6TH IEF IGU MINISTERIAL GAS FORUM

Session 2:
Gas demand growth beyond power generation

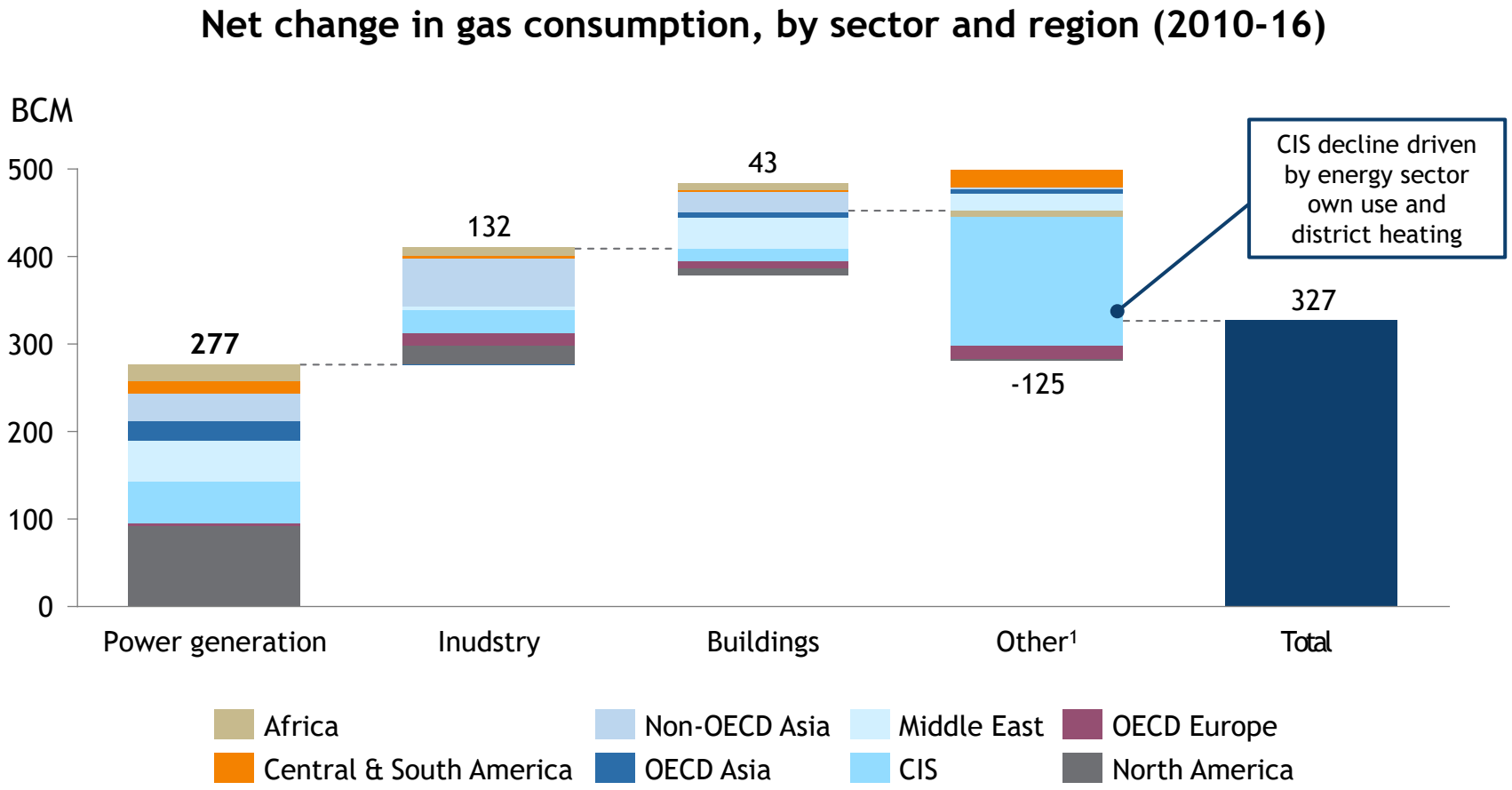
IEF-IGU Gas Ministerial

22nd November 2018

INTERNATIONAL ENERGY FORUM

BCG ENERGY

Past: Demand growth concentrated in power sector



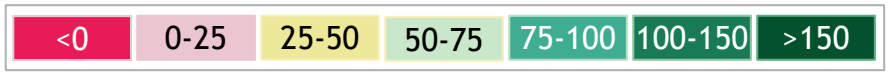
1. Other Energy Sector: covers the use of energy by transformation industries and the energy losses in converting primary energy into a form that can be used in the final consuming sectors. It includes losses by gas works, petroleum refineries, coal and gas transformation and liquefaction. It also includes energy used in coal mines, in oil and gas extraction and in electricity and heat
Source: IEA, BCG analysis

Future: High projected growth outside of power

Heat map - net additional gas consumption (2016-2040, bcm/yr)[1]

Regions	Power	Industry[2]	Buildings	Other[3]	Total
Non-OECD Asia-Oceania	227	240	84	68	619 (38%)
Middle East	116	77	88	38	318 (20%)
North America	20	27	13	120	180 (11%)
Africa	82	29	39	20	169 (10%)
Latin America	34	42	9	22	107 (7%)
OECD Asia-Oceania	-3	36	24	18	75 (5%)
CIS	0	19	16	26	61 (4%)
Europe	34	-4	3	6	39 (2%)
Global Bunkers	-	-	-	50	50 (3%)
Total	510 (32%)	465 (29%)	275 (17%)	368 (23%)	1,619

Transportation included



1. Chart represents net change in annual gas consumption between 2016 and 2040 2. Industry sector: includes fuel used within the manufacturing and construction industries. 3. Other Energy Sector: covers the use of energy by transformation industries and the energy losses in converting primary energy into a form that can be used in the final consuming sectors. It includes losses by gas works, petroleum refineries, coal and gas transformation and liquefaction. It also includes energy used in coal mines, in oil and gas extraction and in electricity and heat
Source: IEA, WEO 2017, BCG analysis

What will it take? Four levers to achieve growth

Cost reduction

- LNG cost innovation
- Carbon pricing
- Enablement of new gas resource development

Policy advocacy

- Localized pollution regulations
- Sector-specific growth enablers
- Reduction of political barriers

Infrastructure development

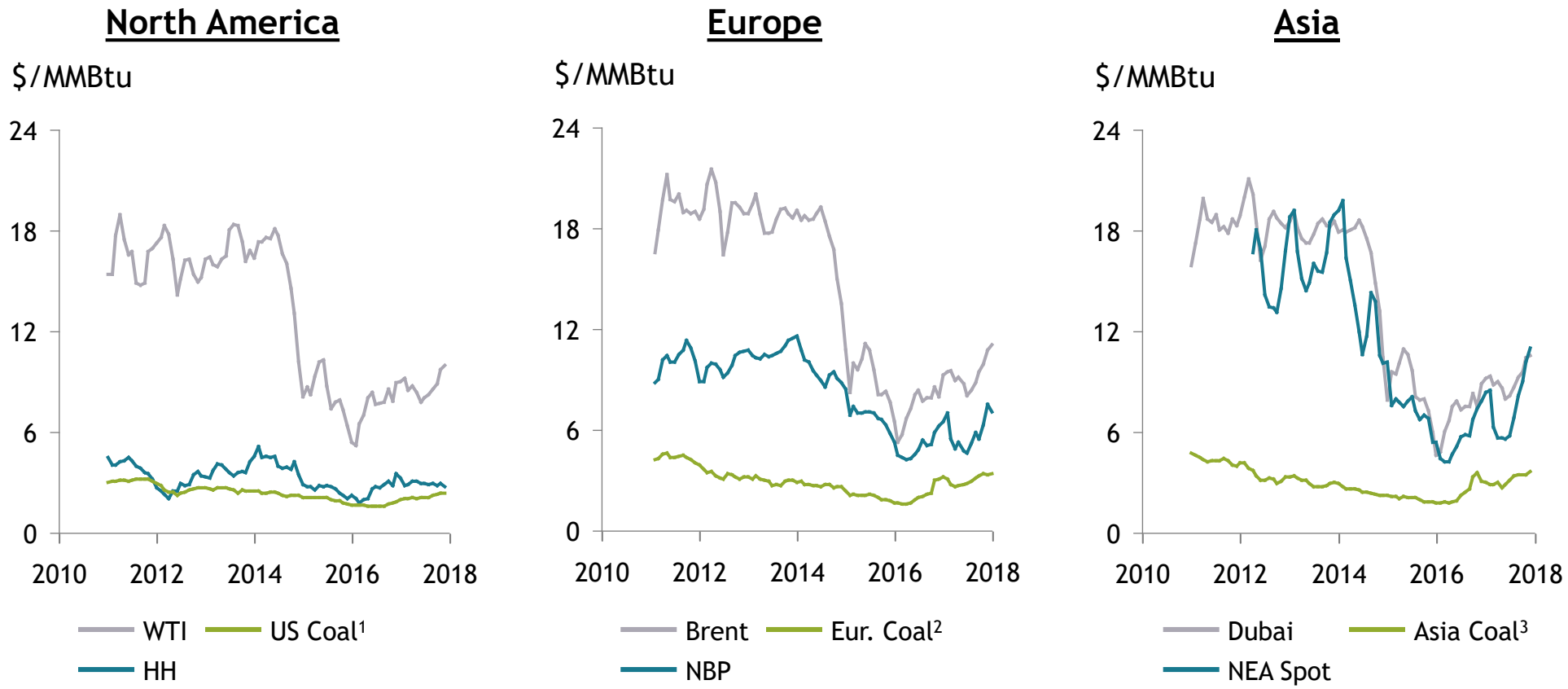
- Substantial capital investment
- Access to low cost debt
- Innovative financing measures

New business models

- Flexible technologies
- Downstream gas mkt. development
- Focus on gas for cities

Cost: Gas remains uncompetitive vs. coal in Asia and Europe

Oil, Gas and Coal prices in major reference markets 2011-2017



1. US coal price is Central Appalachia price, 2. Rotterdam index, 3. Australia coal
Source: World Bank, Bloomberg, EIA, BCG analysis

Policy: China demonstrates the impact of sector-specific policies

Multiple government policies supporting gas

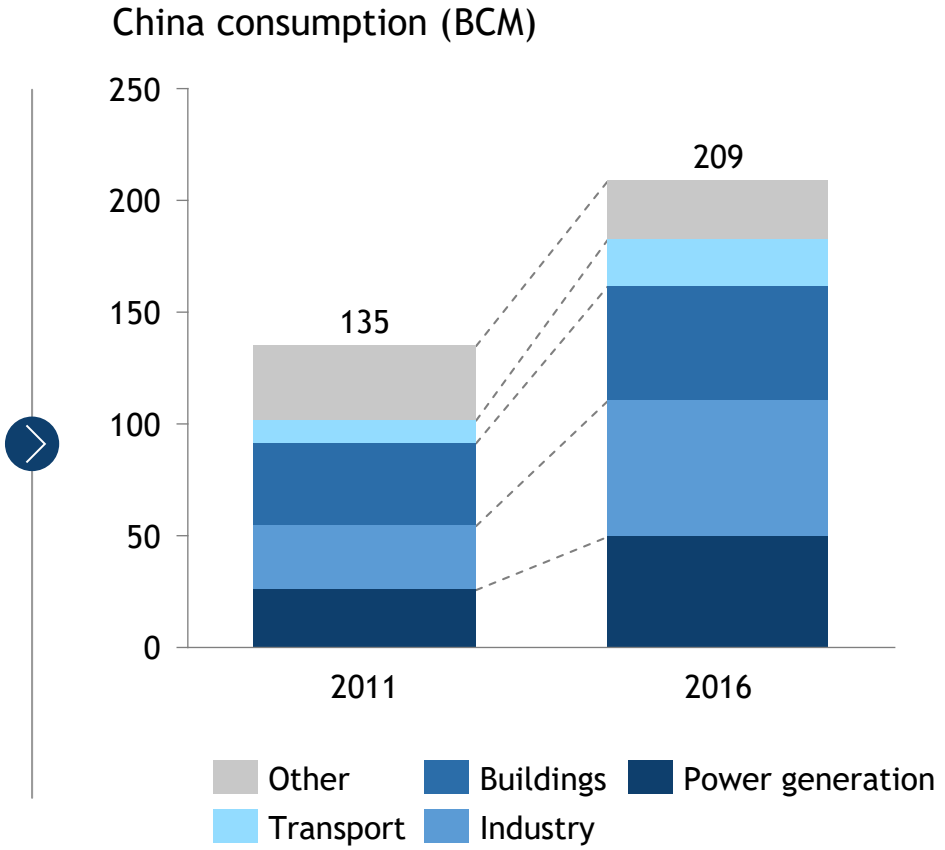
Coal boiler conversations to gas
- Target conversation of 200k coal boiler units to natural gas to meet local pollution targets

New residential connections
- Target to increase penetration from 35% to 85%, adding >120m new connections

Incentives for CNG/LNG for transport
- Discounts provided on prices in gas price formula
- Gas consumption of cars targeted to more than double from 2014 to 2020

5 year plan target gas capacity
- Targeting 44GW of new gas-fired capacity

Consumption growth across sectors

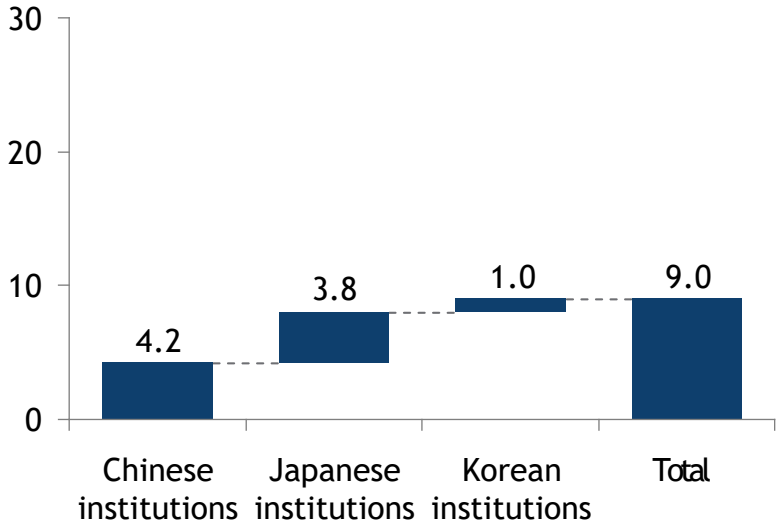


Source: CEDIGAZ data (Terminals and Plants), IEA data (Natural gas balance), analyst reports, BCG analysis

Infrastructure: Limited development assistance available for gas to date

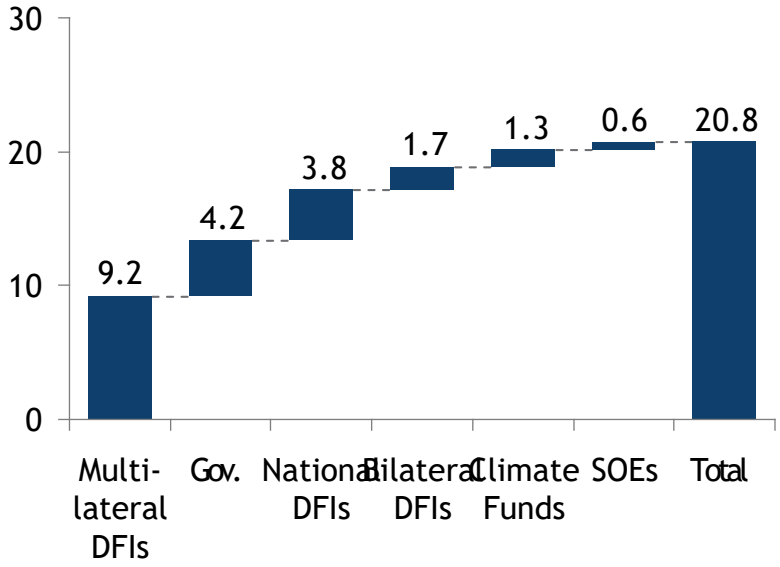
Coal – Public sector development finance

2016 total ($B)



Renewables - Public sector development finance

2016 total ($B)



VS. Total development funding for gas of <$1.0 B

Source: NRDC, IRENA, Climate Policy Initiative, BCG analysis

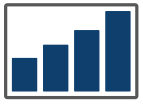
New business models: Focus on gas for cities

Gas provides specific advantages for cities...

Air pollution: nearly zero sulphur dioxide, nitrogen oxide, and no particulate matter emissions

GHG emissions: 40% less than coal and 20% less than oil

Heat intensity: Most heat intensive (and thus highest efficiency) fuel source



Scalability: Ease of adding customers to existing networks once infrastructure is developed

... But requires multiple enablers

1. **Infrastructure** investment of $34-55bn/yr in gas midstream
2. **Scaling up consumption** over time, starting with large scale anchor customers in industry and power generation
3. **Technological innovation** to expand gas applications and enable sustainability goals
4. **Government policies** enabling consumption, particularly for reducing air pollution

Source: BCG analysis

Questions for discussion

1. **Opportunities for greater gas demand growth in industry, buildings, and transport sectors**
   - What sectors provide the greatest opportunity for gas demand growth?
   - What will it take to accelerate gas demand growth in Asia?
   - How can industry make the case for gas in non-power sectors?

2. **Key barriers to adoption of gas outside the power sector**
   - How can gas become more cost competitive?
   - How can governments and industry facilitate gas infrastructure investment outside of power?
   - What is needed to convince businesses and consumers to switch to gas?

3. **Lessons learned from examples of fuel switching**
   - What are effective means of advocating gas to governments and the public, outside the power sector?
   - Can the experience of Chinese coal boiler switching be replicated elsewhere?
   - What should the role of regulated prices and/or government incentives (standards, fiscal measures) be for facilitating fuel switching?