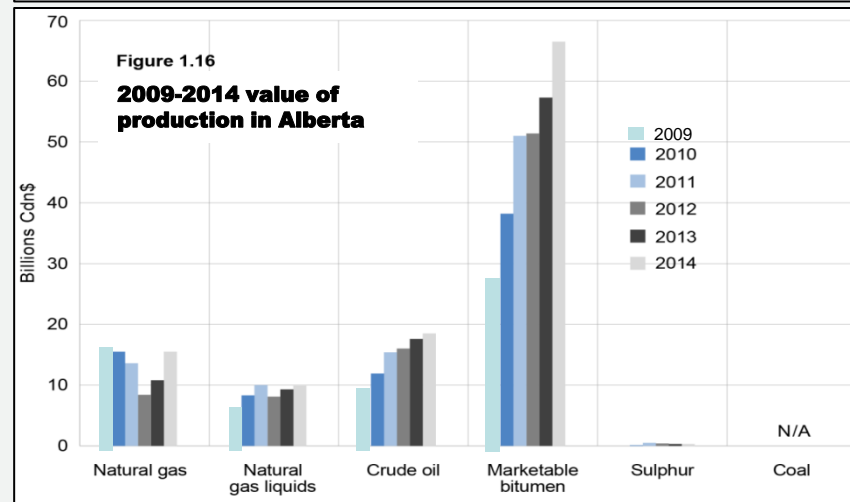
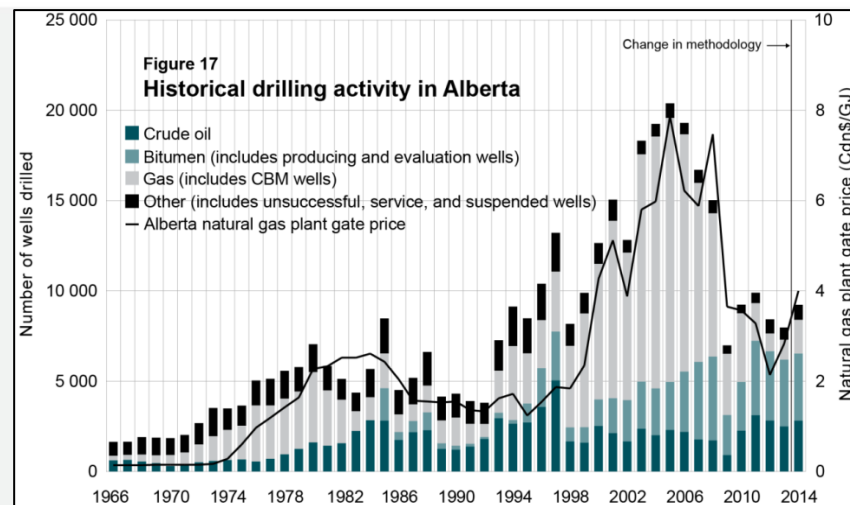
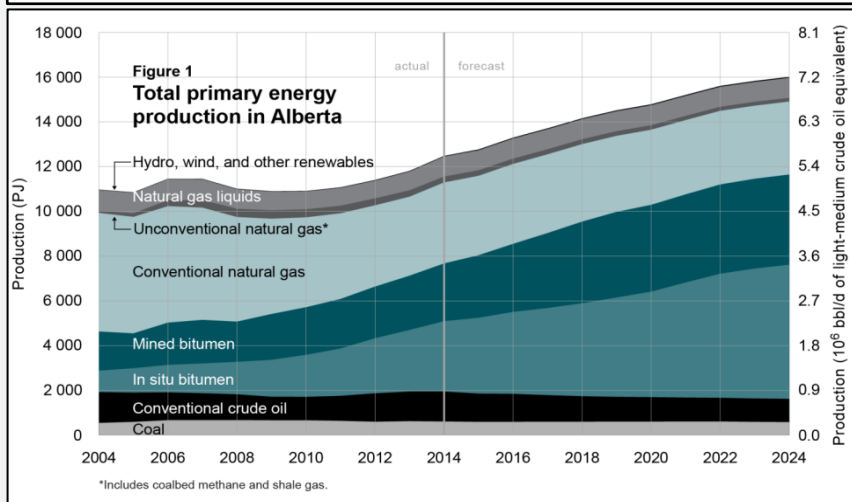
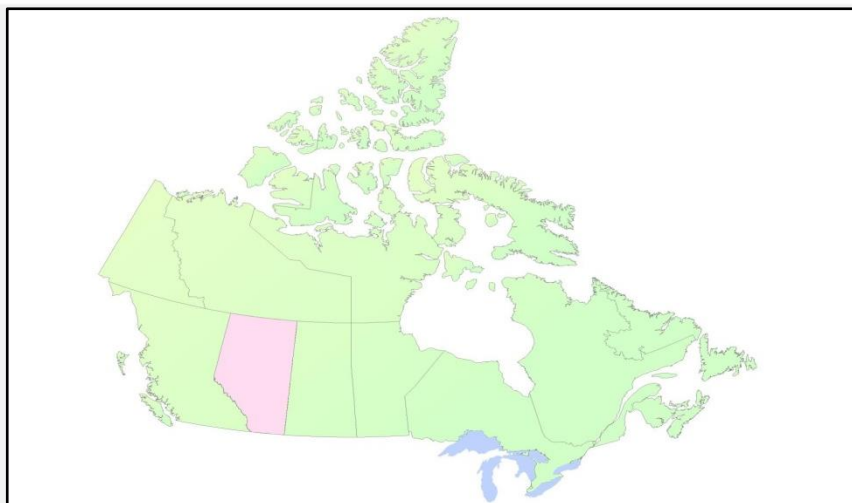


Assessment of Non-saline Water Use in Alberta's Upstream Oil and Gas Sector between 2004 and 2013: Implications on Forecasted Water Use

T.G. Lemay

October, 2015

Background - Energy Development



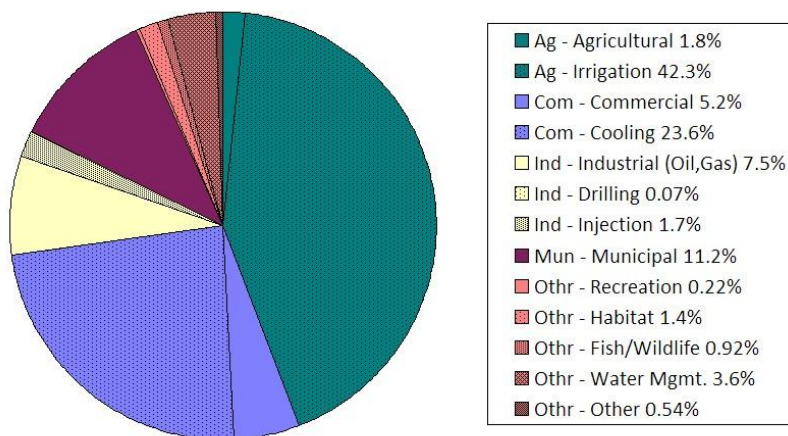
Source: Alberta Energy Regulator ST-98 (2014)

www.ags.gov.ab.ca

Background - Water Allocations

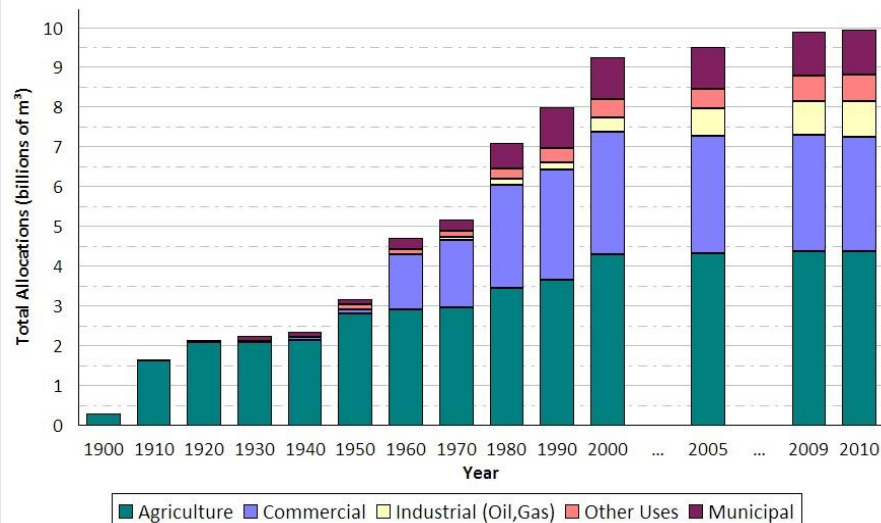
2010 Allocations in Additional Detail

Government
of Alberta
Environment



Sectoral Water Allocations Index

Government
of Alberta
Environment



Oil & Gas allocations: $\sim 7.5 + 0.07 + 1.7 = 9.3\%$

2005: 5.2%, 0.11% and 1.8%

2008: 6.1%, 0.23% and 1.9%

Total allocations in 2010 ~ 10 billion m³

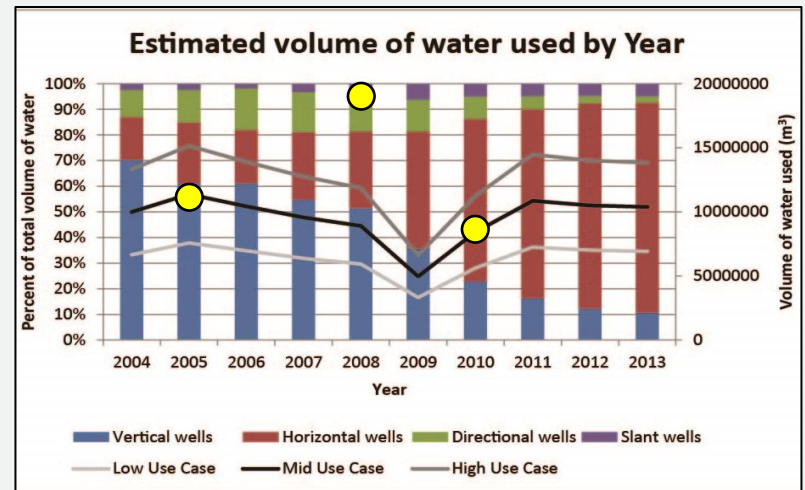
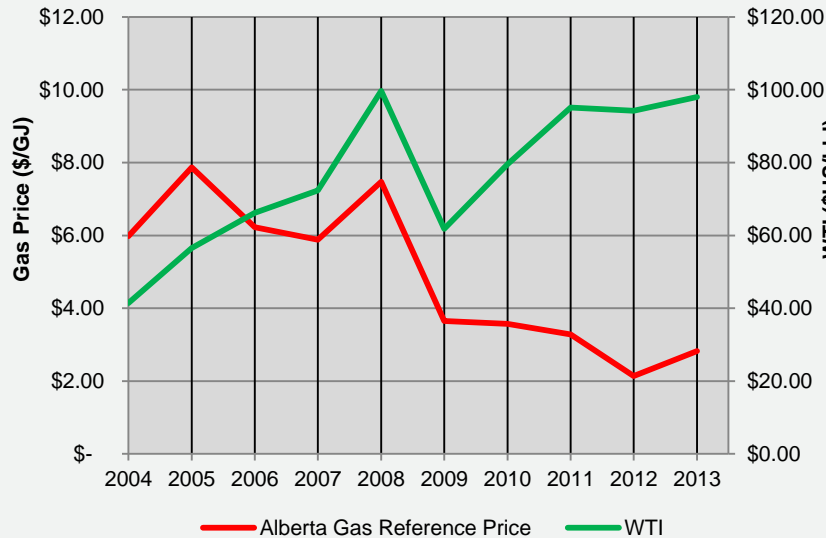
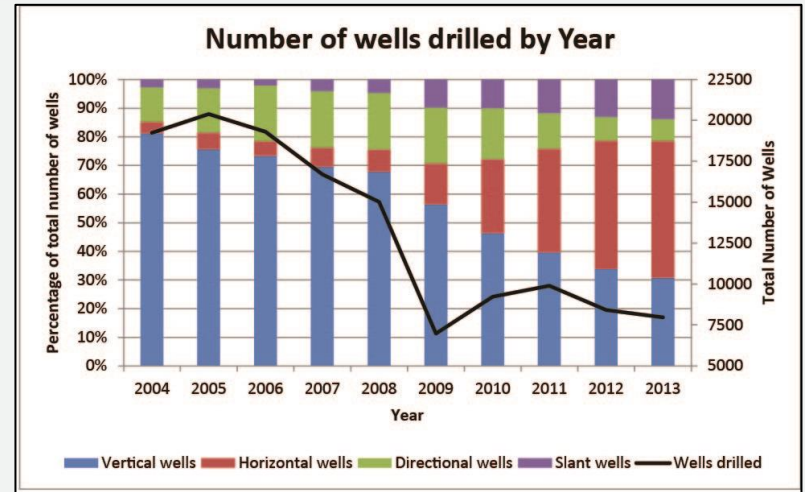
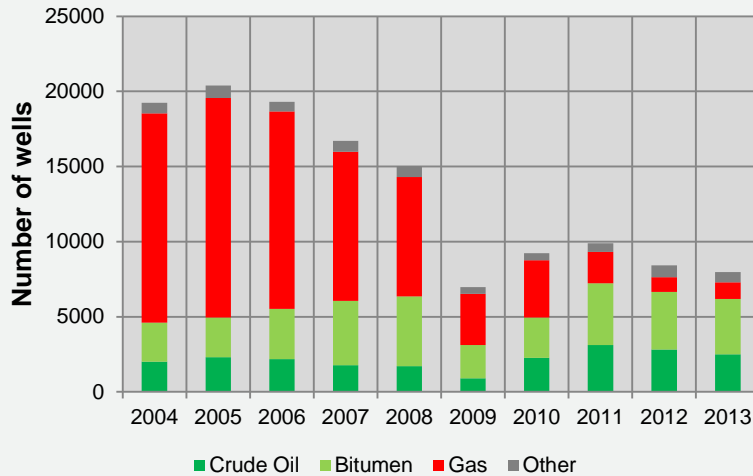
Oil & Gas allocations ~ 930 million m³

750 million m³ - industrial

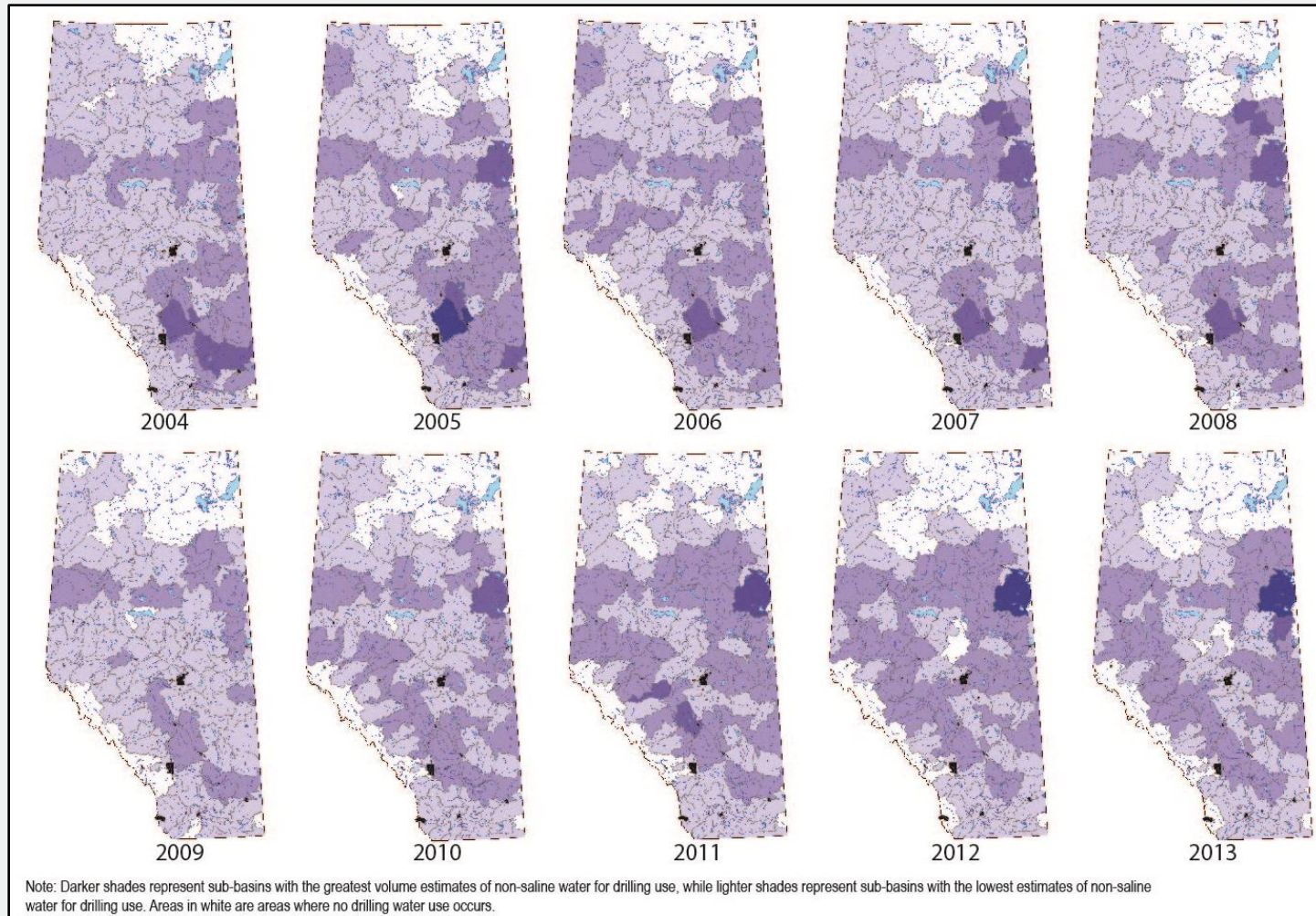
7 million m³ – drilling

170 million m³ – injection

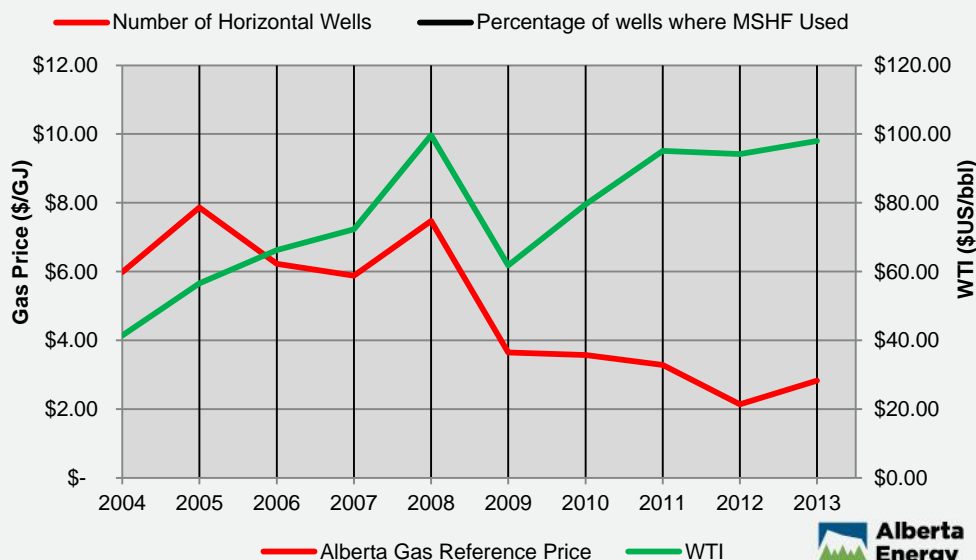
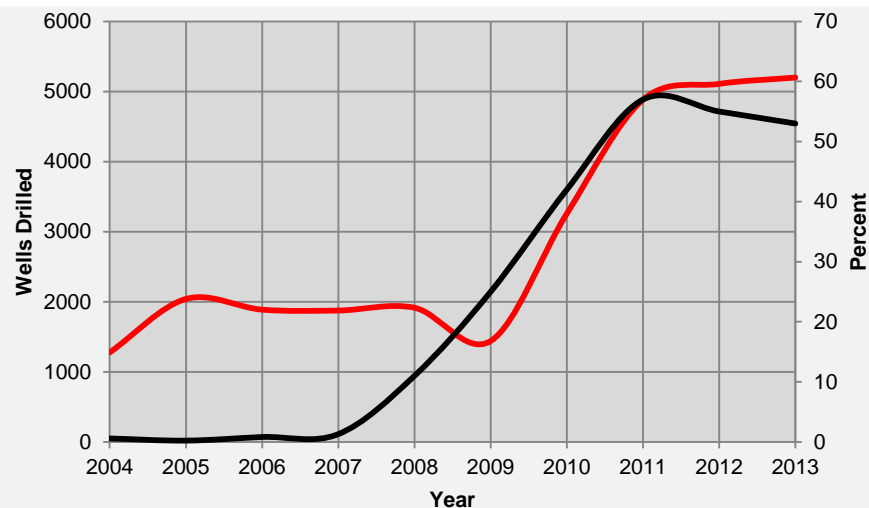
Summary of Use - Drilling



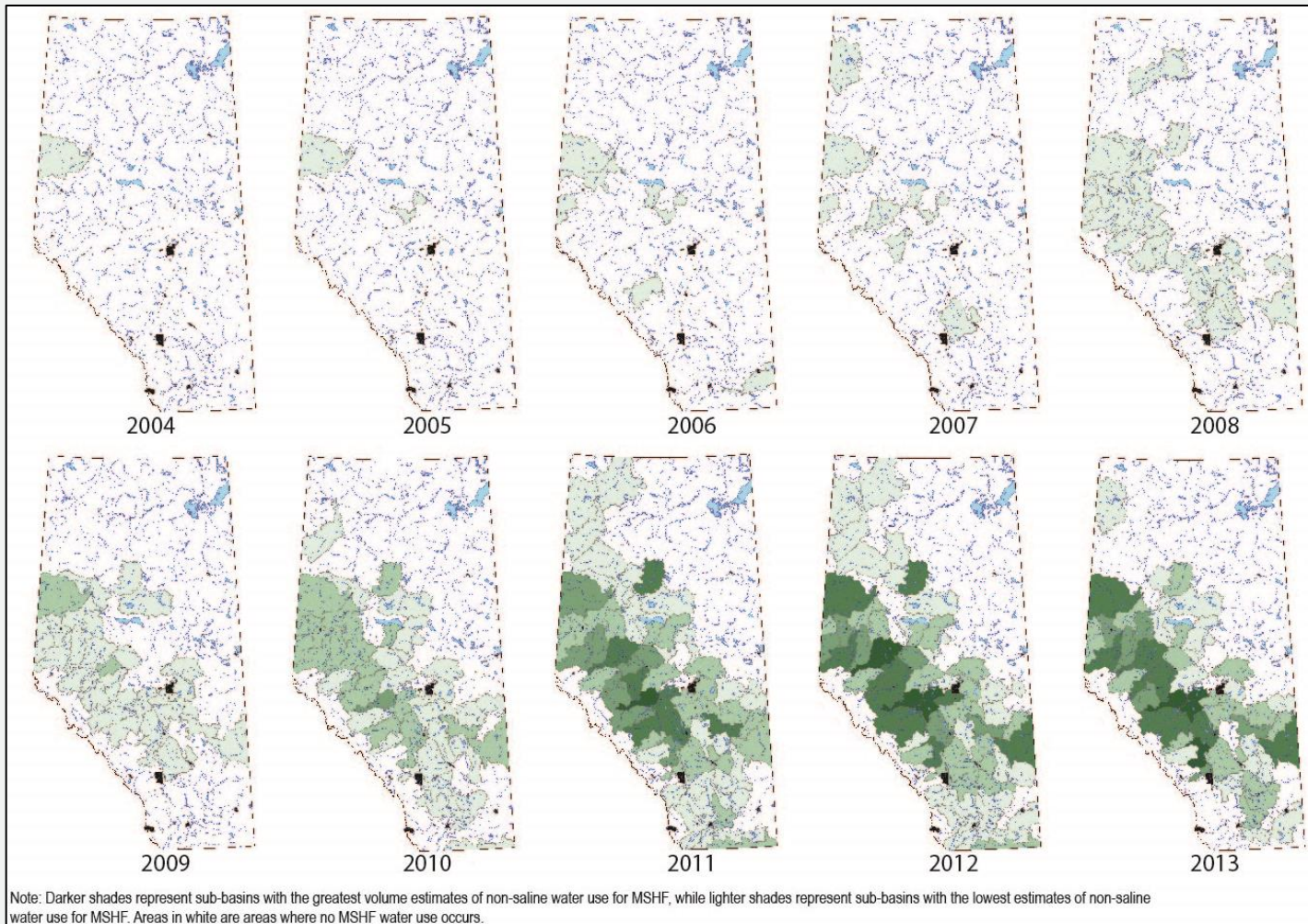
Summary of Use - Drilling



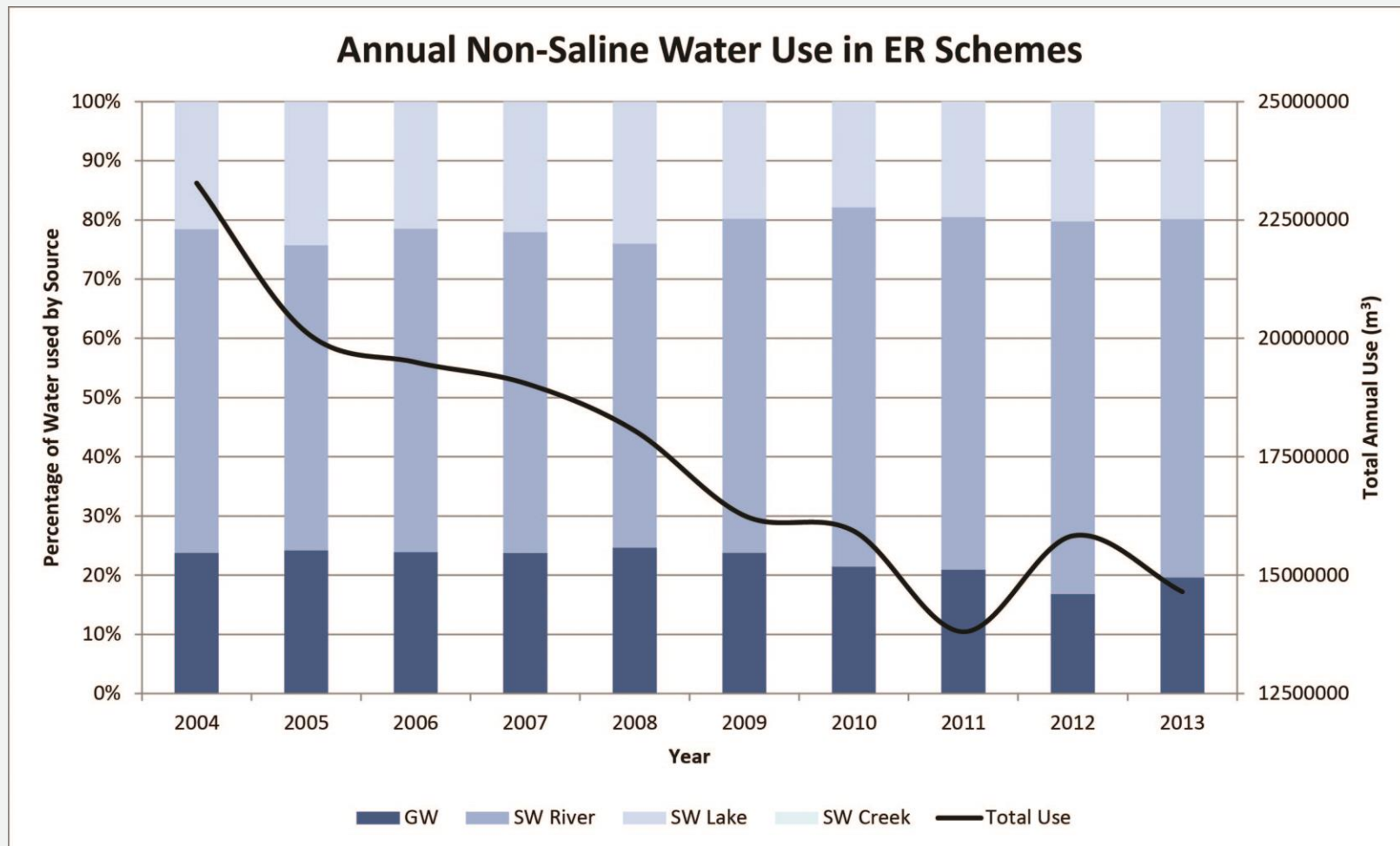
Summary of Use - MSHF



Summary of Use - MSHF

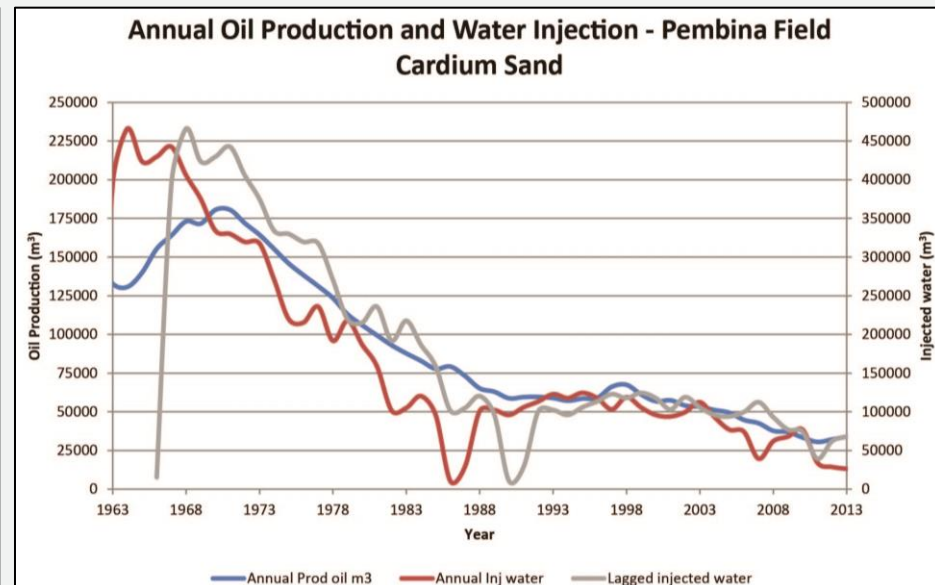
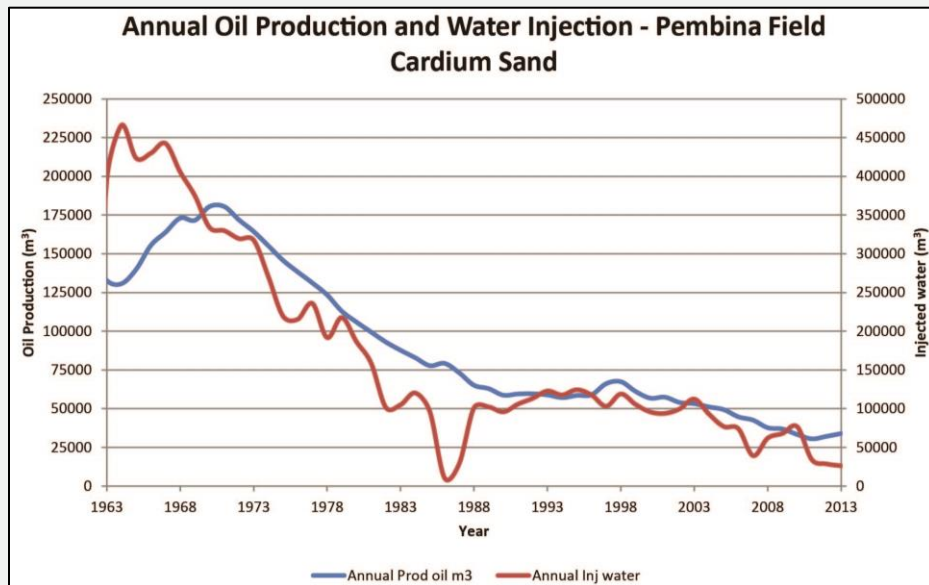


Summary of Use – Enhanced Recovery

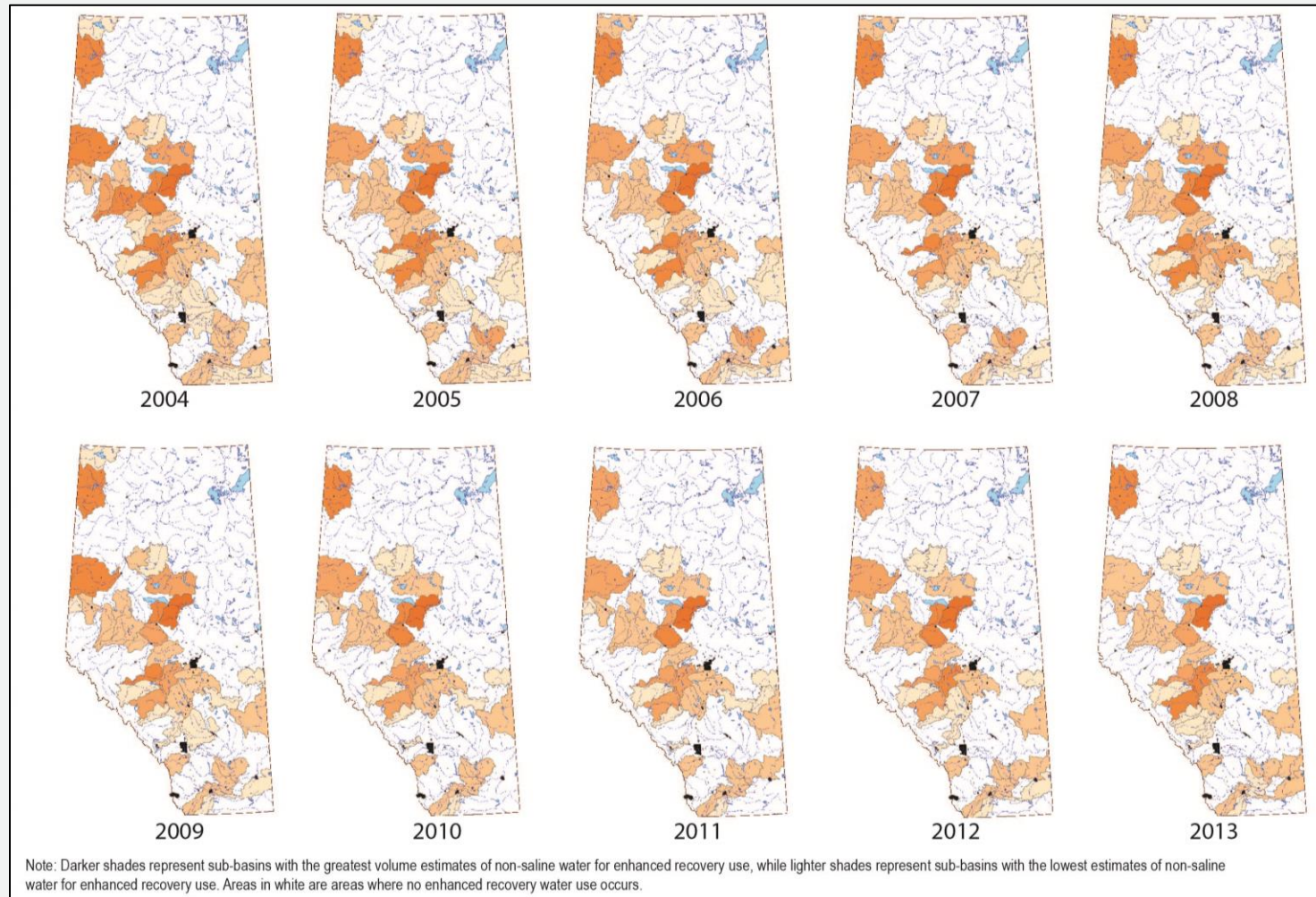


Note: GW=groundwater and SW=surface water

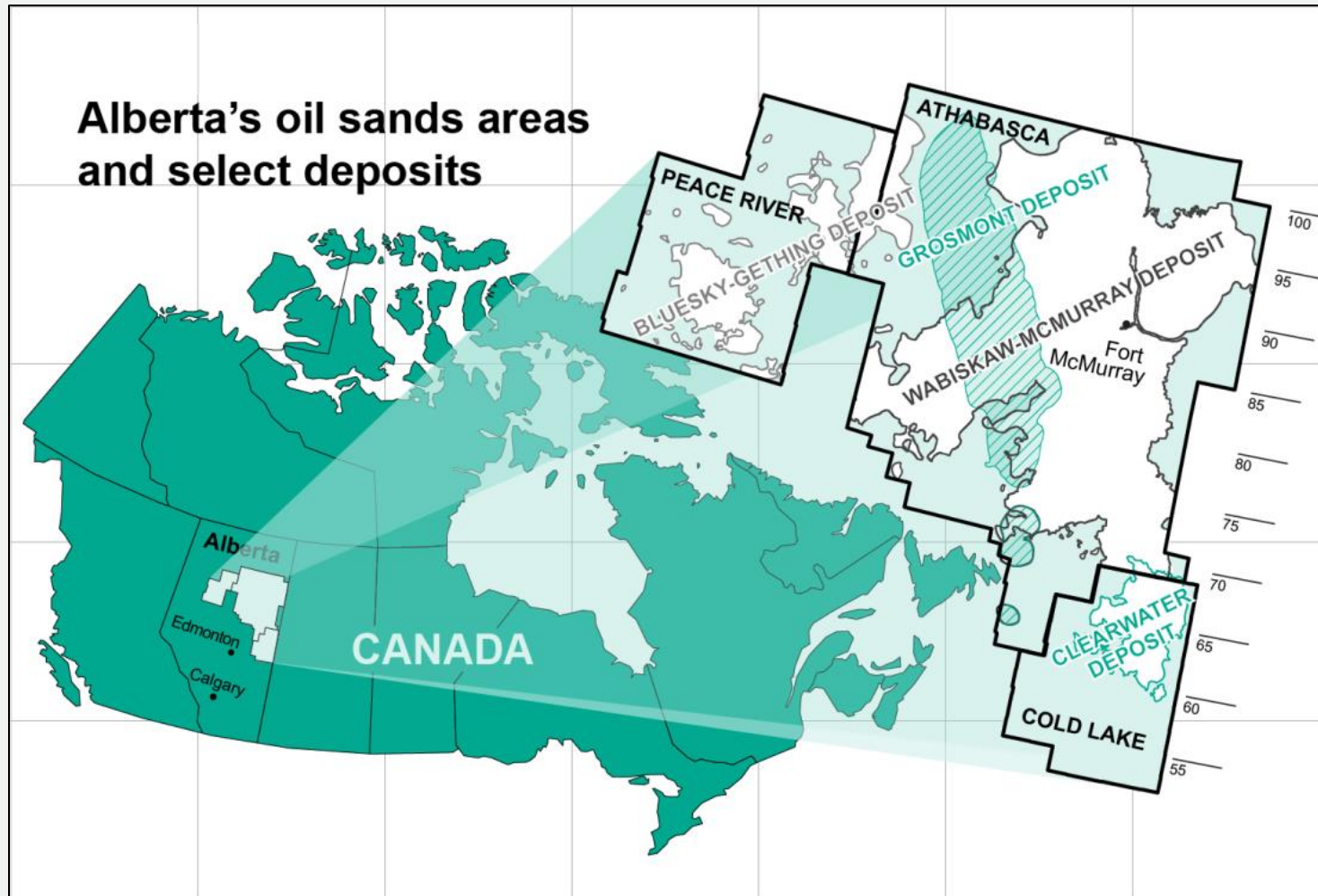
Summary of Use – Enhanced Recovery



Summary of Use – Enhanced Recovery

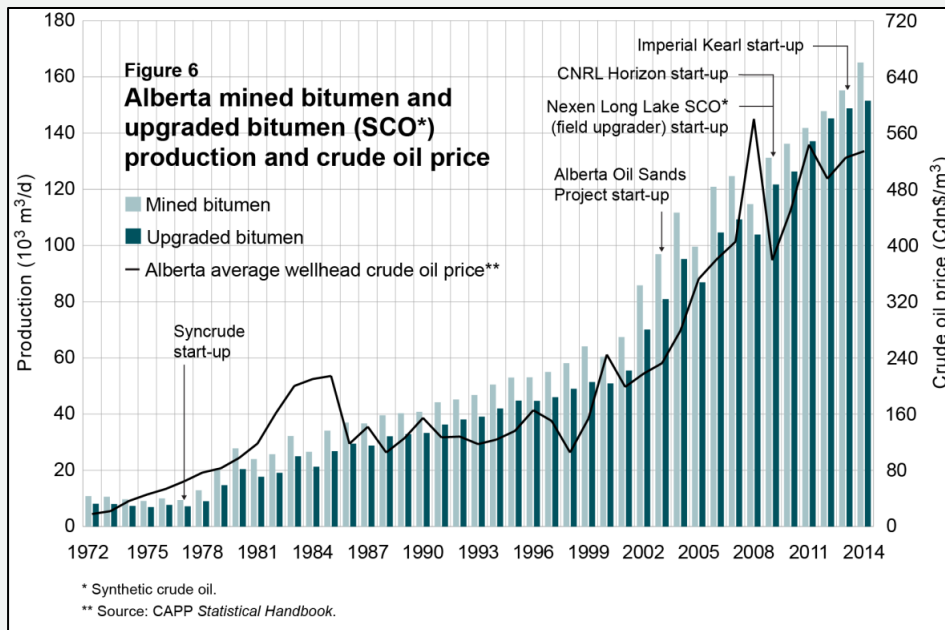


Summary of Use – Oil Sands

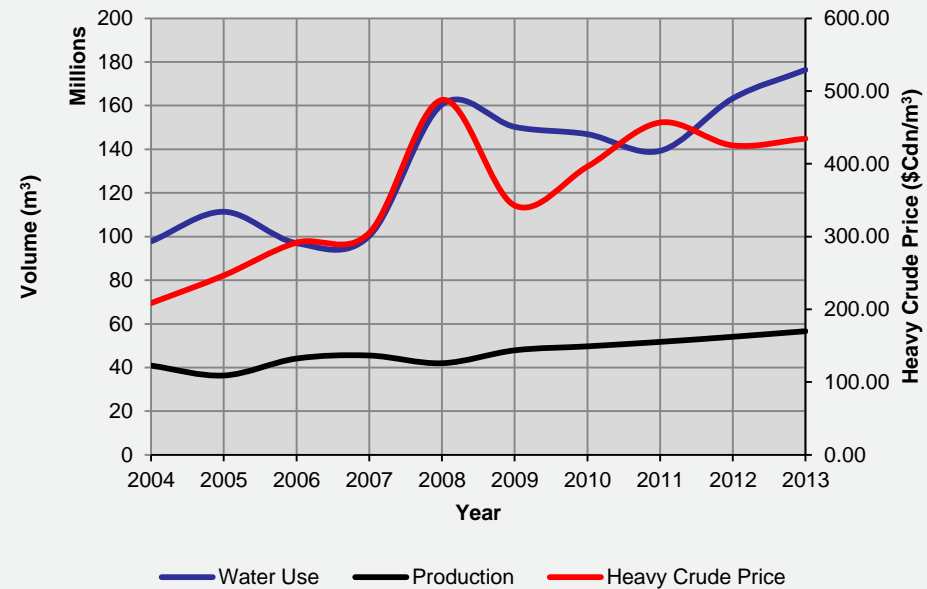


Source: Alberta Energy Regulator ST-98 (2014)

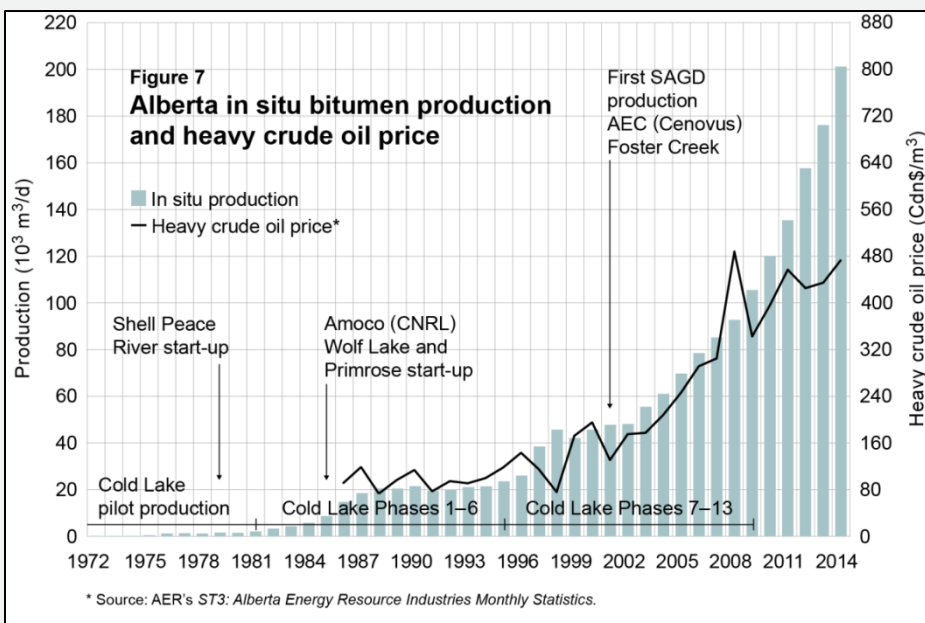
Summary of Use - Oil Sands Mining



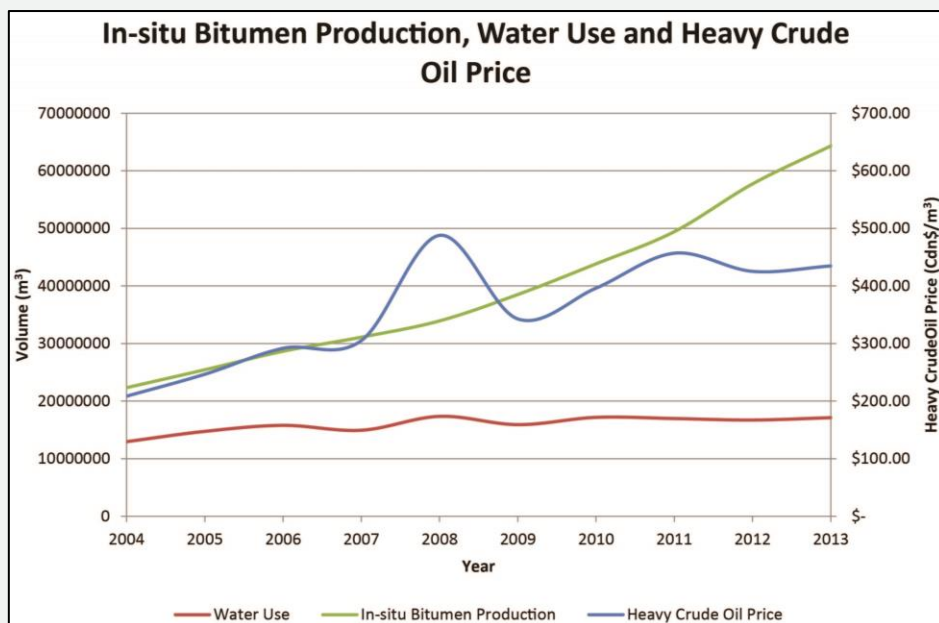
Source: Alberta Energy Regulator ST-98 (2014)



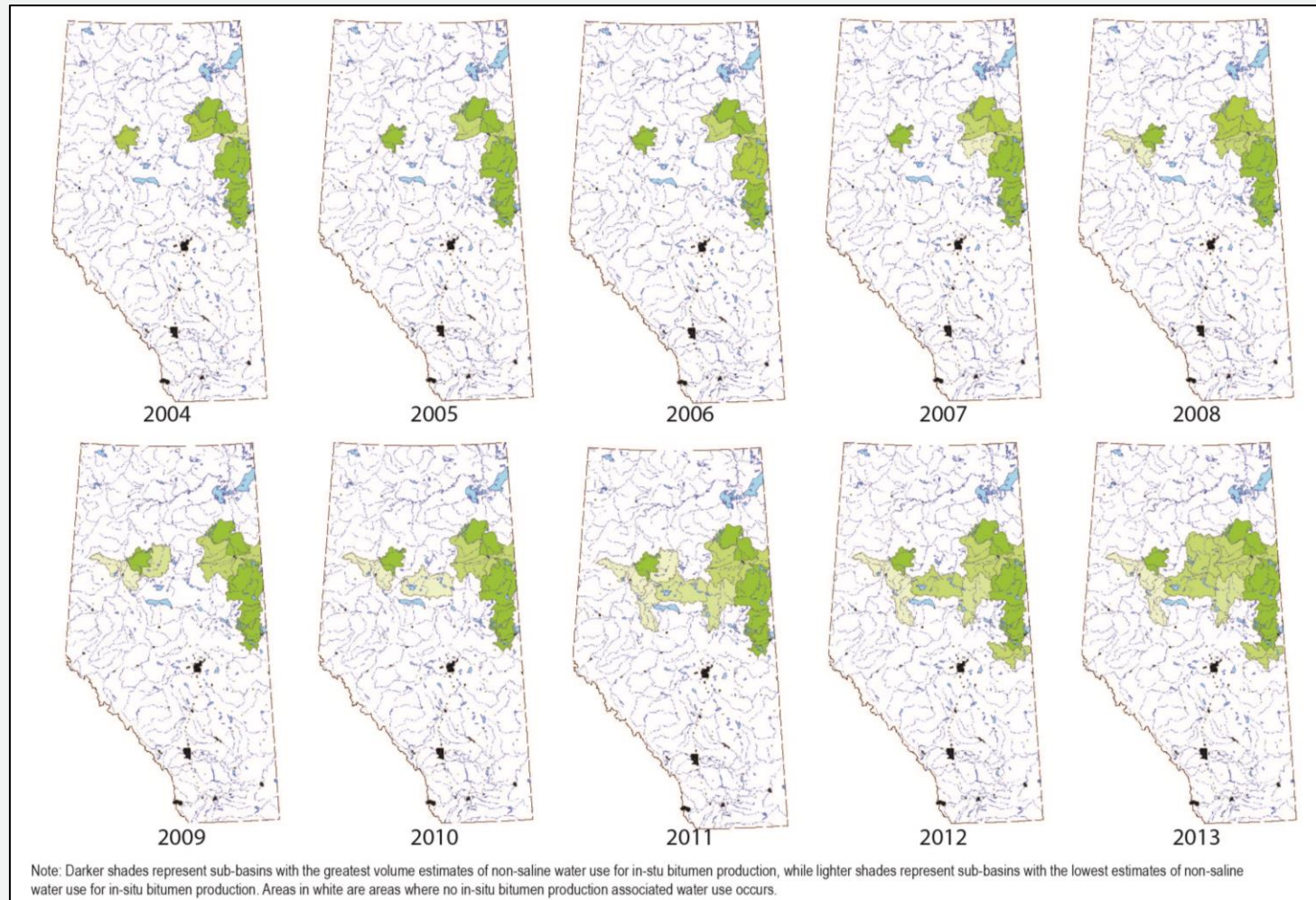
Summary of Use – In-Situ Oil Sands



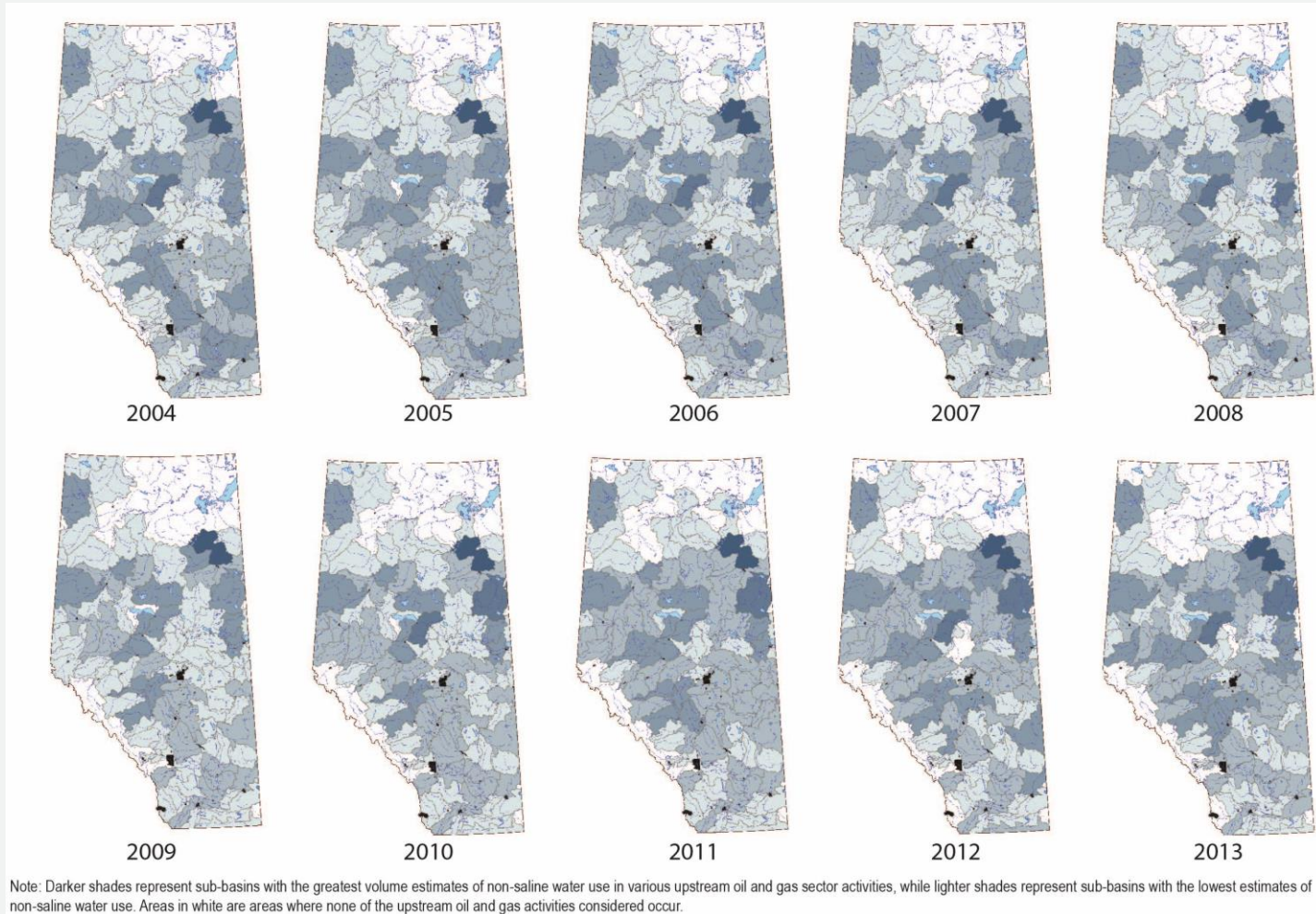
Source: Alberta Energy Regulator ST-98 (2014)



Summary of Use – In Situ Oil Sands



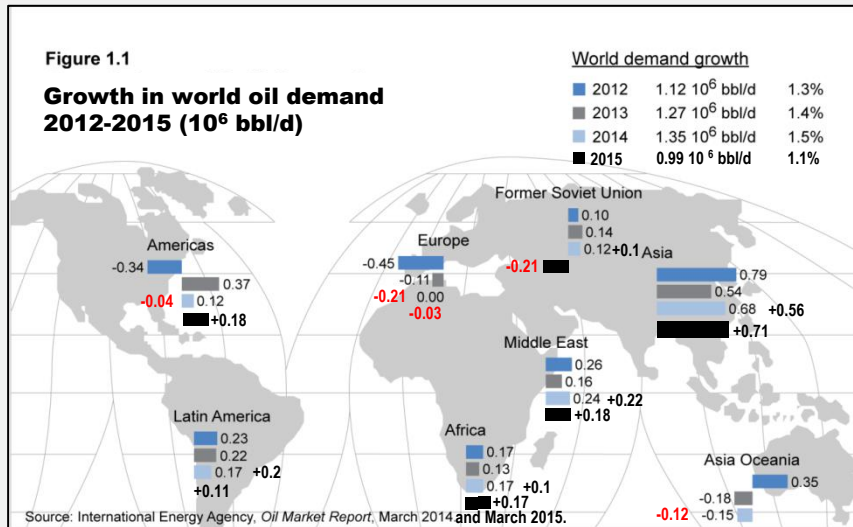
Summary of Use – Total Use



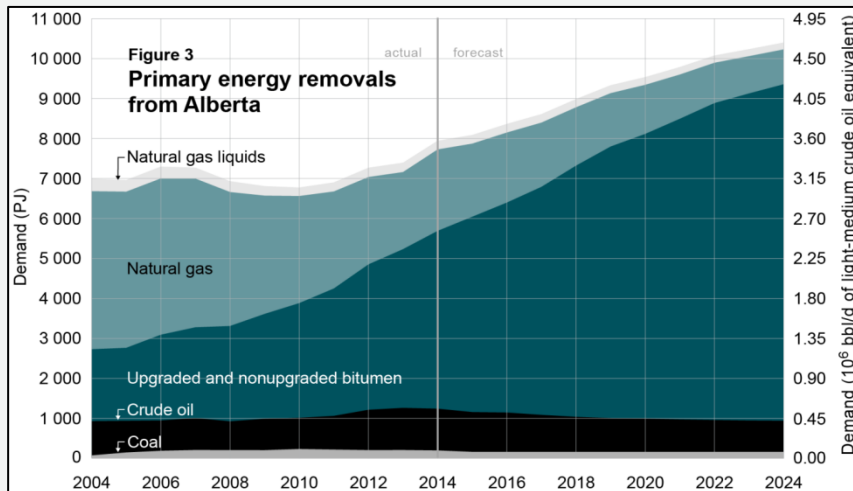
Future Forecasts

- » Tied to demand for hydrocarbons
- » Tied to economics of hydrocarbon extraction

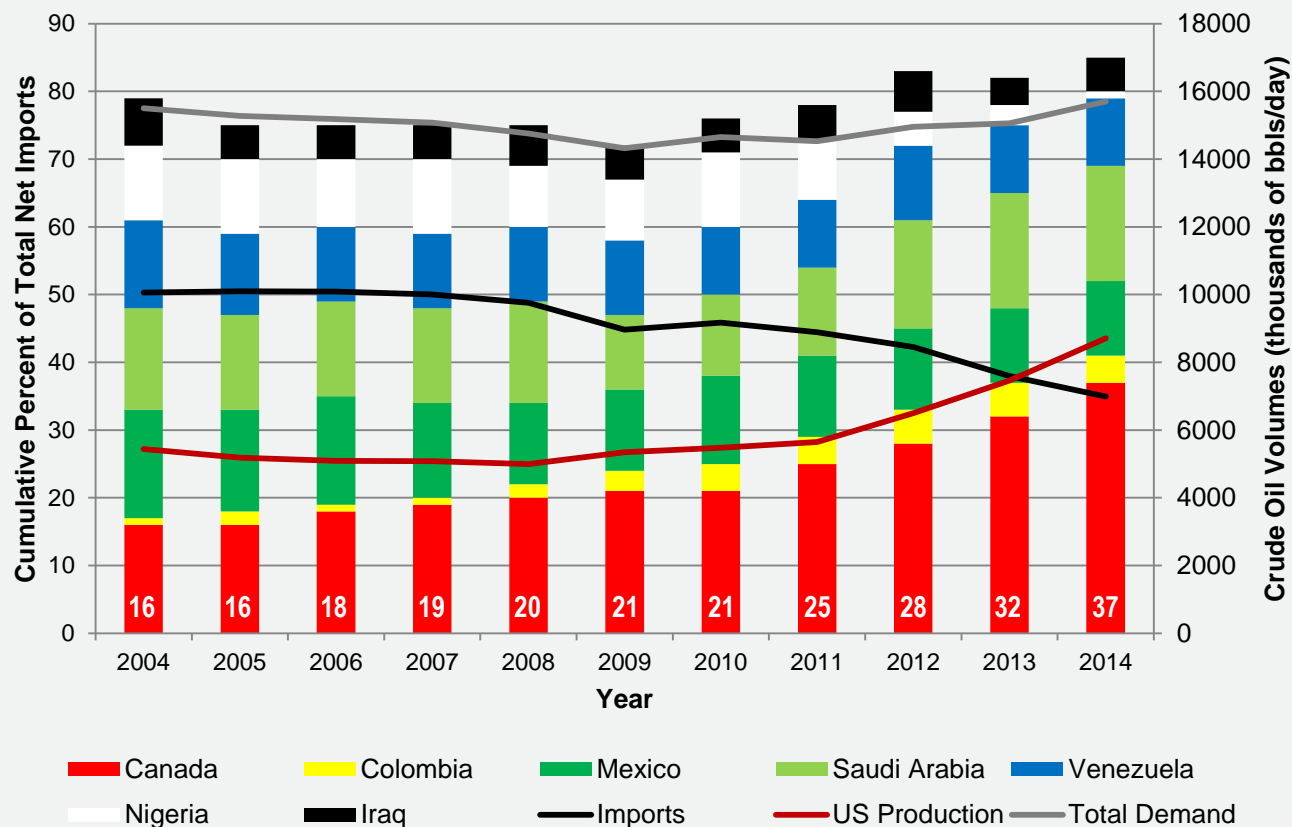
Future Forecasts – Hydrocarbon Supply and Demand



- › Demand to grow by 37% by 2040, but the pace of growth slows from above 2% per year, to 1% per year after 2025 (IEA, WEO 2014)
- › Global oil trade flows continue their shift to emerging economies, particularly China, India and the Middle East (IEA, WEO 2013)
- › U.S. tight oil output slows and flattens in the early 2020s, with the oil sands emerging as the engine of North American supply (IEA, WEO 2014)



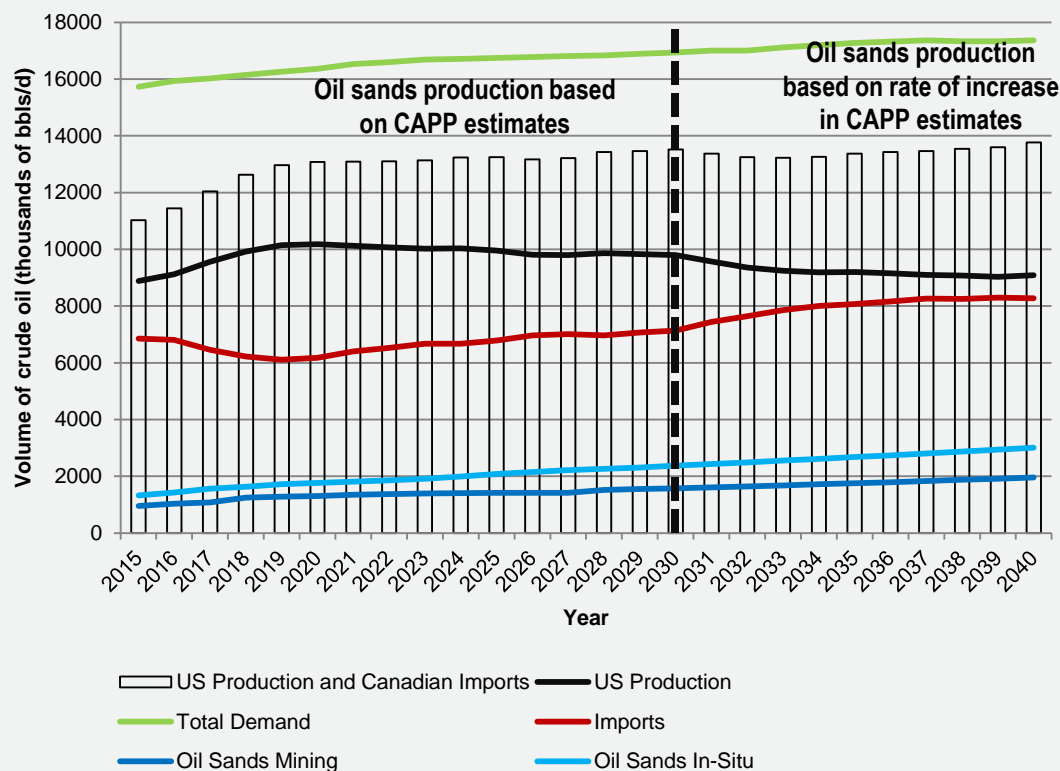
Future Forecasts – Hydrocarbon Supply and Demand



Year	Net Imports (x10 ³ bbls/d)	Total Imports (x10 ³ bbls/d)
2004	1592	1617
2005	1603	1633
2006	1778	1803
2007	1861	1888
2008	1928	1957
2009	1899	1943
2010	1929	1971
2011	2178	2224
2012	2358	2425
2013	2445	2578
2014	2561	2885

- IEA expects 1% growth in US demand for 2015 to ~ 16×10^6 bbls/d based on EIA numbers from 2014
- EIA numbers show US crude oil production at ~ 9×10^6 bbls/d and imports at ~ 6×10^6 bbls/d in 2015

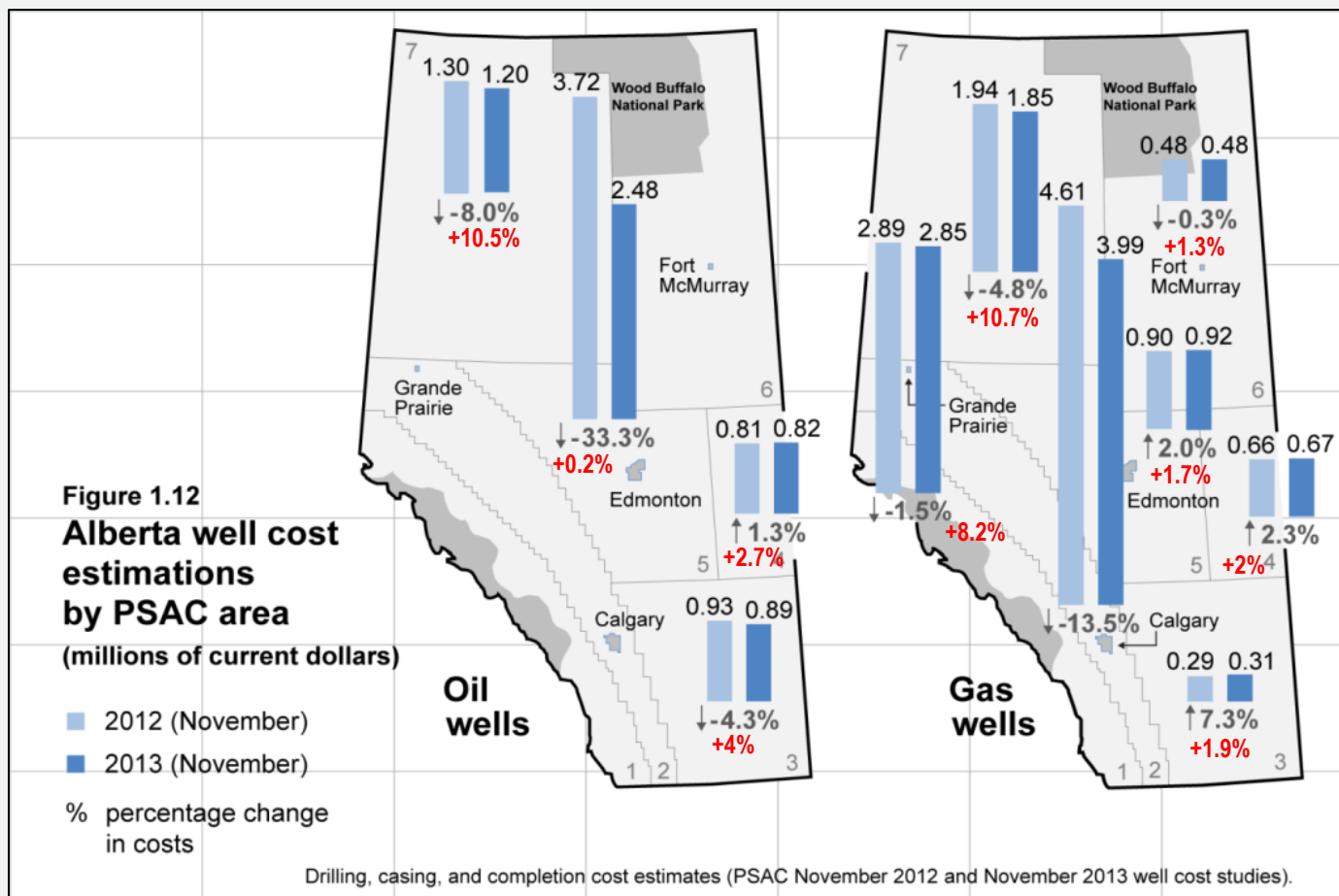
Future Forecasts – Hydrocarbon Supply and Demand



Year	Oil Sands Production Exported (x10 ³ bbls/d)	US Imports (x10 ³ bbls/d)	Percent of US Imports
2015	2148	6854	31
2020	2895	6181	47
2025	3294	6786	49
2030	3716	7141	52
2035	4167	8071	52
2040	4674	8280	56

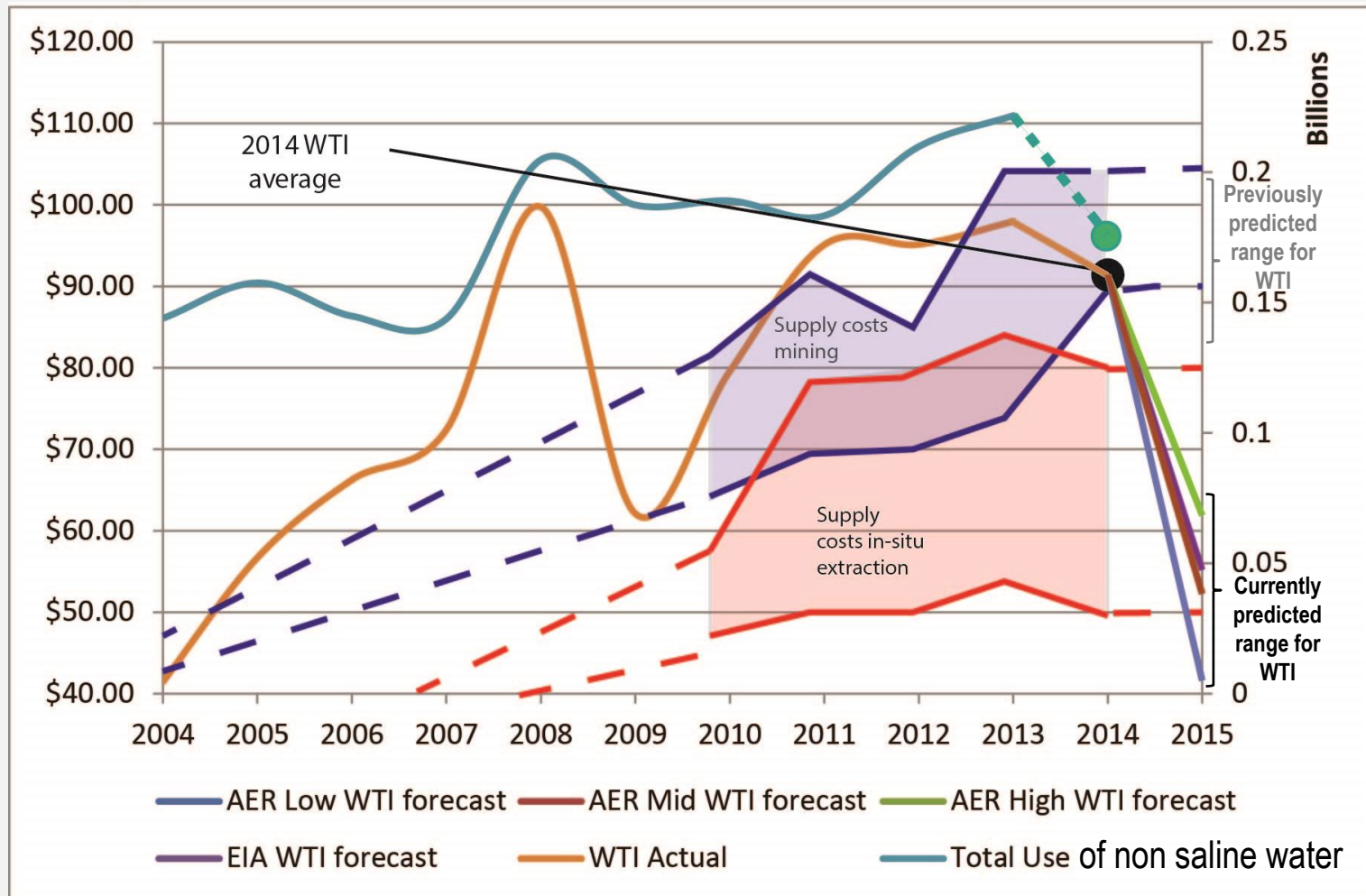
- Annual production increases after 2030 from oil sands mining and in-situ means based on rate of production increase calculated from CAPP production estimates (2.2% for mining and 2.4% for in-situ)
- Used figures from AER ST-98 to determine percentage available for export
- EIA reference case used for US crude oil production and imports

Future Forecasts - Economics

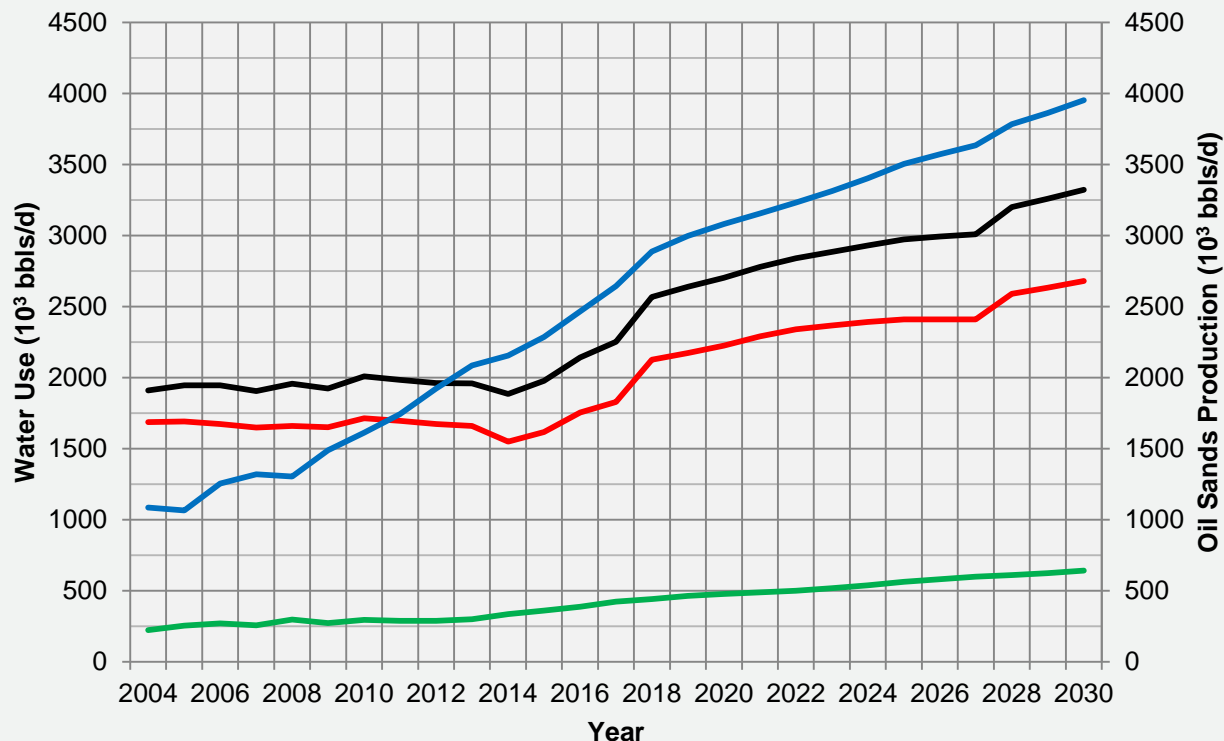


Drilling, casing, and completion cost estimates (PSAC November 2014 well cost study)

Future Forecasts - Economics



Future Forecasts – Water Use in Oil Sands Mining and In-Situ Extraction



Year	Oil Sands Produced (x10 ³ bbls/d)	Water Use (x10 ³ bbls/d)
2015	2285	1977
2020	3080	2703
2025	3504	2974
2030	3953	3321
2035	4433	3724
2040	4972	4176



Thank you



Questions

