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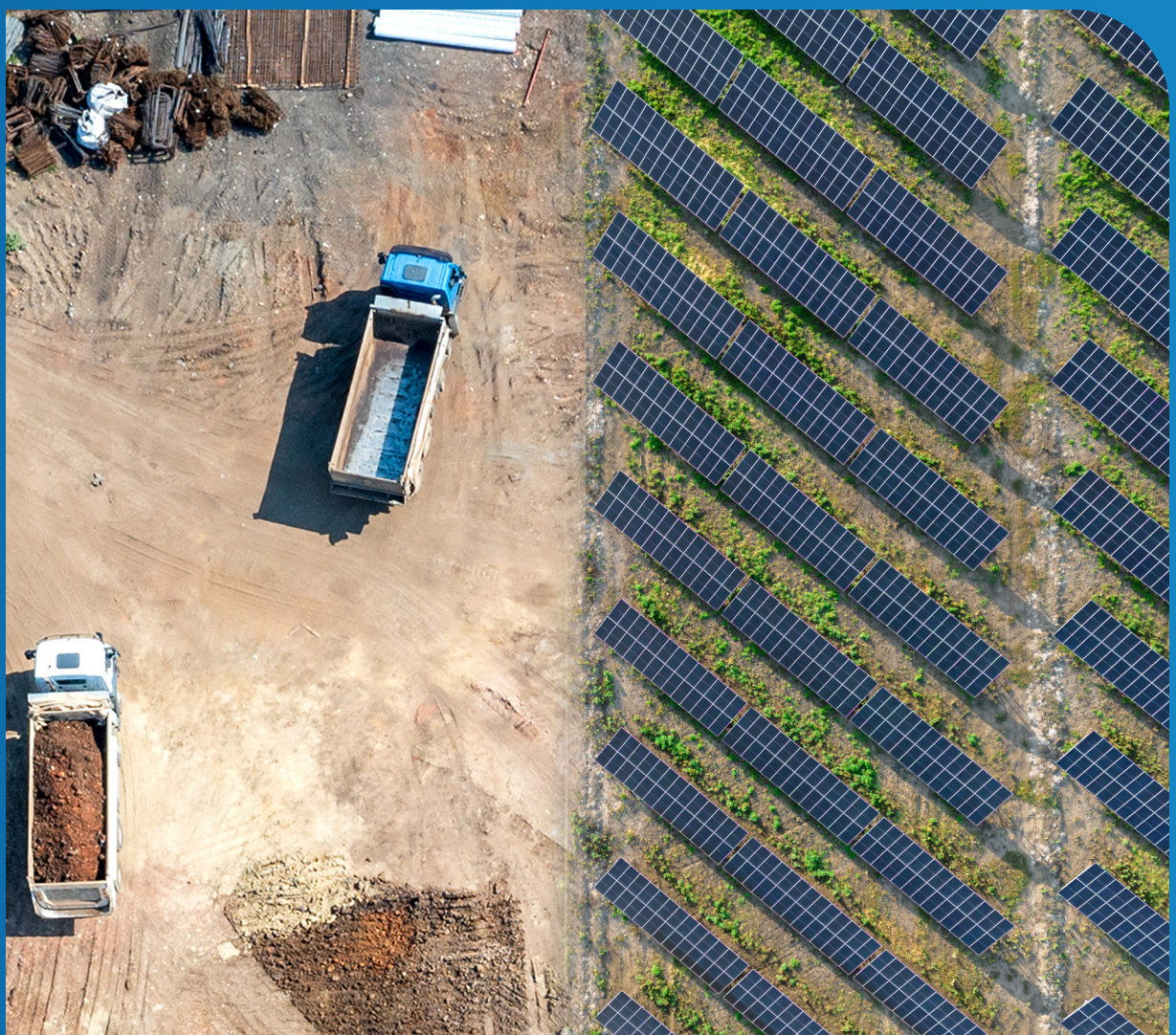
ENERGY STORAGE NORTH AMERICA

eBook

Power Shift: Converting America's Brownfields to Brightfields



Introduction

Renewable energy projects will require a land mass roughly the size of Texas[1] to reach U.S. net zero targets by 2050. Brownfield sites, such as former coal plants and landfills, present a compelling opportunity for renewable energy development, especially as land costs rise and competition for greenfield sites intensifies. The rehabilitation of these sites presents strategic advantages for developers, as well as economic and environmental benefits for involved communities. The Inflation Reduction Act's enhanced incentives for brownfield renewable projects, paired with a growing number of supporting state policies, allows developers to transform these underutilized spaces into clean energy assets.

This eBook explores the evolving landscape of brownfield renewable development—also known as "brightfield" development—by examining key opportunities, challenges, and strategies for success. Through analysis of recent projects and market trends, it provides developers and other industry stakeholders with practical insights for capitalizing on this growing market segment while contributing to community revitalization and responsible land use.



Foreword

Renewable energy developers stand at a pivotal moment, with ample opportunities to reshape America's energy landscape. Together with solutions providers, policymakers, and other clean energy industry stakeholders, they are driving innovation and opening new pathways, reimagining energy infrastructure in pursuit of a more resilient, sustainable world.

America's brownfield sites, with their existing infrastructure and proximity to load centers, represent a unique opportunity for renewable development.

Focused on empowering clean energy innovation, Intersolar & Energy Storage North America is proud to provide strategies for transforming these underutilized spaces into clean energy assets while maximizing community benefits and navigating development complexities.

With innovation as our catalyst and collaboration as our tool, we can power the change our world needs.



Krista Simicich
Digital Editor
Intersolar & Energy Storage North America

CHAPTER 1

The Need for Land

By the Numbers: From Brown to Bright

200,000
sq. miles of projects needed to reach net zero[2]

450,000
brownfield sites in the US[3]

530
brightfield projects as of Oct. 2023[4]

63 GW
of solar potential on closed landfills[5]

The U.S. faces an unprecedented challenge in its transition to clean energy: finding enough suitable land for utility-scale renewable projects while preserving valuable agricultural land and natural habitats. To achieve the Department of Energy's (DOE) goal of 95% grid decarbonization by 2035, installed solar capacity alone must reach approximately 1,600 gigawatts (GW), requiring an estimated 11,000 square miles of land for development[6]. The Nature Conservancy estimates that reaching net zero by 2050 could require up to 200,000 square miles of land[7] for wind and solar development combined—almost the size of Texas.

The Need for Land

While the current estimated utility-scale solar capacity of 131 GW[8] spans merely 1,000-1,400 square miles today (based on the U.S. average of 5-7 acres for every 1 MW of solar capacity[9]), the renewable energy sector faces growing pressure and competition for viable sites for utility-scale projects. Mounting land-use concerns, interconnection and infrastructure limitations, and community opposition will increasingly compel developers to explore creative alternatives beyond greenfield development.

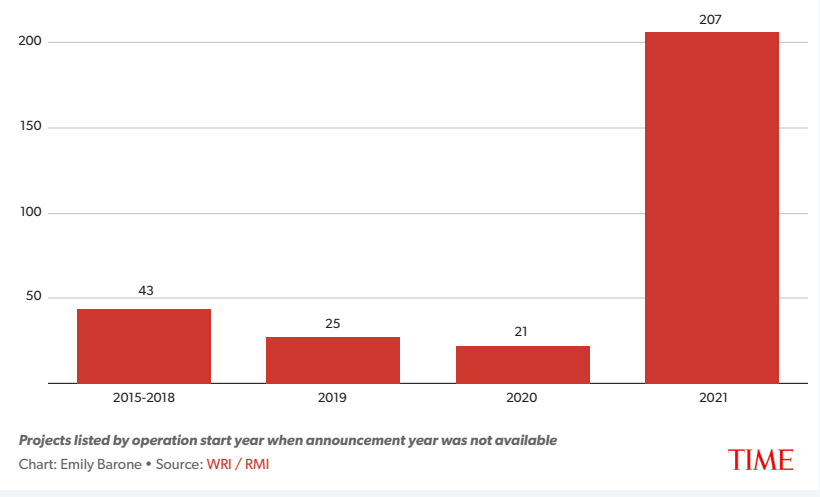
Brownfield sites—previously developed properties that may be otherwise unsuited for reuse—represent a significant untapped opportunity for renewable energy development. The U.S. Environmental Protection Agency (EPA) estimates there are more than 450,000 brownfield sites across the United States[10]. Research nonprofit RMI estimates that there are more than 10,000 closed and inactive landfills alone—with the potential for roughly 63 GW of solar capacity. Converting even a fraction of these sites into renewable energy projects could add substantial clean power capacity[11].

Greenfield solar projects often face significant local resistance when proposed on agricultural or undeveloped land, with concerns ranging from loss of farmland to impacts on wildlife habitats and preserving natural views. In contrast, brownfields are often viewed as too expensive or difficult to rehabilitate, potentially presenting health, safety, and environmental hazards. Despite that, brownfield projects can garner strong community support more easily, as they transform abandoned or contaminated properties into productive assets that generate clean energy and tax revenue while improving environmental and local health conditions.

As of December 2024, 624 brownfield renewable energy project sites with a total capacity of 4.4 GW have been completed in the U.S.[12] This represents less than 1% of total brownfield site potential—and just a fraction of what's needed for a sustainable low-carbon future.

Local Government Brightfield Deals Announced by Year

In megawatts



Source: Time

CHAPTER 2:

The Brown Blueprint: Understanding Brownfields

Advantages of Brownfield Development

Despite their technical and environmental complexities, these sites have the potential to greatly benefit developers and local communities alike. Their redevelopment offers developers strategic infrastructure advantages while bringing economic and environmental benefits to surrounding neighborhoods.

Advantages for Developers

Existing Infrastructure: Sites typically offer ready access to transmission lines, substations, roads, and other critical infrastructure. Transmission line construction can cost $250,000 to $3 million per mile, while substations range from $500,000 to $2.5 million[13].

Strategic Locations: Most brownfield sites are near load centers and often feature flat, unshaded spaces ideal for solar installations. Many also maintain previous industrial zoning designations compatible with energy development.

Streamlined Local Permitting: Brownfield projects can take advantage of faster land permitting processes—sometimes just a few months compared to the industry average of 18-24 months[14] for greenfield development. Local authorities often prioritize brownfield redevelopment due to the community benefits.

What Are Brownfields?

The U.S. Environmental Protection Agency (EPA) defines a brownfield as "a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." Brownfields are typically sites that, due to past use or conditions, have limited redevelopment options today.

Brownfield Sites Include:

- Decommissioned power plants
- Former industrial facilities
- Closed landfills
- Abandoned mines
- Contaminated commercial properties
- Former military installations



Enhanced Community Support: Unlike greenfield projects that frequently face local opposition, brownfield renewable energy development typically receives strong community backing for rehabilitating previously contaminated or abandoned sites.

Financial Incentives: Projects may qualify for additional tax credits and grants, including specific provisions under the Inflation Reduction Act (IRA) for energy communities and brownfield development. The IRA offers clean-energy projects up to 10 percent additional financial incentives if the projects are sited within an "energy community[15]."

Advantages for Local Communities

Economic Revitalization: Increases local tax bases while creating construction and operational jobs. This can be particularly impactful in communities historically dependent on fossil fuel or mining industries.

Property Value Enhancement: Brownfield cleanup and redevelopment can increase nearby property values by 5.0% to 11.5%[16] while generating new revenue from previously underutilized land.

Environmental Benefits: Reduces pressure on undeveloped land, helping preserve natural habitats and agricultural areas. This helps lessen further habitat fragmentation and biodiversity loss associated with greenfield development.

Environmental Justice: Helps address historical inequities by transforming hazardous sites disproportionately placed near disadvantaged communities, creating new clean energy opportunities.

Grid Resilience: Often provides improved local energy reliability due to their proximity to population centers and existing grid infrastructure.

Cost-Effective Land Management: For municipalities, converting maintenance-intensive brownfield sites into renewable energy facilities can transform financial liabilities into revenue-generating assets while potentially providing lower-cost power for the community.

Key Challenges

Brownfield projects can present unique challenges that require careful planning, risk management, and thorough site assessment. While many hurdles can be overcome with proper due diligence and expertise, developers must be prepared for additional complexity ranging from environmental liability to high upfront project costs.

Liability Concerns: Environmental contamination could pose liability risks for developers, requiring careful legal and insurance management. Developers may face additional cleanup responsibilities or risks tied to historic site use.

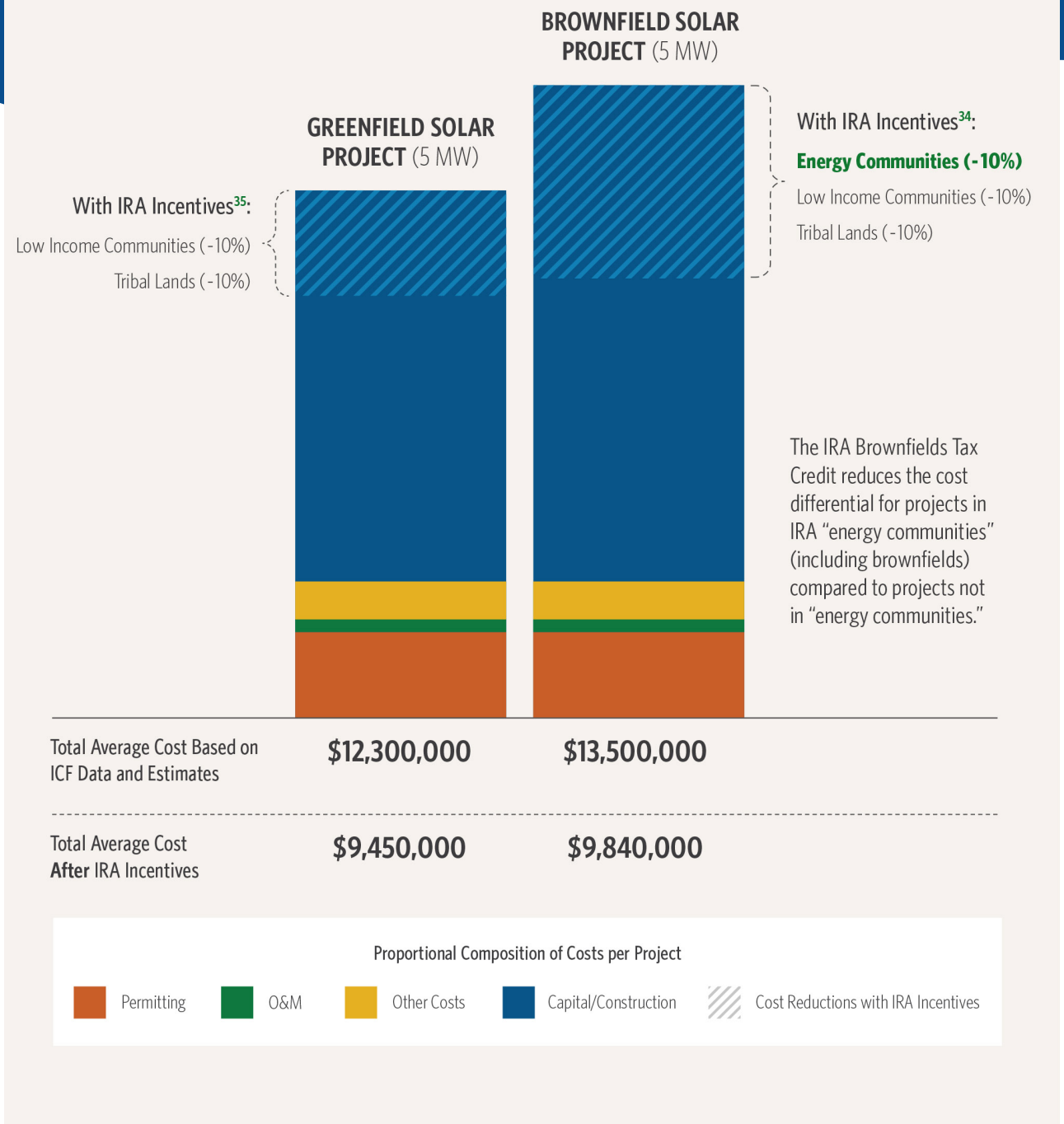
Site Suitability and Geotechnical Issues: Existing soil contamination or subsurface instability can complicate construction and affect foundation stability for solar panels, leading to increasing costs and timelines.

Environmental Permitting and Regulatory Complexity: Redeveloping brownfields often requires navigating stringent environmental regulations, including state and federal cleanup requirements, which can slow project approval.

Higher Upfront Costs: Brownfield projects may cost 10-15% more than greenfield projects[17], which may be related to environmental assessments, cleanup, and site preparation.

Risk of Unknown Contamination: Historical site records may be incomplete, leaving developers vulnerable to discovering unforeseen contamination or obstacles during construction.

IRA Tax Credits Offset Increased Cost of Brownfield Solar Projects



Source: The Nature Conservancy

CHAPTER 3:

Policy Powers: How Legislation Transforms Brownfields to Brightfields



The Inflation Reduction Act

Developers can leverage the Inflation Reduction Act's (IRA) tax credits, targeted funding, and direct payment options to maximize project viability, mitigate site-specific risks, and unlock new investment opportunities in underutilized or previously contaminated areas.

Relevant IRA Provisions

10% Bonus Credit for Energy Communities: Renewable projects in qualifying energy communities benefit from a 10% credit in addition to the ITC.

Direct Pay Options for Tax-Exempt Entities: Public utilities, municipalities, and other tax-exempt organizations can now receive direct payments equivalent to tax credits. This eliminates the need for complex financing structures, streamlining projects on public or community-owned brownfields, and expanding opportunities for partnerships with private developers.

Transferability of Tax Credits: The IRA allows developers to transfer unused tax credits to third parties. This flexibility enables better cash flow management and creates new financing mechanisms, making brownfield projects more attractive to investors and joint ventures.

$5 Billion in Energy Infrastructure Reinvestment Grants and Loans: Aimed at modernizing energy systems, these funds can be leveraged to integrate renewable energy on brownfields with existing infrastructure, such as grid enhancements or microgrid deployment. This provision is particularly beneficial for brownfield sites in areas with outdated or constrained energy infrastructure.

Other Supporting Policies

The Infrastructure Investment and Jobs Act (IIJA) allocates $1.5 billion to the EPA's Brownfields Program, reducing cleanup costs and enabling site reuse. The IIJA also includes a Clean Energy Demonstration Program on Current and Former Mine Land, with $500 million allocated for large-scale clean energy projects[18].

State Policies

State policies have played a decisive role in driving regional brownfield renewable development through targeted incentives, procurement requirements, and streamlined permitting processes. As of 2023, just four states—New Jersey, Connecticut, Massachusetts, and New York—hosted 73% of all U.S. utility-scale landfill solar projects.

Massachusetts exemplifies how effective state policy can accelerate brownfield development. The state's Solar Massachusetts Renewable Target (SMART) Program provides adders of $0.04/kWh for landfill projects and $0.03/kWh for brownfield solar projects beyond standard incentives. By 2020, Massachusetts hosted 52% of all utility-scale landfill solar projects in the U.S. despite having only 7% of the country's landfills.[19]

New Jersey has driven significant development through its renewable portfolio standard brownfield carve-out and multiple incentive programs. The state's Community Solar Energy Program only allows projects on certain site types, including landfills and brownfields, while the Hazardous Discharge Site Remediation Fund provides grants covering up to 75% of remedial action costs for renewable energy reuse[20].

Other states have also created brownfield renewable programs. Michigan announced its Brownfield Renewable Energy Pilot grant program as part of a $129.1 million federal investment[21]. Virginia's Clean Economy Act requires utility Dominion Energy to construct or acquire 200 MW of solar or wind capacity on previously developed sites including brownfields, landfills, and former coal mines[22]. These early state policies demonstrate how targeted incentives and requirements can effectively drive brownfield renewable development while creating environmental and economic benefits for local communities.



CHAPTER 4:

Reinventing Coal Communities

According to the Energy Information Administration (EIA), more than 546 coal plants with a total capacity of 102 GW were retired between 2010 and 2019[23]. An additional 22 GW of coal capacity was retired between 2022 and 2023[24]. The EIA estimates that coal-fired capacity could continue to fall by up to 88% by 2050, with only 23 GW remaining[25].

Factors Influencing U.S. Coal Plant Retirements:

- Aging fleets driving up operation and maintenance (O&M) costs
- Reduced cost of competing technologies like wind and solar
- Low growth in peak load and annual energy consumption
- Costs associated with complying with federal and state regulations

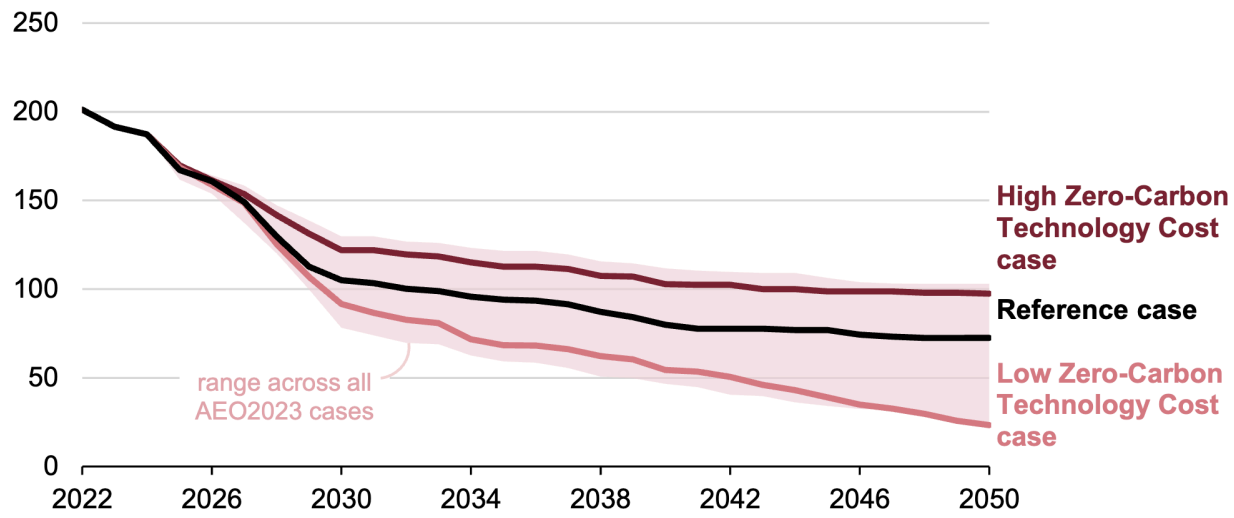
These retirements have had devastating impacts on local economies. Between 2014 and 2024, coal mining jobs fell by almost 45% from 76,000 to 42,500[26]. As a coal plant is often one of the largest taxpayers in a region, local municipalities lose precious tax revenue, leaving residents to shoulder this burden in higher property taxes [27].

Brownfield development on the sites of former coal plants can not only stimulate the local economy with short-term jobs and long-term tax revenue but also trigger remediation measures critical to preserving the health and safety of local residents and wildlife.



The DOE has recognized the potential for former coal communities to participate in the clean energy transition. In October 2024, the DOE announced $428 million in grant funding across 14 projects in 15 U.S. coal communities to expand clean energy manufacturing. These projects, spanning 12 states, are expected to leverage over $500 million in private-sector investments while creating more than 1,900 jobs.[28]

U.S. Coal-Fired Electric-Generating Capacity



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)

Source: EIA

Coal Plant Case Study: CPV Backbone Solar

- **Location:** Garrett County, MD
- **Brownfield Site:** Closed Arch Coal Strip Mine
- **Project Size:** 208 MW[29]
- **Developer:** Competitive Power Ventures
- **Status:** Announced, COD in 2025
- **Details:** The 120-year old mine includes 45 acres of coal refuse that has been reclaimed through this project. It will avoid more than 133,000 tons of CO2 annually[30], create 200+ short-term jobs, and provide millions in local tax revenue[31].



CHAPTER 5:

Bright Ideas in Action: Case Studies Beyond Coal

Landfill Case Study: Mount Olive Solar

- **Location:** Mount Olive Township, NJ
- **Brownfield Site:** Combe Fill North Landfill Superfund
- **Project Size:** 25.6 MW
- **Developer:** CEP Renewables
- **Status:** Operational since 2023
- **Details:** Built on a capped landfill that was a U.S. EPA Superfund site, and at the time of completion, it was the largest landfill solar project in North America[32]. The township recouped almost $2.3 million in past taxes through this project, which won POWER Magazine's Top Renewable Energy Plan of the Year Award[33].

Refinery Case Study: MCE Solar One

- **Location:** Richmond, CA
- **Brownfield Site:** Chevron Richmond Refinery
- **Project Size:** 10.5 MW solar
- **Developer:** S-Power
- **Status:** Operational since 2023
- **Details:** Owned by community choice aggregator (CCA) Marin Clean Energy (MCE), the project is built on a 60-acre remediated brownfield site. Project construction consisted of a 50% local resident workforce, many of which were trained through a local workforce program[34].

Superfund Site Case Study: Woburn EPA Superfund Solar

- **Location:** Woburn, MA
- **Brownfield Site:** Woburn EPA Superfund site
- **Project Size:** 4 MW solar
- **Developer:** ECA Solar
- **Status:** Operational since 2023
- **Details:** This was a chemical and glue manufacturing facility contaminated with toxic levels of metals and hydrocarbons[35]. In the 1980s, the 245-acre property was the fifth most polluted site in the U.S. Today, it generates solar credits to cover demand for one-third of the City of Somerville's municipal functions[36].

Industrial Case Study: Danville Solar

- **Location:** Danville, TX
- **Brownfield Site:** Former General Motors Powertrain Division Plant
- **Project Size:** 2.62 MW solar
- **Developer:** Ameresco
- **Status:** Operational since 2022
- **Details:** Developed in collaboration with the City of Chicago, the project generates more than 3,600 MWh of electricity and offsets over 1,500 metric tons of carbon dioxide annually[37]. It also provides tax revenue to the Danville area and created more than 100 new jobs.

CHAPTER 6:

Building Better Brightfields: Developer Strategies for Success

Evaluate Early and Thoroughly

- **Assess site contamination:** Examine the extent of contamination and remediation needs through environmental site assessments.
- **Evaluate location and infrastructure:** Assess proximity to the grid, transportation networks, and other utilities.
- **Assess land stability and suitability:** Ensure the site can physically support renewable energy installations like solar panels, wind turbines, and/or battery storage units.
- **Community and stakeholder considerations:** Engage with local communities and stakeholders early to address concerns and gain support.

Form Strategic Partnerships

- **Collaborate with environmental remediation experts:** Work with specialists to address contamination concerns effectively and ensure the site meets environmental and safety standards.
- **Engage local economic development agencies:** Leverage local expertise and resources to identify opportunities for economic revitalization.
- **Partner with experienced brownfield developers:** Collaborate with developers with a proven track record of transforming brownfields into viable projects.

Prioritize Community Engagement

- **Develop comprehensive stakeholder engagement plans:** Foster transparent communication and build trust with community members, addressing their concerns and expectations.
- **Engage early and meaningfully:** Speak at town hall meetings and other public forums to ensure concerns are addressed well in advance.
- **Create local job training programs:** Offer training initiatives that prepare residents for employment opportunities associated with the project.
- **Communicate project benefits clearly:** Highlight economic, environmental, and social advantages to secure broad-based support from community leaders and advocates.

Ensure Careful Risk Mitigation

- **Secure appropriate environmental insurance:** Protect the project from unforeseen contamination-related liabilities.
- **Structure contracts to address liability concerns:** Clearly define responsibilities for remediation and future risks.
- **Build contingencies into project timelines and budgets:** Account for potential delays and cost overruns associated with site remediation.
- **Maintain transparent communication with regulators:** Ensure regulatory compliance and build trust through open dialogue.

CHAPTER 7:

Market Forces Shaping Brightfield Growth

Key Market Insights and Future Growth Drivers

The brownfield renewable energy market is poised for significant growth amid increasing demand for sustainable development. The EPA has identified more than 38,000 contaminated sites across the United States with solar development potential, representing an estimated 300 GW of potential clean energy capacity. The Inflation Reduction Act's tax credits and funding mechanisms, extending through 2032, create a strong foundation for market growth.

Multiple forces are accelerating brownfield renewable development. Rising land costs and competition for project sites are making brownfield sites increasingly attractive, particularly given their strategic proximity to urban load centers—a crucial advantage as transmission constraints challenge renewable energy deployment nationwide.

State and local incentives enhance project economics through financial support and streamlined regulatory pathways.

Corporate sustainability commitments are driving additional market momentum. As companies pursue Environmental, Social, and Governance (ESG) goals, brownfield renewable projects offer an attractive investment opportunity that combines clean energy production and tangible community benefits, especially as previously developed sites often face less local opposition than greenfield developments.

The sector's trajectory suggests that developers who build expertise in brownfield project development will be well-positioned to capture growing market share while advancing the clean energy transition and creating lasting community value.



Brightening Tomorrow's Energy Landscape

Brownfield renewable energy development represents a crucial opportunity to expand clean energy capacity while revitalizing communities and preserving undeveloped land. With renewable energy projects requiring land mass roughly the size of Texas to reach U.S. net zero targets by 2050, the conversion of contaminated or previously developed sites into clean energy assets offers a strategic solution for developers navigating site-specific challenges.

The economic and environmental advantages of brownfield development are compelling. These sites typically offer existing infrastructure—including transmission lines and substations—and strategic locations near load centers. The Inflation Reduction Act, combined with state and local incentives, helps offset the additional costs of site remediation. Furthermore, brownfield projects often garner stronger community support than greenfield developments.

Successful brownfield projects across the country demonstrate the transformative potential of this approach. These projects generate clean energy while creating local jobs, increasing tax revenue, and delivering environmental benefits to their communities. With more than 450,000 brownfield sites across the United States—including 63 GW of solar potential on closed landfills alone—the opportunity for growth is substantial. Success requires careful planning, strong partnerships, and strategic use of available incentives.

As competition for traditional sites grows, developers who master brownfield project development will be well-positioned to capture market share and deliver value to stakeholders.



Footnotes

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Additional Resources

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2. https://www.epa.gov/re-powering/re-powering-tracking-matrix

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