

Virginia Coal Counties Need Renewable Energy

In 2017 Virginia 9th-District U.S. Representative Morgan Griffith introduced a bill ([H.R. 2880](#)) "Promoting Closed-Loop Pumped Storage Hydropower Act". It was unanimously approved by the House Energy and Commerce Committee on 6 December 2017.

I submitted a letter to the editor of The Roanoke Times about the bill:

"I am in favor of Congressman Griffith's bill to promote closed-loop pumped storage hydropower. Of course, there is no realistic "closed-loop" system; because of continual evaporation some outside water needs to be continuously added to the system.

If he is thinking over long term of only coal to provide the energy to be stored, he will be greatly disappointed. He should amend the bill to promote solar farms and wind farms, as Virginia coal extraction (<https://tinyurl.com/VACoal>) is on a fast decline, now at about 12-million tons per year compared to about 47-million tons per year in 1990. There may have been a slight uptick in 2017, but the rapid decline in Virginia coal extraction will continue over time.

Perhaps he is thinking of natural-gas to be provided for energy production. Its extraction rate in the U.S. (<https://tinyurl.com/USNatGas>) will peak soon and then fall, probably causing the price to rise. Given the fact that solar and wind prices are falling (<https://tinyurl.com/SolarWindCosts>), they are the best bet for energy storage.

To have storage for energy produced by solar and wind, he should add large battery storage (<https://tinyurl.com/BatteryStorageLarge>) to the bill, especially for most coal-field areas where pumped storage is not possible."

With most current energy for Virginia's coal counties coming from combusting coal, the only use for the proposed pump storage is to enable coal power plants to run at higher efficiency during night hours when demand is low. If the coal counties had renewable energy, solar and/or wind, the pumped storage could allow the energy collected when the sun is shining and/or the wind is blowing to use during other times. However, even better than pumped storage would be large battery storage.

Below I show that the possibility that coal extraction will revive in Virginia is very small. It would be wise for Virginia's coal counties to create large solar farms and large wind farms where the wind speeds are sufficient. Such renewable energy in coal regions would provide incentives for industries to locate there for the long term. Many industries are now committed to a large fraction of the energy they use to be renewable.

Some possibilities for establishing solar energy in Virginia coal counties are:

- Lease land to a solar company for it to construct the solar-energy collector (solar panels) and the battery system at a fixed price for electricity for a period of about 25 years for industries that have agreed to be in the Virginia coal counties to use the electricity.
- Arrange for a company such as [Amazon](#), [Google](#), etc. to make all the arrangements for the solar system as they have done in many other places and put one or more of their facilities in Virginia coal counties.
- Get Appalachian Power to install the solar-energy system with battery and pumped storage.

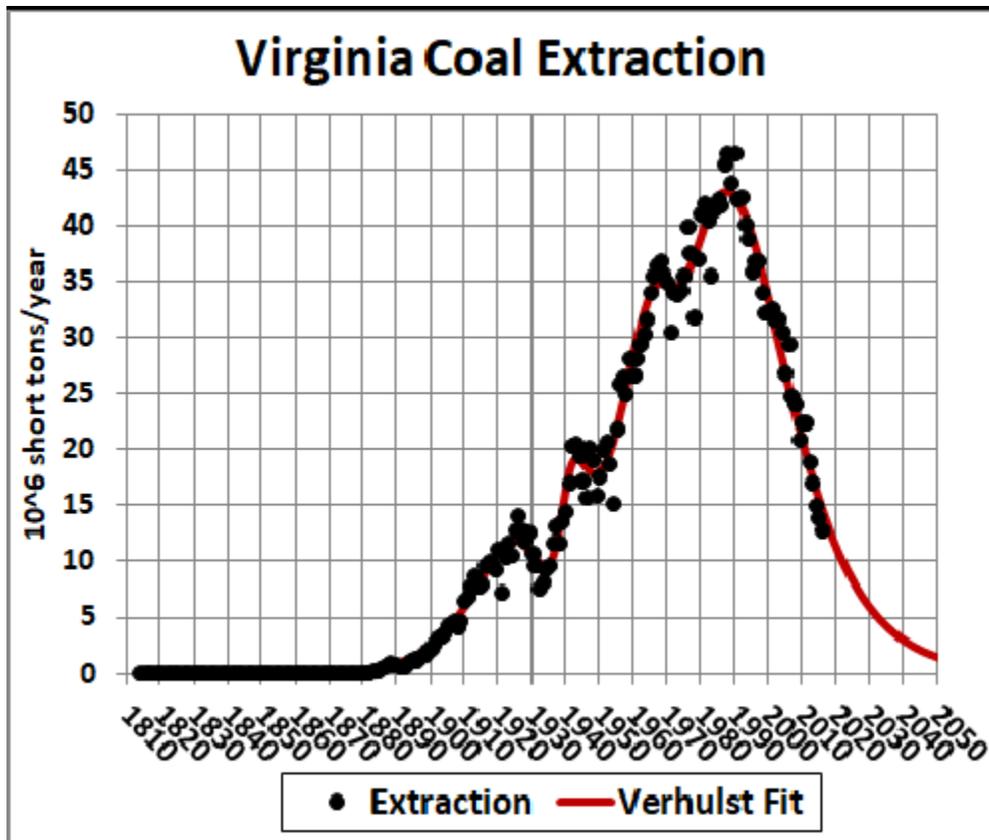
I suggest that, however it is done, it should be contracted that only administrative and supervisory jobs be from outside the coal counties. It should involve extensive training for local construction and long-term maintenance jobs by the community colleges in the coal counties (Mountain Empire Community in Big Stone Gap in Wise County, Southwest Virginia Community College in Richlands in Tazewell County).

Coal Extraction in Virginia



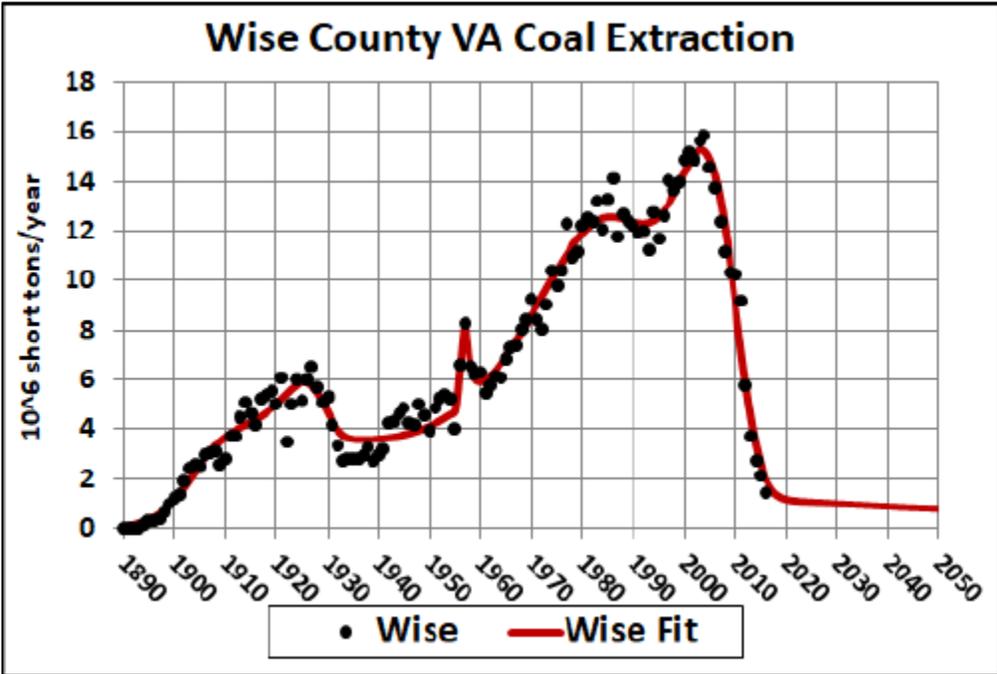
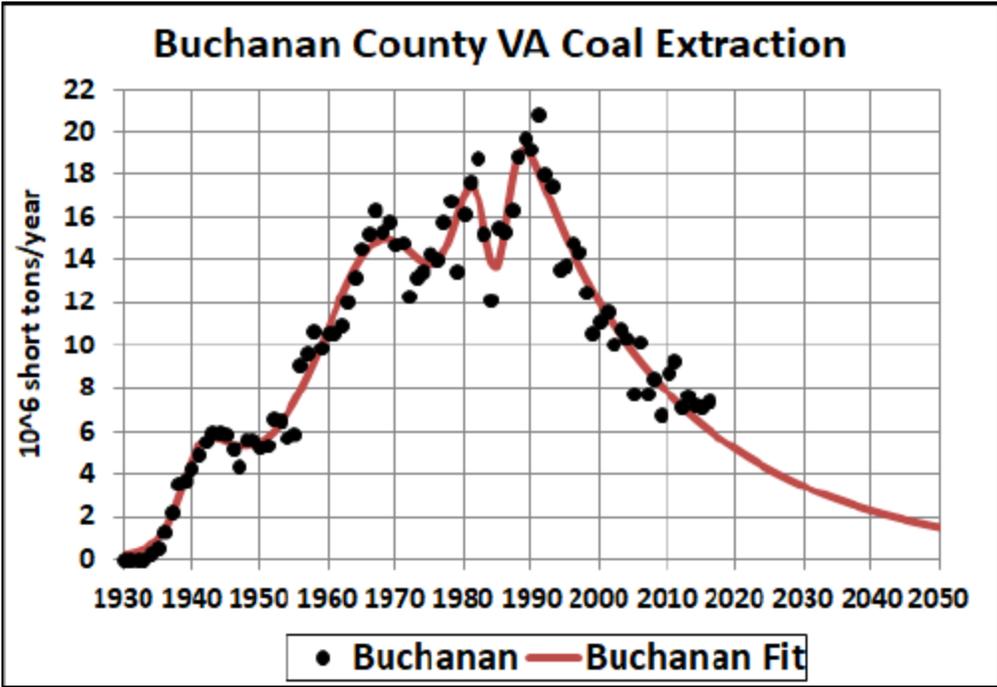
Virginia County	Maximum Coal Extraction/Year (million tons, year)	2016 Coal Extraction (million tons, year)
Buchanan	20.8, 1991	7.43
Wise	15.9, 2004	1.44
Dickenson	9.58, 1968	3.50
Tazewell	4.80, 1944	0.250
Lee	3.14, 1993	0.112
Russell	2.76, 1958	0.179
Scott	0.124, 1987	0
All Counties	46.5, 1990	12.91

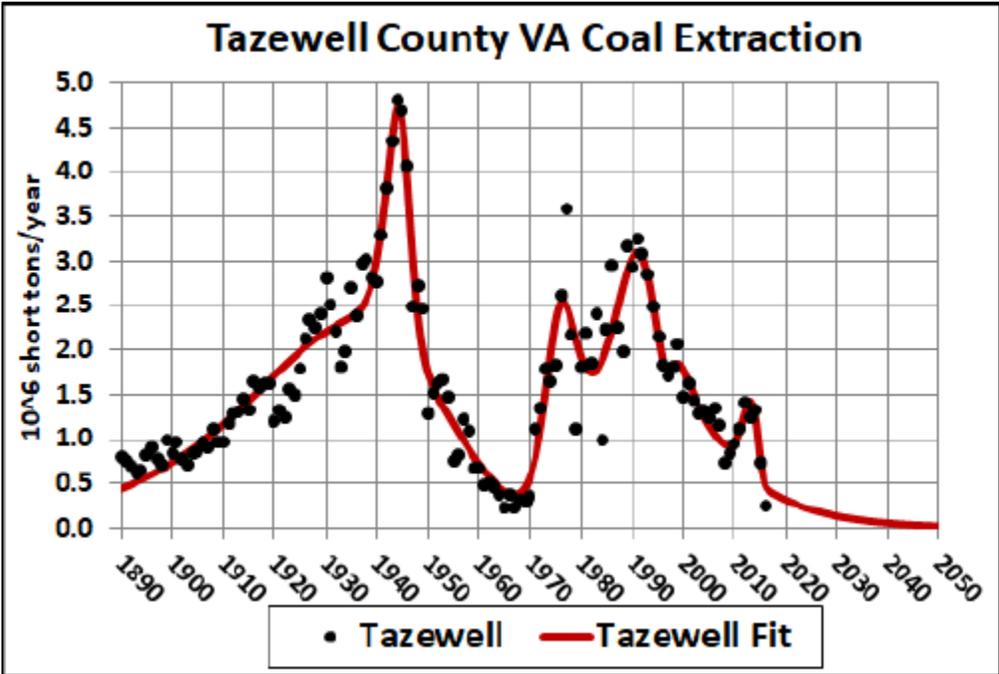
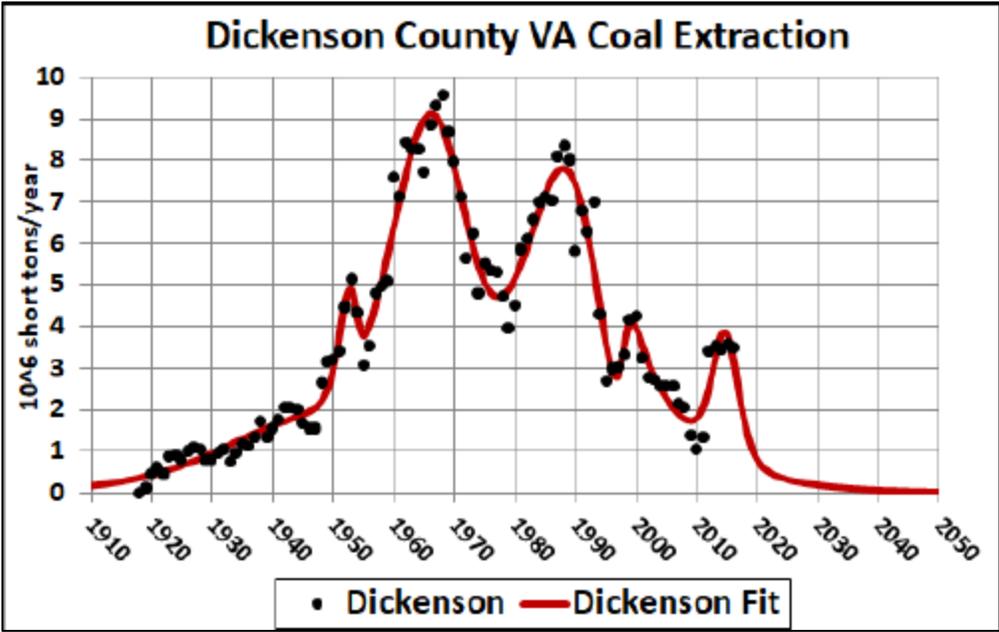
Note that the **three counties with the largest coal extraction** are contiguous.



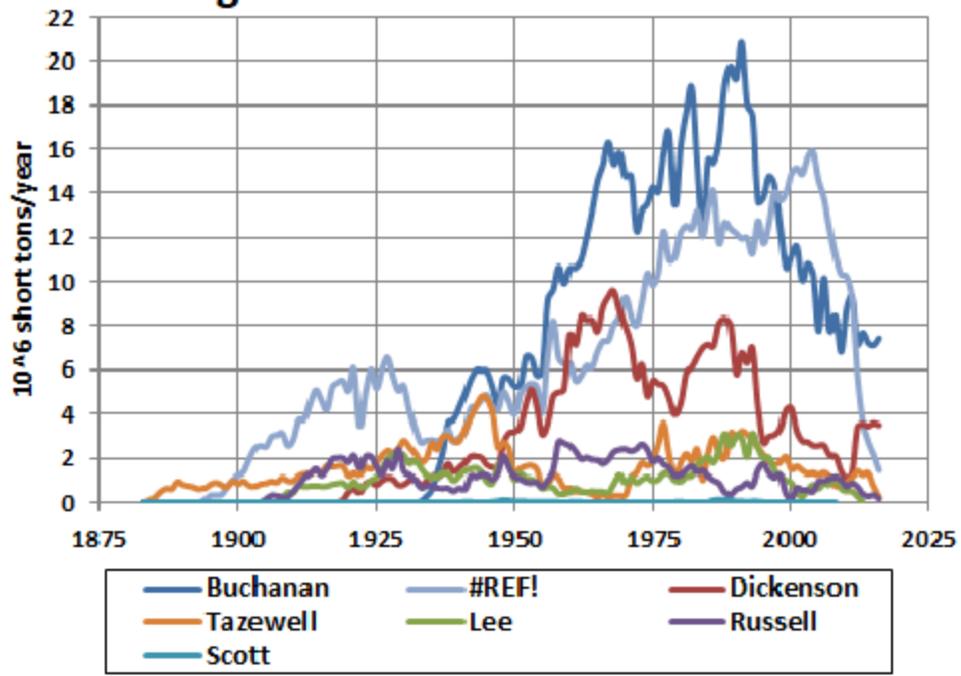
The fit (**red curve**) corresponds to reserves of 256-million tons yet to be extracted. The [U.S. Energy Information Agency](#) gives 195-million tons as the 2015 reserves for Virginia.

Therefore, the **red curve** may fall faster than shown.

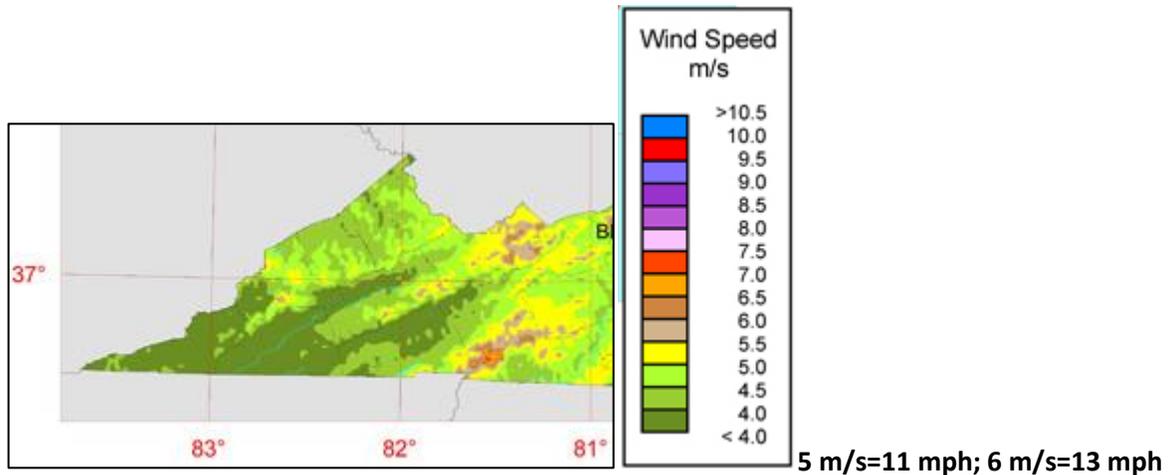




Virginia Counties Coal Extraction



Wind Map of Virginia Major Coal Counties



This map is for wind at 80-meters (262 feet) height, a typical height of a wind turbine.

Minimum wind speed needed for large wind turbines is **4.5 m/s (10 mph)**.

Note that Tazewell county and southwestern Wise county are the best locations for wind farms, although specific locations in Buchanan and Dickenson counties may be viable. One-year or longer [wind studies](#) need to be done at a specific site for a wind farm.

There are no wind farms in Virginia; the first one, a 75-megaWatt [Rocky Forge Wind](#) in Botetourt County, is scheduled to be built in 2018. It will create 150 construction jobs and 7 well-paid permanent jobs. It can power about 22,700 homes.

West Virginia has three major wind farms:

- [Beech Ridge Wind Farm](#): 100-megaWatts (MW) in Greenbrier County built in 2010. It has 67 GE 1.5-MW 250-foot tall wind turbines. It can power about 30,300 homes.



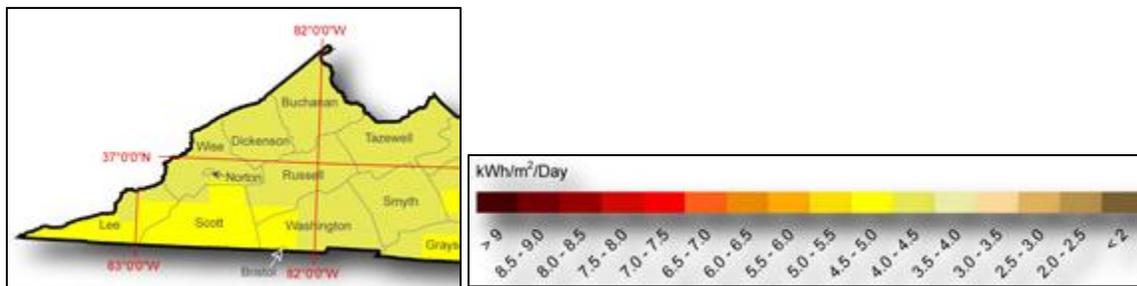
- [Mount Storm Wind Farm](#): 264-MW in Grant County built in 2007. It has 132 Gamesa G80 2.0-MW wind turbines. It can power about 80,000 homes.
- [Mountaineer Wind Energy Center](#): 66-MW in Preston and Tucker counties built in 2002. It has 44 NEG Micon 1.5-MW wind turbines. It can power about 20,000 homes.

For its long-term energy future Tazewell County would be wise to contact [Amazon, Microsoft, Google, Dow Chemical and 3M](#) about bringing their companies into Tazewell with wind energy supplying the energy.



Topographical Map of Tazewell County in Virginia

[Solar Map of Virginia Major Coal Counties](#)



The average solar incidence of 4.0-4.5 kWh/m²/Day in the major coal counties of Virginia is sufficient for locating efficient solar farms.

[2017 Guide to Virginia Wind and Solar Policy](#)

From this document:

- The rules for solar development in Virginia are complex and are evolving quickly, becoming more favorable for renewable energy after the 2017 legislative election.
- There are no wind farms in Virginia; the first one, a 75-megaWatts [Rocky Forge Wind](#) in Botetourt County, is scheduled to be built in 2018. It will create 150 construction jobs and 7 well-paid permanent jobs.
- Large solar farms in Virginia:
 - [80-MW solar farm](#) contracted by [Amazon Web Services](#) (AWS) to the wholesale market transmission organization [PJM](#) in Accomack County, avoiding [Dominion Energy's](#) monopoly restrictions.
 - AWS has contracted 180-MW with Dominion Energy in five Virginia counties.
 - The recent Governor McAuliffe of Virginia stated that about 1500-MW of solar farms are under development in Virginia.
 - Dominion Energy states that it intends to build 240-MW solar farms in Virginia each year through at least 2032.
 - The recent Governor McAuliffe committed the state government to 8% or 110-Mw of its electricity usage.
 - AWS and other corporations are committed to renewable energy in Virginia using various methods to bypass the monopoly of the electric utilities.

- Dominion has the right to develop a 2,000-MW wind farm offshore of Virginia Beach, nothing has happened yet.

Solar farm with battery backup on Kauai, Hawaii



13 megawatt solar farm and 52 megawatt-hour battery storage on 50 acres

Kauai contracted with Tesla for 20 years to buy solar power for 13.9 cents per kilowatt hour. This is much higher cost than it would be in Virginia coal counties, which would probably be less than 5 cents per kWh.

Comparison of Virginia with its Neighboring States

At the end of 2016, except for the end of 2015 for West Virginia:

Type	Maryland	North Carolina	West Virginia	Tennessee	Virginia
Solar (MW)	637.8	3,015.8	3.4	171.1	238.3
Wind (MW)	191	208	686	29	0

So, Virginia has moderate experience with solar farms and no experience with wind farms compared to its neighboring states. Virginia would do well to study and emulate renewable energy development in North Carolina, which has similar topology to Virginia. Virginia's coal counties could lead in this.

Solar Farms in Virginia Coal Counties

Solar farms (solar panels and large batteries for storage when the sun is not shining) are being built across the world. Virginia coal counties could do something similar.

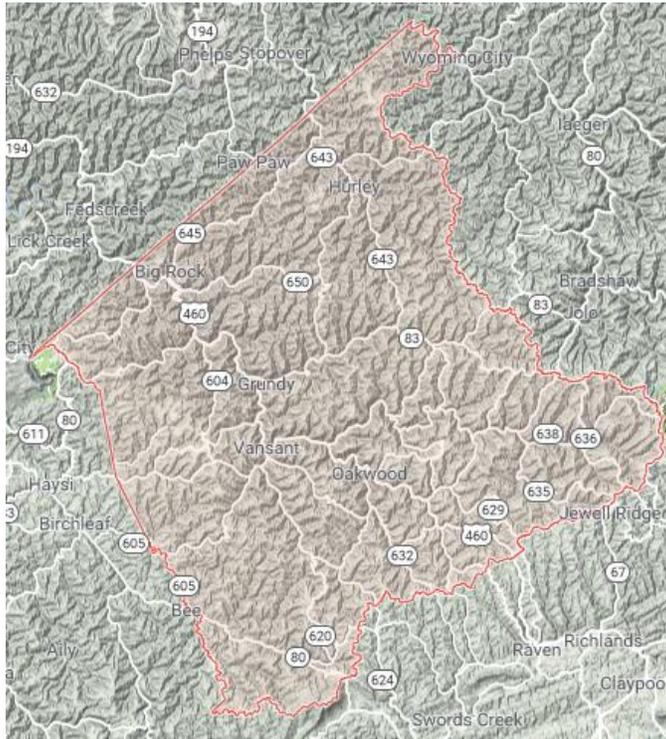
This table compares the areas and population with the island of Kauai, Hawaii to show that three Virginia coal counties could do [what Kauai has done with a large solar farm](#):

Virginia County	Area (Sq. Miles)	Population
Buchanan	504	22,800
Wise	405	39,700
Dickenson	334	15,100
Kauai, HI	552	66,921

The population for these three Virginia counties is 67,600 people, comparable to the Kauai population. The area for the three Virginia counties (1,243 Sq. Miles) is more than twice the Kauai area. So, even though the three Virginia counties are covered with mountains, the following topographical maps indicate that there are probably more flat areas in the three Virginia counties than there is in Kauai, Hawaii.



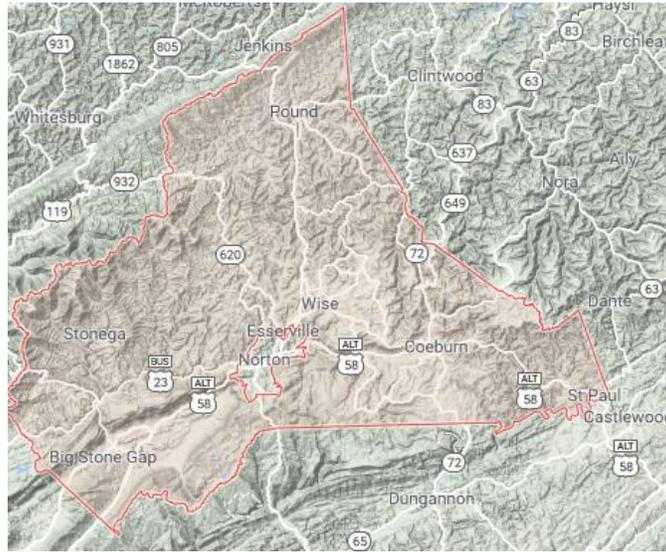
Topographical Map of [Kauai Island](#) in NW Hawaii
The Tesla solar farm is near [Lihue](#) in the SE part of Kauai.



Topographical Map of Buchanan County in Virginia



Topographical Map of Dickinson County in Virginia



Topographical Map of Wise County in Virginia

It appears that Dickinson and Wise counties have more flat land than does Buchanan County. A gently sloping south side of a mountain solar farm might allow more solar-energy collection than flat land.

Storage for Solar and Wind Energy

After fossil fuel extraction in the U.S. ends, energy storage will be needed for solar energy when there is no sunshine and for wind energy when the wind is not at the minimum speed of 4.5 m/s (10 mph).

Hydro Storage

This requires huge water storage at an elevation higher than a water-turbine electricity generator. The [Griffith proposal for closed loop hydro storage](#) is one way to do it.

Battery Storage

An easier energy-storage method is battery storage, which has become much less expensive and much more reliable than it was only a few years ago, mainly because of the rapid rise in electric cars on the roads.

- An example of large battery storage is <https://tinyurl.com/BatteryStorageLarge>
- [General Electric has a battery-storage option for its large wind turbines](#) to smooth out short-term wind peaks and valleys over periods of 15-60 minutes.
- [Only about 8% of a wind farm's capacity is required](#) to eliminate about 90% of the fluctuations in wind energy production.
- It may sound counterintuitive that [high-voltage power lines connecting solar-energy and wind-energy facilities across the U.S. serve the same purpose as massive energy storage](#), because in the U.S. solar energy peaks at noon (high 11 AM-7 PM EST), onshore-wind energy peaks at 2 AM (high 9 PM-8 AM EST and never average zero), offshore-wind peaks at 8 PM (high 3 PM-midnight EST) and there are four time zones. The total peak hour and high time period for these three renewable energies depends on their relative factors.

Renewable Energy Costs

Solar and wind costs have been falling rapidly: <https://tinyurl.com/SolarWindCosts>).

Most comparisons of costs do not include the costs of energy production incurred by global warming, which will constantly increase with time for hundreds of years; for example, the extra costs due to global warming of the 2017 U.S. hurricanes and wildfires.

Levelized Cost of Electricity for Plants Entering Service in 2022

Conventional Combined Cycle	Advanced Combined Cycle	Conventional Combustion Turbine	Advanced Combustion Turbine	Advanced Nuclear	Geothermal	Biomass	Wind Onshore	Solar PV	Hydroelectric
58.6	53.8	100.7	87.1	96.2	41.1	97.7	44.3	58.1	63.9

Conclusion

There is no doubt that the energy future for the coal counties of Virginia, Virginia, the United States and the rest of the world is renewable energy, especially solar and wind. The coal counties of Virginia need to quickly move toward solar and wind energy to provide jobs for its citizens in building and managing the facilities and in attracting companies to provide jobs.

References

- [Reevaluation of the Impact of Coal Mining on the Virginia State Budget](#)
- [Why is Corporate America Picking Wind Power Over Solar?](#)
- [Coal Production in Virginia](#)
- [Battery Storage Takes Hold in the Wind Industry](#)

Submissions

- [Virginia Coalfield Economic Development Authority](#) (mail@e-region.org; PO Box 1060, 527 East Main Street, Lebanon, Virginia; 276-889-1830)
- [Buchanan County Industrial Development Authority](#) (rchorn@vzavenue.net; PO Box 1072, Grundy, Virginia 24614, 276-935-2712)
- [Wise County Business & Economic Development](#) (econdev@wisecounty.org; PO Box 570, 206 E. Main St., Wise, Virginia 24293, 276-328-2321)
- [Dickenson County Industrial Development Authority](#) (msykes@dickensonva.org; 276-926-1699)

[L. David Roper, roperld@vt.edu](mailto:roperld@vt.edu)

Dave Roper was born and raised on a wheat and dairy farm in northwest Oklahoma and has lived in Blacksburg, Virginia since 1967. That NW area of Oklahoma has seen many boom and bust cycles for oil and natural-gas extraction and is now facing the impending U.S. peak of fracked [tight crude oil](#) and [natural gas](#), which will be almost completely extracted by 2050. Fortunately, that area has [high 80-meters-height wind speeds \(7.4-9 m/s\)](#), which has allowed [enormous wind farms](#) to be constructed. So, NW Oklahoma is moving quickly beyond energy by combusting fossil fuels to wind energy. Dave hopes that Virginia's coal counties can do the same using mostly solar energy and some wind energy.