Energy Production per Acre: Corn Ethanol vs Solar Panels

Infinity Turbine LLC

[TEL] +1-608-238-6001 (Chicago

[Email] greg@infinityturbine.com

https://infinityturbine.com/infinity-turbine-solar-pv-vs-thermal-energy-production.html

A detailed comparison of energy output from one acre of corn used for ethanol production versus one acre of solar panels near Chicago, Illinois. Discover which method yields more usable energy per year.

This webpage QR code

PDF Version of the webpage (maximum 10 pages)

Energy Production per Acre: Corn Ethanol vs Solar Panels

How much energy does one acre of corn really produce when turned into ethanol? And how does that compare to the same acre covered in solar panels? Explore the numbers and find out which solution is more energy efficient.

Comparing Energy Output: Corn for Ethanol vs Solar PV Panels

Overview

In the American Midwest, many farmers grow corn destined for ethanol production. At the same time, solar photovoltaic (PV) technology offers an alternative way to harvest energy from the same land. This article compares the annual energy yield from one acre of corn grown for ethanol to the output of one acre of solar panels, using realistic data for a location near Chicago, Illinois.

Energy Output from One Acre of Corn for Ethanol

Average corn yield: 180 bushels per acre per year

Ethanol yield per bushel: 2.8 gallons

Total ethanol yield per acre: 180 bushels multiplied by 2.8 gallons = 504 gallons

Energy content of ethanol: 76,100 BTU per gallon

Total energy content: 504 gallons multiplied by 76,100 BTU = 38,354,400 BTU

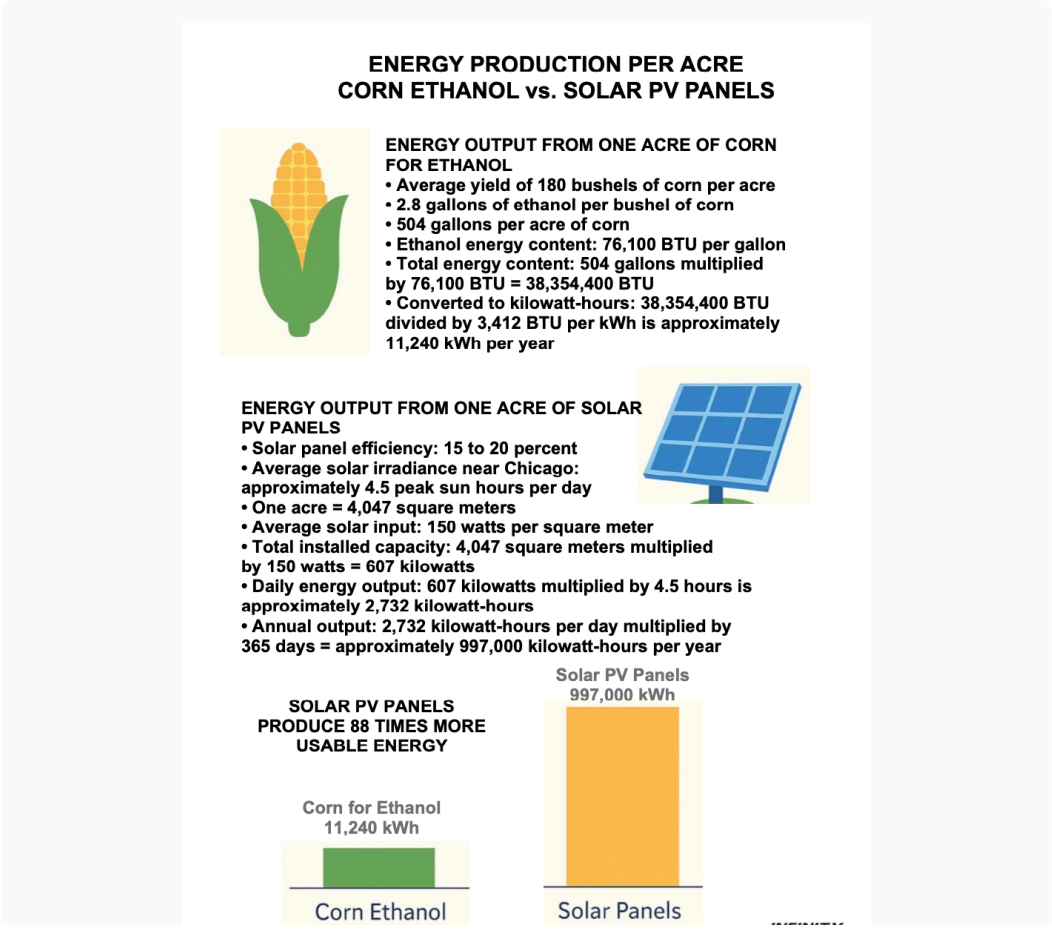
Converted to kilowatt-hours: 38,354,400 BTU divided by 3,412 BTU per kWh = approximately 11,240 kWh per year

Annual energy output from one acre of corn for ethanol: approximately 11,240 kilowatt-hours

Note: This is a gross value and does not account for fossil fuel inputs such as fertilizer, harvesting equipment, or ethanol refining.

Energy Output from One Acre of Solar Panels

Usable land area: 43,560 square feet (1 acre)
Solar panel efficiency: 15 to 20 percent
Average solar irradiance near Chicago: approximately 4.5 peak sun hours per day
One acre = 4,047 square meters



Energy Production per Acre: Corn Ethanol vs Solar Panels

How much energy does one acre of corn really produce when turned into ethanol? And how does that compare to the same acre covered in solar panels? Explore the numbers and find out which solution is more energy efficient.
Comparing Energy Output: Corn for Ethanol vs Solar PV Panels
Overview
In the American Midwest, many farmers grow corn destined for ethanol production. At the same time, solar photovoltaic (PV) technology offers an alternative way to harvest energy from the same land. This article compares the annual energy yield from one acre of corn grown for ethanol to the output of one acre of solar panels, using realistic data for a location near Chicago, Illinois.

Energy Output from One Acre of Corn for Ethanol
Average corn yield: 180 bushels per acre per year
Ethanol yield per bushel: 2.8 gallons
Total ethanol yield per acre: 180 bushels multiplied by 2.8 gallons = 504 gallons
Energy content of ethanol: 76,100 BTU per gallon
Total energy content: 504 gallons multiplied by 76,100 BTU = 38,354,400 BTU
Converted to kilowatt-hours: 38,354,400 BTU divided by 3,412 BTU per kWh = approximately 11,240 kWh per year
Annual energy output from one acre of corn for ethanol: approximately 11,240 kilowatt-hours
Note: This is a gross value and does not account for fossil fuel inputs such as fertilizer, harvesting equipment, or ethanol refining.

Energy Output from One Acre of Solar Panels
Usable land area: 43,560 square feet (1 acre)
Solar panel efficiency: 15 to 20 percent
Average solar irradiance near Chicago: approximately 4.5 peak sun hours per day
One acre = 4,047 square meters
Average solar input: 150 watts per square meter
Total installed capacity: 4,047 square meters multiplied by 150 watts = 607 kilowatts
Daily energy output: 607 kilowatts multiplied by 4.5 hours = approximately 2,732 kilowatt-hours
Annual output: 2,732 kilowatt-hours per day multiplied by 365 days = approximately 997,000 kilowatt-hours per year
Annual energy output from one acre of solar panels: approximately 997,000 kilowatt-hours

Energy Comparison Table
| Energy Source | Annual Output per Acre (kWh) | Notes |

| Corn for Ethanol | 11,240 | Gross energy, significant fossil inputs |
| Solar PV Panels | 997,000 | Clean, renewable, continuous output |
Solar panels produce nearly 90 times more usable energy per acre per year than corn grown for ethanol.

Conclusion
In terms of raw energy output, one acre of solar panels provides a dramatically higher yield than one acre of corn used for ethanol. While corn-based ethanol is renewable, it requires substantial energy input to grow, harvest, and refine. Solar panels, by contrast, convert sunlight directly into electricity and operate with minimal maintenance.
For policymakers, landowners, and farmers seeking to maximize energy efficiency and sustainability, the case for solar energy over biofuel crops is clear.

6/30/2026

Energy Production per Acre: Corn Ethanol vs Solar Panels

How much energy does one acre of corn really produce when turned into ethanol? And how does that compare to the same acre covered in solar panels? Explore the numbers and find out which solution is more energy efficient.
Comparing Energy Output: Corn for Ethanol vs Solar PV Panels
Overview
In the American Midwest, many farmers grow corn destined for ethanol production. At the same time, solar photovoltaic (PV) technology offers an alternative way to harvest energy from the same land. This article compares the annual energy yield from one acre of corn grown for ethanol to the output of one acre of solar panels, using realistic data for a location near Chicago, Illinois.

Energy Output from One Acre of Corn for Ethanol
Average corn yield: 180 bushels per acre per year
Ethanol yield per bushel: 2.8 gallons
Total ethanol yield per acre: 180 bushels multiplied by 2.8 gallons = 504 gallons
Energy content of ethanol: 76,100 BTU per gallon
Total energy content: 504 gallons multiplied by 76,100 BTU = 38,354,400 BTU
Converted to kilowatt-hours: 38,354,400 BTU divided by 3,412 BTU per kWh = approximately 11,240 kWh per year
Annual energy output from one acre of corn for ethanol: approximately 11,240 kilowatt-hours
Note: This is a gross value and does not account for fossil fuel inputs such as fertilizer, harvesting equipment, or ethanol refining.

Energy Output from One Acre of Solar Panels
Usable land area: 43,560 square feet (1 acre)
Solar panel efficiency: 15 to 20 percent
Average solar irradiance near Chicago: approximately 4.5 peak sun hours per day
One acre = 4,047 square meters
Average solar input: 150 watts per square meter
Total installed capacity: 4,047 square meters multiplied by 150 watts = 607 kilowatts
Daily energy output: 607 kilowatts multiplied by 4.5 hours = approximately 2,732 kilowatt-hours
Annual output: 2,732 kilowatt-hours per day multiplied by 365 days = approximately 997,000 kilowatt-hours per year
Annual energy output from one acre of solar panels: approximately 997,000 kilowatt-hours

Energy Comparison Table
| Energy Source | Annual Output per Acre (kWh) | Notes |

| Corn for Ethanol | 11,240 | Gross energy, significant fossil inputs |
| Solar PV Panels | 997,000 | Clean, renewable, continuous output |
Solar panels produce nearly 90 times more usable energy per acre per year than corn grown for ethanol.

Conclusion
In terms of raw energy output, one acre of solar panels provides a dramatically higher yield than one acre of corn used for ethanol. While corn-based ethanol is renewable, it requires substantial energy input to grow, harvest, and refine. Solar panels, by contrast, convert sunlight directly into electricity and operate with minimal maintenance.
For policymakers, landowners, and farmers seeking to maximize energy efficiency and sustainability, the case for solar energy over biofuel crops is clear.

Corn for Ethanol (1 acre near Chicago)

Corn for Ethanol (1 acre near Chicago)

Average yield: \~177 bushels per acre in the U.S. ([Reddit][1], [Wikipedia][2])
Farm-gate corn price: \$4.64 per bushel (May 2025 avg) ([YCharts][3])
Gross revenue: 177 bu × \$4.64 = \$821 per acre

Net profit will depend on input costs (seed, fertilizer, labor, transport, ethanol plant differential), but gross revenue is about \$820/acre.

Solar PV Farm (1 acre near Chicago)

Annual electricity output: \~400 MWh ≈ 400,000 kWh per acre ([YCharts][3], [sungoldsolar.us][4])
Export value to grid: \$0.10 per kWh (given)
Gross revenue: 400,000 kWh × \$0.10 = \$40,000 per acre-year

Net profit depends on costs (panel installation, maintenance, financing, tax credits), but gross revenue is \~\$40k per acre—roughly 50× the corn revenue.

Comparison Summary

Use of 1 Acre	Annual Gross Revenue
------------•	--------------------•
Corn–ethanol	\~\$820
Solar PV	\~\$40,000

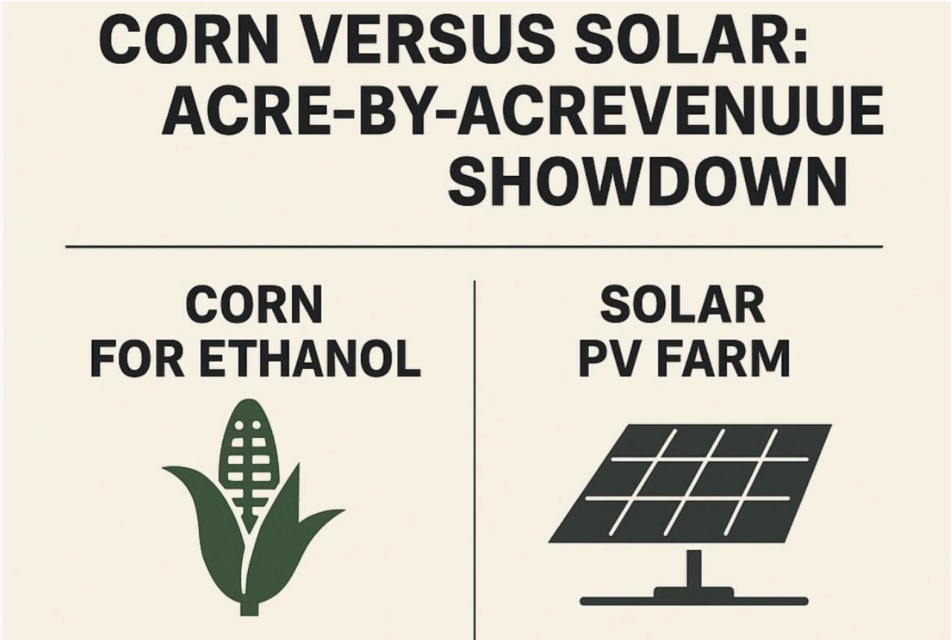
Solar PV farming yields about 50× higher gross revenue per acre compared to growing corn for ethanol—before accounting for capital and operational costs.

Wehbe-Style Article

Page: 1

Title: Corn Versus Solar: Acre-by-Acre Revenue Showdown

Meta: This article compares annual per-acre revenues from corn grown for ethanol versus electricity produced by solar PV near Chicago. Corn yields roughly \$820 per acre, while solar commands about \$40,000 per acre, highlighting the dramatic economic advantage of solar farming in that region.



Corn (Ethanol Feedstock)

Corn (Ethanol Feedstock)

Total production cost per bushel in Illinois (2023 avg): \$5.82 ([Purdue Agriculture][1], [farmdoc daily][2])
Based on yield of 177 bushels/acre, total cost per acre = 177 × \$5.82 ≈ \$1,030/acre
Cost per bushel: \$5.82 (as above)

Solar PV Farm

Overnight installation cost (utility-scale): \~\$1.06 per watt ([MarketWatch][3])
1 acre ≈ 43.56 kW AC capacity → upfront cost ≈ 43.56 kW × \$1,060/kW = \$46,174
Amortized over 20 years (straight-line): \$46,174 / 20 = \$2,309/year
Annual output: \~400,000 kWh ([Reddit][4])
Capital cost per kWh: \$2,309 / 400,000 = \$0.0058/kWh
O\&M & fixed costs (typical): \~\$0.010/kWh&x20;
All-in cost: \~\$0.016/kWh
Capital cost per year: \$2,309
Total cost per kW installed: \$1,060

Summary Table

comparison of energy outputs

Here is a comparison of energy outputs for three solar technologies based on 1 square meter of surface area under typical conditions (assumed irradiance: 1,000 W/m² peak, average 5.5 sun-hours/day, near Chicago or similar climate):

---

1. Bifacial Solar PV Panel (1 m²)

Conversion efficiency: \~20% front-side, \~5–10% rear-side (bifacial gain \~10–15% total)
Total effective efficiency: \~22%
Daily energy output:

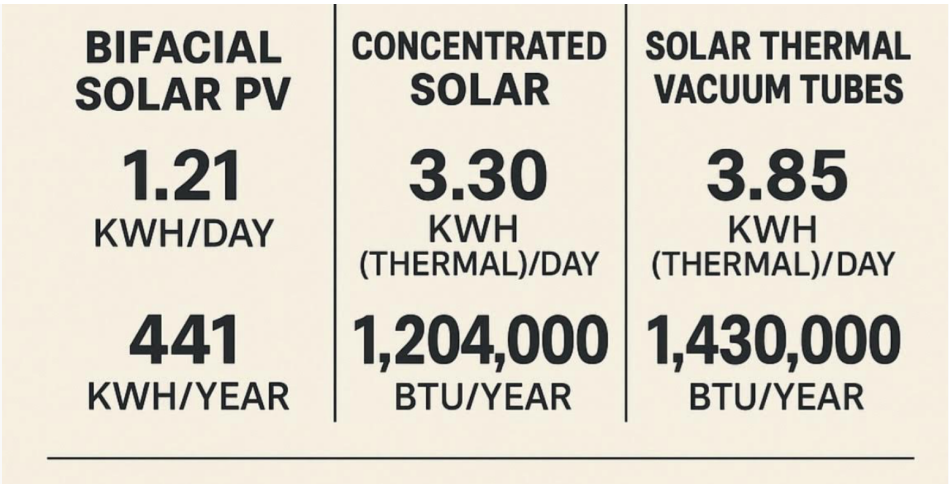
1,000 W/m² × 5.5 hrs/day × 22% = 1.21 kWh/day
Annual energy output:

\~441 kWh/year

---

2. Concentrated Solar Thermal (1 m² aperture)

Thermal collection efficiency: \~60% (varies with design, mirrors, and temperature)
Peak solar irradiance: 1,000 W/m²
Daily thermal energy output:



Here is a comparison of energy outputs for three solar technologies based on 1 square meter of surface area under typical conditions (assumed irradiance: 1,000 W/m² peak, average 5.5 sun-hours/day, near Chicago or similar climate):

---

1. Bifacial Solar PV Panel (1 m²)

Conversion efficiency: \~20% front-side, \~5–10% rear-side (bifacial gain \~10–15% total)
Total effective efficiency: \~22%
Daily energy output:

1,000 W/m² × 5.5 hrs/day × 22% = 1.21 kWh/day
Annual energy output:

\~441 kWh/year

---

2. Concentrated Solar Thermal (1 m² aperture)

Thermal collection efficiency: \~60% (varies with design, mirrors, and temperature)
Peak solar irradiance: 1,000 W/m²
Daily thermal energy output:

1,000 W/m² × 5.5 hrs × 60% = 3,300 Wh = 11,262 BTU/day
Annual output:

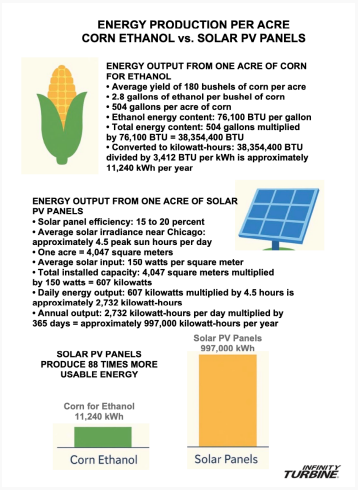
\~1,204,000 BTU/year
\~353 kWh (thermal)

---

3. Solar Thermal Vacuum Tubes (1 m²)

Efficiency: \~70% at mid-range temperatures (\~60–80°C)
Daily thermal energy output:

1,000 W/m² × 5.5 hrs × 70% = 3,850 Wh = 13,142 BTU/day
Annual output:



Here is a written comparison chart showing the hourly and daily electricity production per square meter for each solar technology, assuming:

5.5 solar hours/day
Bifacial Solar PV produces electricity directly
Concentrated Solar and Vacuum Tube Solar produce thermal energy, converted to electricity using supercritical CO_2 at a heat rate of 40,000 BTU/kWh

---

Electricity Production per Square Meter

Technology	Type	Hourly Output (kWh)	Daily Output (kWh)
Bifacial Solar PV	Electrical	0.22	1.21
Concentrated Solar (thermal → elec)	Thermal	0.0825	0.454
Vacuum Tube Solar Thermal (→ elec)	Thermal	0.0963	0.530

Notes:

Hourly Output is calculated as daily output divided by 5.5 sun-hours.

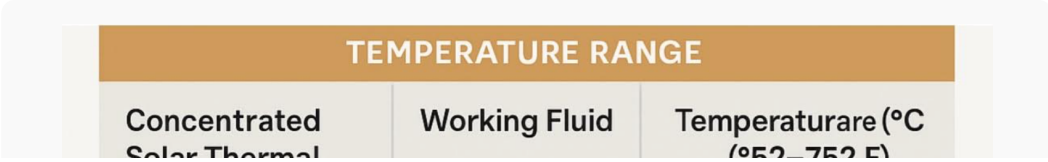
Typical Operating Temperatures

Typical Operating Temperatures

System Type	Working Fluid	Temperature Range (°C)	Temperature Range (°F)
Concentrated Solar Thermal	Thermal Oil	300–400 °C	572–752 °F
Vacuum Tube Solar Thermal	Thermal Oil	100–200 °C	212–392 °F
Concentrated Solar (advanced)	Supercritical CO_2 (sCO_2)	500–700 °C	932–1,292 °F
Advanced CSP or ORC	Salt–CO_2 mix (sCO_2 + molten salt)	550–750 °C	1,022–1,382 °F

Comparison of Heat Transfer Fluids

Fluid	Max Temp (°C)	Cost (USD/ton)	Pressure Required	Advantages	Drawbacks
Thermal Oil	\~400	\$1,000–\$3,000	Low (1–3 bar)	Stable, non-corrosive, simple system	Fire risk, degrades at high temp, limited to \~400°C
Supercritical CO_2	\~700	\$100–\$300	High (≥7.38 MPa)	High efficiency, compact system, non-toxic, abundant	Needs high pressure equipment, corrosion issues at high temps
Salt–CO_2 Mixture	\~750	\~\$300–\$500	High (10–20 MPa)	Enhanced heat transfer, thermal storage, higher temp = better cycle eff.	Corrosion, complex material compatibility, experimental in some systems



Solar Thermal		(~52–752 F)
Concentrated Solar Thermal	**Thermal Oil**	300–400 °C (572–352 F)
Vacuum Tube Solar Thermal	**Thermal Oil**	100–200 °C (212–392 F)
Concentrated Solar (advanced)	**Supercritical CO_2**	500–700 °C (932–1,292 F)

COMPARISON OF HEAT TRANSFER MEDIA

Cost	Rressure	Pressure Required	Advantaces I Drawbacks
Thermal Oil	$1,000–$3,000	1-3 bar	Firé, risk, degrades at high temp
Supercritical CO_2	$100–3000	High ≥7,381Pa	Needs high-pressure equipment
Salt–CO_2 Mixture	$300–3500	High 10-20 MPa	Enhanced heat transfer, thermal storage

Page Title:
Choosing the Best Working Fluid for Solar Thermal Systems: Thermal Oil vs Supercritical CO2 vs Enhanced CO2 with Salt or Sand

Meta Description:
Explore the pros, cons, temperatures, and costs of using thermal oil, supercritical CO2, and enhanced CO2 with salt or sand in solar thermal and concentrated solar power (CSP) systems. Identify the best solution for performance, cost, and scalability.

Page Description:
Selecting the right working fluid is critical in designing efficient and cost-effective solar thermal systems. This article compares thermal oil, supercritical CO2, and enhanced CO2 mixtures using salt or sand. We evaluate each option for temperature range, efficiency, cost, and suitability for small-scale and utility-scale applications, guiding engineers and developers toward optimal fluid selection.

Teaser:
Thermal oil is simple and proven, supercritical CO2 delivers high efficiency, and enhanced CO2 mixed with salt or sand offers next-level performance and storage. Which working fluid is right for your solar thermal system? Discover the best match by application, cost, and energy yield.

Choosing the Best Working Fluid for Solar Thermal and CSP Systems

Working Fluids for Solar Thermal and CSP

THERMAL OIL	SUPERCRITICAL CO_2	ENHANCED CO, WITH SALT OR SAND
Up to 400°C (752°F)	500–700°C (932°F–1,292°F)	600–750°C (1,112°F–1,382°F)
Low	Very High ≥ 7.38 MPa	High, 10-20 MPa
$1,000–$3,000	$100–$300	$300–$500
Advantages: • Simple and Reliability • Degradation at HT • Limited Efficiency	**Advantages** • High Efficiency • Compact Turbines	**Advantages** • Combine Heat Storage & High Efficiency • Complexity, Limiteding
Best Use Small- / Medium-Scale	**Best Use** High-Efficiency CSP	**Best Use** Utility-Scale with Storage