Solar Deployment in South Yorkshire: A 40-Year Technical and Economic Assessment

Executive Summary

This report provides a structured assessment of large-scale solar and battery projects proposed or under development in the Rotherham–Doncaster grid zone, including Fenwick Solar Farm, Whitestone Solar Farm, Tween Bridge Solar Farm and BESS, alongside the Thorpe Marsh Battery Energy Storage System (BESS) and the Brinsworth 400 kV substation upgrade. The findings show that, despite a concentration of £2–3 billion in generation and storage investment plus hundreds of millions in grid reinforcements, the effective winter output from these schemes will be minimal, and lifecycle costs remain significantly higher than alternative technologies such as nuclear small modular reactors (SMRs) or combined-cycle gas turbines (CCGTs). Solar generation in the UK averages a 10% capacity factor annually, with seasonal extremes ranging from ~5% in winter months to ~22% in peak summer months. Over a 40-year lifecycle, incorporating realistic repowering of PV arrays (every 20 years), replacement of battery systems (every 12–15 years), inverter replacement, degradation losses, curtailment, operations and maintenance, and grid reinforcements, the effective cost of solar in South Yorkshire is estimated in the range of £125–145 per MWh. The South Yorkshire case illustrates the central challenge of UK energy policy: large capital deployment in intermittent renewables is driving disproportionate grid investment while failing to deliver secure or affordable power.

Introduction – Why South Yorkshire is the Test Case

South Yorkshire has emerged as a focal point in the UK's renewable energy programme. The region combines several characteristics that make it a test case for national policy: - Legacy industrial infrastructure: Former coal sites such as Thorpe Marsh are being repurposed as nodes for new energy projects, particularly large-scale batteries. - Concentrated solar deployment: Multiple NSIP-scale solar farms (Fenwick, Whitestone, Tween Bridge, Marr Farm) are clustered within a relatively small geographic area, each seeking to connect to an already constrained transmission network. - Grid reinforcement projects: National Grid's "Great Grid Upgrade" includes the Brinsworth 400 kV substation and uprating of existing transmission lines. These upgrades are primarily justified by anticipated renewable connections. - Sensitive land use: Much of the proposed solar capacity would be located on agricultural land, greenbelt, or areas of ecological significance, raising biodiversity and planning concerns. The region therefore provides an instructive lens through which to analyse the costs, outputs, and impacts of solar deployment over the long term.

Project Overview

Thorpe Marsh BESS (~£1bn, 2.8 GWh, grid balancing not generation); Brinsworth 400 kV Substation (several hundred million, new node); Fenwick Solar Farm (237.5 MW + BESS, 500 hectares); Tween Bridge (800 MW solar + 400 MW BESS, 2,500 hectares); Whitestone (~600 MW solar, 1,383 hectares).

Performance Realities

- Annual CF ~10%; Winter ~5%; Summer ~20–22%. - Fenwick 12 MW effective winter; Tween Bridge 40 MW; Whitestone 30 MW. - Degradation 0.6%/yr; repower at 20 years. - Curtailment ~10% average.

Cost Modelling over 40 Years

Assumptions: PV capex £1.1m/MW; BESS £0.6m/MW (2h); PV repower yr20, 90%; BESS replace yr12 & 24, 80%; inverters yr12 & 25, 12% of PV capex; O&M; £15k/MW-yr; Grid £400m placeholder. Lifecycle costs: Fenwick ~£975m; Tween Bridge ~£3.4bn; Whitestone ~£2.6bn. Energy delivered: Fenwick ~7.1 TWh; Tween ~23.8 TWh; Whitestone ~17.9 TWh. Cost/MWh: £138–144.

Results and System Implications

- Minimal reliable capacity despite high capital spend. - Output lowest in winter; batteries shift hours not seasons. - Firm capacity (nuclear/gas) required in parallel. - Every +£100m grid adds ~£2/MWh.

Environmental and Land Use Impacts

- 4,000+ hectares sterilised. - Loss of BMV farmland. - Hedgerow and biodiversity harm. - Visual landscape impact.

System Security Risks

- Solar collapse at winter peak. - Batteries cover hours not weeks. - Curtailment and balancing costs rise. - Reliance still on nuclear/gas/imports.

Strategic Alternatives

- SMRs: 470 MW, 90% CF, 148 TWh/40y each, domestic build potential. - Gas CCGTs: flexible, proven. - Rooftop solar film: local generation, avoids grid stress.

Conclusion and Policy Recommendations

- Pause new solar in constrained zones. - Redirect to firm capacity. - Prioritise SMRs, CCGTs, rooftop solar. - Protect farmland and biodiversity. - Ensure full lifecycle/system costs included.

Campaign-Style Summary

Billions are being sunk into South Yorkshire solar, but in winter the output will barely light Doncaster. Over 40 years, costs will exceed £7bn and power costs £140/MWh—far more than nuclear or gas, with farmland lost forever. Batteries can only help for a few hours. South Yorkshire proves solar sprawl is a waste of land and money. The future is British-built SMRs, flexible gas, and rooftop solar—not sacrificing the countryside for projects that don’t deliver.