HM TREASURY

Infrastructure and Projects Authority
in conjunction with the Department for Energy Security & Net Zero

Carbon Free Future Programme

Full Business Case
Five Case Model — HM Treasury Green Book Methodology

Prepared by: National Energy Sovereignty Programme Business Case Team
Based on the CFF blueprint by David Waugh
Classification: OFFICIAL — SENSITIVE (COMMERCIAL)

April 2026 | Version 1.0

GREEN BOOK COMPLIANT

Contents

Methodology Note. This business case has been prepared in accordance with HM Treasury's Green Book (2022 edition) and the Infrastructure and Projects Authority's guidance on the Five Case Model. All monetary values are expressed in 2026 prices unless otherwise stated. Net Present Values (NPV) are calculated over a 60-year appraisal window using the Green Book social discount rate of 3.5% for years 0–30 and 3.0% for years 31–60. **Note:** CFF is permanent national infrastructure designed to operate in perpetuity; the 60-year appraisal window is the standard Green Book assessment period, not the asset lifespan. Benefits beyond Year 60 are excluded, making all NPV figures conservative. Optimism bias adjustments have been applied in accordance with Supplementary Green Book Guidance on Optimism Bias. Employment multipliers are derived from ONS input-output tables and the National Infrastructure and Construction Pipeline. GDP multipliers are sourced from the Global Infrastructure Hub and cross-referenced with OBR fiscal multiplier guidance.

Executive Summary

This document presents the Full Business Case for the **Carbon Free Future (CFF) Programme** — a state-owned, nationally integrated energy sovereignty system based on a fleet of Rolls-Royce Small Modular Reactors, producing firm electricity, green hydrogen, desalinated water, district heat, oxygen, and zero-waste brine products from UK territorial waters.

Headline Figures (Central Estimates — 60-Year Rolling Programme Appraisal Window)

Note: CFF is permanent national infrastructure designed to operate in perpetuity. The 60-year window is the initial appraisal period; actual infrastructure life is centuries.

Total Programme CAPEX	£55–85 billion (phased over 25 years)
Programme NPV (Net Present Value)	**+£180–320 billion**
Benefit-Cost Ratio (BCR)	3.2 : 1 — 4.8 : 1
Peak Direct Employment	80,000 — 120,000
Total Employment (Direct + Indirect + Induced)	330,000 — 570,000
Annual GDP Contribution (at maturity)	£50–80+ billion
Annual Exchequer Tax Uplift (at maturity)	£15–25 billion
CAPEX Payback Period	18–25 years
Net Exchequer Position (first 60 years of perpetual operation)	**+£400–700 billion (cumulative; continues growing in perpetuity)**
Annual Avoided Import Costs (at maturity)	£30–50 billion
Annual Avoided Constraint Payments	£1–3 billion

The business case demonstrates that CFF represents **high value for money** under Green Book criteria (BCR > 2.0). Even under pessimistic assumptions with full optimism bias adjustments, the programme returns a positive NPV and a BCR above 2.0. The strategic, commercial, financial, and management cases each confirm that the programme is viable, deliverable, and in the national interest.

3.2–4.8
BENEFIT-COST RATIO

£180–320bn
NET PRESENT VALUE

330k–570k
TOTAL JOBS

18–25 yr
PAYBACK PERIOD

1. The Strategic Case

1.1 Statement of the Problem

The United Kingdom faces a compound energy crisis characterised by three mutually reinforcing failures:

1. **Import Dependency.** The UK imports approximately 36% of its primary energy, at an annual cost of £50–80 billion (varying with global commodity prices). This dependency exposes the national economy to price shocks, supply disruption, and geopolitical coercion — as demonstrated by the 2022 energy crisis, which cost HM Treasury over £40 billion in emergency consumer support.
2. **System Fragmentation.** The Government currently funds 12+ disconnected green energy pilot programmes, at a combined annual cost exceeding £2 billion. These programmes are individually incapable of systemic transformation and collectively fail to constitute a coherent national energy plan.
3. **Intermittency Without Firm Power.** The UK's growing renewable capacity lacks a firm power baseload. Constraint payments to wind generators exceeded £1.1 billion in 2023. Gas-fired peaking plants and continental interconnector imports fill the gap — undermining both decarbonisation and sovereignty.

1.2 Strategic Alignment

The CFF programme aligns with the following government strategic objectives:

STRATEGIC OBJECTIVE	CFF ALIGNMENT
Net Zero by 2050 (Climate Change Act 2008)	Zero operational carbon from nuclear generation; eliminates fossil fuel dependency
Energy Security Strategy (2022)	100% sovereign fuel source; eliminates import dependency
Levelling Up (2022 White Paper)	Brownfield sites in deindustrialised regions; regionally distributed employment
Industrial Strategy	Firm power attracts advanced manufacturing, data centres, green steel
Nuclear Roadmap (2024)	Fleet deployment of Rolls-Royce SMRs; UK nuclear supply chain
Hydrogen Strategy (2021)	Industrial-scale green hydrogen production as core output
NHS Long Term Plan	Upstream health improvements through employment, air quality, fuel poverty elimination

1.3 SMART Objectives

ELEMENT	OBJECTIVE
Specific	Deploy a fleet of 25–40 Rolls-Royce SMR-based CFF sites across the UK, each producing electricity, hydrogen, water, heat, oxygen, and zero-waste brine products — a fully zero-waste system
Measurable	Achieve firm baseload capacity of 12–19 GW; produce 2–4 Mt/year green hydrogen; create 330,000–570,000 jobs

ELEMENT	OBJECTIVE
Achievable	Phased rolling programme; proven PWR technology; brownfield sites with existing infrastructure
Relevant	Directly addresses energy security, net zero, industrial strategy, and levelling up objectives
Time-bound	Phase 1 operational by 2033; national coverage by 2045; 60-year rolling build-out programme with statutory protection; infrastructure operates in perpetuity — maintained, renewed, and expanded across centuries like the Victorian sewers and railways

1.4 Benefits, Risks, and Constraints

Key Benefits

- Energy sovereignty — zero import dependency on fossil fuel markets
- Firm, 24/7 baseload power independent of weather conditions
- Six revenue streams per site (electricity, hydrogen, water, heat, oxygen, zero-waste brine products) — a fully zero-waste system where every by-product is used or sold
- State ownership — all revenues return to HM Treasury
- Transformative employment — moving towards full employment conditions
- Geographic justice — investment in deindustrialised regions
- NHS cost avoidance through upstream health determinants

Key Risks

- SMR technology delivery risk (mitigated by GDA process, Rolls-Royce track record)
- Construction cost escalation (mitigated by standardisation, factory build, fleet learning)
- Political discontinuity (mitigated by statutory body, cross-party engagement)
- Workforce availability (mitigated by national training programme, phased demand)

Constraints

- ONR regulatory timeline for GDA completion
- Rolls-Royce factory capacity ramp-up schedule
- Brownfield site availability and environmental remediation requirements
- Fiscal headroom for initial capital commitment before self-funding commences

2. The Economic Case

2.1 Options Appraisal

In accordance with Green Book requirements, a long-list of options was assessed and filtered to a short-list of five for detailed appraisal:

OPTION	DESCRIPTION	ASSESSMENT
Option 0: Do Nothing	Continue current fragmented approach. Maintain import dependency, constraint payments, and disconnected pilot programmes.	**Baseline.** Costs escalate. Import bill £50–80bn/yr. Constraint payments rising. Net zero target at risk. No industrial renaissance.
Option 1: Accelerated Renewables	Massively expand wind and solar with battery storage. No new nuclear.	**Rejected.** Does not provide firm power. Storage costs prohibitive at scale. Intermittency unresolved. No hydrogen, water, or heat co-production.
Option 2: Large Nuclear (Hinkley model)	Build additional large-scale reactors (EPR/AP1000).	**Rejected.** Hinkley cost overrun (£33bn+), 10+ year delays. Bespoke design prevents fleet learning. No multi-output integration.
Option 3: CFF Programme (SMR fleet)	Rolling programme of standardised Rolls-Royce SMRs producing electricity, hydrogen, water, heat, oxygen, and zero-waste brine products. State owned. Zero waste.	**Preferred.** Firm power + multi-output + zero waste. Standardisation + factory build. Self-funding rolling model. Sovereign fuel source. Highest NPV and BCR.
Option 4: Hybrid (CFF + Renewables)	CFF as baseload backbone with wind/solar as supplementary surplus generation.	**Viable complement.** CFF provides the firm foundation that makes renewables work as surplus. This option is compatible with Option 3 and is the expected long-term outcome.

Preferred option: Option 3 (CFF Programme), with Option 4 as the expected long-term system architecture.

2.2 Cost-Benefit Analysis Framework

The economic appraisal quantifies costs and benefits over a 60-year appraisal window (2027–2086), in accordance with Green Book guidance for long-life infrastructure. It must be emphasised that **CFF is permanent national infrastructure designed to operate in perpetuity** — like Victorian sewers and railways, it will be maintained, renewed, and expanded across centuries. The 60-year window reflects the initial rolling programme and statutory protection period, not the asset lifespan. Individual SMR units have a 60-year design life before replacement on permanent site infrastructure; sites are future-proofed for SMR-to-fusion reactor transition. Benefits beyond Year 60 — which are substantial and perpetual — are excluded from the NPV calculation, making the figures presented here conservative. Values are discounted at the Green Book social discount rate (3.5% years 0–30; 3.0% years 31–60). The analysis covers:

- **Costs:** Capital expenditure (construction), operating expenditure, decommissioning provision, nuclear waste management

- **Benefits:** Revenue streams, avoided import costs, avoided constraint payments, employment and GDP multiplier effects, tax uplift, NHS cost avoidance, carbon value, energy price stabilisation

2.3 Capital Cost Estimates

COMPONENT	LOW ESTIMATE	CENTRAL	HIGH ESTIMATE
SMR Units (25–40 units, incl. fleet learning)	£38bn	£52bn	£70bn
Electrolysis Plants	£4bn	£6bn	£8bn
Desalination Facilities	£1.5bn	£2.5bn	£3.5bn
District Heating Networks	£3bn	£5bn	£7bn
Hydrogen Pipeline Network	£4bn	£7bn	£10bn
Site Preparation & Infrastructure	£2bn	£4bn	£6bn
Regulatory, Design, Programme Management	£2.5bn	£3.5bn	£5bn
Total Programme CAPEX	**£55bn**	**£80bn**	**£109.5bn**

Note: High estimate includes 40% optimism bias uplift on construction costs per Green Book guidance for non-standard civil engineering.

Fleet Learning Methodology. SMR unit costs assume First-of-a-Kind (FOAK) cost of £2.0bn (central) per 470MW unit, declining by 15–25% through Nth-of-a-Kind (NOAK) fleet learning. This is consistent with international evidence on nuclear fleet learning rates (France's Messmer Plan achieved ~20% cost reduction across the standardised fleet). The Rolls-Royce SMR factory build model is expected to accelerate learning compared to bespoke on-site construction.

2.4 Employment Impact Analysis

Methodology. Employment estimates are derived from ONS Standard Industrial Classification multipliers, the National Infrastructure and Construction Pipeline (NICP) workforce demand model, and analogous data from the Hinkley Point C workforce profile (scaled for SMR fleet deployment). The indirect multiplier (supply chain) is 1.9× direct employment; the induced multiplier (spending effect) is 1.3× direct employment. These multipliers are consistent with HM Treasury guidance for major infrastructure programmes.

2.4.1 Construction Phase Employment (Years 1–25)

EMPLOYMENT CATEGORY	LOW	CENTRAL	HIGH
Peak direct construction workforce (per site)	3,500	4,500	5,500
SMR factory manufacturing workforce	4,000	6,000	8,000
Peak direct construction (all sites concurrent)	30,000	45,000	60,000
Indirect (supply chain) — 1.9× multiplier	57,000	85,500	114,000
Induced (spending) — 1.3× multiplier	39,000	58,500	78,000
Total Construction Phase Employment	**126,000**	**189,000**	**252,000**

2.4.2 Operational Phase Employment (permanent — per SMR unit 60-year design life, then replacement)

EMPLOYMENT CATEGORY	LOW	CENTRAL	HIGH
Direct operational workforce (per site)	500	700	900
Total direct operational (25–40 sites)	12,500	24,500	36,000
Hydrogen, water, heat network operations	8,000	15,000	22,000
SMR factory (ongoing production & maintenance)	4,000	6,000	8,000
Total direct operational	24,500	45,500	66,000
Indirect (supply chain) — 1.9×	46,550	86,450	125,400
Induced (spending) — 1.3×	31,850	59,150	85,800
Total Operational Phase Employment	**102,900**	**191,100**	**277,200**

2.4.3 Industrial Renaissance Employment (Attracted Industries)

In addition to direct programme employment, the firm power and hydrogen supply created by CFF is expected to attract significant inward industrial investment. Based on analogous evidence from jurisdictions with abundant firm power (e.g. France, Ontario, Scandinavia), the following additional employment is projected:

ATTRACTED SECTOR	LOW	CENTRAL	HIGH
Advanced manufacturing & engineering	25,000	50,000	80,000
Data centres & digital infrastructure	10,000	25,000	40,000
Green steel & metals	8,000	15,000	25,000
Chemical, pharmaceutical, semiconductor	12,000	25,000	40,000
Maritime, aerospace, transport	5,000	12,000	20,000
Induced from attracted industry workforce	40,000	80,000	130,000
Total Attracted Industry Employment	**100,000**	**207,000**	**335,000**

Combined Peak Employment Impact (Construction + Operational + Attracted):
Low: **330,000** | Central: **450,000** | High: **570,000**

At the central estimate, this represents a reduction in the UK unemployment count of approximately **35–40%**, contributing materially to conditions approaching full employment.

2.5 GDP Impact

Methodology. GDP multipliers are sourced from the Global Infrastructure Hub (GIH) and cross-referenced with Savills' UK infrastructure investment research and OBR fiscal multiplier guidance. Standard UK infrastructure multipliers: £1 invested → £0.80 GDP within 1 year; £1.50 GDP over 5 years. During periods of economic slack, the multiplier may reach £1.60. CFF analysis uses the conservative 5-year multiplier of £1.50.

2.5.1 Capital Investment GDP Impact

SCENARIO	PROGRAMME CAPEX	5-YEAR GDP MULTIPLIER	TOTAL GDP IMPACT
Low	£55bn	×1.50	£82.5bn
Central	£80bn	×1.50	£120bn
High	£110bn	×1.50	£165bn

2.5.2 Annual Operational GDP Contribution (at maturity)

Once fully operational, the CFF system generates annual GDP through:

GDP COMPONENT	LOW	CENTRAL	HIGH
Electricity revenue (12–19 GW at £50–70/MWh)	£5.3bn	£9.2bn	£14.6bn
Hydrogen revenue (2–4 Mt at £2–4/kg)	£4bn	£8bn	£16bn
Water revenue	£0.5bn	£1bn	£2bn
Heat revenue	£1bn	£2bn	£4bn
Oxygen revenue (NHS & industrial — public services first, surplus sold)	£0.8bn	£1.5bn	£2.5bn
Zero-waste brine products revenue (de-icer, chemical feedstocks, minerals)	£0.3bn	£0.7bn	£1.2bn
Avoided imports (GDP retention effect)	£30bn	£40bn	£50bn
Attracted industry GVA	£8bn	£18bn	£30bn
Total Annual GDP Contribution	**£49.9bn**	**£80.4bn**	**£120.3bn**

2.6 Tax Uplift Analysis

Methodology. Tax uplift is calculated from three sources: (i) Income Tax and National Insurance from new employment (using HMRC average effective rates by income band); (ii) Corporation Tax from NESC operations and attracted industries (25% headline rate); (iii) VAT from consumption spending by new employees (using ONS household spending data and 20% standard rate applied to VATable proportion). Calculations assume average CFF salary of £38,000–48,000 (construction/operational), reflecting skilled industrial employment above the national median.

TAX STREAM	LOW (£BN/YR)	CENTRAL (£BN/YR)	HIGH (£BN/YR)
Income Tax & NICs 330k–570k workers × avg £38–48k × ~30% effective IT+NIC rate	£3.8bn	£6.5bn	£9.6bn
Corporation Tax NESC surplus + attracted industry profits × 25%	£3.0bn	£5.5bn	£8.5bn
VAT Employee consumption spending × ~60% VATable × 20%	£2.2bn	£3.8bn	£5.5bn
Business Rates, Stamp Duty, other	£0.8bn	£1.5bn	£2.4bn
Total Annual Tax Uplift	**£9.8bn**	**£17.3bn**	**£26.0bn**

Welfare Savings

In addition to tax revenues, moving 330,000–570,000 people from unemployment or underemployment into productive work reduces Exchequer spending on Universal Credit, Housing Benefit, and associated welfare transfers. Estimated annual welfare saving: **£4–8 billion**.

2.7 Cost-Benefit Summary (60-Year Appraisal Window NPV — Permanent Infrastructure)

ITEM	LOW (NPV)	CENTRAL (NPV)	HIGH (NPV)
COSTS (Present Value)			
Capital expenditure	£48bn	£68bn	£90bn
Operating expenditure (60-year appraisal window; operations continue in perpetuity)	£25bn	£38bn	£52bn
Unit replacement and renewal provision (sites are permanent; individual SMR units replaced at end of 60-year design life)	£3bn	£5bn	£8bn
Nuclear waste management	£2bn	£4bn	£6bn
Total Costs (PV)	**£78bn**	**£115bn**	**£156bn**
BENEFITS (Present Value)			
Revenue from six outputs (electricity, H_2, water, heat, oxygen, brine products)	£95bn	£155bn	£230bn
Avoided fossil fuel imports	£80bn	£130bn	£190bn
Avoided constraint payments	£8bn	£15bn	£25bn
Tax uplift (net additional Exchequer revenue)	£60bn	£105bn	£155bn
Welfare savings	£20bn	£38bn	£55bn
NHS and social care cost avoidance	£15bn	£30bn	£50bn
Carbon value (DECC/BEIS carbon values)	£20bn	£35bn	£55bn
Energy price stabilisation (consumer surplus)	£15bn	£28bn	£45bn
Total Benefits (PV)	**£313bn**	**£536bn**	**£805bn**
Net Present Value (NPV)	**+ £235bn**	**+£421bn**	**+ £649bn**
Benefit-Cost Ratio (BCR)	**4.0 : 1**	**4.7 : 1**	**5.2 : 1**

GREEN BOOK VALUE FOR MONEY ASSESSMENT

Under HM Treasury Green Book guidance, a BCR of 2.0 or above represents **"high value for money"**. The CFF programme achieves a BCR of **4.0–5.2** across all scenarios. Even with aggressive optimism bias adjustments (40% cost uplift, 20% benefit reduction), the programme returns a BCR of **2.3–3.0** — still firmly in the "high value for money" category. **These figures are conservative:** they capture only the first 60 years of what is permanent infrastructure. As CFF assets operate in perpetuity — with SMR units

replaced and sites eventually transitioned to fusion reactors — the true lifetime value is substantially higher than any finite appraisal can capture.

2.8 Comparison with Current System Costs (Do-Nothing Baseline)

COST CATEGORY	CURRENT SYSTEM (ANNUAL)	UNDER CFF (ANNUAL)	ANNUAL SAVING
Fossil fuel imports	£50–80bn	£0 (at maturity)	£50–80bn
Constraint payments	£1.1–3bn (rising)	Negligible	£1–3bn
Energy price volatility cost	£10–40bn (crisis years)	Fixed, predictable	Variable
Emergency consumer support	£0–40bn (crisis years)	£0	£0–40bn
Welfare spending (energy-poverty related)	£8–12bn	£4–6bn	£4–6bn

2.9 Sensitivity Analysis

The following key variables were stress-tested:

VARIABLE	PESSIMISTIC SHIFT	IMPACT ON NPV	BCR (ADJUSTED)
CAPEX +50%	All costs rise 50% above central	NPV falls to +£310bn	3.2 : 1
Construction delay +3 years	All phases delayed 3 years	NPV falls to +£350bn	3.5 : 1
Hydrogen price -40%	H_2 revenue falls 40%	NPV falls to +£370bn	3.8 : 1
Combined pessimistic	All above simultaneously	NPV falls to +£180bn	2.3 : 1

Conclusion: The CFF programme is robust under all tested scenarios. Even the combined pessimistic scenario delivers a positive NPV exceeding £180 billion and a BCR above 2.0 — meeting the Green Book threshold for "high value for money."

3. The Commercial Case

3.1 Procurement Strategy

The CFF programme rejects the PFI/PPP procurement models that have produced cost overruns and value extraction in previous UK infrastructure programmes. Instead, it adopts a **state-led strategic partnership** model:

3.1.1 The State Ownership Model

- The **National Energy Sovereignty Corporation (NESC)** is the sole owner and operator of all CFF assets.
- There are no private equity investors, no offshore shareholders, no dividend extraction.
- All net revenues flow to HM Treasury.
- The model is analogous to EDF (state-owned, France), KEPCO (state-owned, South Korea), or the NHS.

3.1.2 Rolls-Royce SMR Strategic Partnership

The commercial relationship with Rolls-Royce SMR Ltd takes the form of a **Strategic Partnership Agreement (SPA)** with the following key terms:

TERM	PROVISION
Scope	Design, manufacture, and delivery of 25–40 SMR units over 20–25 years
UK Content	Minimum 80% UK content by value (contractual obligation)
Pricing	Open-book cost-plus model for FOAK; fixed-price fleet contract for NOAK units
Factory Investment	Joint investment in UK-based SMR manufacturing facility
Technology Transfer	Full operational knowledge transfer to NESC for lifecycle management
Performance Guarantees	Availability, output, and schedule guarantees with liquidated damages
Export Rights	NESC retains right to license CFF site design to allied nations

3.2 Market Assessment

3.2.1 Electricity Market

CFF electricity enters a market currently characterised by volatile wholesale prices (£50–300/MWh range in 2022–2025). CFF's marginal generation cost (estimated £30–45/MWh LCOE at fleet maturity) positions it as a highly competitive supplier. As a state-owned entity, NESC can offer long-term fixed-price contracts to industrial consumers, providing the price certainty that attracts investment.

3.2.2 Hydrogen Market

The UK hydrogen market is projected to grow from near-zero today to 20–35 TWh by 2035 and 80–120 TWh by 2050 (Climate Change Committee estimates). CFF's green hydrogen production cost (estimated £2.50–4.00/kg at

scale) is competitive with both grey hydrogen (£1.50–2.50/kg, but subject to carbon pricing) and alternative green hydrogen sources.

3.2.3 Water and Heat Markets

Desalinated water addresses growing water stress in southern and eastern England. District heat replaces gas boiler demand, serving an addressable market of 5–8 million homes within viable heat network distance of CFF sites.

3.3 Risk Allocation

RISK	ALLOCATED TO	RATIONALE
Design risk	Rolls-Royce (via SPA performance guarantees)	Rolls-Royce is the design authority
Construction cost risk	Shared (open-book FOAK; fixed-price NOAK)	Learning curve shifts risk progressively to manufacturer
Demand/market risk	NESC / HM Government	State can manage demand through long-term PPAs and policy levers
Regulatory risk	HM Government	Fleet licensing legislation removes per-site regulatory uncertainty
Operational risk	NESC	As owner-operator; mitigated by standardisation and Rolls-Royce support

4. The Financial Case

4.1 Affordability Assessment

The CFF programme requires significant upfront capital investment, phased over 25 years. This section demonstrates that the programme is affordable within the UK's fiscal framework.

4.1.1 Capital Expenditure Profile

PERIOD	ANNUAL CAPEX (CENTRAL)	CUMULATIVE CAPEX	REVENUE OFFSET
Years 1–5 (Pathfinder)	£2–4bn/yr	£10–20bn	£0 (pre-operational)
Years 6–10 (Scale-Up)	£4–6bn/yr	£30–50bn	£2–5bn/yr (Phase 1 operational)
Years 11–15 (Expansion)	£3–5bn/yr	£45–75bn	£8–15bn/yr
Years 16–25 (Completion)	£1–3bn/yr	£55–85bn	£15–25bn/yr

4.2 Funding Model

The CFF programme employs a blended funding model designed to minimise upfront fiscal impact:

1. **Sovereign Green Bonds (Years 1–10).** The UK Government issues CFF-specific green bonds to fund the Pathfinder and Scale-Up phases. At current gilt rates (~4.0–4.5%), the annual debt service cost for £20bn of initial bond issuance is approximately £0.8–0.9bn/year. Green bonds attract a "greenium" discount of 5–15 basis points below conventional gilts.
2. **Redirected Fragmented Programme Budgets (Year 1 onwards).** Consolidation of existing disconnected green energy programme spending provides £1.5–2.5bn/year in redirected funding without additional fiscal outlay.
3. **Operational Revenue Self-Funding (Year 6 onwards).** As Phase 1 sites become operational, revenue from electricity, hydrogen, water, heat, oxygen, and brine product sales is reinvested into subsequent phases. By Year 12, the programme is fully self-funding from operational revenue.
4. **Tax Uplift Fiscal Offset (Year 5 onwards).** The employment-driven tax uplift (£10–26bn/yr at maturity) significantly exceeds the programme's annual capital and operating costs, creating a net positive fiscal position for HM Treasury from approximately Year 15 onwards.

4.3 Payback Period

SCENARIO	TOTAL CAPEX	ANNUAL NET REVENUE (AT MATURITY)	PAYBACK PERIOD
Low	£55bn	£10bn	~25 years
Central	£80bn	£20bn	~20 years
High (optimistic)	£80bn	£30bn	~18 years

4.4 Impact on National Debt

DEBT PROFILE OVER PROGRAMME LIFE

Phase 1 (Years 1–10): National debt increases by approximately £15–25 billion (net of redirected budgets and early revenues). In context, this represents approximately 0.5–0.9% of GDP — comparable to the annual cost of the Energy Price Guarantee emergency intervention, but creating permanent national infrastructure that will serve the country for centuries — rather than a temporary consumer subsidy.

Phase 2 (Years 10–20): Programme becomes self-funding. Debt attributable to CFF begins to stabilise as revenues offset ongoing capital expenditure.

Phase 3 (Years 20–60): Capital costs fully amortised. Programme generates net surplus revenue for HM Treasury. CFF becomes a debt-*reducing* asset, contributing £15–30 billion per year in net fiscal surplus (revenues + tax uplift + welfare savings - operating costs).

Phase 4 (Year 60 onwards — in perpetuity): Like Bazalgette's sewers and the national railway, CFF infrastructure continues operating indefinitely. Individual SMR units are replaced at end of their 60-year design life; sites are eventually transitioned to fusion reactors when that technology is ready. The infrastructure is never decommissioned — only renewed and upgraded. Net fiscal surplus continues growing across centuries.

First 60 years — Exchequer position: Net positive £400–700 billion — and growing in perpetuity thereafter. CFF is not a depreciating asset with a finite life; it is permanent national infrastructure that becomes more valuable with each passing decade, transforming it into one of the most valuable assets on the national balance sheet for centuries to come.

4.5 Comparison with Alternative Fiscal Commitments

PROGRAMME	COST / COMMITMENT	ASSET CREATED
CFF Programme (total CAPEX)	£55–85bn over 25 years	Permanent national infrastructure; revenue-generating in perpetuity — never decommissioned, only renewed and expanded across centuries
Energy Price Guarantee (2022–23)	~£40bn (one year)	None — emergency consumer subsidy
Hinkley Point C	£33bn+ (single site, rising)	One reactor; CfD locks in above-market price for 35 years
HS2 (Phase 1 only)	£45–55bn (rising)	Single rail line; no revenue offset from energy
Annual fossil fuel imports	£50–80bn/year	None — consumed and gone

Key Finding: The UK currently spends the equivalent of the entire CFF programme capital cost on fossil fuel imports *every single year*. CFF replaces a permanent revenue drain with permanent national infrastructure that generates revenue in perpetuity — like the Victorian sewers and railways, built once and serving the nation for centuries.

5. The Management Case

5.1 Delivery Structure

The CFF programme will be delivered through a dedicated statutory body with the following organisational architecture:

National Energy Sovereignty Corporation (NESC)

FUNCTION	RESPONSIBILITY	REPORTS TO
NESC Board	Strategic direction, financial oversight, risk governance. Non-executive Chair and board appointed by Secretary of State for fixed terms.	Parliament (via Select Committee)
Chief Executive	Overall programme delivery, operational management, stakeholder relations. Recruited from major infrastructure delivery background.	NESC Board
Director of Construction	Site delivery, supply chain management, contractor oversight, health & safety.	CEO
Director of Operations	Reactor operations, hydrogen/water/heat production, fleet performance.	CEO
Director of Commercial	Rolls-Royce SPA management, procurement, market development, offtake agreements.	CEO
Director of Finance	Programme finances, bond management, revenue accounting, Treasury liaison.	CEO / NESC Board
Regional Delivery Directors	Site-level delivery, community engagement, local workforce development. One per UK nation/region.	Director of Construction

5.2 Governance Framework

- **Statutory Protection:** NESC is established by Act of Parliament with a statutory duty to deliver the CFF programme. Board members serve fixed terms and cannot be removed without Parliamentary approval — insulating the programme from short-term political interference.
- **Parliamentary Oversight:** A dedicated Energy Sovereignty Select Committee provides democratic scrutiny. NESC publishes annual reports, is subject to NAO audit, and the CEO appears before the Committee annually.
- **Spending Controls:** Capital expenditure above defined thresholds requires HM Treasury approval. The Infrastructure and Projects Authority conducts gateway reviews at each programme phase.
- **Regulatory Interface:** NESC works within the existing nuclear regulatory framework (ONR, EA) with fleet licensing provisions to streamline approvals for standardised units.

5.3 Programme Management Approach

1. **IPA Project Delivery Framework.** The CFF programme will adopt the Government's Major Project methodology, with IPA assurance reviews at each gate.
2. **Earned Value Management.** Standardised EVM across all sites, reported monthly to NESC Board.
3. **Integrated Risk Register.** Programme-level and site-level risk registers maintained in real-time, with escalation protocols to Board level.
4. **Benefits Realisation Framework.** Employment, GDP, tax, and social outcomes tracked against the business case projections, with annual publication of an independently verified Benefits Report.

5.4 Workforce Strategy

A National CFF Workforce Programme will be established in partnership with:

- The Construction Industry Training Board (CITB)
- Further Education colleges in all CFF site regions
- UK universities with nuclear engineering, chemical engineering, and hydrogen technology programmes
- Rolls-Royce apprenticeship and graduate programmes
- Armed Forces transition programmes

Target: 10,000 apprenticeship starts in Year 2; 30,000 by Year 5; ongoing pipeline of 5,000+ per year to support construction and operational phases.

5.5 Monitoring and Evaluation

METRIC	FREQUENCY	REPORTING BODY
Construction progress (schedule, cost, quality)	Monthly	NESC Board
Employment creation (direct, indirect, induced)	Quarterly	NESC / ONS
Revenue generation (all six outputs)	Quarterly	NESC Finance
GDP and tax contribution	Annually	OBR / HMRC
Carbon emissions avoided	Annually	CCC / DESNZ
Value for money	Every 5 years	NAO / IPA
Community and health impact	Every 5 years	DHSC / OHID

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*This Full Business Case has been prepared in accordance with HM Treasury Green Book methodology and the Infrastructure and Projects Authority's Five Case Model guidance. It demonstrates that the Carbon Free Future programme — based on the blueprint by **David Waugh** — represents high value for money, is commercially viable, financially affordable, and deliverable within established governance frameworks.*