

# Hydrogen Energy Country Overview: China

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# Policy Background for Hydrogen Energy

- In 2014, President Xi Jinping called for “4 revolutions” and “one cooperation” for energy

## Four revolutions

- 1 Promote the energy **consumption** revolution
- 2 Promote the energy **supply** revolution
- 3 Promote the energy **technology** revolution
- 4 Promote the energy **system** revolution

## One cooperation

Strengthen all-round international cooperation

- In 2015, President Xi Jinping made the solemn promise of China's carbon emission peak around 2030 (China's carbon emission reduction target) at the Paris Climate Change Conference.



China's energy development is directed to establish a clean, low-carbon, safe, efficient modern energy system (quote from the 19th China National Congress).

# The Chinese Government Attaches Great Importance to the Development of Hydrogen Energy Technologies and Industry



H2 Energy is a part of the “Made in China 2025” initiative issued in 2015 by the State Council.

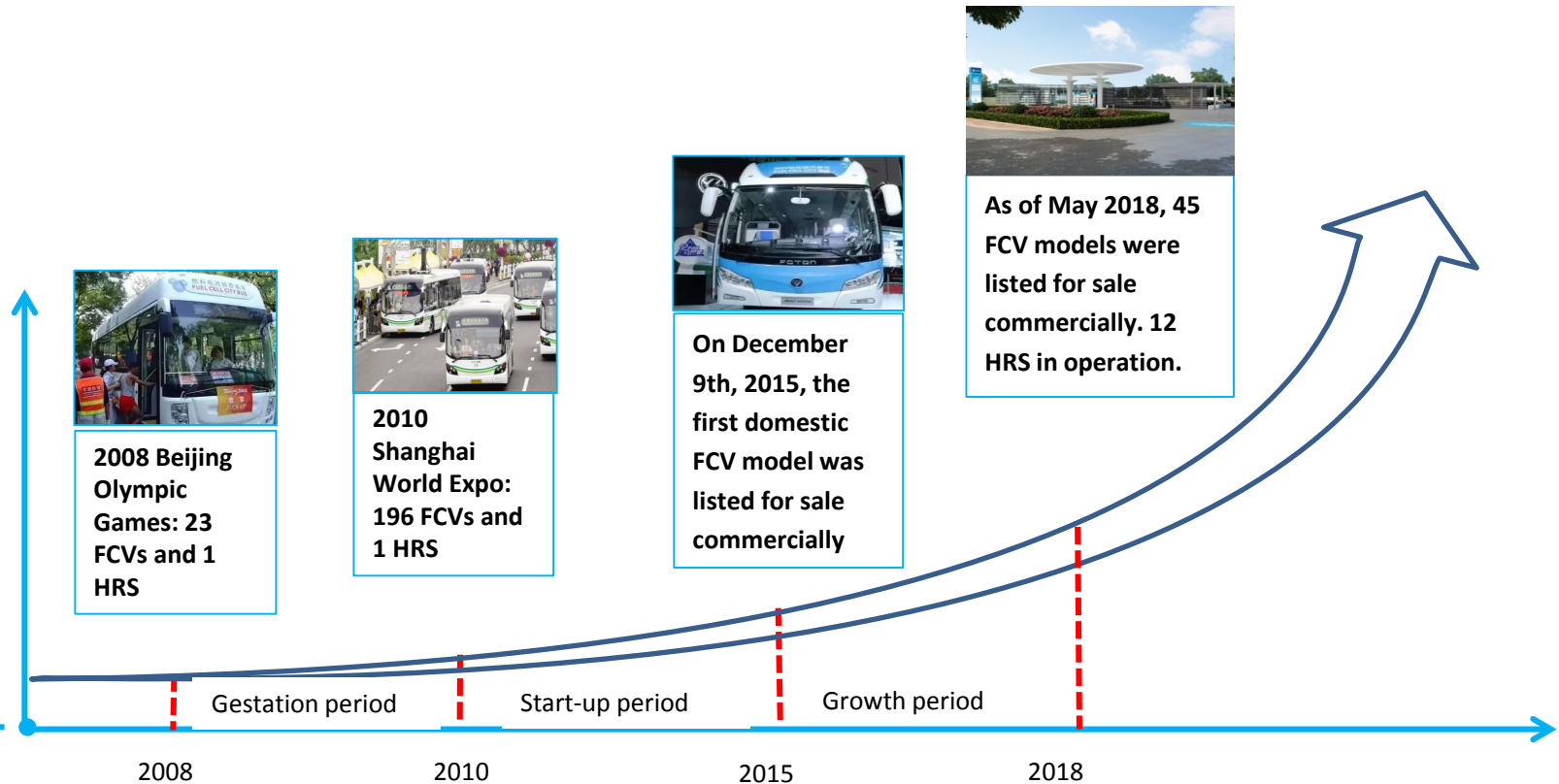
H2 Energy was included in the “13<sup>th</sup> Five-Year Plan” in Dec 2016



Year	HRS	FCV
2020	>100	5000 in demo (60/40 split in MD/HD vs. LD)
2025	>300	50,000 in service (20/80 split)
2030	>1000, >50% H2 from renewables	1 million+ in service

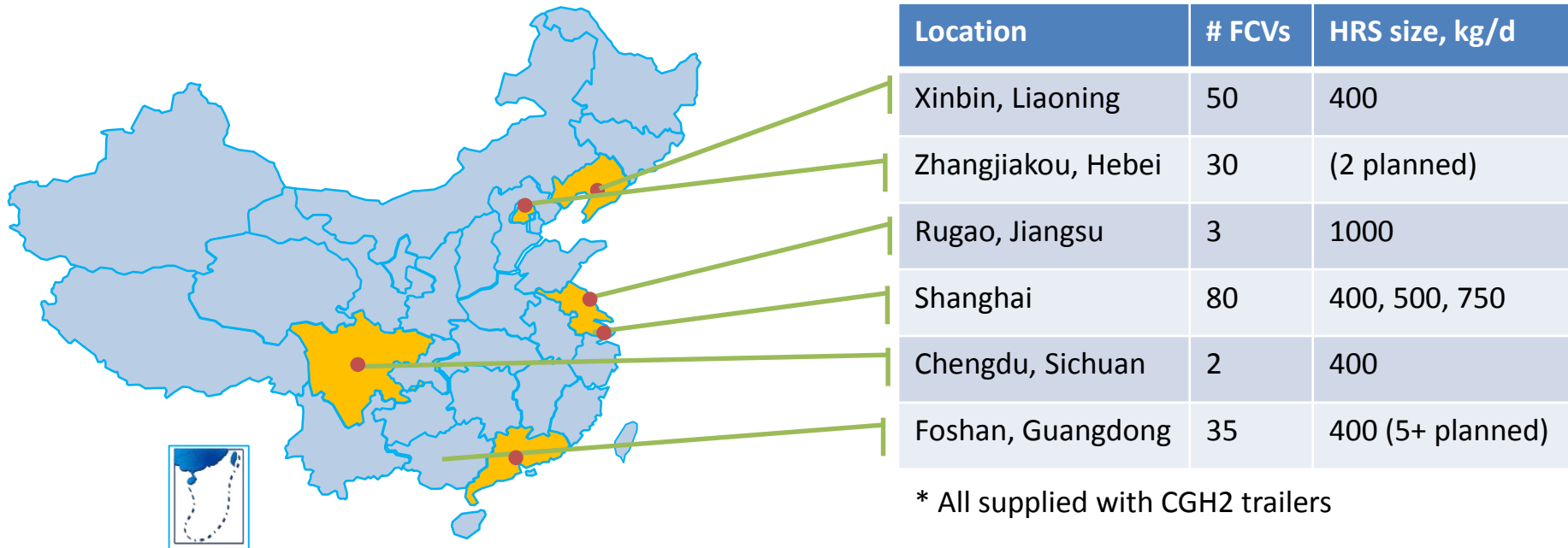
Source: Hydrogen FCV Technology Roadmap, 2016.

# The Developing Course of Hydrogen Fuel Cell Vehicles in China



# Hydrogen Energy Industry Distribution

- There have been **12** hydrogen refueling stations in operation and over 150 fuel cell vehicles under operation across the country till now.



# Policy Incentives

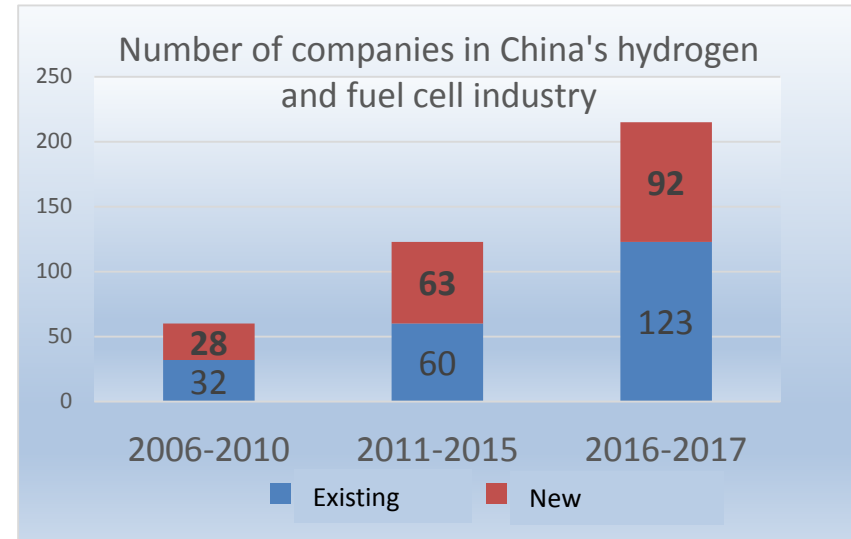
The state maintains a high subsidy for hydrogen fuel cell vehicles

Types of fuel cell vehicles	Subsidy standards (k RMB)
Fuel cell Passenger vehicles	200
Fuel cell light buses and trucks	300
Large and medium-sized fuel cell vehicles, medium and heavy type trucks	500

Some local subsidiaries

**1 : 1**

Shanghai    Wuhan



**¥ 100 Bn**

More investments go to hydrogen and fuel cell industry within last two years

# China National Alliance of Hydrogen Energy and Fuel Cell (China Hydrogen Alliance)

- China National Alliance of Hydrogen and Fuel Cell ( China Hydrogen Alliance for short ) was established in February in Beijing with **CHN ENERGY** serving as chair.



# Leadership by China Energy is Significant



- China's largest power company, accounting for 15% of electricity production
- Assets: 1.8 TT RMB (\$286 BB)
- Employees: 350,000
- Formed in 2017 through the merger of Shenhua Group and China Guodian Group



## Coal production and use



480 MM tons mined/yr



15 MM tons chemicals/yr

## Electricity generation



226 GW total installed capacity



30 GW installed wind

## Transportation



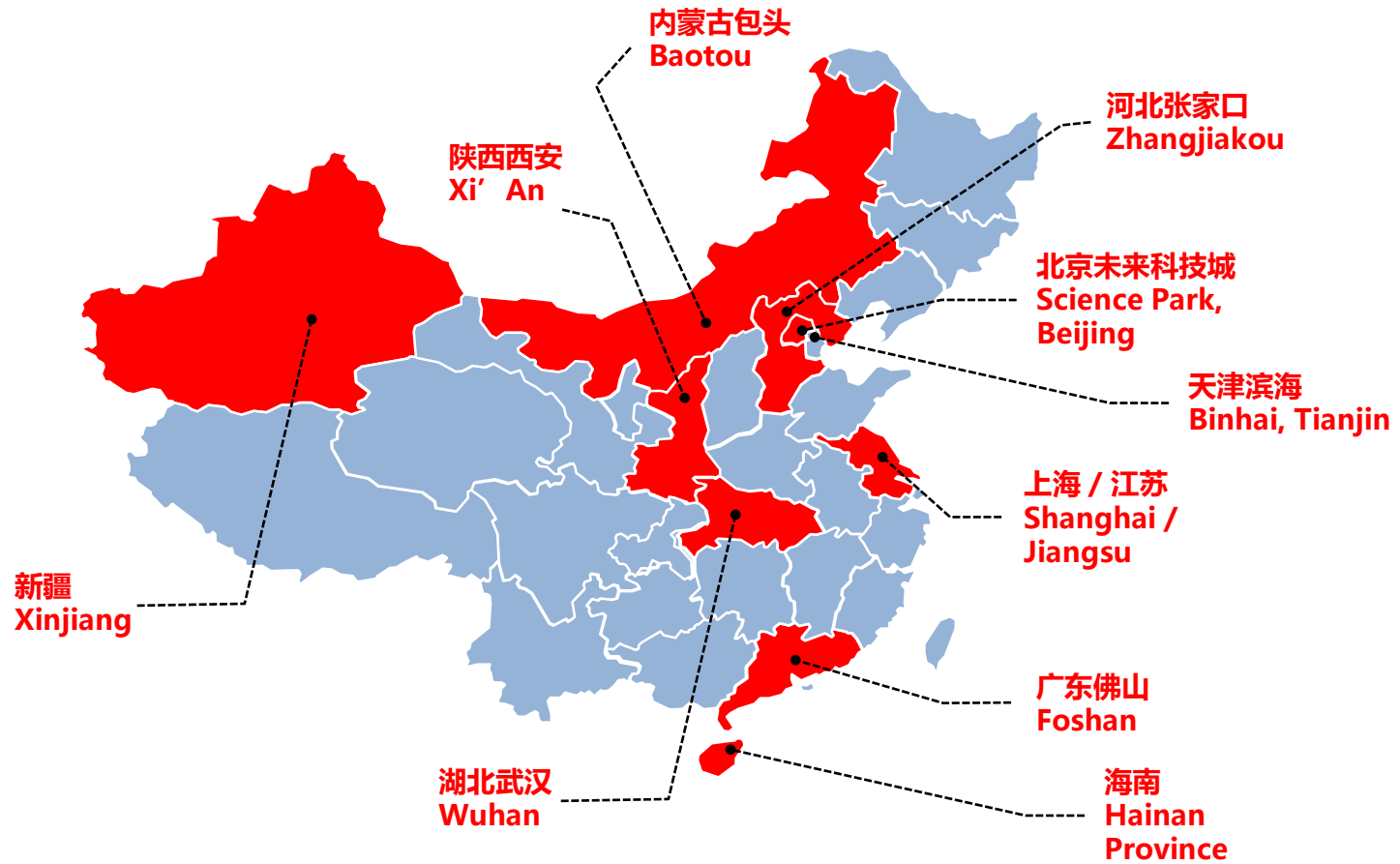
2155 km rail network



270 MM tons  
port capacity



# CHN Energy -- Industrial Layout of Hydrogen Energy



# CHN Energy--Jiangsu Rugao HRS



- Land area: 2583 square meters
- Dispensers: 35MPa, 70MPa
- Hydrogen storage capacity: 586 kg
- Daily capacity: 1000 kg/d
- To be completed in Sept 2018

China's first hydrogen refueling station that meets 35 MPa/70 MPa dual mode international standard.

# H2 Liquefaction R&D: China Aerospace Science and Technology Corp.

The Aerospace Science and Technology Group has made important breakthroughs in the liquefaction, storage, and high pressure applications of hydrogen, leveraging its R&D foundation in aerospace.

- ◆ The **total production capacity** of liquid hydrogen has reached **79.2** cubic meters/day
- ◆ **Testing of the hydrogen equipments:** the highest experimental pressure reaches **90MPa**.



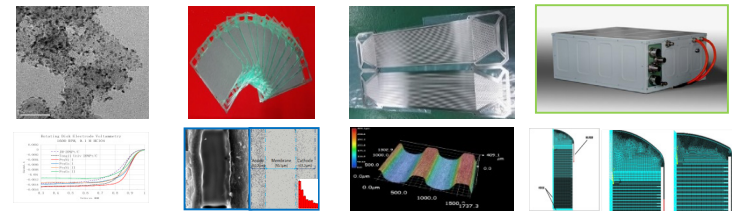
# R&D on Fuel Cell and System Integration - Tongji University

■ Tongji University has been doing fuel cell R&D for 18 years

■ Currently it has >200 FCVs in operation

■ G4 Fuel Cell Powertrain, bench test reaches about 5000 hours, 100 km hydrogen consumption is about 0.9kg

Material, Components and Fuel Cell Stack



Catalyst

MEA

Bipolar plate

Stack



Start I-20kW

2001



Start III-40kW

2005



Olympic in Beijing

2008



Demonstration in California

2009



EXPO in Shanghai

2010



Mobile Power Plant for China Telecom

2016



Start II-30kW



Challenge Bibendum



Backup Power 5kW for Telecom Base Station

# Commercialization of Hydrogen Fuel Cell Passenger Vehicles-SAIC Motor

SAIC has vehicle design, supply chain and manufacturing for FCV mass production



Rongwei 950 Fuel Cell Sedan

- Driving range : 430km
- H2 Bottle Pressure : 70MPa



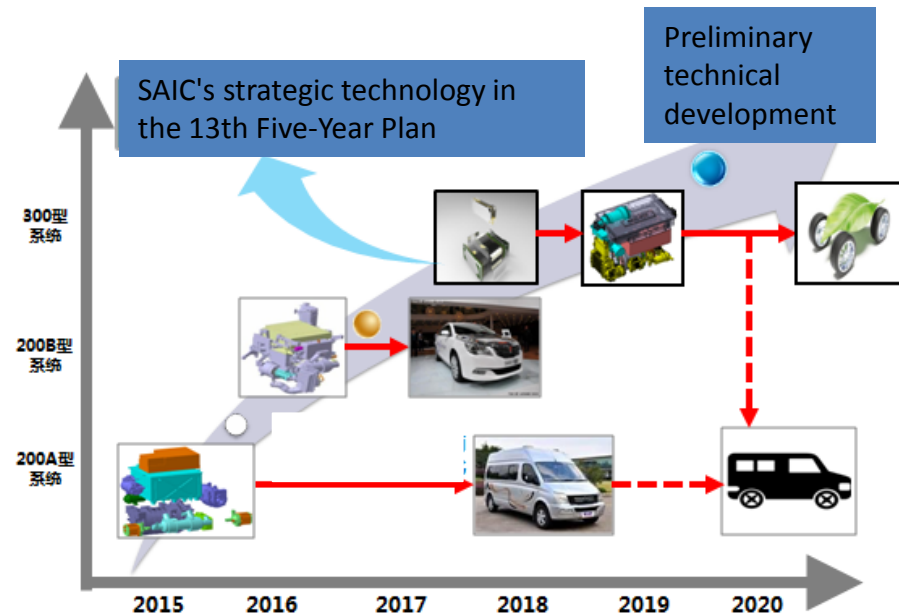
Shanghai Shenwo Fuel Cell Public Bus

- Hydrogen consumption per 100km : < 8kg
- H2 Bottle Pressure : 35MPa



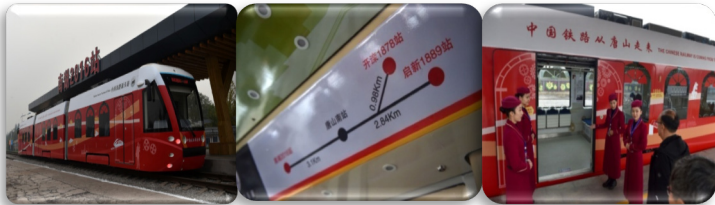
Datong FCV80 fuel cell light passenger

- Driving range : 490km
- H2 Bottle Pressure : 35MPa



# Commercialization of Hydrogen Fuel Cell Railcars - CRRC

- Completed prototype development of the hydrogen fuel cell railcar.
- CRRC has the ability to produce pure fuel cell rail car and hybrid (super capacitor / power battery / solar) rail car, evidencing its power system integration and vehicle manufacturing capabilities.



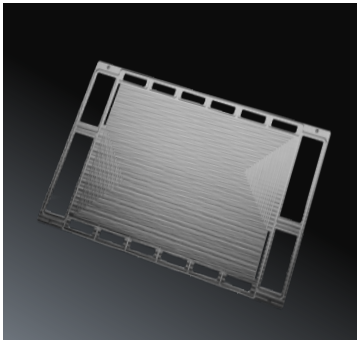
Demonstration operation in Tangshan in October 2017



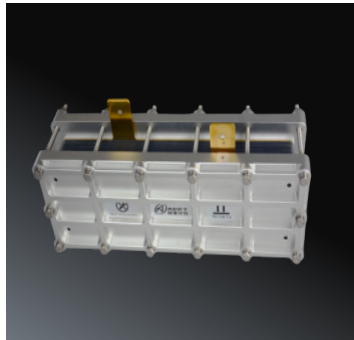


# Preparation of key material in hydrogen fuel cell- China Iron & Steel Research Institute Group

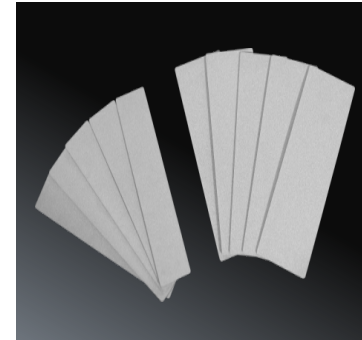
- Metal bipolar plate design and manufacturing
  - 5-60 kW metal plate FC, 2.7 kW/L
  - Up to 30 kW, graphite FC



Key Material: Metal Bipolar Plates



Fuel Cell Stack



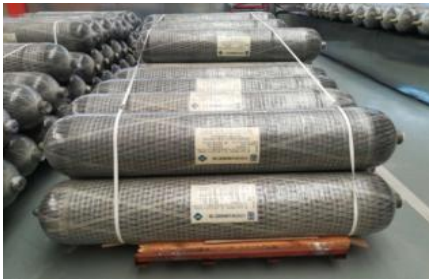
Key Material: GDL

# Hydrogen Storage Vessels for FCVs – Tianhai Industry

Supplies 35 MPa and 70 MPa Type 3 storage vessels

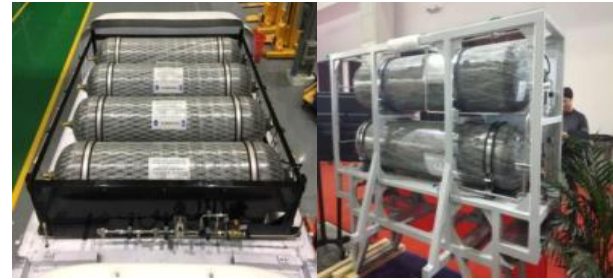
35MPa aluminum liner carbon fiber

wound cylinder



35 MPa hydrogen fuel

automotive air supply system



70 MPa aluminum liner carbon fiber full-wound gas cylinders for fuel cell cars are currently installed on two gas supply systems.





# Summary

- Hydrogen energy is supported by Chinese government
  - Energy security, clean environment, global commitment, industry transformation are among the drivers
  - The government has incentives and policies in place
- Buses and delivery vehicles are first, passenger cars are next
  - MD/HD ahead of LD
- Byproduct gases, renewables and coal to H2 with CCS are the paths to hydrogen fuel
  - H2 from natural gas is not competitive in China
- Systematic effort is being orchestrated by major players
  - China Hydrogen Alliance is a milestone



# 2018 China Hydrogen Energy and Fuel Cell Industry Forum

Oct 10-11, 2018

Hainan, China

Releasing “China H2 and FC Industry White Paper”

Unveiling “Hainan Eco-island” and “Hainan H2 Energy Demo Zone”

Multiple technical sessions

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**Thank you. Questions?**