

Engineering Counterfactual Brief

Wind Turbine Blades

20-Claim Counterfactual Audit - Recycling and end-of-life claims

Audit scope	20 common absolute negative claims
Verdict standard	Contradicted as an absolute claim only when two cited records directly identify a counter-pathway or structural application.
What remains true	Collection logistics, economics, local capacity, recovered-material quality, and pathway availability remain real constraints.
Public source layers	Crossref scholarly metadata and U.S. DOE OSTI research records
Generated	July 21, 2026

Executive claim register

These are intentionally overbroad formulations of negative criticism. The audit rejects only their universal wording, not the underlying engineering constraints.

#	Negative claim	Cited correction	Verdict
1	Wind-turbine blades cannot be recycled.	Cited records document blade-recycling and material-recovery pathways.	Contradicted as absolute
2	Wind-turbine blades must be landfilled at end of life.	Cited end-of-life, reuse, recycling, and circular-economy records contradict landfill as the only pathway.	Contradicted as absolute
3	There is no technology that can enable wind-turbine blade recycling.	DOE and scholarly records identify assessment, separation, chemical, and thermochemical technology pathways.	Contradicted as absolute
4	Wind-turbine blade material cannot be repurposed.	Cited records document second-life and repurposing approaches, including 3D-printing-related work.	Contradicted as absolute
5	Recycling wind-turbine blades can never support a circular pathway.	Cited circular-economy and end-of-life records document pathways evaluated for wind-turbine blades.	Contradicted as absolute
6	No economic case can be evaluated for wind-turbine blade recycling.	Cited economic-comparison and techno-economic records evaluate blade end-of-life options.	Contradicted as absolute
7	The environmental trade-offs of blade recycling cannot be measured.	Cited life-cycle and environmental-assessment records measure and compare those trade-offs.	Contradicted as absolute
8	Recyclable wind-turbine blades cannot be manufactured.	DOE records identify recyclable thermoplastic and recyclable-resin blade work.	Contradicted as absolute
9	Blade recycling cannot yield usable secondary material.	Cited records address material recovery, aggregate use, reclaimed chemicals, and separation pathways.	Contradicted as absolute
10	Wind-blade end-of-life has no alternatives beyond disposal.	Cited records describe recycling, repurposing, second-life applications, and circular end-of-life options.	Contradicted as absolute
11	Wind-turbine blade waste cannot be used as aggregate in concrete.	Cited records identify blade-composite material used as aggregate in concrete.	Contradicted as absolute
12	Wind-turbine blade polymers cannot be separated after service.	Cited records identify triboelectric and other separation approaches for end-of-life blades.	Contradicted as absolute
13	Wind-blade composite waste cannot be processed thermochemically.	Cited records document thermochemical, pyrolysis, solvolysis, and acetolysis recycling approaches.	Contradicted as absolute

#	Negative claim	Cited correction	Verdict
14	Wind-blade polymers cannot be chemically recycled.	Cited records document chemical-recycling and solvolysis pathways for end-of-life wind-turbine blades.	Contradicted as absolute
15	Wind-turbine blades cannot be designed with recycling in mind.	DOE and scholarly records identify recyclable resins, thermoplastic blades, and design-for-recycling principles.	Contradicted as absolute
16	Wind-blade recycling cannot be compared with landfill or incineration.	Cited records perform life-cycle and trade-off comparisons among recycling, landfill, and incineration pathways.	Contradicted as absolute
17	There are no documented wind-blade recycling baselines in the United States.	DOE records explicitly document U.S. wind-turbine blade-recycling baselines and assessments.	Contradicted as absolute
18	Wind-turbine blade recycling cannot support additive-manufacturing reuse.	Cited DOE records connect blade repurposing and recycling with 3D-printing technology.	Contradicted as absolute
19	No recycling route is being studied for wind-blade composites.	Cited records document mechanical and separation-based recycling routes for end-of-life wind-turbine blade composites.	Contradicted as absolute
20	Wind-turbine blade recycling cannot be evaluated as a business or value-chain model.	Cited records analyze circular business models, value chains, and end-of-life management options.	Contradicted as absolute

How to read the evidence pages

Each following claim page pairs the exact absolute statement with two cited public records. The cited records demonstrate a counter-pathway, application, or documented assessment. They do not remove the practical engineering constraints stated on page one.

Review sequence	Read the claim, open the cited DOI or OSTI record, then assess costs, scale, safety, design, local capacity, and the decision context.
Verdict boundary	A verdict rejects only a universal negative statement. It does not claim every recycling or reuse pathway is mature, economical, or appropriate in every setting.

Claim 1: Wind-turbine blades cannot be recycled.

Cited correction

Cited records document blade-recycling and material-recovery pathways.

Direct cited counter-evidence	Why it is included
DOI 10.3390/en18195182 End-of-Life Strategies for Wind Turbines: Blade Recycling, Second-Life Applications, and Circular Economy Integration Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 2311242 Wind Turbine Blade Repurposing and Recycling: Coupling Repurposing Methods with 3D Printing Technology DOE OSTI 2023 Conference	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 2: Wind-turbine blades must be landfilled at end of life.

Cited correction

Cited end-of-life, reuse, recycling, and circular-economy records contradict landfill as the only pathway.

Direct cited counter-evidence	Why it is included
DOI 10.3390/en18195182 End-of-Life Strategies for Wind Turbines: Blade Recycling, Second-Life Applications, and Circular Economy Integration Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 2311242 Wind Turbine Blade Repurposing and Recycling: Coupling Repurposing Methods with 3D Printing Technology DOE OSTI 2023 Conference	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 3: There is no technology that can enable wind-turbine blade recycling.

Cited correction

DOE and scholarly records identify assessment, separation, chemical, and thermochemical technology pathways.

Direct cited counter-evidence	Why it is included
DOI 10.1177/0734242x251364672 Triboelectric separation technology for recycling end-of-life wind turbine blades Crossref 2026 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 2311242 Wind Turbine Blade Repurposing and Recycling: Coupling Repurposing Methods with 3D Printing Technology DOE OSTI 2023 Conference	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 4: Wind-turbine blade material cannot be repurposed.

Cited correction

Cited records document second-life and repurposing approaches, including 3D-printing-related work.

Direct cited counter-evidence	Why it is included
DOI 10.3390/en18195182 End-of-Life Strategies for Wind Turbines: Blade Recycling, Second-Life Applications, and Circular Economy Integration Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 2311242 Wind Turbine Blade Repurposing and Recycling: Coupling Repurposing Methods with 3D Printing Technology DOE OSTI 2023 Conference	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 5: Recycling wind-turbine blades can never support a circular pathway.

Cited correction

Cited circular-economy and end-of-life records document pathways evaluated for wind-turbine blades.

Direct cited counter-evidence	Why it is included
DOI 10.3390/en18195182 End-of-Life Strategies for Wind Turbines: Blade Recycling, Second-Life Applications, and Circular Economy Integration Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.2172/1879228 The Institute for Advanced Composites Manufacturing and Innovation Circular Economy for Wind Workshop Report DOE OSTI 2021 Technical Report	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 6: No economic case can be evaluated for wind-turbine blade recycling.

Cited correction

Cited economic-comparison and techno-economic records evaluate blade end-of-life options.

Direct cited counter-evidence	Why it is included
DOI 10.1016/j.resconrec.2022.106202 Wind turbine blade end-of-life options: An economic comparison Crossref 2022 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1021/acssusresmg.4c00256 Environmental and Economic Assessment of Wind Turbine Blade Recycling Approaches Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 7: The environmental trade-offs of blade recycling cannot be measured.

Cited correction

Cited life-cycle and environmental-assessment records measure and compare those trade-offs.

Direct cited counter-evidence	Why it is included
DOI 10.1021/acssusresmg.4c00256 Environmental and Economic Assessment of Wind Turbine Blade Recycling Approaches Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1061/icemd4.coeng-13718 Life Cycle Assessment and Life Cycle Cost Analysis of Repurposing Decommissioned Wind Turbine Blades as High-Voltage Transmission Poles DOE OSTI 2024 Journal Article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 8: Recyclable wind-turbine blades cannot be manufactured.

Cited correction

DOE records identify recyclable thermoplastic and recyclable-resin blade work.

Direct cited counter-evidence	Why it is included
DOI 10.1088/1742-6596/2265/3/032013 Manufacturing, Testing and Recycling of a small recyclable wind turbine blade Crossref 2022 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 1543115 Innovative and Recyclable Thermoplastic Wind Turbine Blades DOE OSTI 2019 Program Document	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 9: Blade recycling cannot yield usable secondary material.

Cited correction

Cited records address material recovery, aggregate use, reclaimed chemicals, and separation pathways.

Direct cited counter-evidence	Why it is included
DOI 10.31274/etd-180810-4761 Recycling wind turbine blade composite material as aggregate in concrete Crossref None dissertation	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1016/j.jenvman.2024.123995 Management of wind-turbine blade waste as high-content concrete addition: Mechanical performance evaluation and life cycle assessment Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 10: Wind-blade end-of-life has no alternatives beyond disposal.

Cited correction

Cited records describe recycling, repurposing, second-life applications, and circular end-of-life options.

Direct cited counter-evidence	Why it is included
DOI 10.3390/en18195182 End-of-Life Strategies for Wind Turbines: Blade Recycling, Second-Life Applications, and Circular Economy Integration Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 2311242 Wind Turbine Blade Repurposing and Recycling: Coupling Repurposing Methods with 3D Printing Technology DOE OSTI 2023 Conference	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 11: Wind-turbine blade waste cannot be used as aggregate in concrete.

Cited correction

Cited records identify blade-composite material used as aggregate in concrete.

Direct cited counter-evidence	Why it is included
DOI 10.31274/etd-180810-4761 Recycling wind turbine blade composite material as aggregate in concrete Crossref None dissertation	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1007/978-3-031-80892-0_15 Recycling of Raw-Crushed Wind-Turbine Blade for Concrete Production: Mechanical and Durability Performance Crossref 2025 book-chapter	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 12: Wind-turbine blade polymers cannot be separated after service.

Cited correction

Cited records identify triboelectric and other separation approaches for end-of-life blades.

Direct cited counter-evidence	Why it is included
DOI 10.1177/0734242x251364672 Triboelectric separation technology for recycling end-of-life wind turbine blades Crossref 2026 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1016/j.resconrec.2025.108490 Efficient separation and recycling of waste wind turbine blades through in-situ generation of peroxyacetic acid Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 13: Wind-blade composite waste cannot be processed thermochemically.

Cited correction

Cited records document thermochemical, pyrolysis, solvolysis, and acetolysis recycling approaches.

Direct cited counter-evidence	Why it is included
DOI 10.1021/acs.energyfuels.5c04260.s001 Microwave-Assisted Thermochemical Recycling of Wind Turbine Blade Composite Waste: Experimental Pyrolysis and Solvolysis Assessment and Reclaimed Chemicals Characterization Crossref None component	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.2139/ssrn.3918150 A Multidisciplinary Assessment of Pyrolysis for Recycling of Wind Turbine Blade Waste Material Crossref 2021 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 14: Wind-blade polymers cannot be chemically recycled.

Cited correction

Cited records document chemical-recycling and solvolysis pathways for end-of-life wind-turbine blades.

Direct cited counter-evidence	Why it is included
DOI 10.1016/j.resconrec.2025.108159 Mild chemical recycling of waste wind turbine blade for direct reuse in production of thermoplastic composites with enhanced performance Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1088/1757-899x/942/1/012013 Chemical recycling of End-of-Life wind turbine blades by solvolysis/HTL Crossref 2020 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 15: Wind-turbine blades cannot be designed with recycling in mind.

Cited correction

DOE and scholarly records identify recyclable resins, thermoplastic blades, and design-for-recycling principles.

Direct cited counter-evidence	Why it is included
OSTI 1543115 Innovative and Recyclable Thermoplastic Wind Turbine Blades DOE OSTI 2019 Program Document	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 2497727 Manufacturing, Characterization and Recycling of 9- and 13-m Recyclable Wind Blades Made with Recyclable Resins DOE OSTI 2025 Conference	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 16: Wind-blade recycling cannot be compared with landfill or incineration.

Cited correction

Cited records perform life-cycle and trade-off comparisons among recycling, landfill, and incineration pathways.

Direct cited counter-evidence	Why it is included
DOI 10.2139/ssrn.5615868 Life-Cycle Assessment of wind turbine blade recycling strategies: co-processing vs. landfilling and incineration Crossref 2025 posted-content	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1016/j.susmat.2026.e01925 Life-cycle assessment of wind turbine blade recycling strategies: Co-processing vs. incineration and landfilling Crossref 2026 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 17: There are no documented wind-blade recycling baselines in the United States.

Cited correction

DOE records explicitly document U.S. wind-turbine blade-recycling baselines and assessments.

Direct cited counter-evidence	Why it is included
DOI 10.1016/j.resconrec.2021.105439 Wind turbine blade material in the United States: Quantities, costs, and end-of-life options Crossref 2021 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.2172/2498327 Recycling Wind Energy Systems in the United States Part 1: Providing a Baseline for America's Wind Energy Recycling Infrastructure for Wind Turbines and Systems DOE OSTI 2025 Technical Report	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 18: Wind-turbine blade recycling cannot support additive-manufacturing reuse.

Cited correction

Cited DOE records connect blade repurposing and recycling with 3D-printing technology.

Direct cited counter-evidence	Why it is included
DOI 10.2139/ssrn.4772345 Microstructure and Performance of Recycled Wind Turbine Blade Based 3d Printed Concrete Crossref 2024 posted-content	The public title directly identifies the counter-pathway or application used to test this absolute claim.
OSTI 2311242 Wind Turbine Blade Repurposing and Recycling: Coupling Repurposing Methods with 3D Printing Technology DOE OSTI 2023 Conference	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 19: No recycling route is being studied for wind-blade composites.

Cited correction

Cited records document mechanical and separation-based recycling routes for end-of-life wind-turbine blade composites.

Direct cited counter-evidence	Why it is included
DOI 10.1016/j.compositesa.2025.108711 Environmental and economic assessment of mechanical recycling of end-of-life wind turbine blades into rebars and comparison with conventional disposal routes Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.1016/j.resconrec.2025.108490 Efficient separation and recycling of waste wind turbine blades through in-situ generation of peroxyacetic acid Crossref 2025 journal-article	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Claim 20: Wind-turbine blade recycling cannot be evaluated as a business or value-chain model.

Cited correction

Cited records analyze circular business models, value chains, and end-of-life management options.

Direct cited counter-evidence	Why it is included
DOI 10.2139/ssrn.4895829 Value Chains for Recycling End-of-Life Wind Turbine Blades: A Multiple Case Study Crossref 2024 posted-content	The public title directly identifies the counter-pathway or application used to test this absolute claim.
DOI 10.2139/ssrn.5141165 A Conceptual Triple Bottom-Line Framework for Assessing Wind Turbine Blade End-of-Life Business Models and Value Chains Comparative Analysis of Closed-Loop and Open-Loop Recycling Crossref 2025 posted-content	The public title directly identifies the counter-pathway or application used to test this absolute claim.

Cross-claim limits and due diligence

Collection logistics, economics, local capacity, recovered-material quality, and pathway availability remain real constraints.

Cited public records relevant to conditions, trade-offs, or implementation

Cited public record	Use in review
DOI 10.1016/j.resconrec.2022.106202 Wind turbine blade end-of-life options: An economic comparison Crossref 2022 journal-article	Use this record to assess conditions, trade-offs, implementation limits, or scope boundaries.
DOI 10.1021/acssusresmgt.4c00256 Environmental and Economic Assessment of Wind Turbine Blade Recycling Approaches Crossref 2025 journal-article	Use this record to assess conditions, trade-offs, implementation limits, or scope boundaries.
DOI 10.1016/j.resconrec.2021.105439 Wind turbine blade material in the United States: Quantities, costs, and end-of-life options Crossref 2021 journal-article	Use this record to assess conditions, trade-offs, implementation limits, or scope boundaries.
DOI 10.1016/j.susmat.2026.e01925 Life-cycle assessment of wind turbine blade recycling strategies: Co-processing vs. incineration and landfilling Crossref 2026 journal-article	Use this record to assess conditions, trade-offs, implementation limits, or scope boundaries.
DOI 10.2139/ssrn.4895829 Value Chains for Recycling End-of-Life Wind Turbine Blades: A Multiple Case Study Crossref 2024 posted-content	Use this record to assess conditions, trade-offs, implementation limits, or scope boundaries.
DOI 10.1061/jcemd4.coeng-13718 Life Cycle Assessment and Life Cycle Cost Analysis of Repurposing Decommissioned Wind Turbine Blades as High-Voltage Transmission Poles DOE OSTI 2024 Journal Article	Use this record to assess conditions, trade-offs, implementation limits, or scope boundaries.

Method and limits

Sources are public metadata records collected from Crossref and the U.S. Department of Energy OSTI API. The audit uses source titles, identifiers, source type, and date for cited discovery. It does not reproduce restricted abstracts or full text, assess every study's methodology, establish a commercial guarantee, or replace engineering, safety, legal, or regulatory review. Each verdict applies only to the exact absolute sentence shown above.

The useful distinction is between an overbroad negative claim and the real engineering constraint. The cited record can establish a pathway or application exists without claiming that it is always economical, mature, or appropriate.