

Berkeley Energy & Climate Institute: 2015 Philomathia Forum

The Next Decade on the Bridge to Renewables

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Shale, shale, shale: US supply side revolution driving global energy market outlook

US shale revolution drives step down in oil price range

- US shale oil growth needed to slow to match softer global demand trends...US shale now the “swing” barrel.
- Need for higher cost barrels deferred...normalized price now likely \$65-\$80/bbl from \$80-\$90/bbl before.
- Significant oil price volatility likely to continue after a period of relative calm.

Shale gas led the way: Demand response coming

- The shale revolution began with natural gas in the mid-late 2000s.
- Range-bound prices expected around \$3-\$4/MMBtu.
- Demand response phase of the cycle has begun.

Shale and climate: Not mutually exclusive

- Cheap energy key to economic growth, middle class expansion, and poverty reduction.
- Strong enforcement of existing rules key to safe drilling, fracing, and development.
- Would a price on carbon help with energy efficiency?

This is not the first crash in oil: Sharp downturns seem to occur every 5-10 years

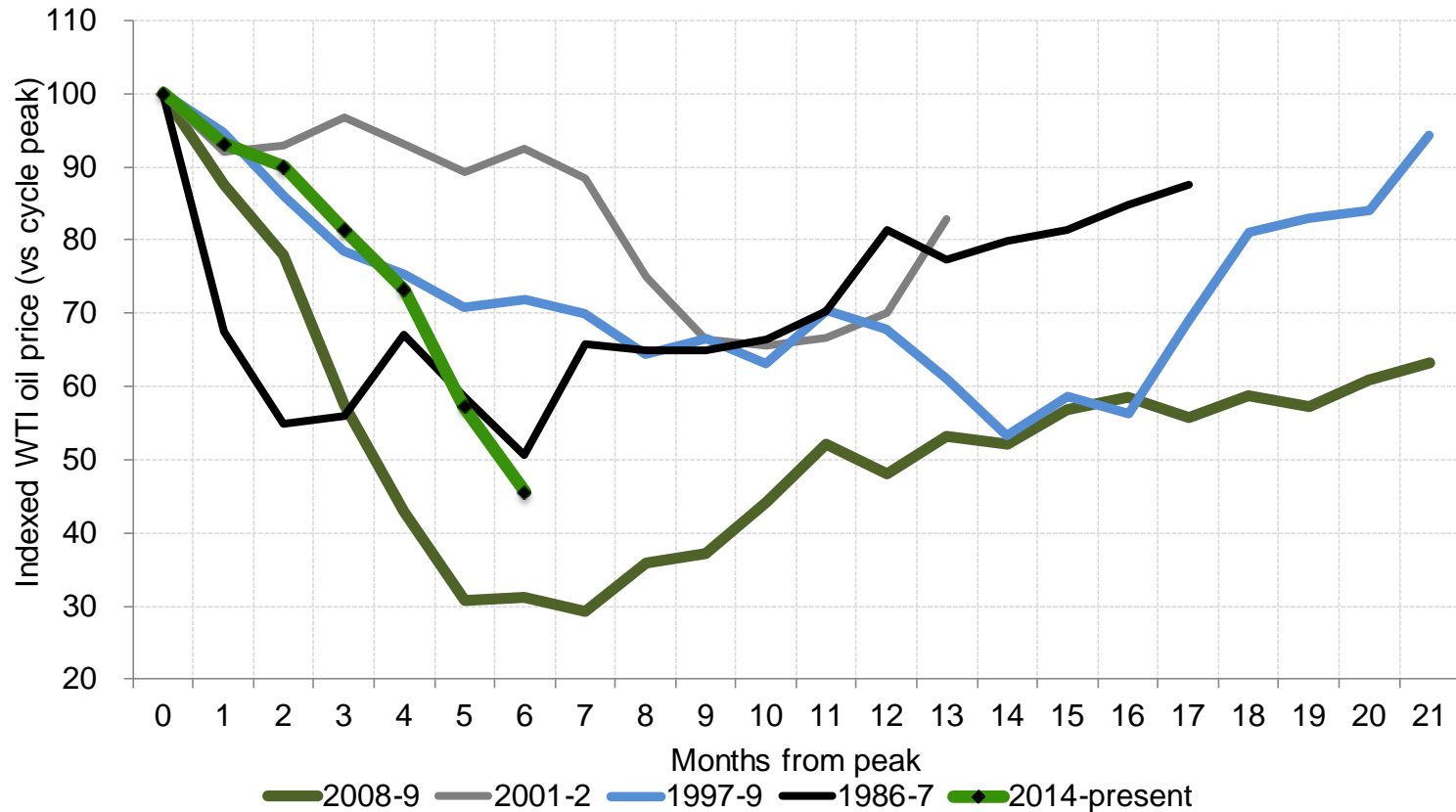
WHY DID OIL PRICE CRASH?

1. US oil supply growth accelerated in 2014 to +1.4 mn b/d...

2. ...at a time demand slowed to +0.7 mnb/d and Brazil/other non-OPEC + Libya recovered.

3. The perceived structural imbalance of surging US shale vs softer demand drove the collapse and "lower for longer" view.

Last 30 years have seen five big oil price downcycles and recoveries



A comparison to 1980s bust: Then (bearish) versus Now (not so bad)

in million b/d, unless otherwise indicated

Global oil demand

OPEC "spare capacity"

% of demand

Spare cushion

"Swing" barrel

Potential for cost reductions/efficiency gains

Nature of post-bust supply growth

Demand-side substitution

Leadership sector

Laggard sector

THEN	NOW
60 1974-1985	92 2014
13	3
22% 1985	3% 2014
significant	modest
OPEC/Saudi	US shale
yes	yes
"creep"	full cycle
yes	unlikely
major oils	E&Ps
E&Ps	super majors

¹ Figure excludes the FSU which collapsed during this period; inclusive of the FSU, average non-OPEC growth was +0.1

Anticipating the turn: Demand recovering, non-OPEC supply growth moderating

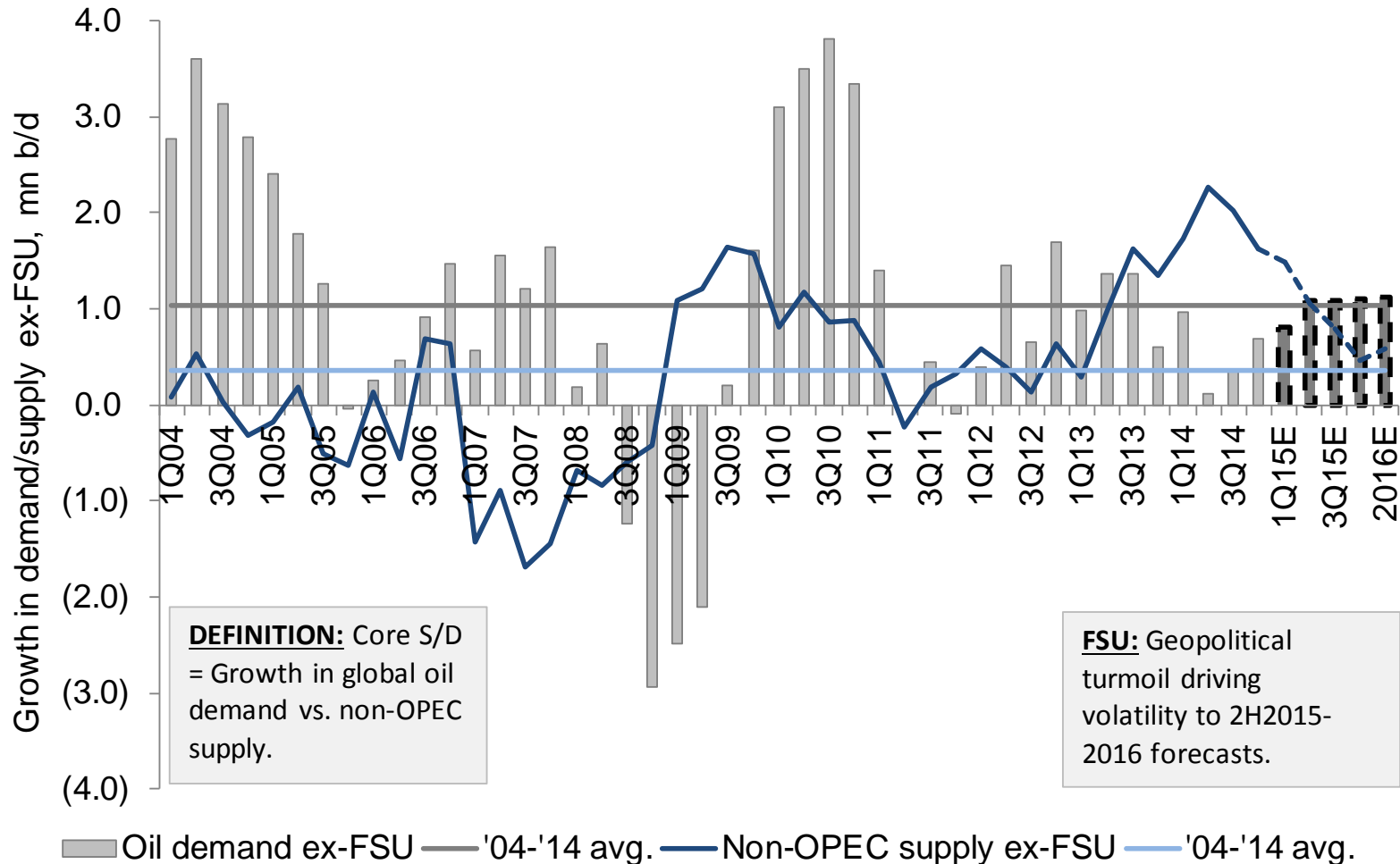
1. Core balance was tight for past decade...

2. ...but US shale and slower EM changed outlook.

3. Core balance weakest in 2Q2014.

4. 3Q14-1Q15 already getting better...

5. ...Setting the stage for a 2H15-2016 recovery.

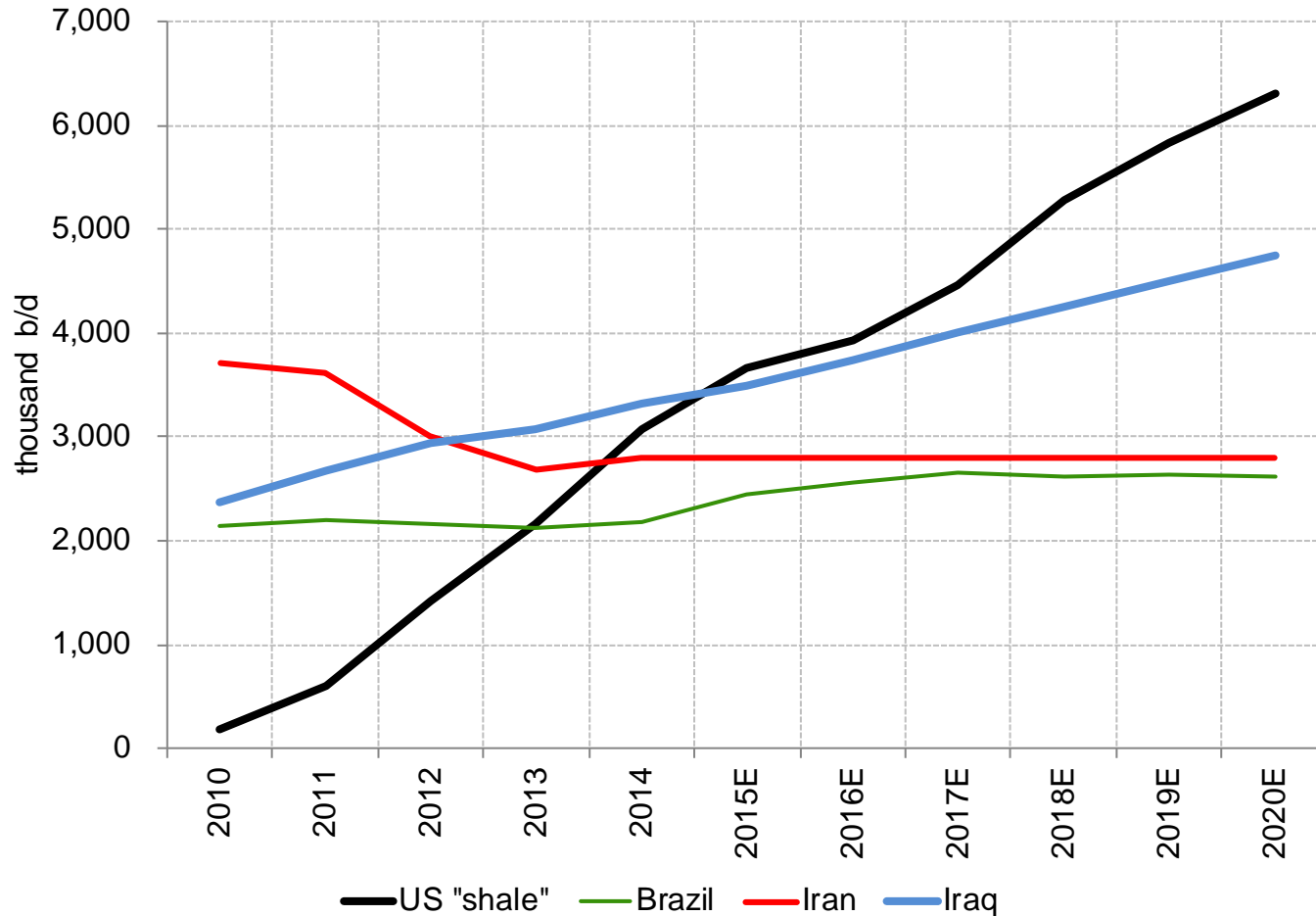


US shale oil supply: Dramatically outperforming other major areas

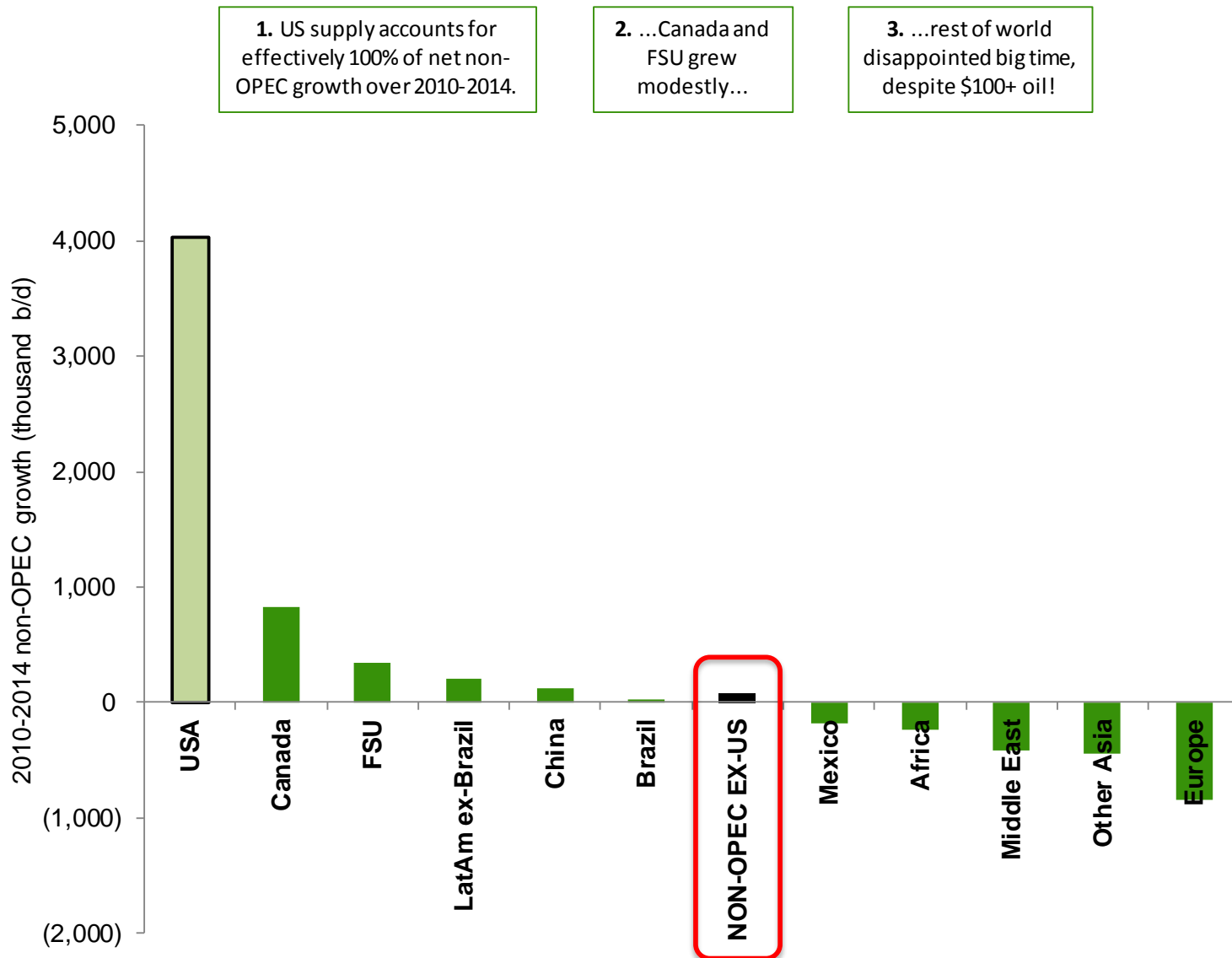
1. US "shale" oil dramatically outgrows other key areas.

2. ...and has already passed Iraq and Iran...

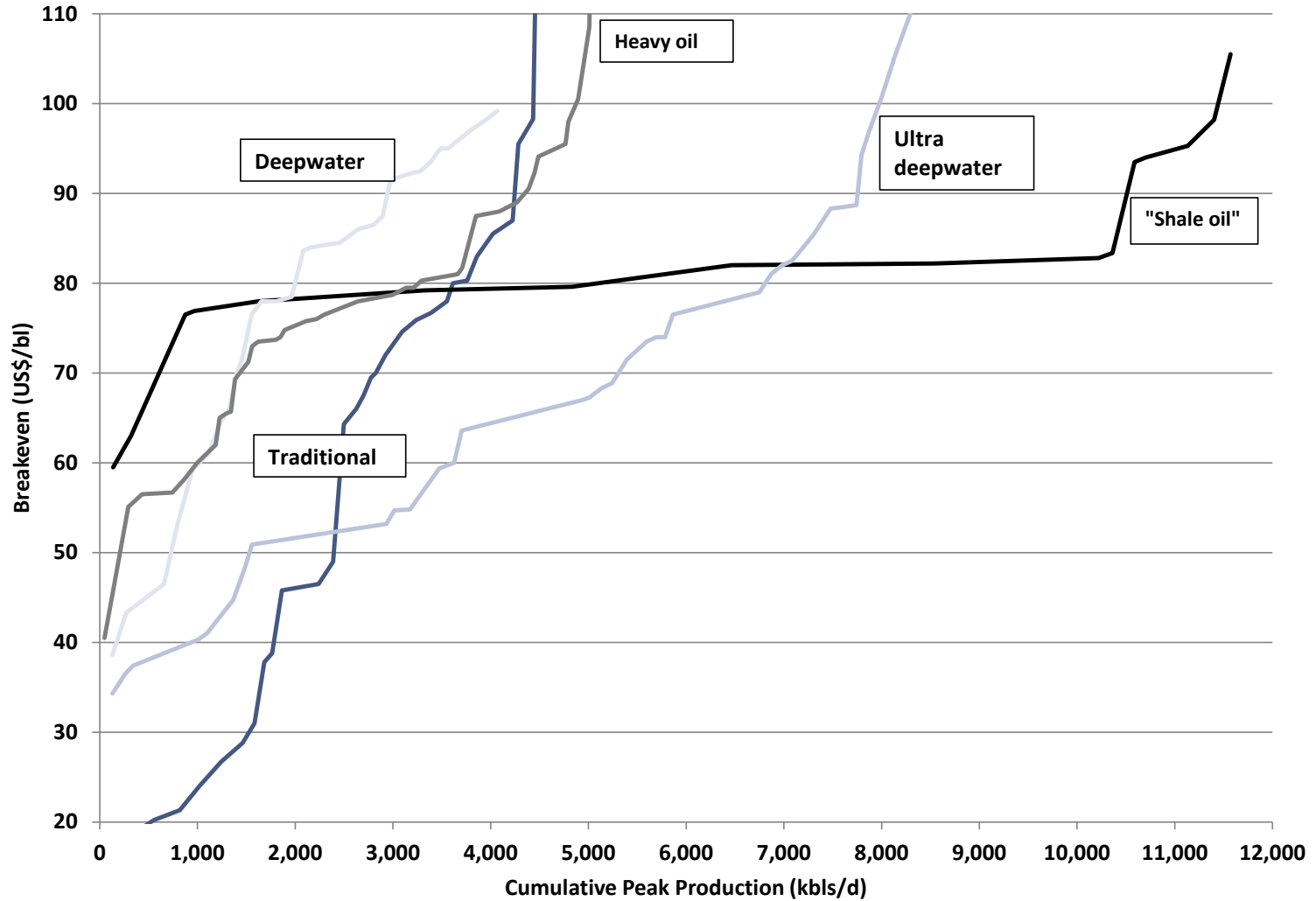
3. ...Brazil highlights the difference in economic systems.



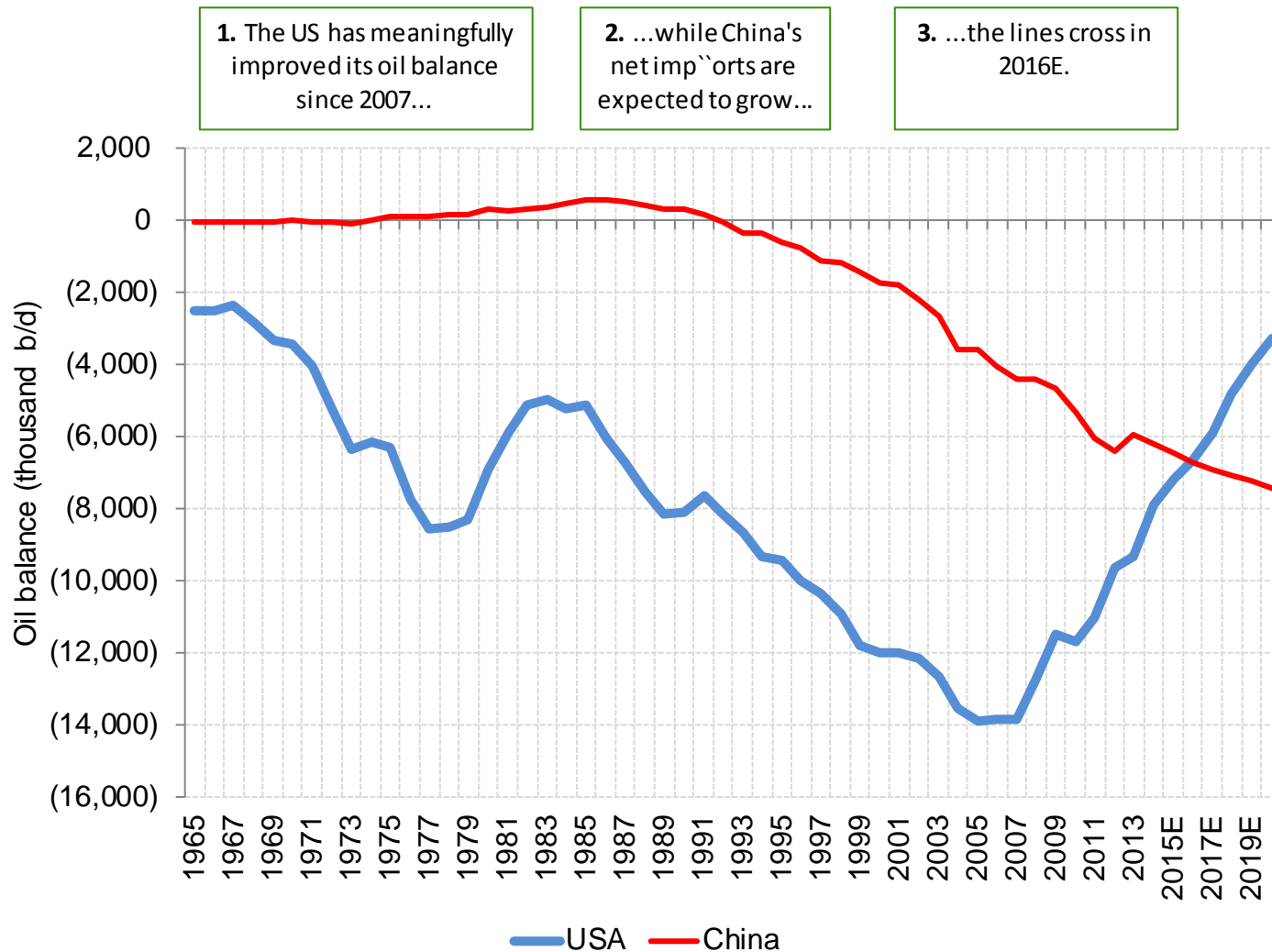
Without US shale, global oil supply would not have grown



US “shale oil” dominates the oil cost curve, obviating high-cost projects



USA v. China: Very different oil import trends

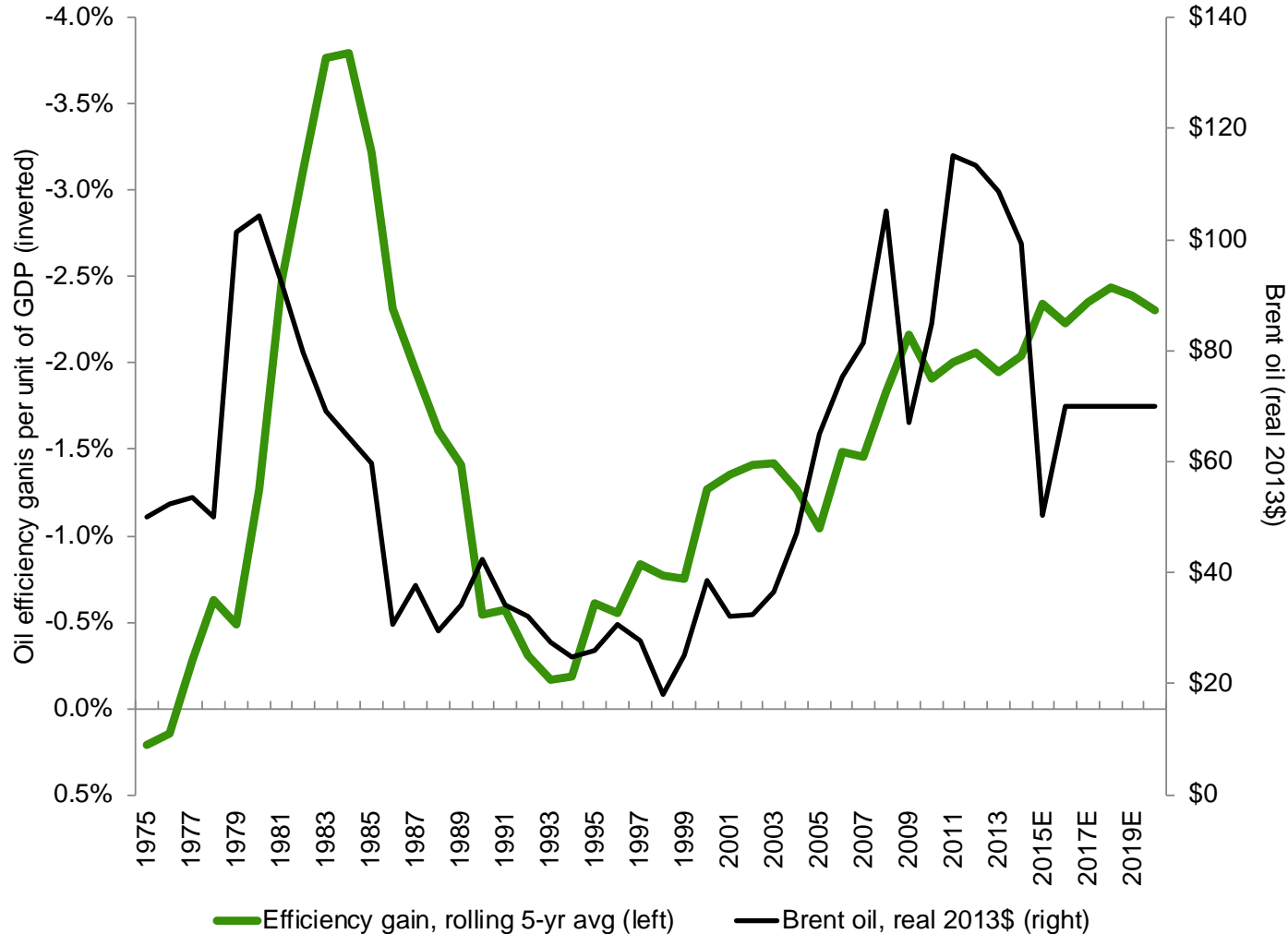


Oil demand and efficiency gains: A function of price incentives

1. Oil demand grows at a slower pace than GDP as a result of efficiency gains...

2. ...efficiency gains a function of oil prices...

3. ...will the recent easing in oil prices slow efficiency gains?

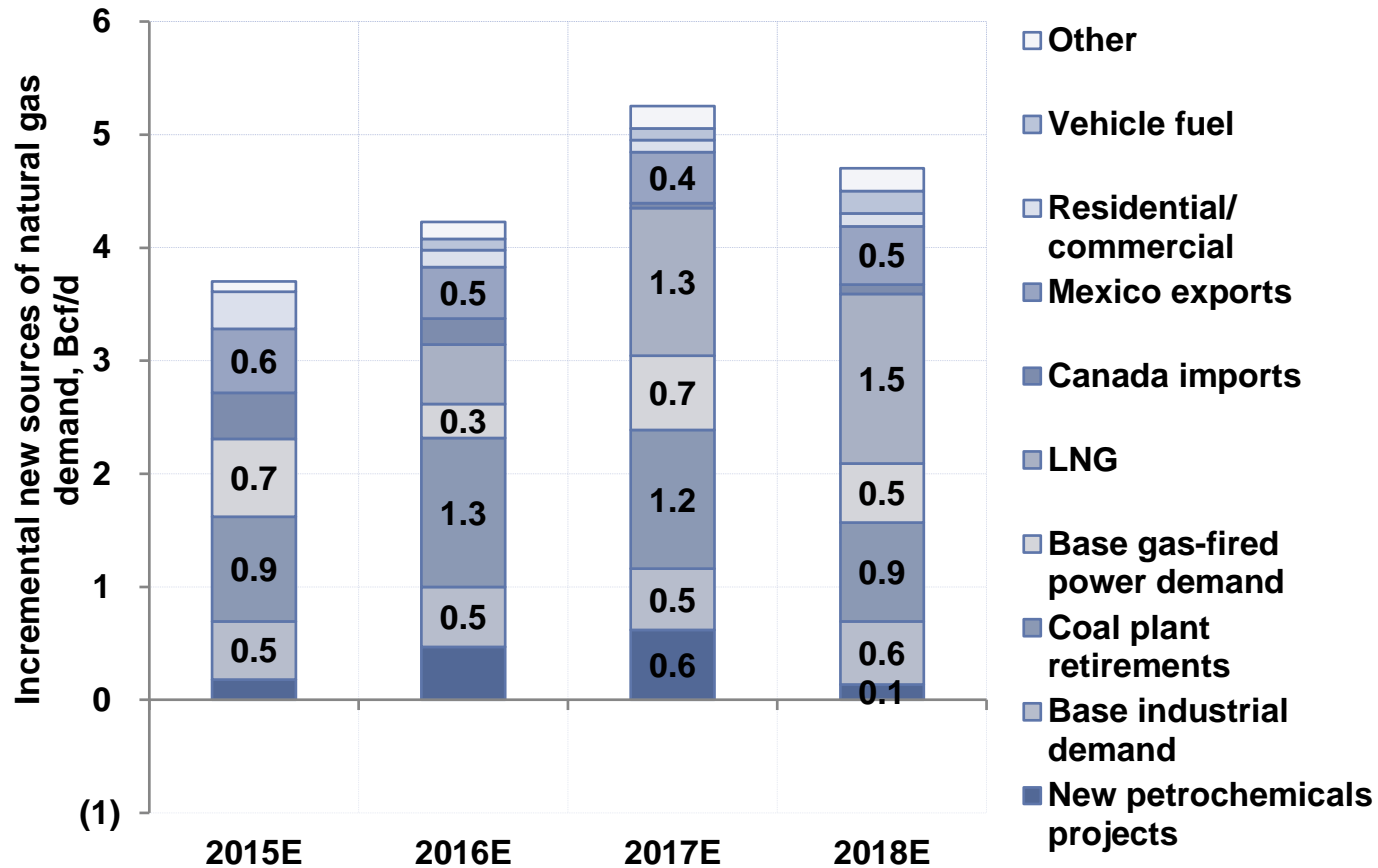


US “shale gas”: Lots of resource at <\$4/MMBtu required gas price

Henry Hub gas price (\$/MMBtu) required for 11% IRR in GS new cost scenario and sensitivity if capital and operating costs are 10% below base case

Assumes WTI oil price of \$65/bbl and NGL as 40% of realized oil price (GS est.)

US “shale gas” now entering the demand response phase



Shale and climate: Not mutually exclusive

1

Cheap energy is a key underpinning to healthy GDP growth, a rising middle class, and poverty reduction.

2

USA and Canada have stronger environmental regulations than most other key producing areas.

3

Fracing and safe shale development: Stronger enforcement of existing rules is key.

4

Cheap oil raises risk of moderating efficiency gains...would putting a price on carbon help ensure appropriate incentives to moderate oil demand?