



Energy 2020: North America, the New Middle East?

Commodities Research and Strategy

Edward L Morse

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20 March 2012

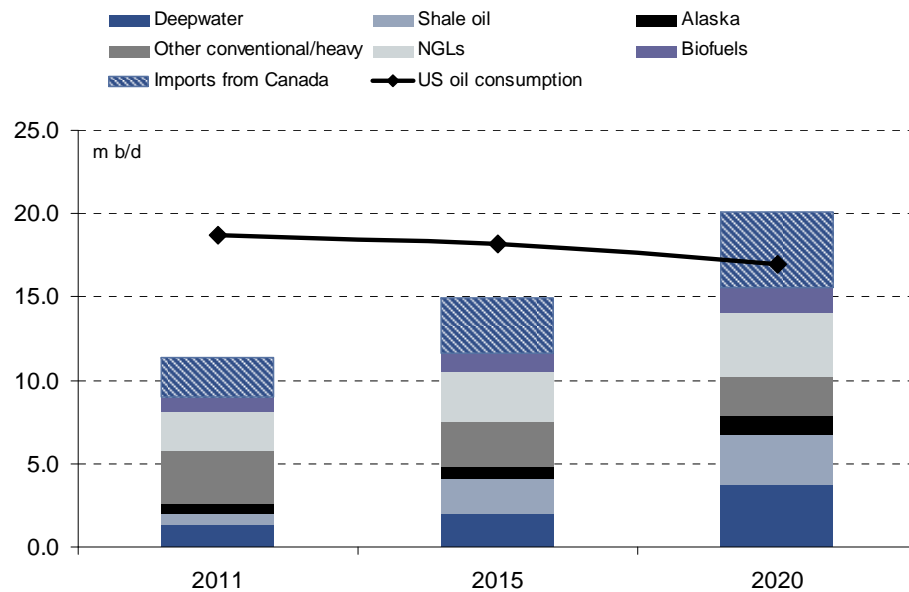
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Overview: North America as the new Middle East?

North America has become the fastest growing oil and gas region in the world, and is likely to remain so for the rest of the decade and into the 2020s, with the main obstacles as political rather than geological or technological.

The US could see combined domestic supply and Canadian imports reach over 20-m b/d in 2020 from around 11.4-m b/d today, while US oil demand could fall to under 17-m b/d by 2020



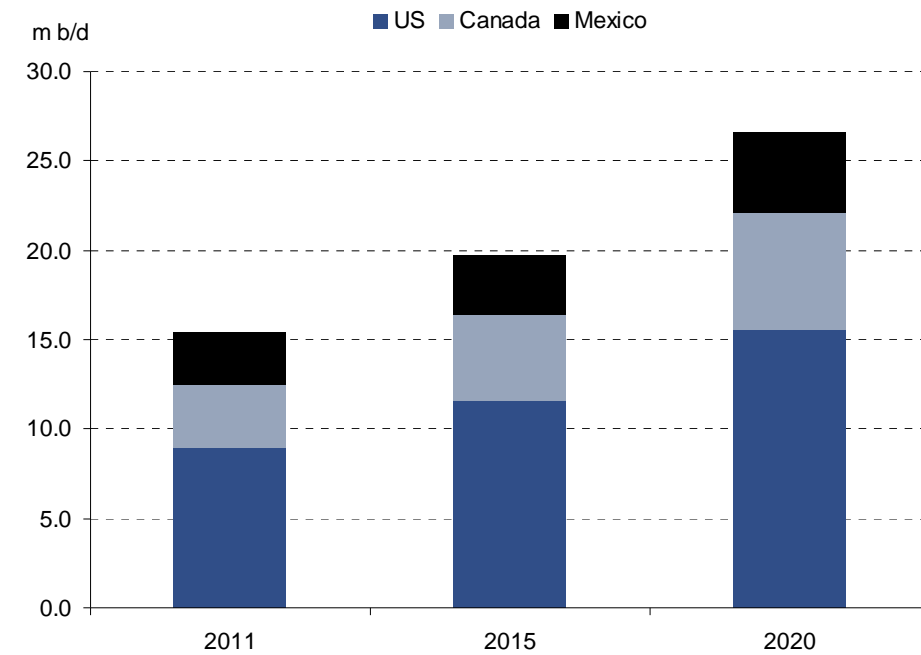
Source: CIRA

- Surging supply growth could transform North America into the new Middle East by 2020, driven by growth in shale oil and gas, deepwater and oil sands resources
- And US liquid fuels demand is in structural, secular decline due to demographics, fuel efficiency, transport technology shifts
- The US looks to have inched out Russia as the largest refined petroleum product exporter in the world
- US and Canadian production growth is bumping up against infrastructure constraints, causing a crude glut in the US midcontinent, and blowouts in crude price spreads, while pipeline capacity build-out to Gulf Coast adds pressure to export crude
- Abundant domestic natural gas triggers an industrial revolution in energy intensive industries, as well as shifts to gas-fired power generation, natural gas vehicles and LNG exports
- The potential economic consequences by 2020 are dramatic:
 - An additional 2 to 3% of real GDP
 - +2.7 to 3.6 million net new jobs
 - Current account deficit narrowing by 2.4% of GDP
 - US dollar appreciation in real terms of +1.6 to 5.4%

Oil supply growth: No end in sight?

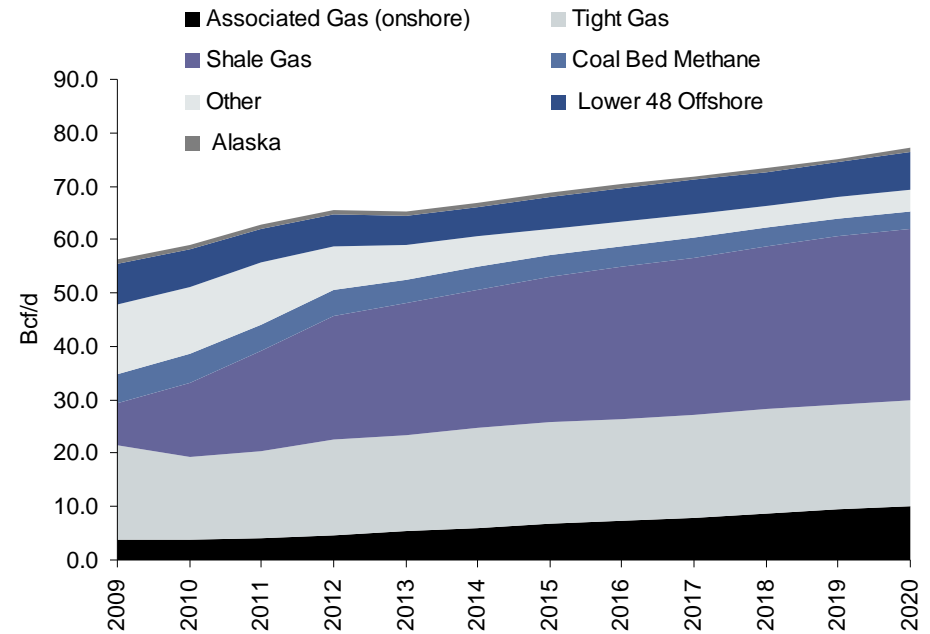
The US has become the fastest growing oil and gas producing country in the world, and is likely to remain so for the rest of this decade and into the 2020s

North American total liquids production could almost double from over 15-m b/d at end-2011 to almost 27-m b/d in 2020



Source: CIRA

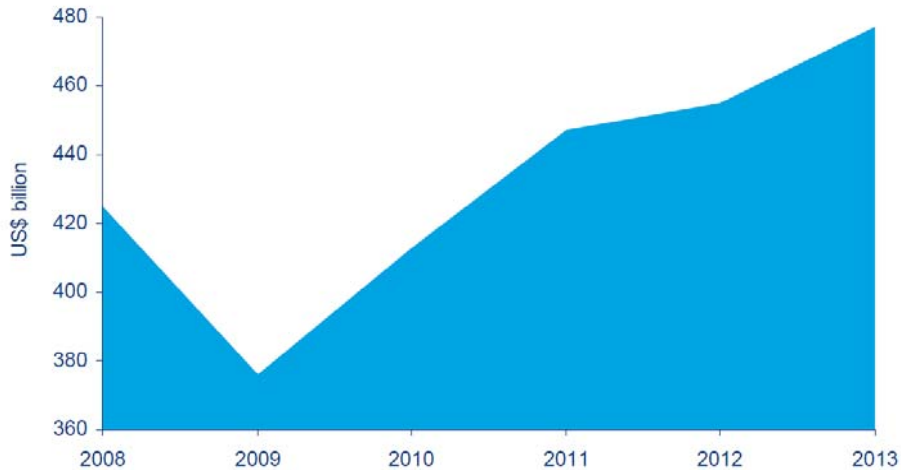
The US and Canada could see natural gas rise by 22-Bcf/d by 2020, with 14-Bcf/d from the Lower 48 states, 4-Bcf/d from Alaska and 4-Bcf/d from Canada (only US natural gas production pictured below)



Source: CIRA

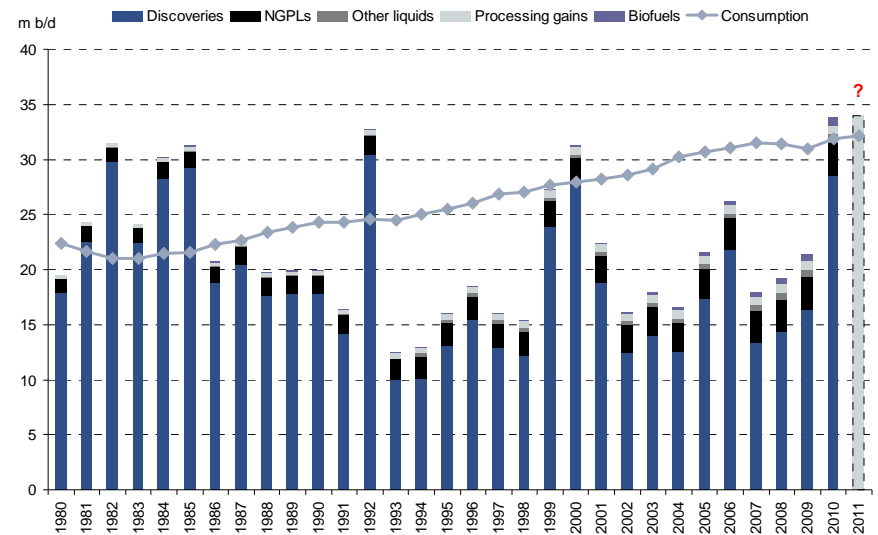
High oil prices have encouraged resurgent global capex

Actual and planned global upstream spending 2008-2013



Source: Wood Mackenzie

Global oil discoveries since 1980 plus other liquids, versus consumption (m bbls)

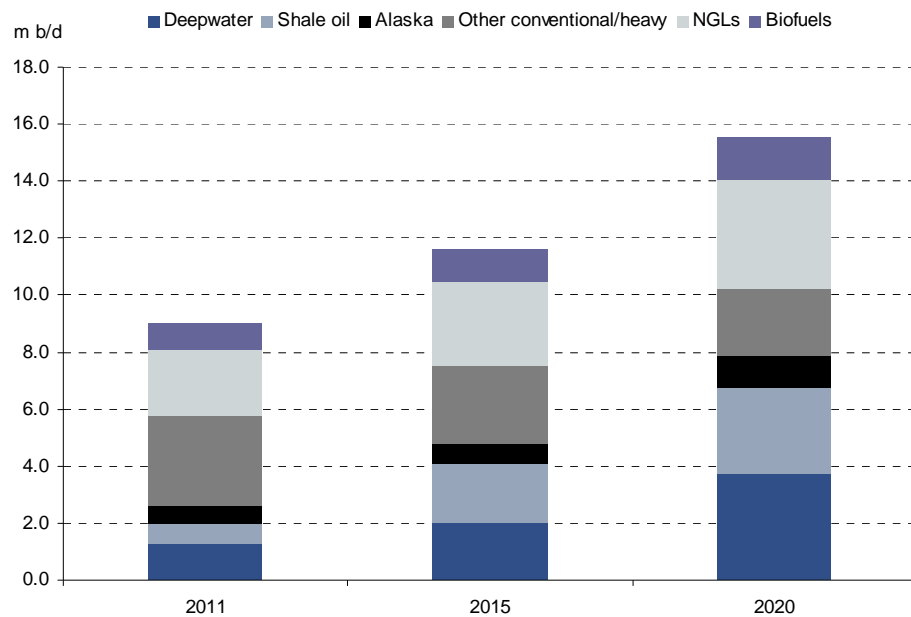


Source: IHS, BP, EIA, CIRA

US 2020: Deepwater

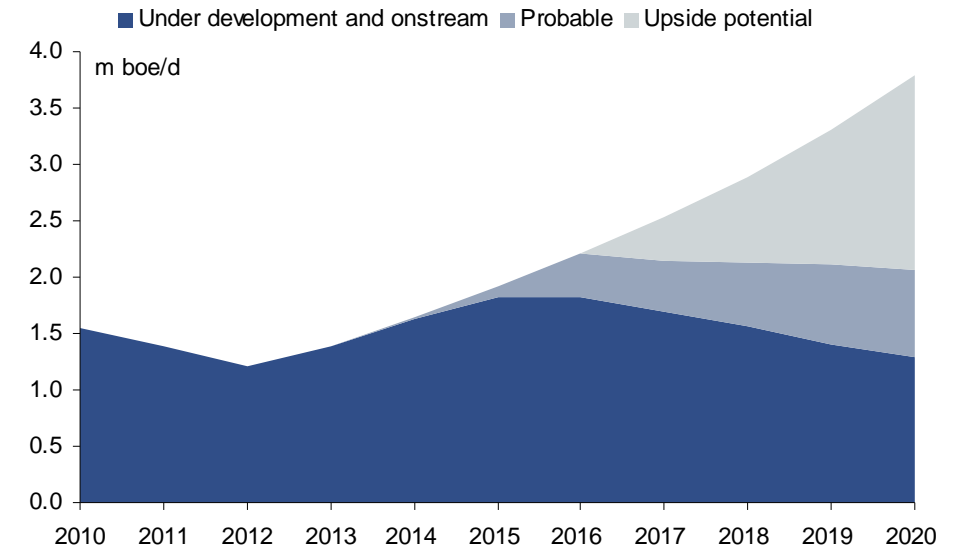
After a moratorium on drilling in the wake of the BP Macondo disaster, deepwater production is bouncing back and could see a hockey-stick trajectory that takes total Gulf of Mexico output from 1.3-m b/d today to 3.75-m b/d by 2020

Projected US total liquids production 2011-2020



Source: CIRA

Deepwater Gulf of Mexico total liquids production could grow as much as 2.5-m b/d to 3.75-m b/d by 2020



Source: Woodmac, CIRA

US 2020: Shale and tight oil

The shale revolution which has driven massive gains in natural gas production is now doing the same for oil, with potential shale liquids production growth of +3.8-m b/d by 2020

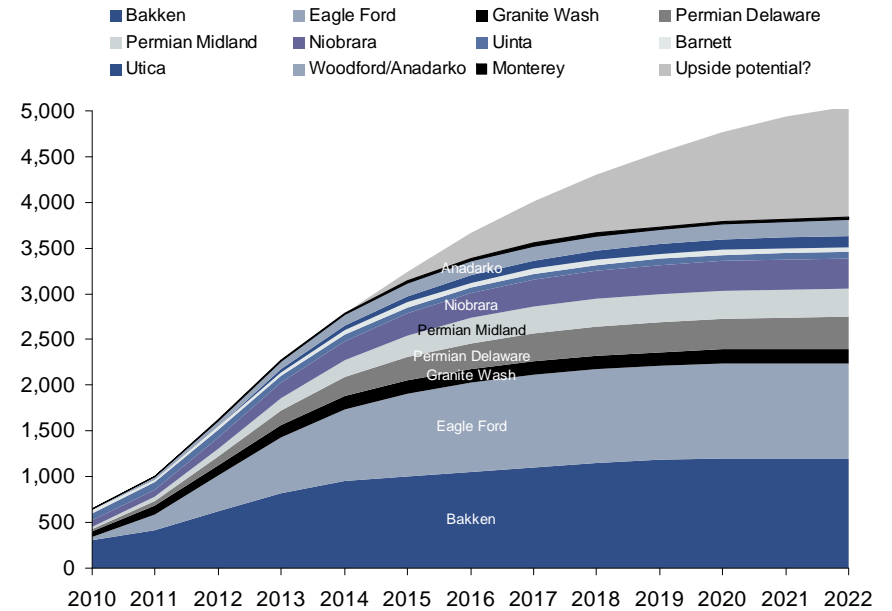
Abundant shale plays, accessed by hydraulic fracturing and horizontal drilling technology, are a key driver behind North America becoming the globe's "energy island" by 2020



Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI. Updated: May 9, 2011

Source: EIA

US shale liquids projections could see +3.8-m b/d of growth by 2020

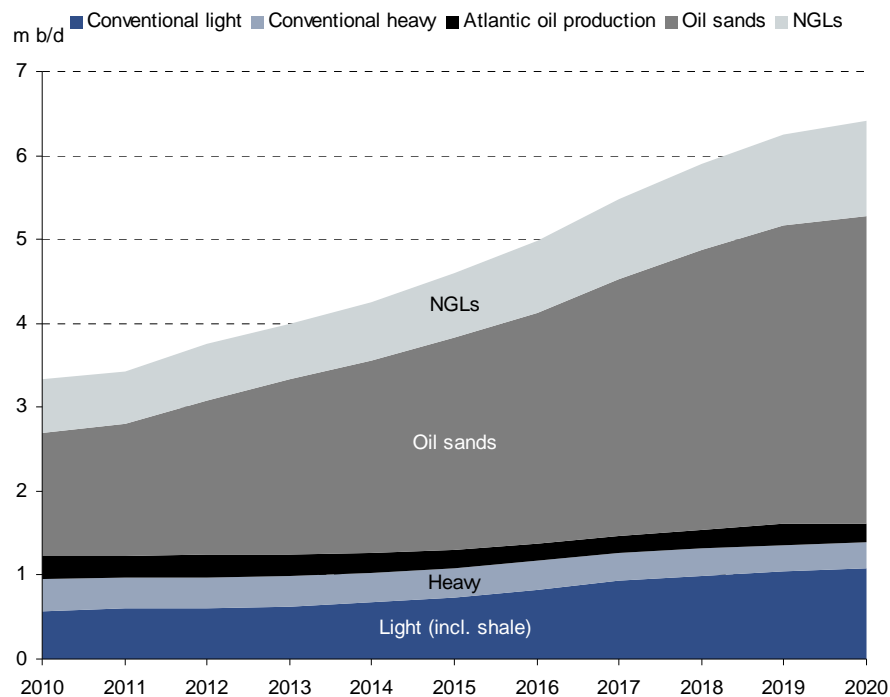


Source: CIRA

Canada 2020: Oil sands, but shale too

If the US has become the fastest growing oil and gas producing country in the world, then Canada is not far behind and is likely to see annual +200-k b/d growth for the next 20 years

Canadian total liquids production could grow +3-m b/d to 6.5-m b/d by 2020, with +2.1-m b/d from Western Canadian oil sands, but also +0.5-m b/d from tight oil and +0.5-m b/d from NGLs



Source: CAPP, CIRA

Canadian oil sands projects 2011-2020 (k b/d)

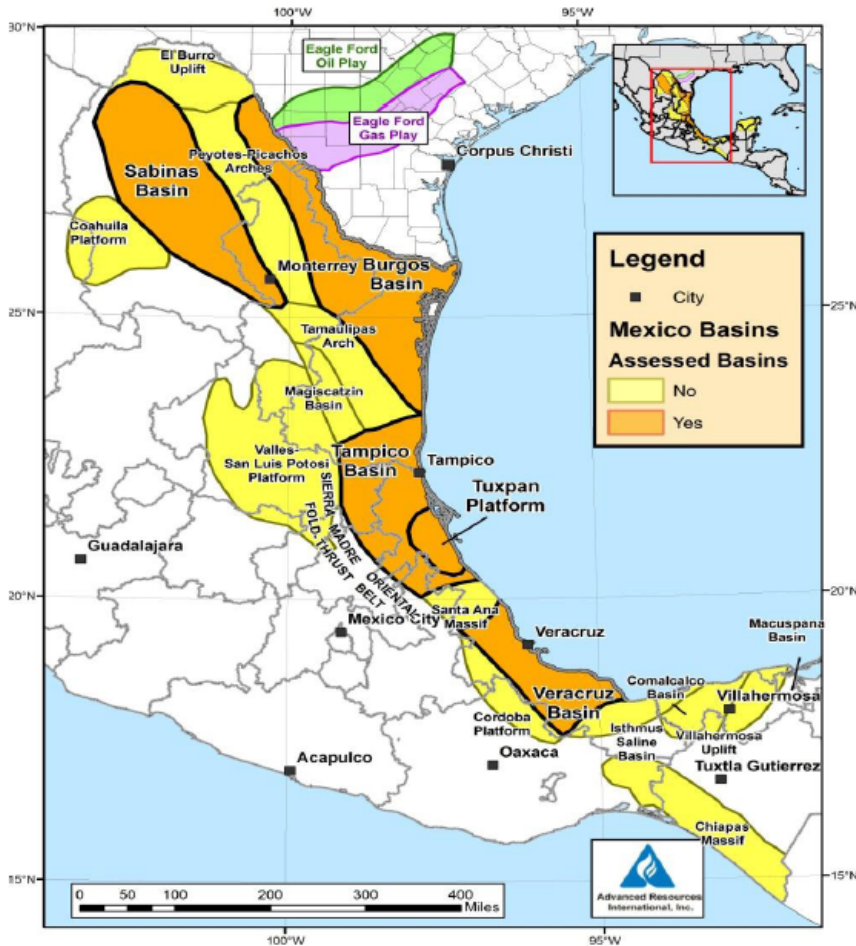
Project	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Althabasca Oil Sands Project	190	235	255	265	285	305	335	355	370	370
CNRL Kirby	-	-	-	6	16	26	36	40	40	40
Christina Lake	20	33	58	75	98	123	158	193	218	218
Cold Lake	150	150	150	150	155	165	175	180	180	157
Fort Hills	-	-	-	-	-	40	80	120	160	160
Foster Creek	105	118	120	122	132	142	165	184	210	210
Great Divide Project	16	18	20	20	20	20	20	20	20	20
Hangingstone	8	8	9	12	22	32	40	40	40	40
Horizon	60	103	124	141	143	152	167	207	238	279
Jackfish	38	45	58	68	73	80	93	103	105	105
Joslyn	-	-	-	-	-	-	30	50	80	100
Kai Kos Dehseh	8	14	19	19	24	34	50	65	80	80
Kearl	-	27	50	90	130	160	200	220	235	265
Long Lake	42	33	40	44	48	53	59	64	71	78
ME G Christina Lake	25	25	30	50	60	60	60	60	60	60
MacKay River	30	30	30	30	30	35	50	65	70	70
Orion	6	10	13	16	18	20	20	20	20	20
Peace River	9	10	12	12	12	12	12	12	12	12
Primary CNRL Cold Flow	25	24	23	22	21	20	19	18	17	16
Primary CNRL Pelican Lake	45	46	64	76	80	80	72	65	58	52
Primary Cenovus Pelican Lake	22	25	30	35	40	40	38	36	34	33
Primary Penn West Seal	6	8	12	14	16	16	15	13	12	11
Primary Shell Canada Seal	14	16	16	15	14	12	11	10	9	8
Primrose/Wolf Lake	101	120	120	120	120	120	120	120	120	120
Suncor Mining Project	255	266	278	278	278	278	278	278	278	278
Suncor SAGD Project	79	131	191	219	229	229	229	229	229	229
Sunrise	-	-	-	5	10	35	45	66	75	106
Summont	25	27	27	27	33	42	52	74	102	110
Synarude Project	289	305	322	340	405	405	405	405	405	405
Tucker	8	12	18	22	22	22	22	22	22	22
Total Liquids (k b/d)	1,576	1,839	2,089	2,293	2,534	2,758	3,056	3,334	3,570	3,674

Source: Woodmac, CIRA

Mexico 2020

The aftermath of the Mexican Revolution of 1938 continues to linger, although 2011 could be a turning point

Mexico shale resources

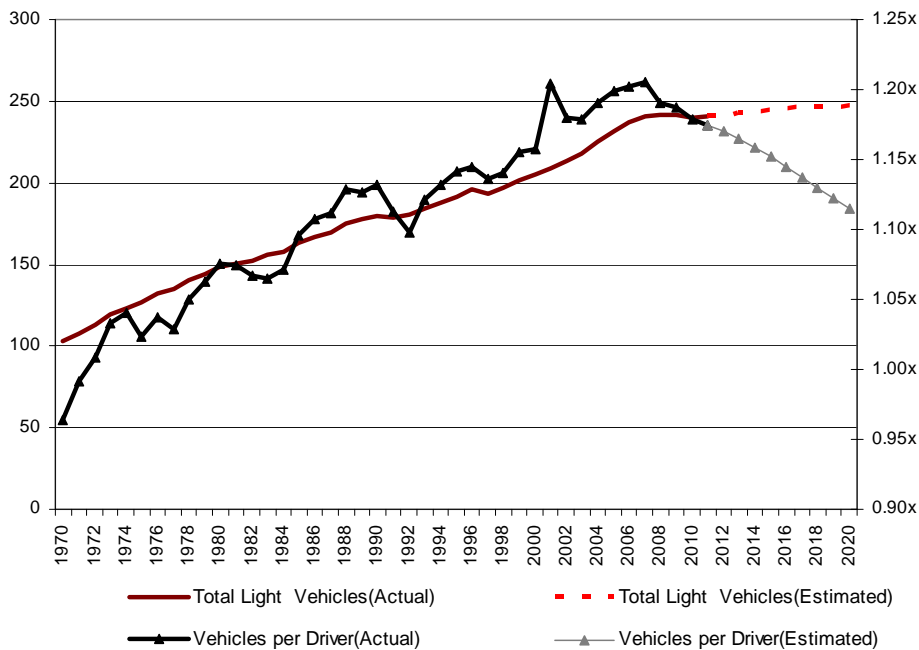


- The history and politics of Mexico's hydrocarbon sector is placing a stranglehold on deepwater and shale development, but 2011 could be the turning point
- Total Mexican liquids production reached a peak of 3.8-m b/d in 2004 (with crude oil alone at 3.38-m b/d) before falling to 2.9-m b/d in 2011 (with crude oil accounting for 2.5-m b/d of this)
- Total liquids production could rise by 1.6-m b/d to over 4.5-m b/d by 2020, from deepwater and onshore shale
- ...including extensions of the Eagle Ford shale play in Mexico

US oil demand in decline

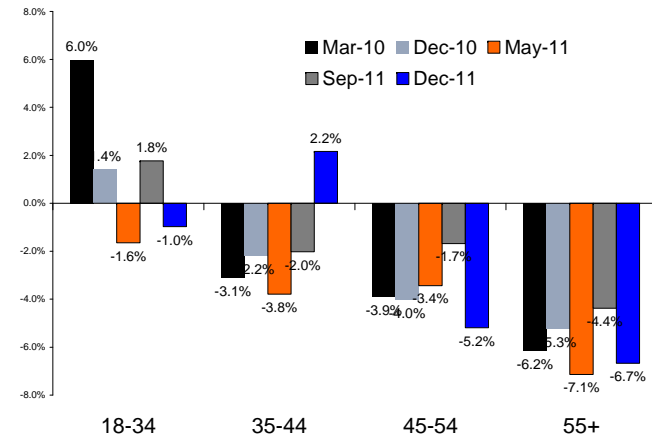
US oil demand is in structural, secular decline, driven by demographic changes, fuel efficiency (CAFE standards) and new transportation technologies, particularly natural gas vehicles (NGV), likely to be first adopted in fleet vehicles

Total light vehicles and vehicles per driver (actual and forecasts)

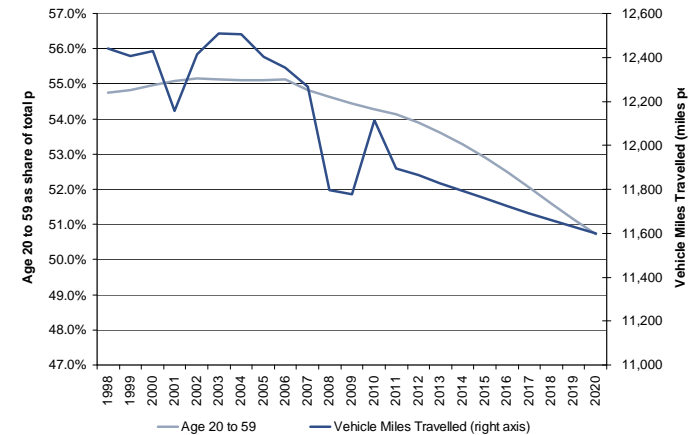


Source: US FHWA, CIRA

Vehicle density by age group



Vehicle Miles Traveled vs Age 20-59 as share of total population



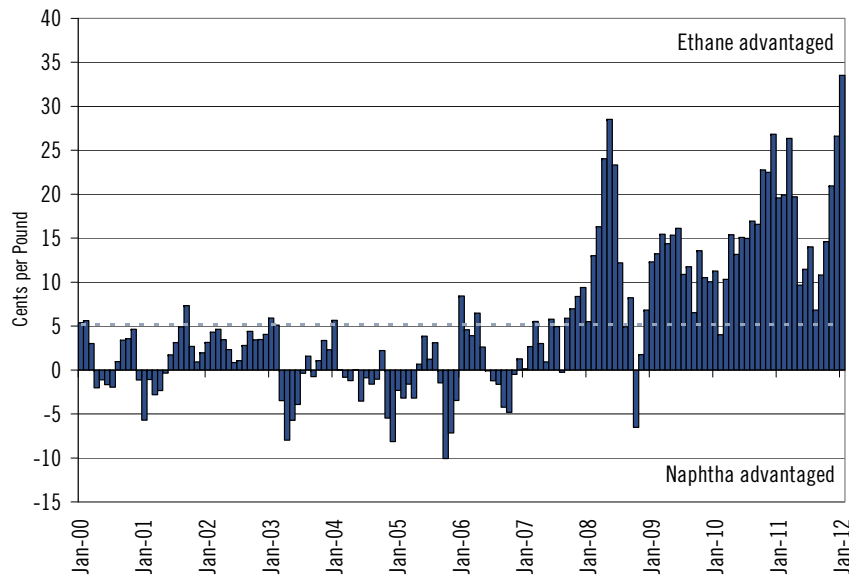
Sources: Census, CIRA

Shale gas revolution drives paradigmatic shifts across sectors

Natural gas production was the starting point of the game-changing shale revolution, and is beginning to transform multiple industries and sectors

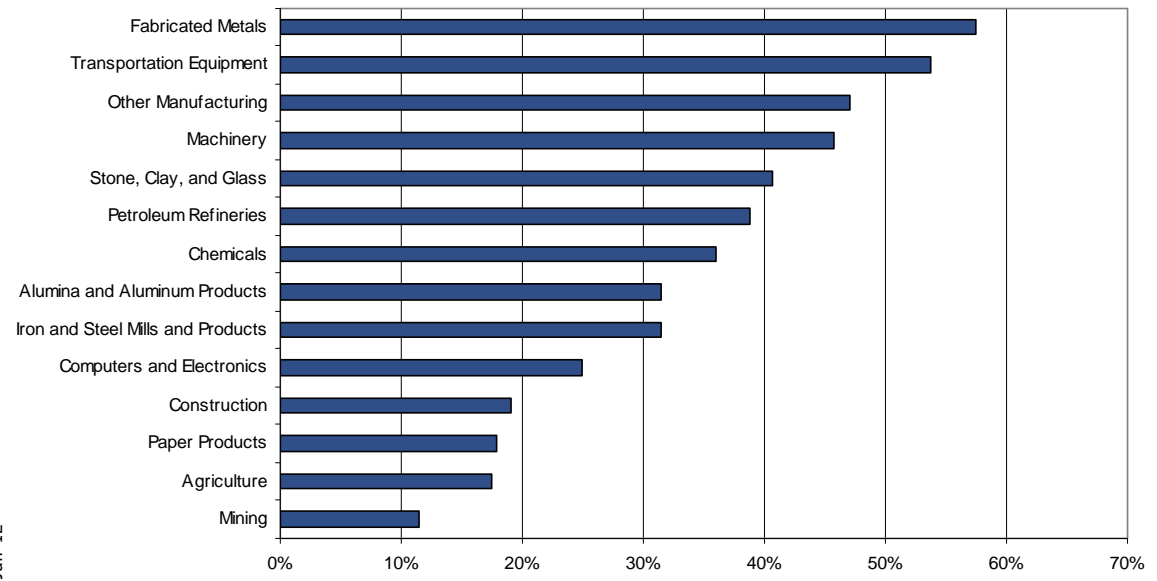
- These transformations include:
 1. a step-wise jump in gas-fired power generation
 2. a dramatic rise in natural gas use in land- and marine-based transportation, including natural gas vehicles (NGVs)
 3. resumption of solid growth in residential/commercial requirements due to switching of heating oil to gas, and falling vacancy rates
 4. a shift in global trade flows in gas, with growing North American LNG exports
 5. the re-industrialization of America based on dramatically lower cost feedstock than is available anywhere in the world, with the possible exception of Qatar, benefiting sectors ranging from petrochemicals to steel

Ethylene margin delta: ethane - naphtha



Source: CIRA, CMAI

Natural gas as a share of total energy consumption by sector



Source: EIA, CIRA

Politics and policies look likely to point to second-best solutions

Theoretical production growth provides a useful benchmark to measure the potential impact of policy responses

- Rampant hydrocarbon production growth brings up a myriad of political obstacles, with political trade-offs hotly contested between bitter rivals
- The politics of energy are front and center in a year full of key elections worldwide, not least the one in the US, with oil and gas tax breaks under siege and regulatory and environmental concerns at the Federal and local levels
- Petrochemical, industrial and transportation sectors could increasingly look to block exports of natural gas to maintain an input cost advantage against global competitors, while crude export controls and the Jones Act also pose constraints to crude oil moving abroad or between US ports, respectively
- Pipeline infrastructure build out has been slowed or halted by US politics – not by technology or economics
- The approval of the Keystone XL pipeline project as a particularly contested process, portrayed as a binary choice between environmental protection on the one hand, and job creation on the other

Keystone XL proposed pipeline extension



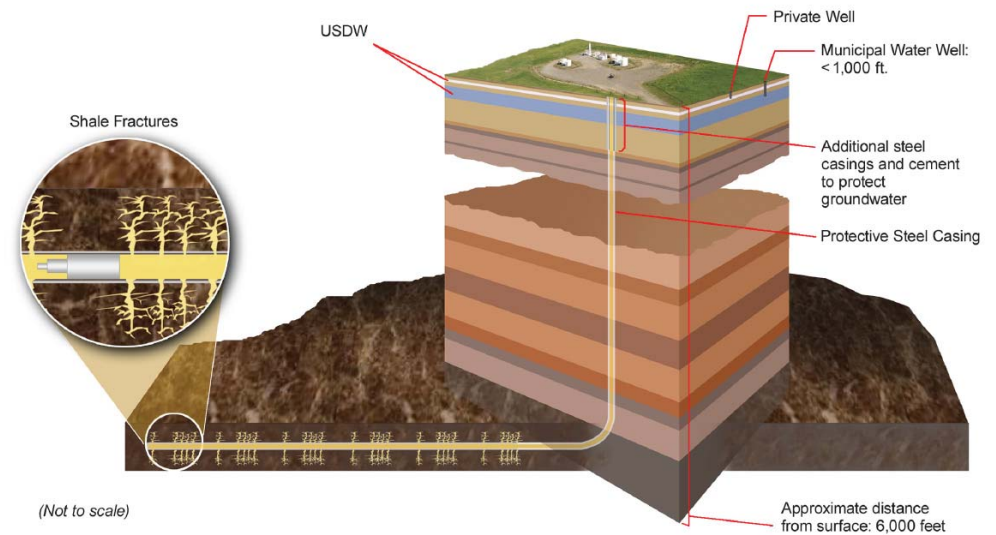
Source: Company filings, CIRA

Regulatory risks to hydraulic fracturing

The increasing use of hydraulic fracturing has led to a large policy debate on how safe the procedure is and if the energy benefits outweigh the costs

- The regulatory risks to shale gas and oil production largely relate to two key technologies – horizontal drilling and hydraulic fracturing
- Emissions
 - Hydrocarbon remaining in the rock formation
 - Hydrocarbons that are extracted and burnt
 - Hydrocarbons leaked as fugitive emissions
- Water use
 - Adequacy of aquifers and water resources
 - Disposal of waste water
 - Integrity of aquifers
 - Disclosure of composition of frack fluids
 - An EPA study on the impact of fracking on drinking water resources could see an initial report out in 2012
- Seismic activity

Hydraulic fracturing (“fracking” or “fracing”) schematic



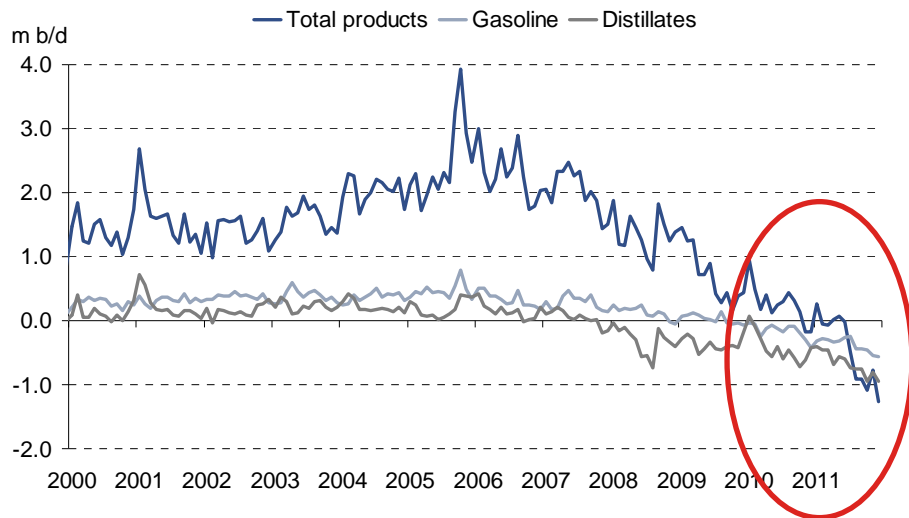
Steel casing lines the well and is cemented in place to prevent any communication up the wellbore as the fracturing job is pumped or the well is produced. Shallow formations holding fresh water that may be useful for farming or public consumption are separated from the fractured shale by thousands of feet of rock.

Source: US DOE, NETL

North America is becoming a major hydrocarbon exporting center

North America is emerging as a major petroleum product exporter, and LNG exports are also likely to grow, with the continent playing an increasingly important role in balancing global markets

US net petroleum imports have become firmly negative – the US is solidifying its position as a growing net petroleum exporter – and looks to now be the largest (gross) refined products exporter globally



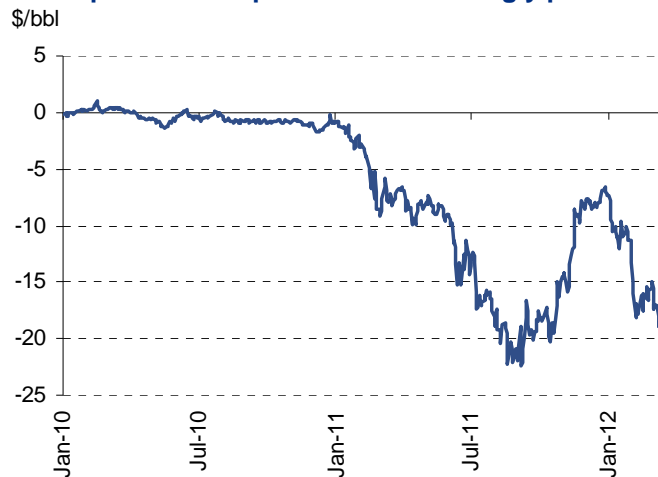
Source: EIA, CIRA

- The US reached its peak as a net petroleum importing country in 2005-06. Since then, crude oil imports have fallen by almost 2-m b/d from its peak
- With the largest refining sector in the world, as US demand has fallen by some 2-m b/d since its peak in 2005, the US has become a net petroleum product exporting country of over 1.2-m b/d by end-2011, the first time since 1949
- Preliminary estimates suggest that the US has surpassed Russia as the largest refined petroleum product exporter in the world
- Growing crude output is impacting the spread between light sweet and heavy sour grades, moving them toward structural parity by 2020
- But over that time, pressures will arise for even the US to join Canada and Mexico as a crude oil exporting center
- And Canadian non-upgraded oil sands crude has a limited refinery market, and will create competitive conditions for Venezuela and some Middle East producers of similarly heavy oil, forcing them to discount or reduce production

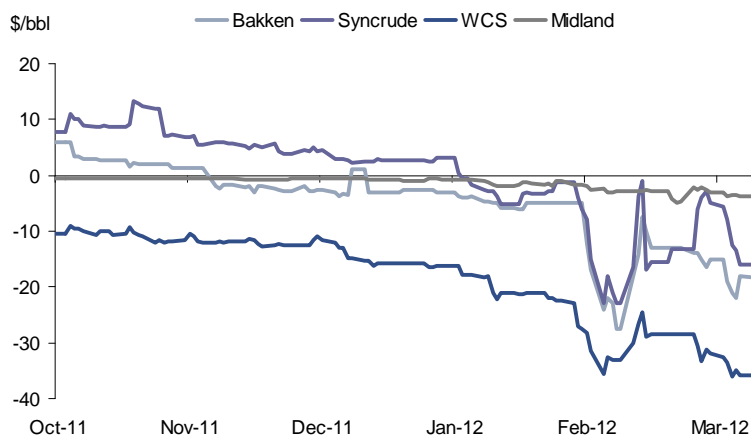
Congested pipeline infrastructure in the US midcontinent

The massive reshaping of the North American oil supply picture puts into motion forces that put pressure on existing transportation infrastructure within North America, as well as trade flows in and out of the North American continent.

WTI-Brent spread has experienced increasingly persistent blowouts



And Bakken, syncrude, WCS and Midland cash differentials too



- The transformation of the North American oil supply landscape pressures existing transportation infrastructure as well as driving hydrocarbon exports, although restrictions on crude exports or movements between US ports present obstacles
- The symptoms of these dynamics are seen in the trials and tribulations of the WTI-Brent spread, and underlying and related differentials between WTI, WCS, Bakken, Syncrude, LLS and Brent
- Dietary changes of US midcontinent and Gulf Coast refineries impact the heavy-light crude spread, as refinery upgrade projects to process heavier crudes put further pressure on light WTI-like crudes.

US refinery upgrades to process heavier crudes leave ~420-k b/d of light crude without a home in PADD II by 2013

<i>k b/d</i>	date	Before		After		Delta	
		light	heavy	light	heavy	light	Heavy
WRB Wood River	end-2011	200	100	70	260	-130-150	160-180
Marathon Detroit	mid-2012	80	20	10	100	-70	80
BP Whiting	early-2013	300	100	70	330	-230	230

Source: Company data, CIRA

Source: Bloomberg, CIRA

Degrees of freedom for evacuating the North American crude glut

Over the next 5-10 years, infrastructure or political bottlenecks look like they will make it impossible for WTI to reach equilibrium price levels with global waterborne crude streams.

Selected major US and Canadian pipelines, existing and proposed

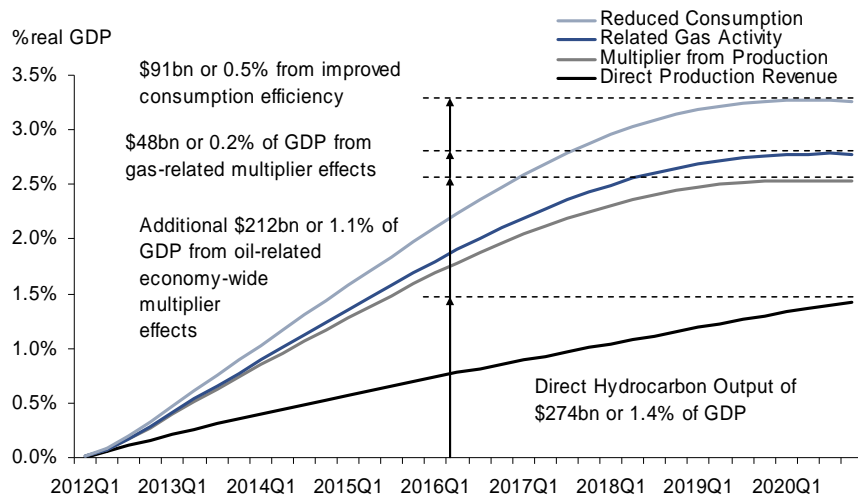
Source: CAPP, CIRA



Economic consequences: GDP impacts

Real GDP could be 2% to 3.3% higher than it otherwise would have been in the Energy 2020 scenario

Cumulative Impact on US Real GDP, 2012-2020



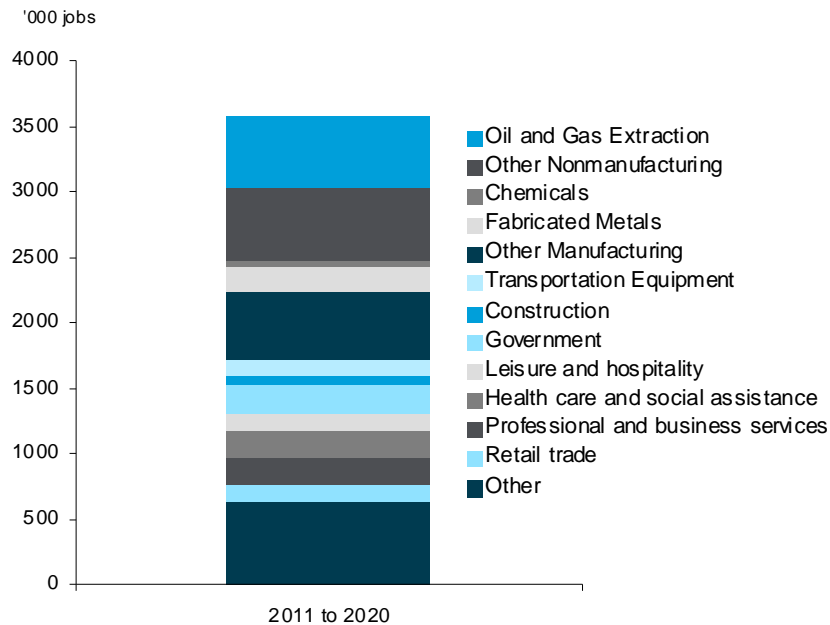
Source: CIRA

- The cumulative impact of new production, reduced consumption, and associated activity could increase real GDP by 2.0 to 3.3%, or \$370-\$624 billion (in 2005\$) respectively
- \$274 billion of this comes directly from the output of new hydrocarbon production alone
- The rest is generated by multiplier effects as the surge in economic activity drives higher wealth, spending, consumption, and investment effects that ripple through the economy

Economic consequences: job creation, and the current account

2.2 to 3.6 million more jobs could be created on net; and cumulatively, some -\$471 billion (in 2005 \$) could be shaved off the current account deficit – about 2.4% of the hypothetical GDP in 2020

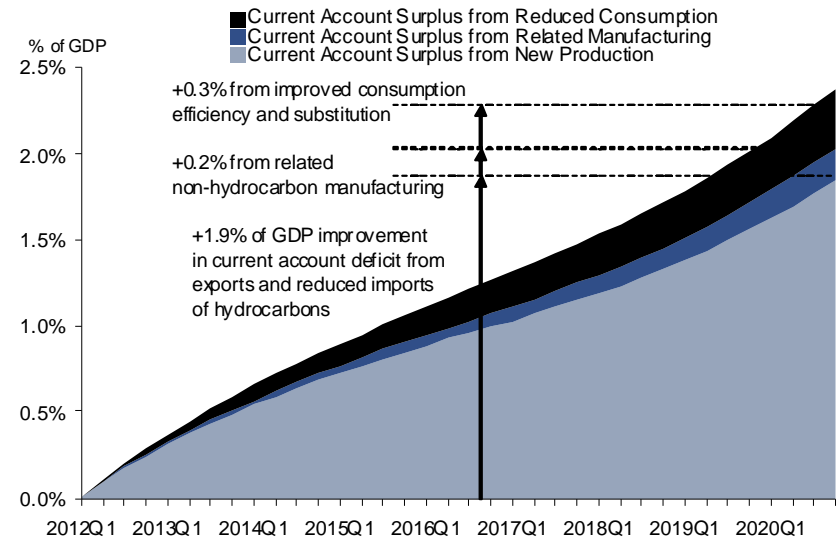
Impact on Job Creation, 2011-2020



Source: CIRA

- As many as 3.6 million new jobs may be created on net by 2020
 - 600,000 jobs would be in the oil and gas extraction sector
 - 1.1 million jobs in related industrial and manufacturing activity
 - ...and the remainder in ancillary job sectors
 - National unemployment could fall by as much as 1.1%

Impact on US current account, 2011-2020



Source: CIRA

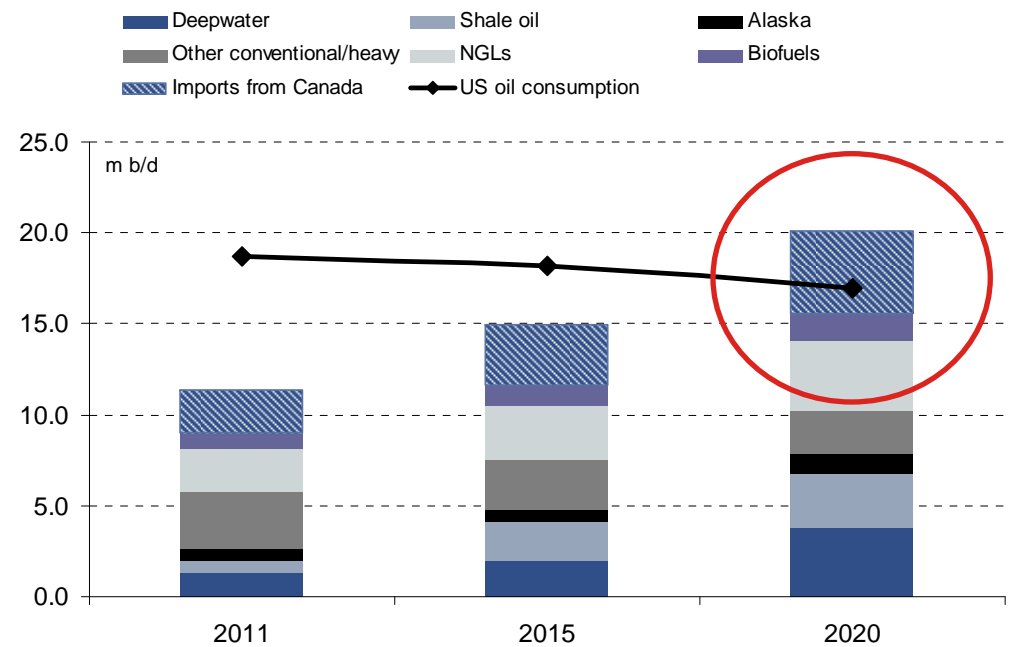
- The current account deficit, currently 3% of GDP, could be reduced by 1.2% to 2.4% of GDP
- This would also have implications on the US dollar, potentially helping it appreciate by 2% to 5% in real exchange rate terms

Impacts on the US, OPEC and the international energy order

The US will need to reflect deeply on its resurgent ability – but waning willingness – to play its traditional, major role at the center of the global energy order. What does this mean for global stability?

- As North America becomes the new Middle East, this poses a challenge to the future role of OPEC
- After near-term supply tightness, the end of the decade sees investments coalescing in offshore output in the Gulf of Mexico, offshore West and East Africa, India, the Caspian and various places in Asia, turning markets looser – US energy independence is likely to come to fruition at a time of weakening prices
- What are the political consequences of changing American attitudes towards playing the various roles it has adopted since World War II – guarantor of supply lanes globally, protector of main producer countries in the Middle East and elsewhere?
- A US economy that is less vulnerable to oil disruptions, less dependent on oil imports and supportive of a stronger currency should inevitably play a central role globally...
- ...but with such a turnaround in its energy dependence, it is questionable how arduously the US government might want to play those very roles

The US could see a 3-m b/d surplus of crude supply over consumption, putting on the pressure to export crude out of the US Gulf Coast



Source: CIRA

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