Predicting U.S. Wind Energy Installed Capacity

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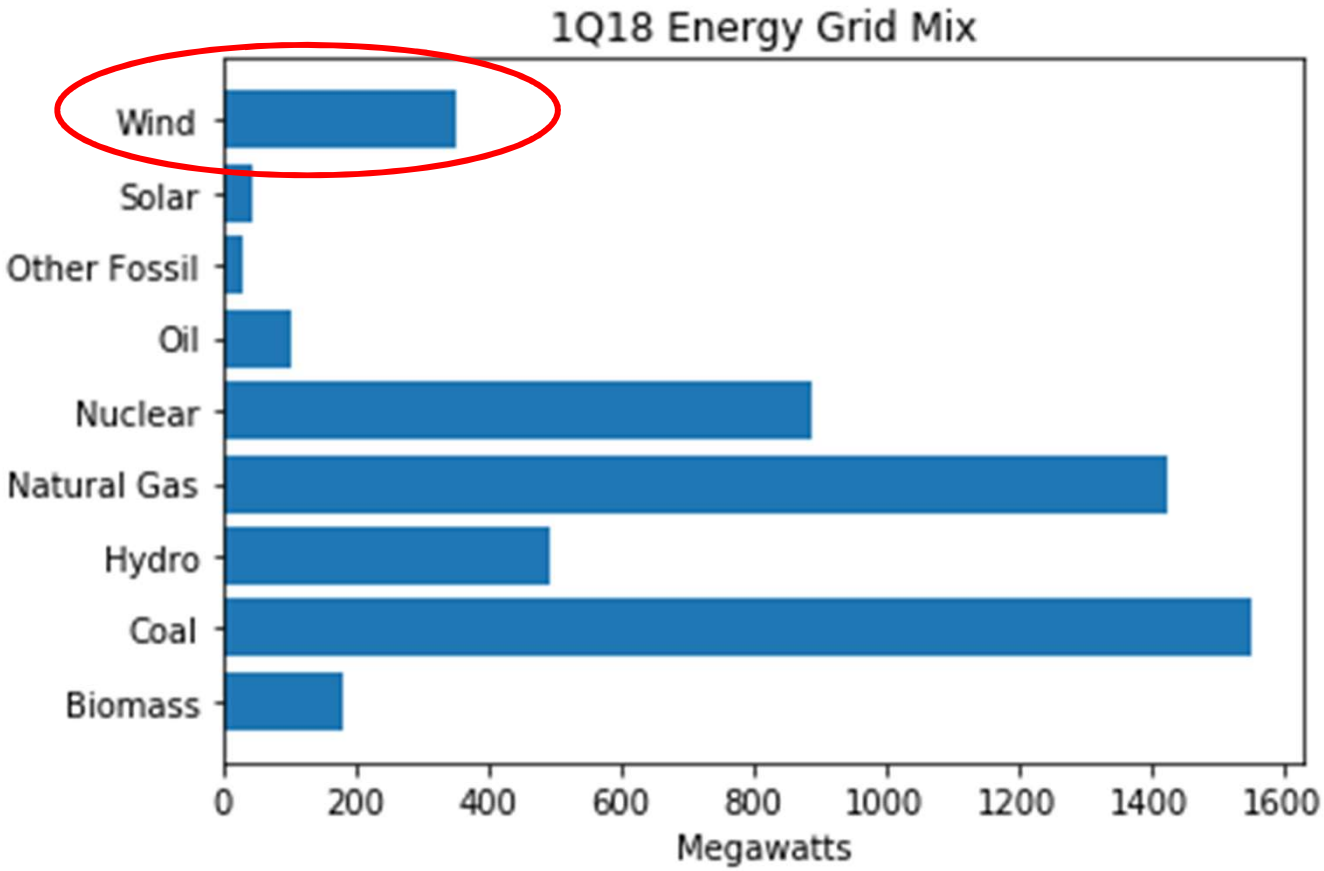
U.S. Wind Energy Facts

- One largest renewable energy source
- More reliable / resilient electricity mix
- Saves consumers money
- Clean air benefits
- Generated $108b air-quality & public health benefits between 2007-2015
- Over 100,000 wind-related jobs as of 2016 → 248,000 estimated by 2020

Energy Grid Mix



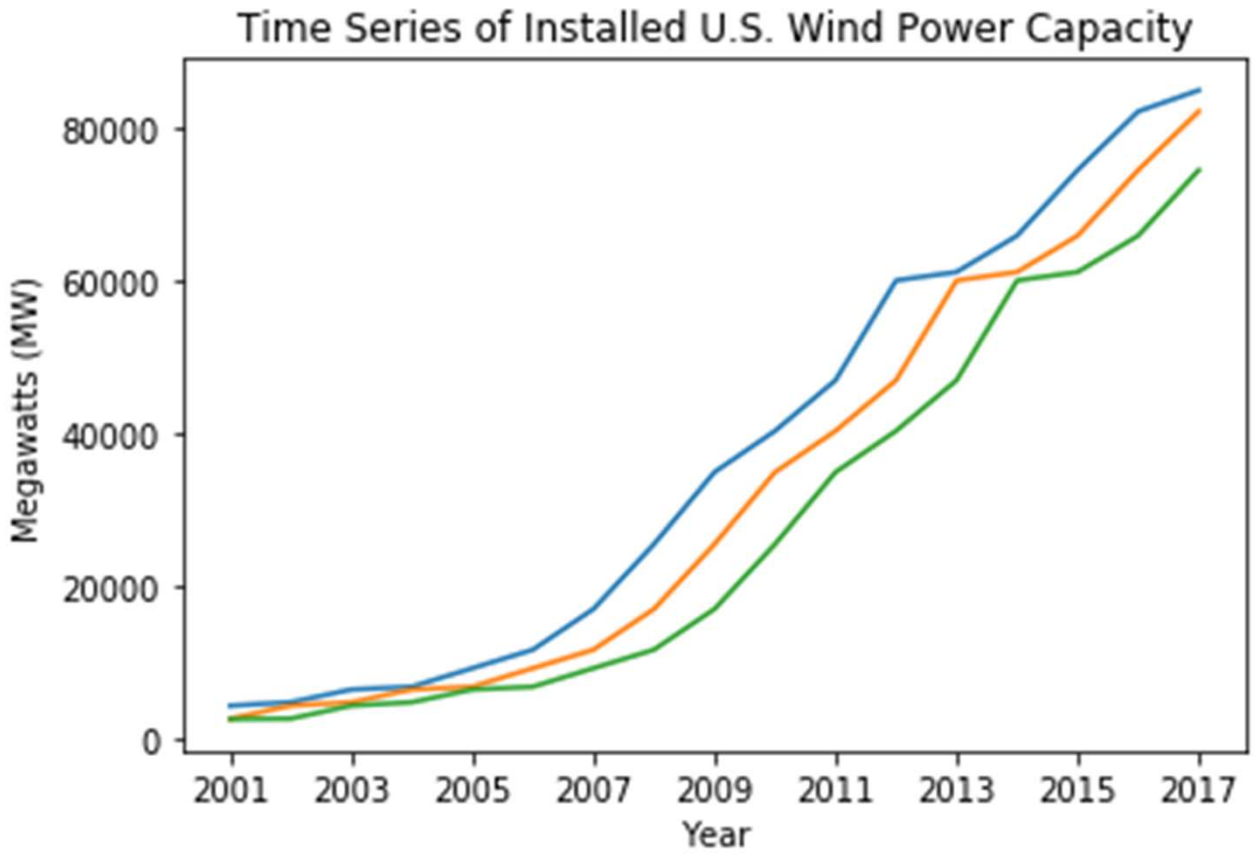
- Wind accounts for 7% of all installed energy capacity in the U.S.

AR-2 Matrix

- Autoregression model of installed wind energy megawatts (mw)
- Maps mw for current year 0 to 1 and 2 years prior
- mw_year_1 (1 year prior) & mw_year_2 (2 years prior) calculated as X input variables

year	mw_year_0 (y)	mw_year_1 (X1)	mw_year_2 (X2)
2001	4231.7730	2539.3230	2472.4780
2002	4687.3610	4231.7730	2539.3230
2003	6349.9420	4687.3610	4231.7730
2004	6723.1240	6349.9420	4687.3610
2005	9147.0640	6723.1240	6349.9420
2006	11574.5050	9147.0640	6723.1240
2007	16907.0495	11574.5050	9147.0640
2008	25410.0420	16907.0495	11574.5050
2009	34863.3530	25410.0420	16907.0495
2010	40266.9610	34863.3530	25410.0420
2011	46916.1000	40266.9610	34863.3530
2012	60005.0000	46916.1000	40266.9610
2013	61108.0000	60005.0000	46916.1000
2014	65877.0000	61108.0000	60005.0000
2015	74472.0000	65877.0000	61108.0000
2016	82171.0000	74472.0000	65877.0000
2017	84945.0000	82171.0000	74472.0000

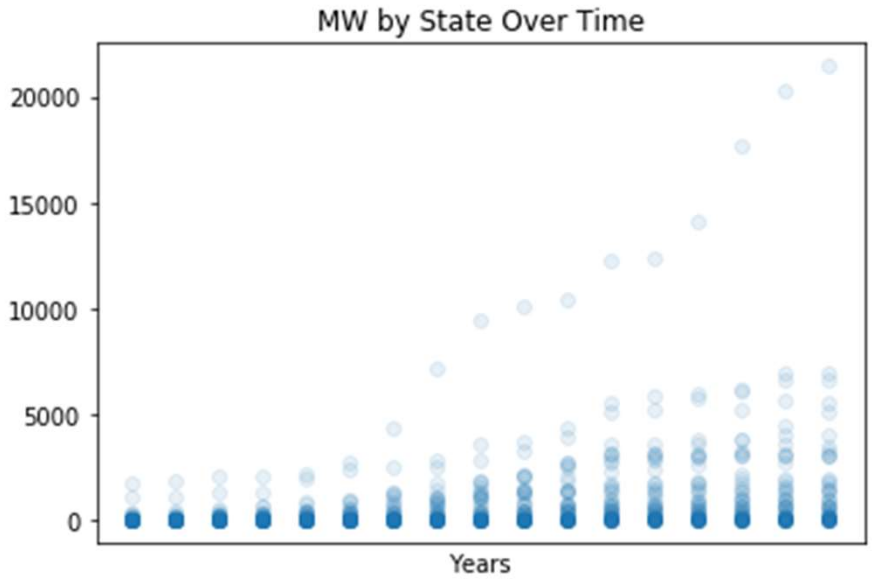
Time Series



- Total U.S. installed wind energy capacity reached 85k mw by the end of 2017

EDA Considerations / Outliers

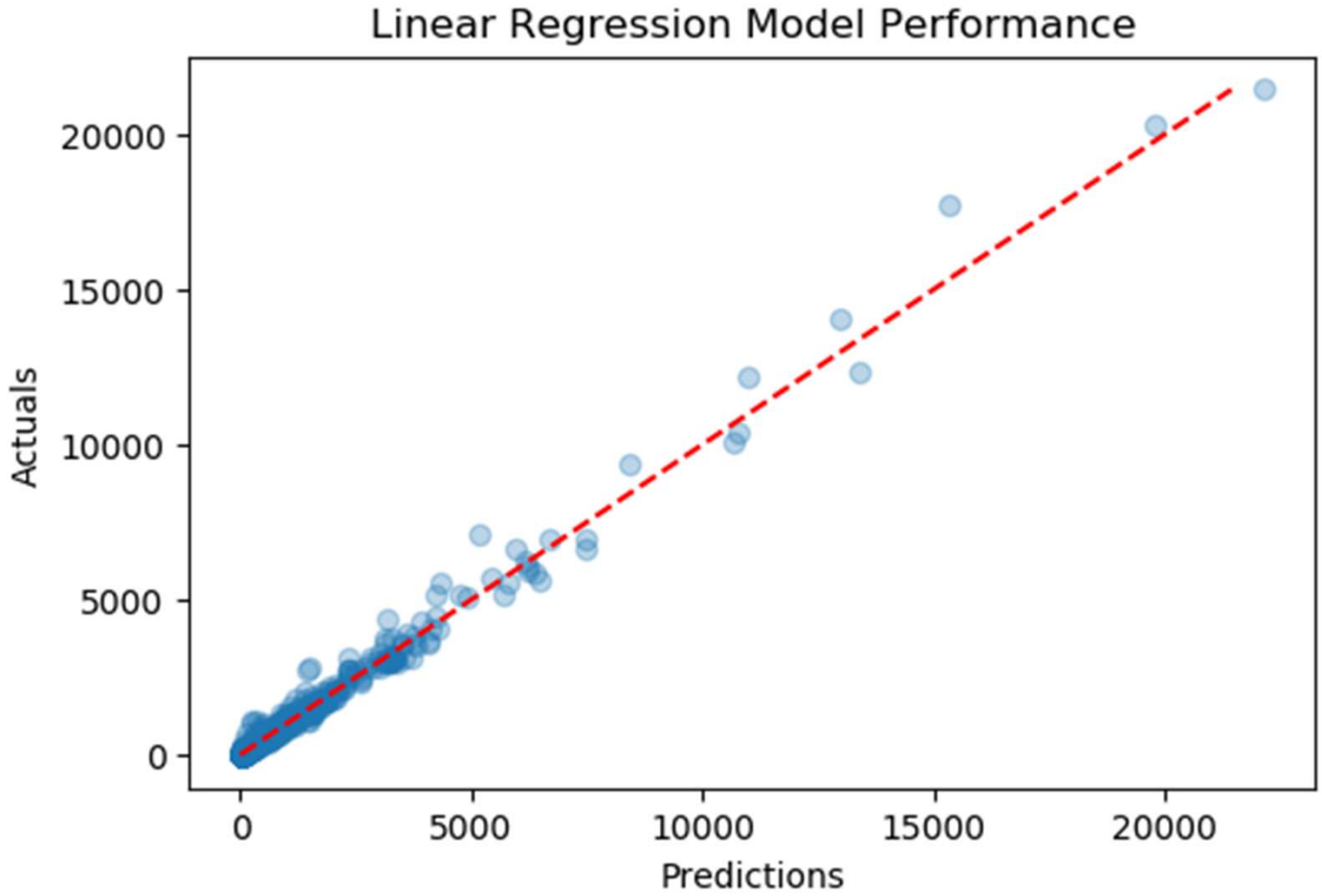
- How will Texas impact my model?



State	mw_year_0	*year1_change*	*year2_change*
Texas	149,004	*21,266*	*20,137*
California	61,715	*3,945*	*4,046*
Iowa	55,388	*6,731*	*6,675*
Oklahoma	35,803	*6,645*	*6,645*
Minnesota	32,512	*3,208*	*3,253*

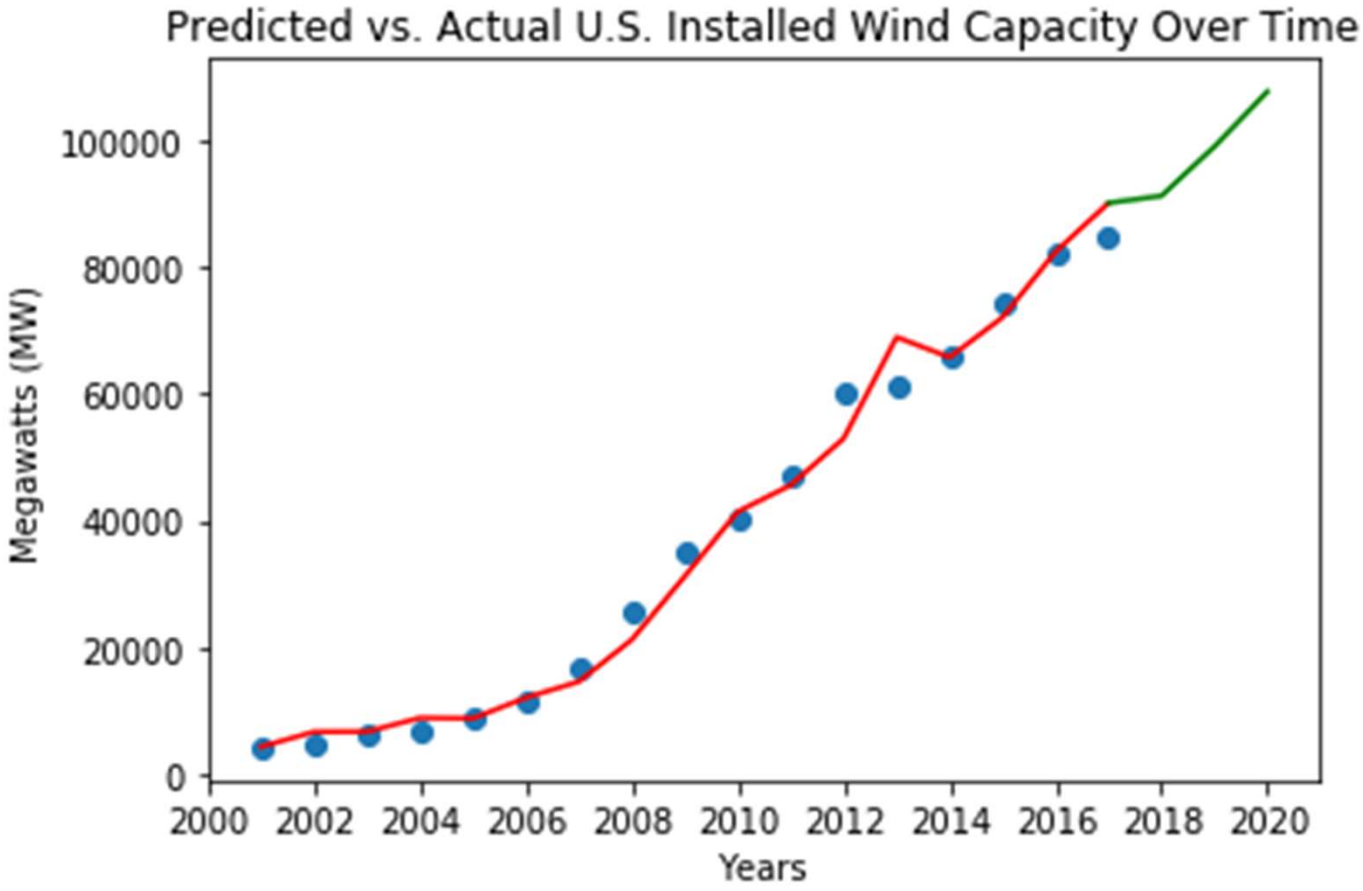
Top five states by 2017 installed capacity (mw)

Linear Regression



RMSE = 212 mw

Model Predictions



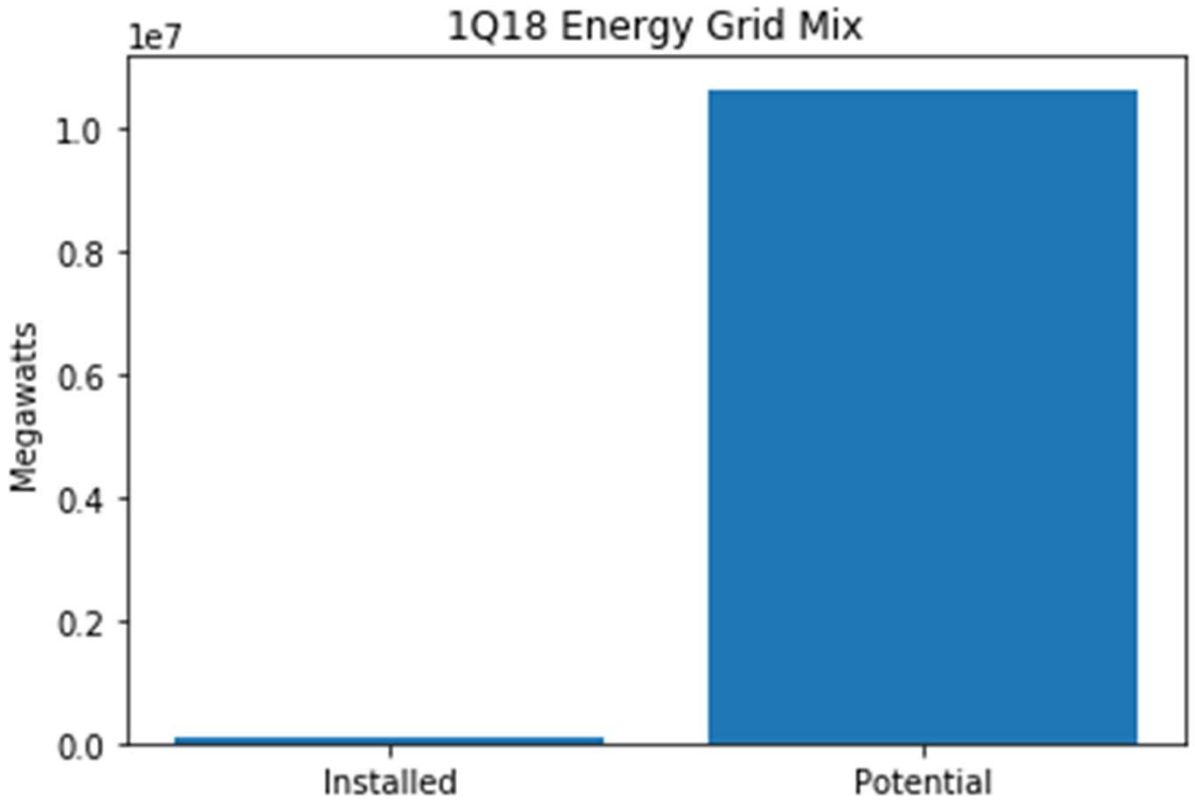
- Installed wind energy capacity is predicted to rise to 108k mw by 2020

Next Steps

- Additional web-scraping → Corrective regression model
  - State size
  - Median household income
  - Political party affiliations
  - Time Series

State	year	mw_ year_0	mw_ year_1	mw_ year_2	mw_ 0_pred	mw_ +1_pred	mw_ +2_pred	mw_ +3_pred	area_mi	median_ income	Dem / Rep
Alabama	2001	0.0	0.0	0.0	31.6	31.6	76.0	126.9	52,420	35,160	0
Alabama	2002	0.0	0.0	0.0	31.6	31.6	76.0	126.9	52,420	37,603	0
Alabama	2003	0.0	0.0	0.0	31.6	31.6	76.0	126.9	52,420	37,255	0
Alabama	2004	0.0	0.0	0.0	31.6	31.6	76.0	126.9	52,420	36,629	0
Alabama	2005	0.0	0.0	0.0	31.6	31.6	76.0	126.9	52,420	37,150	0

Future of Wind



- Installed capacity is only 89k mw / 0.8% compared to current potential capacity of 106m

Citations

- American Wind Energy Association, http://www.awea.org
  - Into the Wind, the AWEA blog
- Office of Energy Efficiency & Renewable Energy, https://windexchange.energy.gov
- U.S. Geological Survey, www.usgs.gov
- The U.S. Wind Turbine Database, https://eerscmap.usgs.gov/uswtdb/
- U.S. Census Bureau, Current Population Survey, Annual Social and Economic Supplements, https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-income-households.html
- State Area Measurements and Internal Point Coordinates, www.census.gov/geo/reference/state-area.html
- The American Presidency Project, www.presidency.ucsb.edu/showelection