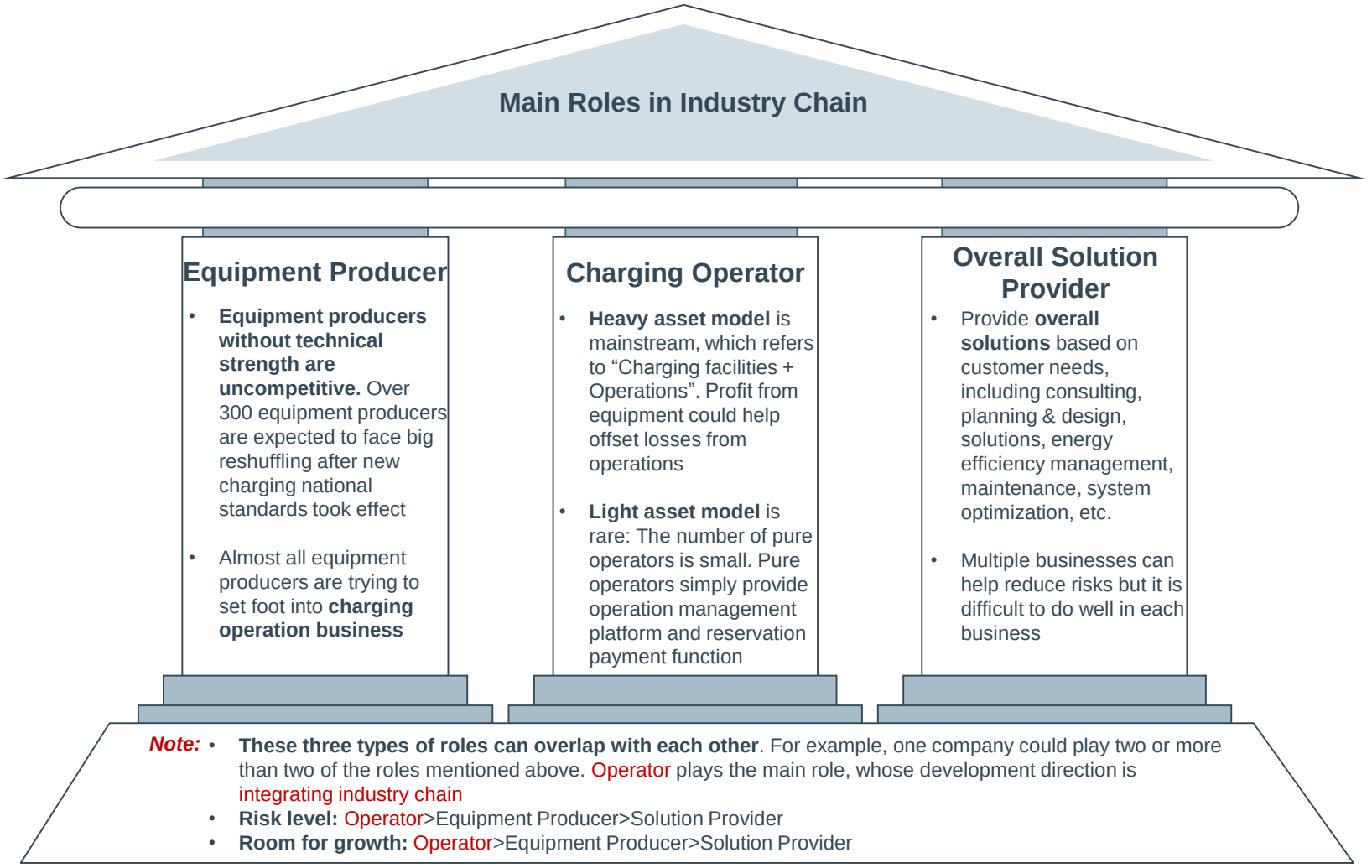
3 Problems

Difficulty in resource integration and innovation in business model

Note:

- **Traditional business model is the mainstream** at present, which is **difficult to recover equipment costs in the short term**, given low charger utilization rate
- **Integrated business model is direction of industry development**

Main Roles in Industry Chain



Operator Operation Model

Shanghai Metals Market

Model		Advantages	Disadvantages	Cases
Government-led Model	Government, as main investor, is responsible for construction and operation	• Orderly construction • Helpful to unified and centralized development	• Add to government's financial pressure • Hamper marketization	• Beijing Olympics charging station • Shanghai Expo charging station
Enterprise-led Model	Enterprise is responsible for investment and operation	• Guarantee capital input; • Better operation efficiency and management level	• Disorderly construction • A lack of unified standards among different enterprises can lead to inconsistency between vehicles and chargers	• **Tesla** provides multiple charging solutions for Tesla car owners
Mixed Model	Led by the enterprise supported by government and government participates in	• Ease government financial pressure and reduce investment risks for enterprises • Improve operation efficiency	• Difficulty in coordinating government and enterprise	• **TGOOD** obtained RMB 25 million subsidies from central government
Crowd funding Model	Collect capital from enterprise, society and government, and promote the construction by crowd funding on the internet	• Integrate multiple resources • Improve efficiency	• Difficulty in coordinating parties involved	• **Star Charge** builds chargers by crowd funding, mainly for free and partly from institutions

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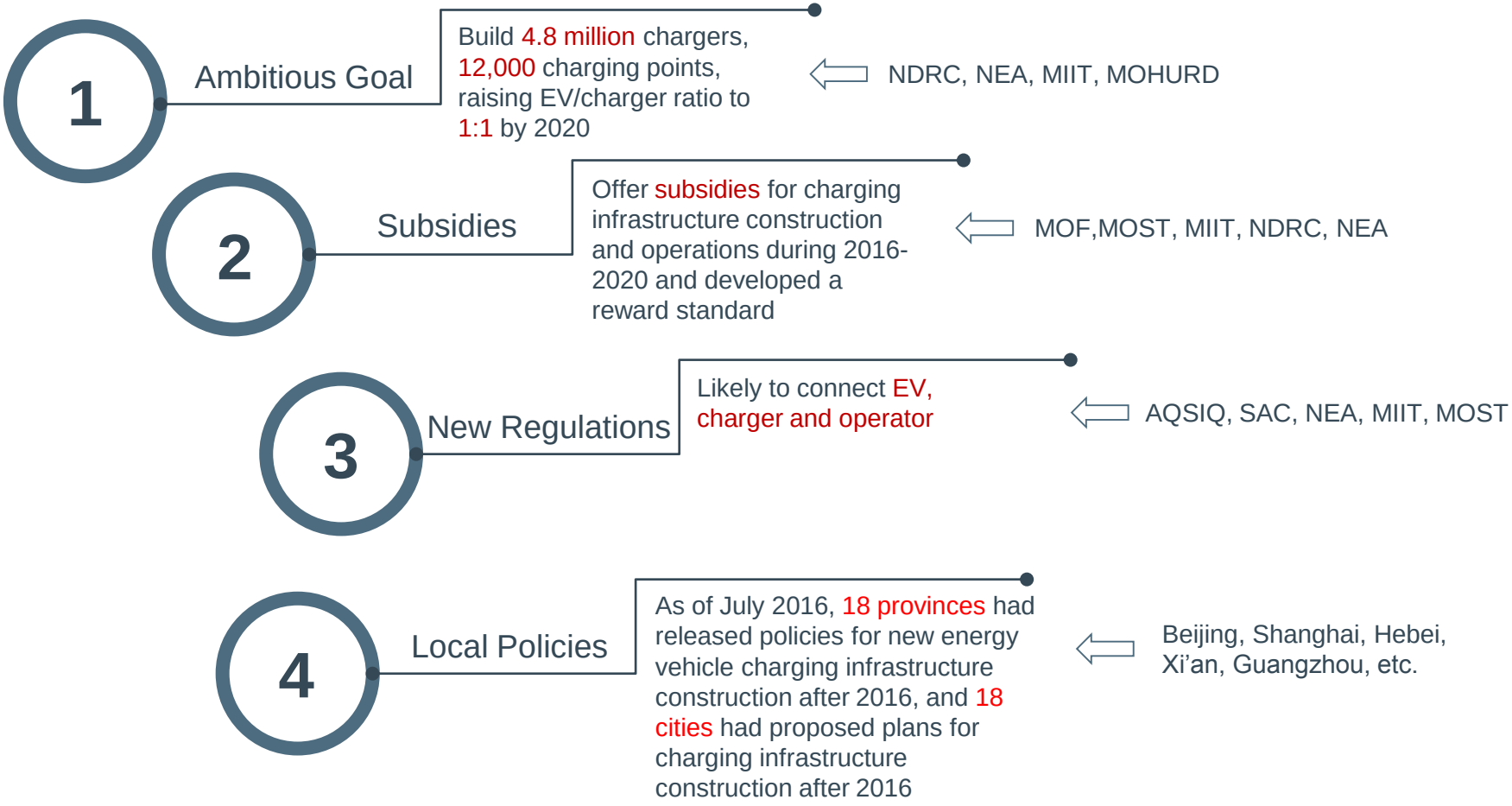
Policy Analysis



Note: *EV charging stations can be located in traffic artery, streets, communities, parking lots and are equipped with many chargers*

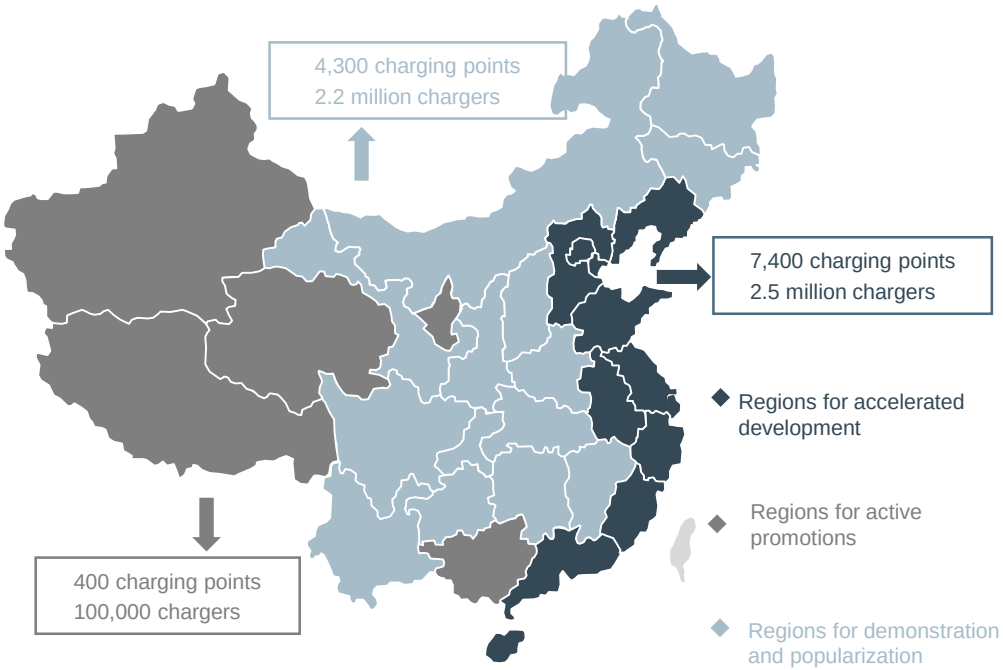
Ambitious Goal

Clear Regional Goal

4.8 million chargers,
12,000 charging points,
EV/Charger Ratio at 1:1

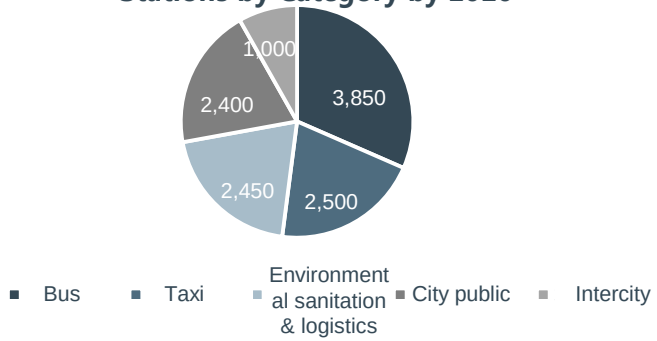
Clear Construction Site

Charging Facility Construction Goals by Region by 2020

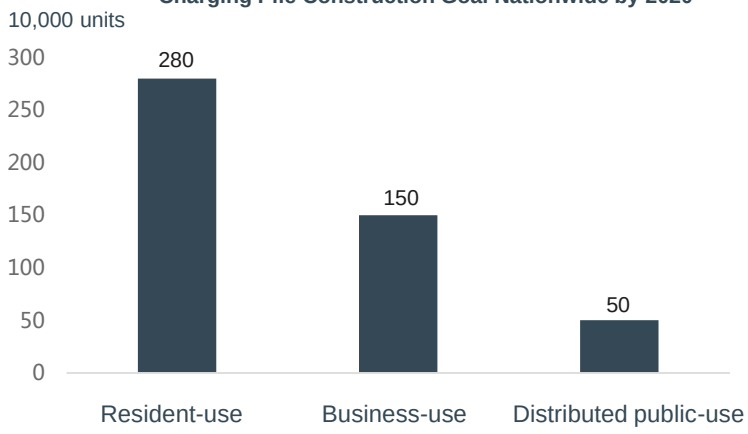


Source: *EV Charging Infrastructure Development Guidelines 2015-2020*

Number of Charging and Swap Stations by Category by 2020



Charging Pile Construction Goal Nationwide by 2020



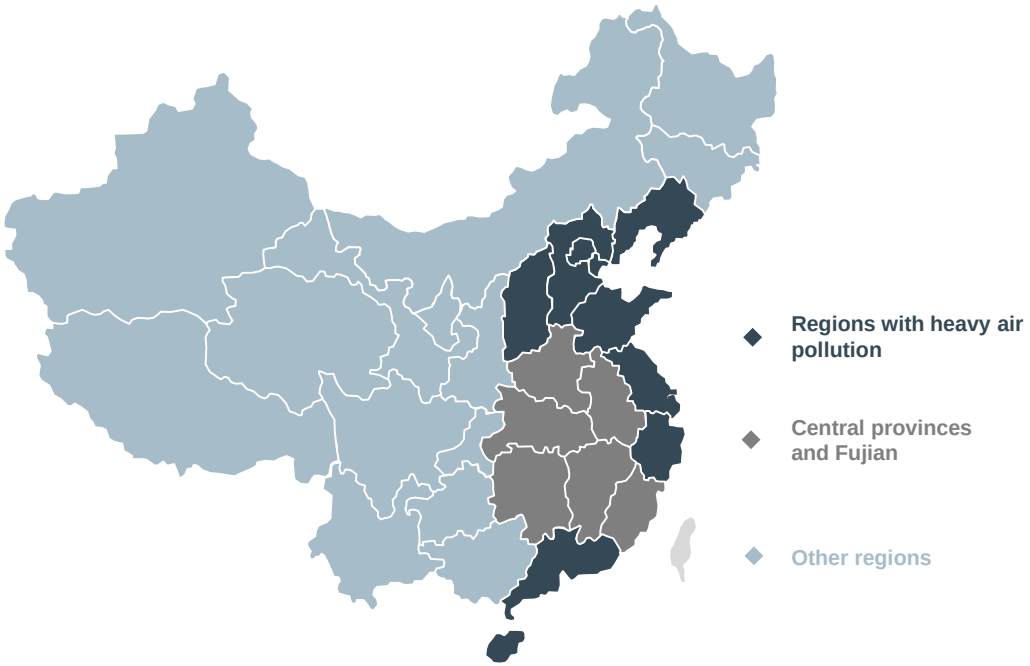
Source: *EV Charging Infrastructure Development Guidelines 2015-2020*

Subsidy Policy

Shanghai Metals Market

Subsidy by Region

Subsidy by region



Source: *Notice on New Energy Vehicle Charging Infrastructure Subsidy Policy and Enhancing New Energy Vehicle Popularization 2016-2020*

Subsidy Threshold

EV / Standard EV Conversion Ratio

Vehicle Type		Conversion Ratio
pure electric passenger vehicle (driving range<150km)		0.8:1
pure electric passenger vehicle (driving range≥150km)		1:1
plug-in hybrid passenger vehicle		1:1
pure electric bus		12:1
pure electric fast charging bus		20:1
plug-in hybrid bus		5:1
fuel battery passenger vehicle		30:1
fuel battery bus		50:1
plug-in hybrid special-purpose vehicle		0.6:1
pure electric special-purpose vehicle	maximum design total mass≥3500kg	3:1
	maximum design total mass<3500kg	1.5:1

Note: Subsidy threshold is based on popularization of standard new energy vehicles

Subsidy Policy

Shanghai Metals Market

EV Charging Infrastructure Subsidy Standards by Region 2016-2020

Unit: vehicle; RMB 10,000

Year	Regions with heavy air pollution			Central provinces and Fujian			Other regions		
	subsidy threshold	subsidy amount	subsidy above threshold	subsidy threshold	subsidy amount	subsidy above threshold	subsidy threshold	subsidy amount	subsidy above threshold
2016	30,000	9,000	Additional RMB 7.5 million subsidy for 2,500 vehicles above threshold; subsidy ceiling at RMB 120 million	18,000	5,400	Additional RMB 4.5 million subsidy for 1,500 vehicles above threshold; subsidy ceiling at RMB 120 million	10,000	3,000	Additional RMB 2.4 million subsidy for 800 vehicles above threshold; subsidy ceiling at RMB 120 million
2017	35,000	9,500	Additional RMB 8 million subsidy for 3,000 vehicles above threshold; subsidy ceiling at RMB 140 million	22,000	5,950	Additional RMB 5.5 million subsidy for 2,000 vehicles above threshold; subsidy ceiling at RMB 140 million	12,000	3,250	Additional RMB 2.8 million subsidy for 1,000 vehicles above threshold; subsidy ceiling at RMB 140 million
2018	43,000	10,400	Additional RMB 9.5 million subsidy for 4,000 vehicles above threshold; subsidy ceiling at RMB 160 million	28,000	6,700	Additional RMB 6 million subsidy for 2,500 vehicles above threshold; subsidy ceiling at RMB 160 million	15,000	3,600	Additional RMB 3 million subsidy for 1,200 vehicles above threshold; subsidy ceiling at RMB 160 million
2019	55,000	11,500	Additional RMB 10 million subsidy for 5,000 vehicles above threshold; subsidy ceiling at RMB 180 million	38,000	8,000	Additional RMB 7 million subsidy for 3,500 vehicles above threshold; subsidy ceiling at RMB 180 million	20,000	4,200	Additional RMB 3.2 million subsidy for 1,500 vehicles above threshold; subsidy ceiling at RMB 180 million
2020	70,000	12,600	Additional RMB 11 million subsidy for 6,000 vehicles above threshold; subsidy ceiling at RMB 200 million	50,000	9,000	Additional RMB 8 million subsidy for 4,500 vehicles above threshold; subsidy ceiling at RMB 200 million	30,000	5,400	Additional RMB 4.5 million subsidy for 2,500 vehicles above threshold; subsidy ceiling at RMB 200 million

Source: *Notice on New Energy Vehicle Charging Infrastructure Subsidy Policy and Enhancing New Energy Vehicle Popularization 2016-2020*

Note:

- The Ministry of Finance will continue allocating money for charging infrastructure construction and operations during 2016-2010
- Local governments must reach thresholds to be able to obtain subsidies
- Subsidy threshold and amount increase year by year, with the former increasing faster than the latter

New Regulations

Shanghai Metals Market

- Five state departments, including the NEA and MIIT, jointly released revised 5 national standards for EV charging interface & communication protocol (short as new charging national standards), effective January 1, 2016

Safety

- Add functions, such as **charging interface** temperature monitoring, electronic locks, insulation monitoring, bleeder circuit, etc.
- Specify **DC charging vehicle terminal interface protection** measures
- **Forbid** applications of unsafe charging models

Compatibility

- **AC/DC charging interface types and structures** are compatible with previous standards; new standards modify specifications on sizes of some contactors and mechanical locks, but plugs and sockets under new standards are compatible with those in previous standards
- **DC charging interface** adds electronic locking device, but this does not affect electric connection between new and old products. Users can realize basic charging functions simply by updating communications protocol
- The relations between AC charging duty ratio and current limits are compatible with international standards

Issues in Charging Pile Industry

Improve safety

Improve compatibility

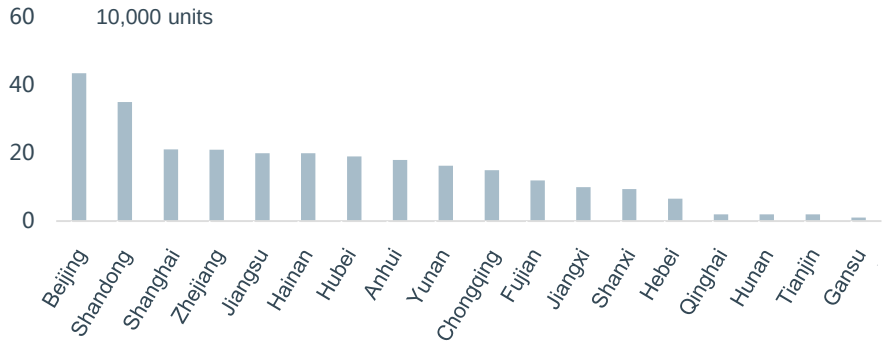
New Charging National Standards

- EV Conductive **Charging System** Part 1: General Requirements
- EV Conductive **Charging Connecting Device** Part 1: General Requirements
- EV Conductive Charging Connecting Device Part 2: **AC Charging Interface**
- EV Conductive Charging Connecting Device Part 3: **DC Charging Interface**
- **Communications Protocol** between EV Non-Vehicle-Carried Conductive Charger and BMS

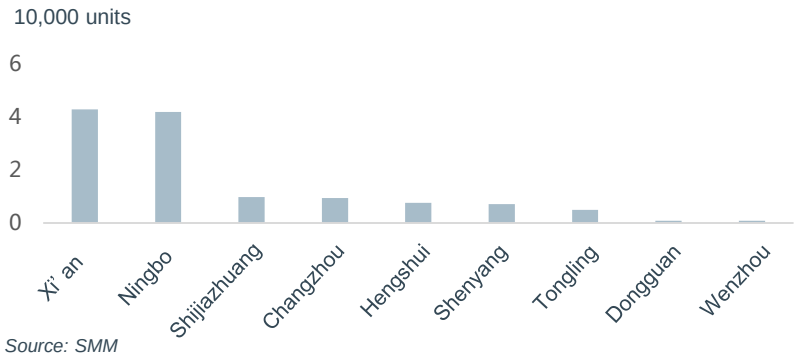
Local policies

- As of July 2016, 18 provinces had released policies for EV charging infrastructure construction after 2016, and 18 cities had proposed plans for charging infrastructure construction after 2016

Charging Pile Target by 18 Provinces by 2020



Charging Pile Target by some Cities by 2020



Source: SMM

Distribution of Provinces that Have Released Policies

Note: 18 cities include Guangzhou, Shenyang, Yuncheng, Luzhou, Harbin, Xi'an, Weifang, Hengshui, Zhengzhou, Shijiazhuang, Huizhou, Wuxi, Hangzhou, Changzhou, Wenzhou, Dongguan, Ningbo, Tongling

Note:

- Central and local policies will boost development of charging pile industry
- **Except Beijing and Shanghai,** other regions need to improve their policies and **most regions have not released implementation programs**
- Policies by some local governments **did not mention specific charging facility construction goals and subsidies**
- Policy implementation will meet obstacles from land use, power grid planning, property management, charging pile utilization rate, etc.

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Overview of Mainstream Chinese Enterprises

Shanghai Metals Market

ownership	Company name	Target markets	Direction of charging business	Advantages	Targets
Central SOE	SGCC	Nationwide intercity traffic artery	Power grid construction & operations; charging pile construction	Directly under the State Council; industry leader	Build 10,000 public fast charging stations, 120,000 chargers nationwide by 2020
	Petevio New Energy	Beijing, Shanghai, Shenzhen, Hefei	Charging networks construction, operation and service	Complete set of solutions for charging station and charging pile	Cooperate with BMW in “ChargeNow” service; sign strategic cooperation agreement with JVC Motor over coordinated development of vehicle and charging facility networks
SOE (not central SOE)	Huashang Sanyou New Energy	Beijing	Charging infrastructure construction and operation	Build many chargers for SGCC	It plans to launch “electrical community initiative” to solve no electricity in parking lots
	Xuji Electric	Chongqing, Yichang, Zhuhai	Charging pile, EV charge/discharge station solutions	EV charging and battery swap core technology	It won bid for 61 DC chargers and 228 AC chargers in China Southern Power Grid’s first round of EV charging device bid invitations in 2016
Private	Tellus Power	Beijing	Charging infrastructure manufacturing and operation	The only charging pile manufacturer that has passed certifications from US UL, EU CE and China CQC	It plans to invest RMB 3.55 billion in building 710 super charging stations and 28,800 chargers and double investment in 2017
	TGOOD	Beijing	Intelligent charging system construction	Connects power grid, vehicle networks and Internet	Its charging subsidiary company Teld plans to cover over half of China’s EV charging market in cooperation with BAIC
	ZHONHEN	Hangzhou	EV charging and battery swap system	Complete set of mature DC and AC charging device	It plans to invest RMB 500 million in building new energy vehicle intelligent charging equipment production lines
	Shenzhen Auto Electric Power	Shenzhen	Charging station and charging pile solutions	Early entry into EV charging field	It plans to invest RMB 312 million in building and operating EV concentrated charging facilities in Shenzhen
	Clou Electronics	Shenzhen, Luoyang	EV charging pile	Cover the widest range of charging and battery swap products	It plans to invest RMB 7.5 billion in building several projects in Luoyang, including “smart city construction” and “concentrated charging networks platform”
	EAST	Huaibei	EV charging pile	Key hi-tech company; complete set of charging device	It plans to invest RMB 8 billion in building eco-tourism agricultural PV power generation project and supporting facilities in Huaibei

Note: Red denotes listed companies.

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Examples of Chinese Companies

Shanghai Metals Market

Power Supplier + Operator: SGCC

Basic Information

- **Headquarters:** Beijing
- **Annual operation revenues: USD** 329.6 billion
- **Financing**: investment is subject to approval by the State Council
- **Main business:** power grid investment, construction and operations
- **Collaborators:** China Energy Engineering Corporation, local governments, foreign power companies, etc.

Business Model

- "**Power Supplier + Charger construction & Operations**" Model

Charging solutions

- **City and intercity charger** networks construction & operations
- Issue **bids to buy charging equipment**

Advantages

- **SOE:** National authorized investment, industry benchmark
- **Scale :** It has built "2 south-north, 2 east-west, 1 ring" highway intercity fast charging networks and is beginning to build "7 south-north,4 east-west, 2 grids" highway fast charging networks. It plans to cover highway fast charging networks across Beijing-Tianjin-Hebei-Shandong circle, all cities in Yangtze River Delta and major cities in other regions by 2020

Note: "2 south-north, 2 east-west, 1 ring" refers to Beijing-Shanghai, Beijing-Hong Kong-Macao, Qingdao-Yinchuan, Shanghai-Chengdu and Shanghai-Ningbo-Hangzhou; "7 south-north, 4 east-west, 2 grids" refers to Shenyang-Haian, Beijing-Shanghai, Beijing-Taibei, Daqing-Guangzhou, Beijing-Hong Kong-Macao, Erenhot-Guangzhou, Baotou-Maoming highway, Qingdao-Yinchuan, Lianyungang- Horgos, Shanghai-Chengdu, Shanghai-Kunming highway, Beijing-Tianjin-Hebei-Shandong circle and Yangtze River Delta

Examples of Chinese Companies

Shanghai Metals Market

Equipment supplier + operator: Shenzhen Clou Electronics

Basic Information

- **Headquarters:** Shenzhen
- **Annual operation revenues: RMB** 12.37 billion
- **Financing:** restricted stock（41.53%), subscribed capital contribution RMB 495 million；circulating shares without restrictive selling（58.47%）, subscribed capital contribution RMB 697 million
- **Main business:** power equipment, power use management system
- **Collaborators:** CDB Development Fund, China Southern Power Grid, etc.

Business Model

- **"EV Operations + Charger Construction & Operations"** Model

Charging solutions

- **City and intercity charger** networks construction & operations
- Issue **bids to buy charging equipment**

Advantages

- **Technology:** It is the first company in China whose products have passed tests under high temperatures, in extreme cold and plateau
- **Bid winning:** It won RMB 282 million bid for charging equipment from SGCC in May 2016, and won bid for EV charging device from China Southern Power Grid in July 2016
- It raised share holdings in Zhongdian Lvyuan and bought share in DST, allowing it to integrate charging pile manufacturing and operations

Examples of Chinese Companies

Shanghai Metals Market

Basic Information

- **Headquarters**: Beijing
- **Annual operation revenues:** not listed, company value estimated at over RMB 1 billion
- **Financing:** It obtained A round of financing from LETV in tens of millions of yuan in 2015 and has now completed B round of financing.
- **Main business:** EV integrated service operations
- **Collaborators:** LeSEE, ZOTYE Auto, China Life Insurance, Amap, etc.

Business Model

- **"Charger APP + City Intelligent Charging Networks + Operation System"** Model
- Establish service and sharing networks by connecting equipment suppliers, automakers, governments, distributors and users

Pure operator: Beijing DZ Technology
(App brand——DZ)

Charging solutions

- **Intelligent charging destinations:** cities and landmark
- **"**DZ"App: charging destination search; convenient applications for charging facility construction; charger sharing; EV sales and maintenance stores; EV owner's life circle
- **Charging pile installation solution:** cooperate with automakers who recommend chargers to car owners, and introduce China's first charger insurance in cooperation with China Life Insurance

Advantages

- Realize **"Vehicle-Charger-Internet"** integration and begin establishing Internet of chargers and Internet of Vehicles
- **Scale:** It has entered over 30 cities in China and city landmarks
- **Innovation:** It has developed China's **first vehicle-carried charger system** in cooperation with ZOTYE Auto, which initiates vehicle and charging pile system at the same time, allowing car owners to look for charging piles, check charging status and pay for charging in the car

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Examples of Foreign Enterprises

Shanghai Metals Market

Automaker + operator: Tesla

Basic Information

- **Headquarters:** California
- **Annual operation revenues: USD** 33.22 billion
- **Financing:** It completed D round of financing in 2007, with total financing in excess of USD 105 million. It obtained financing from Fidelity Investment and Alyeska Investment Group in Q2 2016
- **Main business:** high-performance pure EV
- **Collaborators:** It will establish Chinese partners within 2016

Business Model

- **"EV Manufacturer + Charger Construction & Operations"** Model

Charging solutions

- Focus on **home chargers,** also **target destination charging points** and super charging points as well as general-purpose mobile chargers
- Super charging points provide life-time free charging service for Tesla car owners
- Establish destination charging points at hotels, shopping malls and office buildings; have established over 200 super charging points in China so far

Advantages

- **Home charging service:** Tesla installs home-use chargers for Tesla car owners, offer 2-year maintenance and spot detection within 48 hours
- **Fast charging:** Owing to its unique battery structure and BMS, Tesla is now the only EV manufacturer that is able to charge EVs at 120 kW. Vehicles can run up to 270 km with just 30 minutes of charging at Tesla super charging station

Note: Virtually no chargers common in the market are compatible with Tesla vehicles, so Tesla vehicles must be equipped with Tesla charging piles.

Examples of Foreign Enterprises

Shanghai Metals Market

Basic Information

- **Headquarters:** California
- **Annual operation revenues:** not listed
- **Financing:** It has raised USD 164 million capital and completed F round of financing in USD 50 million from Linse Capital and US Constellation Energy, etc.
- **Main business:** charging equipment construction & operations
- **Collaborators:** Volkswagen , BMW, etc.

Business Model

- **O2O closed-loop**: "Online App + Charging Networks + Offline Charging Equipment" connects car owners, vehicles and chargers
- Sell chargers to shopping malls, hotels, etc. **by "Net+"** installment and collect service fees every month

Operator + Solution Provider: ChargePoint

Charging solutions

- **Intelligent charging system:** provide charging hardware and charging service management by connecting different charging facility to "Cloud Service" platform
- App service: locate and make reservations for available charging piles, check charging status on a real-time basis, make payment for charging service

Advantages

- **Scale:** As of August 2015, it had built 22,885 charging piles, claiming 70% of public charging pile market in the US, and most chargers offer charging for free
- **"Cloud Service":** users check information with App; charging station operators make pricing strategy and improve management efficiency via data analysis; power companies conduct remote technology diagnosis
- **Integrate value chain**: connect drivers, charging station operators and EV manufacturers

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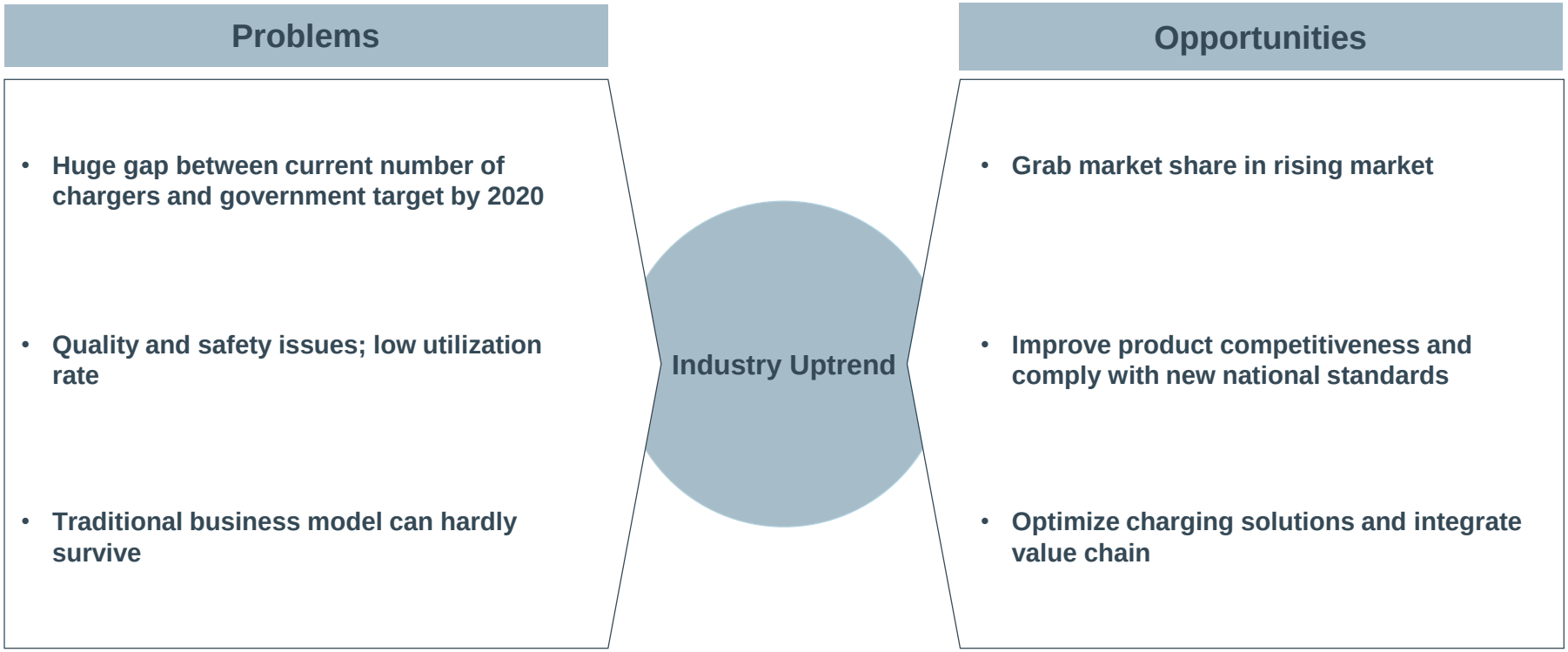
Problems & Opportunities

Shanghai Metals Market



Note: Five state departments, including the NEA and MIIT, jointly released revised 5 national standards for EV charging interface & communication protocol (short as new charging national standards), effective January 1, 2016

Future Trend

Shanghai Metals Market

Utilize Basic Functions

- **Charging-payment**
- Collect **differential power tariffs and charging service fees**

Dig Potential Functions

- Chargers can have **data collection and storage functions**, which upload real-time data, such as working status of chargers and charging time, onto “cloud” terminal so as to form “**cloud service**” that allows for easy remote monitoring and scheduling
- Chargers can serve as **payment terminal**
- Chargers are **combined with intelligent parking system**, which allow data to be updated on a real-time basis and improve parking lot utilization rate

…

As an **entrance for Internet of Vehicles and Internet of Things** and then form **charging service ecosystem**

Note: The Internet of Vehicles refers to the networks that encompass a large amount of information on vehicle location, speed and route, etc. The Internet of Things (IoT) is the internetworking of physical devices, vehicles, buildings and other items, embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure

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