Solar Opportunities in Rural Kansas:
Siting on Marginal Agricultural Land, Community Solar Projects, and Support for Solar in Rural Communities

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Kansas State University

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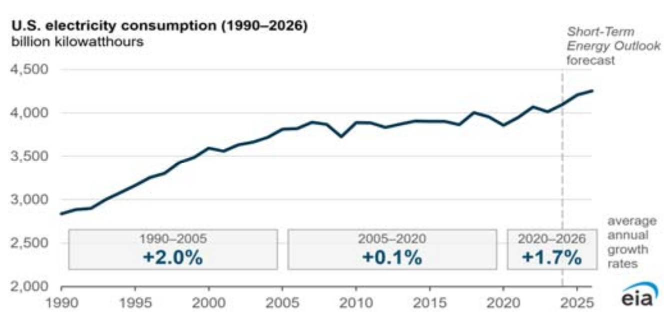
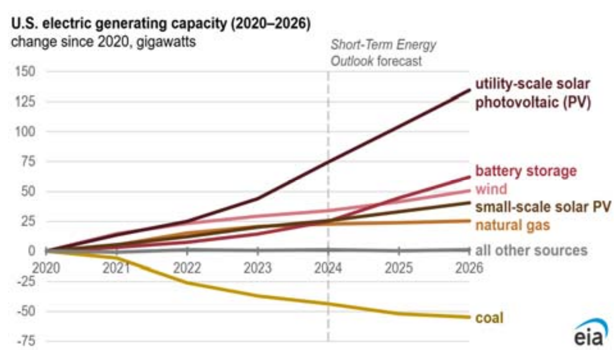
Why solar matters?

- Growing electricity demand
- Renewable energy source



Data source: U.S. Energy Information Administration, *Monthly Energy Review* and *Short-Term Energy Outlook*, May 2025
Data values: Electricity Overview (history) and U.S. Electricity Industry Overview (forecast)



Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook*, May 2025
Data values: U.S. Electric Generating Capacity

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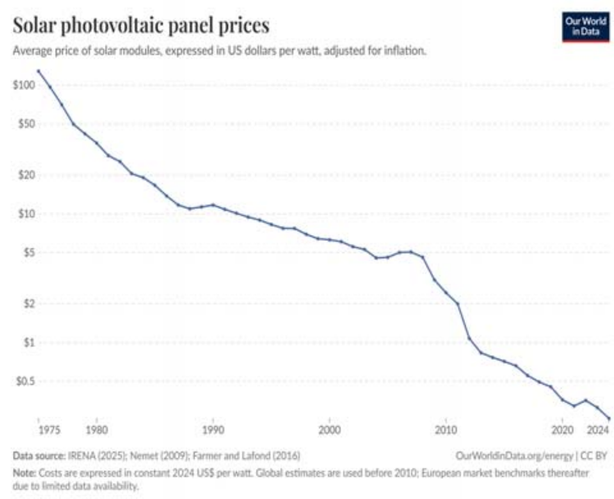
Evolution of solar photovoltaic (PV): From niche technology to mainstream energy source

- **PV module prices have fallen by more than 95% since the 1970s.**
- **Utility-scale solar electricity costs have declined by approximately 90% since 2010.**
- **Solar has become one of the lowest-cost sources of new electricity generation globally.**

The economics of solar have fundamentally changed over the last 15 years. Today, solar developers are increasingly looking for economically viable sites, including marginal agricultural lands in rural communities.



Source: https://ourworldindata.org/grapher/solar-pv-prices
Data source: IRENA (2025)

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What we will explore here today:

- **Solar perceptions in micropolitan and rural communities;**
- **Rural community support for solar in Kansas and the surrounding states;**
- **Farmers' willingness to lease land for solar installations; and**
- **Suitability of marginal and CRP lands for solar installations.**

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Perceptions About Solar in Micropolitan and Rural Communities of the Central Great Plains

Concerns About Solar

The Survey

Study Area

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The Question

Q2. Solar energy is a rapidly evolving form of green energy. As such, it is challenging to stay up to date about new developments. Below are ten statements about solar energy that have been talked about in communities and in the popular press. After each statement, please indicate whether you knew this information already, you just learned about this, you disagree with this, or you do not know what to think about it.

	I already knew this 1	I just learned this 2	I disagree with this 3	I do not know about this 4
a. The cost of energy produced from utility-scale solar projects has dropped significantly over the past two decades. [2001]	☐	☐	☐	☐
b. Solar power can be cheaper than power generated from coal. [2002]	☐	☐	☐	☐
c. Solar power projects do not affect neighboring property values. [2003]	☐	☐	☐	☐
d. Solar power projects would not significantly impact agricultural production in your region. [2004]	☐	☐	☐	☐
e. Modern solar panels do not impact local air or water quality. [2005]	☐	☐	☐	☐
f. Solar projects do not cause significantly higher ambient temperatures in surrounding communities. [2006]	☐	☐	☐	☐
g. New solar projects are designed to minimize impact on local wildlife. [2007]	☐	☐	☐	☐
h. Modern solar panels are designed so they do not emit chemicals into the ground that pose a risk to public health. [2008]	☐	☐	☐	☐
i. Solar projects have minimal impact on the local environment and don't drive away wildlife. [2009]	☐	☐	☐	☐
j. Solar panels can be safely disposed of in landfills or recycled. [2010]	☐	☐	☐	☐

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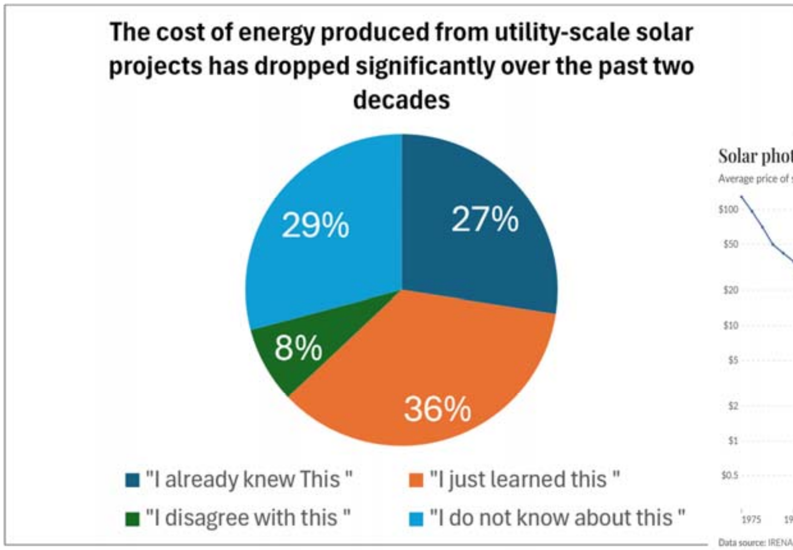
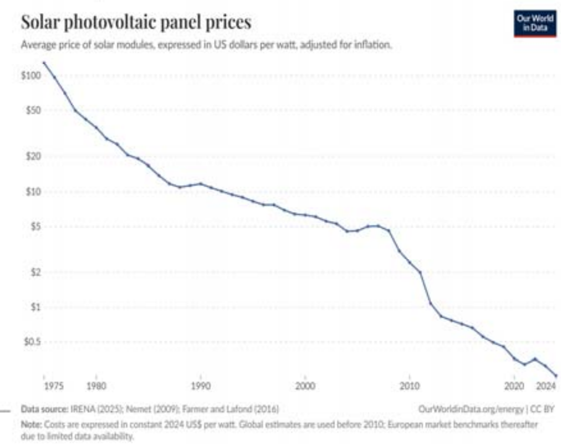
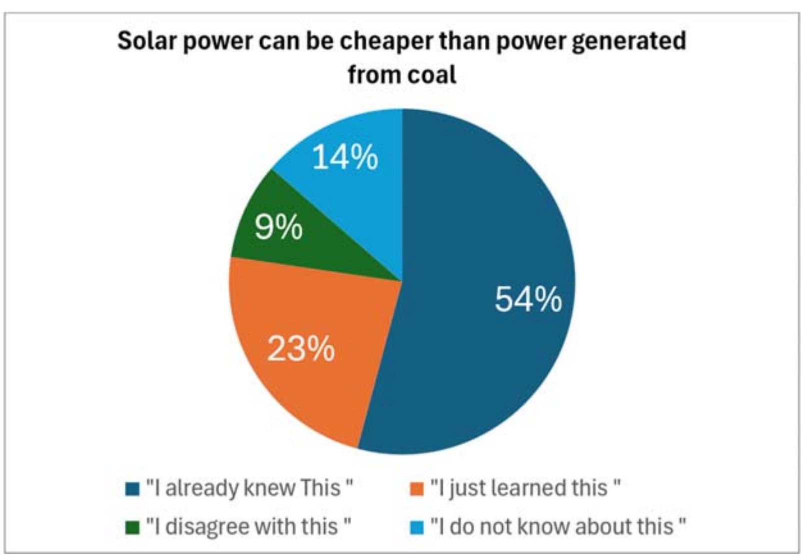
Statement #1





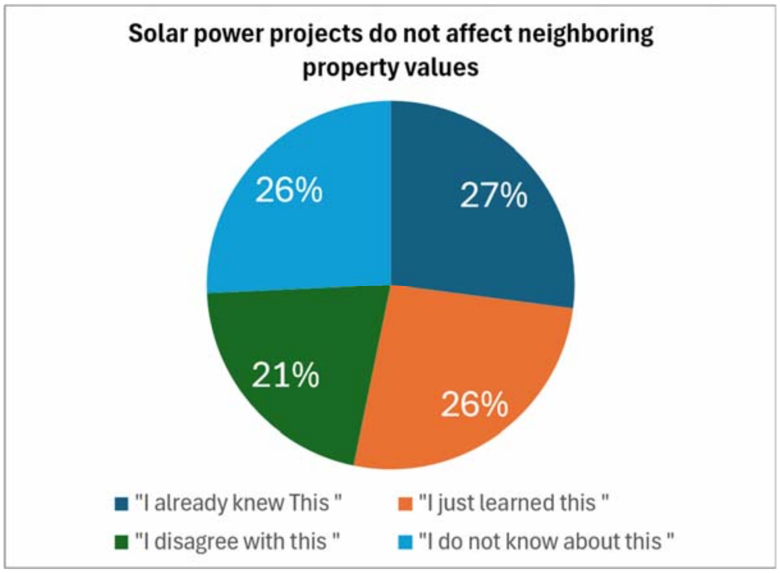
Statement #2



As of 2025, the cost of producing electricity from solar installations, new natural gas plants, and coal power plants were all comparable. The cost of electricity from solar continues to fall.

Source: https://www.scientificamerican.com/article/wind-and-solar-energy-are-cheaper-than-electricity-from-fossil-fuel-plants/

Statement #3



A study by Hu et al. (2025) finds mixed results for impacts of solar installations on property values. On average it decreased home values, but increased land values. Decreased home value may be due to a stigma effect.

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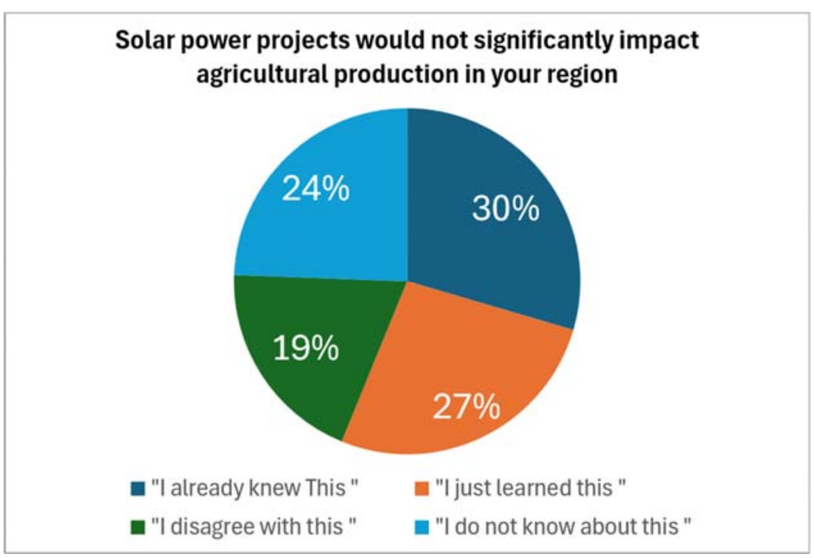
Source: Hu, C., Z. Chen, P. Liu, W. Zhang, X. He and D. Bosch. (2025). Impact of a large scale solar on property values in the United States: Divers effects and causal mechanisms. *Proceedings of the National Academies of Science* 122(24): https://doi.org/10.1073/pnas.2418414122.

Statement #4



A rough conservative estimate of the total land required to meet all of Kansas's electricity needs through solar is about 190,000 to 240,000 acres of land (assuming 10 acres per MW and an annual demand of 19,000 to 24,000 MW).

This represents about 0.5% of acreage of ag land in Kansas.

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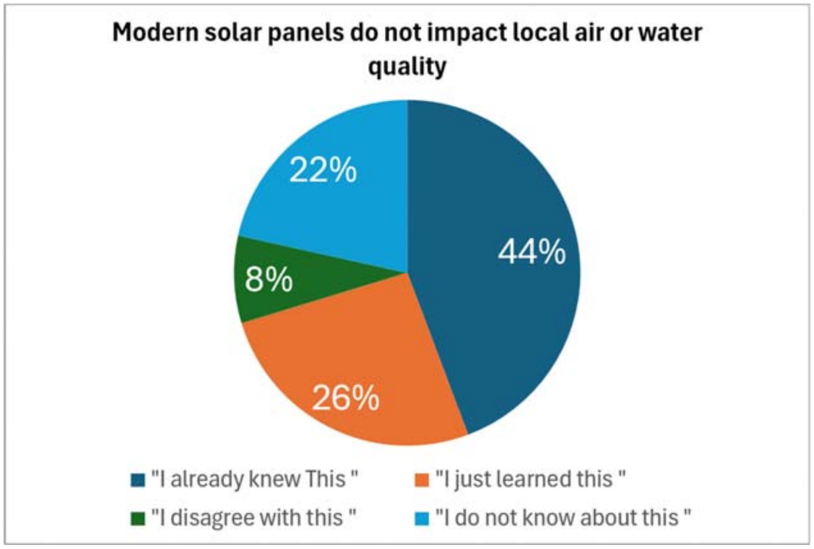
Statement #5



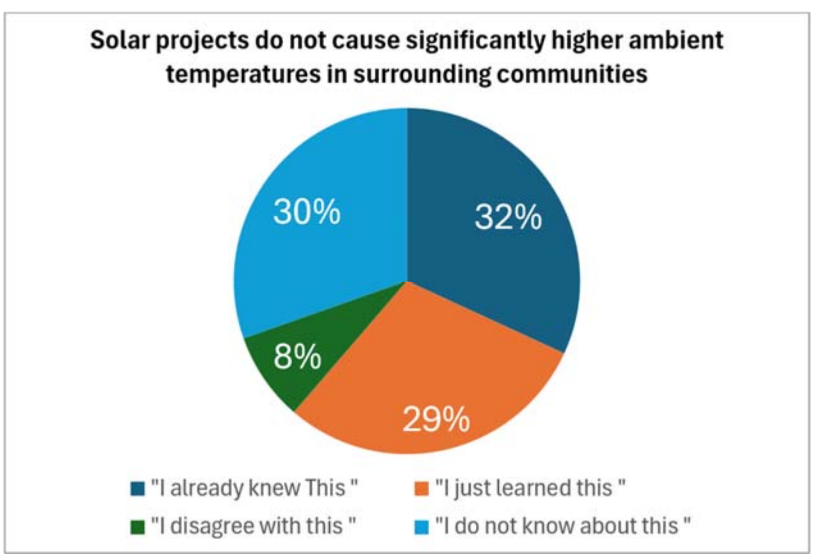
Yandem et.al (2025) found no elevated concentrations of hazardous metals after testing water runoff water from solar panels does.

Abel et.al (2018) found use of solar decreases the concentration of nitrate and sulfate particulate matter in the atmosphere in areas with large solar installations.

Sources: Yandem, G., Grygoyć, K. & Jabłońska-Czapla, M. (2025). Impact of photovoltaics on soil and water by metal(loid)s including technology critical elements: preliminary study. Environ Geochem Health, 47, 389, https://doi.org/10.1007/s10653-025-02686-4.

Abel, D., Holloway, T., Harkey, M., Rrushaj, A., Brinkman, G., Duran, P., Janssen, M., Denholm, P. (February 17, 2018). Potential air quality benefits from increased solar photovoltaic electricity generation in the Eastern United States. Atmospheric Environment, Volume 175, Pages 65-74, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2017.11.049

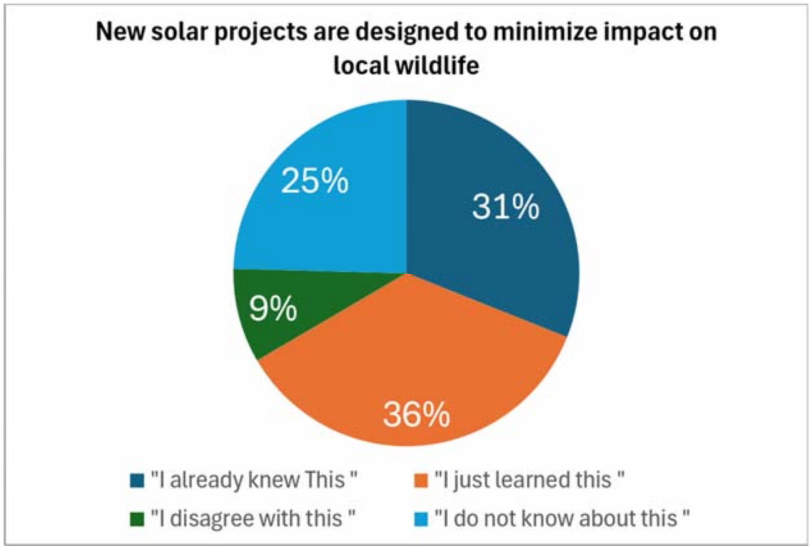
Statement #6



Temperature changes are usually within the immediate vicinity of the solar panels and not neighboring communities.

Source: Broadbent, A. M., Krayenhoff, E. S., Georgescu, M., & Sailor, D. J. (2019). The Observed Effects of Utility-Scale Photovoltaics on Near-Surface Air Temperature and Energy Balance. Journal of Applied Meteorology and Climatology, 58(5), 989-1006, https://doi.org/10.1175/JAMC-D-18-0271.1

Statement #7



Solar installations can impact wildlife habitats. Installations should be designed to minimize that impact through proper permeable fencing and protecting wildlife corridors

Source: Fleming, P.A (2025). All that glitters – Review of solar facility impacts on fauna. Renewable and Sustainable Energy Reviews, Volume 224, 115995,ISSN 1364-0321, https://doi.org/10.1016/j.rser.2025.115995

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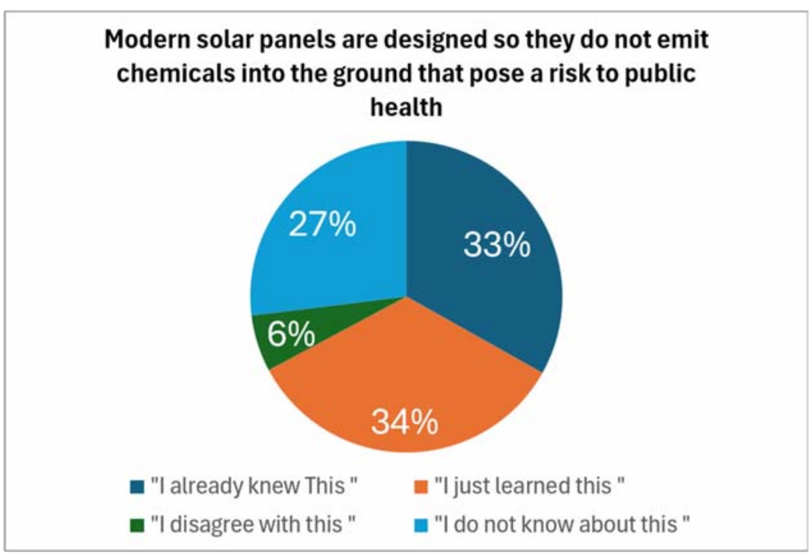
Statement #8



Research has shown that solar panels are designed not to emit chemicals and actual testing has provided evidence of this.

Source: Robinson, S. & Meindl, G. (2019). Potential for leaching of heavy metals and metalloids from crystalline silicon photovoltaic systems. Journal of Natural Resources and Development. 9. 19-24. https://doi.org/10.5027/jnrd.v9i0.02

Solar panel frequent questions. (2025, September 24). U.S Environmental Protection Agency. https://www.epa.gov/hw/solar-panel-frequent-questions

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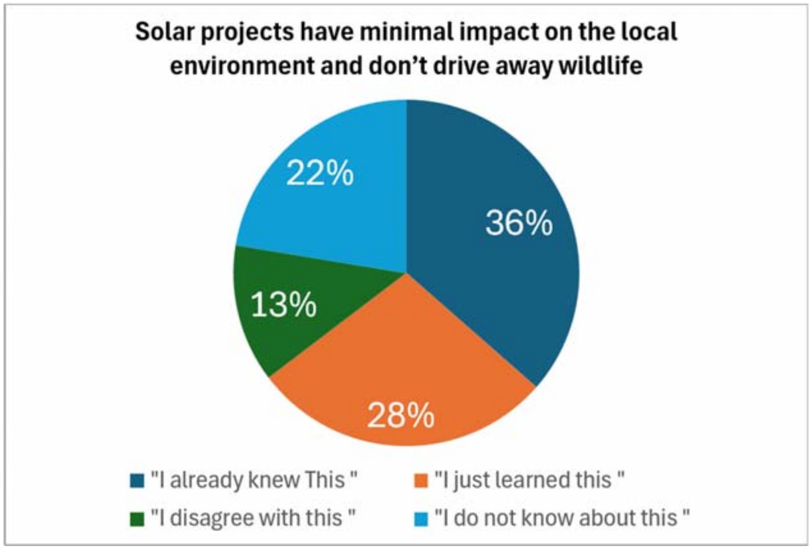
Statement #9



Solar installations can help to conserve wildlife habitat, integrate agricultural operations (agrivoltaics), and be sites for pollinators and local bird species.

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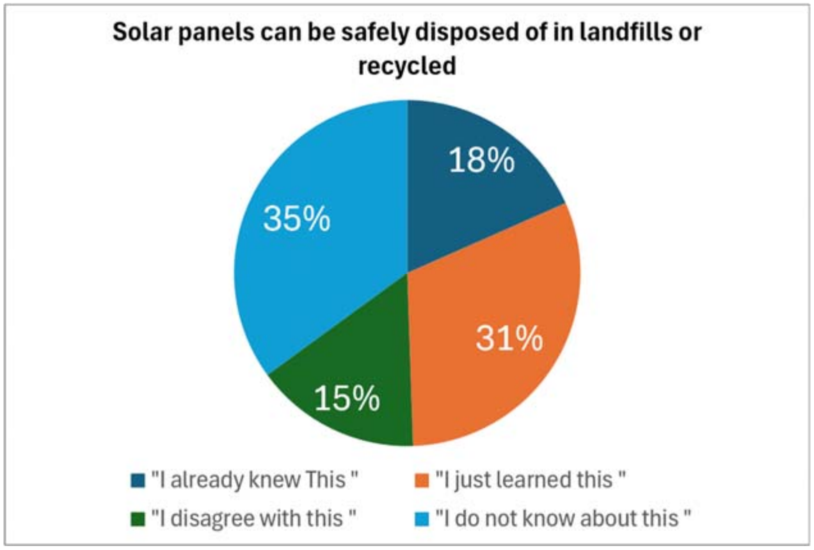
Statement #10



Solar panels can be recycled. We just have to do it.

Source: Xu, Y., Li, J., Tan, Q., Peters, A.L, Yang, C. (May, 2018). Global status of recycling waste solar panels: A review. Waste Management, Volume 75, Pages 450-458, ISSN 0956-053X, https://doi.org/10.1016/j.wasman.2018.01.036

Dunlap, A. A., & Sovacool, B. K. (2026, March 5). Does Solar Energy get recycled? exploring the political ecology and toxic geographies of solar panel disposal - Alexander A. Dunlap, Benjamin K. Sovacool, 2026. Human Geography. https://journals.sagepub.com/doi/10.1177/19427786261419021

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Rural Community Support for Solar

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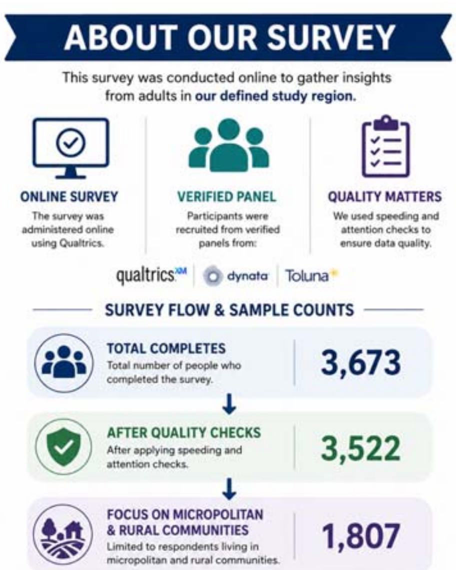
The Survey



Study Area

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The Question

Q4. Indicate your willingness to support investment in different renewable energy options in your local community using the following scale. Circle one answer for each statement.

1 – Strongly Support 2 – Support 3 – Neither Support or Not Support 4 – Not Support 5 – Strongly Not Support. 7 – Do Not Know

Statement	Level of Support
a. Investments in large solar energy projects by local power companies[3001]	1 2 3 4 5 7
b. Investments in smaller sized solar projects to enhance energy resilience in your community[3002]	1 2 3 4 5 7

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The Response

Q4. Indicate your willingness to support investment in different renewable energy options in your local community using the following scale. Circle one answer for each statement.

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Large Project Support (1 or 2)

67%

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N = 1807

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Statement	Level of Support					
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b. Investments in smaller sized solar projects to enhance energy resilience in your community 3002	1	2	3	4	5	7

Large Project Support (1 or 2)

67%

Small Project Support (1 or 2)

71%

N = 1807

Statistical Analysis

- We estimated a regression model to predict what factors influence support for large solar installations in micropolitan and rural communities across the study region.

- Factors included when respondents disagreed with the statements examined earlier, household energy situation, experience with solar technology on a respondent's home or involvement in a community solar project, and demographics.

Influence of Information

When respondents disagreed with the following statements about solar technology in the table to the right, they had less support for large solar installations.

#	SOLAR INFORMATION STATEMENTS
1	The cost of energy produced from utility-scale solar projects has dropped significantly over the past two decades.
2	Solar power can be cheaper than power generated from coal.
3	Solar power projects do not affect neighboring property values.
4	Solar power projects would not significantly impact agricultural production in your region.
7	New solar projects are designed to minimize impact on local wildlife.
8	Modern solar panels are designed so they do not emit chemicals into the ground that pose a risk to public health.
9	Solar projects have minimal impact on the local environment and don't drive away wildlife.
10	Solar panels can be safely disposed of in landfills or recycled.

Influence of Experience with Solar Technology

Having shopped for solar panels for your home, having solar panels on your home, and/or being involved in a community solar project increased support for large solar installations.

Influence of Demographics

Being older in age and more conservative in your political ideology tended to lower support for large solar installations.

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Influence of Demographics

Being older in age and more conservative in your political ideology tended to lower support for large solar installations.

These are preliminary findings and research is still under way.

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Farmers' Willingness for Leasing CRP and Marginal Lands for Solar Energy

Why this study

- **Avoid competition with productive agricultural lands**
  - From 2012 to 2020, 70% of solar farms in rural areas were installed on agricultural land (either cropland or pasture-rangeland) (Maguire et al. 2024)

Why this study

- **CRP and marginal lands are promising alternatives**

What is marginal agricultural land?

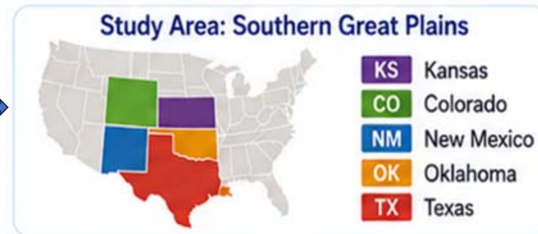
- Low productivity land, CRP acres, highly erodible areas, and land with limited crop returns.
- These lands may present opportunities for solar development.

➢ However, there is limited empirical evidence of farmers' willingness to lease these lands and the compensation required.

Research Questions & Objectives

Research Question: Are farmers willing to lease their CRP or marginal lands for solar? What compensation do producers require to lease these lands?

Study Area & Data



We received 554 total usable responses across the study region

We only surveyed producers with more than 220 acres in size to avoid surveying hobby farmers, smaller specialized producers, and retired operators

We used 219 total responses for our analysis

Stated Choice Experiment

Consider the opportunity of signing a lease with an agribusiness or utility company to install and operated a small solar panel installation for power generation on your CRP or marginal land and assume that this would be approved by the USDA, Farm Service Agency. The land around the solar installation would have to be managed as native grasslands or following your CRP contract. The lease would be for a period of 25 years, which may extend beyond the life of a CRP contract (if not re-enrolled). Under the lease, you would be responsible for helping to maintain vegetative cover (e.g. mowing, dealing with woody encroachment, weeds etc.) on the land where the solar installation is located. For land not under a CRP contract, grazing of livestock and periodic haying would be allowed. Finally, the lease would require access for a power company to come onto the land to maintain the solar installation when needed. It should be emphasized that there are currently no significant leasing efforts for solar power being undertaken in your area, therefore actual payment levels are uncertain. Final leasing rates would be the same for farmers in your local area.

Please indicate if you would be willing to sign a lease agreement for the following payment amounts.

Payment ($) you receive per acre per year	**I would be willing to sign a lease at this payment level.**
$25	□ Yes □ No □ Unsure
$50	□ Yes □ No □ Unsure
$100	□ Yes □ No □ Unsure
$250	□ Yes □ No □ Unsure
$500	□ Yes □ No □ Unsure
$1000	□ Yes □ No □ Unsure

Solar land lease contingent valuation question

Results

Results

VS

Current utility-scale solar leases in Kansas commonly fall about **$800 to $1,500** per acre annually, with some exceptional sites commanding higher payments where transmission access and project economics are particularly favorable

Results

VS

Current utility-scale solar leases in Kansas commonly fall about **$800 to $1,225** per acre annually, with some exceptional sites commanding higher payments where transmission access and project economics are particularly favorable

Solar lease rates per acre by state

State	Lower-output band	Typical-output band	Higher-output band
California	$1,100-$1,650 (mid $1,350)	$1,325-$1,950 (mid $1,600)	$1,550-$2,200 (mid $1,850)
Arizona	$825-$1,225 (mid $1,000)	$1,000-$1,450 (mid $1,200)	$1,175-$1,675 (mid $1,400)
New York	$800-$1,225 (mid $1,000)	$975-$1,475 (mid $1,200)	$1,150-$1,700 (mid $1,400)
Florida	$725-$1,100 (mid $900)	$900-$1,325 (mid $1,100)	$1,075-$1,550 (mid $1,300)
New Mexico	$725-$1,100 (mid $900)	$900-$1,350 (mid $1,100)	$1,075-$1,575 (mid $1,300)
Texas	$725-$1,100 (mid $900)	$900-$1,325 (mid $1,100)	$1,075-$1,550 (mid $1,300)
Colorado	$700-$1,075 (mid $875)	$850-$1,275 (mid $1,050)	$1,000-$1,475 (mid $1,225)
Illinois	$675-$1,050 (mid $850)	$825-$1,250 (mid $1,025)	$1,000-$1,500 (mid $1,225)
Indiana	$650-$1,025 (mid $825)	$800-$1,225 (mid $1,000)	$975-$1,475 (mid $1,200)
Iowa	$650-$1,025 (mid $825)	$800-$1,225 (mid $1,000)	$950-$1,425 (mid $1,175)
Kansas	**$650-$1,025 (mid $825)**	**$800-$1,225 (mid $1,000)**	**$950-$1,425 (mid $1,175)**
Ohio	$625-$1,000 (mid $800)	$800-$1,225 (mid $1,000)	$975-$1,475 (mid $1,200)

Data source: AgriTerra's solar farm lease rates by state, compiled from AgriTerra (Purdue Ag Economy Barometer and OSU Extension anchored), as of 2026-08-01. Retrieved August 2026.

Results

Significant determinants of willingness to accept solar lease payments

INCREASE COMPENSATION REQUIRED

RANGELAND — More rangeland increases compensation required. **+$437.88*** ** ($81.78)

LIVESTOCK HEAD — More livestock increases compensation required. **+$0.032*** ** ($0.011)

AGE (years) — Older producers require higher compensation. **+$10.02*** ** ($3.02)

DECREASE COMPENSATION REQUIRED

CRP ACRES — More CRP acres reduce compensation required. **−$0.53*** ** ($0.11)

SUPPORT FOR WIND ENERGY — Supporters of wind energy require lower compensation. **−$224.25*** ** ($131.12)

PASTURELAND RATE — Higher pasture rental rate reduces compensation required. **−$21.89** ** ($10.72)

RISK FACTOR — More risk-tolerant producers require less compensation. **−$245.85*** ** ($142.46)

Risk-averse producers require higher compensation; less risk-averse producers require lower compensation.

***** p<0.01, ** p<0.05, * p<0.10**

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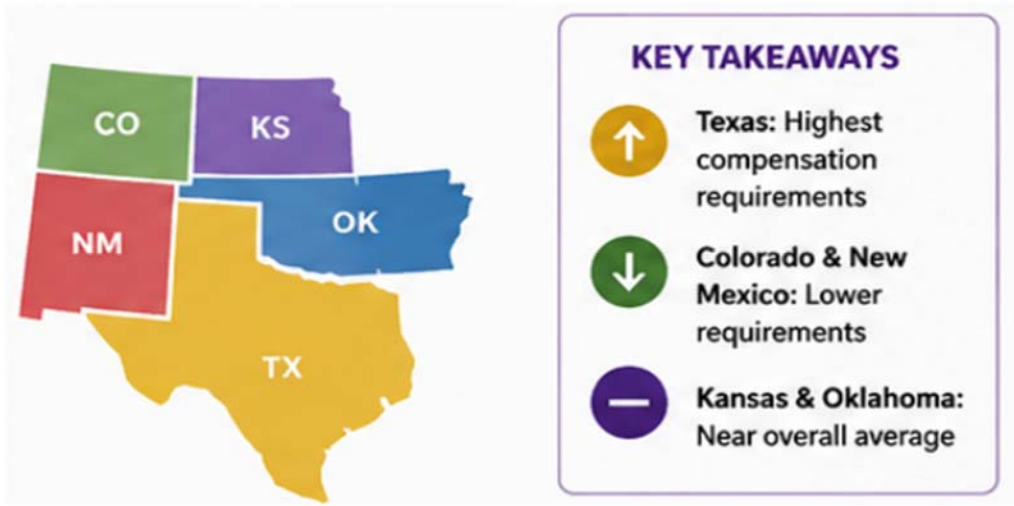
More insights from the state estimates



Takeaways

This study provides market-based compensation estimates that can support efficient solar development on CRP and marginal lands while protecting productive agricultural land.

Agricultural producers

- Solar leasing on CRP or marginal lands can provide an additional and stable income source.
- Compensation expectations vary across producers
- Land use, livestock, and risk preferences shape compensation expectations.
- Evaluate contracts based on true opportunity costs
- Long-term contracts should reflect land-use implications

Takeaways

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Solar developers and utilities

- CRP and marginal lands can be targeted for future solar projects**
- Compensation strategies should reflect opportunity costs of land use and regional differences.
- Engage with renewable energy supportive landowners

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Takeaways

This study provides market-based compensation estimates that can support efficient solar development on CRP and marginal lands while protecting productive agricultural land.

Policy

- CRP and marginal lands offer opportunities to expand solar while protecting productive ag. land.
- Incentives and policy tools can align renewable energy goals with producer interests to encourage participation.
- Ensure compensation reflects:
  - Local market conditions
  - Producers' opportunity costs

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Suitability of CRP and Marginal Ag Land for Solar Installations

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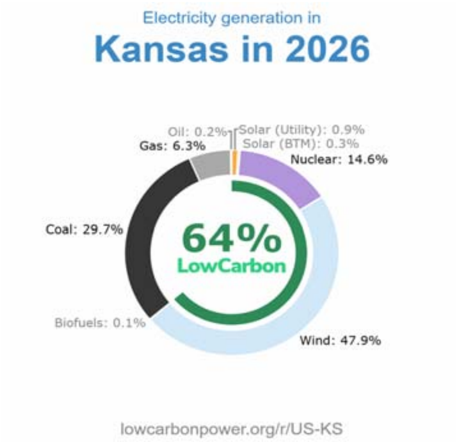
Solar in Kansas



Source: LowCarbonPower (2026). https://lowcarbonpower.org/region/Kansas

- Solar energy accounts for only 0.9% of Kansas's state energy profile, with its expansion facing many challenges
- Kansas has only 3% of the total microgrid projects operating in the US (Ajaz 2019)

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Research Objectives

(1) Identify marginal lands suitable for SPV in Kansas

(2) Evaluate the potential use of marginal lands as suitable sites for SPV development through a GIS-based multi-criteria approach, known as "Analytic Hierarchy Process"

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Marginal land criteria

List of criteria, reference, and spatial resolution for selecting marginal lands in our study

Marginality Criteria	Variables	Threshold	Spatial resolution	Year	Sources
Soil Biophysical Criteria	Slope	Greater than 5%	1/3 arc-second DEM		USGS
	Soil erosion	Class 2,3, and 4	30m	2023	The Gridded Soil Survey Geographic Database or gSSURGO,
	Flood duration	At least 5%-50% chances of flooding in a year	30m		
	Drainage	(a) poorly drained, and (b)very poorly drained	30m		
Landcover Based Classification	CRP	Land cover	Vector	2012-2021	USDA FSA(Farm Service Agency)
	LCC	LCC (class 5 to 7)	30m	2023	(gSSURGO
	Barren/Idle Land cover	Land cover that has been barren/fallow for at least four years	30m	2019-2022	USDA NASS Cropland Data Layer (CDL).
	Non- prime Farmland	Land cover that avoids statewide and locally important and unique farmlands.	30m	2023	(gSSURGO

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Suitability criteria

Major Criteria	Sub-criteria	Source and Metadata
Locational	Road	USGS National Transportation Dataset (NTD)
	Transmission Lines	Homeland Infrastructure Foundation-Level Data (HIFLD) & GeoPlatform ArcGIS Online
	Distance to residential areas	NLCD
Orographic	Slope	USGS
	Aspects	USGS
Environmental/Climatic	Global Solar Irradiance (Daily average) (kWh/m^2/day)	Global Solar Atlas
	Average annual temperature	PRISM Climate Group
	Sunshine duration	NASA POWER

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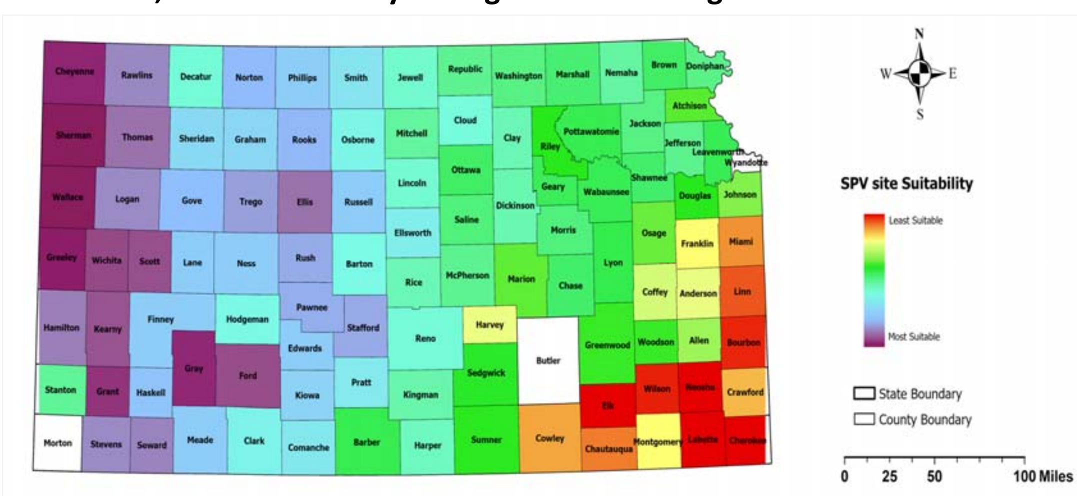
Results

Available marginal lands for SPV site selection process

Results: Suitability map at the county level

Site suitability across the counties in Kansas: blue to purple gradient showing the most suitable counties, whereas red to yellow gradient showing least suitable counties.



Takeaways

The analysis shows that areas with very high and high suitability for SPV projects are concentrated primarily in specific regions of southwest Kansas

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% of lands and number of acres

- Approximately 0.26% of Kansas's marginal lands fall within the very high suitability class.
- About 50% are classified as highly suitable.
- 47.72% as moderately suitable
- 0.0004% of marginal lands fall into the least suitable category

Takeaways

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- Approximately 0.26% of Kansas's marginal lands fall within the very high suitability class.
- About 50% are classified as highly suitable.
- 47.72% as moderately suitable
- 0.0004% of marginal lands fall into the least suitable category

- Approximately 0.4736 million hectares, or 1,170,185.54 acres, of marginal land across Kansas.
- about 770 km², or 0.077 million hectares, of the marginal lands are considered highly suitable for SPV
- Overall, approximately 90% of the marginal lands are deemed to have very high to moderate suitability for SPV deployment

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Takeaways

The analysis shows that areas with very high and high suitability for SPV projects are concentrated primarily in specific regions of southwest Kansas

% of lands and number of acres

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- Overall, approximately 90% of the marginal lands are deemed to have very high to moderate suitability for SPV deployment

These results suggest that Kansas offers substantial potential for leveraging marginal lands for future SPV deployment. At the same time, it provides a guide for the solar industry, policymakers, and producers on suitable areas for siting solar rather than productive agriculture land

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Questions/Suggestions?

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