Electrification in China: Overview

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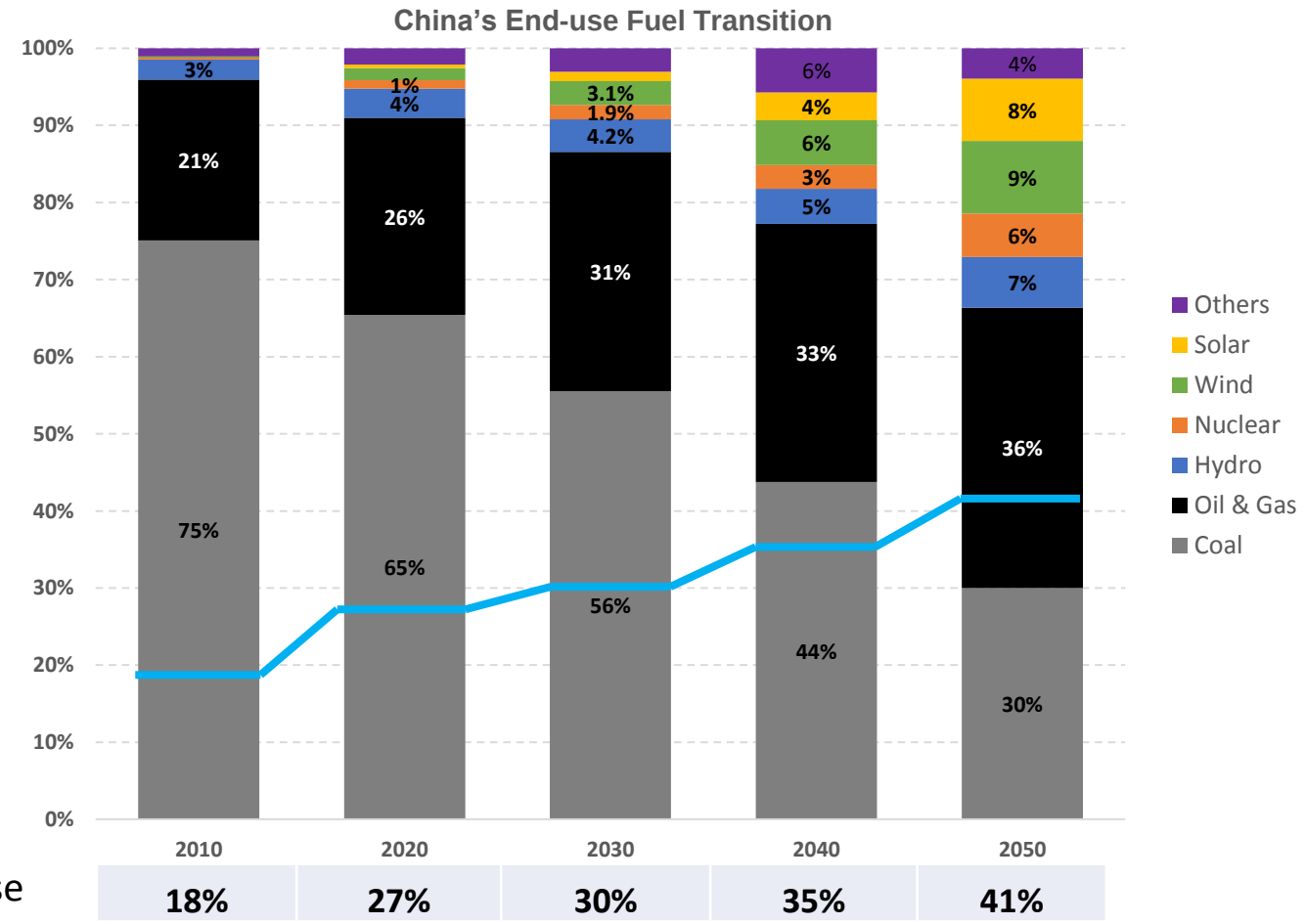
China’s electrification pathway

Primary motivation: air pollution reduction



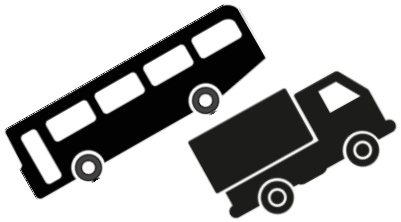
Electrified End-use	2010	2020	2030	2040	2050
	18%	27%	30%	35%	41%

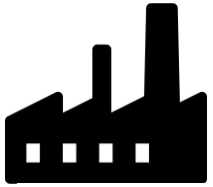
* Primary electricity converted using the direct equivalent method (consistent with IPCC) and consists of non-fossil electricity only. Electricity converted to primary energy using the direct equivalent method. Shares may not add to 100% due to rounding.
Source: Reinventing Fire: China team analysis.

Major drivers in each sector

	Buildings	**Transportation**	**Industry**
2010->2050 levels	22% → 66%	1% → 22%	19% → 38%
Major levers	Rural and district heating Water heating	Passenger vehicles Rail and buses Light freight	Key processes (e.g. electric arc furnaces)

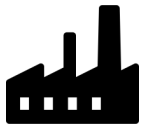
Vehicle Electrification: Huge growth





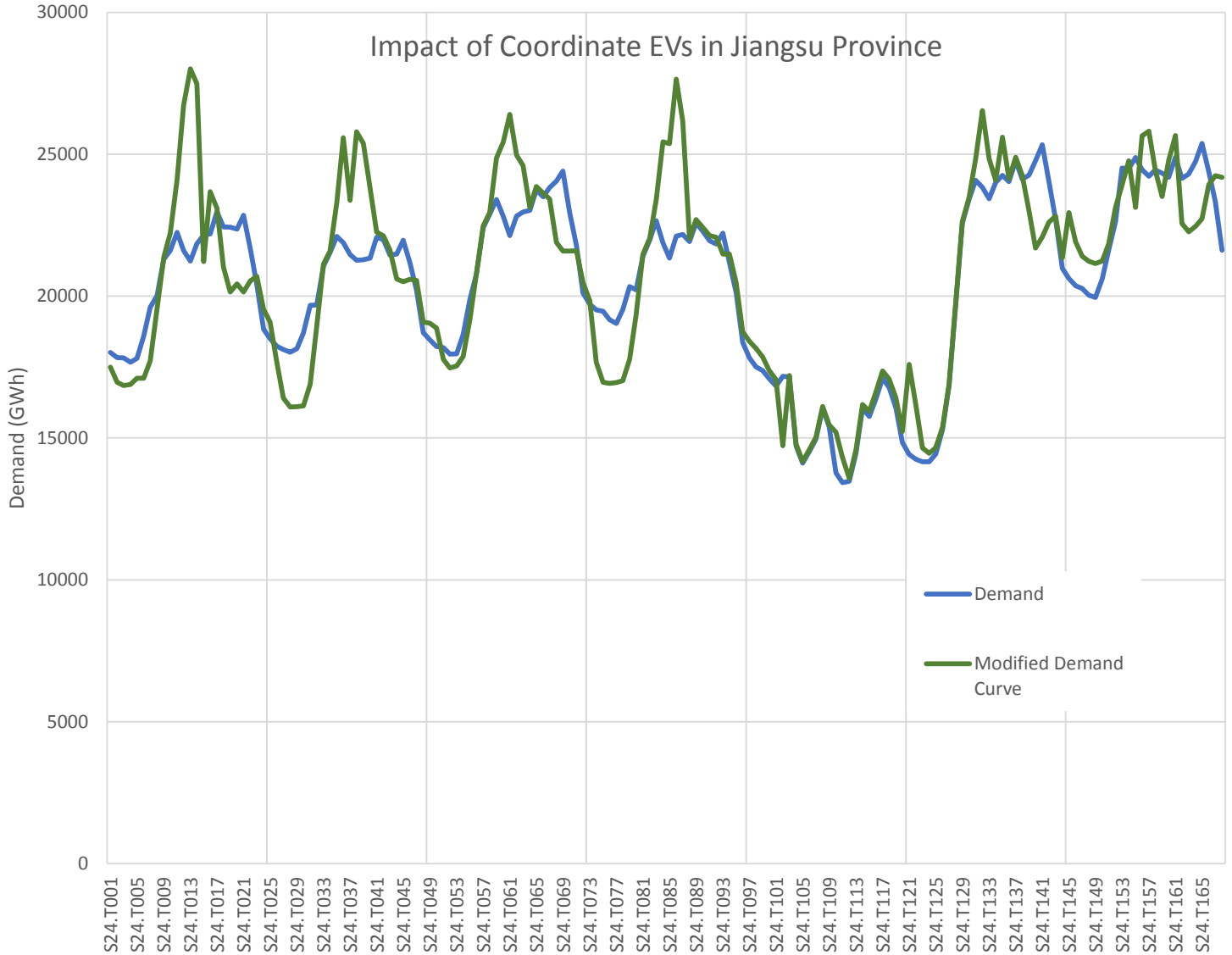
2017 Estimates		2020 Goals
579,000 passenger EVs sold annually **198,000** commercial medium- and heavy-duty EVs (mostly **large buses**) sold annually	**1.7 million** total electric vehicles in China	**5 million electric vehicles** on China's roads
794,000 electric vehicles were **manufactured** in China, **10%** of all vehicles manufactured		EVs are **12%** of all vehicle **manufacturing**
Estimated **475,000 chargers,** 210,000 publicly accessible		**5 million chargers** by 2020
Estimated **43%** of train travel electrified		**70%** of all **trains electrified**

Vehicle Electrification: Policy-driven

	Policy applied to…	Types of policies
	Manufacturers/retailers	• Subsidies for cars produced • Targets for imports and manufacturing
	Fleet Owners	• Subsidies for vehicles purchased • City targets for fleet electrification (bus, cabs, etc.)
	End Customers	• Priority registration and parking, no travel restrictions • Subsidies and tax exemptions
	Charging Station Owners	• Subsidies for public charging • Grid company allowed to rate base in some cities
	Railway Companies	• Engine import subsidies • Restrictions on road freight to increase rail use

Vehicle Electrification: Misaligned incentives for smart charging

- China has no electricity markets, hard to value EV demand shifting
- Chargers have TOU rates, but not coordinated with grid operation and investment
- Coordinated EV charging reduces 130 GW of additional plants by 2030



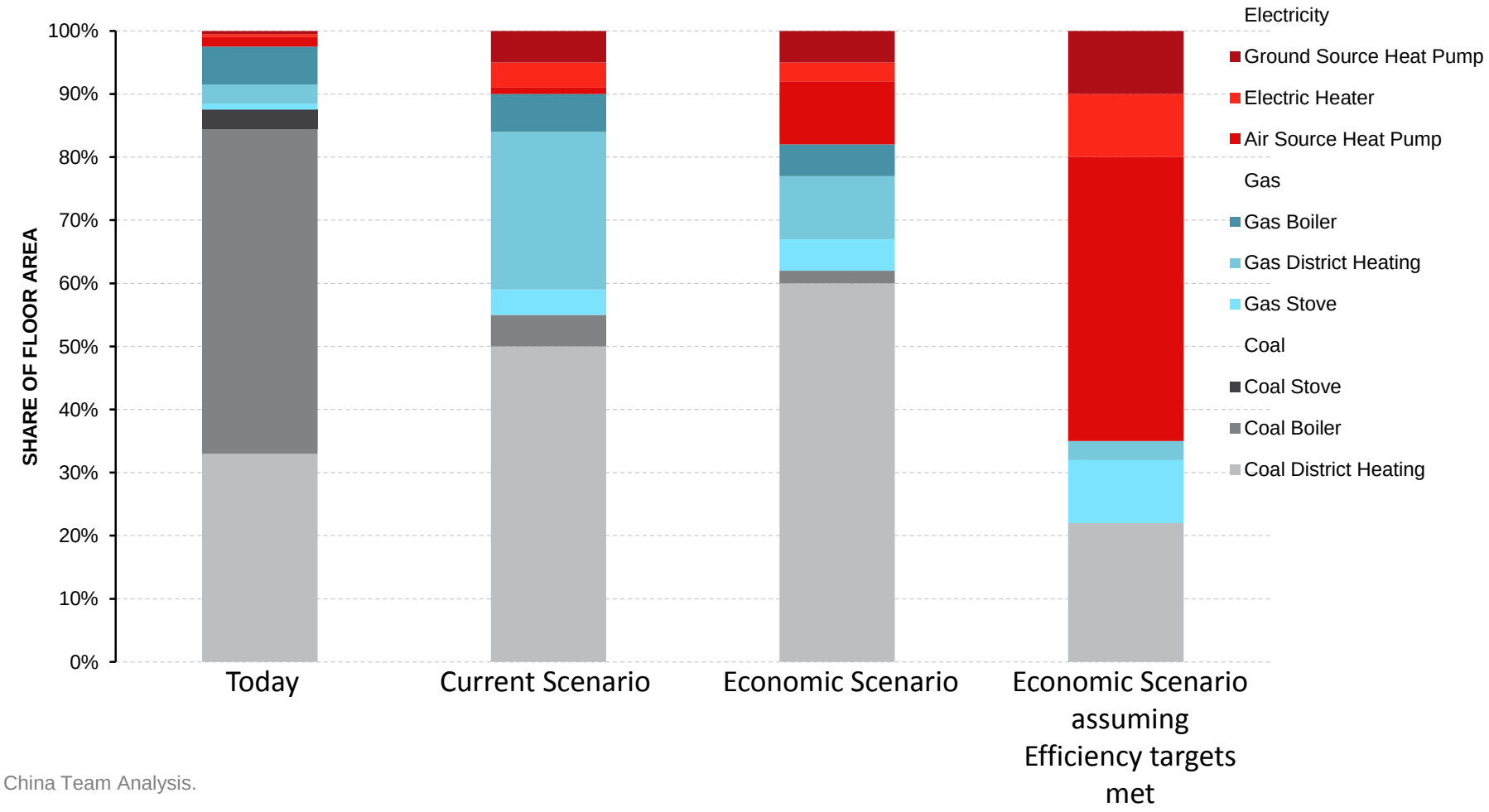
District Heating: Growing demand

- District heating only in the North, South typically uses minimal heating.
- The dividing line has been moved further South, meaning huge growth in CHP
- Development in the south means increased heating demand

Source: Reinventing Fire: China Team Analysis.

District Heating: Electrification potential

FIGURE 5.13:
SHARES OF RESIDENTIAL SPACE HEATING EQUIPMENT BY FLOOR SPACE 2010 AND 2050, FOR NORTHERN CLIMATE



Source: Reinventing Fire: China Team Analysis.

Heating: Policy directives

Urban	Rural
Now: Mostly coal CHP **Switching to:** natural gas or district geothermal heat pumps **Policies:** Restrictions on standalone boilers, forced conversion to NG/electricity (regional or city), retrofit CHP to increase flexibility (heat storage and electric heating) **Challenge:** • Earlier heat pump campaign encountered quality issues • Coal plants more profitable, jobs, GDP, sells electricity • Heat pumps don't buy at market rates yet • Inflexible CHP plant operation increases renewable curtailment	**Now:** Mostly standalone coal boilers, kang stoves **Switching to:** heat pumps, electric radiant heat, LPG or NG boilers **Policies:** Ban on burning coal, subsidies to use heat pumps or LPG or NG **Challenge:** • Low enforcement • Unreliable infrastructure

Industry: Too costly and low motivation

Current situation:

- Industrial power prices are the highest, cross-subsidize other users
- Industries built their own generation

Future situation:

- Market reforms are lowering on-grid power prices
- May make electrification competitive
- Industry is overcapacity, little new build, no cash on hand to retrofit
- Captive generators will be targeted by new air quality laws