Investing in the Future

Business Innovation, Transformation & Disruptions in Asia's Energy Sector

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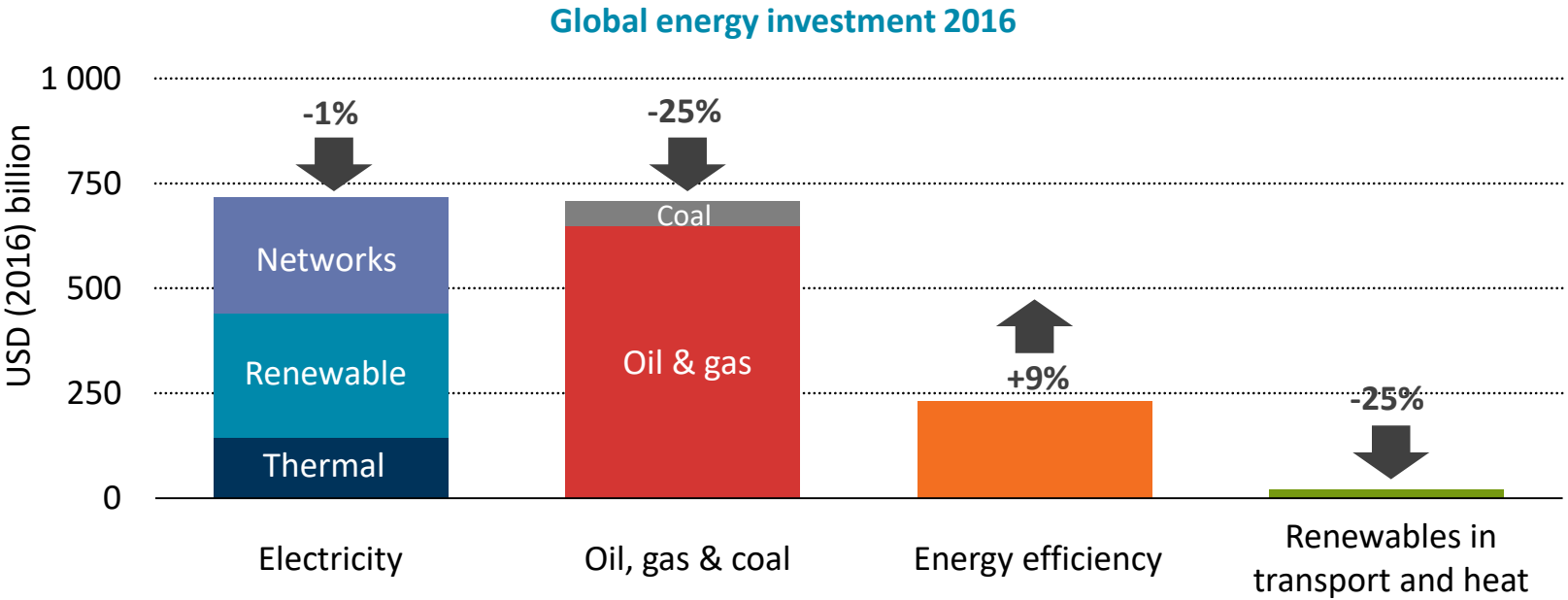
IEA

A shifting landscape for global energy investment

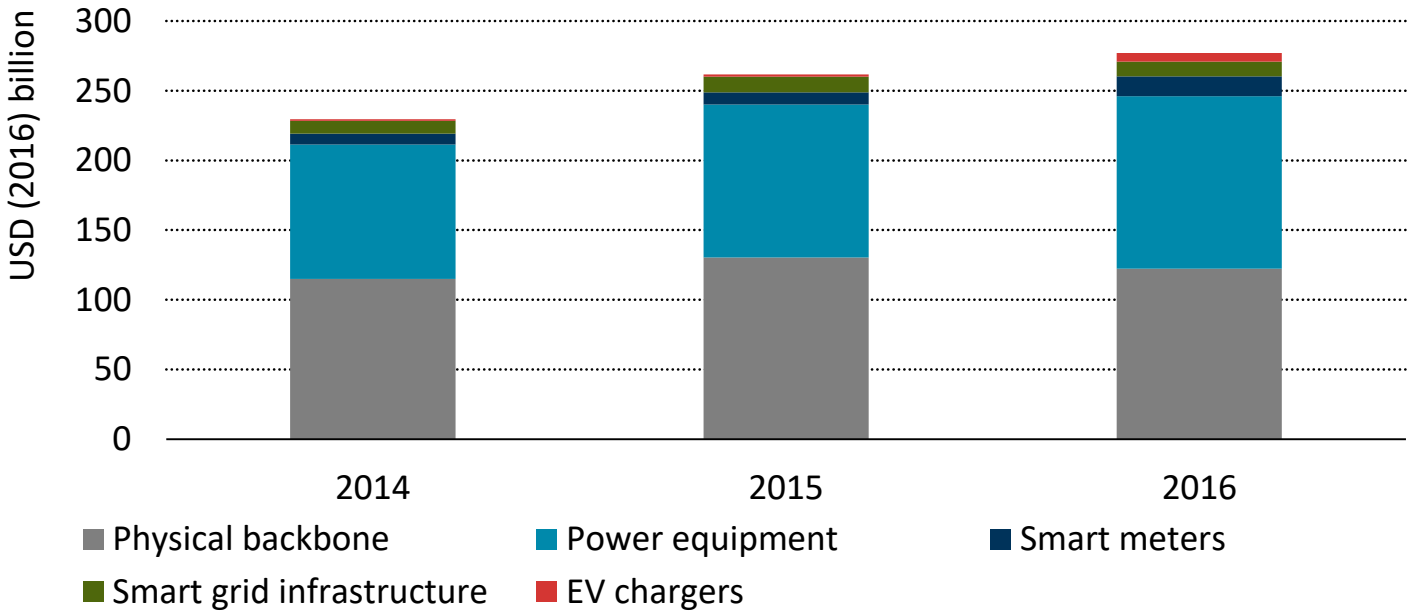


Source: IEA World Energy Investment 2017

Total energy investment was $1.7 trillion in 2016. Electricity sector investment overtook oil and gas for the first time, led by renewables, while energy efficiency was the biggest growth sector.

A smarter grid to support increased electrification and higher renewables

Investment in digital grid infrastructure and total electricity networks spending

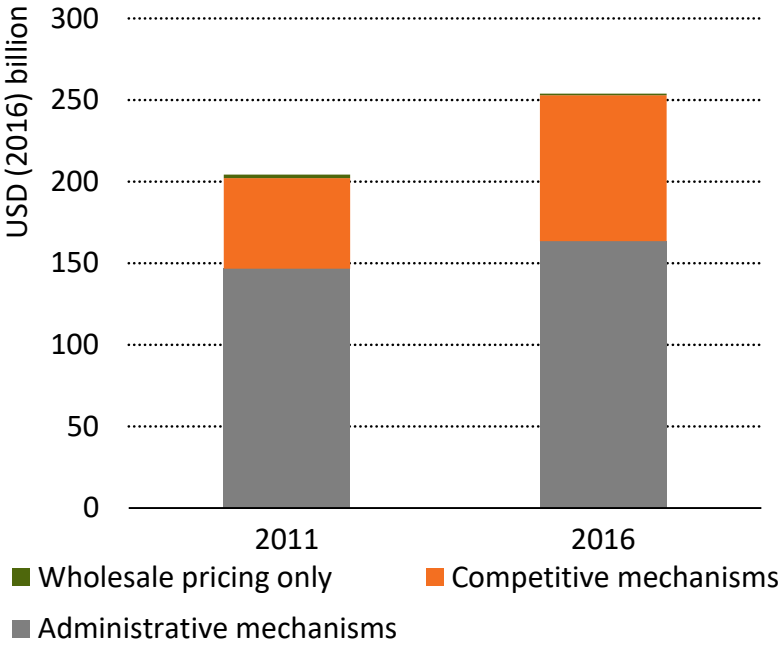


Source: IEA World Energy Investment 2017

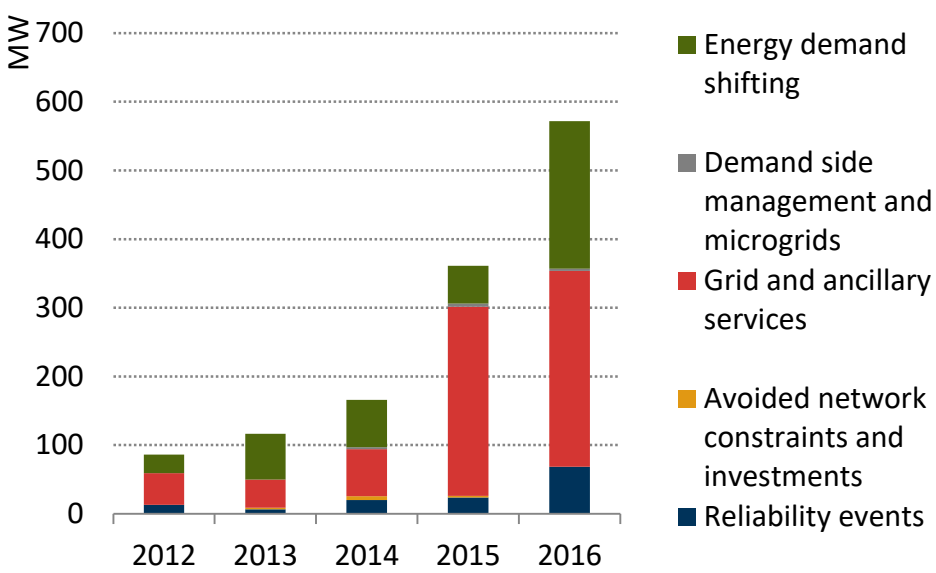
Grid spending is dominated by traditional lines and equipment, but digital smart grid infrastructure – with advanced connectivity and communication - now accounts for over 10% of networks investment.

Evolving business models for renewables and power system flexibility

Utility-scale renewables investment by price setting mechanism



Main applications of world battery storage investment



Source: IEA World Energy Investment 2017

35% of renewable investments now driven by competitive mechanisms, with attention to system integration, but largely have fixed pricing. Batteries (<1% grid investment) hinge on policies to reward capacity, flexibility & avoided grid costs.

Power company moves in 2017 illustrate range of strategic approaches

- **Economic stabilization and diversification of supply**

中国神华 CHINA SHENHUA Merger + 中国国电 CHINA GUODIAN

sembcorp Acquisition → Solar C&I Holdings

- **Fundamental shifts in supply towards renewables**

DONG energy Transformation → Ørsted

ENGIE Joint venture ↔ UNISUN 联盛新能源

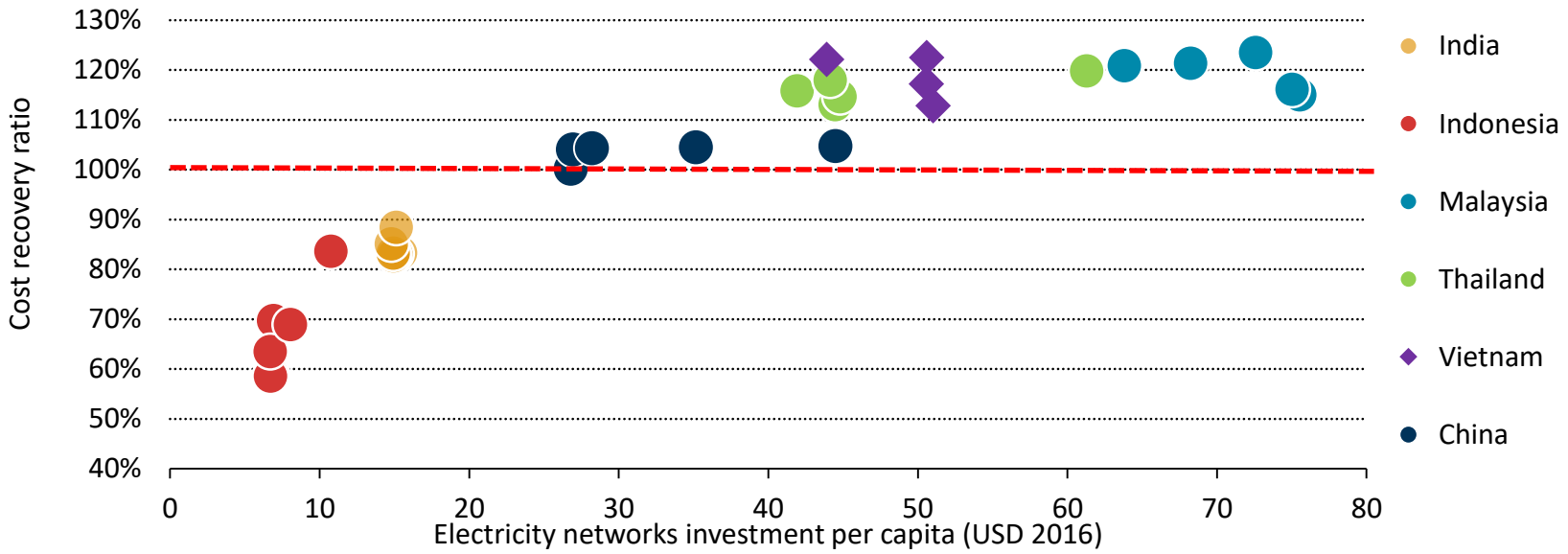
- **Integration of supply with networks, flexibility, demand management and new services**

enel Acquisition → ENERNOC, DEMAND energy

LTECH 科泰電源 Acquisition → New Energy Automobiles

Grid modernization underpinned by regulatory framework & market design

Electricity grid investment per capita versus system cost recovery ratio (most recent five years)

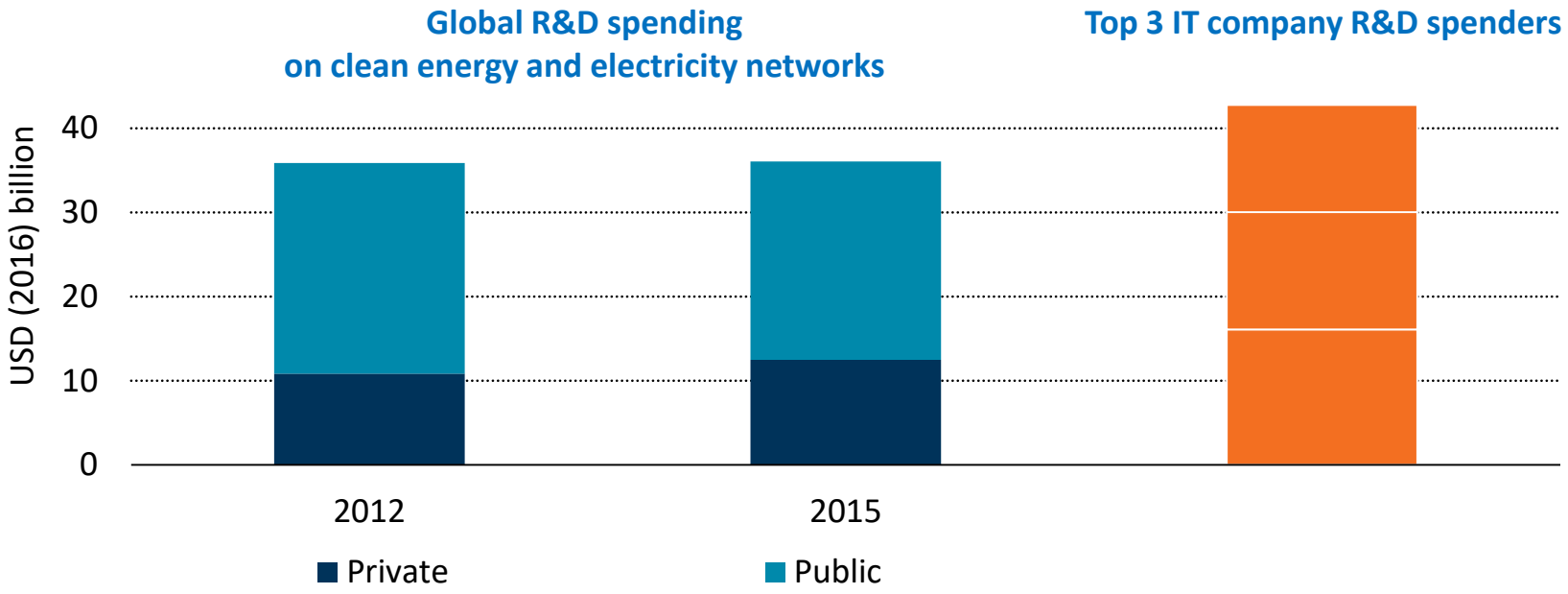


Note: cost recovery is measured as the ratio of total revenues/operating costs and excludes subsidy payments; data points reflect 3-year trailing average

Source: IEA World Energy Investment 2017

60% of 2016 grid investment was made in single buyer markets (e.g. China, India, SE Asia). Investment depends on regulatory models that address cost recovery, tariff design and key performance metrics.

Global clean energy R&D funding needs a strong boost



Source: IEA World Energy Investment 2017

We've tracked a steady $37 billion/year of clean energy and electricity networks R&D spending, with room for growth from the private sector. As a share of GDP, China now spends most on energy R&D