**Appalachian Coal Data**

**Abstract:**

Appalachian Coal Data were prepared in late 2019 and early 2020 to support technical writing about Appalachian coalfield history, environment, and communities. The data originate from US federal government publications. All data sources are non-copyrighted. The data concern Appalachian and US coal production quantities, pricing, and revenue generation; Appalachian coal’s role in the USA’s energy economy; land areas disturbed by Appalachian coal mining; and selected coal-production, population, economic, and human-health metrics for counties and independent cities in seven states encompassing the Appalachian coalfield classified by coal-production status. The posted data are time series covering differing periods, some extending as far back as the late 1700s and all terminating in recent years, 2011 through 2019. The database was constructed while considering the Appalachian coalfield to include coal-mining areas of Tennessee, eastern Kentucky, West Virginia, Maryland, Pennsylvania, and the southwestern coalfield area of Virginia.

**Introduction:**

These data were prepared by Carl E. Zipper in late 2019 and early 2020 to support technical writing about Appalachian coalfield history, environment, and communities (Zipper et al. 2020 in preparation; Santopietro and Zipper 2020 in preparation; Gohlke 2020 in preparation). The data originate from US federal government publications as noted. All of the sources are non-copyrighted. Some of those publications are not accessible on the internet; and some are accessible but in not-text-readable forms. In some cases, data from different publications were combined to produce a time series that extends over a period bridging those covered by individual publications. In all cases, original data sources are noted. Users of these data are encouraged to acknowledge and reference the original data sources. For this database, we consider the Appalachian coalfield the Appalachian coalfield to include coal-mining areas of Tennessee, eastern Kentucky, West Virginia, Maryland, Pennsylvania, and the southwestern coalfield area of Virginia.

**Table 1. Appalachian Coal Production by State and US Coal Production, 1800-2018**

Data are coal mined in various locales reported as short tons per year.

State-level data (1800-1979) and U.S. coal production (1800-1948) are from Milici (1997) with modifications as noted below. Virginia pre-1980 totals were adjusted by subtracting production in the Richmond basin and the valley coalfield based on Hibbard (1990) which states that Virginia’ Appalachian coalfield commercial production was initiated in 1880. Hence, all Virginia production recorded by Milici (1997) prior to 1881 was deleted. Virginia’s Appalachian coal production is listed a 0 tons for 1881 and 1882 because Richmond basin production totals for those years as tallied by Hibbard (1990) are equivalent to Virginia’ statewide production as tallied by Milici (1997). For 1881-1979, coal production in the Richmond and Valley coalfields as documented by Hibbard (1990) was subtracted from the Milici (1997) Virginia production totals to estimate Virginia production in the Appalachian coalfield. Post-1980 production from Virginia’s Valley Coalfield is not included.

West Virginia’s coal production for 1840 is based on Laing (1966), assuming 1 bushel of coal is equivalent to 80 pounds. Commercial coal production is said to have begun in West Virginia in 1810 (WV MHS&T 2002) but data for other years prior to 1863 were not found.

US national production for 1800 – 1948 are determined by summing all U.S. state-level production tallied by Milici (1997). US national production for 1949-1979 is from US EIA (2012), Table 7.2. US national and state-level production for 1980-2018 are from US EIA (2019) and predecessor publications.

**Table 2. Coal Production by Mining Method, 1900-2018.**

Data are coal mined in various locales reported as 1000 short tons per year.

USA data for 1900-1948 are from US BOC (1975a). “Strip” is the term used by that source for surface mining. Production prior to 1914 is presumed to be 100% underground. USA data for 1948-2018 are from US EIA (2012 and 2019). Appalachian coal data for 1980-2017 are from US EIA (2019). Appalachian coal includes coal mined in Tennessee, Virginia’s southwestern coalfield, eastern Kentucky, West Virginia, Maryland, Ohio, and Pennsylvania

**Table 3. Coal Production by County, State, and Mine Type, 1980-2018.**

Data are coal mined in various locales reported as short tons per year.

US EIA (2019, including predecessor publications) and US EIA/MSHA (2019) provide the basis for the analysis. Data for Tennessee, Virginia, eastern Kentucky, West Virginia, Maryland, Pennsylvania, and Ohio were analyzed. West Virginia data were analyzed separately for the state’s northern and southern regions as defined by US EIA (2019). Similarly, Pennsylvania data were analyzed separately for anthracite- and bituminous- producing counties as classified by EIA (2019).

For 1983-2015, primary data originated US EIA/MSHA (2019). These data are posted as individual mine totals and assigned to a mine type (refuse, surface, underground), with most mines assigned to a state and county. For some refuse-recovery coal operations, no was state was listed; this production was assigned to a state based on the name of the county for that record and the mining company address. Of the ~14 billion tons of coal in the database, state locations for 14.0 million tons were assigned in this manner. Some records designated states without designating a county; these records were assigned to a county based on the operator’s listed address if the address was within that same state; using this method, county locations were assigned to another 3.8 million tons.

The EIA/MSHA data were used, when available, because they were posted for an extended period (1983-2015) in an electronic format that can be processed using common computer software. County-based coal production data posted by US EIA (2019) and predecessor publications were accessed to supplement the US EIA/MSHA (2019) data for 1980-1982 and 2016-2018 (Table 2. Coal Production and Number of Mines by State, County, and Mine Type).

Coal production was tallied by state, county, and mine type for each analysis year. For the purpose of validation, these data were then summed to state or sub-state regional totals and compared to comparable totals published by US EIA (2019) and predecessor publications. For states and sub-state regions during most years and EIA/MSHA-derived coal production totals varied from EIA totals by <0.1%; and some comparisons were identical. MSHA/EIA totals exceeded EIA (2019 and predecessor) totals by >1% for West Virginia in 2013; Virginia in 2013-2015; and Pennsylvania for 2009, 2011-2012, and 2014-2015; these deviations ranged from 1.2% to 3.0%. In all cases, refuse-recovery coal production exceeded 1% of the state’s totals for that year, suggesting that MSHA and EIA handle refuse-recovery coal production differently. EIA-estimated production exceeded MSHA-tallied production by 3.7% for Pennsylvania in 2013; and MSHA-estimated production exceeded EIA-estimated production for Virginia by 1.1% in 1997 when no refuse-recovery production was tallied. These differences are unexplained. All other comparisons yielded <1% difference between MSHA-data totals and those posted by EIA.

The procedure above yielded a database for which errors were noted and corrected.

* Snyder County PA is anthracite, not bituminous
* Claiborne County TN was incorrectly spelled by MSHA as Clairborne for some years.
* The MSHA data listed incorrectly some Pennsylvania production for Monongalia County; check against EIA published data revealed that these coals were produced in Greene County PA. This correction was made.
* Similarly, the MSHA data listed incorrectly some Maryland production for Tucker County; check against EIA published data revealed that these coals were produced in Garrett County MD. This correction was made.

**Table 4. Appalachian Coal Prices, 1980-2018**

Data are coal prices reported as US $ per short ton. Prices are listed in current (non-inflated) dollars..

Table 4A reports price data are as published by US EIA (2019) and predecessor publications. US EIA did not publish regional prices for West Virginia 1980-1984. All other missing data were withheld by EIA as per the agency's standard practice for pricing derived from small numbers of producers. This practice is intended to prevent interested parties from deriving price information applicable to individual producers. Data are average mine sales prices as-published by EIA. As stated by EIA (2019): “An average sales price is calculated by dividing the total free on board (f.o.b) rail/barge value of the coal sold by the total coal sold. Excludes mines producing less than 25,000 short tons …”.

Table 4B replaces missing data with estimated prices. For prices not available from EIA, the following estimation methods were applied:

• Maryland and Tennessee: If surface and underground mine-type prices were withheld, the total state price for that year was applied to all mine types. Maryland and Tennessee production combined constituted <2% of the database total.

• Ohio 2017: Surface and underground mine-type prices were withheld, so the total state price for 2017 was applied to all mine types.

• For West Virginia: northern vs. southern region pricing is not available for 1980-1984 so state-average surface and underground coal prices are applied in both regions. The average West Virginia regional price differentials for all coal during 1985-1990 was less than 4%, suggesting that 1980-1984 regional price differentials may also have been low.

• Post-1984 West Virginia regional pricing for surface and underground mine types were not published by EIA for 1985-1992 and were withheld for 2015-2017. For each of these missing-data years, regional mine-type price estimates were computed from known data (state-level mean prices for surface- and underground-mine coal, and regional all-coal prices) using the following method. First, regional surface/underground price ratios were assumed identical to the state-level surface/underground price ratio. With this assumption in place, regional mine-type prices were set at levels ensuring that regional revenue totals were equivalent (+/-0.01%) to what would have been calculated if the regional all-coal prices were applied across all mine types. Northern West Virginia pricing for 2018 was estimated by applying the regional price to both surface and underground mine types, given that surface production constituted a small part of the regional total. For southern West Virginia in 2018, the 2015-2017 method was applied.

• Pennsylvania anthracite- and bituminous-region surface- and underground-mine prices were withheld for 2007, 2010-2011, and 2016.; but regional all-coal pricing was published for these years.

o For anthracite in all withheld-price years except 2016: Underground/surface price ratios were assumed to be averages of comparable prices for the year immediately preceding and the year immediately following the withheld-price period. With this assumption in place as for West Virginia regional prices above: regional mine-type prices were set at levels ensuring that regional revenue totals were equivalent (+/-0.01%) to what would have been calculated if the regional all-coal prices were applied across all mine types.

o For bituminous (which comprised >94.9% of statewide production during all withheld-price years) in all withheld-price years except 2016: Underground/surface price ratios were assumed to be identical to state totals; while ensuring that regional revenue totals. With this assumption in place as for West Virginia regional prices above: regional mine-type prices were set at levels ensuring that regional revenue totals were equivalent (+/-0.01%) to what would have been calculated if the regional all-coal prices applied across all mine types.

o For anthracite and bituminous in 2016: Underground/surface price ratios were assumed to be identical to those posted for 2015. With this assumption in place as for West Virginia regional prices above: regional mine-type prices were set at levels ensuring that regional revenue totals were equivalent (+/-0.01%) to what would have been calculated if the regional all-coal prices applied across all mine types.

o For anthracite and bituminous in 2018, underground/surface price ratios were assumed to be identical to the state ratio. With this assumption in place, regional mine-type prices were set at levels ensuring that regional revenue totals were equivalent (+/-0.01%) to what would have been calculated if the regional all-coal prices applied across all mine types.

Refuse-recovery coal-price data are not available from EIA. Surface-mine coal price were applied to estimate refuse-recovery coal prices. Refuse coal constitutes 0.31% of the database total.

**Table 5. Estimated Sales Revenues for Coal Mined by County, 1980-2018.**

Data are estimated revenues received by mining firms for coal mined in each county annually. Data are reported as current US dollars (not adjusted for inflation).

The nominal (non-inflated, as-reported, current-dollar) “all coal” prices posted by EIA and estimated as above (Table 4) were applied to coal produced in each county during each year. Nominal county-based revenue totals were calculated by multiplying the estimated price ($/ton) by the tonnage produced within that county (Table 3).

**Table 6. USA Average Coal Prices, 1900 – 2011**

Data are USA average coal prices reported as US $ per short ton. Prices are listed in current (non-inflated) dollars. Data were compiled from US EIA (2012) and US BOC (1975a).

**Table 7. USA Primary Energy Consumption by Source, 1775 – 2018.**

Data are annual primary energy consumption estimates for USA, reported as quadrillion Btus per year.

Primary energy consumption data by energy source were obtained from US EIA (2011) for 1775-1948; and from US EIA (2012 and 2020) thereafter. Primary energy consumption originating from Appalachian coal is estimated by a two-step process:

1. Applying the fraction of US coal production mined in Appalachia (from Table 1) to the primary energy estimates for coal provided by the above data sources to estimate the primary energy generated from Appalachian coal;
2. Calculating the fraction of US primary energy consumption attributable to Appalachian coal.

That data column is truncated starting in 1981 because the estimating method becomes increasingly inaccurate for recent decades as low-Btu coal from western US makes up an increasing share of US coal, and as exports of Appalachian coal increase. Appalachian coal is defined as that produced in Tennessee, eastern Kentucky, Virginia, West Virginia, Maryland, Pennsylvania, and Ohio.

**Table 8. US Electricity Production by Energy Source, 1920 – 2017.**

Data are annual amounts of electrical energy generated from individual fuel sources reported as million kilowatthours per year. The fraction of total kilowatthours generated from coal is calculated. Data sources are US BOC (1975b) for 1920 - 1948, and US EIA (2012 and 2020) for 1949 - 2017. For coal, gas, and petroleum-fueled generation estimates from US BOC (1975b): Data were calculated from annual listings of total fuel consumed and of fuel consumed per kilowatt-hour for each of these fuels. Note that total generation figures provided by US BOC (1975b) do not match totals provided by the US Energy Information Administration for overlapping time periods.

**Table 9. Land Disturbed by SMCRA-permitted Mining, 1978-2019.**

Data are acres of land disturbed by coal mining in seven states (Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia) under Surface Mining Control and Reclamation Act (SMCRA) permits, as documented by U.S. Office of Surface (US OSMRE) and state mining agencies operating under US OSMRE oversight. Data sources are US OSMRE (1998) for 1978 - 1997, US OSMRE (various years) 1998 - 2012; and US OSMRE (2020) for subsequent years.

Two primary data types were tallied for this database:

* Lands released from SMCRA oversight after mining and reclamation for each year available (1978 through 2017 for Tennessee, through 2018 for Kentucky, and through 2019 for the other five states). Such lands are known as .Phase III bond-released lands
* SMCRA-permitted areas disturbed for mining but not yet released from SMCRA obligations as tallied for each state in the most recent available report.

These two data series were summed to estimate disturbed areas. The data contain some double-counting, as some lands mined and reclaimed in the years immediately following implementation of the Surface Mining Control and Reclamation Act (SMCRA) were re-mined in subsequent years as larger equipment with greater earth-moving capacity became available.

Kentucky data required special treatment because US OSMRE tallies statewide data but the western Kentucky coalfield is not within Appalachia. Surface-mine coal production for eastern Kentucky and for Kentucky statewide were tallied for each year; and the fraction attributable to eastern Kentucky was calculated. A three-year rolling average, terminating in each calculation year, of the Kentucky coal-production fraction attributable to eastern Kentucky was calculated; and that fraction was applied to Kentucky’s Phase-III bond-release and remaining-disturbance to estimate an acreage attributable to eastern Kentucky for each calculation year. A similar method was applied to estimate eastern Kentucky’s disturbed acreage.

**Table 10. County Classifications for Economic and Human-Health Analyses with Selected Data**

Santopietro and Zipper (2020, in preparation) and Gohlke (2020, in preparation) have conducted analyses of economic and human-health data, respectively, for Appalachia’s coal-producing areas. Those analyses compare economic and human-health metrics for Appalachia’s coal-producing counties, as stratified by cumulative coal production over 1980-2017 (Table 3), to other county-types within seven states (Tennessee, Kentucky, Virginia, West Virginia, Maryland, Pennsylvania, Ohio). This table lists counties by those classifications and reports selected economic and human-health metrics for each county. For further details and analyses, see Santopietro and Zipper (2020, in preparation) and Gohlke (2020, in preparation).

County types are:

* Coal > 300 Mt: Cumulative coal production, 1980-2017, > 300 million short tons (based on data in Table 3).
* Coal 100-300 Mt: Cumulative coal production, 1980-2017, of 100 – 300 million short tons (based on data in Table 3).
* Coal 10-100 Mt: Cumulative coal production, 1980-2017, 10 - 100 million short tons (based on data in Table 3).
* Coal < 10 Mt: Cumulative coal production, 1980-2017, greater than zero short tons but less than 10 million short tons (based on data in Table 3).
* Coalfield 0 t: Counties for which some segment of Appalachian coal-bearing geological formations (including Pennsylvania anthracite) are located within their borders but with no recorded 1980-2017 coal production (based on data in Table 3).
* Other ARC: Counties located within Appalachian Regional Commission service area but not classified as coal-production or coalfield counties.
* Non-Coal/ARC: Other counties in the seven states.
* Pop > 100,000: Counties with populations greater than 100,000 in 2018 (this classification supersedes those above)..
* Giles County, Virginia, and Davidson County, Tennessee, are located outside of Appalachian coalfield areas of focus for the analyses; therefore, they were not classified by coal-production status.

Selected human health and economic metrics for each county and independent city are:

* County coal production, cumulative, 1980-2017: Data from Table 1, as tabulated from US EIA (2019) and US EIA/MSHA (2019).
* County populations for 2010 (census), and 2017, 2018, and 2019 (estimated): Data from US BOC (2020a).
* Age-adjusted mortality, annual average over 2009-2017: Data from US CDC (2020).
* Median household income and poverty rates for 2018; Data from US BOC (2020b).
* Unemployment rate for 2019: Data from US BLS (2020).

For further information on county-type classifications and for data analyses using these and related data, see Santopietro and Zipper (2020, in preparation) and Gohlke (2020, in preparation).

**Final Comment:**

Users of posted data are encouraged to credit the original sources.

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