Oil and Gas Projections Overview

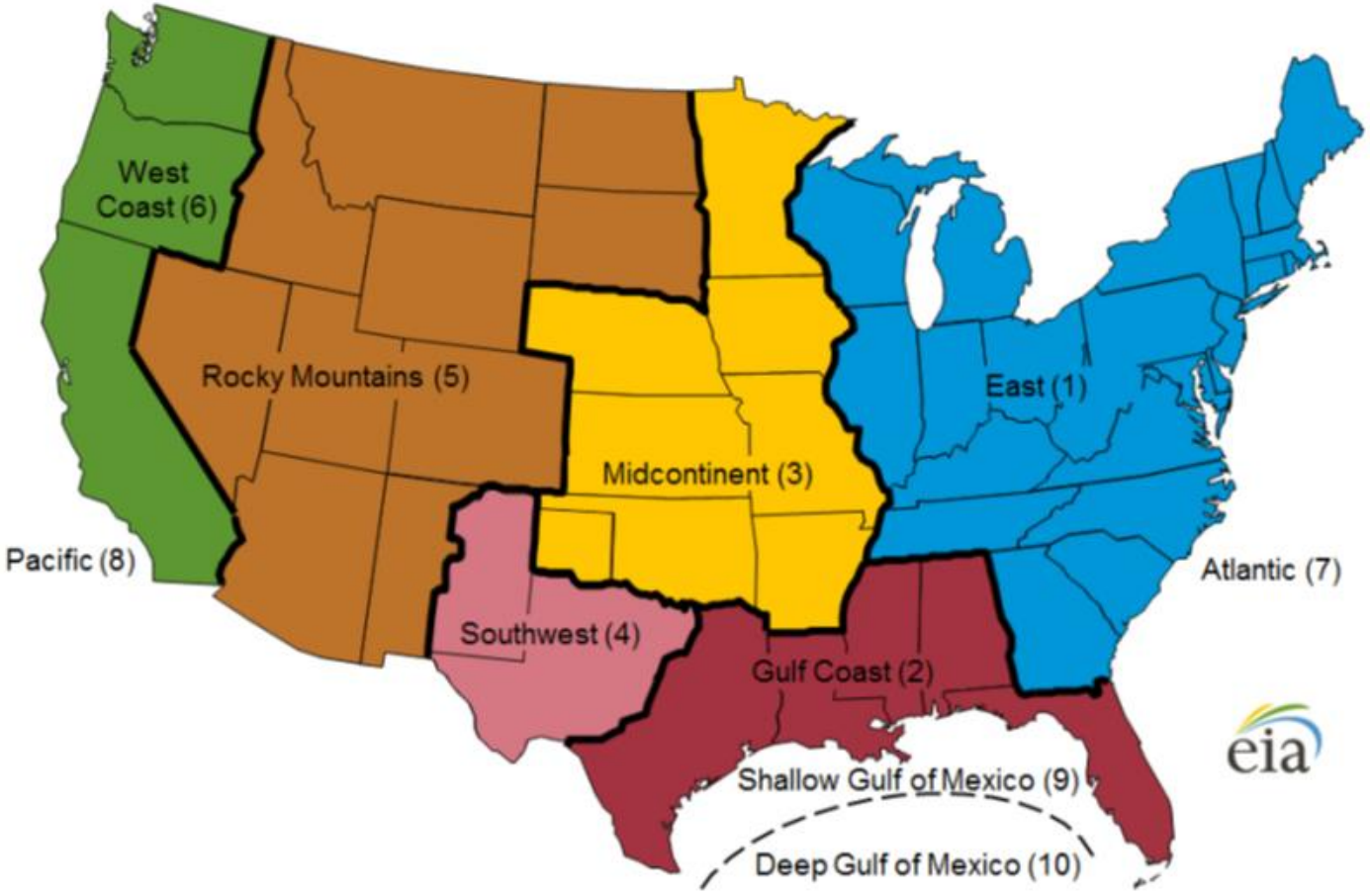
- Consists of 2 components
  - Growth (forecast production, other info)
  - Controls (function of growth, NSPS, other)
- Issues to consider when estimating growth from base modeling year to future-year
  - Gaps between base modeling year and current year (e.g. 2014 modeling year)
  - Spatial resolution of any forecast information (e.g. volumes, # of active wells)
  - Other changes (conv. vs unconventional production)
  - How best to apply growth factors
    - Separate factor for oil and natural gas growth
    - Non-point (by region-SCC, other)
    - Point (by region, NAICS, SCC, facility, by some combination)
    - SCCs in base year may not always reflect forecasted activity
  - Offshore sources
  - Coalbed Methane (tcf)
  - Natural Gas Liquids (barrels)

Oil and Gas Projections: Historical state data bridge to Supply Region-level forecast

- Historical state production data publicly available on EIA website used to project sources from base year to a recent year (e.g. 2015 or 2016)
- http://www.eia.gov/dnav/ng/ng_sum_lsum_a_epg0_r20_bcf_a.htm
- http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm

- Can then use AEO Supply Region production forecasts to project from 2015 to desired future year
- Some adjustments based on historical trends for “low production” states may be needed
- Combine factors to get a state-specific projection factor from base year to desired future year
- Use SCC-oil/gas/both cross-reference to apply state-specific factors

Oil and Gas Projections: NEMS (or Supply) Regions



Source: U.S. Energy Information Administration.

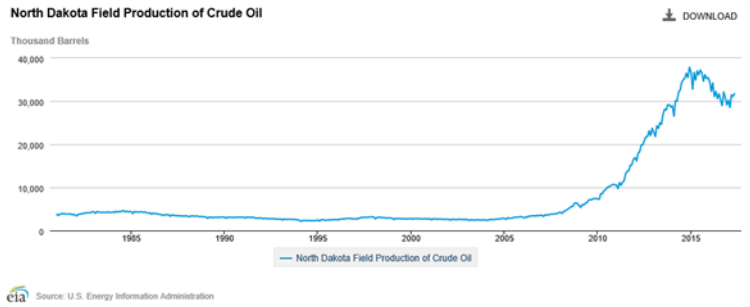
AEO example

60. Lower 48 Crude Oil Production and Wellhead Prices by Supply Region

Region	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Production 1/													
(million barrels per day)													
Lower 48 Total	**8.42**	**8.76**	**9.47**	**9.96**	**10.27**	**10.49**	**10.59**	**10.60**	**10.82**	**10.84**	**10.82**	**10.91**	**10.99**
Lower 48 Onshore	**6.75**	**6.98**	**7.61**	**7.95**	**8.22**	**8.40**	**8.54**	**8.69**	**8.83**	**8.94**	**9.03**	**9.19**	**9.31**
East	0.15	0.15	0.18	0.18	0.19	0.20	0.20	0.21	0.22	0.22	0.23	0.24	0.24
Gulf Coast	1.65	1.57	1.61	1.80	1.84	1.87	1.91	1.95	1.97	1.97	1.98	1.99	1.99
Midcontinent	0.61	0.62	0.62	0.63	0.62	0.62	0.62	0.63	0.63	0.64	0.64	0.66	0.67
Southwest	2.11	2.49	2.99	3.09	3.29	3.43	3.52	3.61	3.68	3.74	3.79	3.85	3.90
Dakotas/Rocky Mountains	1.72	1.75	1.87	1.95	1.96	1.98	1.99	2.00	2.04	2.09	2.12	2.19	2.25
West Coast	0.51	0.41	0.34	0.31	0.31	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.27
East Projection factor	**1.000**	**1.020**	**1.211**	**1.256**	**1.302**	**1.344**	**1.393**	**1.429**	**1.468**	**1.499**	**1.534**	**1.605**	**1.629**
Gulf Coast factor	**1.000**	**0.951**	**0.978**	**1.087**	**1.113**	**1.133**	**1.157**	**1.183**	**1.193**	**1.195**	**1.199**	**1.202**	**1.206**
Lower 48 Offshore	**1.67**	**1.77**	**1.85**	**2.01**	**2.05**	**2.09**	**2.05**	**1.91**	**1.99**	**1.90**	**1.78**	**1.73**	**1.68**
Gulf	1.62	1.70	1.79	1.95	1.99	2.03	2.00	1.86	1.94	1.85	1.74	1.68	1.62
200 meters	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
than 200 meters	0.21	0.19	0.13	0.13	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.06
Deep (Federal)	1.39	1.48	1.63	1.80	1.86	1.90	1.88	1.75	1.84	1.77	1.66	1.60	1.55
Pacific	0.05	0.08	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
State	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Federal	0.01	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Atlantic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
State	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Oil and Gas Projections: Historical state data + AEO Supply Region

Historical state change



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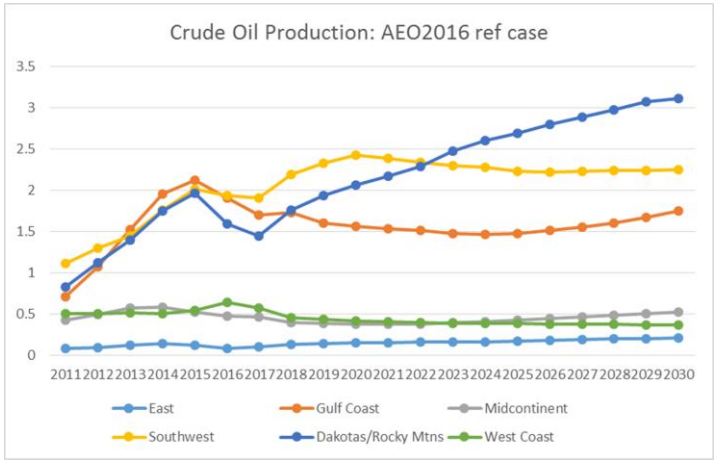
AEO Supply Region change



Combined Factors representing both historical state data and AEO supply region change for each state; Application by state-SCC for non-point and point (SCCs= 310XXXXX)

Oil and Gas Projections: NSPS Controls

- For future-year NSPS controls (oil and gas, RICE, Natural Gas Turbines, and Process Heaters), we attempted to control only new sources/equipment using the following equation to account for growth and retirement of existing sources and the differences between the new and existing source emission rates.
- $Control\_Efficiency\ (\%) = 100 * (1- [(P_f-1)*Fn + (1-Ri)^t + (1-(1-Ri)^t)*Fn]/ P_f)$
  - P_f = growth rate expressed as ratio (e.g., 1.5=50% cumulative growth)
  - t = number of years between base and future years
  - Fn = emission factor ratio for new sources
  - Ri = retirement rate, expressed as decimal (e.g., 3.3%=0.033)