Oil, Refining & Transportation Market Trends

Ad Hoc Refinery Oversight Committee Meeting

San Francisco, CA

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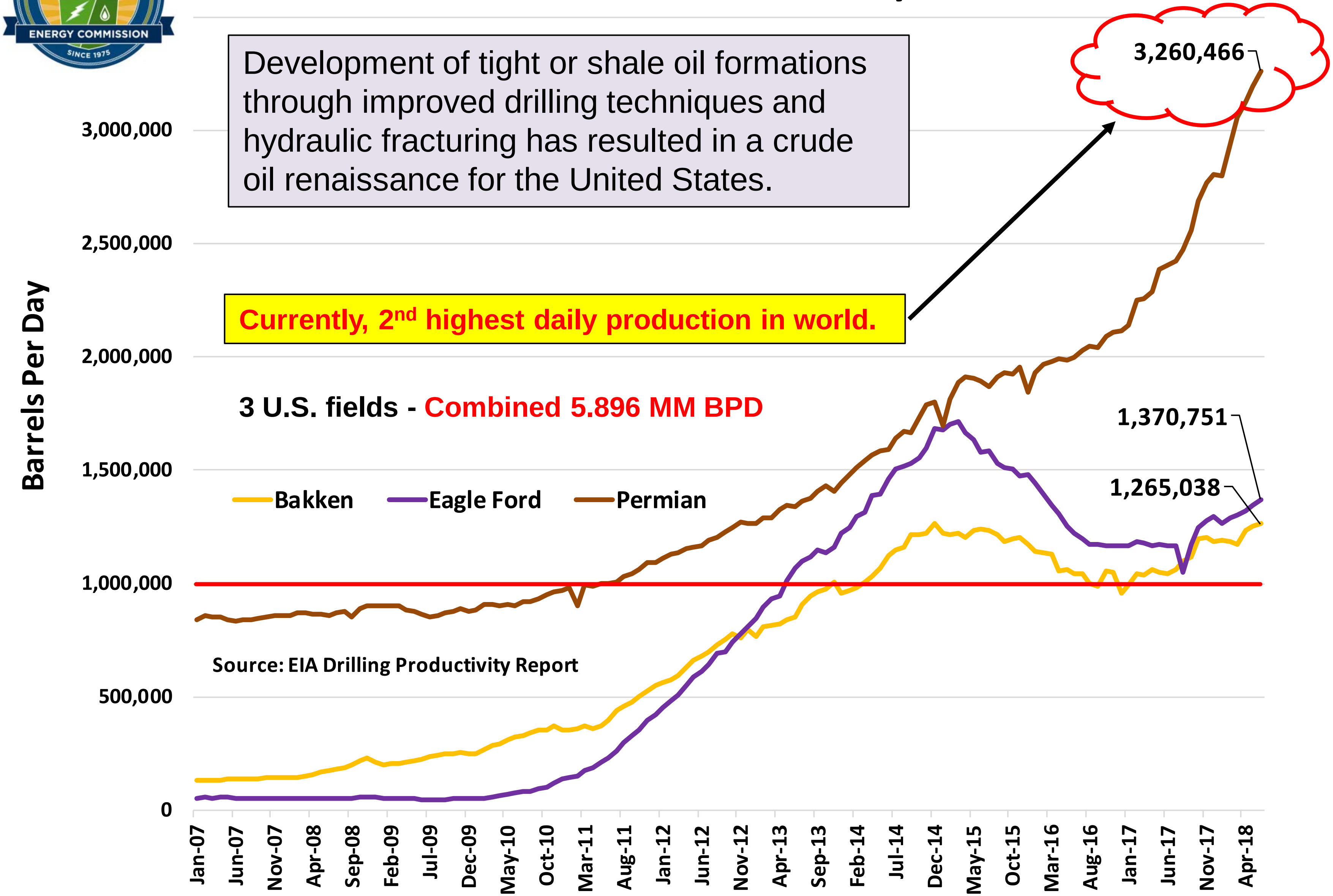
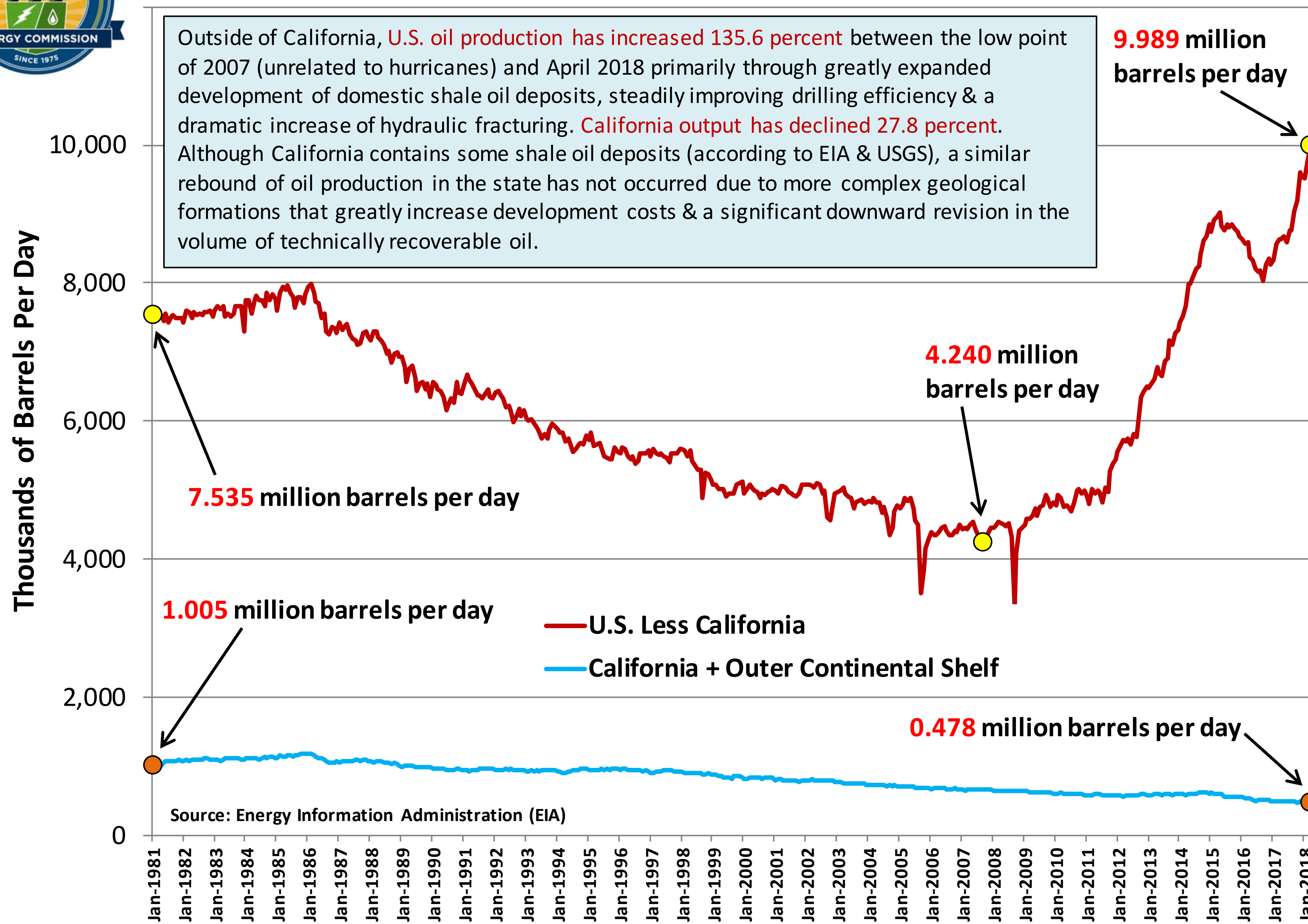
Crude Oil Trends

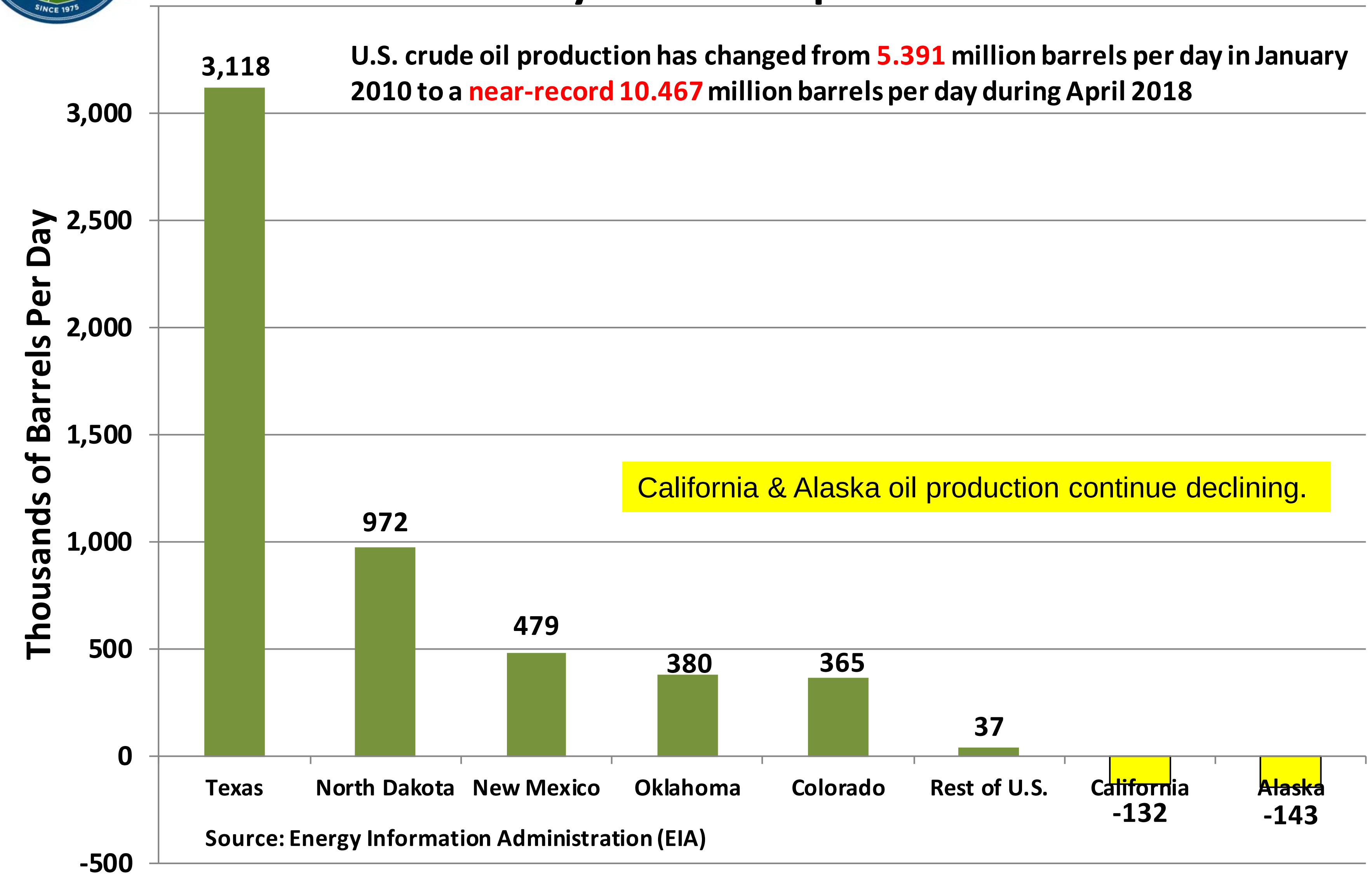
U.S. Oil Production by Shale Basin



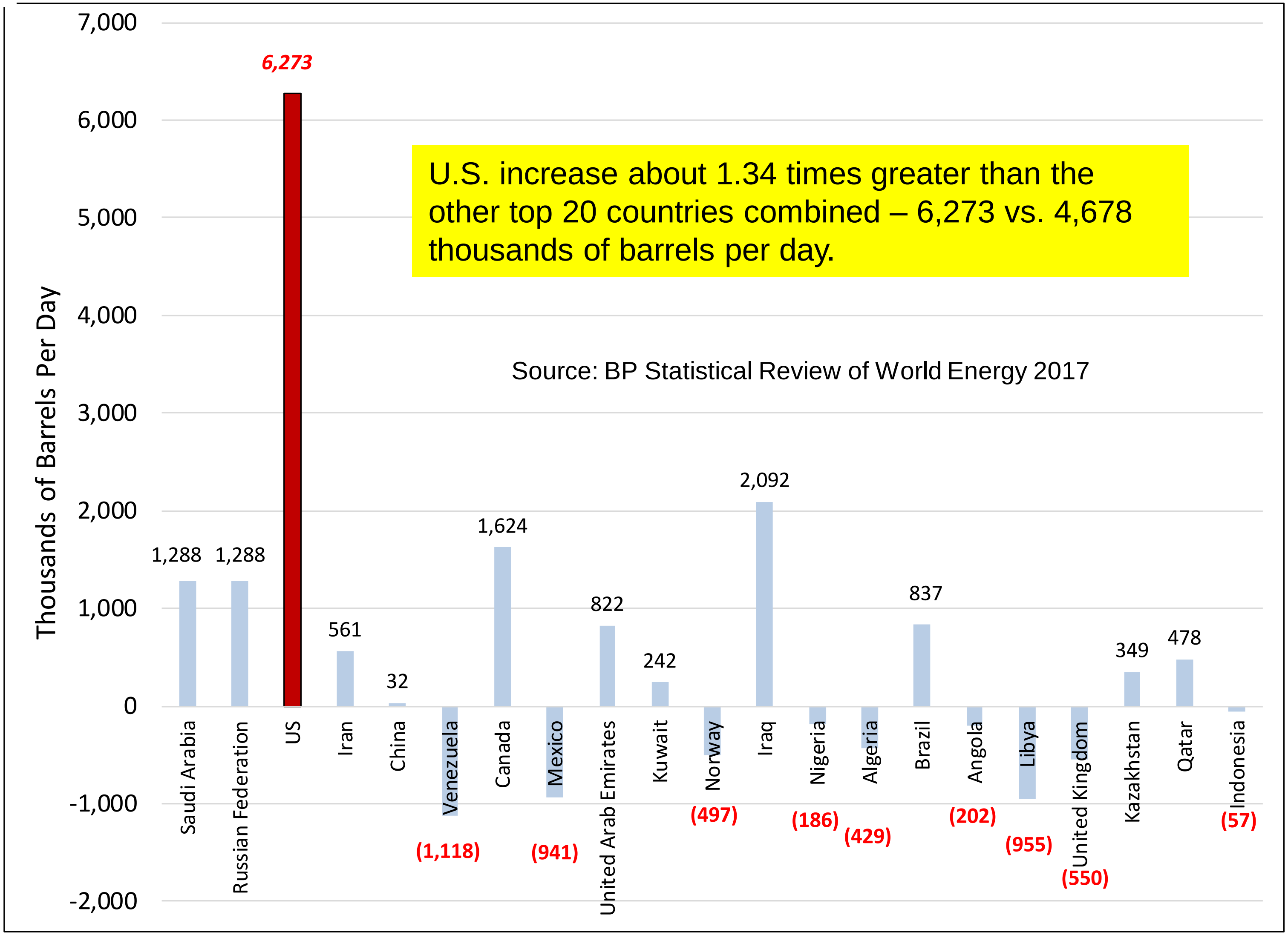
California & U.S. Production 1981-2018



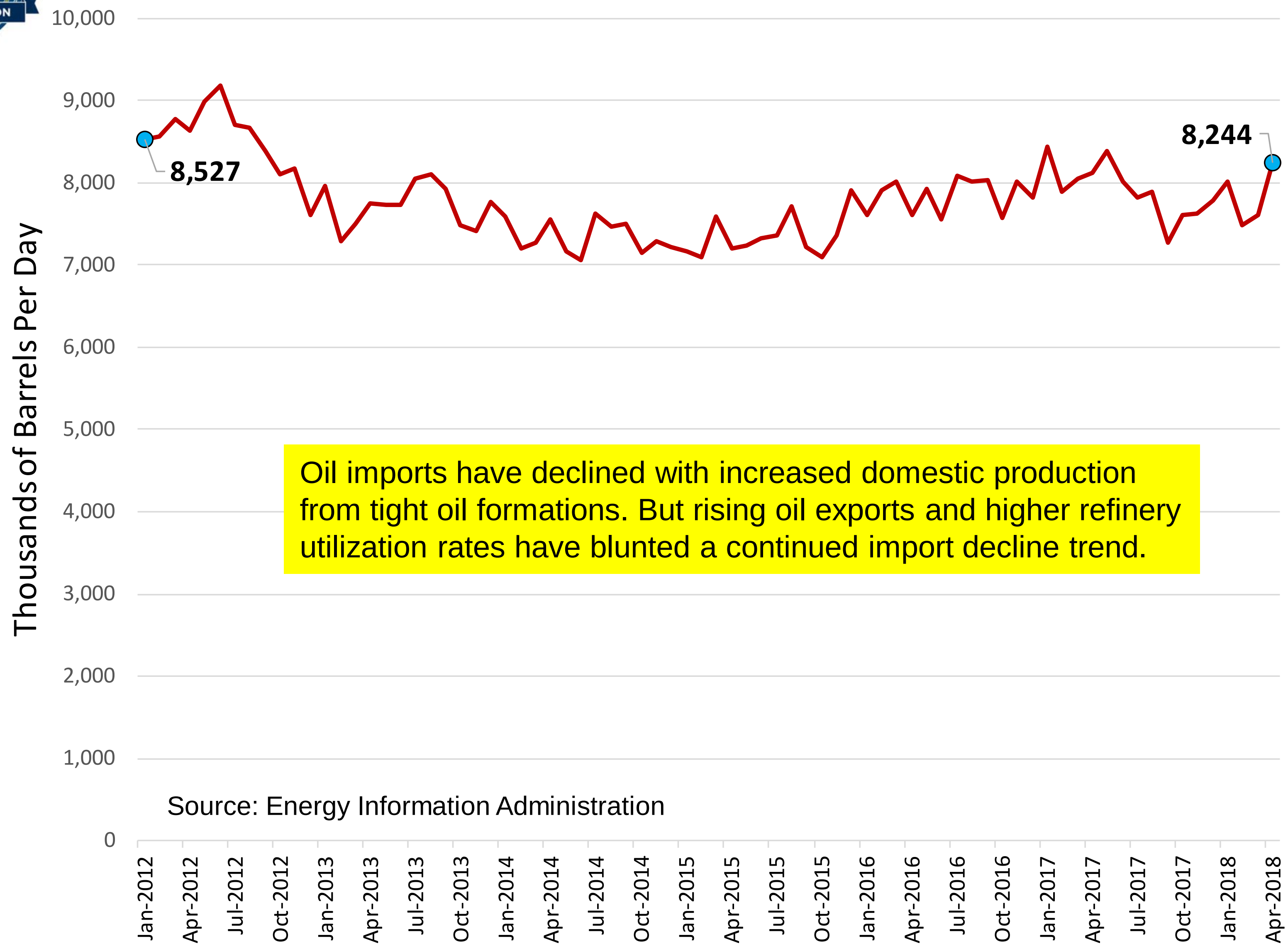
Change in Crude Oil Production
January 2010 vs. April 2018



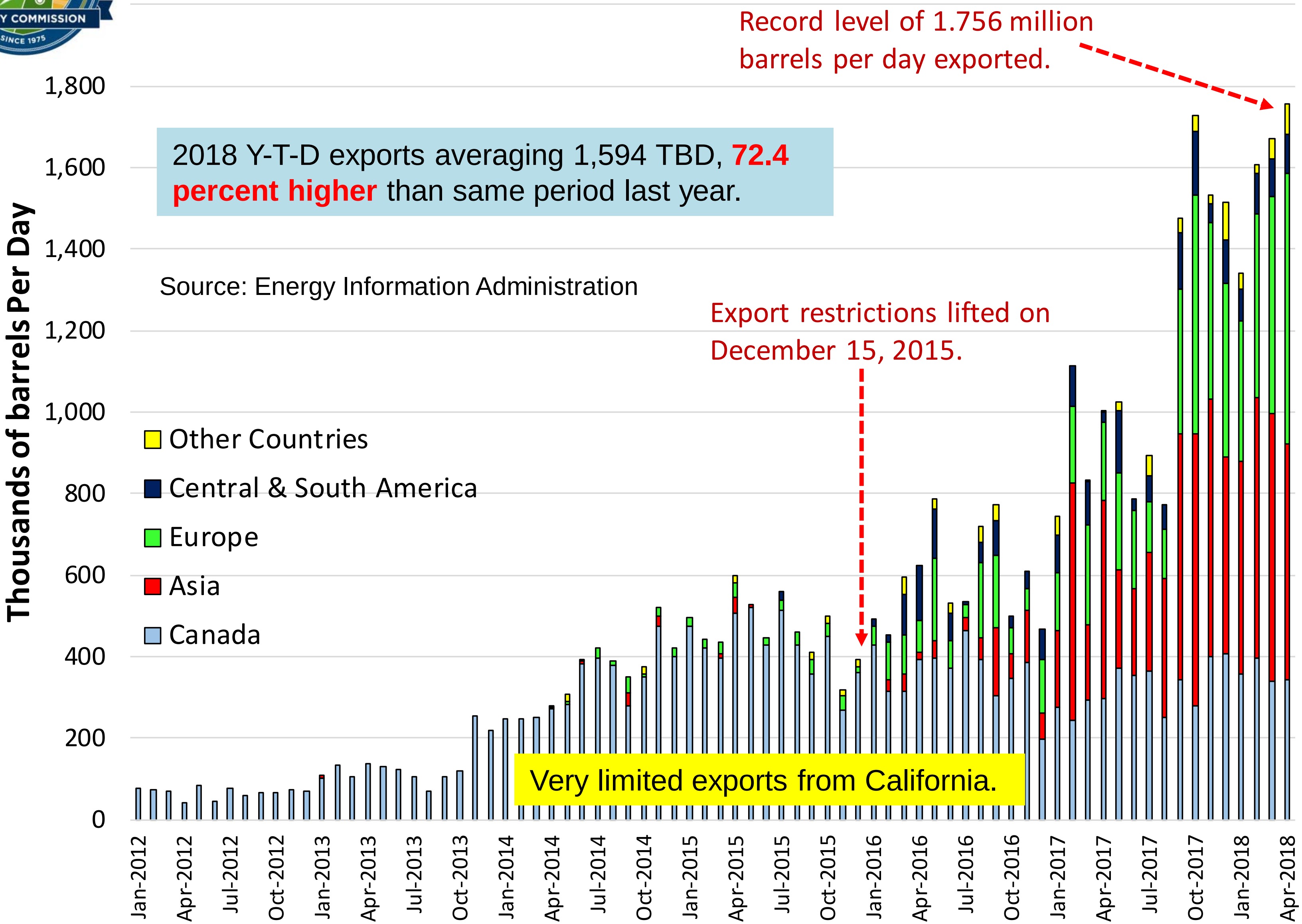
Global Crude Oil Production Change 2017 vs. 2008



U.S. Crude Oil Imports

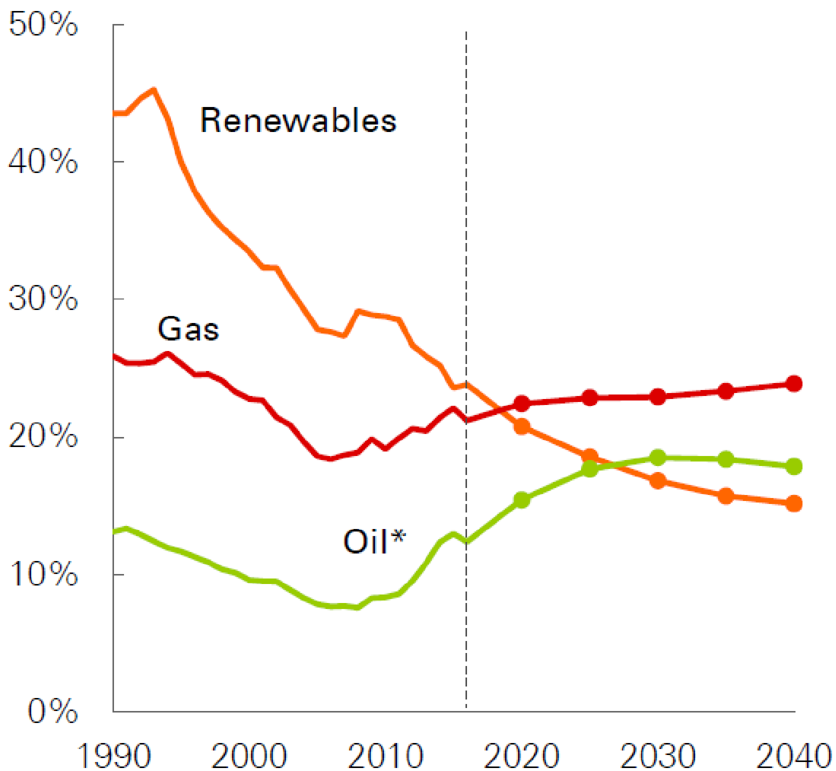


U.S. Crude Oil Exports



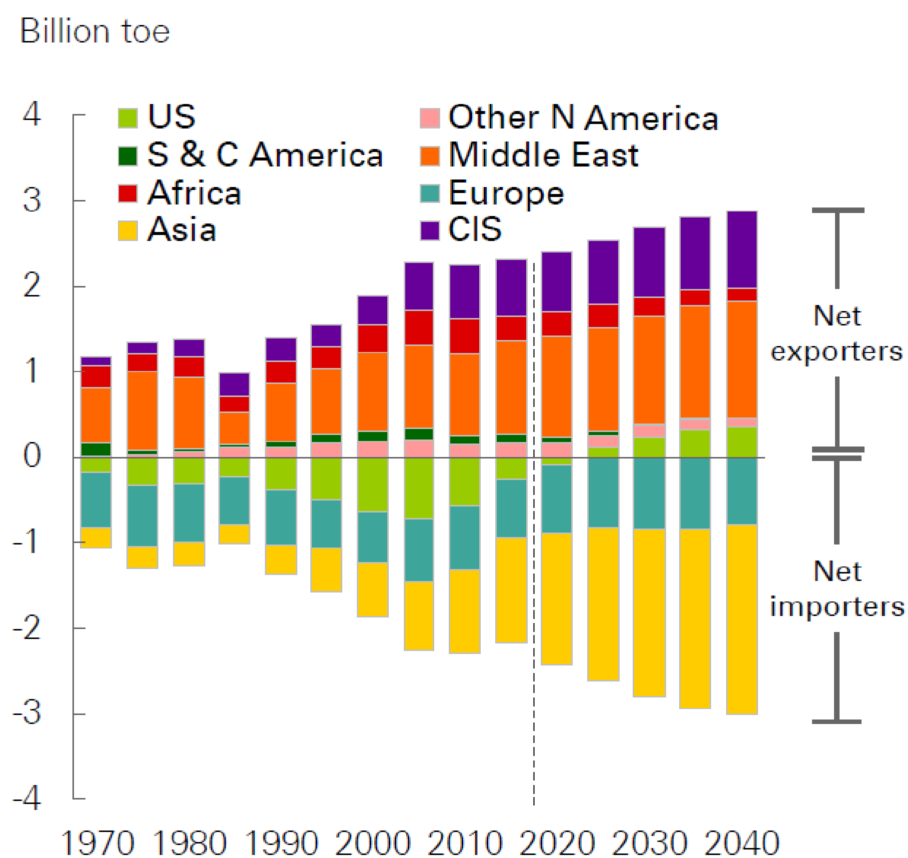
Increasing Output Shifts U.S. to Net Exporter

US shares of global production



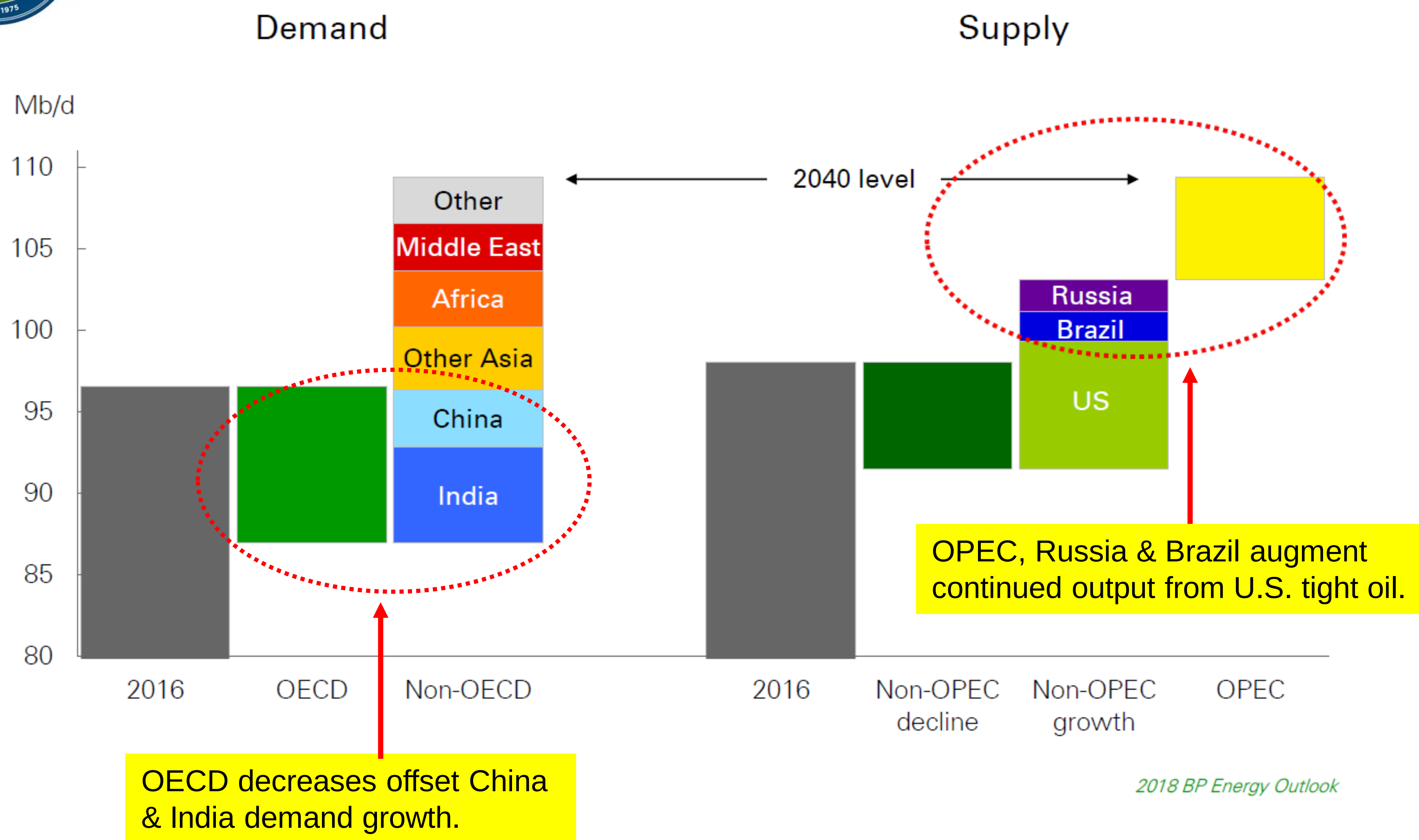
* Includes crude and NGLs

Regional oil/gas imbalances



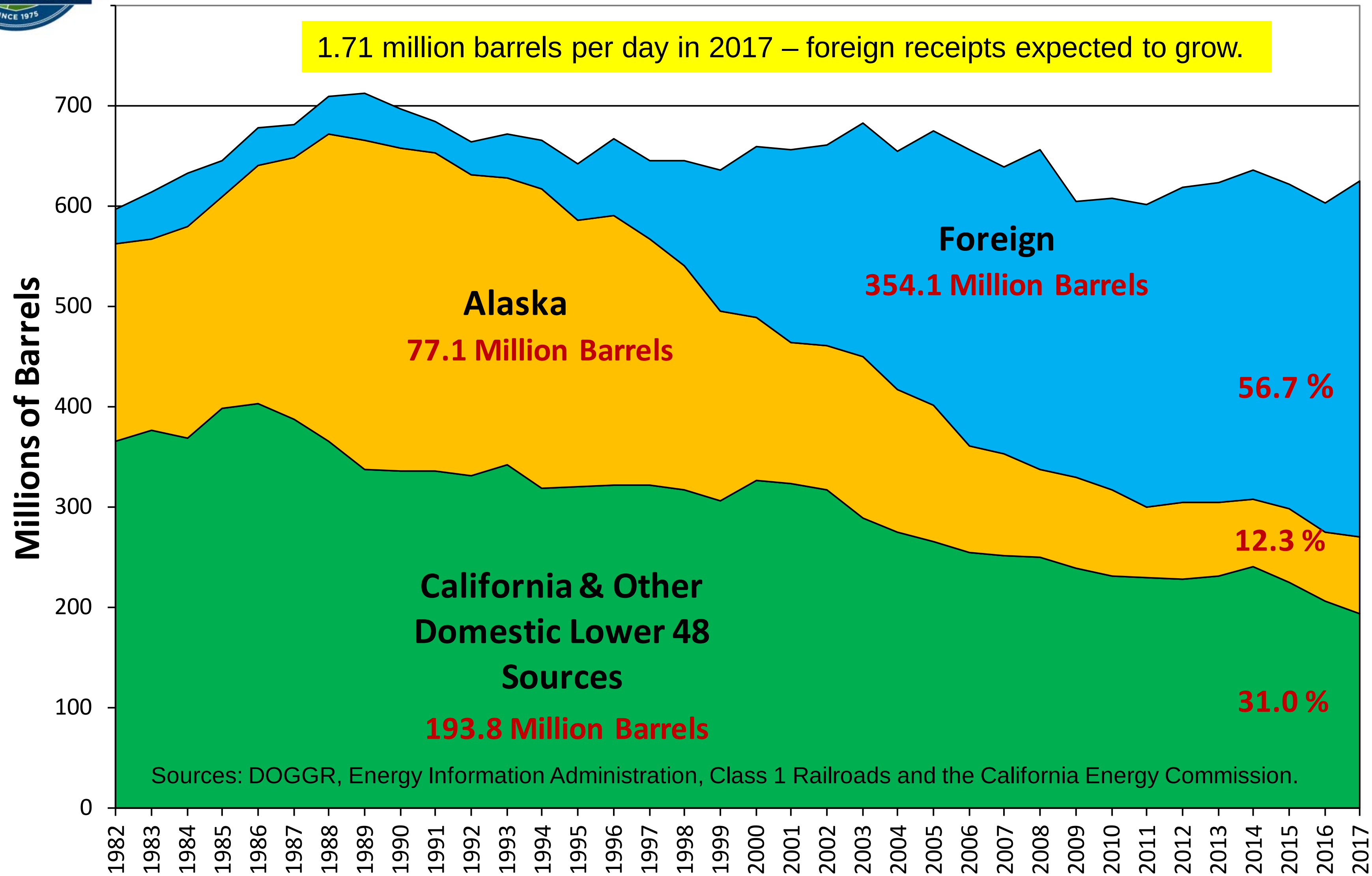
2018 BP Energy Outlook

Future Demand Increases & Supply Sources



California Refineries – Shifting Oil Sources

California Refinery Oil Sources (1982–2017)

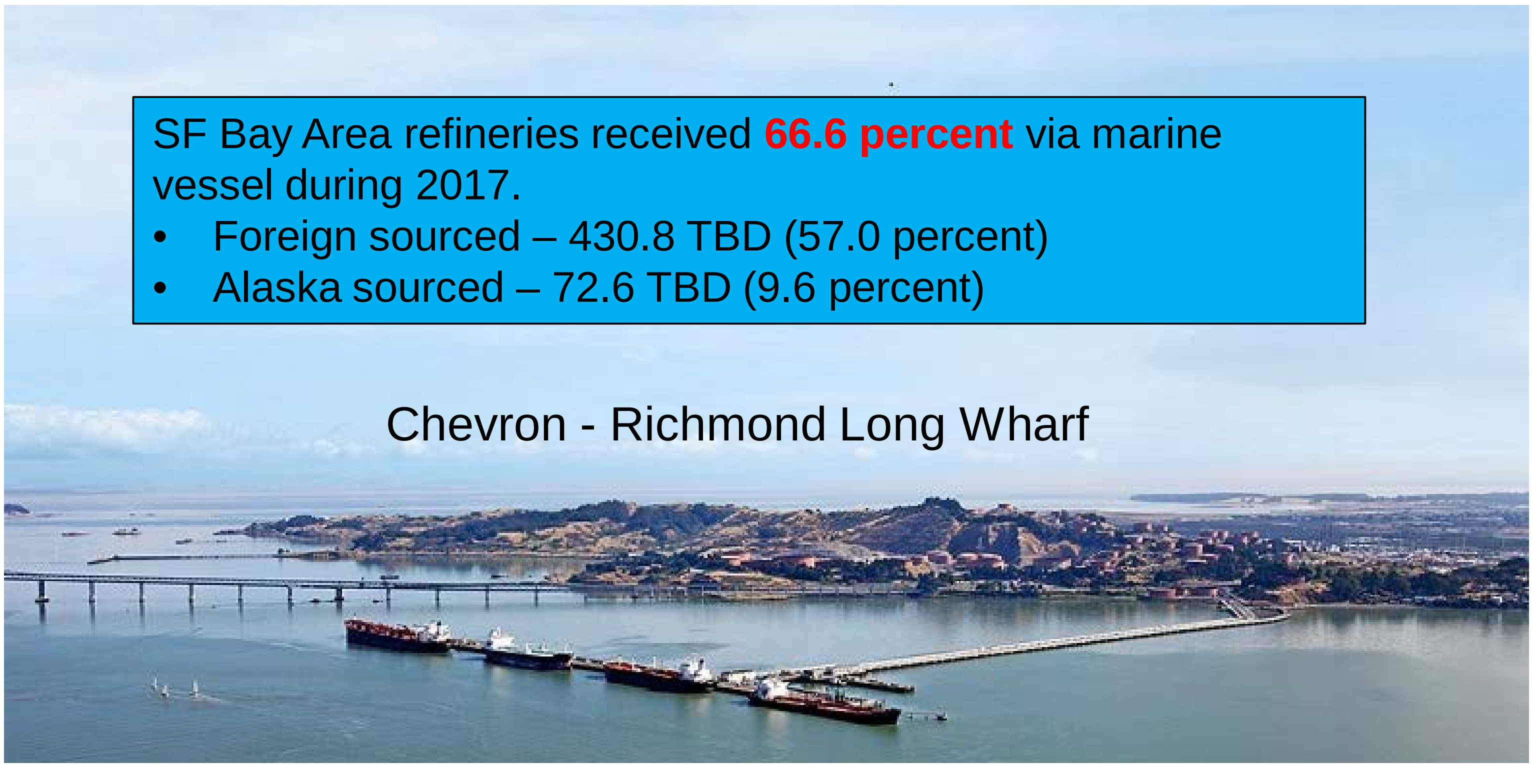


Crude Oil - Marine Movements

- **68.8 percent** of crude oil transported by marine vessel in 2017
  - Foreign sourced – 968.7 TBD (56.4 percent)
  - Alaska sourced – 211.2 TBD (12.3 percent)

SF Bay Area refineries received **66.6 percent** via marine vessel during 2017.

- Foreign sourced – 430.8 TBD (57.0 percent)
- Alaska sourced – 72.6 TBD (9.6 percent)



Source: Quazoo.com.

Crude Oil - Marine Movements

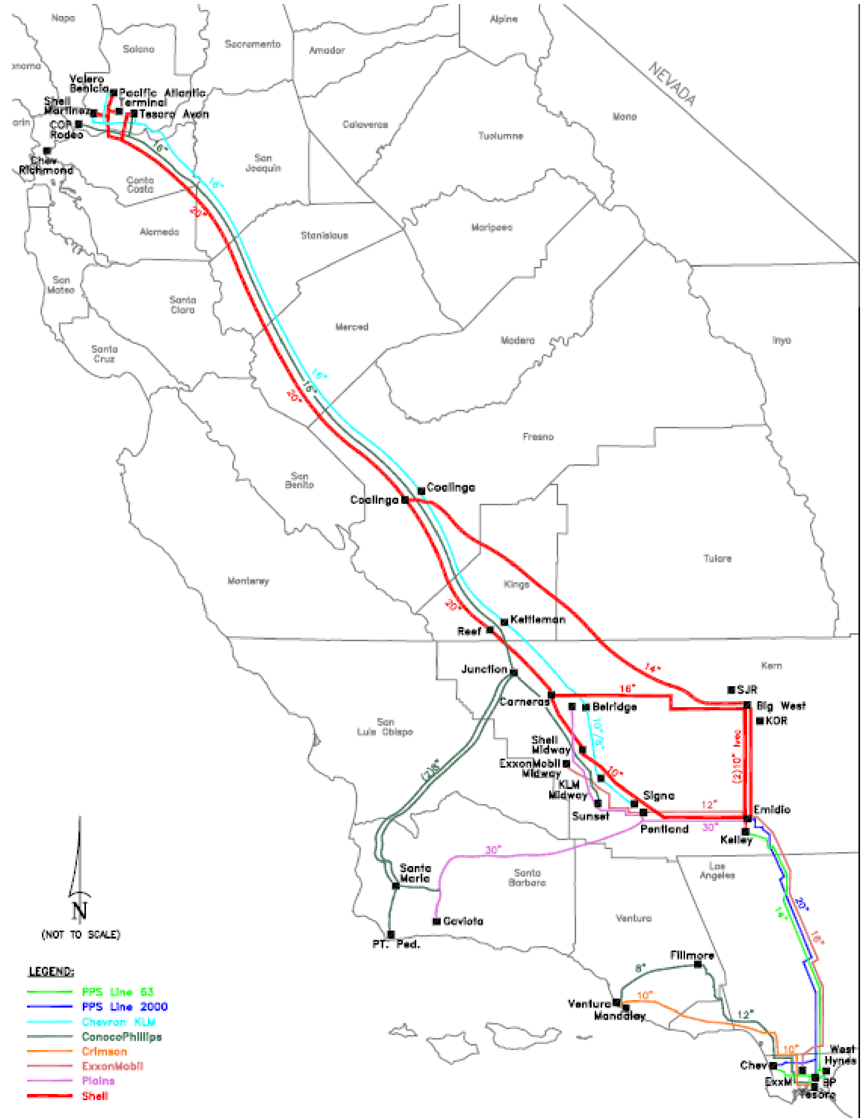
Southern California refineries received **70.4 percent** via marine vessel during 2017.

- Foreign sourced – 537.9 TBD (56.0 percent)
- Alaska sourced – 138.5 TBD (14.4 percent)

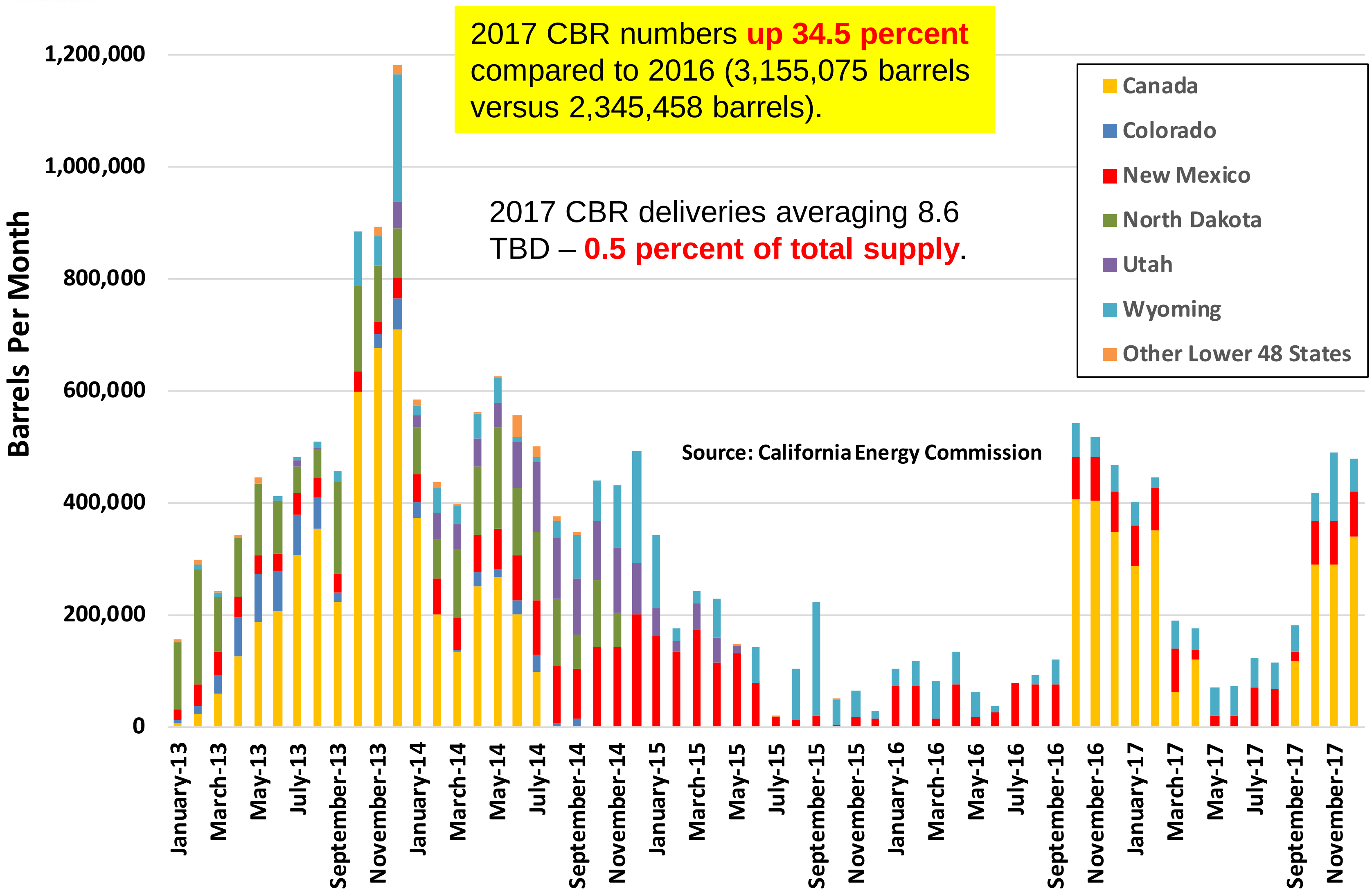
Source: General Steamship Agencies – Oil tanker Nissos Kythnos operated by Andeavor Maritime.

California Oil Sources – Pipelines

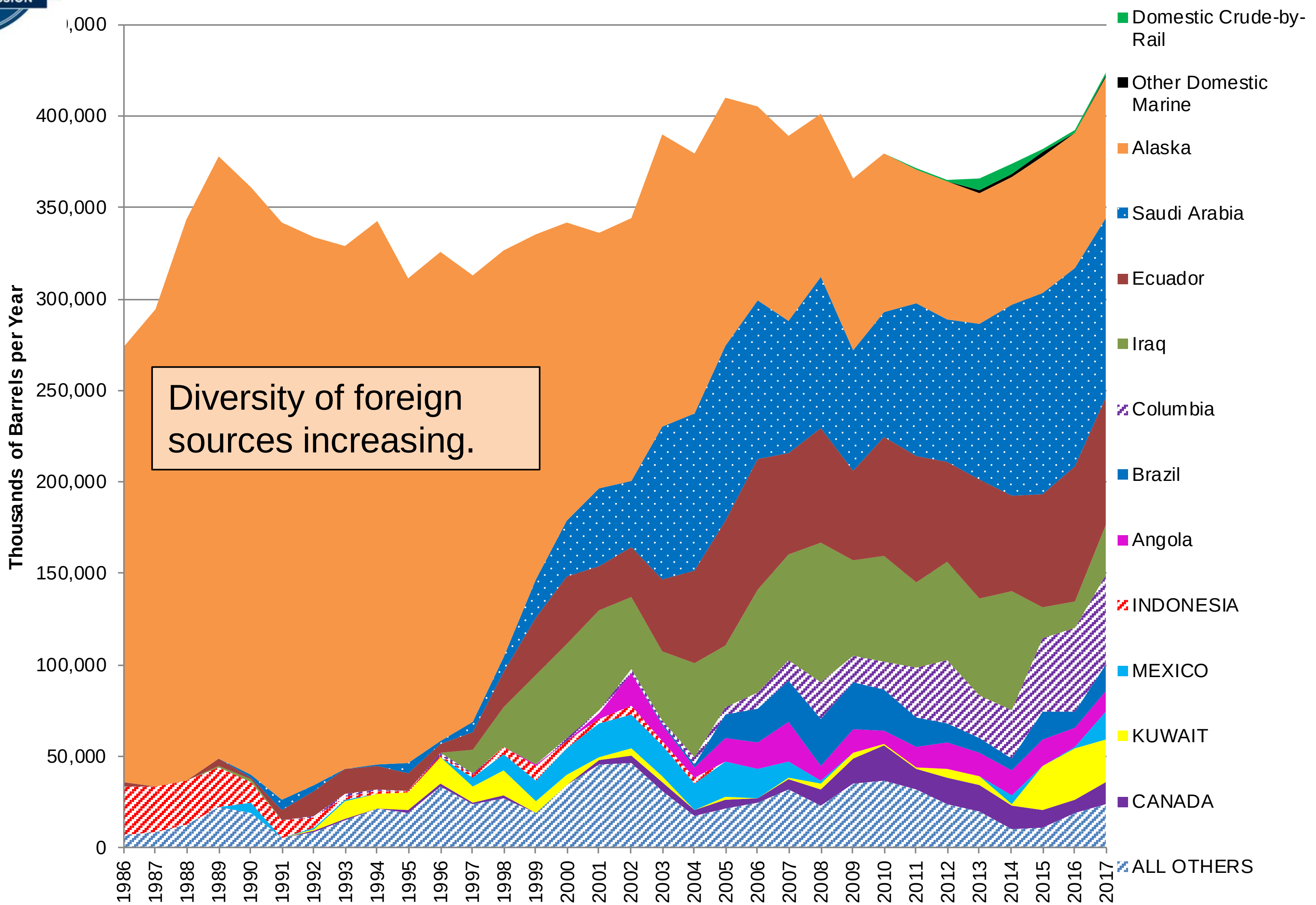
- **31.0 percent** of crude oil received by all California refineries transported via pipelines – 532.5 thousand barrels per day during 2017
  - SF Bay Area refineries received 252.0 thousand barrels per day of CA crude oil via three main trunk lines from southern San Joaquin Valley – **33.4 percent** of total receipts during 2017
  - Southern California & Bakersfield refineries received 280.5 thousand barrels per day of CA crude via local & main trunk lines from southern San Joaquin Valley – **29.2 percent** of total receipts during 2017



California CBR Imports



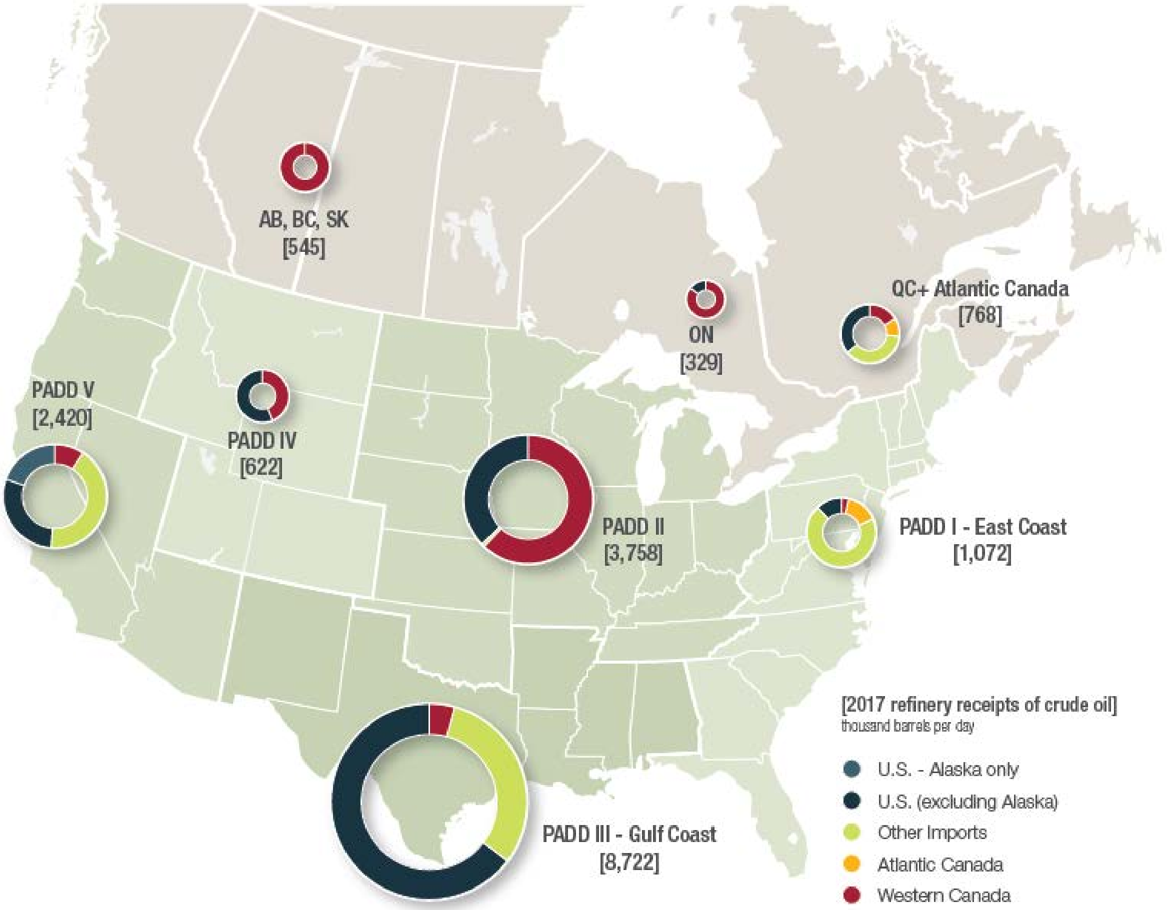
Annual Crude Oil Receipts into California



Sources: Energy Information Administration and the California Energy Commission.

Distribution of Canada Production

Figure 3.1 Canada and U.S.: 2017 Crude Oil Receipts by Source

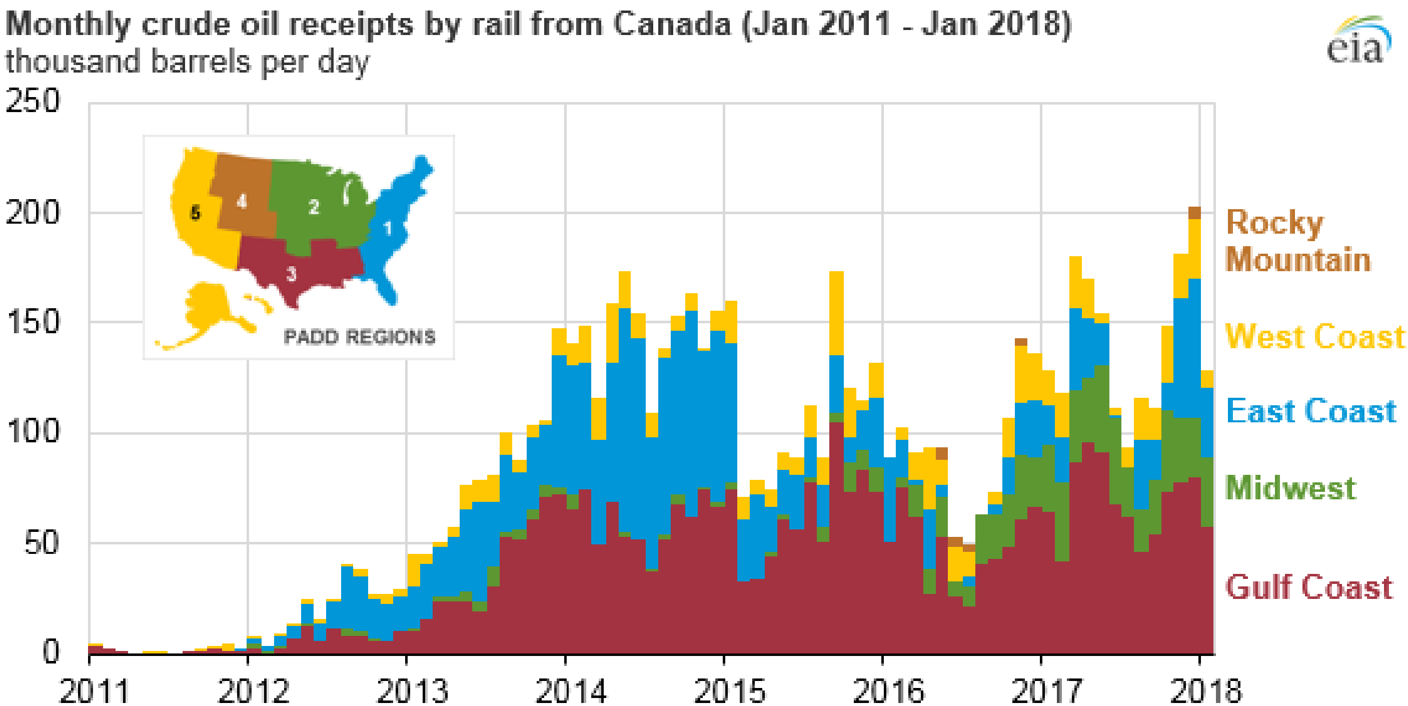


Sources: CAPP, CA Energy Commission, EIA, NEB, Statistics Canada

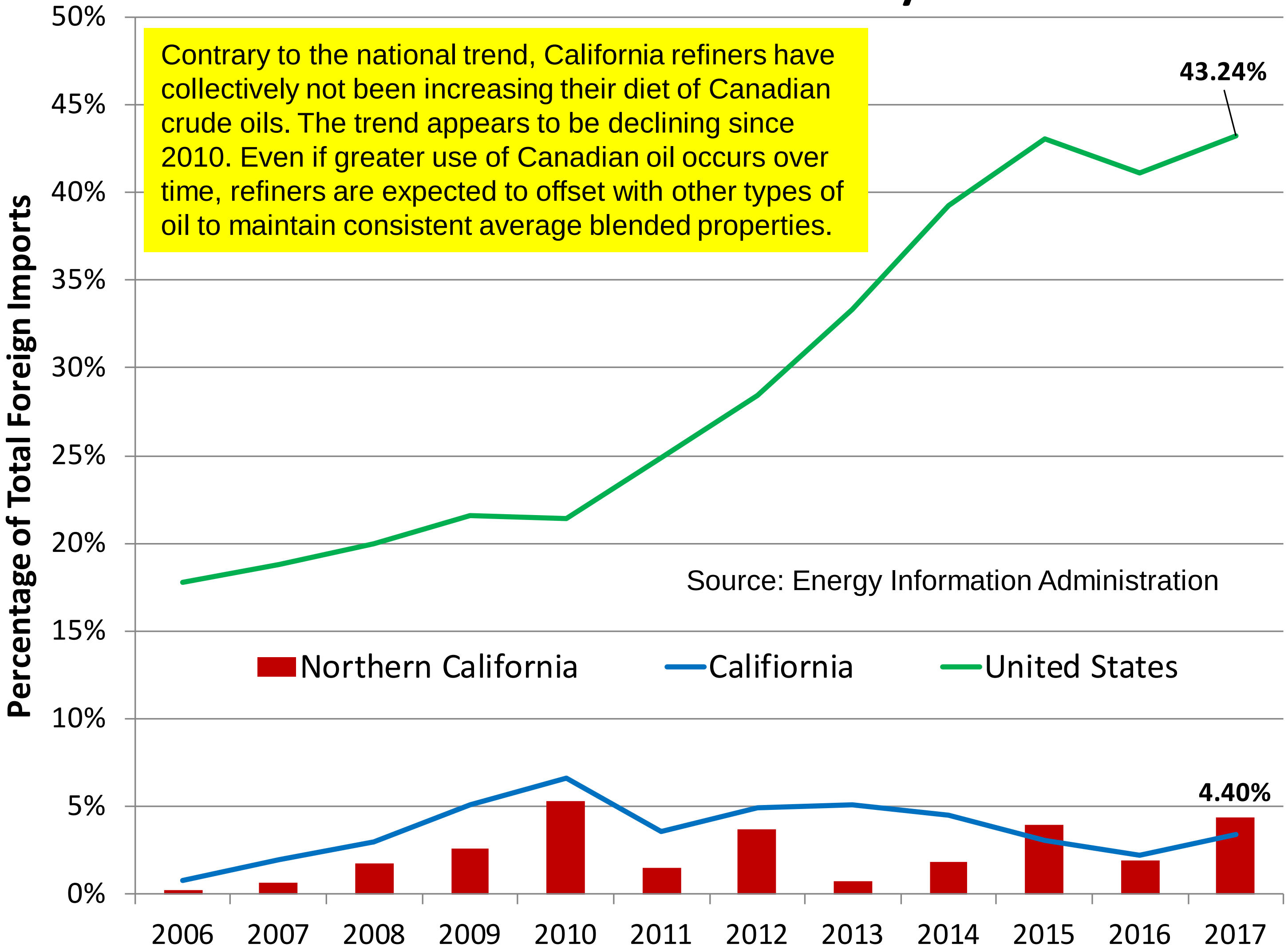
0.9 percent of Canada crude oil exports were delivered to California during 2017.

Canadian Crude Oil Imports by Rail

- Majority of Canada rail imports destined for U.S. Gulf Coast refiners
  - Smaller portion delivered to West Coast, majority to WA refiners



Canadian Crude Oil Imports – California & SF Bay Area



Types of Canadian Oil Imports

Crude Oil Marketing Name	Type of Crude Oil	Oil Sands Sourced	Mined	CI	2013 Barrels	2014 Barrels	2015 Barrels	2016 Barrels	2017 Barrels
Access Western Blend	Production is generated by SAGD thermal methods. Blended with condensate.	Yes	No	16.31	228,810	4,074,970	247,794	167,231	568,417
Albian Heavy Synthetic (all grades)	Partially upgraded dilbit produced from the Scotford Upgrader.	Yes	Yes	19.90	3,258,978	746,514	1,463,238	1,382,106	168,890
Albian Muskeg River Heavy	Partially upgraded dilbit produced from the Scotford Upgrader.	Yes	Yes	20.52	124,000				
Albian Vacuum Blend	Heavy, low sulfur gas oil residium blend.			19.90		124,685			487,278
Borealis	Production comprised of SAGD produced bitumen and naphtha/conventional diluent.	Yes	No	18.32	386,249				
Boundary Lake	Light sour conventional crude.	No	No	8.27			102,760		
Bow River	Conventionally produced heavy sour crude at 21.4-22.9 API gravity, 2.74-2.82 wt% sulphur.	No	No	9.27	270,383				
Burnaby Blend	Blend of conventional and synthetic crudes.	Partial	Partial	11.98			154,030	342,430	1,930,580
Canadian Conventional Heavy	Blend of conventionally produced heavy crudes.	No	No	9.27		51,871	269,969	8,028	
Cardium	Produced from tight oil formation.	No	No	8.27	16,611				
Christina Dilbit Blend	Diluted bitumen produced at Christina Lake SAGD facility.	Mostly	No	13.34				71,874	
Christina Synbit	Synthetic crude.	Yes	Yes	17.43				61,151	
Cold Lake	Production is bitumen based and requires the use of steam.	Yes	No	18.40	6,772,240	5,334,932	3,605,136	3,205,705	3,791,933
Fosterton	Conventionally produced heavy sour crude at 20.9 API gravity, 3.24 wt% sulphur.	No	No	9.27	1,060,536	609,584			
Halkirk	Conventionally produced crude.	No	No	8.27	35,728				
High Prairie Bitumen	Conventionally produced heavy sour crude at 15.2 API gravity, 2.99 wt% sulphur.	No	No	9.27		92,820			
Kearl Lake	Bitumen is mined by shovel and truck and then undergoes onsite paraffinic froth treatment.	Yes	Yes	12.05		546,566	308,662	1,235,972	3,330,330
Koch Alberta	Light sour conventional crude.	No	No	8.27	86,900	87,459		63,119	
Light Sweet	Light sweet conventional crude.	No	No	8.27	37,148	162,424			
McKay Heavy	Production comprised of SAGD produced bitumen/diluent + upgraded sweet synthetic crude.	Yes	Partial	20.01		549,285			
Mixed Sweet	Conventionally produced light sweet crude.	No	No	8.27		371,558	1,707,626	320,359	164,629
Peace River Sour	Conventionally produced light sour stream.	No	No	8.27	92,915	33,421		63,807	42,447
Pembina	Produced from tight oil formation.	No	No	8.27	201,500				
Premium Albian Synthetic	Light sweet synthetic crude produced from the Scotford Upgrader.	Yes	Yes	21.39		672,100			
Seal Bitumen (blended with diluent)	From Peace River oilsands by conventional (cold flow, CHOPS) production methods.	Yes	No	9.27		17,980			
Shell Synthetic (all grades)	Light sweet synthetic crude produced from Shell Canada's Scotford complex.	Yes	Yes	21.39			199,994		
Suncor Synthetic (all grades)	Synthetic crude produced from the Suncor Canada Project.	Yes	Yes	23.71	4,898,699	710,900	2,286,703	557,872	534,094
Surmont Heavy Blend	Heavy sour synbit composed of SAGD production and domestic synthetic crude.	Yes	Partial	18.26		918,406	792,787	895,151	951,762
Synthetic Sweet Blend	A combination of Suncor Synthetic A and Syncrude Sweet Premium.	Yes	Yes	22.55					165,328
Wabasca	Blend of heavy oil production obtained by polymer injection and water flooding.	No	No	6.79			269,509		
Western Canadian Select	Blend of conventional and oilsands production.	Mostly	Partial	18.43		9,390	29,942		54,578

	2013	2014	2015	2016	2017
Canadian Crude Oil - Total Volume	17,470,697	15,114,865	11,438,150	8,374,805	12,190,266
All Crude Oils - Total Volumes	588,254,470	612,332,497	605,749,048	582,101,235	621,246,732
Canadian Crude - Share of Total (Percent)	2.97%	2.47%	1.89%	1.44%	1.96%
Canadian Volume Sourced from Oil Sands (Whole or Part)	15,668,976	13,581,043	9,088,286	7,919,492	11,495,912
Canadian Portion Sourced from Oil Sands (Whole or Part)	89.69%	89.85%	79.46%	94.56%	94.30%
Oil Sands Portion of Total Crude Oil	2.66%	2.22%	1.50%	1.36%	1.85%
Canadian Oil Sands Portion Carbon Intensity (CI)	20.36	18.07	19.65	17.65	15.70
Canadian Average Carbon Intensity (CI)	19.19	17.22	17.30	17.14	15.74
Total Average for All Crude Oils (CI)	11.37	11.19	12.06	12.14	11.93

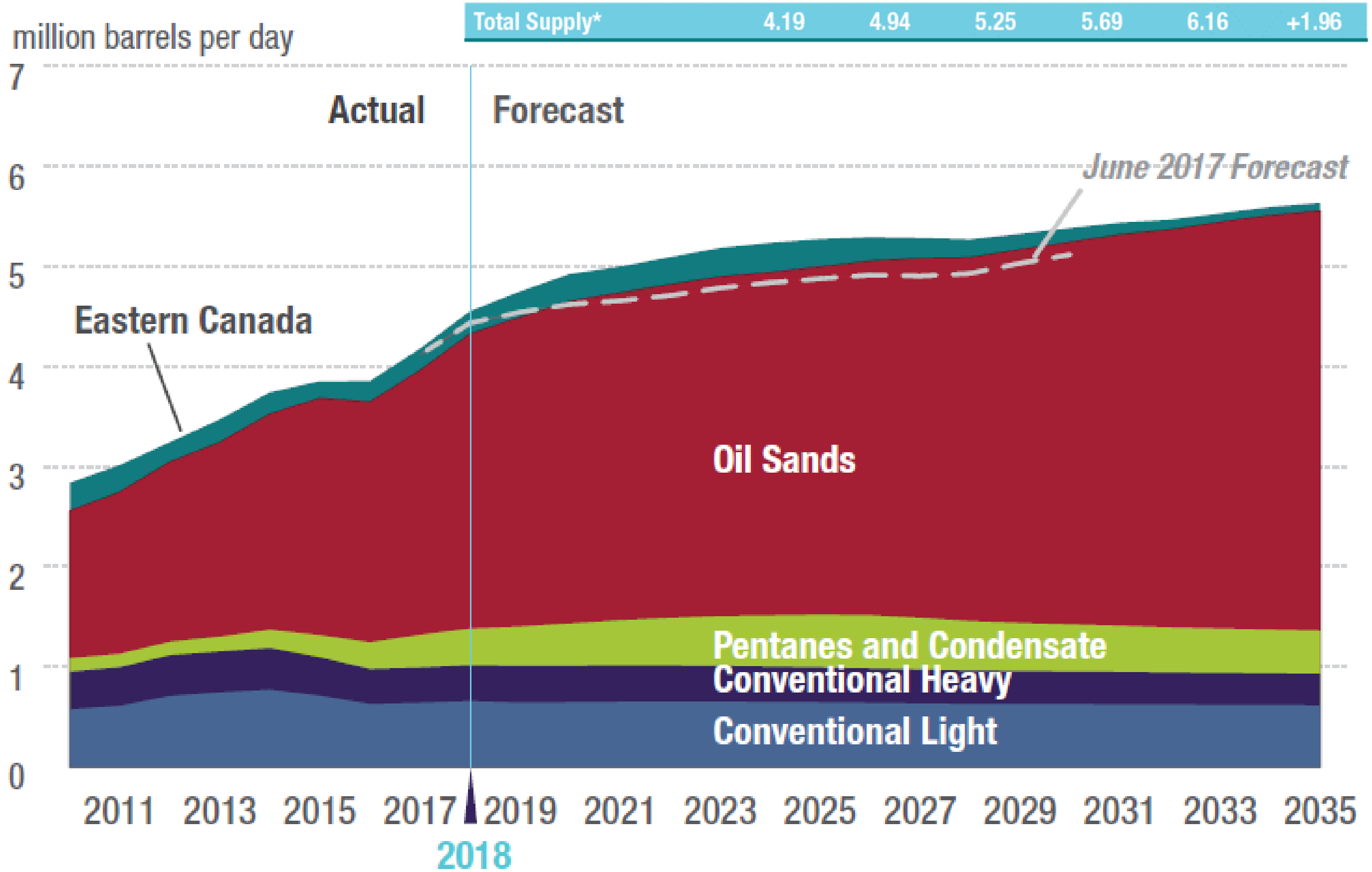
94.3 percent of oil imported from Canada sourced from oil sand formations during 2017. Canadian crude oil CI averaged 15.74 in 2017 compared to 11.93 for all crude oil types.

Sources: California Energy Commission analysis of California Air Resources Board (CARB) crude oil carbon intensity data.

Canadian Oil Production – Rising & Heavy

Table 2.5 Western Canada Crude Oil Supply

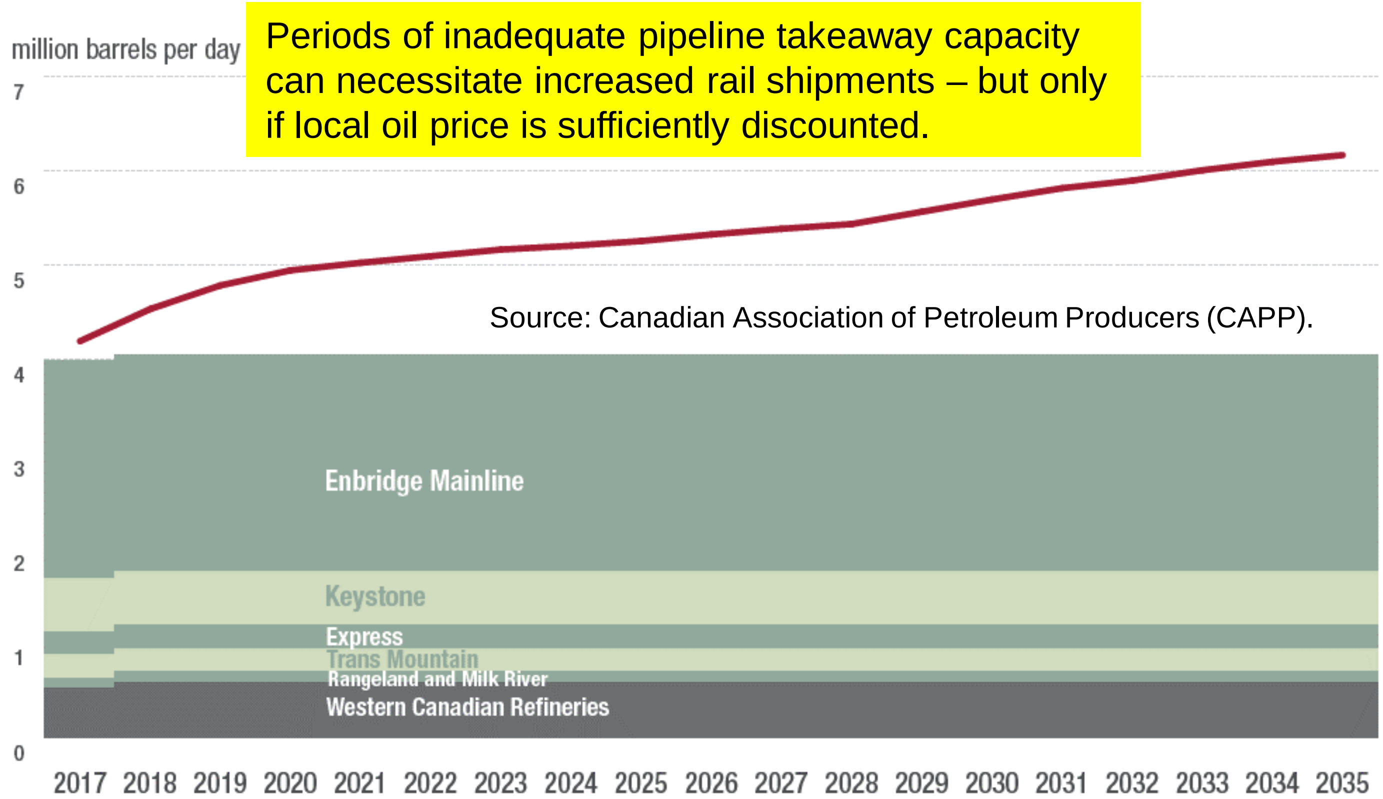
million b/d	2017	2020	2025	2030	2035	Change
Light	1.31	1.62	1.63	1.64	1.61	+0.30
Heavy	2.89	3.32	3.62	4.05	4.55	+1.66
Total Supply*	4.19	4.94	5.25	5.69	6.16	+1.96



Source: Canadian Association of Petroleum Producers (CAPP).

Decreasing Spare Pipeline Capacity

Figure 4.6 Existing Takeaway Capacity from Western Canada vs. Supply Forecast

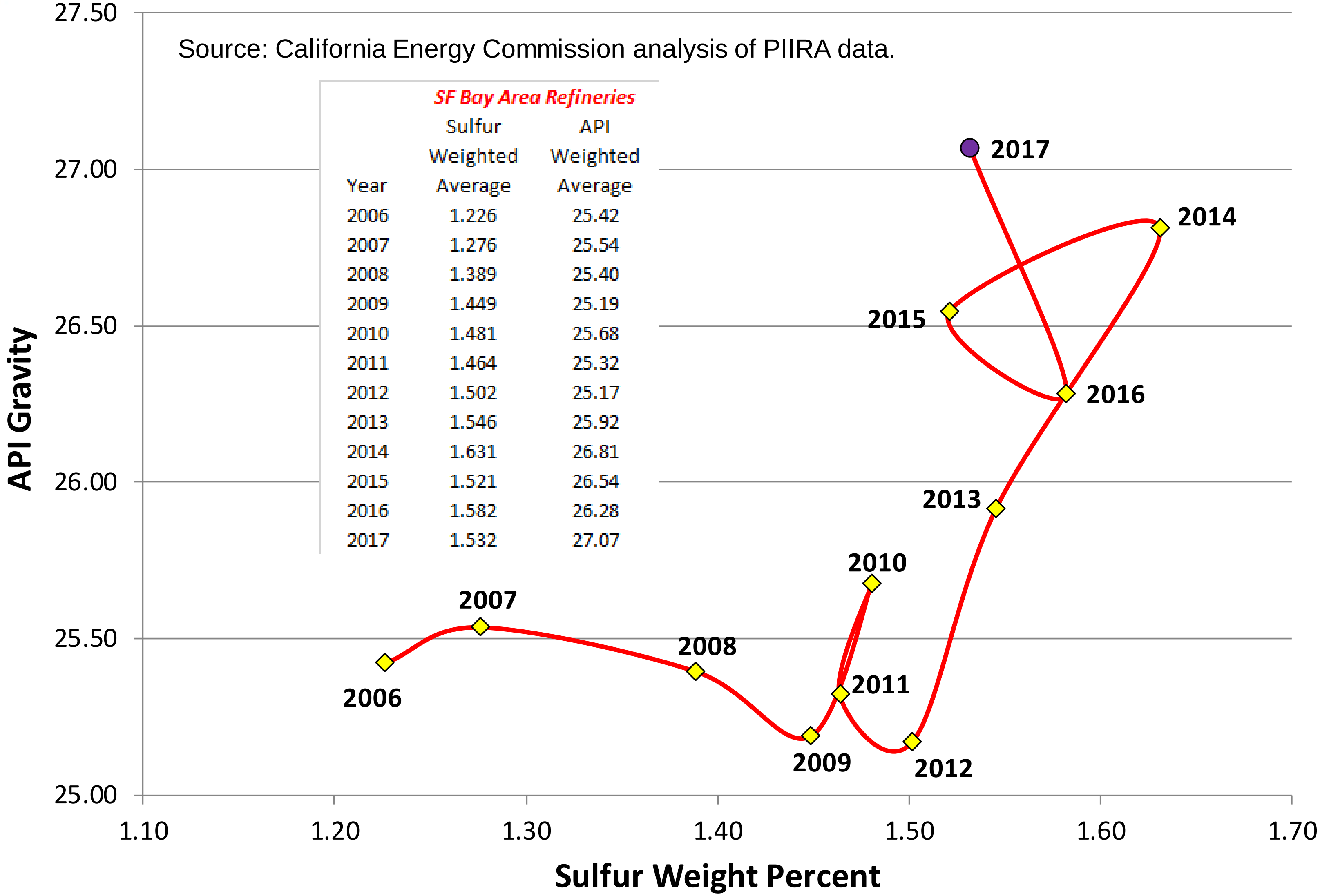


Capacity shown can be reduced by any extraordinary and temporary operating and physical constraints.

Notes:
1) Enbridge capacity adjusted by operational downtime and capacity for RPP and U.S. Bakken crude oil.
2) Keystone: adjustment to 95% of nameplate capacity for maintenance downtime.
3) Express: contract capacity only due to downstream Platte pipeline constraints.
4) Trans Mountain: RPP capacity requirements subtracted from nameplate capacity.
5) Rangeland & Milk River: throughput estimated at 107,000 b/d, which is the maximum realized annual crude oil throughput since 2010.
6) Western Canadian refineries: approximate refinery intake in AB (incl. Sturgeon refinery from 2018+) and SK but excludes BC (85% of 682,000 b/d).

California Refineries – Oil Property Trends

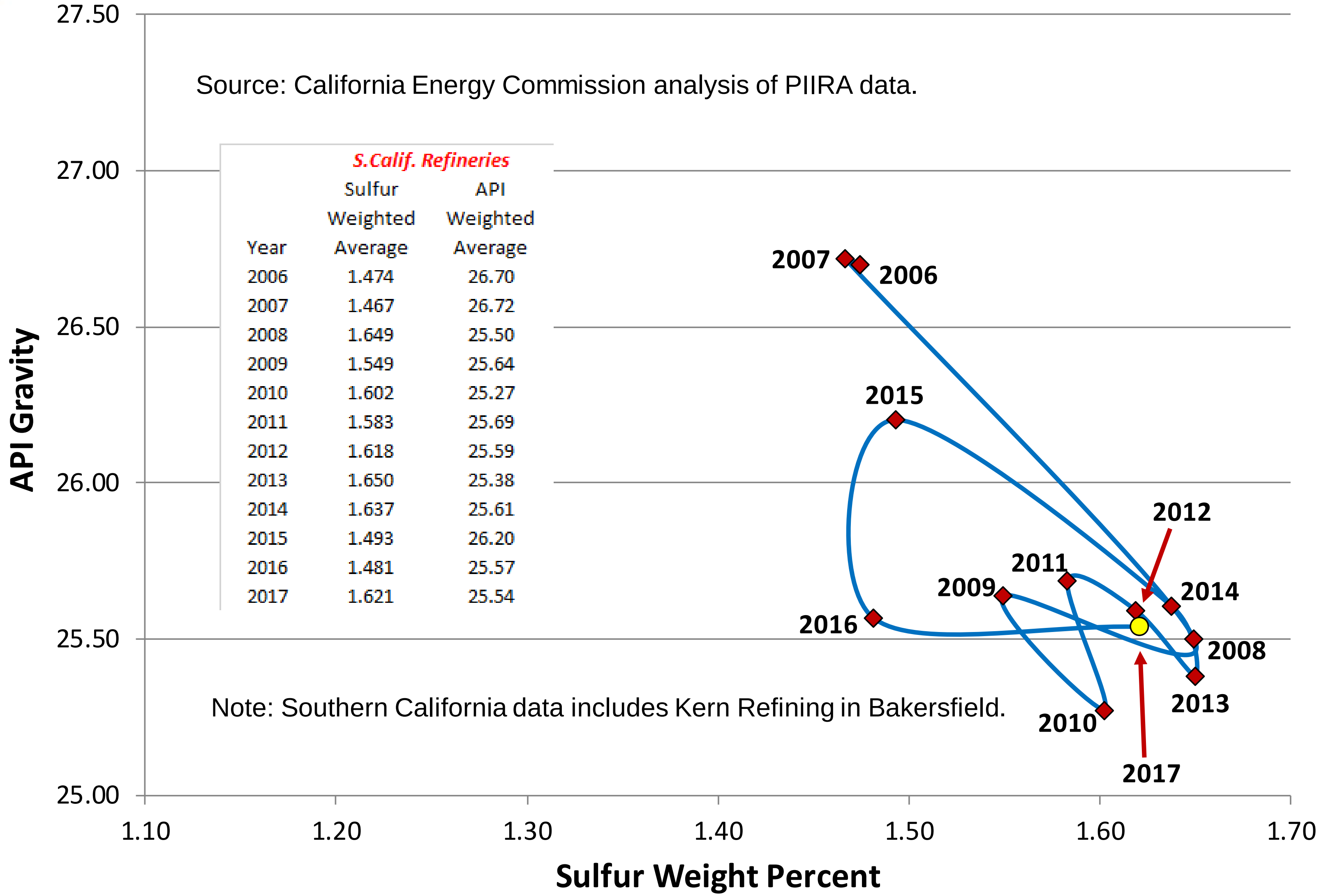
SF Bay Area Refineries – Crude Oil Properties



SF Bay Area Refineries

Year	Sulfur Weighted Average	API Weighted Average
2006	1.226	25.42
2007	1.276	25.54
2008	1.389	25.40
2009	1.449	25.19
2010	1.481	25.68
2011	1.464	25.32
2012	1.502	25.17
2013	1.546	25.92
2014	1.631	26.81
2015	1.521	26.54
2016	1.582	26.28
2017	1.532	27.07

SoCal Refineries – Crude Oil Properties



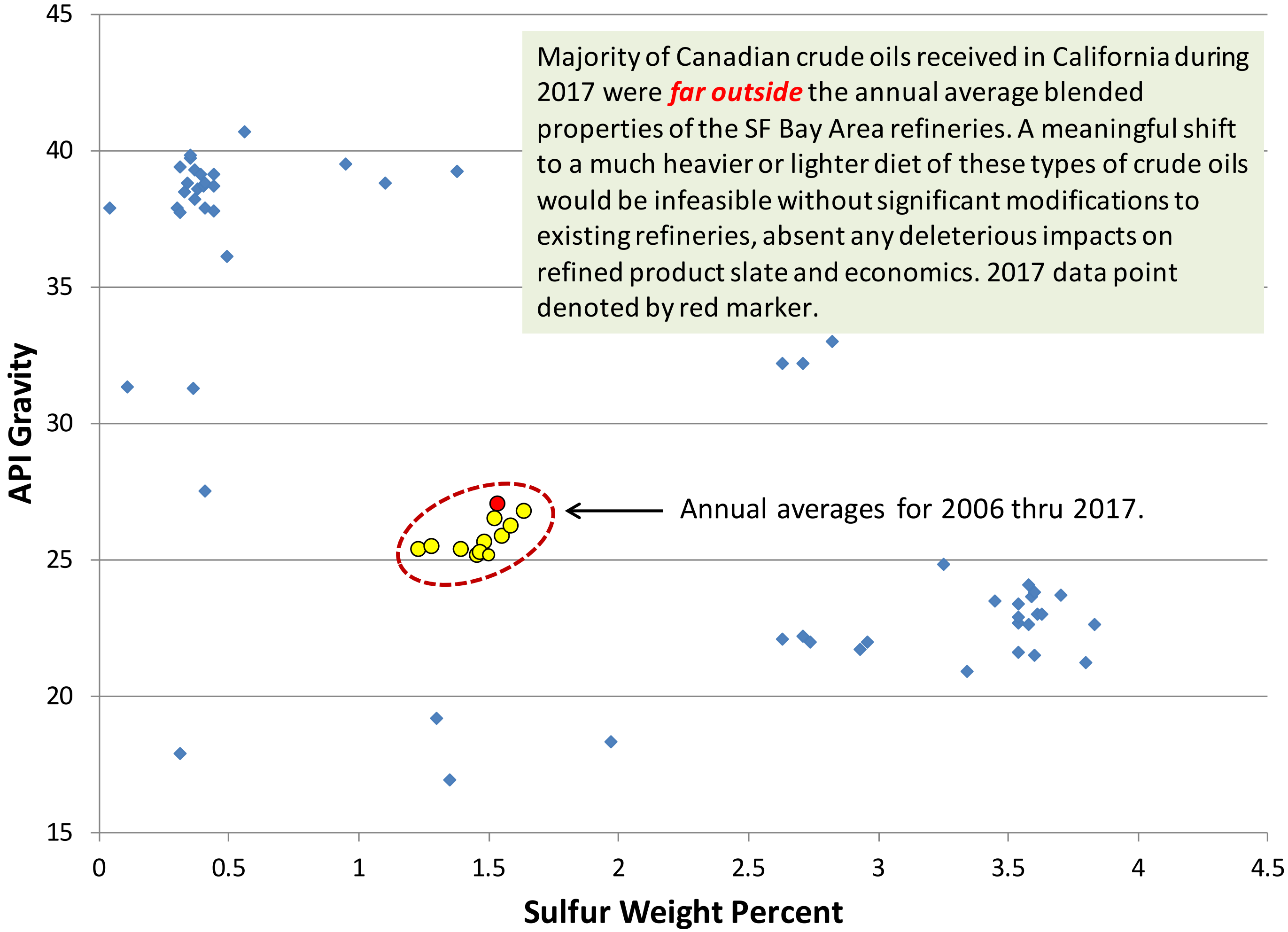
S.Calif. Refineries

Year	Sulfur Weighted Average	API Weighted Average
2006	1.474	26.70
2007	1.467	26.72
2008	1.649	25.50
2009	1.549	25.64
2010	1.602	25.27
2011	1.583	25.69
2012	1.618	25.59
2013	1.650	25.38
2014	1.637	25.61
2015	1.493	26.20
2016	1.481	25.57
2017	1.621	25.54

Refinery Operations - Crude Oil Blending

- As a general practice, refiners blend various types of crude oil together prior to processing in their facility for purposes of maintaining a steady overall quality of crude oil that helps to better control refinery operations and regulate the different ratios and types of transportation fuels produced from one month to the next
- Although the year-to-year variability of the average sulfur and density properties does shift, the degree of change is rather modest when the *scale is adjusted* to include properties of various types of Canadian crude oil processed in the SF Bay Area

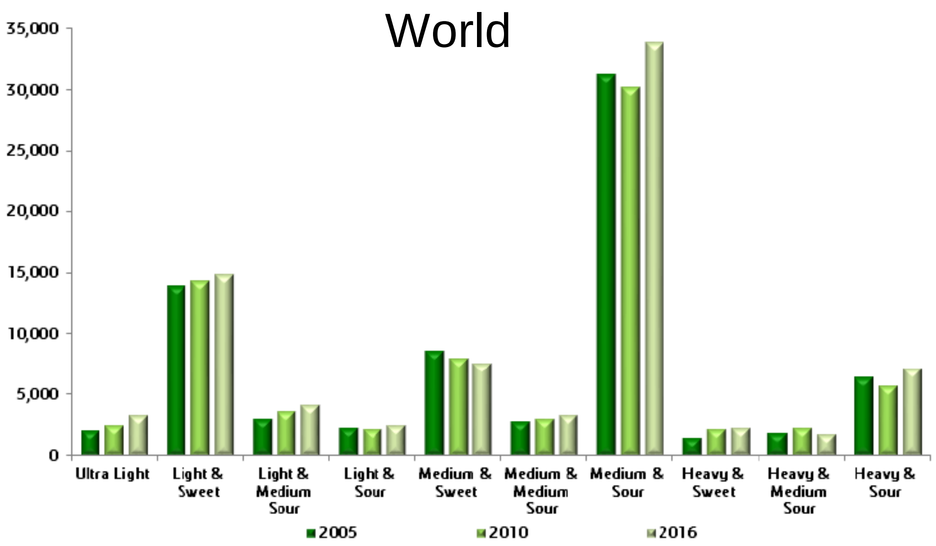
Canadian Crude Oil Import Properties versus Bay Area Annual Refinery Variability

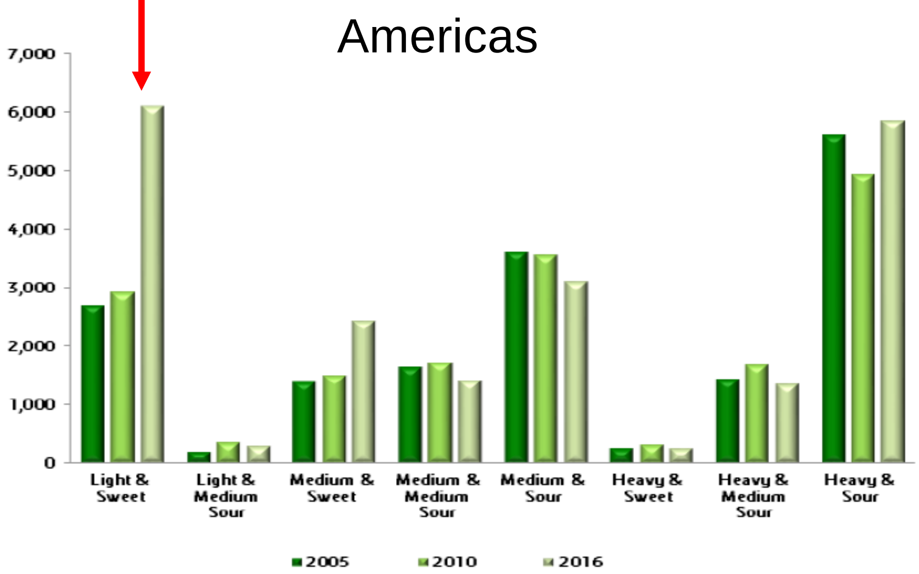


Sources: California Energy Commission analysis of PIIRA and EIA data

Crude Oil Qualities Vary by Region

Global increases of crude oil production primarily a higher sulfur content (sour) vs. disproportionate increase of light/sweet from the Americas.

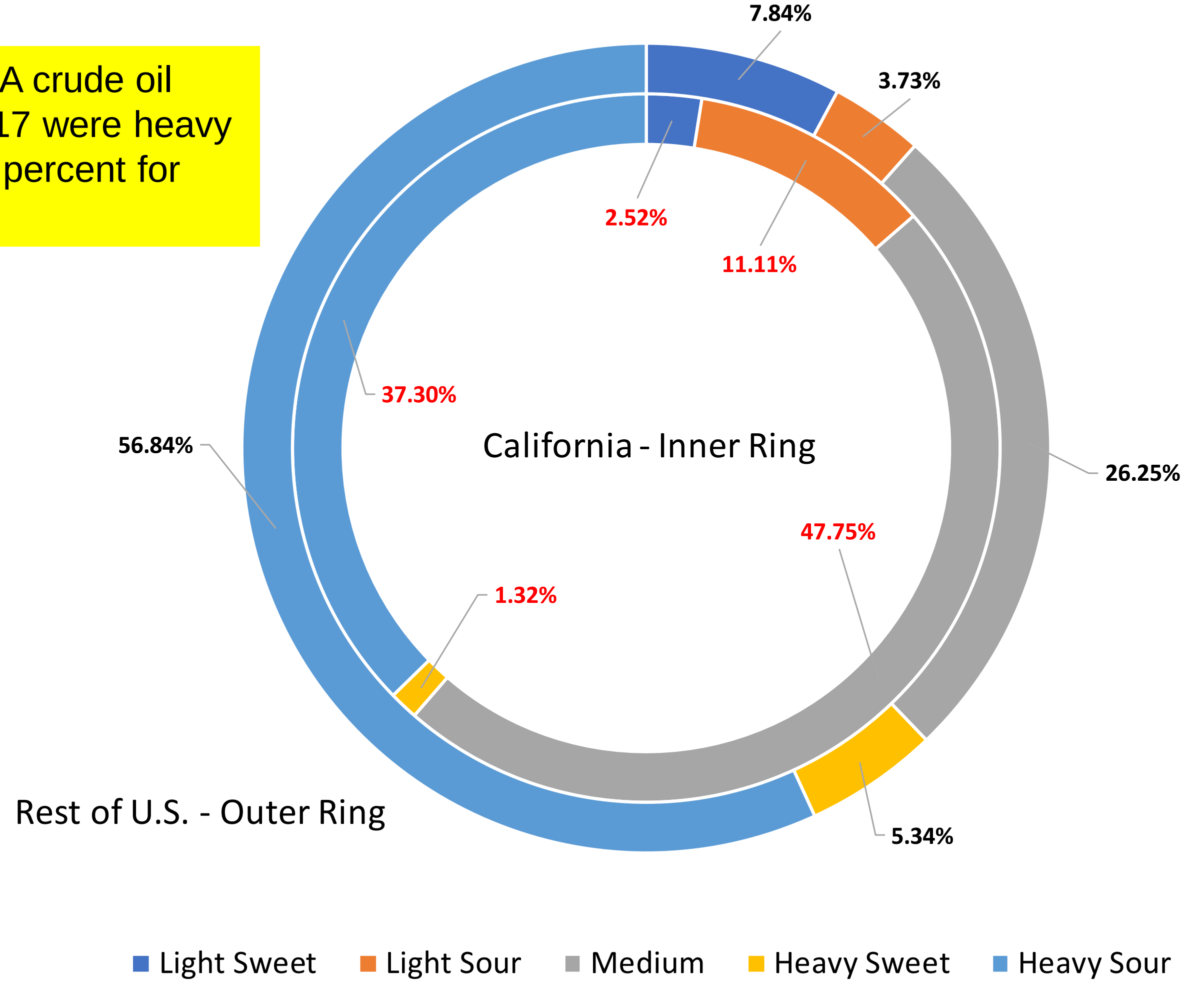




Sources: Eni's elaborations on Monthly Oil Data Services' OECD/International Energy Agency, 2017 data.

Import Quality – CA vs. Rest of U.S.

38.6 percent of CA crude oil imports during 2017 were heavy compared to 61.2 percent for rest of the U.S.



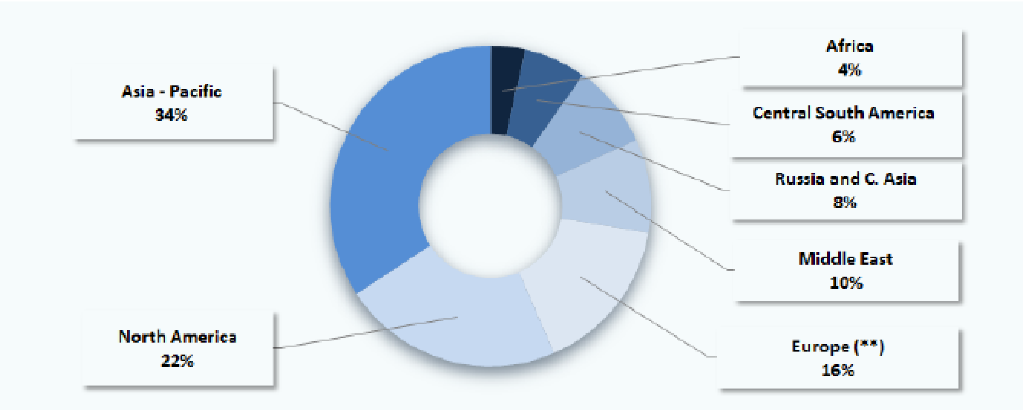
Source: California Energy Commission analysis of EIA data.

Refining Trends

Global Refining & Trends

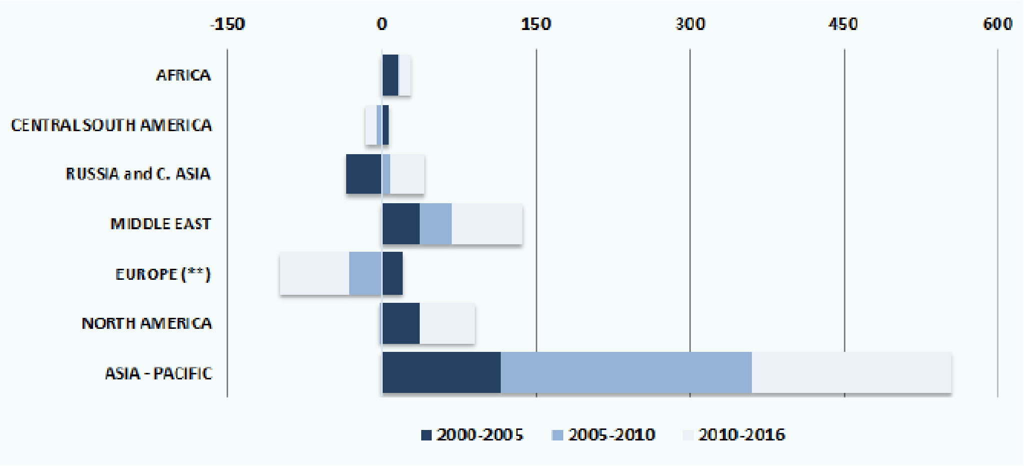
World Primary Capacity (2016)

4,882 million tons



World Primary Capacity Growth (2000-2016)

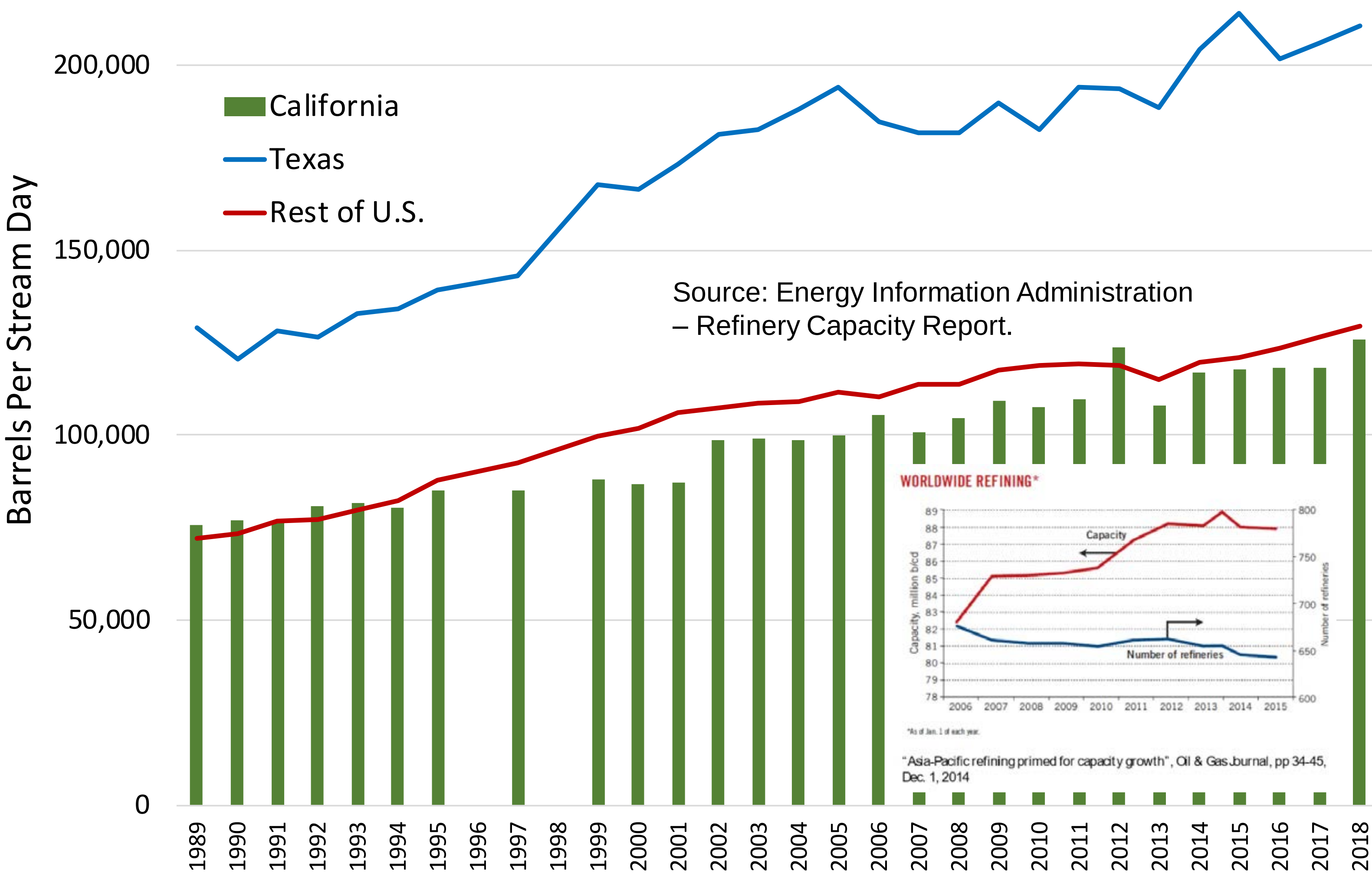
729 million tons



(*) Data source: Eni's calculations on Icis Consulting data.
(**) Belarus and Ukraine aren't included in Europe but in Russia and Central Asia.

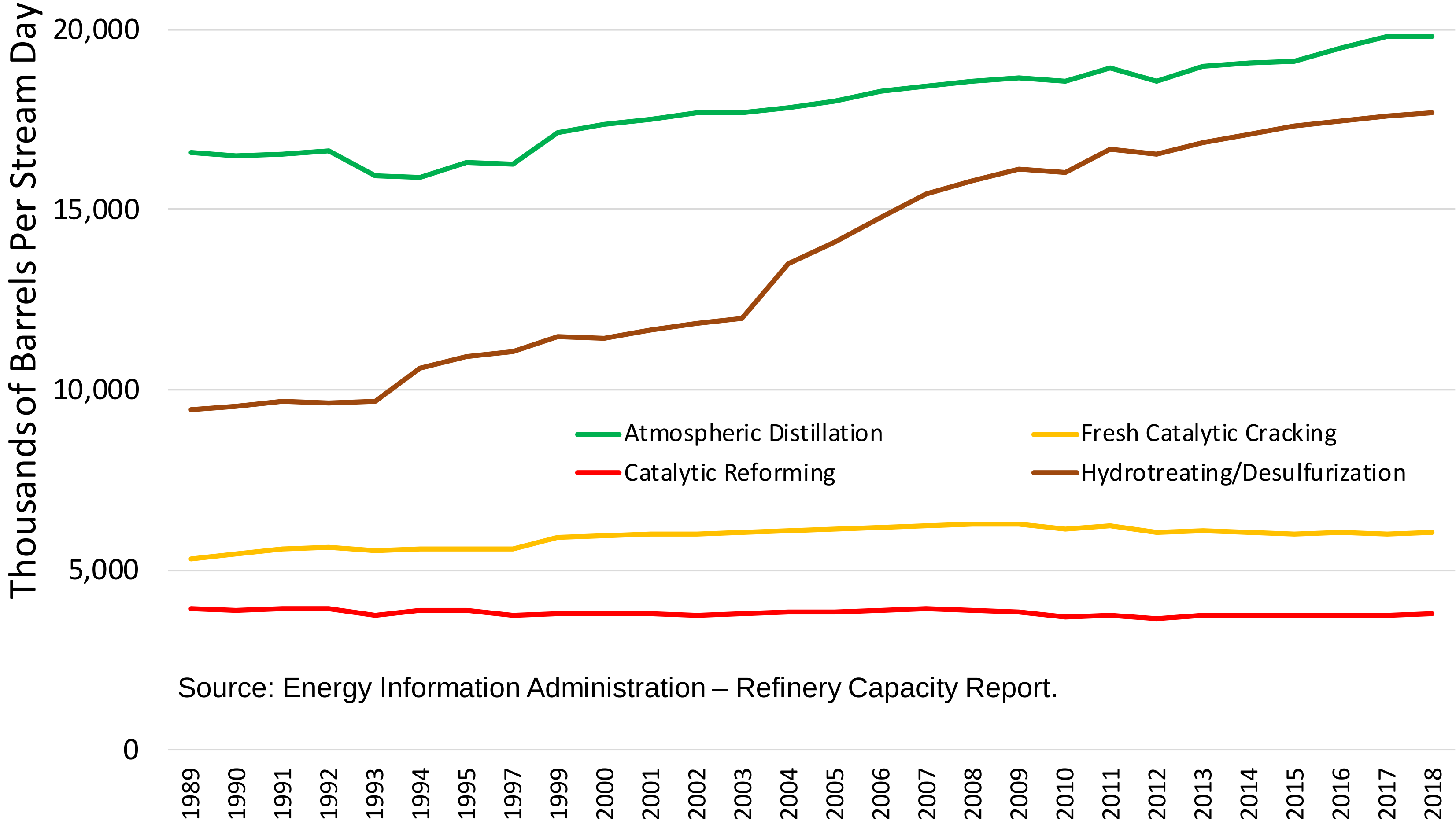
Distillation Capacity per Operating Refinery

Average size of operating refinery continues to rise through expansion & consolidation – faster rate in Texas.



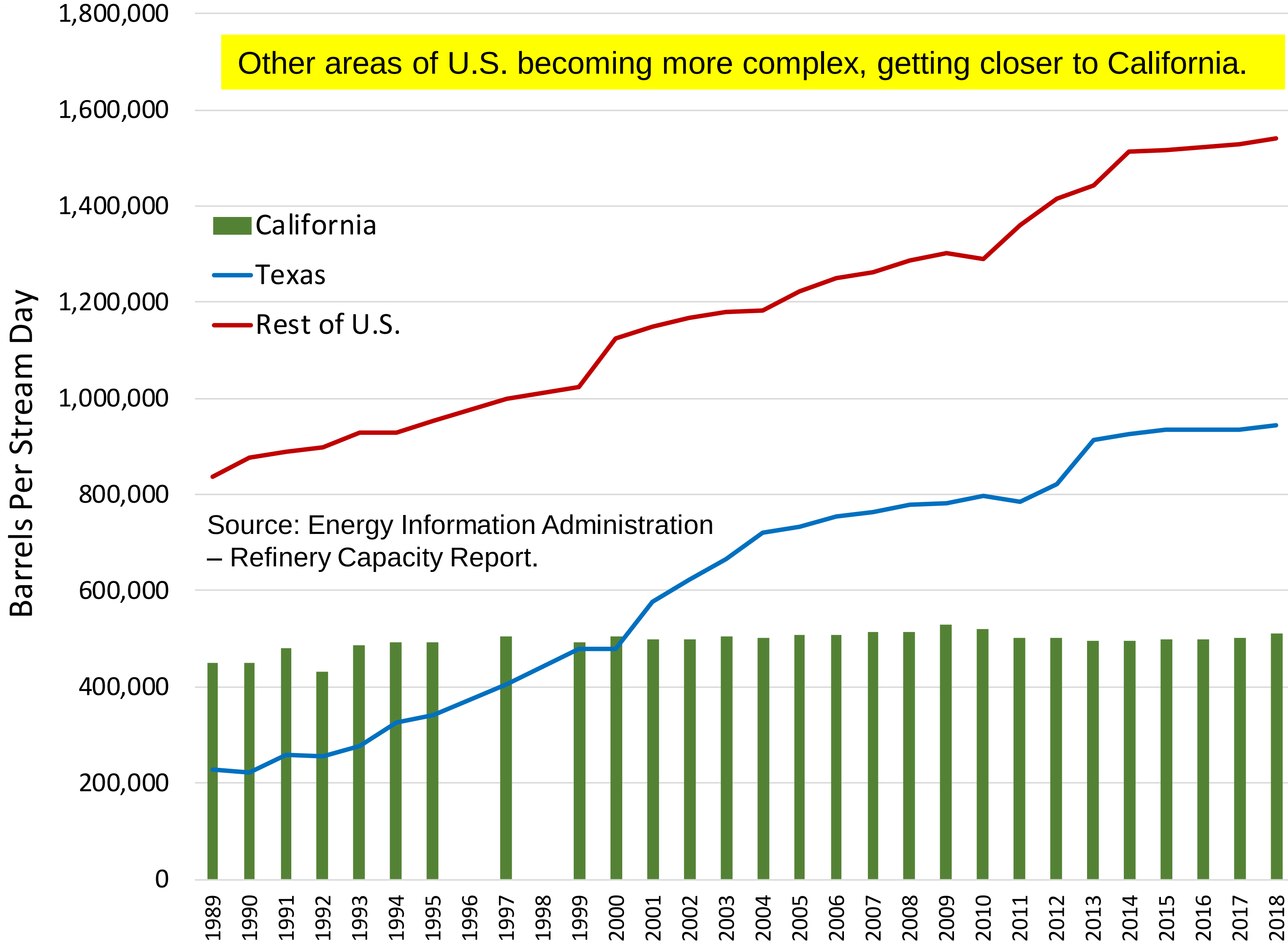
U.S. Refining Capacity – Selected Processes

Desulfurization capacity continues to rise as refiners adjust to handle higher sulfur crude oils & decreasing sulfur limits for refined fuels.



Source: Energy Information Administration – Refinery Capacity Report.

Coking Capacity Trends Vary



Refining Complexity Rises – All Regions

	2000						2005					
	Refineries (no.)	Primary Capacity (mmtons)	Primary Capacity (kbbl/d)	Conversion Capacity (FCC eqv.) (mmtons)	Complexity Ratio FCC eqv. (%)	Complexity Ratio NCI	Refineries (no.)	Primary Capacity (mmtons)	Primary Capacity (kbbl/d)	Conversion Capacity (FCC eqv.) (mmtons)	Complexity Ratio FCC eqv. (%)	Complexity Ratio NCI
Europe (**)	148	852	17,058	268	31	8.3	137	872	17,461	298	34	8.7
Russia and Central Asia	58	404	8,133	55	14	5.8	61	370	7,448	63	17	6.7
Middle East	46	325	6,527	52	16	5.4	47	361	7,324	61	17	5.5
Africa	47	142	2,837	16	11	4.9	46	158	3,154	26	17	5.6
Asia - Pacific	229	1116	22,369	398	36	7.0	243	1,232	24,684	552	45	7.4
Americas	256	1313	26,272	787	60	9.9	253	1,358	27,184	855	63	10.2
North America	*182*	*997*	*19,947*	*659*	*66*	*10.8*	*175*	*1,034*	*20,696*	*709*	*69*	*11.1*
Central South America	*74*	*316*	*6,325*	*128*	*41*	*7.1*	*78*	*324*	*6,488*	*146*	*45*	*7.3*
World	784	4,153	83,196	1,576	38	7.9	787	4,352	87,255	1,856	43	8.2

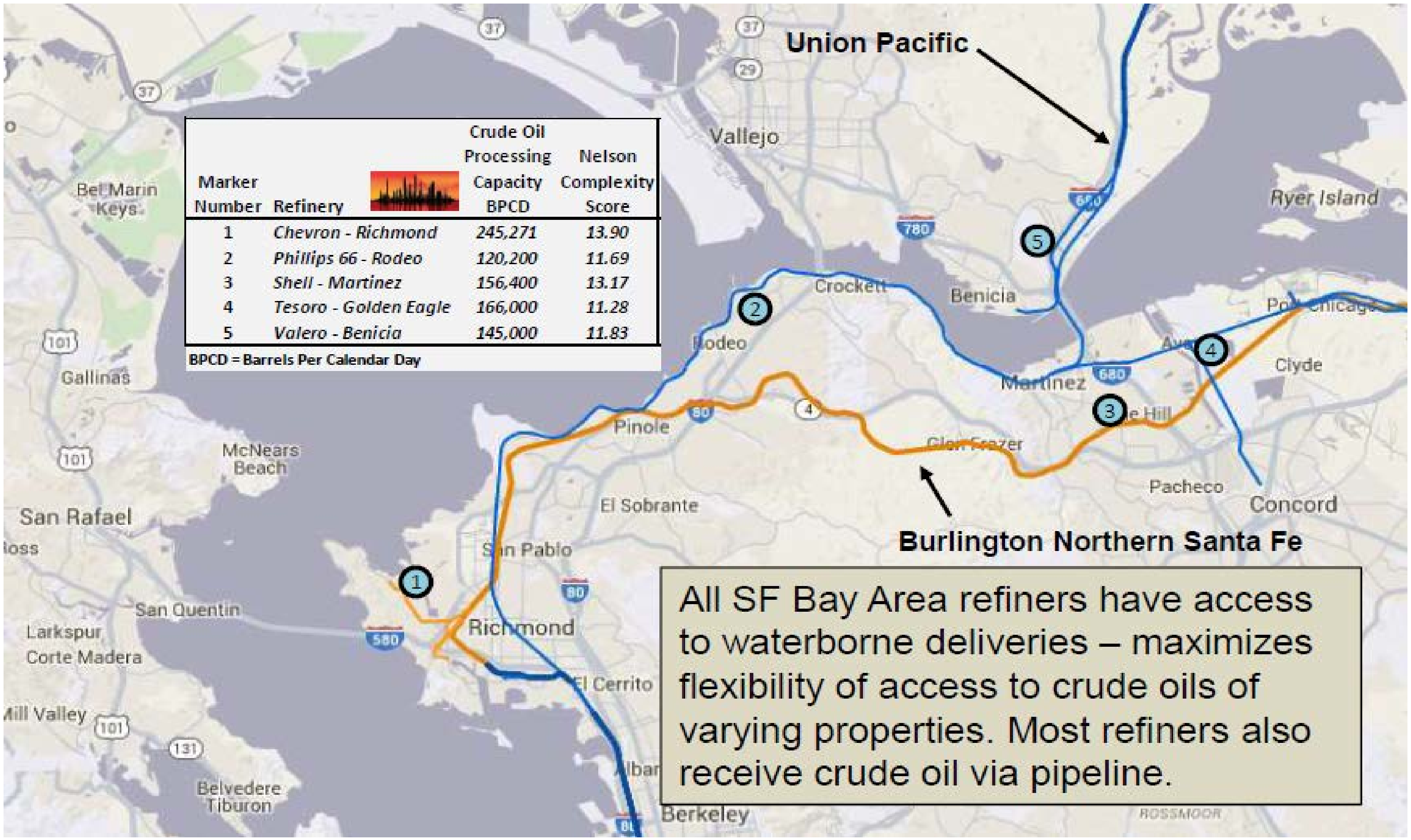
Global complexity up 17.7 % since 2000, Asia-Pacific up 34.3 % & North America up 7.4 %.

2010						2016						
Refineries (no.)	Primary Capacity (mmtons)	Primary Capacity (kbbl/d)	Conversion Capacity (FCC eqv.) (mmtons)	Complexity Ratio FCC eqv. (%)	Complexity Ratio NCI	Refineries (no.)	Primary Capacity (mmtons)	Primary Capacity (kbbl/d)	Conversion Capacity (FCC eqv.) (mmtons)	Complexity Ratio FCC eqv. (%)	Complexity Ratio NCI	
129	841	16,817	309	37	8.9	115	772	15,453	318	41	9.2	Europe (**)
66	379	7,619	66	18	6.9	71	412	8,310	89	22	7.4	Russia and Central Asia
57	394	8,006	79	20	6.0	57	461	9,366	135	29	7.1	Middle East
46	159	3,191	27	17	5.7	49	170	3,421	31	18	5.8	Africa
270	1,477	29,630	794	54	8.3	277	1,671	33,569	1,083	65	9.4	Asia - Pacific
242	1,353	27,075	873	65	10.5	239	1,395	27,947	931	67	10.7	Americas
167	*1,033*	*20,676*	*721*	*70*	*11.5*	*164*	*1,086*	*21,762*	*774*	*71*	*11.6*	*North America*
75	*319*	*6,399*	*153*	*48*	*7.4*	*75*	*309*	*6,185*	*157*	*51*	*7.8*	*Central South America*
810	4,602	92,338	2,149	47	8.7	808	4,882	98,066	2,586	53	9.3	World

Source: 2017 World Oil Review, Eni SpA.

Refinery Locations – Northern California

California refinery complexity generally higher than rest of United States.



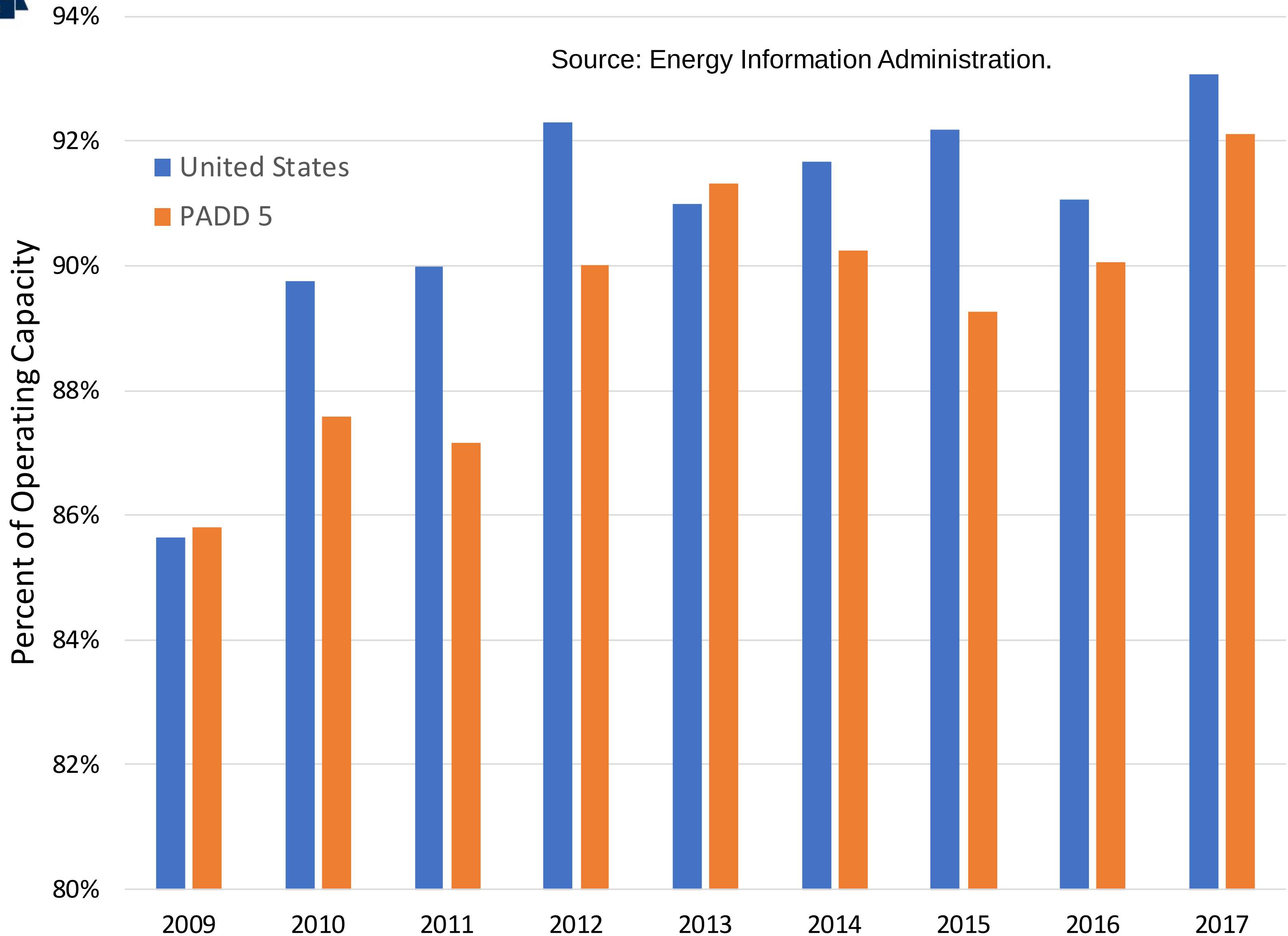
Marker Number	Refinery	Crude Oil Processing Capacity BPCD	Nelson Complexity Score
1	*Chevron - Richmond*	*245,271*	*13.90*
2	*Phillips 66 - Rodeo*	*120,200*	*11.69*
3	*Shell - Martinez*	*156,400*	*13.17*
4	*Tesoro - Golden Eagle*	*166,000*	*11.28*
5	*Valero - Benicia*	*145,000*	*11.83*

BPCD = Barrels Per Calendar Day

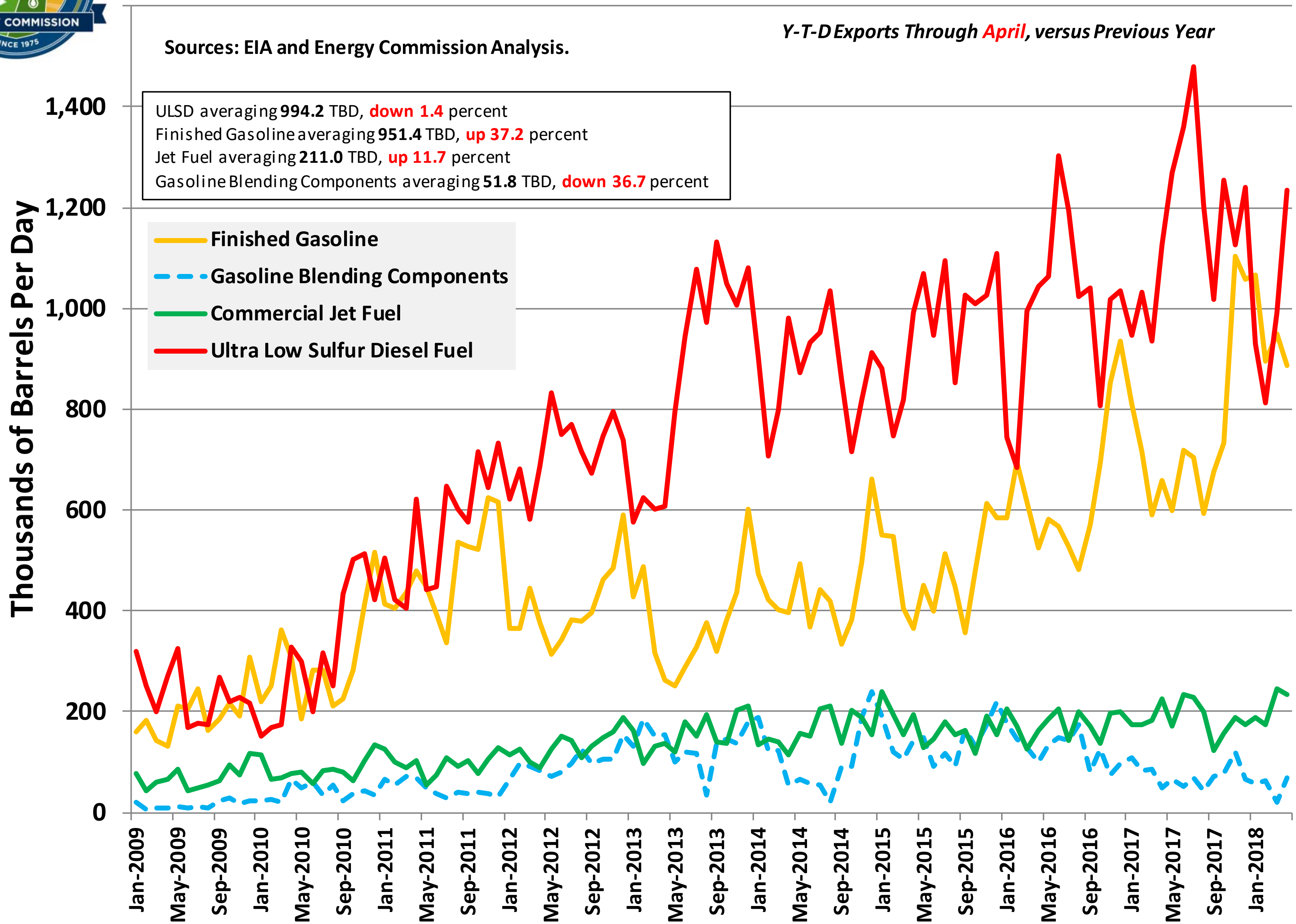
All SF Bay Area refiners have access to waterborne deliveries – maximizes flexibility of access to crude oils of varying properties. Most refiners also receive crude oil via pipeline.

Sources: Oil Change International map, Energy Information Administration refinery data, and Energy Commission analysis

U.S. Refinery Utilization - Increasing

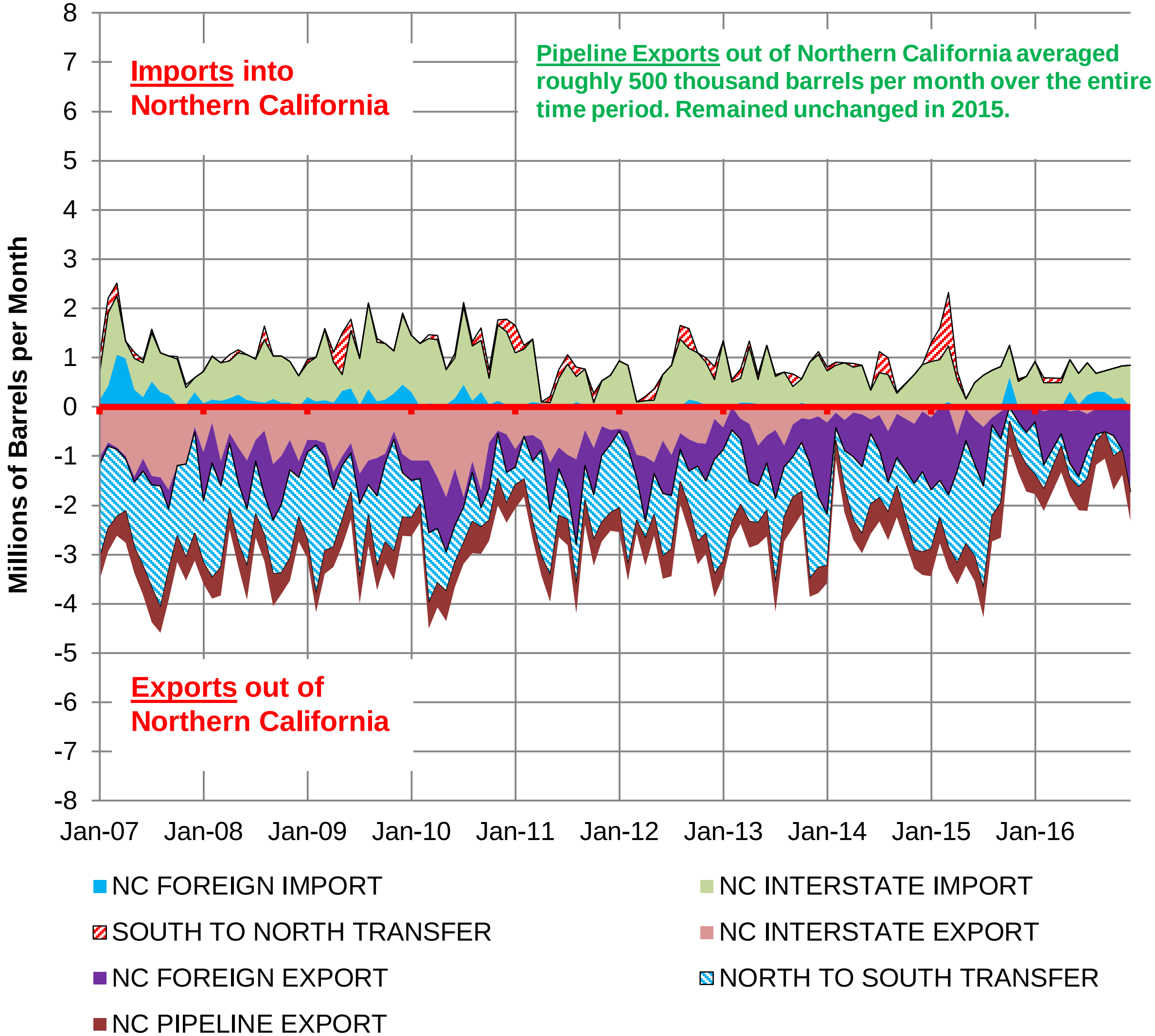


U.S. Transportation Fuel Exports Rising



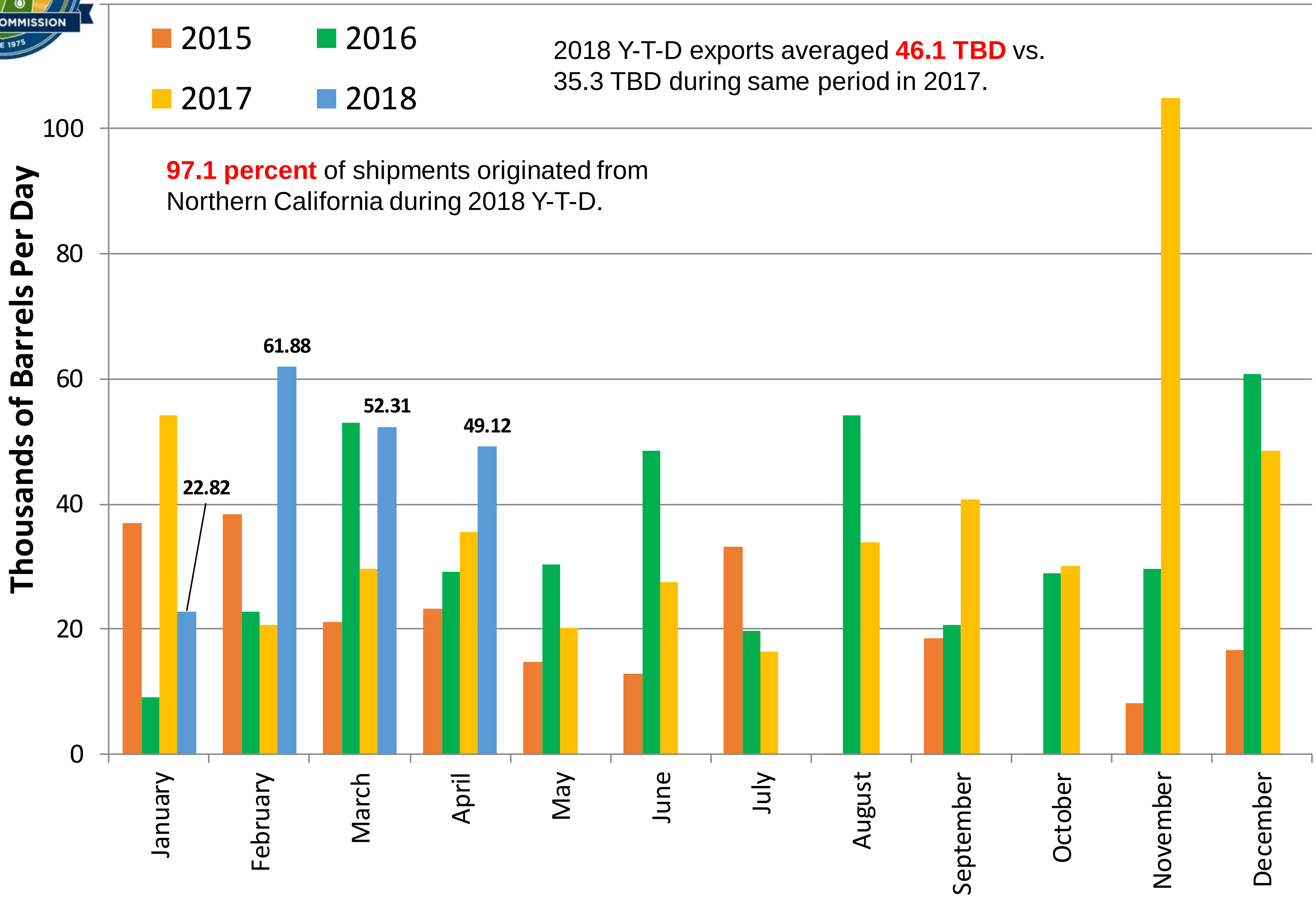
Gasolines Flows – Northern California

- Net exporter
- Foreign imports rare
- Domestic imports from WA refiners – steady
- Imports from S. Calif. intermittent & small – refinery outages
- Pipeline exports to Reno
- Foreign exports growing
- Domestic exports to PNW declined – replaced by WA refiners
- Exports to S. Calif. normal portion of their supply – volumes fluctuate based on refinery outages



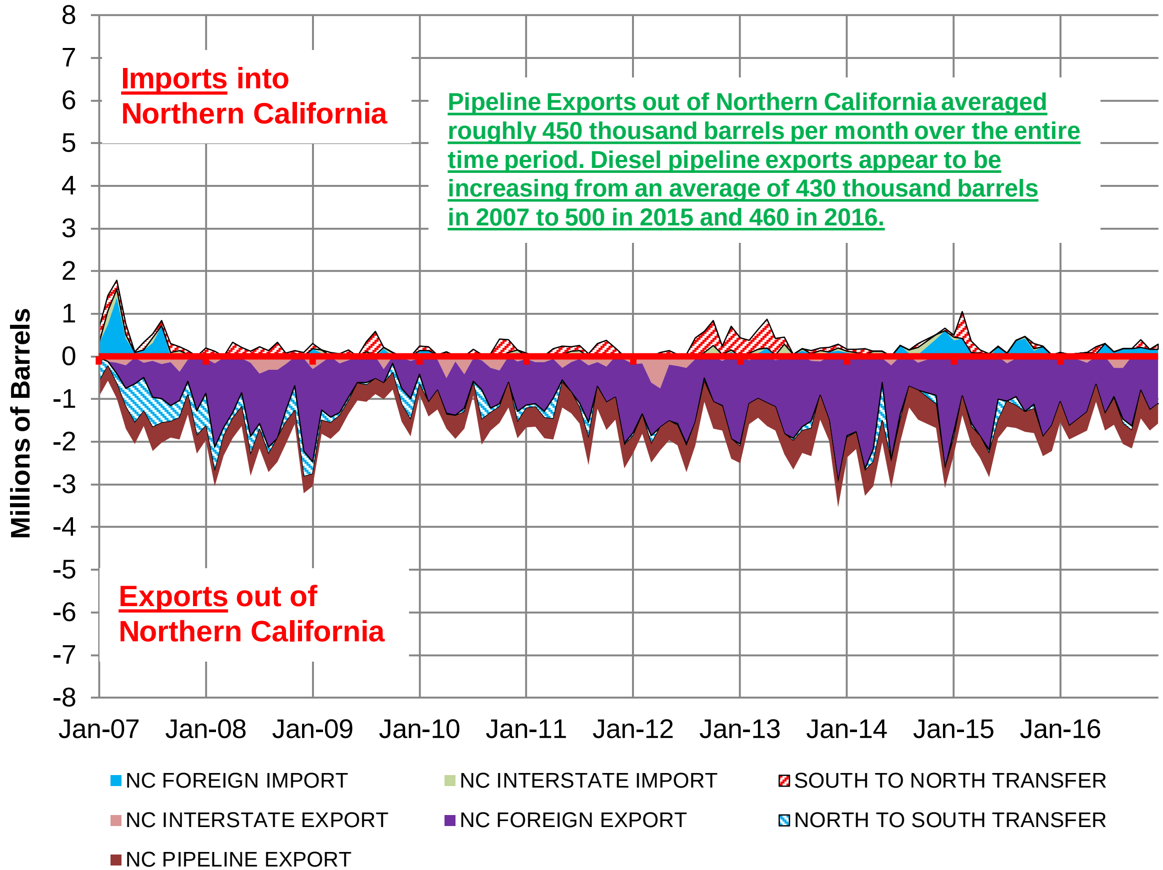
Source: California Energy Commission

California Foreign Gasoline Exports



Source: California Energy Commission analysis of the International Trade Commission's Interactive Tariff and Trade DataWeb.

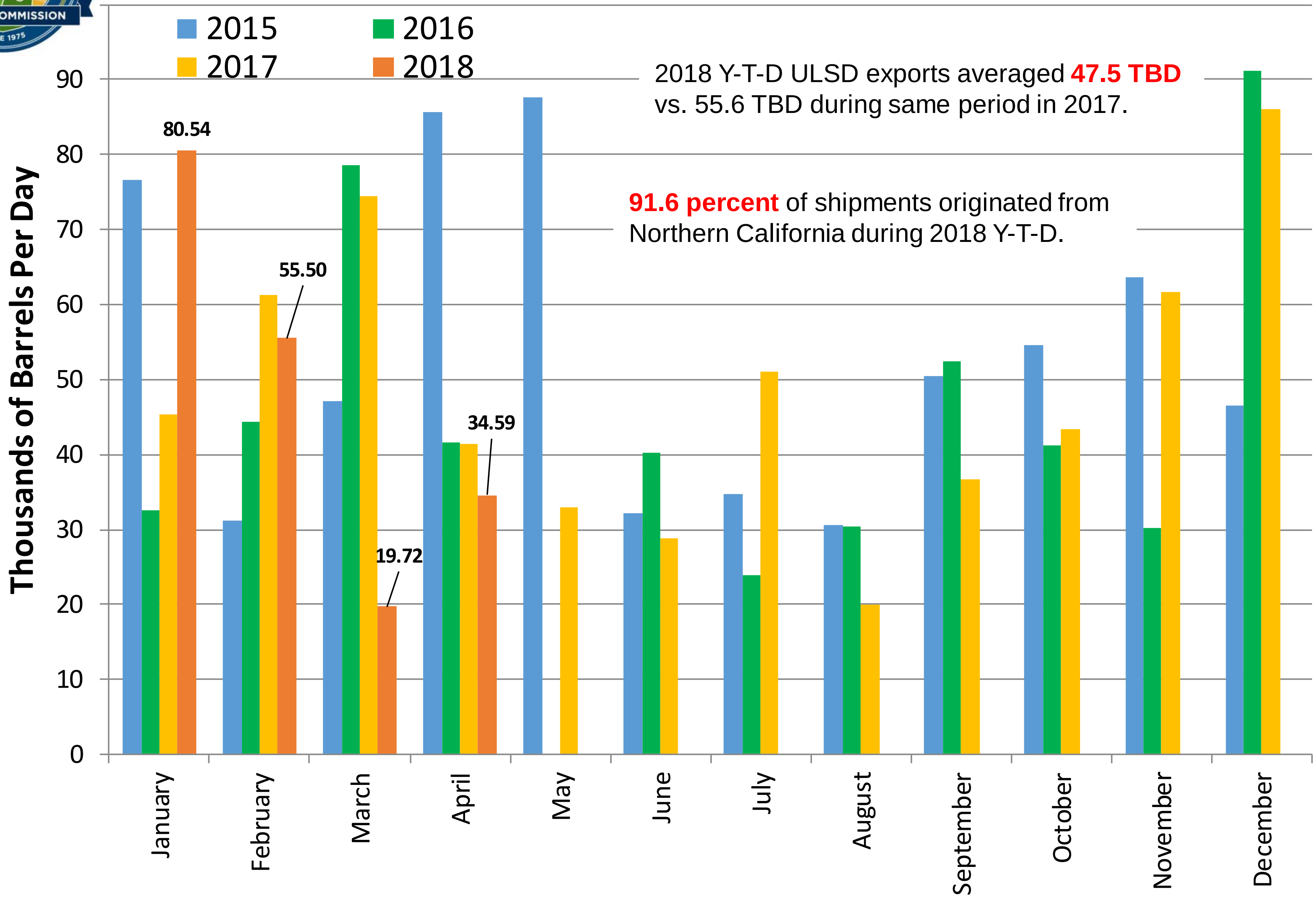
Diesel Flows – Northern California



Source: California Energy Commission

- Large net exporter
- Foreign imports rare
- Domestic imports from WA refiners – not needed
- Imports from S. Calif. Intermittent & small – refinery outages
- Pipeline exports to Reno
- Foreign exports growing
- Domestic exports to PNW small – replaced by WA refiners
- Exports to S. Calif. unusual

California Foreign ULSD Exports

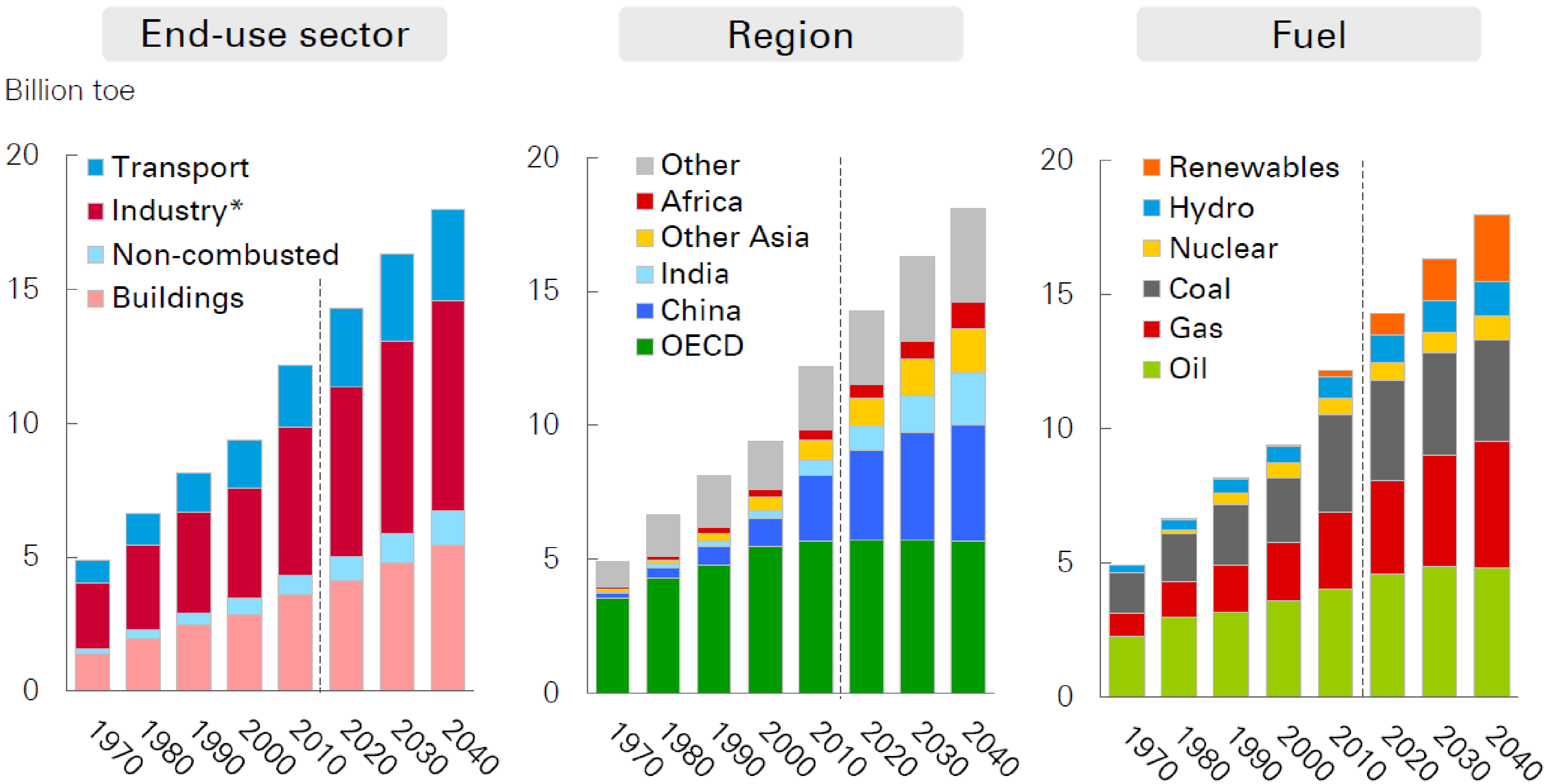


Source: California Energy Commission analysis of the International Trade Commission's Interactive Tariff and Trade DataWeb.

Global Transportation Market Trends

Global Energy Outlook

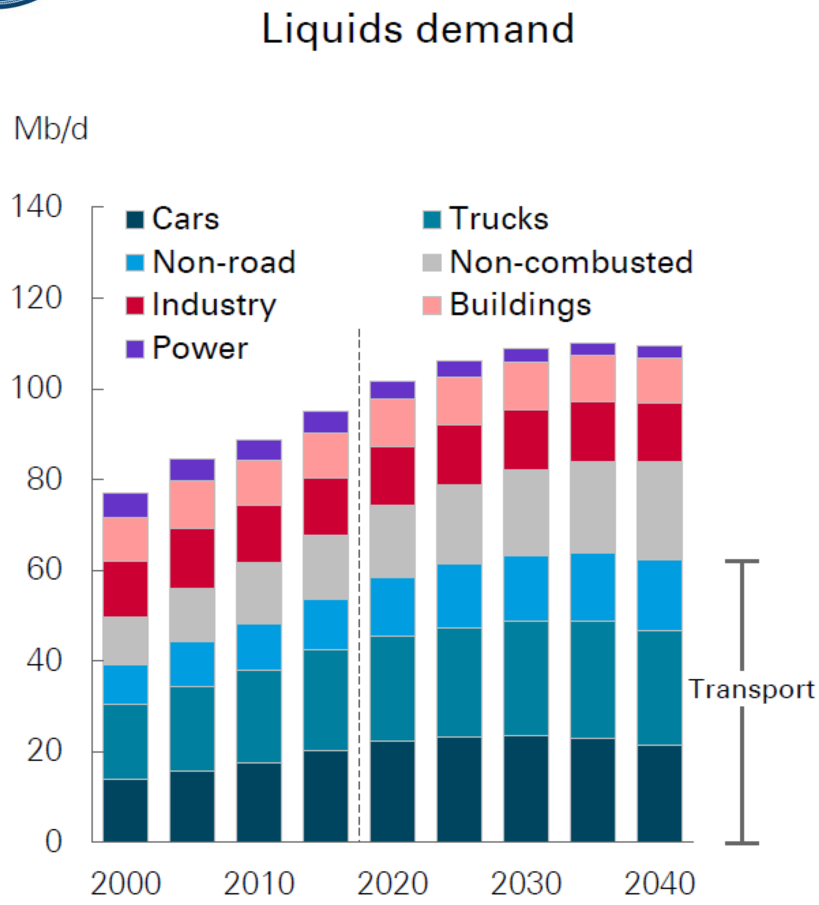
Primary energy demand



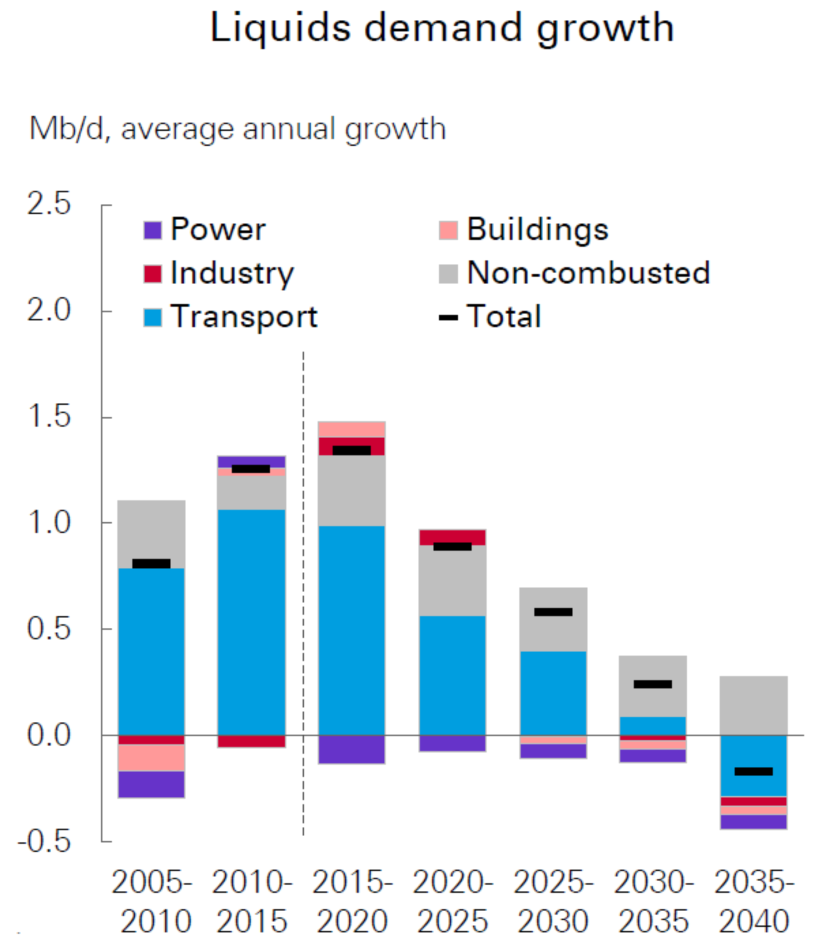
*Industry excludes non-combusted use of fuels

2018 BP Energy Outlook

Transportation Growth Rates Decline

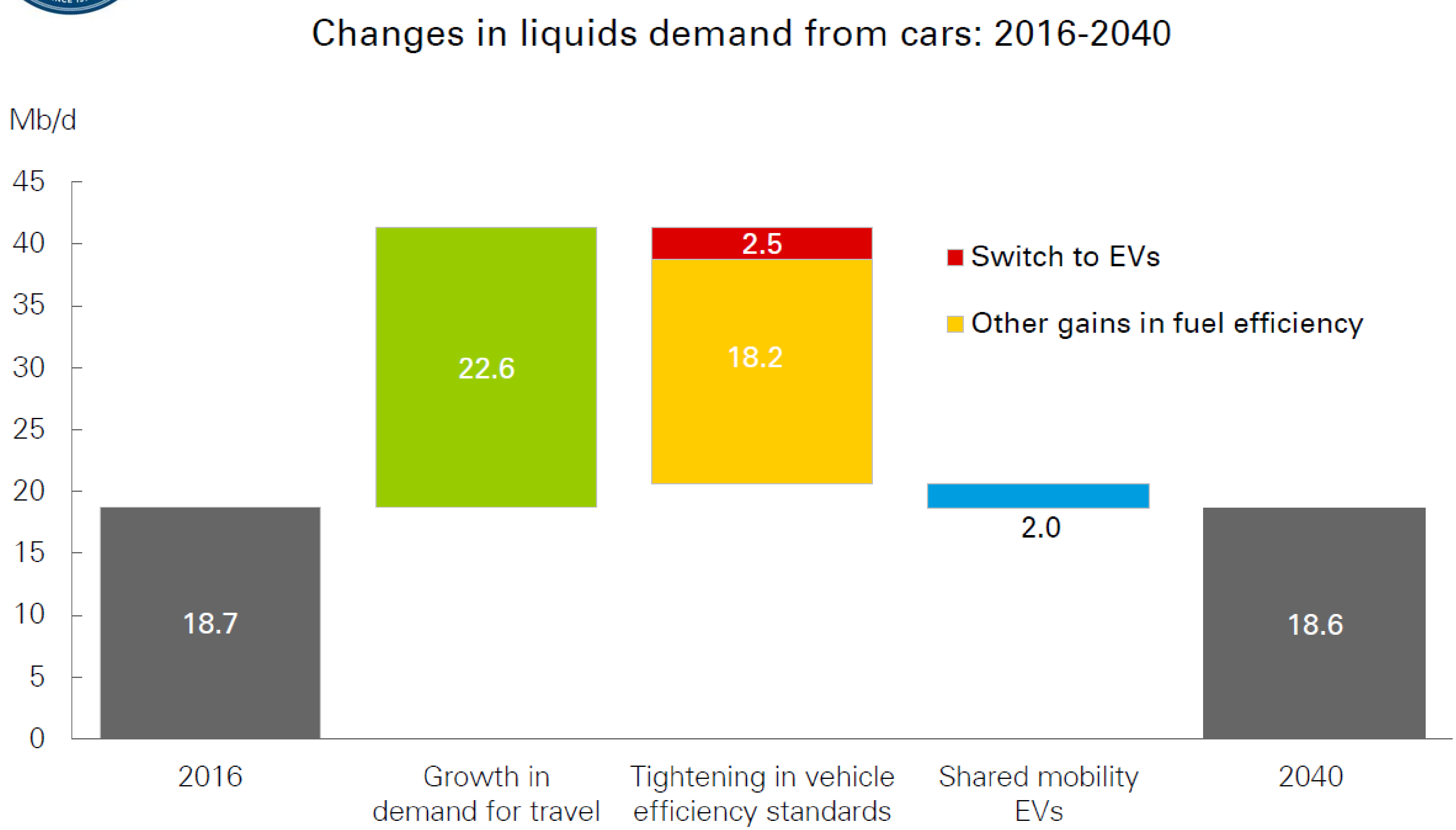


Cars include 2- and 3- wheelers. Trucks include most SUVs in North America.
Non-road includes aviation, marine and rail



2018 BP Energy Outlook

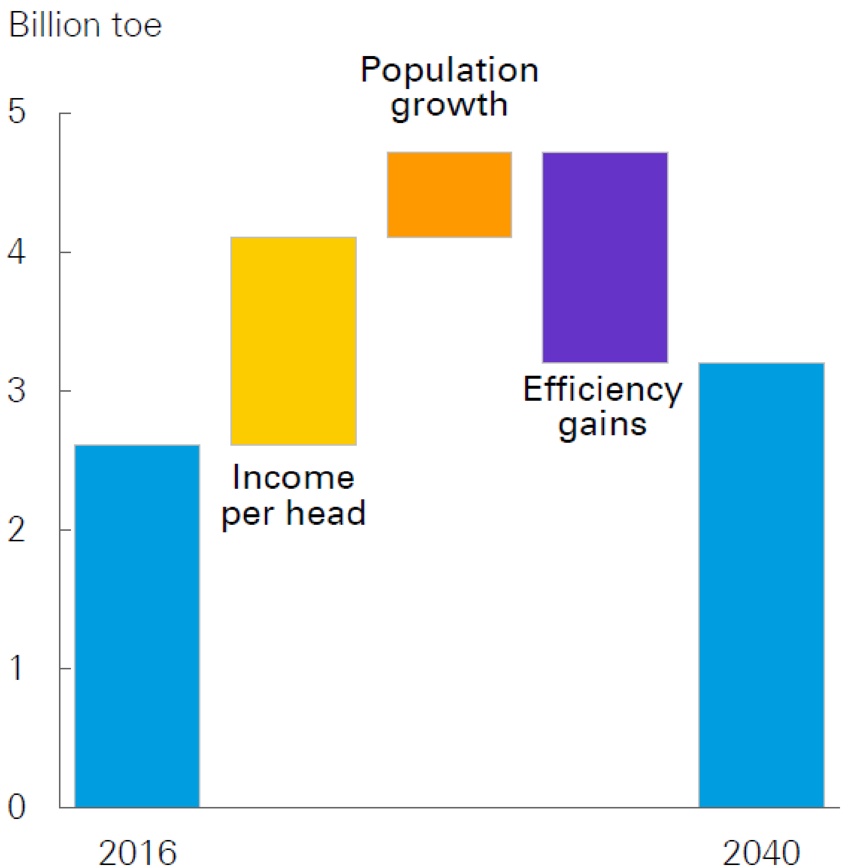
Car Transport Demand Growth Offsets



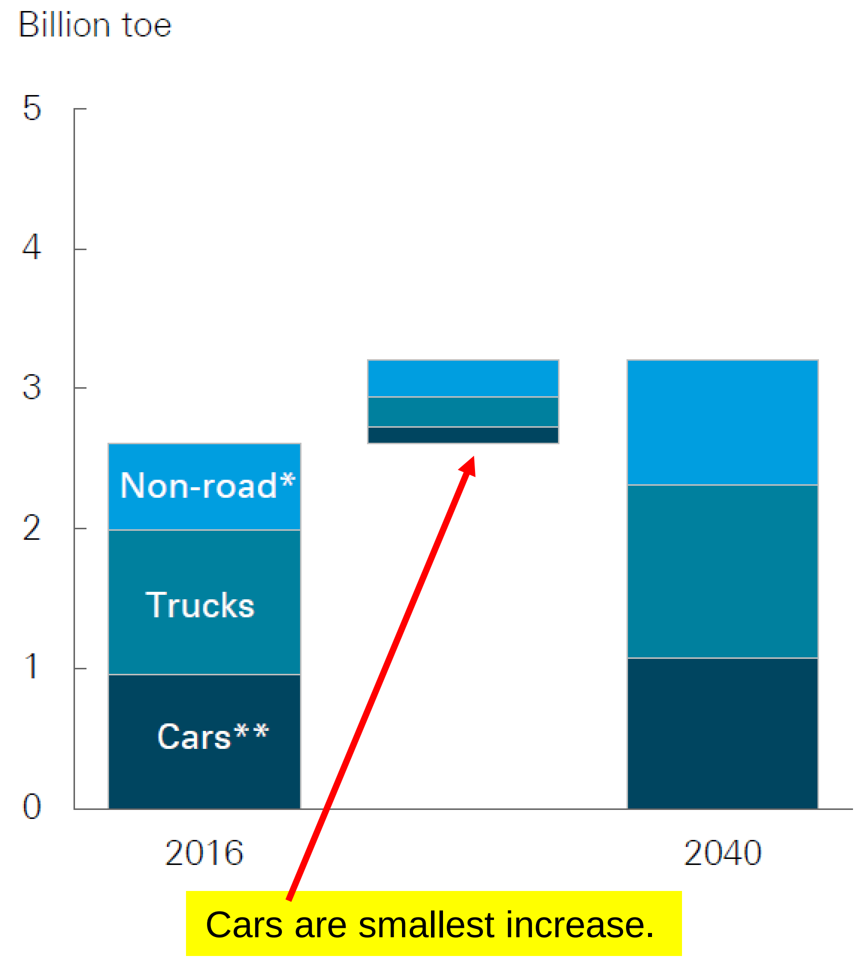
2018 BP Energy Outlook

Greatest Growth for Trucks & Non-road

Contributions to transport energy consumption growth

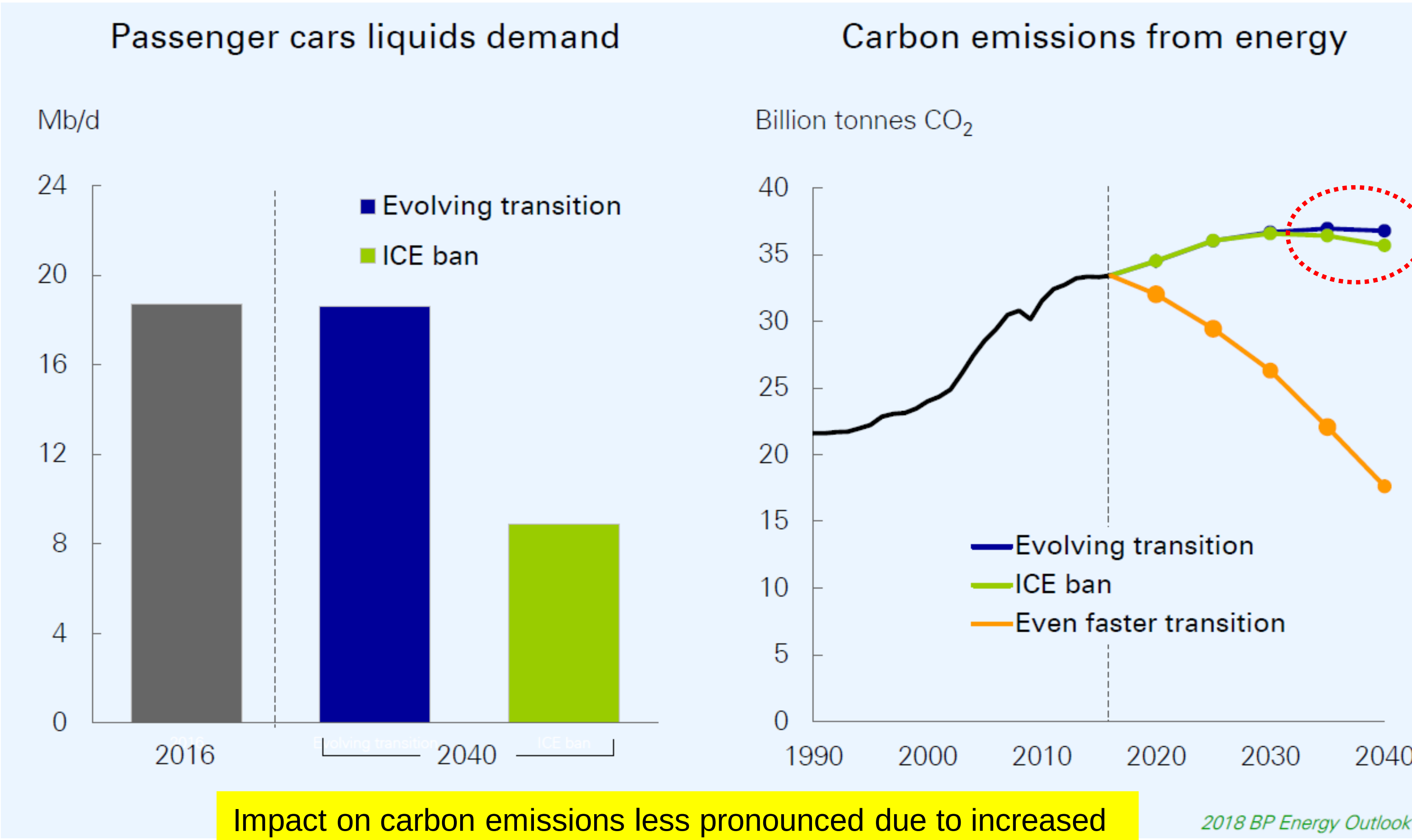


Transport energy consumption by mode



Source: 2018 BP Energy Outlook.

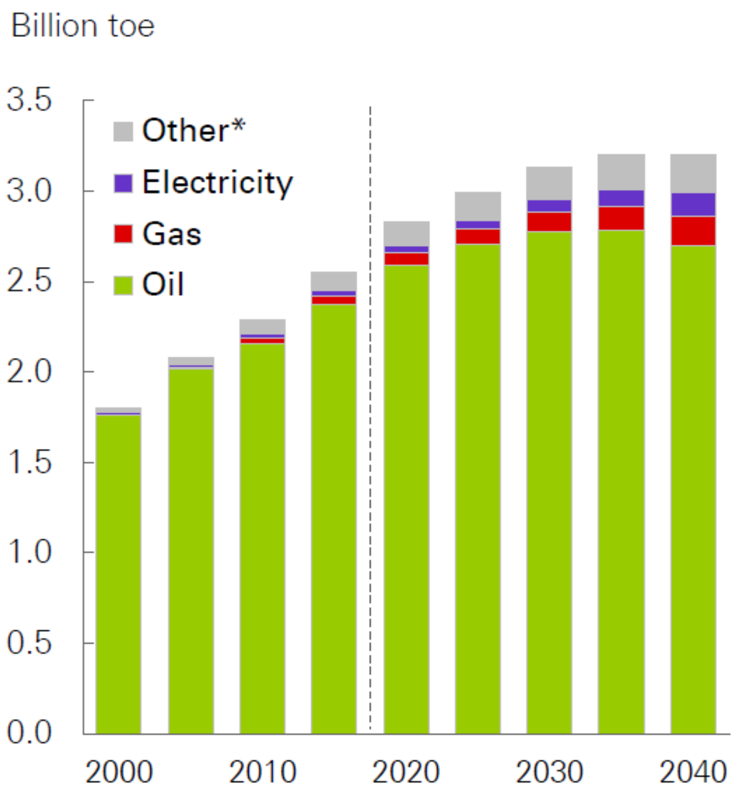
ICE Phaseout Scenario Reduces Fuel Demand from Cars



Impact on carbon emissions less pronounced due to increased energy demand in other end-use sectors (industrial & building).

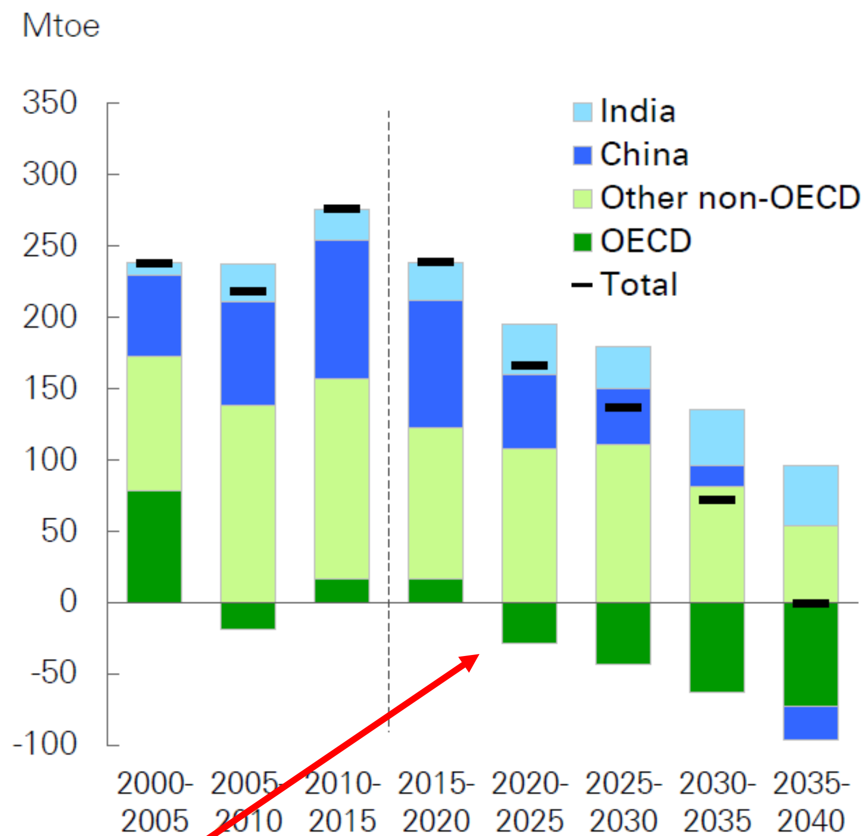
Oil Use for Transportation Peaking

Transport energy consumption by fuel type



*Other includes biofuels, gas-to-liquids, coal-to-liquids, hydrogen

Transport energy consumption growth by region



2018 BP Energy Outlook

Growth in Organization for Economic Co-operation and Development (OECD) decreases.

Additional Questions?

Source: Wonderfulengineering.com

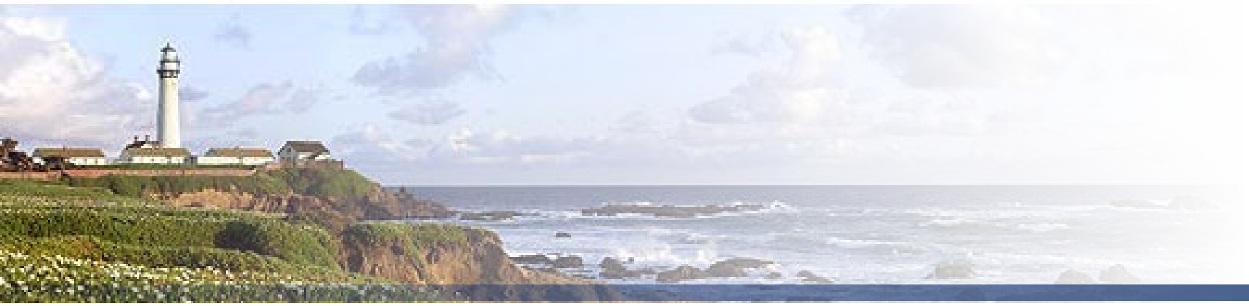
Bay Area Air Quality Management District

AGENDA: 4

Bay Area Refining Crude Slates
Ad Hoc Refinery Oversight Committee

Guy Gimlen

July 25, 2018



Outline

- Refining basics: separation, conversion, treating, & support
- California crude production in decline
- Concerns about tar sand crudes
- Typical refinery processes a mix of crudes
- Oil Climate Index assesses GHG impacts for transportation fuels
- Tar Sands crudes – very high GHG impacts
- Variety of other replacement crudes are available
- Replacement crudes by ship rather than pipeline
- Summary

Recap on Refining Basics

Separation

- Distill crude into various boiling ranges of hydrocarbons
  - Distilled at atmospheric pressure, then again under vacuum
- Light + Heavy Naphtha = Gasoline
- Kerosene = Jet Fuel
- Diesel = Diesel Fuel
- Atmospheric Gas Oil, Light Vacuum Gas Oil, Heavy Vacuum Gas Oil = Conversion unit feedstocks
- Residue (Residuum = Asphalt and Fuel Oil)
  - "Heavy" crudes have more gas oils and residuum that must be converted into gasoline, jet and diesel

Recap on Refining Basics Cont.

Conversion

- "Crack" large (30 – 100+ carbon) molecules into smaller (5 – 20 carbon) molecules (transportation fuels)
- Lighter gas oils to Hydrocrackers (cracking in hydrogen atmosphere)
- Heavier gas oils to Fluid Catalytic Crackers (FCC)
  - Cracking using silica catalyst resembling talcum powder
  - Carbon forms on the catalyst, must be burned off in the regenerator
  - Particulate emissions from regenerator stack

Recap on Refining Basics Cont.

Conversion Cont.

- Residuum to Cokers (or solvent de-asphalting)
  - Some residuum to asphalt (but more of a specialty product)
  - Cokers can crack to gasoline, but mostly crack to create additional gas oils
  - Coker gas oils must go to hydrocrackers or FCC's for further processing

Recap on Refining Basics Cont.

Treating

- Remove contaminants to meets product specifications
  - Sulfur & Nitrogen
- Reform molecules to meet product specifications
  - Octane & Aromatics (benzene, toluene, etc.)

Support

- Utility systems
- Wharves, boilers, electricity, steam, fuel gas, flares, waste-water treating

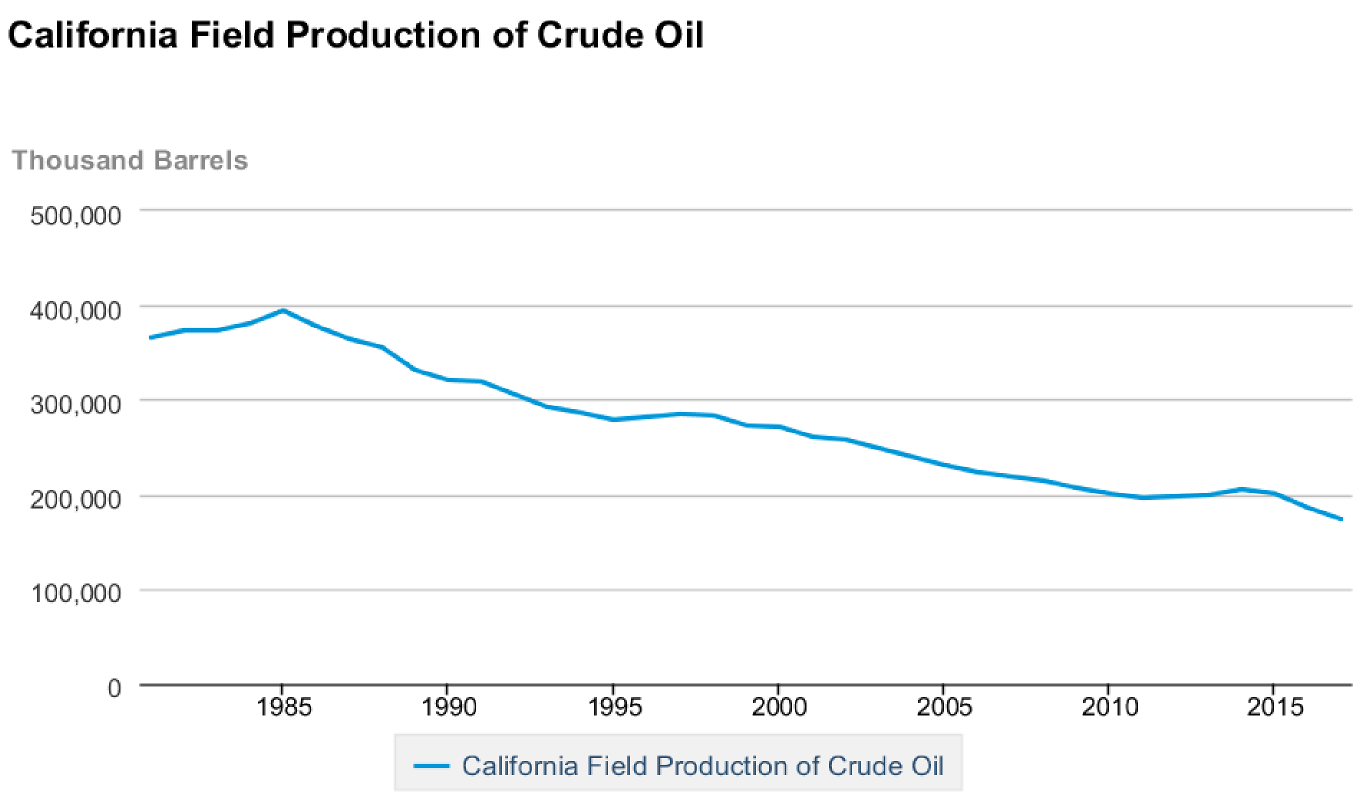
Visual aid for crude & refining is helpful

http://sciencenetlinks.com/interactives/energy/interactive/api_treat_012810.swf

Note, this link works in MS Edge, not in Google Chrome

California Crude Production in Decline

Concern is that California crudes will be replaced with Tar Sands crudes



Source: U.S. Energy Information Administration

Concerns About Tar Sands Crude

Extraction & Production are <u>Extremely</u> GHG Intensive

- Tar sands crudes are very heavy & energy intensive to produce
  - Heated to melt the asphalt (aka bitumen), then diluted with naphtha, jet or diesel so the mixture is liquid (diluted bitumen = dilbit)
  - Some bitumen is upgraded in a coker at the production site to make a "synthetic crude" (syn crude)
  - Sometimes mix dilbit and syn crude together
- Local concern is two-fold
  - High GHG emissions to produce tar sands crudes
    - so prefer to keep tar sands in the ground
  - Potential Local Health Impact of Bay Area refinery emissions

Tar Sands Crude – similar to California Crudes

- Impact on Bay Area Refinery Emissions
  - Heavy high sulfur crudes
    - require more processing,
    - use more energy, and
    - produce more GHG and criteria pollutants
  - However, tar sands crudes are similar to California crudes
  - Refineries have permit limits and physical constraints
  - Stated concerns have extrapolated the emissions from tar sands crudes beyond reasonable limits
- Instead
  - Refineries will likely replace current mix of crudes with a similar mix of crudes, including some tar sands crudes

Most Refineries Process a Mix of Crudes

- Typical refinery runs a mixture of crudes customized to take advantage of its processing capabilities
- Maximize profit by converting low cost raw materials into saleable products
  - Find the lowest cost (typically heaviest) crude oil
  - Maximize cracking to upgrade the non-saleable gas oils and residuum into saleable products
    - i.e. operate Hydrocracker, FCC and Coker at full capacity
  - Minimize fuel oil production (very low value product)
  - Distillation, treating and utilities enable the cracking processes

Oil Climate Index

- Independent assessment of GHG impacts for production and use of transportation fuels from various crudes
- Carnegie Endowment for International Peace
  - Developed an Oil-Climate Index (OCI) that estimates GHG impacts from crude production to end use of transportation fuel
    - Upstream = produce crude and transport to refineries
    - Midstream = refine crude and distribute products
    - Downstream = use transportation fuels in vehicles and equipment
  - Criterial pollutant emissions also correlate with energy use
  - More information at this website:

    http://oci.carnegieendowment.org/#

Oil Climate Index Cont.

- Total Oil Climate Index (oil field to vehicle exhaust)
  - Canadian tar sands crudes are 3 of the worst 10
  - Extremely high GHG emissions

	Crude	Total Oil-Climate Index (kg CO_2e/bbl)
1.	Canada Athabasca DC SCO	736
2.	Canada Athabasca FC-HC SCO	729
3.	California Midway Sunset	725
4.	Indonesia Duri	711
5.	Venezuela Hamaca	704
6.	California South Belridge	690
7.	Canada Cold Lake CSS Dilbit	667
8.	Nigeria Obagi	637
9.	Venezuela Tia Juana	633
10.	California Wilmington	625

Canadian tar sands: (yellow)

California crudes: (green)

Oil Climate Index Cont.

- Upstream Oil Climate Index (oil field to refinery)
  - Canadian tar sands crudes are 3 of the worst 10
  - Extraction and production are extremely energy intensive

	Crude	Upstream Oil-Climate Index (kg CO_2e/bbl)
1.	Canada Athabasca FC-HC SCO	206
2.	California Midway Sunset	180
3.	Venezuela Hamaca	173
4.	Texas Eagle Ford Condensate	166
5.	Canada Athabasca DC SCO	163
6.	Nigeria Obagi	159
7.	Indonesia Duri	154
8.	Nigeria Excravos Beach	138
9.	Canada Cold Lake CSS Dilbit	138
10.	Louisiana Lake Washington Field	136

Canadian tar sands: (yellow)

California crudes: (green)

Oil Climate Index Cont.

- Midstream Oil Climate Index (refining to sales)
  - California crudes are 3 of the worst 10
  - Extremely heavy and energy intensive to refine

Crude	Midstream (Refining) Oil-Climate Index (kg CO_2e/bbl)
1. California South Belridge	98
2. California Wilmington	90
3. Indonesia Duri	87
4. Brazil Frade	84
5. Venezuela Tia Juana	83
6. California Midway Sunset	81
7. China Qinhuangdao	67
8. China Bozhong	67
9. Canada Cold Lake CSS Dilbit	63
10. Venezuela Merey Blend	62

Canadian tar sands: (yellow)

California crudes: (green)

Marine Rather Than Pipeline Deliveries

As California crudes decline…

- Less crude flow from the San Joaquin Valley through pipelines
- Replacement crudes will, by necessity, come in by ships
- More shipping emissions
  - CARB proposing controls

Summary

- As California crude production declines, refiners will find other crude sources
- Concern about tar sands crudes particularly overall GHG emissions from crude production to end use
- Refinery processing and emissions are high for existing California crudes
  - Slightly less processing and emissions for tar sands crudes
- Existing permits, regulations, and physical capacity will constrain refinery crude slates, throughput, and emissions
- Rule 11-18 addresses toxics
- Rule 12-15 provides consistent information on Refinery on Material Input and Air Emissions

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

AGENDA: 5

What is the Legal Framework for Air District Operations?

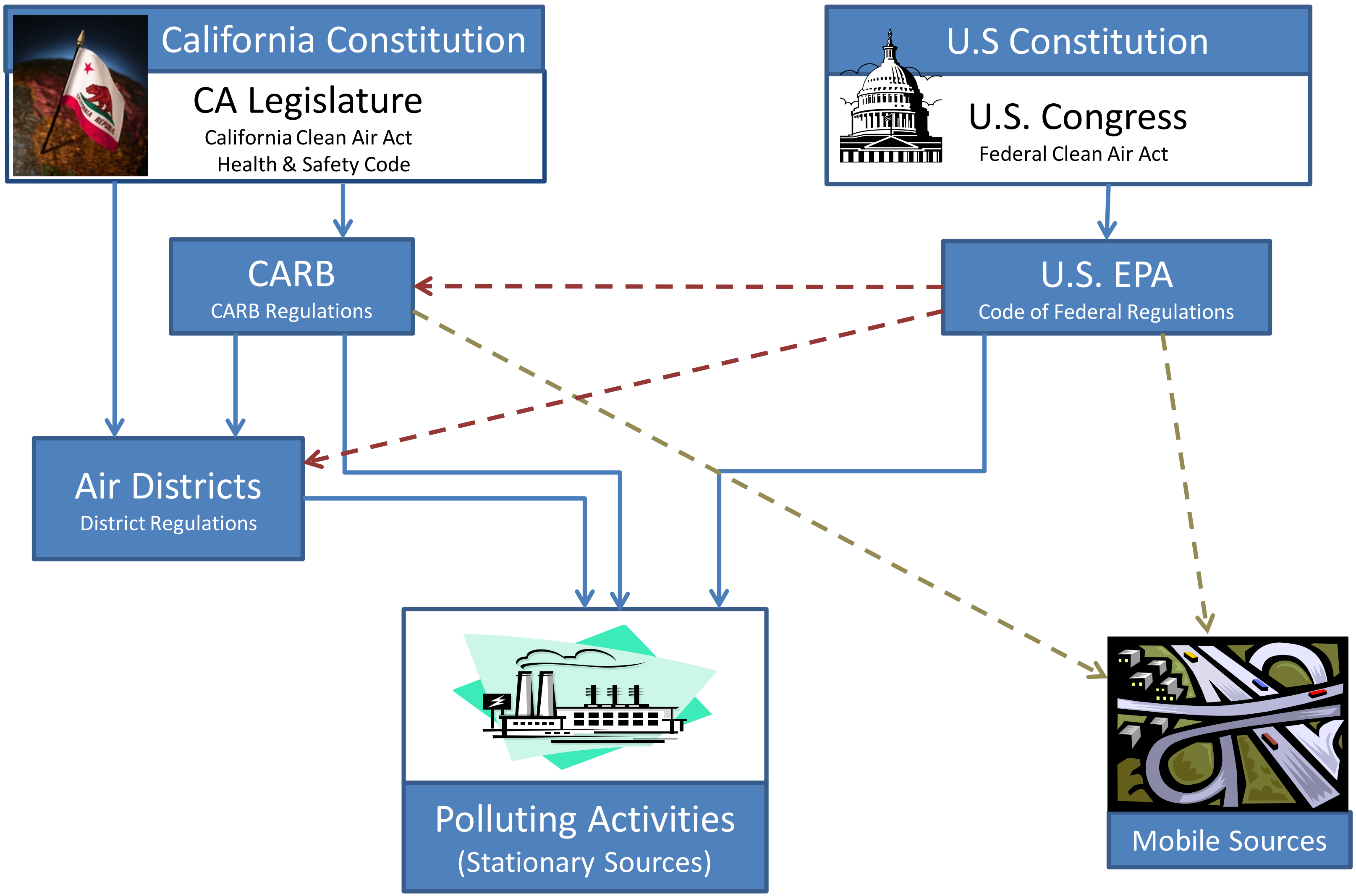
Ad Hoc Refinery Oversight Committee Meeting
July 25, 2018

Brian C. Bunger
District Counsel

Air Quality Problems

- **Criteria Pollutants**
  - **Federal and California: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, lead**
  - **California only: sulfates, hydrogen sulfide, vinyl chloride**
- **Air Toxics**
  - **Federal: hazardous air pollutants (HAPs)**
  - **California: toxic air contaminants (TACs)**
- **Greenhouse Gases (GHGs)**

Regulatory Framework



Air District Authority

- **Primary responsibility: control of air pollution from sources other than motor vehicles**

- **Powers to:**
  - **Adopt and enforce regulations**
  - **Require stationary source permits**
  - **Adopt fees**
  - **Adopt air toxic control measures**

Air District Authority Cont.

- **Powers to:**
  - **Regulate nuisances**
  - **Prohibit dark smoke**

- **Adopt state nonattainment plans**
  - **Adopt regulations necessary to execute duties**

Criteria Pollutant Control - Planning

- **Federal – federal attainment plans, e.g., 2005 Ozone Strategy**
  - **Must demonstrate attainment by a specified date**
  - **Plan Components**
    - **Inventory**
      - **Man-made (“anthropogenic”): stationary sources, area sources, motor vehicles**
      - **Natural (background/non-anthropogenic)**
    - **Modeling**
    - **Control strategy**
    - **“Commitments” for all source types**
  - **Penalties for failing to have plan**
  - **Joint adoption with Metropolitan Transportation Commission (MTC)**

Criteria Pollutant Control - Planning

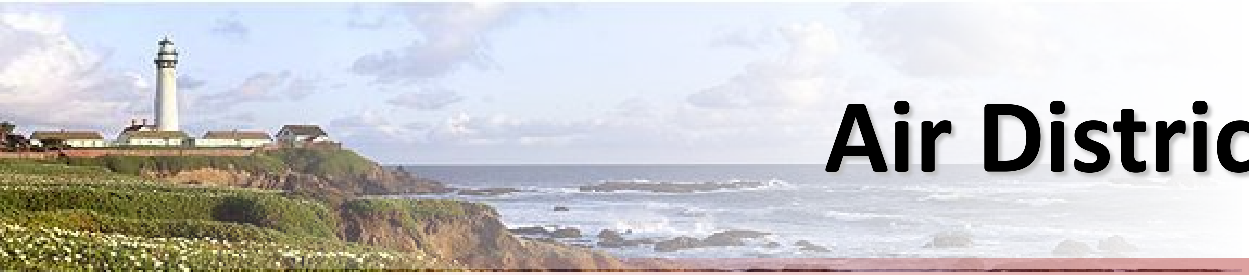
- **California – state attainment plans, e.g., 2017 Clean Air Plan**
  - **Must demonstrate 5% reduction in nonattainment pollutant emissions per year averaged over three years OR that Air District will implement "every feasible measure"**
  - **Plan components: stationary sources, transportation control measures, area/indirect**
  - **To be updated triennially**

Criteria Pollutant Control – Planning Cont.

- **Differences from federal**
  - **Plan elements limited to those within Air District authority**
  - **Continuous improvement rather than target dates**
  - **Ranking of measures**
  - **No citizen suit provisions**

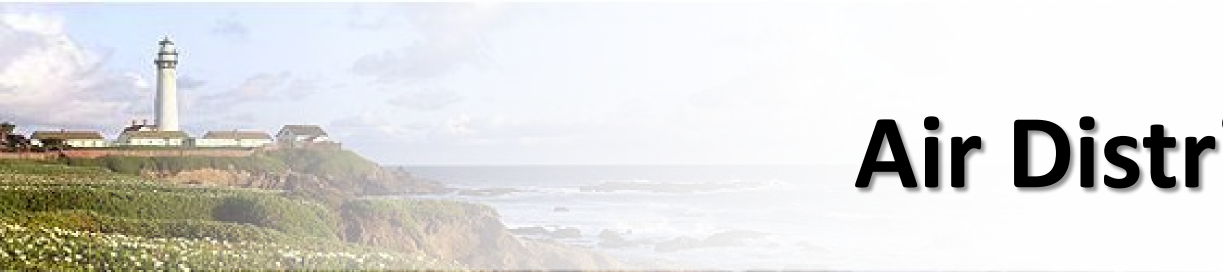
Criteria Pollutant Control - Regulations

- **Federal New Source Performance Standards**
  - **Detailed industry-specific regulations establishing emissions limits for specific items of equipment**
  - **Federal regulations directly applicable to sources**
- **Air District-Implemented Regulations Required by Federal and California Clean Air Acts**
  - **New Source Review Permit Program Requirements**
  - **Specific Regulatory Actions Committed to by District in Attainment Plans**
- **Additional Air District Regulatory Provisions**



Air District Regulations

- Substantive requirements
  - Best Available Retrofit Control Technology (BARCT)
  - Feasible measure
  - Federal requirements if submitted into California state implementation plan



Air District Regulations

- Procedural requirements
  - Noticed hearing
  - Analysis of overlapping requirements
  - Socioeconomic impact analysis
  - Incremental cost analysis
  - Board must find that rule meets requirements of necessity, authority, clarity, consistency, nonduplication, and reference

Criteria Pollutant Control – Permits

Pre-Construction Permits

- Pre-construction Permits for Major Sources
  - New Source Review – for non-attainment pollutants
    - Lowest Achievable Emissions Rate (“LAER”)
    - Emission Offsets – “No Net Increase” Requirement
  - “Prevention of Significant Deterioration” – for attainment pollutants
    - Best Available Control Technology (“BACT”)
    - Analysis of potential to cause violation of air quality standards

Criteria Pollutant Control – Permits

Pre-Construction Permits Cont.

- Pre-construction Permits for Non-major Sources
  - Minor New Source Review
  - Incorporates all other applicable regulatory requirements

Criteria Pollutant Control – Permits
Operating Permits & Equipment Registrations

- **Operating Permit Requirements**
  - **Air District "Permit to Operate"**
    - **Incorporates conditions from Authority to Construct**
    - **Applies to all sources, including existing sources**
  - **"Title V" Operating Permit**
    - **Consolidates major facility permit requirements in a single document for transparency and ease of review**
    - **Can also require additional conditions to improve enforceability, e.g. enhanced monitoring**
- **Equipment Registration Requirements for Certain Sources That Do Not Require Permits**
  - **small boilers**
  - **restaurant char-broilers**

Air Toxics Control

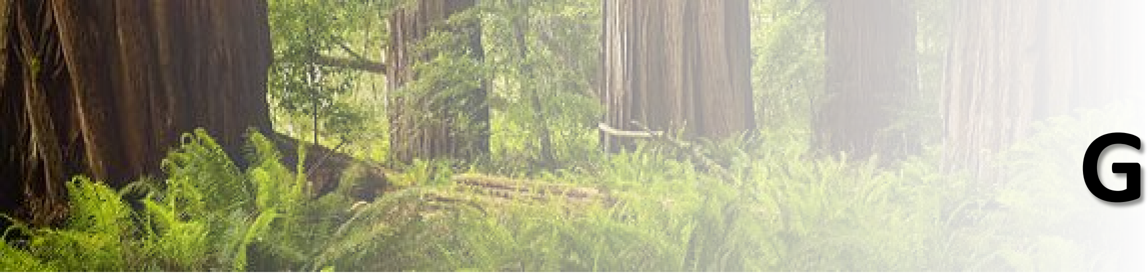
- **Regulations**
  - **Federal – source category toxics standards**
    - **Example – Refinery MACT**
    - **Example – Aluminum and other non-ferrous foundries area source standard (ZZZZZZ)**
  - **California –**
    - **ARB air toxic control measures**
    - **California Toxics Hot Spots Program**
    - **AB 617 – Community monitoring and emission reduction plans**
  - **District –**
    - **Air District source category toxics rules**
    - **Regulation 11, Rule 18 – reduction of air toxics risk from existing facilities**

Air Toxics Control Cont.

- Permits
  - Federal – Title V incorporates federal toxics requirements
  - District –
    - New Source Review of Toxic Air Contaminants
    - Incorporate source category toxics requirements

Greenhouse Gases

- **Federal – Permit requirements for large emitters:**
  - **Requirements apply to facilities with emissions over the “major facility” threshold for some other regulated pollutant and a GHG increase of more than 75,000 tons per year (tpy)**
  - **“Prevention of Significant Deterioration” pre-construction permits**
  - **“Title V” Operating Permits**



Greenhouse Gases

- **California – Various regulatory initiatives, including:**
  - **ARB's AB 32 implementation efforts (cap-and-trade, etc.)**
  - **Utilities' renewable energy portfolio standards ("RPS")**
  - **Motor vehicle tailpipe standards ("Pavley Bill")**
  - **AB 398 – Cap-and-Trade program authorized through 2030**
  - **2030 Scoping Plan approved December 2017**

Greenhouse Gases

- **District –**
  - **AB 398**
    - **Removed Air District authority to regulate CO_2 at cap-and-trade facilities**
    - **Reaffirmed authority to otherwise regulate GHGs**
  - **Permit fees based on GHG emissions**
  - **Permit requirements for GHG emissions**

Other Topics

- **California Environmental Quality Act (CEQA)**
- **SB 375 – The Sustainable Communities Strategy and Climate Protection Act**
- **District Consultative Policy Role**
  - **Regional Transportation Plan (RTP)**
  - **Joint Policy Committee (JPC)/Bay Area Regional Collaborative (BARC)**
- **Prohibition on Public Nuisances**
- **Regulating Visible Emissions**