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Zero-emission Transformation Practice for Cross-regional Freight Transportation in Beijing-Tianjin-Hebei Region

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1. BACKGROUND

2. PRACTICE

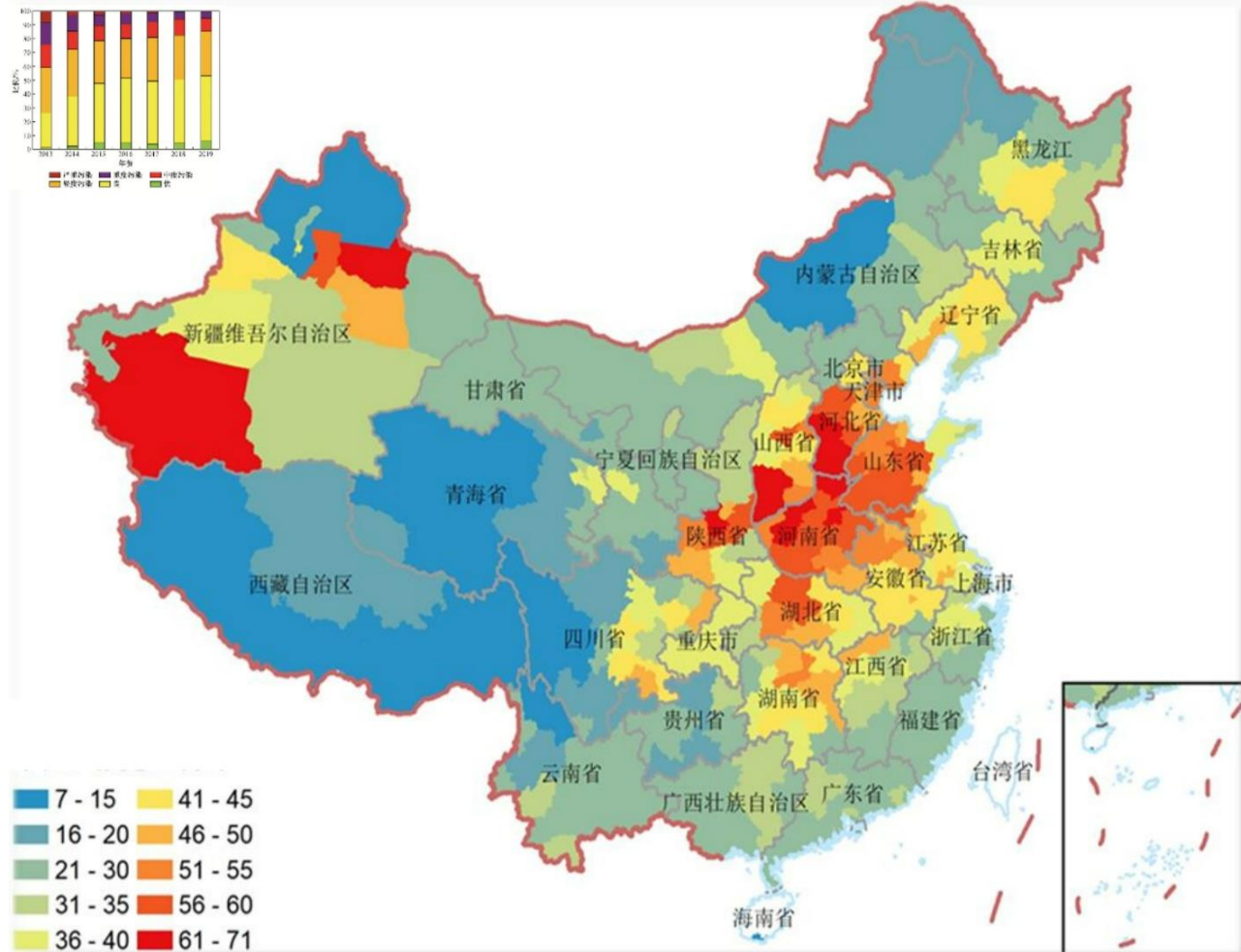
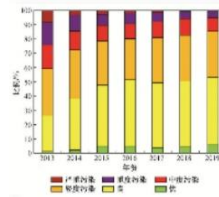
3. REFLECTIONS

Highly developed circulation of materials also brings serious air pollution problems

LOW PROPORTION OF TRUCKS, BUT HIGH CONTRIBUTION OF POLLUTANT EMISSIONS.

Trucks accounts for only **9.5%** of motor vehicles, which contribute **65%** of the vehicle' s carbon emissions and **85%** of NOx emissions.

The material circulation system, especially **the zero-emissions in the freight**, has received great attention.



Upgrading the energy structure of freight vehicles is one of the core strategies to solve pollution emissions in logistics

Urban internal logistics

- **Situation1:** General cargo scenario (mainly light cargo) - **Light electric trucks**



- **Situation2:** Cold chain scenario (mainly fresh goods) - **Light hydrogen fuel trucks**



- **Situation3:** Closed scene (production materials - mainly short circuited) - **battery swapping trucks**



Cross regional logistics

Hydrogen



Battery swapping



Plug-in

Exploration and practice of cross-regional scenarios have been carried out in many places around the world

It is hoped that through pilot demonstrations, the feasibility and large-scale application path of new energy truck technology **in long-distance heavy-load scenarios** can be verified.

Battery swapping trucks



◆ Ningde Xiamen Main Line



◆ shenyang-dalian



◆ Ample Freight Exchange Station (San Francisco Bay Area)



◆ Baotou Power Exchange Station



◆ Tangshan Heavy Truck Exchange Station

Charging heavy-duty truck



◆ German DHL electric heavy-duty truck(Charging heavy-duty trucks)



◆ Tesla truck charging stations along Highway 15 in the United States



◆ German BP company's overcharging station(Charging heavy-duty trucks)

FCV



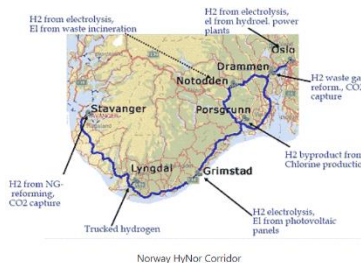
“氢进万家”示范工程总体布局



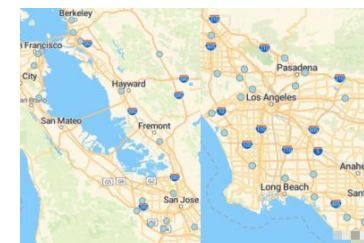
Shandong hydrogen high-speed logistics distribution pilot



Yangtze River Delta Hydrogen Corridor(Hydrogen Energy Shanghai Ningbo Intercity Logistics Main Line)



Hydrogen Road of Norway



California Hydrogen Highway Network (CaH2Net) Planning



Canada h2EA Plan

Our Efforts

We are working hard to promote the implementation of the Beijing-Tianjin-Hebei zero-emission freight corridor project through three stages, and **explore a set of zero-emission freight development models** that are **implementable, sustainable and replicable**.

Stage 1: Elements recognition
& corporate practice



Stage 2: Large-scale operation
& policy empowerment



Stage 3: Model promotion &
leading development

- **An outstanding model project:** annual transportation volume exceeds 10,000 tons, the scale of new energy vehicles exceeds 1,000, and interconnection of freight-vehicle-station-road
- **A set of application patterns:** Standards, Technical Guidelines
- **A range of resolution tools:** Scenario, technology, energy supplement, policy, communication, etc.

Beijing-Tianjin-Hebei is a region with a highly developed material circulation system

The Beijing-Tianjin-Hebei region covers an area of **220,000** square kilometers, has **3.16 million** registered trucks, and has a total annual freight demand of **5.4 billion tons**(14% of the country). There are **7 major material groups**, and the demand for freight is strong.

- Space scope: covering **11 prefecture level cities**
- Area: **220,000** square kilometers
- Population: **110 million**
- Motor vehicles: **30 million vehicles**
- Annual transportation demand: **5.4 billion tons**
- Truck: **3.16 million vehicles/700,000 heavy-duty vehicles**
- Daily driving on the road: around **530,000** heavy-duty trucks
- Highway driving: stable at around **250,000** vehicles



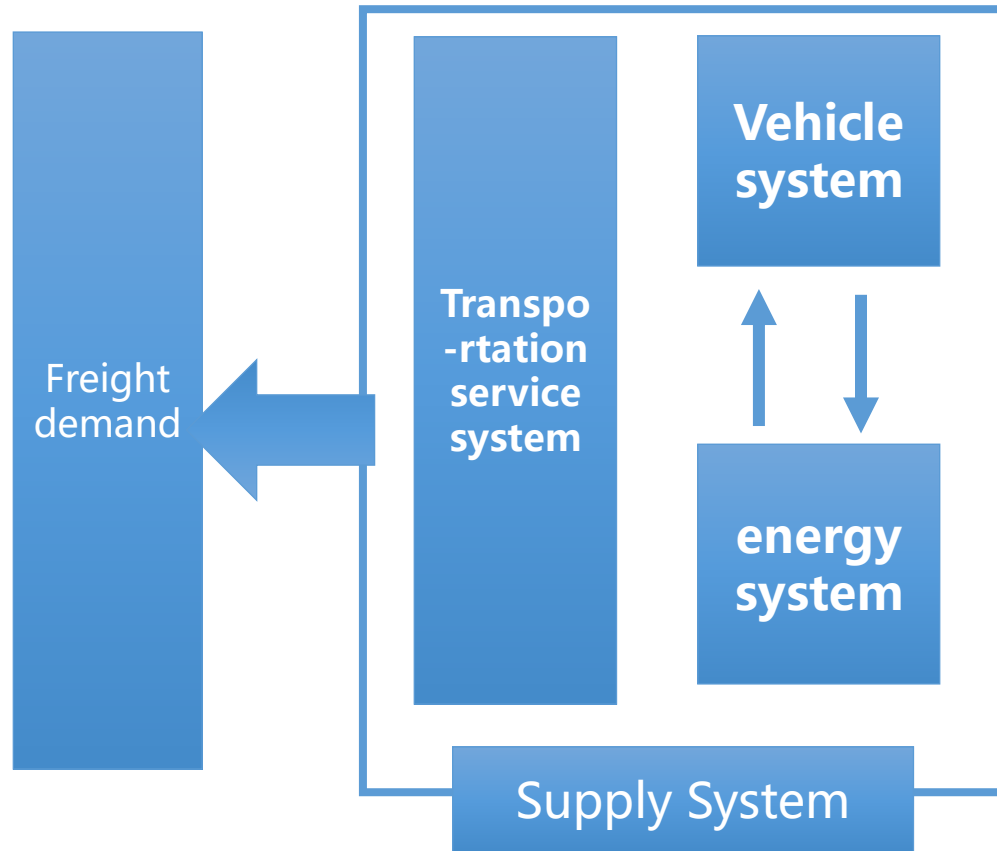


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Operating characteristics of freight system based on diesel system



After a long period of running-in, a freight service system based on **the diesel energy service system** and **the technical performance of diesel vehicles** has been formed, stably adapting to **the demand side**.

Which is likely to come close to or surpass the diesel system?

How to choose **FC/battery swapping/plug-in electric vehicles** in different scenarios?

Operating characteristics of freight system based on diesel system

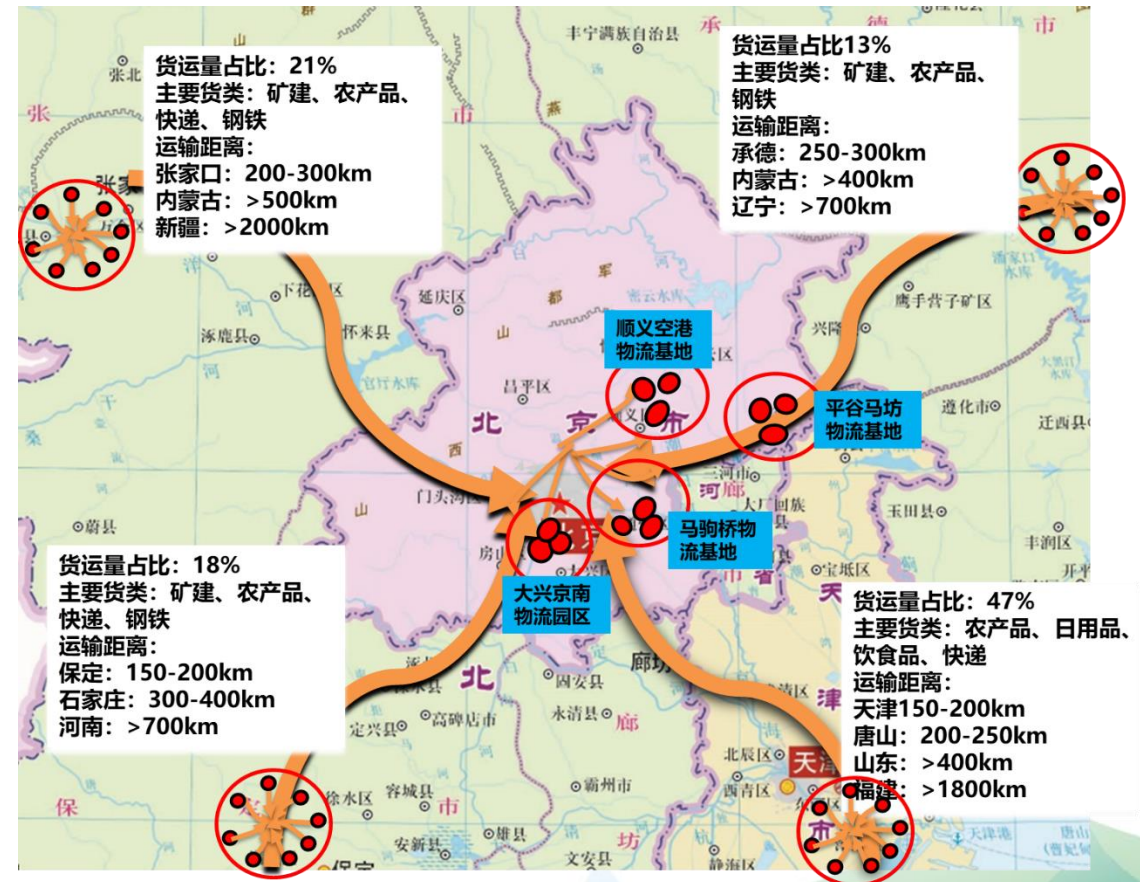
Based on in-depth interviews with over 30 freight companies, the underlying characteristics of the diesel transportation service system are preliminarily extracted:

Stability - vehicle technical performance and energy system can be combined to meet scene requirements

Economical - income is greater than cost, profit can be achieved, or profit potential is possible

Flexibility - the vehicle can serve a variety of scenario combinations after one recharge.

Compatibility - goods from different cargo owners, vehicles from different manufacturers, and hydrogenation stations from different companies are open and compatible with each other, providing diverse choices



Implementation of the zero-emission transformation across the Beijing-Tianjin-Hebei region

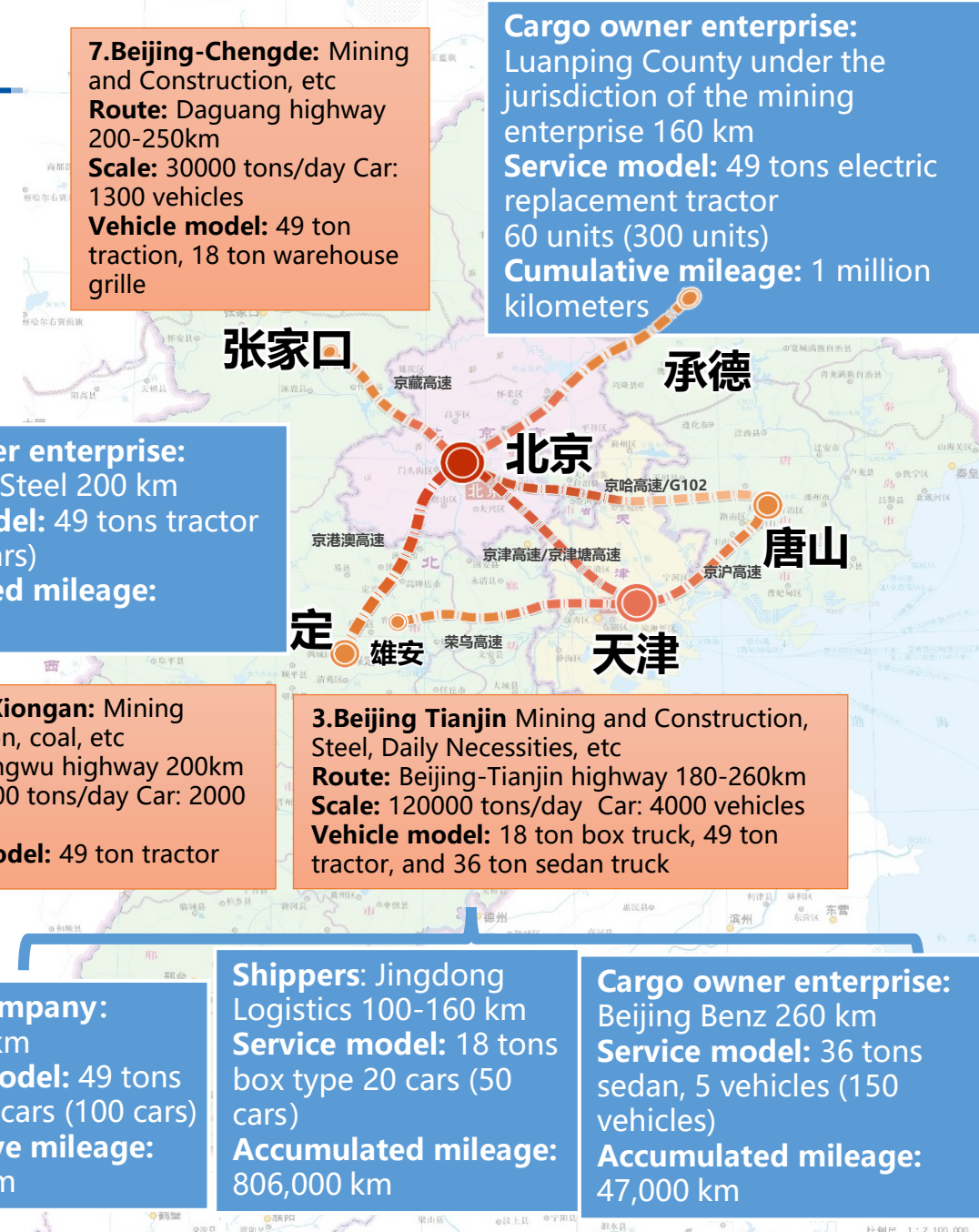
There are 140,000 heavy trucks providing cross-regional services within the Beijing-Tianjin-Hebei region, with a one-way transportation distance of approximately 150-300 kilometers.

Product performance: Pure electric trucks have a full battery range of 150km, and hydrogen fuel trucks have a full hydrogen range of up to 450 kilometers, which can meet the needs of cross-regional scenarios.

Pilot situation:

① **Electricity:** 60 tractors were put into trial operation from Beijing to Chengde, with a cumulative run of 1 million kilometers, involving 49 tons of tractors

② **Hydrogen:** Currently, 61 FCVs are in stable operation between Beijing-Tianjin and Tianjin-Xiongan, with a cumulative run of 1.64 million kilometers. The models involved include 18-ton box trucks, 36-ton sedan trucks and 49-ton tractors.



7. Beijing-Chengde: Mining and Construction, etc
Route: Daguang highway 200-250km
Scale: 30000 tons/day Car: 1300 vehicles
Vehicle model: 49 ton traction, 18 ton warehouse grille

Cargo owner enterprise: Luanping County under the jurisdiction of the mining enterprise 160 km
Service model: 49 tons electric replacement tractor 60 units (300 units)
Cumulative mileage: 1 million kilometers

Cargo owner enterprise: Rongcheng Steel 200 km
Service model: 49 tons tractor 6 cars (20 cars)
Accumulated mileage: 475,000 km

4. Tianjin-Xiongan: Mining construction, coal, etc
Route: Rongwu highway 200km
Scale: 43000 tons/day Car: 2000 vehicles
Vehicle model: 49 ton tractor

3. Beijing Tianjin Mining and Construction, Steel, Daily Necessities, etc
Route: Beijing-Tianjin highway 180-260km
Scale: 120000 tons/day Car: 4000 vehicles
Vehicle model: 18 ton box truck, 49 ton tractor, and 36 ton sedan truck

Owner company: IKEA 230 km
Service model: 49 tons tractor 30 cars (100 cars)
Cumulative mileage: 308,000 km

Shippers: Jingdong Logistics 100-160 km
Service model: 18 tons box type 20 cars (50 cars)
Accumulated mileage: 806,000 km

Cargo owner enterprise: Beijing Benz 260 km
Service model: 36 tons sedan, 5 vehicles (150 vehicles)
Accumulated mileage: 47,000 km

Analysis of pilot operation status

Project 1: Beijing-Tianjin Hydrogen energy corridor for foreign trade container transportation



Overview

- **Cargo type and scale:** 40-foot foreign trade standard container transportation, annual freight volume 110,000 tons
- **Route:** from Beijing IKEA shopping malls to Tianjin Port; and warehouses via Beijing-Tianjin Expressway and Beijing-Tianjin-Tangshan Expressway.
- **Model:** 49-ton hydrogen tractor
- **One-way transportation distance:** 180 kilometers,
- **Frequency of transportation:** 1 round trip per day

Analysis of pilot operation status

Project 1: Beijing-Tianjin Hydrogen energy corridor for foreign trade container transportation

1 Stability (stable)

After three months of operation, in this scenario, 20 49-ton hydrogen tractors have traveled **a total of 320,000 kilometers, initially showing operational stability.**

Pilot operation scale: 3-20 vehicles per day

Pilot running time: 3 months



2 Economical (acceptable with subsidies)

From the perspective of a single transportation, although the cost of FCVs is slightly higher than that of oil vehicles (the difference is 70 yuan), because the cargo owner provides freight incentives for new energy vehicles, the profits of oil and hydrogen are the same; from the perspective of a total cost of ownership, this scenario is After subsidies, the TCO cost of FCVs is slightly lower than that of oil vehicles.

Comparison of diesel and hydrogen in single transportation cost (Unit: RMB)

Cost structure	Diesel vehicle	FCV
Staff cost	400	400
Replenishment cost	996	1067
Overhead cost	72	72
Total	1468	1539

Analysis of pilot operation status

Project 1: Beijing-Tianjin Hydrogen energy corridor for foreign trade container transportation

3 Flexibility (acceptable)

4 hydrogen refueling stations have been built at both ends of the line. Although most of them require a detour of **30-54 kilometers**, the actual operating mileage of FCVs can reach more than 300 kilometers (more than 250 kilometers under full load conditions).



Analysis of pilot operation status

Project 1: Beijing-Tianjin Hydrogen energy corridor for foreign trade container transportation

4 Compatibility (Strong)

More car models to choose from: A total of 140 models from **24 vehicle companies** currently on the market can serve this scenario.

More choices for hydrogen refueling station service entities: There are currently **3 enterprises and 4 hydrogen refueling stations** that can provide hydrogen refueling services, and can provide various types of FCVs to the society.

Analysis of pilot operation status

Project 2: Beijing-Chengde battery swapping corridor for Sand and gravel



Overview and scale: annual cargo volume

30 million tons

- **Route: Chengde Luanping to and from Beijing Miyun and Shunyi Mixing Station via National Highway 101**
- **Pilot model: 49-ton battery swapping heavy truck,**
- **one-way transportation distance: 160 kilometers**
- **Frequency of transportation: 1 round trip per day**

Analysis of pilot operation status

Project 2: Beijing-Chengde battery swapping corridor for Sand and gravel

1 Stability (stable)

- Pilot operation scale: 30 vehicles
- Pilot running time: 3 months
- Availability: The average services days per truck per month is 25-27 days



2 Economical (acceptable with discounted electricity prices)

From a single trip perspective, the cost of battery swapping electric vehicles is 16% lower than that of fuel vehicles due to the advantage of using the terrain. **From a total cost of ownership (TCO) perspective**, the TCO of a 49-ton battery swapping electric heavy-duty truck is slightly higher than that of a diesel truck in this scenario.

Comparison of diesel and Battery swapping Electric in single transportation cost (Unit: RMB)

Cost structure	Diesel vehicle	Battery swapping
Staff cost	200	200
Replenishment cost	800	418.5
Traffic cost	0	140
Other cost	0	0
Other cost	0	80
Total	1000	838.5

Comparison of diesel and Electric in TCO (Unit: RMB)

	Diesel vehicle	Battery swapping
TCO	210.1	220.2

Analysis of pilot operation status

Project 2: Beijing-Chengde battery swapping corridor for Sand and gravel

3 Flexibility (Improving)

Due to the establishment of four self-built swap stations at both ends of the route, the battery swapping electric vehicles with a full load have a range of only 120-150km. For a one-way transportation, at least one battery swap is required, and for a round trip transportation, at least two battery swaps are needed. **The transportation scenario needs to be closely focused on the layout of the swap stations.**



Analysis of pilot operation status

Project 2: Beijing-Chengde battery swapping corridor for Sand and gravel

4 Compatibility (Improving)

The selection of vehicle models is limited:

Currently, the range of compatible vehicle models is relatively limited in this scenario.

Limited diversity in energy service providers:

Although four battery swapping stations have been built, the operating companies for these stations and the battery service providers are all part of the State Grid Corporation of China.

Participant	Principal entity name	Major shareholder/affiliated company
Cargo owner enterprise	Luanping county under the jurisdiction of mining enterprises	—
Vehicle enterprise	Foton, FAW, Dayun, etc	—
Battery service enterprise	Luanping huan electricity	Guodian Investment Shanghai Qiyuan core power
Energy enterprise	Qiyuan Huan Electric (Beijing) Technology Co., LTD	
Transportation enterprise	Luanping Huan can logistics Co., LTD	

小结

When the three technical routes of battery swapping, plug-in, and hydrogen fuel cell electric vehicle are comparable to the freight service system based on the diesel system, a set of **implementable, sustainable and replicable** zero-emission freight large-scale development models can be truly explored.

Technical route Evaluative dimension	Hydrogen	Battery swapping	Plug-in
Stability	stable	stable	wait for verification
Economy	Acceptable (after subsidy)	Acceptable (After discounted electricity prices)	wait for verification
Flexibility	Acceptable	Improving	wait for verification
Compatibility	Stronge	Improving	wait for verification

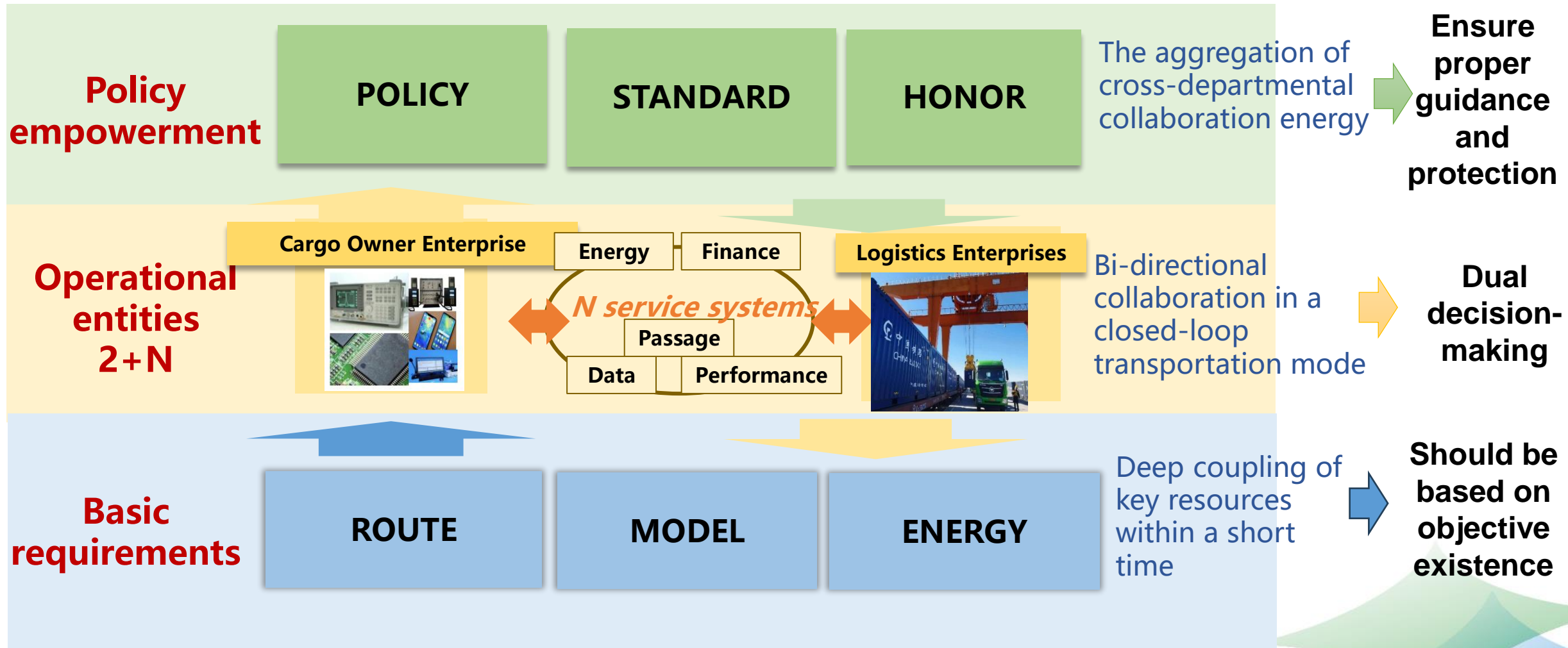


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Composition of the sustainable development model for zero-emission freight corridors



Built an **outstanding zero-emission model project** with the **interconnection of freight-vehicle-station-road**

Through cross-regional hydrogen energy scenarios, it will further assist vehicle product technology research and development , and build renewable energy networks, and aggregate energy from multiple departments. It will also plan to achieve innovative leadership and breakthroughs, providing **a replicable and promotable mode** for the construction of cross-regional hydrogen energy corridors across the country!

3 major technology iterations

- ❑ Vehicle product technology
- ❑ Energy security technology
- ❑ Hydrogen carbon monitoring and measurement technology



3 policy closed loop

- ❑ Car energy subsidy
- ❑ Pass-through concessions
- ❑ Cargo owner incentives



3 major modes innovations

- ❑ Synergies in reducing pollution a carbon
- ❑ Cross energy fusion synergy modes
- ❑ Carbon and industry synergy modes

Annual transportation volume exceeds **10,000 tons**

Scale of new energy vehicles exceeds **10,000**

Carbon emission reduction exceeds **10,000 tons**

THANK YOU!

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