



Photo: Nathan Ratledge, 2016

Impacts of Unconventional Oil and Gas Booms on Public Education

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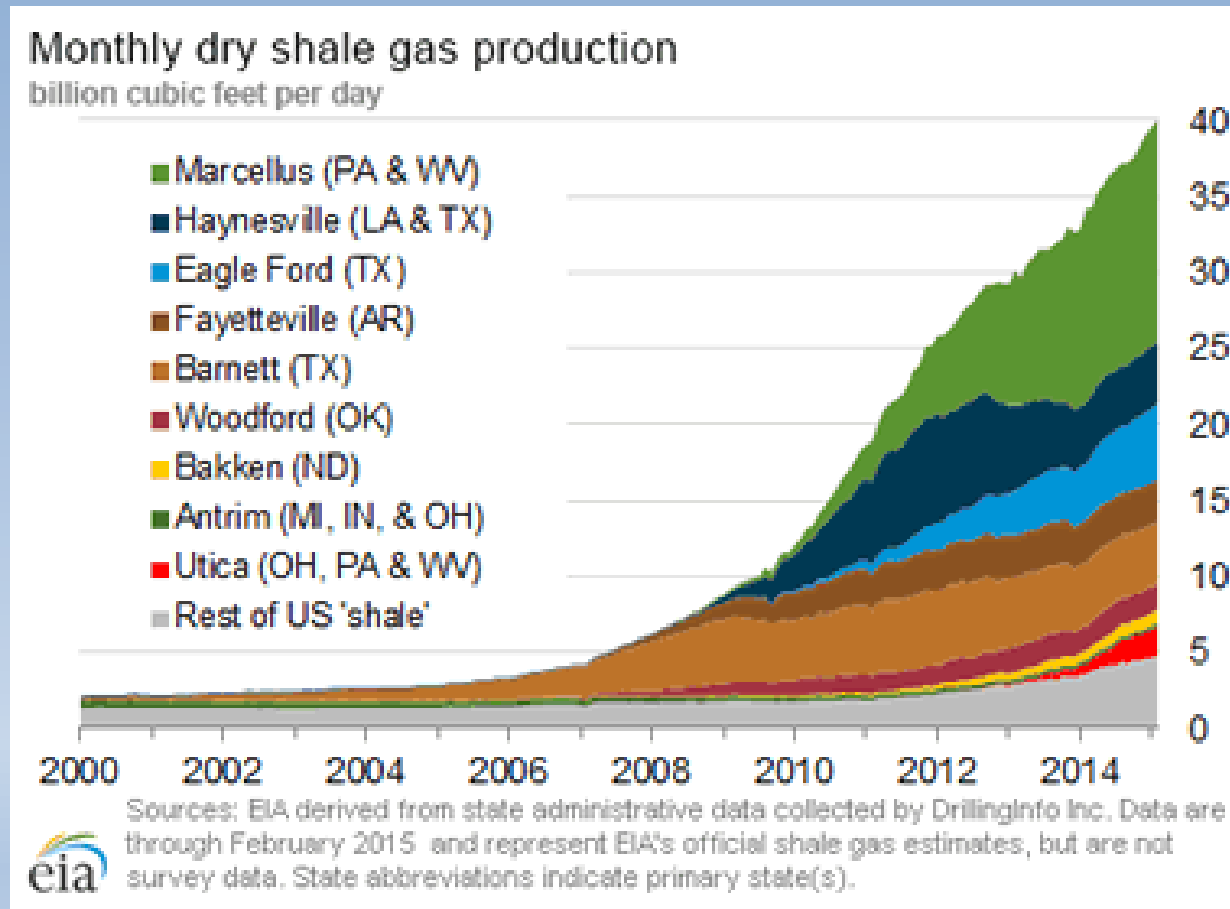
August 10, 2017



PennState

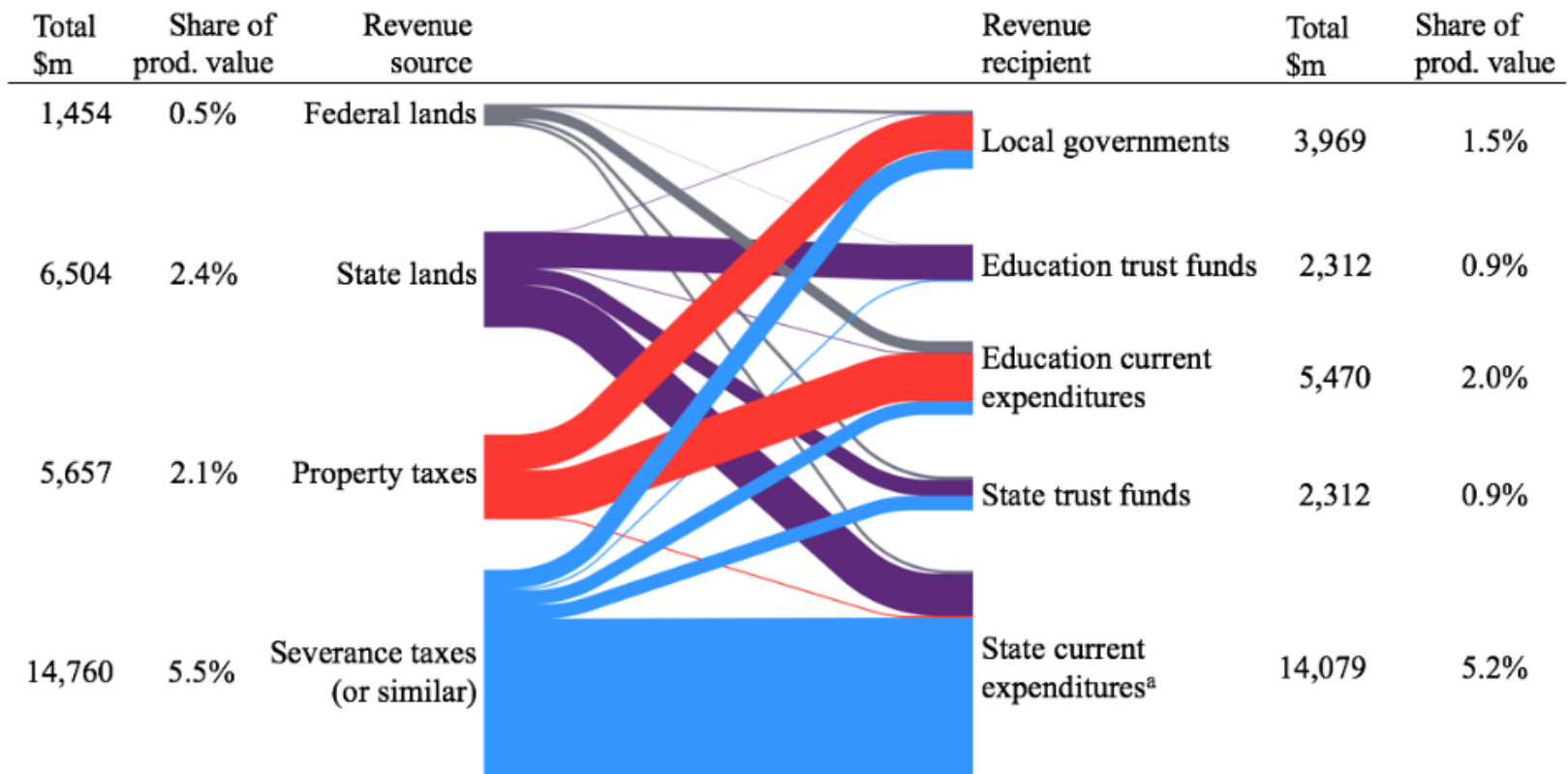
MCOR
Marcellus Center for
Outreach and Research

Unconventional Energy Boom



Related RFF Initiatives: *Shale Public Finance*

Figure 1. FY 2013 Oil and Gas Revenue Flows for State and Local Governments in 16 States



^a A portion of these funds is allocated according to a state budgetary process that includes allocations to education and local government current expenditures.

Part of Ongoing RFF Initiative: *The Community Impacts of Shale Gas and Oil Development*

Projects include:

- Developing a risk-benefit matrix to understand local impacts of shale gas development
- Identifying best-practice protocols for community–industry interactions
- Exploring how gas and oil development impacts K-12 education
- Estimating the costs of road expenditures linked to truck traffic resulting from shale gas well development
- Examining the risks associated with the solid waste generated from shale gas development
- Modeling ways to minimize both producer costs and community risk of impact (via truck traffic and/or spills) for wastewater processing
- Modeling optimal siting of well and pipeline infrastructure to account for both private costs and potential environmental impacts



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Central Research Question

“Did public school districts in regions with high levels of oil and gas production during the recent unconventional energy booms fair better or worse in terms of financial and educational performance outcomes than comparable school districts that did not experience a boom?”



Sample States: CO, MT, ND, OH, PA, WV

Shale plays in the Lower 48 states



Source: [Energy Information Administration](#)

Mixed Methods Research Design

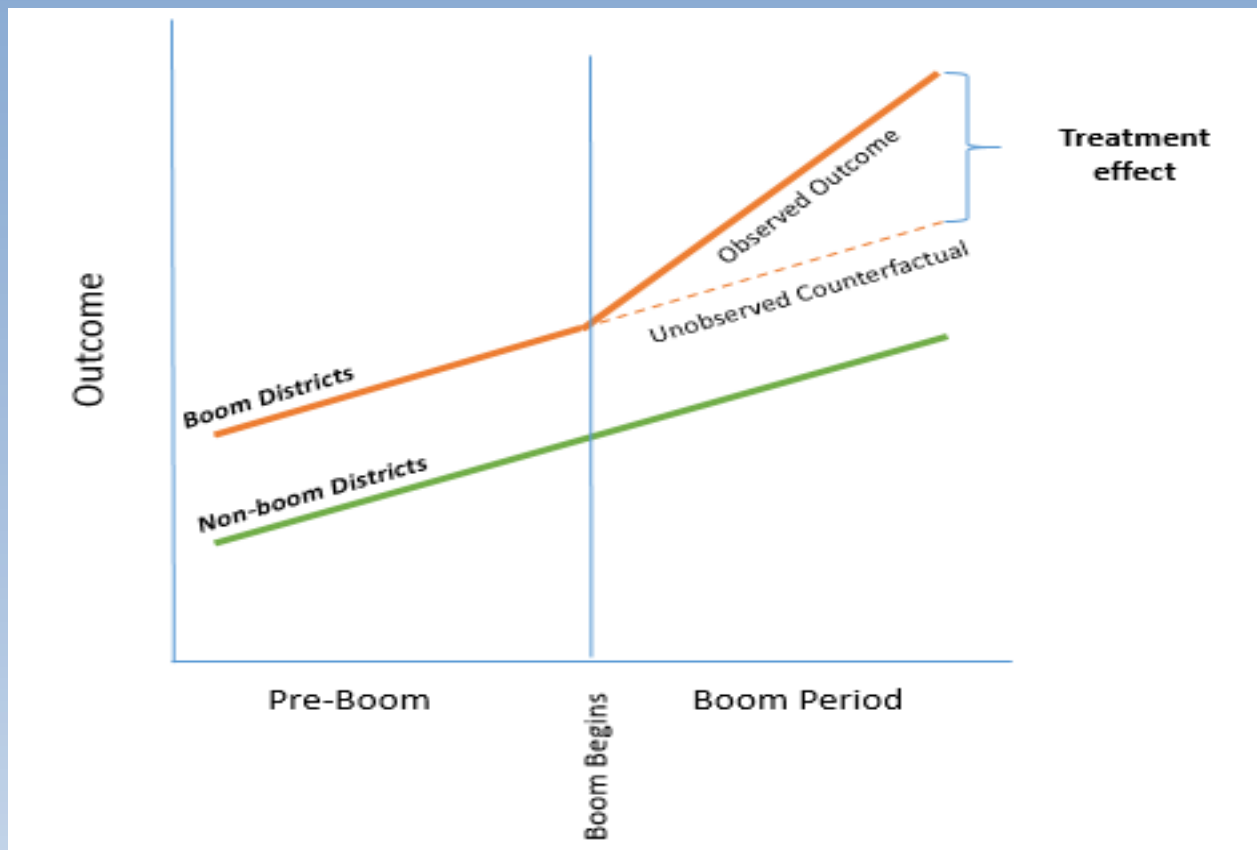
- Statistical analysis paired with semi-structured interviews
- Supported and underscored divergent trends between regions
- Illustrated some challenges were greater than data analysis alone made it appear (i.e. regarding: student population / mobility, teacher acquisition / retention, soft costs)
- First mixed methods analysis of this kind to look at the recent oil and gas boom and community impacts

Primary Data and Key Metrics

- 1,496 non-metropolitan districts
- 2000/01 – 2013/14 (pre-oil price crash)
- National Center for Education Statistics (NCES)
 - Student population; teacher numbers; local, state and federal revenue; education versus capital expenditures.
 - Free and reduced lunch, English Language Learners (ELL), teacher aides, etc.
 - Dropout data retracted by NCES in August 2016
- Stanford Educational Data Archive (standardized test scores)



Regression Design: Difference-in-Difference



$$Y_i = \alpha + \beta + \lambda_t + \delta D_t + x_{it} + \varepsilon_i$$

Y_i is the dependent variable

β is the treatment group

λ_t is the time trend

δD_t is an interaction between group and time variables and represents the treatment effect

Regression Design: Difference-in-Difference

- Boom District Criteria:
 1. Top producing district at 10% or 20%
 2. Above average percent change in production from pre-boom to boom
 3. Positive change in wells numbers over boom period
- Core treatment = top 10% of producing districts
- Total treatment = top 20% of producing districts
- Tested regression outcomes with:
 - Core treatment with neighboring districts
 - ***Core treatment dropping neighboring districts**
 - Total treatment with neighboring districts
 - Total treatment dropping neighboring districts
- ❖ Black et al 2005, Jacobsen and Parker 2014, Weber 2014, Cascio and Narayan 2015, Bartik et al 2016



Mixed Methods Research Design

Interview Component

- Visited all 6 states between May and August 2016 (post oil price crash)
- Conducted 70+ in-person interviews
 - Teachers, staff (i.e. guidance councilors), administrators, School Board members
- Important to hear in-classroom experience versus administrator perspective
 - Example – student mobility in the Bakken



Divergent Trends in Student Enrollment

TABLE 3. EFFECT OF BEING A TOP-PRODUCING DISTRICT COMPARED WITH CONTROL DISTRICTS DURING THE BOOM ON PUBLIC SCHOOL POPULATIONS

	# of students							Student-Teacher Ratio
	PreK & K	1st & 2nd	3rd & 4th	5th & 6th	7th & 8th	9th & 10th	11th & 12th	
5-State Pooled	7.021 (5.496)	-7.961 (5.053)	-15.11*** (4.480)	-17.02*** (4.575)	-17.99*** (5.372)	-22.26*** (5.737)	-6.445 (5.684)	-0.0428 (0.148)
Marcellus Region	7.826 (6.009)	-7.994* (4.304)	-15.63*** (4.243)	-16.77*** (4.555)	-17.82*** (5.654)	-20.76*** (6.016)	-9.415* (5.608)	-0.325** (0.135)
Pennsylvania	-6.445* (3.717)	-14.94*** (4.904)	-21.14*** (4.947)	-15.06*** (5.335)	-11.07 (7.099)	-10.04 (6.948)	-21.21*** (7.044)	-0.292* (0.151)
Ohio	-4.179 (7.707)	-12.56* (7.360)	-14.00 (9.362)	-14.33 (9.317)	-11.69 (8.257)	-11.74 (7.474)	-7.279 (10.01)	-0.0843 (0.393)
West Virginia	-28.98 (48.12)	3.876 (11.51)	-28.76* (16.99)	-33.74* (19.53)	-37.50 (26.26)	-43.82** (21.65)	-24.37* (14.06)	-0.612*** (0.0990)
North Dakota	1.946 (2.233)	8.392** (3.469)	6.965*** (2.586)	5.451* (2.848)	5.739* (3.207)	8.164*** (3.120)	2.517 (2.717)	1.120*** (0.365)
Colorado (D-J)	-16.73 (43.40)	-1.514 (63.80)	-19.61 (59.34)	-18.88 (61.02)	-9.758 (58.85)	-12.41 (58.72)	-32.84 (68.62)	1.391 (1.189)

*** p<0.01, ** p<0.05, * p<0.1

Note: As discussed herein, this report focuses on an analysis of regression results for the Marcellus, North Dakota, and Colorado.

Source: Ratledge and Zachary. 2017

- Marcellus boom districts had significant declines in student population
- Bakken boom districts experienced statistically significant increases.



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Student Mobility and Teacher Retention

Interview Responses

- Stress on Bakken schools and teachers was much greater than population numbers made it appear, due to increased student mobility.
- Teacher acquisition and retention were also significant problems—one school hired 12 teachers within two weeks of the school year starting.
- Hiring was exacerbated by issues such as inflated housing prices.
- Teacher retention was also challenging in many rural western districts.



Divergent Trends in Revenue and Expenses

TABLE 4. EFFECT OF BEING A TOP PRODUCING DISTRICT COMPARED WITH CONTROL DISTRICTS DURING THE BOOM ON PUBLIC SCHOOL FINANCE

	\$ per Pupil (in \$2014)					
	Total Revenue	Local Revenue	Property Tax Revenue	State Revenue	Education Expenditure	Capital Expenditure
5-State Pooled	-127.6 (223.9)	310.5* (181.1)	95.30 (144.3)	-367.3*** (119.6)	-201.5 (151.5)	218.9 (190.6)
Marcellus Region	374.8** (176.1)	138.2 (117.7)	62.56 (109.9)	205.7* (123.0)	240.3** (112.0)	127.5 (208.6)
Pennsylvania	161.3 (162.4)	-2.188 (130.2)	-29.00 (117.5)	103.7 (93.21)	64.84 (122.5)	90.21 (267.6)
Ohio	525.5 (469.6)	428.4*** (149.8)	420.9*** (158.3)	75.42 (403.5)	199.9 (178.6)	424.3 (605.6)
West Virginia	559.3 (474.7)	963.6** (461.9)	875.4** (410.7)	-449.2*** (123.9)	532.9** (211.9)	-182.5 (198.4)
North Dakota	-1,498* (807.2)	-390.4 (470.2)	-1,195*** (376.1)	-1,212*** (250.7)	-1,451*** (548.4)	872.6* (466.4)
Colorado (D-J)	-1,759 (1,657)	-310.2 (1,065)	88.85 (753.7)	-1,341 (1,033)	-1,112 (1,062)	340.1 (1,085)

*** p<0.01, ** p<0.05, * p<0.1

Note: As discussed herein, this report focuses on an analysis of regression results for the Marcellus, North Dakota, and Colorado.

Source: Ratledge and Zachary. 2017

- North Dakota experienced a decline in per pupil revenue and expenditures. Marcellus boom districts saw an increase.
- Similarly divergent trends existed between education and capital expenditures.

Common Trends Across All Regions

Interview Responses

- Low concern with high school dropouts leaving to work in the oil and gas industry.
- Low concern with student academic achievement.
- No evidence of teacher or staff leaving for higher paying industry jobs.
 - The loan exception was district bus drivers.
- Increased stress related financial uncertainty and volatility.
 - Affecting both short and long-term spending decisions.



New \$50m high school near Watford City, ND



Photo: Nathan Ratledge, 2016



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Concluding Thoughts

- Divergent trends largely between eastern and western districts
 - Student enrollment, STR, teacher hiring, per pupil finances
- Common trends among all regions include:
 - Low concern with high school dropouts and reduce student achievement, scant evidence of teachers or staff leaving for industry jobs, high stress from financial uncertainty and volatility.
- **Are boom districts better or worse off?**
 - Despite some specific benefits, it is not convincing that the average regional district is strictly better off.
 - Long-term concerns persist.





Escaping the Resource Curse

Findings from comparative energy impacts research in the Bakken, Powder River Basin and Marcellus



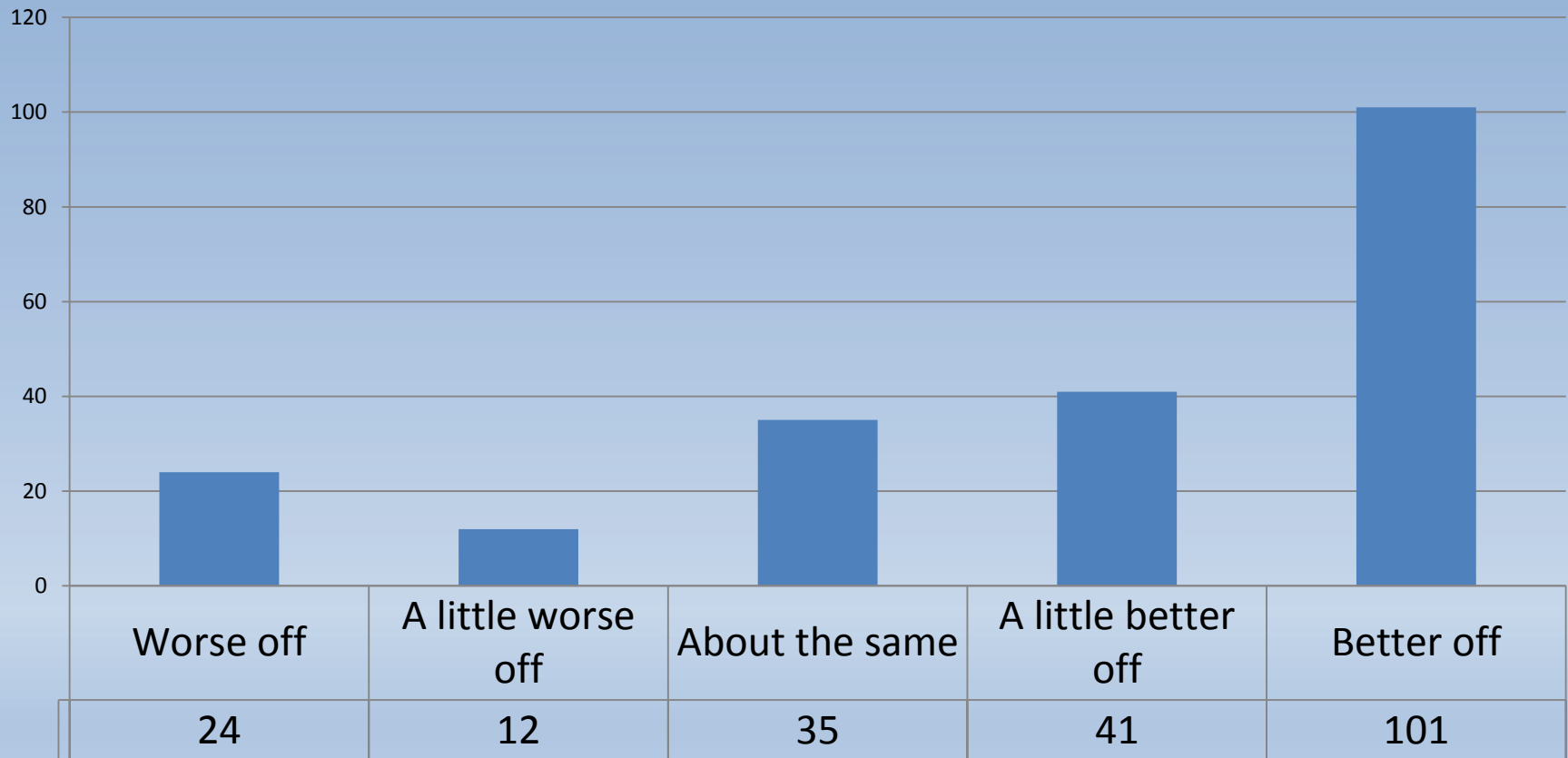
Dr. Julia H. Haggerty, Dr. Paul Lachapelle, Katie Bills Walsh, Kristin K. Smith, Montana State University

Dr. Tim Kelsey & Dr. Jason Weigle, Penn State University

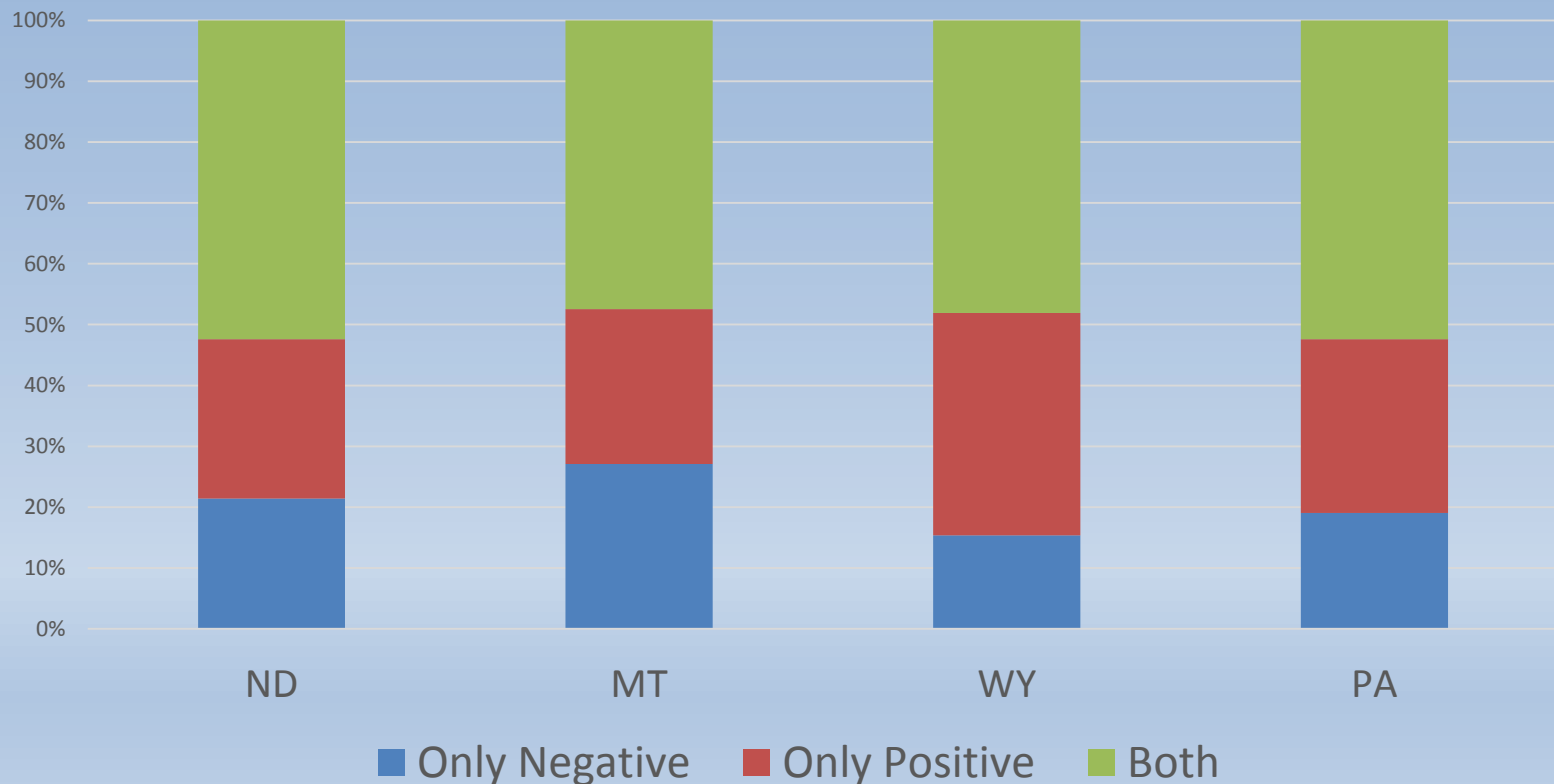
Dr. Roger Coupal, University of Wyoming

Dr. David Kay, Cornell University

Overall, do you feel you and members of your household are better off as a result of O&G development?



What type of impact have the oil or gas development activities in your county had on your **farm or ranch operation**? Select all that apply. (N=97/223)



Expectations

How long did you expect peak to last?

	Less than 10 years	10-20 years	More than 20 years
North Dakota	31.6% (6)	57.9% (11)	10.5% (2)
Montana	43.2% (16)	46% (17)	10.8% (4)
Wyoming	46.2% (12)	53.8% (14)	0% (0)
Pennsylvania	40.4% (19)	53.2% (25)	6.4% (3)
Total	41.1% (53)	51.9% (67)	7% (9)

Were you expecting oil/gas activity to decline when it did?

	No, did not expect decline	No, expected decline earlier	No, expected decline later	Yes
North Dakota	26.3% (5)	10.5% (2)	36.8% (7)	26.3% (5)
Montana	24.3% (9)	8.1% (3)	46% (17)	21.6% (8)
Wyoming	28.1% (9)	3.1% (1)	46.9% (15)	21.9% (7)
Pennsylvania	40% (22)	1.8% (1)	36.4% (20)	21.8% (12)
Total	31.5% (45)	4.9% (7)	41.3% (59)	22.4% (32)

Mitigation = Preparation & Coordination



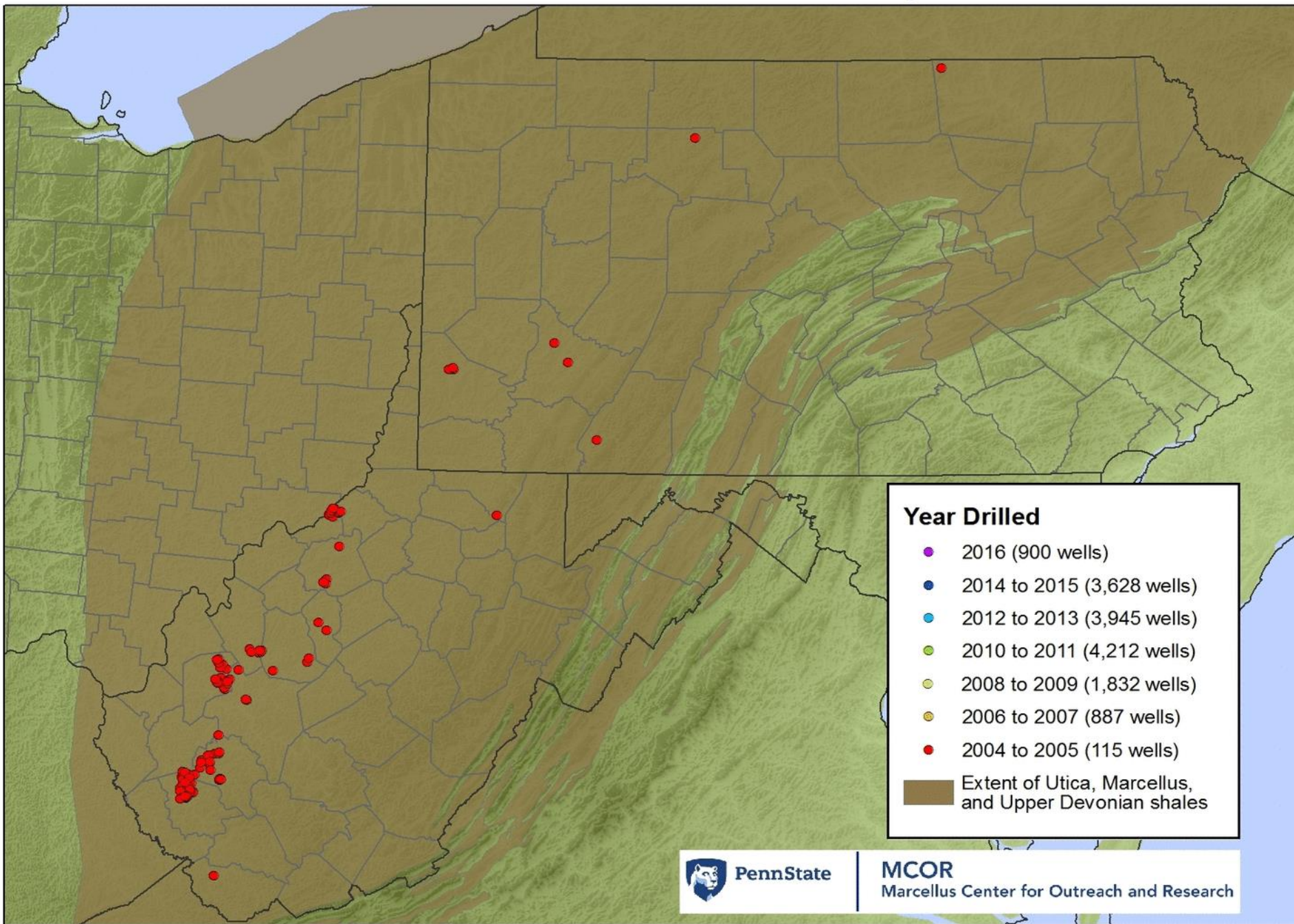
Community Impacts of Shale Development in the Marcellus Region

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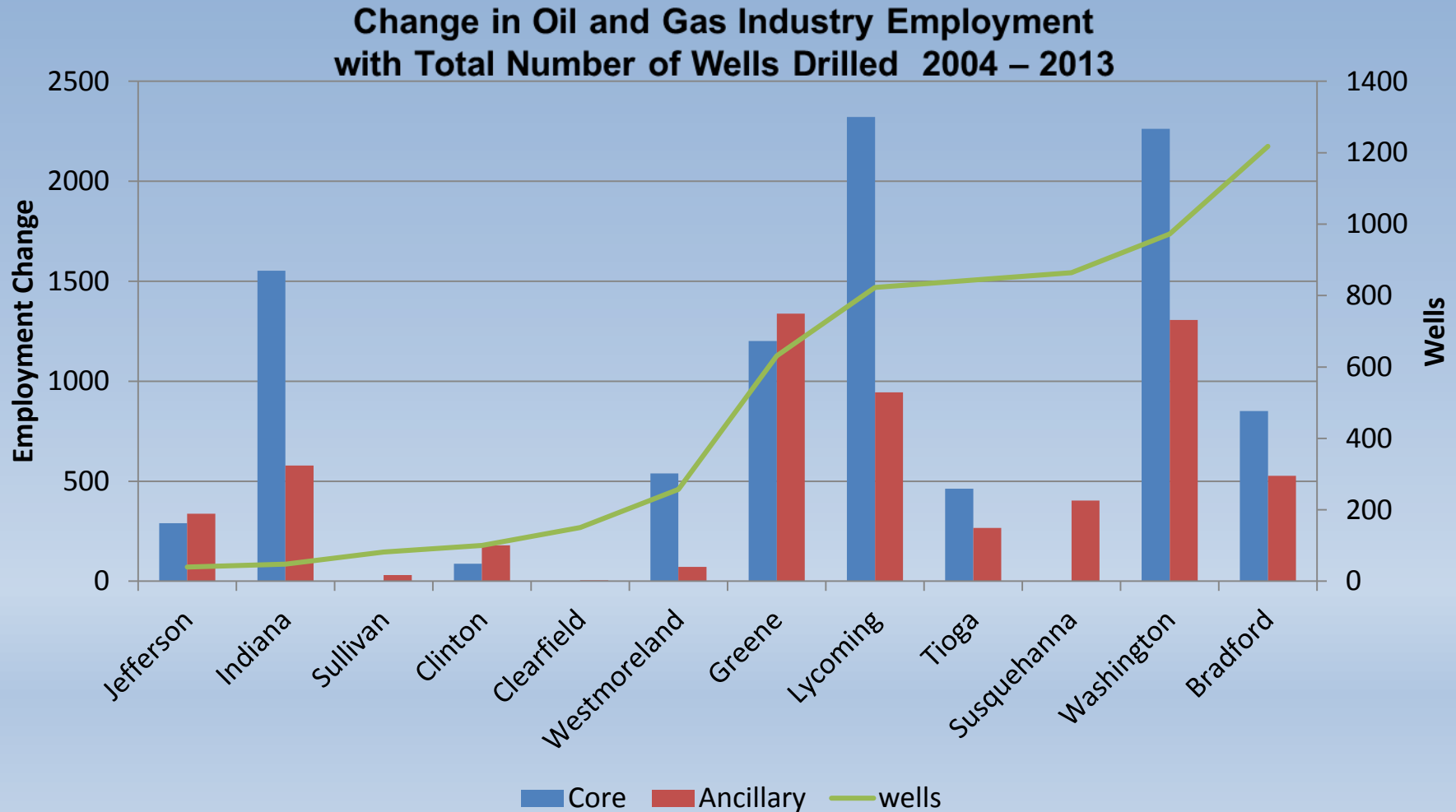
Resources for the Future Webinar
August, 2017



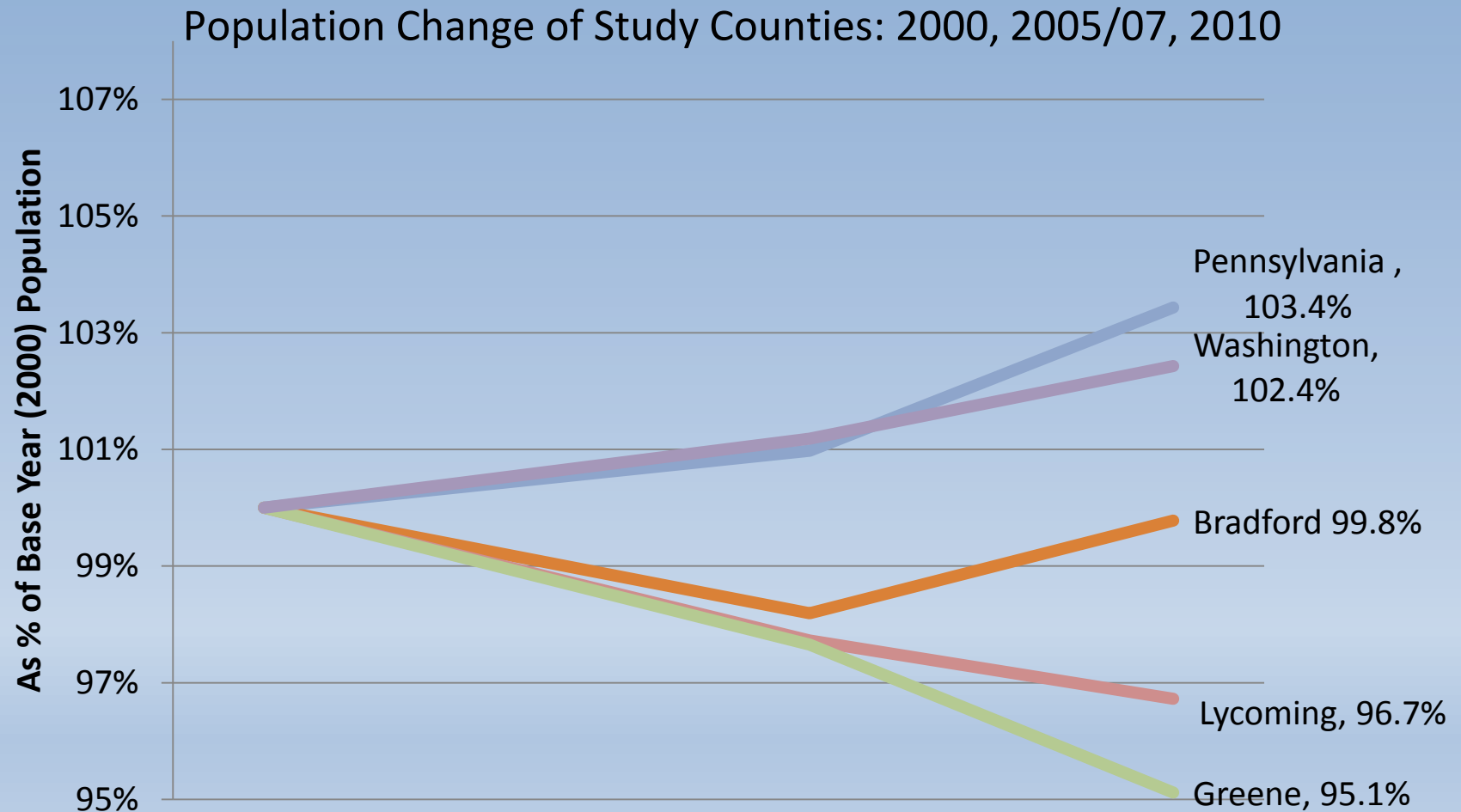
Unconventional Wells Drilled by Year



Impacts Vary across communities



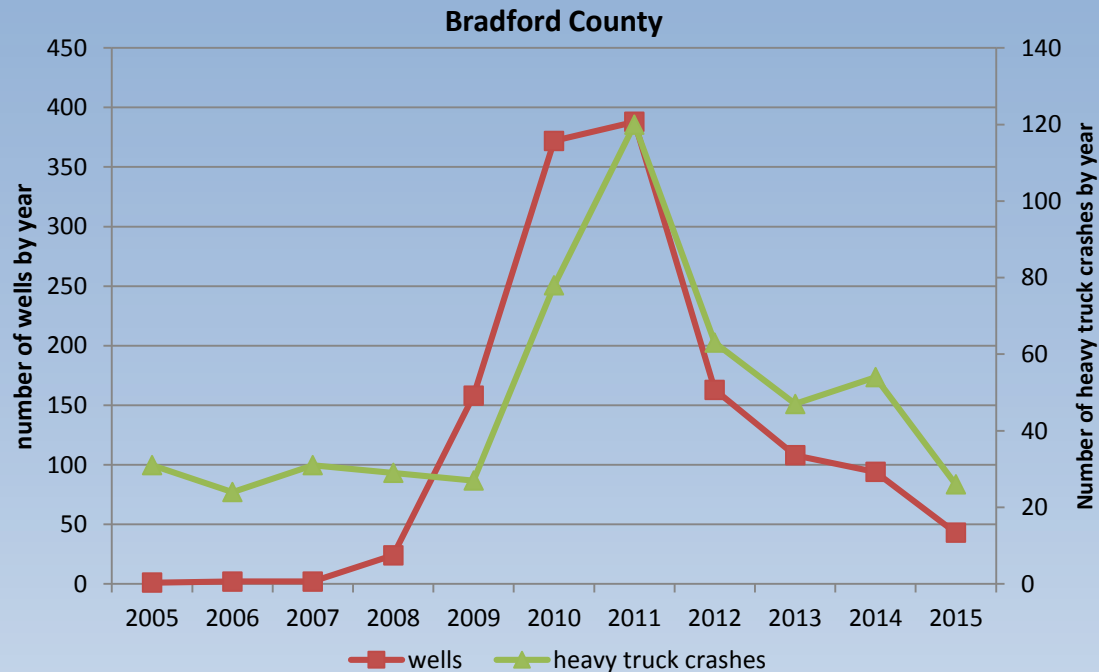
Resident Population Change



Housing in Marcellus Region

- Rental markets tightened
 - Lower availability of units, higher rental rates
- Rental housing use by industry workers results in
 - Displacement of low-income families
 - Emergency shelter
 - Increased homelessness
- Hotels absorb influx
 - Economic opportunity for local entrepreneurs
 - Hotel chains (franchises) displacing local ownership
 - Over-supply of hotels in rural areas
- Others housing:
 - Industry provided units (“man-camps”)
 - Trailers and RVs (infrastructure support)

Traffic and Public Safety concerns



Pct Change between 2009 and 2011	Bradford	Lycoming	Greene	Washington	PA county average
Total crashes	45.0%	14.2%	11.2%	4.5%	3.3%
Heavy truck crashes	344.4%	131.7%	73.7%	23.5%	20.3%

Source: K. Brasier. 2016. *Housing and Marcellus Shale Development*. Center for Rural Pennsylvania.



PROJECTS DESCRIBED HERE WERE CONDUCTED BY TEAMS FROM PENN STATE, CORNELL, AND THE INSTITUTE FOR PUBLIC POLICY AND ECONOMIC DEVELOPMENT, INCLUDING:

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THANK YOU

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